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POWER FROM WITHIN

# MC200 CONTROLLER

SMARTECH

TECHNICAL MANUAL

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| Revision | Date | Notes |
|---|---|---|
| 00 | 05/06/2017 | First version of the manual for the version 01.00 of the controller. |
| 01 | 06/11/2017 | Update paragraph: 6.5.5.1, 6.5.5.2, 7, 7.9.3.1, 7.11, 7.12, 7.15, 8.8 |
| 02 | 20/04/2018 | Update paragraph: 5.6.2, 5.11.2 |
| 03 | 11/03/2019 | Valid from firmware version 1.06.<br>8.016 |
| 04 | 26/06/2019 | Update technical specifications paragraph 3<br>Added paragraph 3.1 |
| 05 | 12/09/2019 | Valid from firmware version 1.10.<br>5.5.7, 5.11.4, 6.5.4.7, 6.5.4.8, 6.5.4.9, 6.5.4.10, 6.5.5.8, 7.18 |
| 06 | 02/02/2021 | Valid from firmware version 1.14.<br>6.5.6.2, 7.4.2, 7.5.1, 7.9.3.1, 7.9.3.2 |
| 07 | 09/09/2021 | Valid from firmware version 1.16.<br>5.4.5, 5.5.7, 6.5.3.17, 6.5.6.2, 7.9.3.1 |
| 08 | 01/12/2021 | Valid from firmware version 1.18.<br>6.5.5.x, 7.15, 7.15.2, 7.16, 7.17, 7.18 |
| 09 | 01/09/2022 | Valid from firmware version 1.21.<br>5.11.4 |
| 10 | 21/09/2022 | Valid from firmware version 1.22.<br>5.4.5, 5.6.5, 7.4.1.3, 7.8.2, 7.9.2.5, 8.279 |
| 11 | 26/10/2023 | Valid from firmware version 1.26.<br>5.5.7, 6.5.3.2, 6.5.3.18, 6.5.3.19, 8.8-211 |
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# 1 Introduction

## 1.1 References

[1] SICES EAAM0588xx MC200 Parameters Chart.

[2] SICES EAAM0458xx - BoardPRG3.xx Manual.

[3] SICES S.r.l EAAS0341xx Serial communication and SMS protocol.

[4] SICES EAAS0589xx MC200 Modbus Registers.

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

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

[7] SICES EAAP0457xx USB driver Installation Guide

[8] SICES EAAM0199xx - DST4602/GC500/GC400/GC600 Parallel functions manual.

[9] SICES EAAM0432xx – PLC Editor Manual

[10] SICES EAAM0412xx – PLC Description for SICES devices

## 1.2 Introduction and prerequisites

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

**WARNING!!!**

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

Do not remove or change any connection while the gensets are running (or more generally, while the plant is operating).

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

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

**Please read this manual carefully before using the device.**

**The device uses many configurable parameters and it is therefore impossible to describe all their possible combinations and effects.**

In this document, there is not a detailed description of all the programming parameters: to this purpose, see documents [1]. Consider that document as part of this manual.

**SICES S.r.l provides the devices with a generic "default" configuration; is at the installer's care to adjust the operating parameters to the specific application.**

SICES S.r.l carries out a great effort to improve and update its products; therefore, they are subject to both hardware and software modifications without notice. Some of the features described in this manual may therefore differ from those present in your device.

## 1.3 Notes on the parameter's configuration of the device

Although most of the parameters and features can be accessed and configured by directly operating on the device, **some features or configurations, due to their nature, can only be set or changed through the PC program SICES Board Programmer3** (hereinafter called "BoardPrg3"), which can be downloaded for free after registration on the SICES S.r.l website www.sices.eu.

It simplifies a lot the configuration of the device and we strongly suggest its use. 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 voltage output.

BoardPrg3 supports all SICES devices; the connection to the PC can be direct via serial RS232 or USB, or by remote via modem, serial RS845 or Ethernet. For the use of the program, refer to the document [2].

## 1.4 Definitions

This document uses the words "**ALARM**" and "**UNLOAD**" to indicate a fault that makes the genset operation impossible; the MGCB circuit breaker or the GCBs circuit breakers are immediately opened (without any power unload). The genset controllers will turn off the engines with standard procedure (with cooling cycle).

This document uses the word "**WARNING**" to indicate a fault that requires an operator action but does not require the opening of MGCB (or GCBs) circuit breakers, and that does not require the shutdown of the gensets.

### 1.4.1 Acronyms

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

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

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

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

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

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

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

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

**MCB** This term identifies the circuit breaker that connects the mains to the load (*"Mains Circuit Breaker"*).

**MGCB** It indicates the circuit breaker that connects the parallel bars of the gensets to the load ("*Master Genset Circuit Breaker*").

**MPM** See the description of the type of plant in [8].

**MPtM** See the description of the type of plant in [8].

**MPtM + MSB** See the description of the type of plant in [8].

**MSB** See the description of the type of plant in [8].

**MSB + MSTP** See the description of the type of plant in [8].

**PMCB** It identifies the communication bus (by SICES) that allows all devices exchange information to manage the parallel functions described in the document [8] ("*Power Management Communication Bus*").

**SPM** See the description of the type of plant in [8].

**SPtM** See the description of the type of plant in [8].

**SPtM + SSB** See the description of the type of plant in [8].

**SSB** See the description of the type of plant in [8].

**SSB + SSTP** See the description of the types of plant in [8].

## 1.5 Conventions

In this manual, a vertical bar on the right of the paragraphs signals the modifications, with respect to the previous version. The modifications on the fields of a table are highlighted with a grey background.

## 1.6 Revisions of the software

Several parts of this manual refer to the controller's software revisions. These revisions are marked with the assigned SICES code (shown on the rear panel of the controller). The format of the code is EB0250270XXYY, where "XX" is the main version and "YY" is the minor version. Thus, the code EB02502700100 refers to the controller software release "1.00". The page "S.03" of the TFT display also shows the software revision.

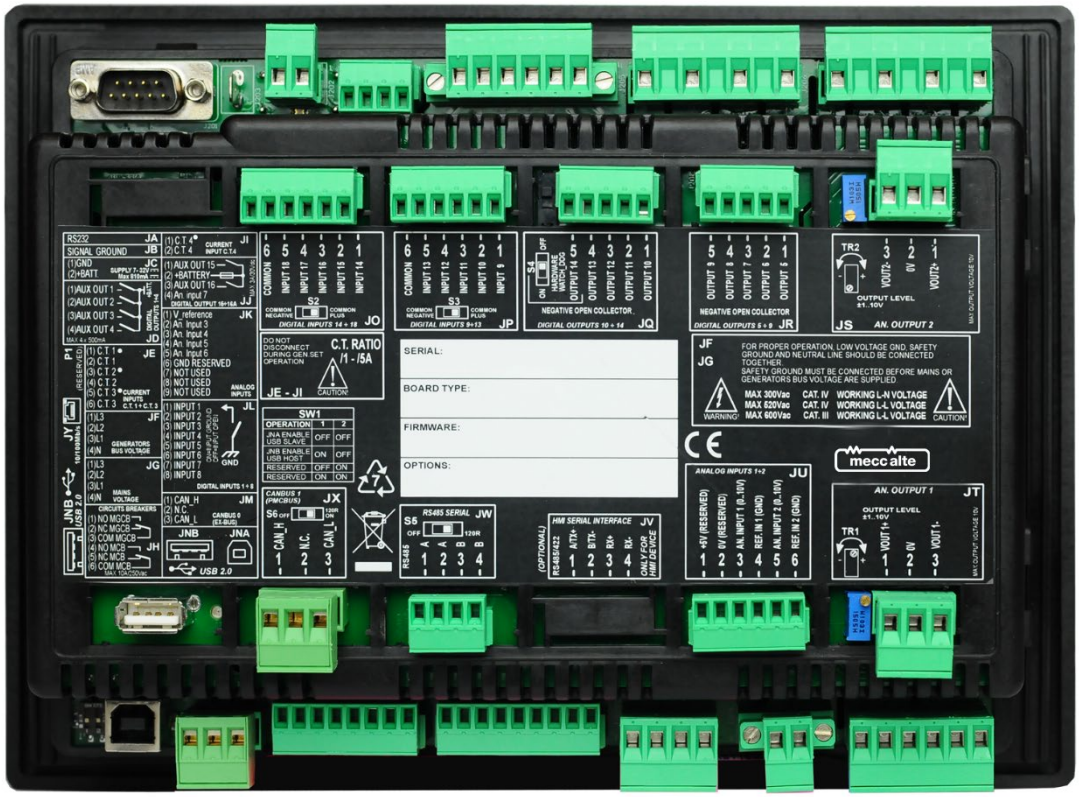
MC200 is a "dual processor" device and uses two different firmwares:

- EB0250270XXYY: for the main processor that deals with the operation management and the user interface (System controller).
- EB0250252XXYY: for the minor processor that deals with the electrical measurements and the related protections (Measure Engine).

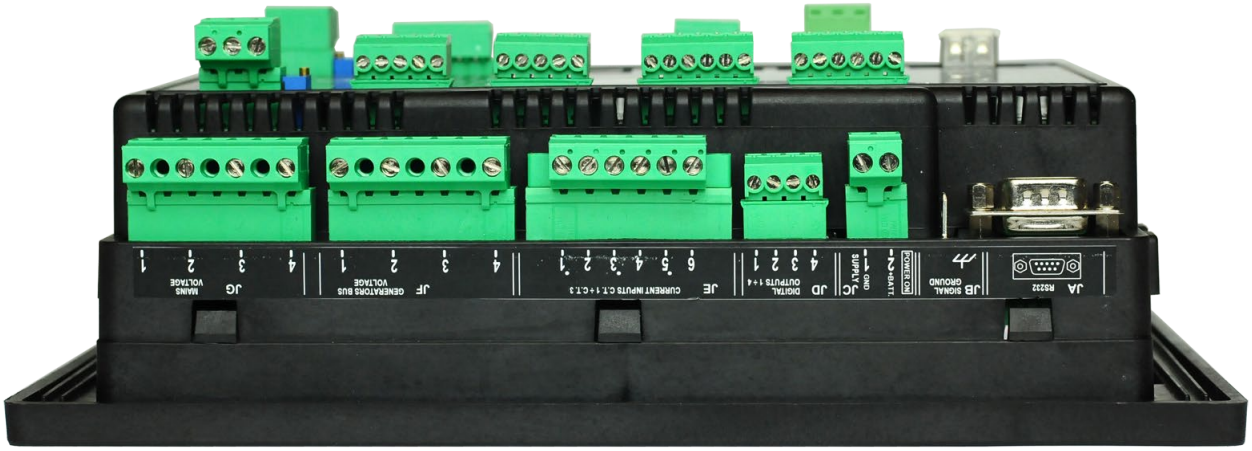
# 2 Views of the device

MC200 Front view

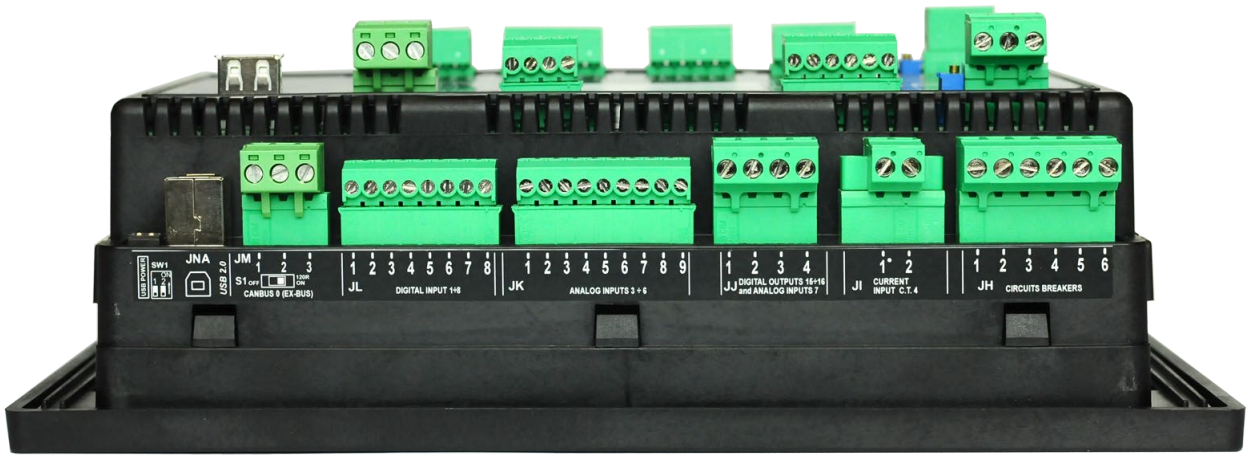

MC200 Rear view




MC200 Upper view



MC200 Lower view



# 3 Technical features

**INFORMATION! GND refers to the potential of the terminal JC-1**

| | |
|---|---|
| **Supply power voltage +VBATT.** | |
| Nominal power supply (Vn) | 12Vdc or 24 Vdc |
| Power supply range<br>(Vn variation) | From 8 to 32Vdc<br>The device identifies the plant operation at 12 or 24V to manage its alarms when powered up and whenever OFF/RESET mode is selected.<br>Protection against polarity reversal with built-in self-resetting fuse. |
| Maximum time of interruption of the supply voltage without resetting the device | 0 Vdc for min. 20 ms from a nominal voltage of 12 Vdc (voltage drop) |
| Starting minimum voltage | The operation is guaranteed during the engine start up to Vbatt=>5Vdc for undefined time |
| Sampling rate | 10kHz |
| Resolution | 12 bits |
| Power consumption in stand-by. | Display minimum brightness:<br>350mA @ 13.5 Vdc<br>200mA @ 27 Vdc<br>Display maximum brightness:<br>420mA @ 13.5 Vdc<br>225mA @ 27 Vdc |
| Maximum power consumption during operation (relays, horn, digital inputs activated; static outputs not activated). | Display minimum brightness:<br>Max. 670mA @ 7 Vdc<br>375mA @ 13.5 Vdc<br>235mA @ 27 Vdc<br>Display maximum brightness:<br>Max. 810mA @ 7 Vdc<br>440mA @ 13.5 Vdc<br>260mA @ 27 Vdc |
| **Mains and generators' bars voltage inputs.** | |
| | Measurement of the L-N and L-L phases voltages<br>Measurements of the neutral voltages referred to the device supply negative<br>External fuse max. 2A slow-blow |
| Nominal Voltage (Vn) | 400Vac L-L (230Vac L-N)<br>100Vac L-L (58Vac L-N) |
| Scale | 400V (HV - High Voltage range)<br>100V (LV - Low Voltage range)<br>Selectable from the device parameter |
| Sampling rate | 10Khz |
| Type of measurement. | True RMS measurements (TRMS). |
| Input impedance. | > 0,8 MΩ L-N<br>> 1,3 MΩ L-N<br>> 0.8 MΩ L-GND<br>> 0.5 MΩ N-GND |

| | |
|---|---|
| Maximum voltages applicable. | MAX 300Vac in CAT.IV for measurements L-N.<br>MAX 520Vac in CAT.IV for measurements L-L.<br>MAX 600Vac in CAT.III for measurements L-L. |
| Maximum voltages measurable with scale HV. | Max 448 Vac for measures L-N (with voltage N-GND = 0 Vrms). |
| Maximum voltages measurable with scale HV. | Max 147 Vac for measures L-N (with voltage N-GND = 0 Vrms). |
| Max tension in Common-Mode from GND with HV scale. | Max 100 Vrms. |
| Max tension in Common-Mode from GND with HV scale. | Max 80 Vrms. |
| Connection modes. | 3 phases 4 wires.<br>3 phases 3 wires.<br>Single-phase 2 wires.<br>Aron insertion with 2 voltage transformers. |
| Measurement resolution. | 12 bits. |
| Measurement accuracy. | <0,5% @Vn |
| **Current measurement inputs.** | |
| | 3 inputs with internal CT and common CTs ratio.<br>1 independent input with internal CT and specific ratio that can be used to measure current / power for mains / loads / gensets or for any other auxiliary source.<br>Internal amplifier with automatic change of scale for currents lower than 1,2Aac and higher than 1,5Aac.<br>It is required the use of current transformers with a secondary current from 1A to 5A. |
| Nominal Current (In) | 1Aac or 5Aac |
| Scale | 1Aac nominal (Low Current range)<br>5Aac nominal (High Current range)<br>Internal amplifier with automatic change of scale for currents lower than 1,2Aac and higher than 1,5Aac. |
| Sampling rate | 10 KHz |
| Max. measurement range | Up to 7Aac. |
| Type of measurement. | True RMS measurements (TRMS). |
| Burden per phase (Auto-consumption) | < 1VA |
| Overload capacity | +40% of the nominal current |
| Overload peak | Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge. |
| Measurement resolution | 12 bits |
| Measurement accuracy | <0,2% @ In |
| **Frequency measurements.** | |
| | 50 or 60Hz nominal frequencies measured by L1-L2 phase voltages, for both the mains and the generators' bars inputs.<br>In case of single-phase systems, the controller measures the frequency on the L1 voltage with respect to N (connected in place of L2). |

<table>
<tr><td>Nominal Frequency (Fn)</td><td>50Hz or 60Hz</td></tr>
<tr><td>Measurement range</td><td>5 to 80 Hz</td></tr>
<tr><td>Measurement accuracy</td><td>± 50 mHz</td></tr>
<tr><td>Frequency minimum sensitivity on mains voltage inputs.</td><td>
<table>
<tr><td>Rated voltage 100Vac</td><td>Rated voltage 400Vac</td></tr>
<tr><td>8 Vrms L1-N @ 50Hz</td><td>24 Vrms L1-N @ 50Hz</td></tr>
<tr><td>14 Vrms L1-L2 @ 50Hz</td><td>41 Vrms L1-L2 @ 50Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>8 Vrms L1-N @ 60Hz</td><td>8 Vrms L1-N @ 60Hz</td></tr>
<tr><td>16 Vrms L1-L2 @ 60Hz</td><td>43 Vrms L1-L2 @ 60Hz</td></tr>
</table>
</td></tr>
<tr><td>Frequency minimum sensitivity on the generators’ bars voltage inputs.</td><td>
<table>
<tr><td>Rated voltage 100Vac</td><td>Rated voltage 400Vac</td></tr>
<tr><td>1 Vrms L1-N @ 10Hz</td><td>1,2Vrms L1-N @ 10Hz</td></tr>
<tr><td>1.7 Vrms L1-L2 @ 10Hz</td><td>2 Vrms L1-L2 @ 10Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>5 Vrms L1-N @ 50Hz</td><td>13 Vrms L1-N @ 50Hz</td></tr>
<tr><td>9 Vrms L1-L2 @ 50Hz</td><td>22 Vrms L1-L2 @ 50Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>6 Vrms L1-L2 @ 50Hz</td><td>18 Vrms L1-N @ 60Hz</td></tr>
<tr><td>10 Vrms L1-L2 @ 60Hz</td><td>31 Vrms L1-L2 @ 60Hz</td></tr>
</table>
</td></tr>
<tr><td>Measurement resolution.</td><td>0.1Hz ± 50ppm, 35ppm/C typical.</td></tr>
<tr><td colspan="2">Digital inputs 01-08.</td></tr>
<tr><td></td><td>8 opto-insulated digital inputs with same supply, internal supply terminal connected to the device positive JC (2) +Vbatt.<br>They are active when the input is connected to the supply negative GND. When they are open, the inputs terminals voltage is like Vbatt.</td></tr>
<tr><td>Activation/deactivation threshold.</td><td>2,5VDC.</td></tr>
<tr><td>Typical current with closed contact.</td><td>5,3mA @ +Vbatt= 13.5Vdc<br>11,5mA @ +Vbatt= 27Vdc</td></tr>
<tr><td>Input signal delay.</td><td>Adjustable by the related parameter for each input.</td></tr>
<tr><td colspan="2">Digital inputs 09-18.</td></tr>
<tr><td></td><td>Two groups of 5 opto-insulated inputs with two separated common supplies, which can be connected to GND (active inputs to +Vbatt) or to +Vbatt (active inputs to GND).<br>Two selectors (S2 and S3) must be set to configure two groups of inputs as Common Plus or as Common Negative.</td></tr>
<tr><td>Activation/deactivation threshold.</td><td>2,5VDC.</td></tr>
<tr><td>Typical current with closed contact.</td><td>5,3mA @ Vbatt= 13.5Vdc<br>11,5mA @ Vbatt= 27Vdc</td></tr>
</table>

| | |
|---|---|
| Input signal delay. | Adjustable by the related parameter for each input. |
| **Digital outputs 01-04.** | |
| Type of output. | 4 independent static outputs to battery positive.<br>The positive supply terminal of the device (JC-2 +Vbatt) supplies the output current.<br>All relay outputs are adjustable by parameter. |
| Rated supply. | Maximum 500mAdc @ 32Vdc for each output |
| Output resistor (status ON). | Max 350mΩ. |
| Leakage current (status OFF). | Max 5uA@32Vdc. |
| Protections. | Internal current limited to about 4A maximum on transients >150us.<br>Thermal protection, short circuit, overvoltage and inverted polarity.<br>**Use suppression diodes on all relays and other inductive loads** |
| **Digital outputs 05-13.** | |
| Type of output. | 9 independent static outputs to battery negative.<br>The negative supply terminal of the device (JC-1 GND) supplies the output current.<br>All relay outputs are adjustable by parameter. |
| Rated supply | Max. 280mAdc @ 32Vdc for each output.<br>Total maximum current for all activated outputs 2A @ 50°C. |
| Output resistor (status ON). | Max 500mΩ. |
| Leakage current (status OFF). | Max 1uA@32Vdc. |
| Protections. | Internal current limited to 2,2A typical.<br>Thermal protection, short circuit, overvoltage with Auto Restart.<br>Inverted protection polarity.<br>**Use suppression diodes on all relays and other inductive loads** |
| **Digital outputs 14 - Output Hardware Watch-Dog.** | |
| Type of output. | 1 static outputs to battery negative.<br>The negative supply terminal of the device (JC-1 GND) supplies the output current.<br>If enabled through the selector S4, the output works as a watchdog system hardware-independent.<br>If the watchdog is enabled (S4=ON) and the device works correctly, the output is activated.<br>If the device is blocked and/or does not refresh the watchdog circuit for a time higher than 5 seconds, the output fails.<br>If the device is turned off, the output immediately fails.<br>If the watchdog is disabled (S4=OFF) the status of the output depends on its configuration. |
| Rated supply. | Max. 280mAdc @ 32Vdc.<br>Total maximum current for all activated outputs 2A @ 50°C. |
| Output resistor (status ON). | Max 500mΩ. |
| Leakage current (status OFF). | Max 1uA@32Vdc. |
| Protections. | Internal current limited to 2,2A typical.<br>Thermal protection, short circuit, overvoltage with Auto Restart.<br>Inverted protection polarity.<br>**Use suppression diodes on all relays and other inductive loads** |
| **Digital outputs 15 and 16.** | |

| | |
|---|---|
| Type of output. | 2 relays with NO contacts and one positive common terminal.<br>The positive common terminal has also the function of input for the emergency stop. The page S.15 of the display shows the measurement of the voltage on the common input (EM-S).<br>All outputs are adjustable by parameter. |
| Rated supply. | Max. 3A @ 30Vdc for each output. |
| Protections. | Self-restoring fuse and integrated opening power-surge protection diodes. |
| **Digital outputs 17 and 18.** | |
| Type of output. | 2 relays with dry contacts for the contactors command.<br>All relay outputs are adjustable by parameter. |
| Rated supply. | Max. 10A @250Vac. |
| **Analogue inputs 01-02.** | |
| Type of input. | 2 differential analogue inputs 0...10Vdc.<br>Both inputs offer the possibility of differential measurement to compensate the differences of negative measurement with respect to GND.<br>There's a 5Vdc (JU-1) regulated and protected output and an internal GND terminal (JU-2) that can be used as reference for external potentiometers on the two analogue inputs. |
| Measurement range. | 0 - 10Vdc. |
| Compensation range. | From -10Vdc to +6Vdc. |
| Input impedance. | > 470kΩ. |
| Frequency. | 10kHz. |
| Resolution. | 12 bits. |
| Measurement accuracy. | <0,4% F.S. |
| **Analogue inputs 03-07.** | |
| Type of input. | 4 adjustable analogue inputs.<br>Adjustable as voltage, current (with external resistor) and digital inputs. |
| Voltage inputs. | Measurement range 0 – 10Vdc with error < 0,2%.<br>Input impedance: >470kΩ. |
| Current inputs. | Measurement range 0 - 20mA with 500Ω external resistor. |
| Frequency. | 10kHz. |
| Resolution. | 12 bits. |
| **Digital outputs 01-02.** | |
| Type of output. | 2 galvanically insulated ±10Vdc voltage outputs.<br>Each output has an integrated trimmer to reduce the maximum output voltage, preserving in this way signal resolution. |
| Regulation range. | From -1Vdc to +10Vdc. |
| Resolution. | 16 bits. |
| Minimum load impedance. | >10 kΩ. |
| Insulation rated voltage. | Max operating 560Vdc.<br>3KVdc on transient < 60s. |
| Insulation resistor. | >1000MΩ @ 500Vdc. |

| | |
|---|---|
| **RS232 Communication interface.** | |
| Type of interface. | 1 RS232 serial port standard TIA/EIA, not insulated on DB connector 9 poles male CANON. |
| Electrical signals. | TX. RX, DTR, DSR, RTS, GND. |
| Settings. | Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps.<br>Parity: **None***, Even, Odd.<br>Stop bit: **1***,2.<br>*** Default Setting.** |
| Type of transmission. | **Modbus RTU Slave***, Modem AT<br>*** Default Setting.** |
| Maximum distance | Maximum Cable length depends cable capacitance, inductance and screening.<br>15m (50ft) @ 9600bps<br>10m (33ft) @ 19200bps<br>7,5m (25ft) @ 38400bps<br>5,0m (16ft) @ 57600bps<br>2.5m (8ft) @ 115200bps |
| **RS485 Communication interface.** | |
| Type of interface. | 1 RS485 serial port standard TIA/EIA, with galvanic insulation.<br>Terminal resistor connectible with S5 switch. |
| Electrical signals. | DATA+ (A), DATA– (B). |
| Settings. | Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps.<br>Parity: **None***, Even, Odd.<br>Stop bit: **1***,2.<br>*** Default Setting.** |
| Type of transmission. | **Modbus RTU Slave***.<br>*** Default Setting** |
| Insulation voltage. | Max operating 560Vdc.<br>1KVdc on transient < 60s. |
| **USB 2.0 Communication interface.** | |
| Type of interface. | 1 USB2.0 serial port not insulated, usable in Function or Host mode.<br>Selection of the operating mode through SW5 dipswitch.<br>**The USB port cannot be used as Function and Host simultaneously.** |
| Function Mode. | Connection to PC by Sices Driver.<br>USB Connector Type B.<br>Type of transmission Modbus RTU Slave. |
| Host Mode. | Pen Driver Management.<br>USB Connector type A.<br>Max current supplied 350mA@5Vdc with overcharge automatic protection.<br>**Host function is not yet supported.** |
| Maximum distance. | 6m (20 feet). |
| **CAN bus Communication interface.** | |
| Type of interface. | 2 CAN bus ports with galvanic insulation.<br>Terminal resistor connectible with S1 and S6 switch. |

| | |
|---|---|
| CAN bus0. | CAN bus connection with protocol Sices for the communication with I/O expansion modules. |
| CAN bus1. | CAN bus connection with protocol Sices PMCBus for the communication with other controllers. |
| Rated impedance. | 120Ω. |
| Insulation voltage. | Max operating 560Vdc.<br>1KVdc on transient < 60s. |
| **Ethernet Communication interface.** | |
| Type of interface. | 1 Ethernet interface 10/100Mbps full-duplex 10T/100Tx Auto.<br>HP Auto-Mdix support.<br>Compliant IEE802.3/802.3u (Fast Ethernet).<br>Compliant ISO802-3/IEEE802.3 (10BASE-T). |
| Insulation voltage. | 1500VRMS. |
| **HMI Communication interface (optional).** | |
| Type of interface. | 1 RS485/422 serial port not insulated for the connection between the SCM (System Control Module) device and the HMI (Human Machine Interface) panel. |
| Rated impedance. | 120Ω. |
| **Display.** | |
| Type of display. | TFT 4.3” colour display with white leds backlight. |
| Resolution. | 480 x 272. |
| Pixel size. | 0,066 x 0,198 mm. |
| Visual area dimensions. | 95 x 54 mm. |
| **Environmental conditions.** | |
| Operating temperature. | From -25°C to +60°C. |
| Stock temperature. | From -30°C to +80°C. |
| Humidity | IEC 60068-2-30<br>Db Damp Heat Cyclic 20/55°C @ 95% RH 48 Hours<br><br>IEC 60068-2-78<br>Cab Damp Heat steady state 40°C @ 93% RH 48 Hours |
| Operating altitude | Up to 2000 m (6561 ft.) |
| **Box.** | |
| Material. | Nylon66 + 30% fiberglass. |
| Size. | 247(L) x 187(H) x 70(D) mm. |
| Weight. | 1100g. |
| Protection degree. | IP55 with gasket for the front panel.<br>IP20 for the panel interior. |

## 3.1 Protection Elements Accuracy

### 3.1.1 Terms and definitions

**G**
The measured value of the characteristic quantity.

**$t_d$**
The theorical operation time (in seconds)

**k, c, α**
The constants characterizing the selected curve

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

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

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

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

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

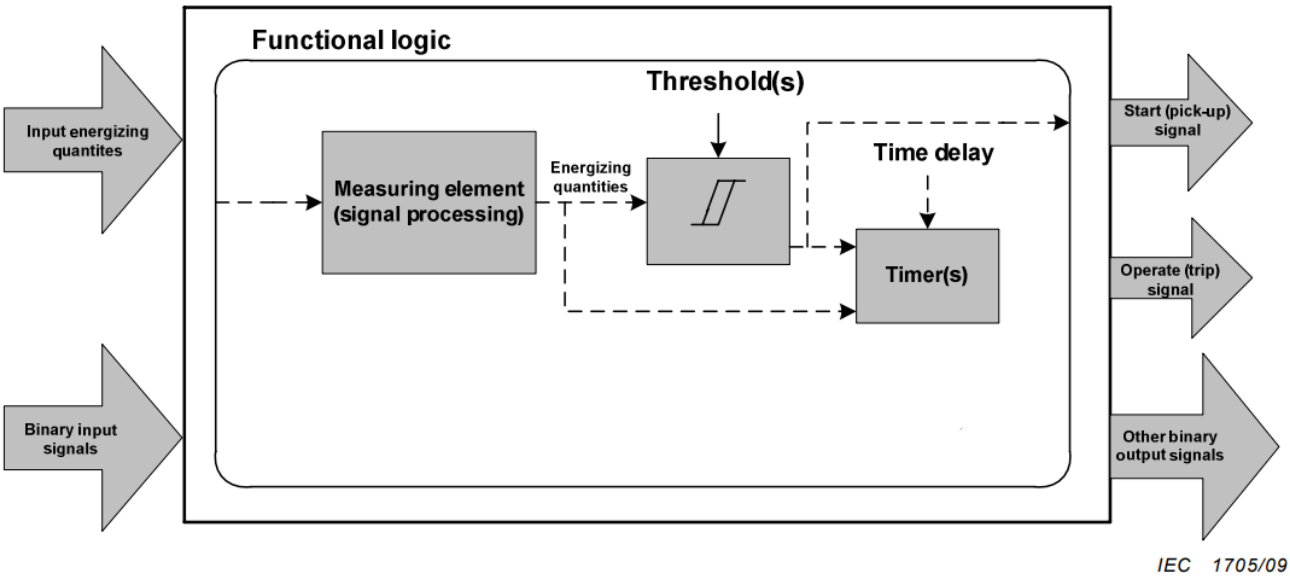
**Overshoot time**
The difference between the operate time of the relay at the specified value of the input energising quantity and the maximum duration of the value of input energising quantity which, when suddenly reduced (for the overvoltage relay)/increased(for the undervoltage relay) to a specified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

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

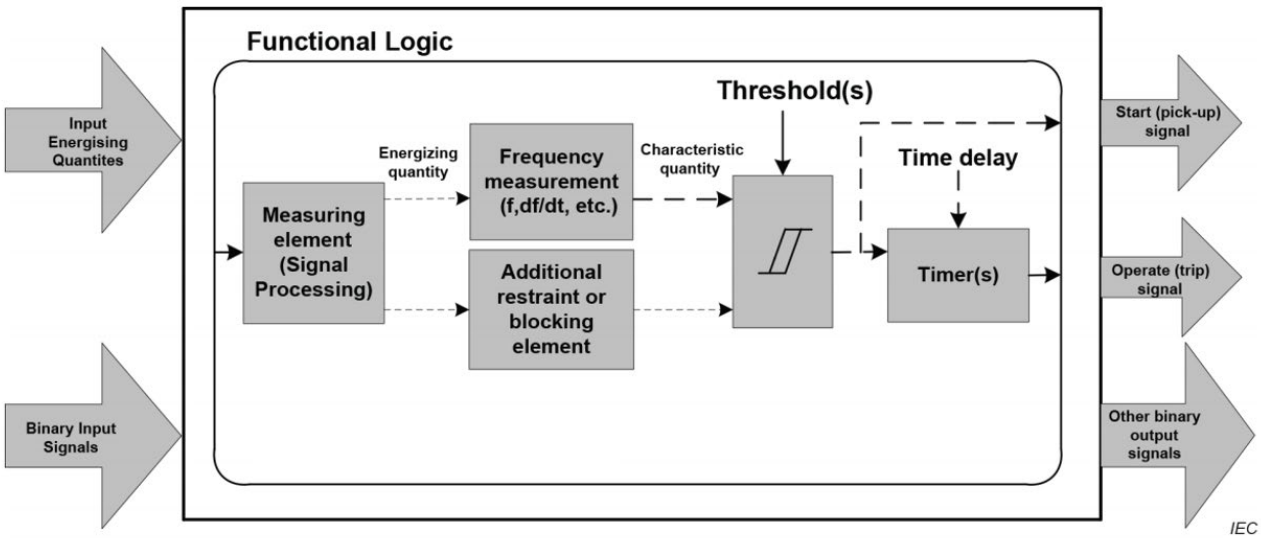
**Threshold of independent time operation**
The value of the characteristic quantity at which the relay operated time changes from dependent time operation to independent time operation.

### 3.1.2 Simplified protection functional block diagram

Voltage/current protections




Frequency protections



### 3.1.3 Protection elements accuracy

#### 3.1.3.1 Generator/Bus protection

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

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

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

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

### 3.1.3.2 Mains protection

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

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

| **Mains - Underfrequency / Overfrequency protection (IEEE/ANSI C37.2 - Function Number 81U/81O)** | | | | |
|---|---|---|---|---|
| **Parameter settings** | | **Value (range)** | | |
| Pickup value ($G_s$)<br>(2 stages) | | 80% … 120% x $F_n$ | Step 0,01 | |
| Definite time delay ($t_d$) | Stage 1 | 0,04…60 sec | Step 0,01 | |
| | Stage 2 | 0,1…60 sec | Step 0,1 | |
| **Characteristic** | | **Value** | | |
| Pickup accuracy | | ±50 mHz | | |
| Pickup time 1) | | Minimum | Average | Maximum |
| | | 10 ms | 23 ms | 45 ms |
| Reset time | | < 160 ms | | |
| Reset ratio | | Depends on the set Relative hysteresis | | |

| | | |
|---|---|---|
| Trip time accuracy | | ±0,1% of the delay time value or ±35 ms 1) |
| Equation operation time | Overfrequency | $t_G = t_d$ when $G > Gs$ |
| | Underfrequency | $t_G = t_d$ when $G < Gs$ |
| 1) Includes the delay of the signal output contact | | |

## 3.2 Measurement resolution

| | |
|---|---|
| **Mains and generators' bars voltages.** | 1Vrms. |
| **Currents.** | Min. 0.1A (it depends on the CT ratio). |
| **Mains and generators' bars frequencies.** | 0.1Hz ± 50ppm, 35ppm/C typical. |
| **Powers** | Min. 0.1 kW/kVA/kvar (it depends on the CT ratio). |
| **Power Factors.** | 0.01. |
| **Energies.** | 1 kWh/kvarh. |

# 4 Installation

## 4.1 Mounting

The device requires permanently mounting on a panel. The rear panel of the device must be accessible only by keys or tools and only by authorized personnel for maintenance operations. It must be impossible to remove the controller without tools.


The mounting dimensions for the installation are 218x159mm. Four hooks with screws carry out the mounting: once the device is positioned, insert the hooks in the holes on the sides and tighten the screws. Pay attention not to tighten excessively the screws in order not to damage the hook on the device.

## 4.2 Wiring

**Due to the high voltages connected to the measurement circuits of the controller, all conductive parts of the electrical panel should be connected to the protective earthing through permanent connections.**

The installation of an overcurrent protection device is required for each phase of the mains and generator's bars voltage inputs. You can use 1A fuses.

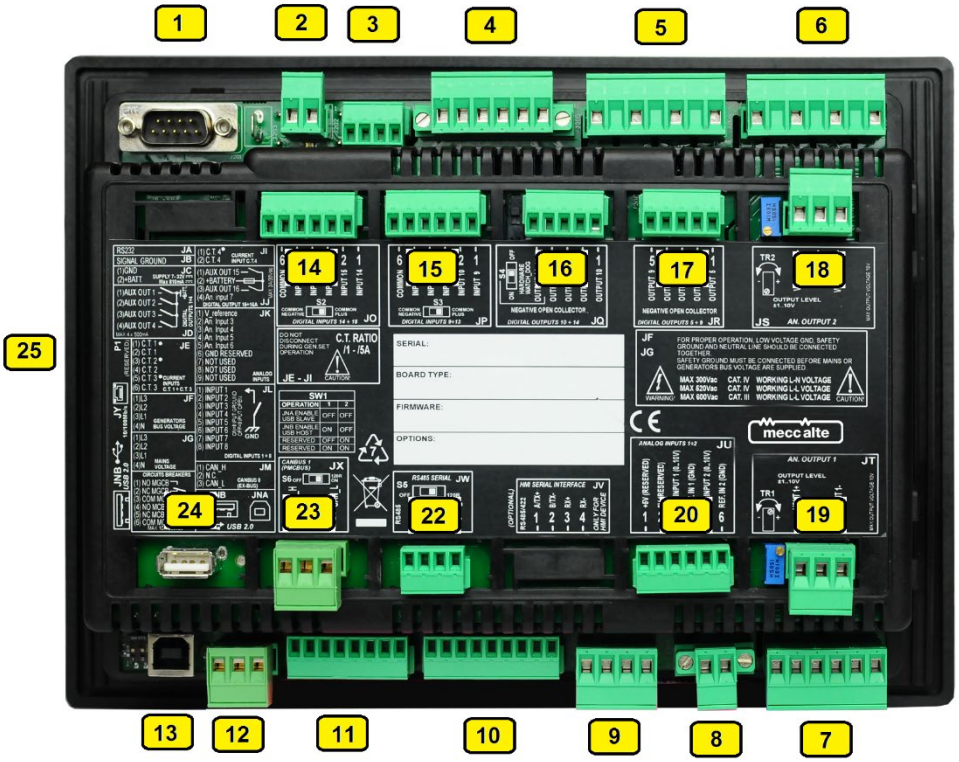
The section of the protective earthing conductor should be at least equal to the section of cables used to wire mains or generators voltages to the control panel. In addition, it must comply with the limit value of the overcurrent protection used.

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

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

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

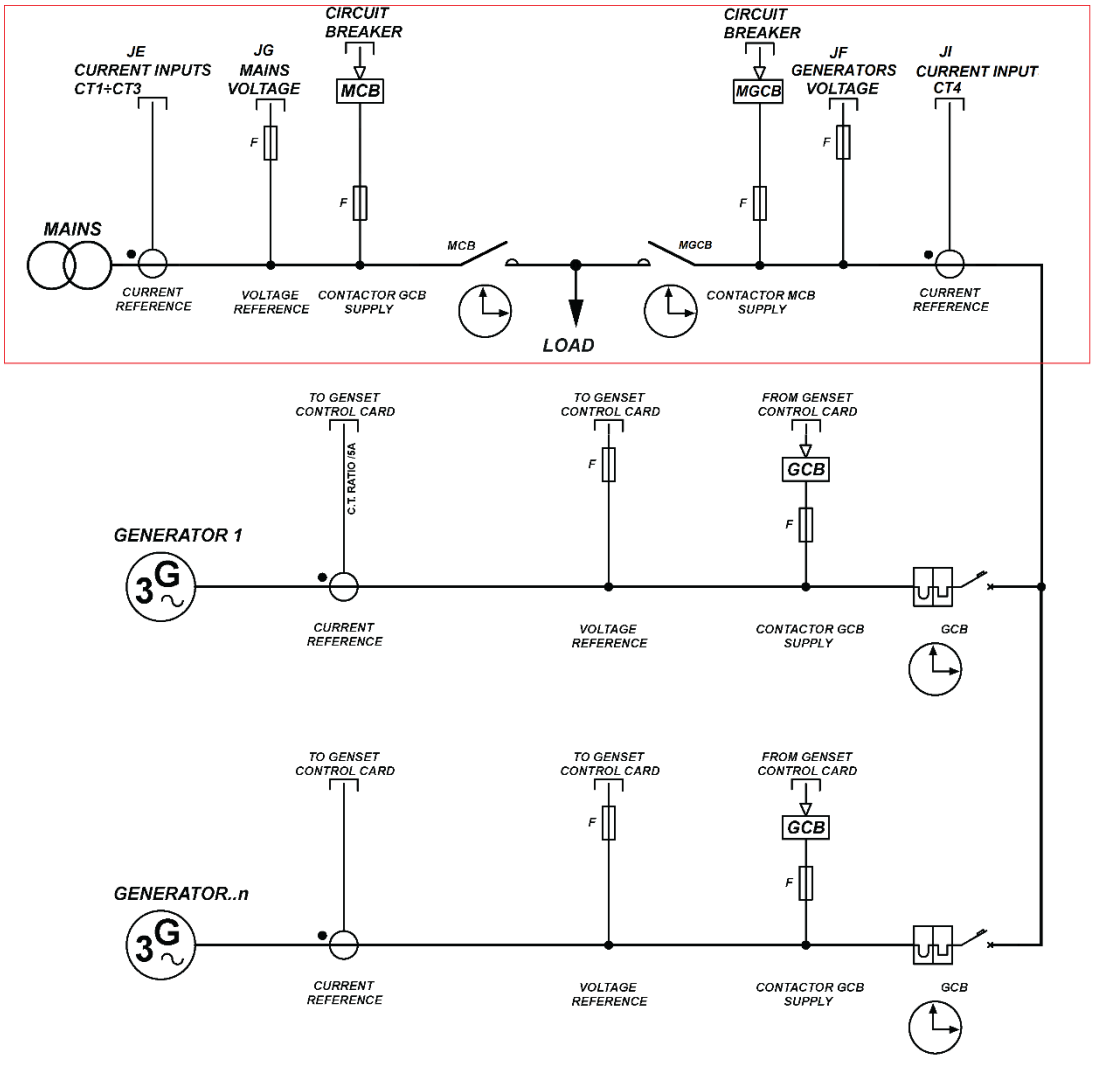
# 5 IN/OUT connections and configuration




| N. | NAME | DESCRIPTION | CONNECTOR |
|---|---|---|---|
| 1 | JA | Communication interface RS232. | 9 Poles Male Canon. |
| 2 | JC+JB | Power supply + functional earth. | 2 poles x 2,5mm$^2$ Screw terminal + faston. |
| 3 | JD | Digital outputs 1-4. | 4 poles x 1,5mm$^2$ Screw terminal. |
| 4 | JE | Current inputs 1-3. | 6 poles x 2,5mm$^2$ Screw terminal. |
| 5 | JF | Generators' bars voltages. | 4 poles x 2,5mm$^2$ Screw terminal. |
| 6 | JG | Mains voltages. | 4 poles x 2,5mm$^2$ Screw terminal. |
| 7 | JH | Digital outputs 17-18. | 6 poles x 2,5mm$^2$ Screw terminal. |
| 8 | JI | Auxiliary current input. | 2 poles x 2,5mm$^2$ Screw terminal. |
| 9 | JJ | Digital outputs 15-16. | 4 poles x 2,5mm$^2$ Screw terminal. |
| | | Analogue input 7. | |
| 10 | JK | Analogue inputs 3-6. | 9 poles x 1,5mm$^2$ Screw terminal. |
| 11 | JL | Digital inputs 1-8 | 8 poles x 1,5mm$^2$ Screw terminal. |
| 12 | JM | CAN bus for I/O expansions. | 3 poles x 2,5mm$^2$ Screw terminal. |
| 13 | JNA | USB 2.0 Function Interface. | USB – B. |
| 14 | JO | Digital inputs 14-18. | 6 poles x 1,5mm$^2$ Screw terminal. |
| 15 | JP | Digital inputs 9-13. | 6 poles x 1,5mm$^2$ Screw terminal. |
| 16 | JQ | Digital outputs 10-14. | 5 poles x 1,5mm$^2$ Screw terminal. |
| 17 | JR | Digital outputs 5-9. | 5 poles x 1,5mm$^2$ Screw terminal. |

| | | | |
|---|---|---|---|
| **18** | **JS** | Analogue output 2. | 3 poles x 2,5mm$^2$ Screw terminal. |
| **19** | **JT** | Analogue output 1. | 3 poles x 2,5mm$^2$ Screw terminal. |
| **20** | **JU** | Analogue inputs 1-2. | 6 poles x 1,5mm$^2$ Screw terminal. |
| **22** | **JW** | RS485 Communication interface. | 4 poles x 1,5mm$^2$ Screw terminal. |
| **23** | **JX** | PCMBUS Interface for parallel functions. | 3 poles x 2,5mm$^2$ Screw terminal. |
| **24** | **JNB** | USB 2.0 Host Interface. | USB – A. |
| **25** | **JT** | Ethernet Interface. | RJ45. |

## 5.1 Basic diagram

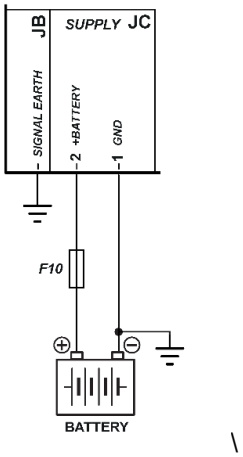



## 5.2 Functional earth (JB)

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

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

## 5.3 Device supply (JC)




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

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

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

At power on, the controller automatically detects if the supply nominal voltage is 12 or 24V for managing the related logics and alarms. In addition, the controller repeats the detection each time you switch to the **OFF/RESET** mode.

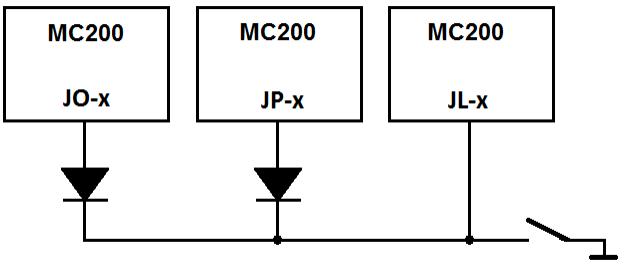
**NOTE: when installing, connect the supply voltage positive only after opening all fuses available in the panel.**

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

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

Besides these 18 inputs, it is possible to use the analogue inputs **JK** and **JU** as digital inputs, if not used as measurement inputs (see par. 5.6) and, with different modes, the **JJ-4** terminal too (see par. 5.6.3).

It is possible to share the same command signal of an input with different devices (for example, one signal for three MC200). If you use the inputs of the JO and JP connectors (positive common), it is necessary to separate them with diodes, as in the figure below. This avoids the wrong activation of the input when one of the devices is switched off. If the JL connector inputs are used, the diode can be omitted as it is already provided internally.

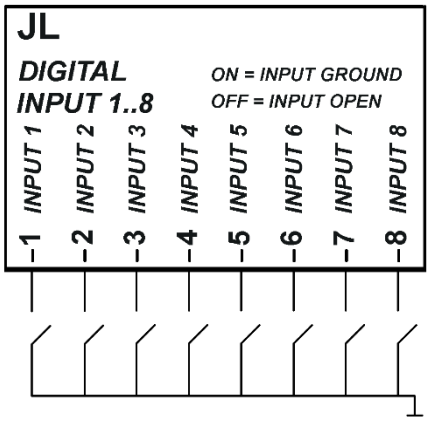



It's also possible to increase the number of digital inputs by adding up to two optional DITEL 16 IN modules (connected by CAN bus) for a total of 32 digital inputs (see par.5.8).

There are also 16 "virtual" digital inputs, which do not exist on the controller or on the expansion modules, but they are represented by the result of the logic combination of physical or virtual inputs, outputs, alarms or logical statuses, by means of the proper programming by BoardPrg3 or through the internal PLC. The virtual inputs can be configured as functions and used as physical inputs; see par.5.4.4.

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

### 5.4.1 JL - Digital inputs 1-8




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

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

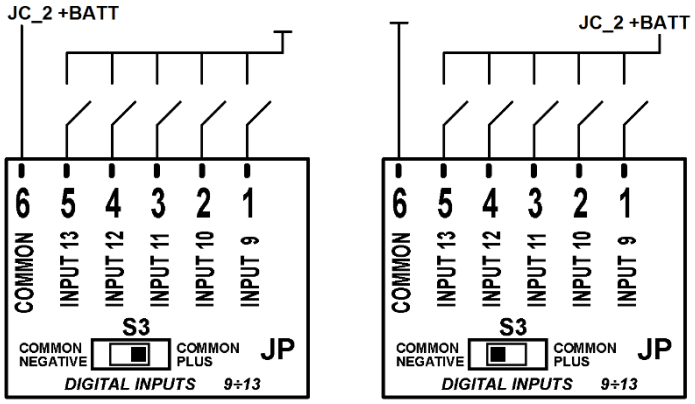
The inputs are wholly configurable (see par. 5.4.5).

By default, the functions of the JL input on the MC200 controller are the following:

| Terminal | Digital input | Default function |
|---|---|---|
| JL-1 | 01 | **DIF.3003 - "Status of MGCB circuit breaker".** |
| JL-2 | 02 | **DIF.3002 - "Status of MCB circuit breaker".** |
| JL-3 | 03 | **DIF.0000 - "Not used".** |
| JL-4 | 04 | **DIF.2702 - "Enables the load function".** |
| JL-5 | 05 | **DIF.0000 - "Not used".** |
| JL-6 | 06 | **DIF.0000 - "Not used".** |
| JL-7 | 07 | **DIF.0000 - "Not used".** |

| Terminal | Digital input | Default function |
|---|---|---|
| JL-8 | 08 | **DIF.0000 - "Not used".** |

### 5.4.2 JP - Digital inputs 9-13




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

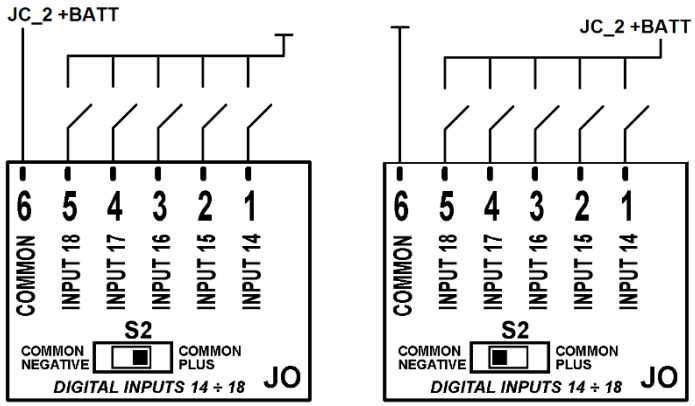
Alternatively, it is possible to activate the inputs by connecting them to the battery negative: in this case, the common terminal **JP-6** must be connected to the battery negative and the selector **S3** must be set on *common negative*.

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

By default, the functions of the JP input on the MC200 controller are the following:

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

### 5.4.3 JO - Digital inputs 14-18



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

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

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

By default, the functions of the JO inputs on the MC200 controller are the following:

| Terminal | Digital input | Default function |
|---|---|---|
| JO-1 | 14 | **DIF.0000 - "Not used"** |
| JO-2 | 15 | **DIF.0000 - "Not used"** |
| JO-3 | 16 | **DIF.0000 - "Not used"** |
| JO-4 | 17 | **DIF.0000 - "Not used"** |
| JO-5 | 18 | **DIF.0000 - "Not used"** |
| JO-6 | - | Positive or negative common input terminal |

### 5.4.4 Virtual digital inputs

Besides 18 physical digital inputs and 32 available with the DITEL modules, the controller manages 16 virtual digital inputs. They are managed by the controller exactly as they were physical inputs (without limitations), but the virtual inputs status is not acquired by the hardware, but determined via software. In fact, each virtual digital input can be associated to an AND/OR logic that determines the status (see par. 5.5.7) or to a logic used by the PLC program.

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

Example of the use of an AND/OR logic. Let us suppose we would like to activate a warning if the mains exceed the tolerance thresholds while the MGCB is closed. Let us use the virtual digital input #1 (as example).

- Using the BoardPrg3 software we associate an AND/OR logic configured as AND to the virtual digital input #1, with the following list of conditions:
  - ST.066 ("MGCB status")
  - ST.017 ("Mains absent or out of tolerance").
- Therefore, the virtual digital input will be active when the MGCB is closed and the mains is out of tolerance.
- Let us set the DIF.4001 function ("Generic warning") within the P.2151 parameter.
- Let us set the desired delay (for example 0.5 s) within the P.2152 parameter.
- Let us set the alarm message (for example "mains voltage warning") within the P.2153 parameter.

### 5.4.5 Digital inputs configuration

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

**The logic status of the input can be reversed with respect to the physical status by ticking the "Reversed polarity" box in the input configuration page on BoardPrg3.**

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

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

| Parameter | Inputs |
|---|---|
| P.2000 | 01...16 |
| P.2050 | 17...18 |
| P.2100 | Analogue inputs used as digital ones |
| P.2200 | DITEL #01 |
| P.2250 | DITEL #02 |

Said parameters have a bit for each output:

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

By default, all bits are set to zero.

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

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

See document [1] for the parameters list.

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

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

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

**NOTE: in BoardPrg3, the boxes for the delay and the message are always displayed, even if they are not used by the controller.**

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

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

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

| Input function xx. | Name | Delay | Message | Description |
|---|---|---|---|---|
| DIF.0000 | Not used. | | | Input not used. |
| DIF.0101 | Used by PLC. | | | Input used by the internal PLC logic. |
| DIF.1001 | Request for MGCB closure. | | | It only acts in MAN mode, used to control the manual closing of the circuit breaker. If there is no input configured with the function DIF.1002, this input works as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed. The controller closes the circuit breaker when the input becomes active. |
| DIF.1002 | Request for MGCB opening. | | | It only acts in MAN mode, used to control the manual opening of the circuit breaker. The controller opens the circuit breaker when the input becomes active. |
| DIF.1003 | MGCB controlled externally. | | | It indicates to the controller that an external logic temporarily controls the circuit breaker: the controller will acknowledge it without activating faults. |
| DIF.1004 | Synchronization request MGCB. | | | It is used when an external device controls the circuit breaker: the external device activates this input if it wants the controller to carry out the synchronization and supply the “synchronized” contact (or if the controller needs to manage the analogue input connected to an external synchronizer). |
| DIF.1005 | MGCB closure allowed. | Yes | | This function allows an external logic to prevent or to delay the circuit breaker closure. If this input is configured, the controller activates an output configured as “ready to close” (DOF.3083) and waits for external acknowledge. If a delay is configured for this input, after this time the controller goes on with closure command even without acknowledgement. |
| DIF.1006 | MGCB opening allowed. | Yes | | This function is used only when the opening of the circuit breaker will result in a blackout on the loads. Before opening MGCB, the device activates an output configured as “ready to open” (DOF.3084) and waits for external acknowledge. If a delay is configured for this input, after this time the controller goes on with opening command even without acknowledgement. |
| DIF.1031 | Request for MCB closure. | | | It only acts in MAN mode, used to control the manual closing of the circuit breaker. If there is no input configured with the function DIF.1002, this input works as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed. The controller closes the circuit breaker when the input becomes active. |
| DIF.1032 | Request for MCB opening. | | | It only acts in MAN mode, used to control the manual opening of the circuit breaker. The controller opens the circuit breaker when the input becomes active. |
| DIF.1033 | MCB controlled externally. | | | It indicates to the controller that an external logic temporarily controls the circuit breaker: the controller will acknowledge it without activating faults. |
| DIF.1034 | Synchronization request MCB. | | | It is used when an external device controls the circuit breaker: the external device activates this input if it wants the controller to carry out the synchronization and supply the “synchronized” contact (or if the controller needs to manage the analogue input connected to an external synchronizer). |
| DIF.1035 | MCB closure allowed. | Yes | | This function allows an external logic to prevent or to delay the circuit breaker closure. If this input is configured, the controller activates an output configured as “ready to close” (DOF.3081) and waits for external acknowledge. If a delay is configured for this input, after this time the controller goes on with closure command even without acknowledgement. |
| DIF.1036 | MCB opening allowed. | Yes | | This function is used only when the opening of the circuit breaker will result in a blackout on the loads. Before opening MGCB, the device activates an output configured as “ready to open” (DOF.3082) and waits for external acknowledge. If a delay is configured for this input, after this time the controller goes on with opening command even without acknowledgement. |
| DIF.2001 | Command for resetting alarms. | | | When the input becomes “active”, the controller carries out a reset of all faults. That is equivalent to change the controller mode to OFF/RESET and back again to the desired mode. |

| Input function xx. | Name | Delay | Message | Description |
|---|---|---|---|---|
| DIF.2002 | Command for alarm acknowledgment. | | | When the input becomes “active”, the controller silences the horn and recognizes the faults as the ACK button was kept pressed on the device display. |
| DIF.2029 | TEST without load (pulse). | | | When the input becomes “active” with the controller in AUTO, the test of the generators is performed without load, not depending from the value set in parameter “P.0222 – Enable generator supply on test”. The test has a configured duration with parameter P.0420: if set to zero, this test is never performed. If there is a second activation of the input during the test, the test is immediately stopped. |
| DIF.2030 | TEST with load (pulse). | | | When the input becomes “active” with the controller in AUTO, the test of the generators is performed with load, not depending from the value set in parameter “P.0222 – Enable generator supply on test”. The test has a configured duration with parameter P.0420: if set to zero, this test is never performed. If there is a second activation of the input during the test, the test is immediately stopped. |
| DIF.2031 | Request for TEST mode. | | | When the input is “active”, the mode of the controller switches from AUTO to TEST (the input does nothing if the controller is not in AUTO or if the automatic intervention of the genset is required). When it becomes inactive, the status changes back to AUTO. The test will be performed with or without load based on how configured with parameter P.0222. |
| DIF.2032 | Request for REMOTE START mode. | 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.2063 | Full override protections. | | | When the input activates, all protections (except some, see [1]) that cause alarms or unloads become warnings. |
| DIF.2093 | Select the import-export mode. | | | When the input is active, the controller switches to the “import/export” mode during the parallel with the mains, whatever is the mode configured in P.0880. |
| DIF.2096 | Transfer to the generators. | | | When the input is active, the controller transfers the load from the mains to the gensets, then it opens the MCB circuit breaker. |
| DIF.2151 | Select configuration 1. | | | When the input becomes “active”, the parameter of the alternative configuration 1 are copied into the work parameters |
| DIF.2152 | Select configuration 2. | | | When the input becomes “active”, the parameter of the alternative configuration 2 are copied into the work parameters |
| DIF.2153 | Select configuration 3. | | | When the input becomes “active”, the parameter of the alternative configuration 3 are copied into the work parameters |
| DIF.2154 | Select configuration 4. | | | When the input becomes “active”, the parameters of the alternative configuration are copied into the work parameters |
| DIF.2181 | Immediate supply. | | | It is used in plants composed by many gensets: if the input is active, the switch of the users between mains and gensets is carried out after the closing of the first GCB circuit breaker. |
| DIF.2251 | Manual disconnection of loads. | | | Each time this input become active, the “load shedding” function disconnects one load (if possible). See the “load shedding” description for more details. |
| DIF.2252 | Manual re-connection of loads. | | | Each time this input becomes active, the “load shedding” function reconnects one load (if possible). See the “load shedding” description for more details. |
| DIF.2271 | Remote OFF. | | | When this input is active, the operating mode of the controller is forced to OFF-RESET, and it is not possible to use the pushbuttons on the front panel to change it. **Note: when this input deactivates, if no inputs are configured with the functions DIF.2272 and DIF.2273, the operating mode is forced to the one set before the input activation.** |
| DIF.2272 | Remote MAN | | | When this input is active, the operating mode of the controller is forced into MAN and you cannot use the buttons on the panel to change it. |
| DIF.2273 | Remote AUTO | | | When this input is active, the operating mode of the controller is forced into AUTO and you cannot use the buttons on the panel to change it. |

| Input function xx. | Name | Delay | Message | Description |
|---|---|---|---|---|
| DIF.2501 | Inhibition of start. | | | When the input is “active”, the automatic start of the generators is inhibited. The “REMOTE START” mode is not influenced by this function |
| DIF.2502 | Inhibition of supply. | | | Automatically, when this input is “active”, the opening of the MGCB circuit breaker is forced (or the opening of all GCBs if MGCB does not exist or is externally managed), and the closing of MCB too. |
| DIF.2503 | MCB closure inhibition | | | If this input is active, the controller keeps the MCB circuit breaker open (in automatic modes). |
| DIF.2701 | Enables remote start request. | | | If this input is not active, the controller does not accept to go to the “REMOTE START” mode. |
| DIF.2702 | Enables the load function. | | | Used in the “load management”. See document [8]. |
| DIF.2704 | Disables protections on the 4° current. | | | When this input is “active”, the auxiliary current protection (normally used for differential protection) is disabled. |
| DIF.2705 | Disables protections on analogue measures. | | | When this input “activates”, the thresholds set on the analogue measures with bit 13 ON, in the third or sixth configuration parameter (see par. 5.6.4) don’t cause the intervention of the relative protections. |
| DIF.2706 | Enables serial port commands. | | | If this input is not “active”, the commands sent by means of Modbus registers HOLDING REGISTER 101 and 102 are not accepted. |
| DIF.2708 | Enables PPR thresholds ‘1’. | | | If this input exists but it is not active, the protections for the parallel with the mains configured with parameters P.0922 e P.0924 are disabled. See document [8]. |
| DIF.2712 | Enables the function 27T. | | | If this input exists and is not active, the function which disables the generator and interface protections 27 for low mains voltage is disabled. |
| DIF.2713 | Enables protection 27Q (PPR). | | | If this input exists and it is not active, the protection for the parallel with the mains “27U & Q” is disabled. |
| DIF.2716 | Enables the acquisition of the mains kW from analogue input | | | If this input exists and is active, the active power on the mains connection point is acquired by an appropriately configured analogue input. If it exists and is not active, the active power is measured using the AC inputs of the controller. |
| DIF.2721 | Enable load shedding. | | | If this input is configured but not active, the “load shedding” function is disabled. |
| DIF.2722 | Enable peak shaving/lopping. | | | If this input is configured but not active, the “peak shaving/lopping” function is disabled. |
| DIF.3002 | Status of MCB circuit breaker. | Yes | | It acquires the circuit breaker status which connects the mains to the users. An input configured in this way is used to activate a warning in the event of a discrepancy between the controls to the circuit breaker given by the board and the status of the same circuit breaker. Warning can be also issued in this case or, even, depending on the configuration, the generators 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 | Status of MGCB circuit breaker. | | | It acquires the general circuit breaker status, which connects the genset parallel bars to the users. It is used for the parallel logics and to disable the “load management” if the loads are not connected to the gensets. |
| DIF.3004 | Status of GCB of other gen-sets. | | | Use this input if the gensets must work in parallel with other gensets controlled by “not Sices” controllers: indicates MC200 that at least another genset has its own GCB closed. |
| DIF.3101 | External sensor for mains. | | | When the input is “active”, the mains is considered “in tolerance” |
| DIF.3102 | No voltages on parallel bars. | | | Used in parallel plants, where the controller cannot directly measure the voltage on the parallel bars. The active input indicates that there is no voltage on the bars. |
| DIF.3103 | External protections for parallel to mains | | | Connect the external device, which manages the protections of parallel with the mains, to this input. The input must be active when no protection has triggered. |
| DIF.3104 | No voltages on loads. | | | Used in parallel plants, where the controller cannot directly measure the voltage on the loads. The active input indicates that there is no voltage on the loads. |
| DIF.3201 | General status (page 1). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.08. |

| Input function xx. | Name | Delay | Message | Description |
|---|---|---|---|---|
| DIF.3202 | Important status (page 1). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.08, which is immediately shown. |
| DIF.3203 | General status (page 2). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.09. |
| DIF.3204 | Important status (page 2). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.09, which is immediately shown. |
| DIF.3205 | General status (page 3). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.10. |
| DIF.3206 | Important status (page 3). | | Yes | When this input is “active”, the controller displays the text set in the parameters associated to the input on page S.10, which is immediately shown. |
| DIF.4001 | Generic warning. | Yes | Yes | When the input is active, a warning is issued: the message shown is the one set in the parameters associated to the input. |
| DIF.4002 | Generic unload. | Yes | Yes | When the input is active, an unload is issued: the message shown is the one set by means the related “text” parameter. |
| DIF.4004 | Generic alarm. | Yes | Yes | When the input is active, an alarm is issued: the message shown is the one set by means the related “text” parameter. |
| DIF.4005 | Warning transmitted to gen-sets. | Yes | Yes | When the input is active, a warning is issued: the message shown is the one set in the parameters associated to the input. All the connected genset controllers will activate the warning “warning from master device”. |
| DIF.4008 | Alarm transmitted to gen-sets. | Yes | Yes | When the input is active, an alarm is issued: the message shown is the one set by means the related “text” parameter. All the connected genset controllers will activate the alarm “alarm from master device”. |
| DIF.4021 | Warning (forces MCB open). | Yes | Yes | When the input is “active” a warning is issued: the message shown is the one set in the parameters associated to the input. The controller forces MCB opened. |
| DIF.4022 | Unload (forces MCB open). | Yes | Yes | If the input is active, an unload is issued: the message shown is the one set in the parameters associated to the input. The controller forces MCB opened. |
| DIF.4024 | Alarm (forces MCB open). | Yes | Yes | When the input is “active”, if the GCB command is active, a warning is issued: the message shown is the one set in the parameters associated to the input. The controller forces MCB opened. |
| DIF.4062 | Unload (subject to override). | Yes | Yes | When the input is “active”, an unload is normally activated. If the Override function of the protections is activated, a warning activates. The message shown is the one set on the parameters associated to the input. |
| DIF.4064 | Alarm (subject to override). | Yes | Yes | When the input is “active”, an alarm is normally activated. If the Override function of the protections is activated, a warning activates. The message shown is the one set by means of the related parameters. |
| DIF.4261 | Production line opened. | Yes | | When the input is “active”, the controller realises to be no more in parallel with the mains and stops the genset with an alarm. |

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

The controller has eighteen digital outputs: four relay outputs (**JJ** and **JH**), four positive static outputs (**JD**) and ten negative static outputs (**JQ** and **JR**). It is possible to add two DITEL modules 16 IN, each of which manages up to two DITEL 8 OUT relay modules, for 32 additional outputs, in addition to the one on the controller.

### 5.5.1 JJ - Digital outputs 15-16

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

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

The default functions of the JJ outputs are:

| Terminal | Digital output | Type | Default function |
|---|---|---|---|

| | | | |
|---|---|---|---|
| JJ-1 | 15 | Normally open contact, of the relay 15. | **DOF.0000 – "Not used".** |
| JJ-2 | - | Terminal positive common input | |
| JJ-3 | 16 | Normally open contact, of the relay 16. | **DOF.0000 – "Not used".** |
| JJ-4 | - | - | |

In detail:

#### 5.5.1.1 JJ-2 COMMON PLUS Common positive

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

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

The voltage at terminal JJ-2 is measured for the management of the relative alarm and is displayed on page S.15 at EM-S

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

#### 5.5.1.2 JJ-1 Digital output 15

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

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

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

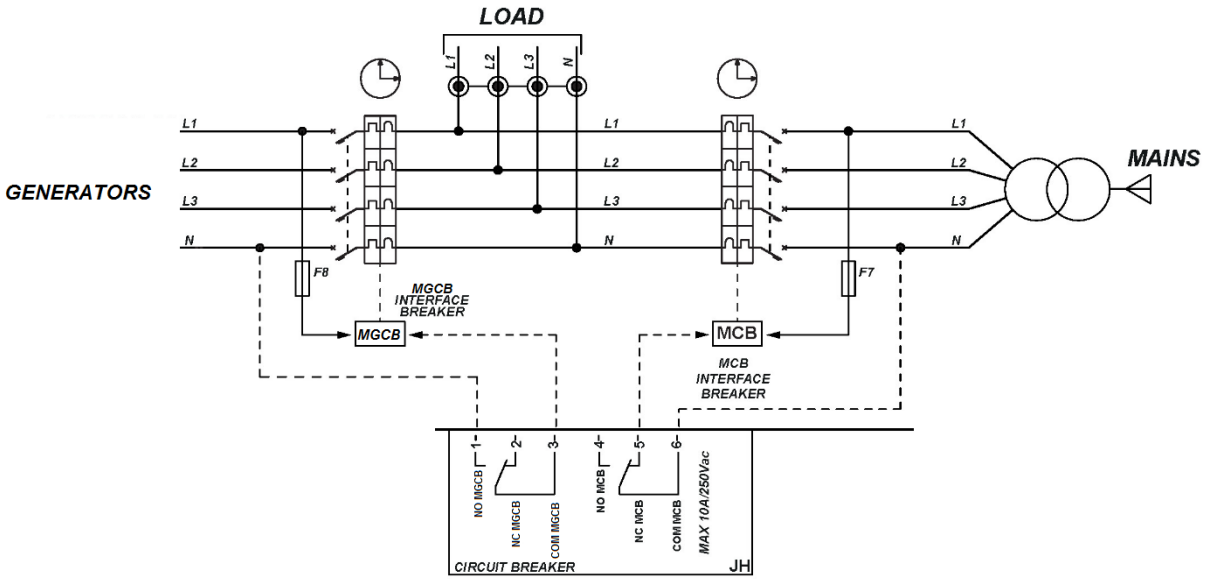
#### 5.5.1.3 JJ-3 Digital output 16

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

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

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

### 5.5.2 JH - Digital outputs 17-18: outputs for the command on the loads switching




The controller uses two 10A@250Vac relays in clean contact for the switching commands of the loads. On JH connector, a clean contact in exchange for each of the two relays is available.

The default functions of the outputs on the controller are:

| Terminal | Digital output | Type of output | Default function |
|---|---|---|---|
| JH-1 | 17 | Normally open contact of the relay 17. | **DOF.2034 - "Stable closing command for MGCB"** |
| JH-2 | | Normally closed contact of the relay 17. | |
| JH-3 | | Common contact of the relay 17. | |
| JH-4 | 18 | Normally open contact of the relay 18. | **DOF.2004 - "Stable opening command for MCB"** |
| JH-5 | | Normally closed contact of the relay 18. | |
| JH-6 | | Common contact of the relay 18. | |

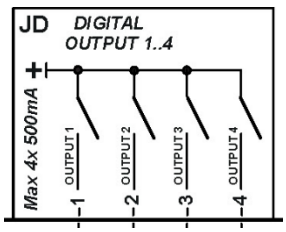
The output 17 is necessary to (as default) connect the loads to the generator. The output 18 is necessary to (as default) connect the loads to the generator. Both the relays can be used for other functions.

The normally closed contact of output 18 and the normally open contact of output 17 should be used; in this way, even with deactivated controller, however the loads remain connected to the electric mains.

For the circuit breakers management see par. 7.8

If there is only one circuit breaker, the MCB output (terminals 4... 6 of JH) is not used, it can be therefore associated to a different function (see par. 5.5.6).

### 5.5.3 JD - Digital output 1-4




They are four digital outputs, wholly programmable. When activated, they bring themselves to the positive supply voltage which is on the **JC-2** supply terminal. The nominal capacity of each

single output is 500mA: the total current is therefore 2A. **Never exceed these maximum current values.**

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

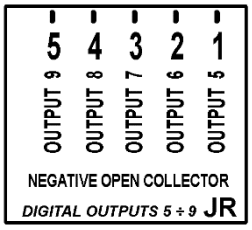
With inductive loads (power relays, electro-magnetic actuators), although already internally present, it is advisable to use damping diodes of the opening over voltages.

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

The default functions of these outputs are:

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

### 5.5.4 JO - Digital output 5-9




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

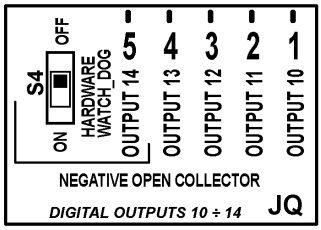
The outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The overload protection intervenes limiting the current peak at an instantaneous value of 2.2A. When this condition is lasting, the intervention of the thermal protection starts, which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

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

The default functions of the outputs are:

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

### 5.5.5 JQ - Digital output 10-14




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

The JQ-5 terminal can be used, alternatively to the function of output 14 as independent hardware watch-dog output. The activation happens through the S4 selector which, if set to ON, connects the output to the internal watch-dog circuit. If the device works properly, the output always remains in operation (output connected to battery negative). If the device is blocked and/or does not refresh the watch-dog circuit for a time higher than 5 seconds, the output automatically fails. If the device is turned off, the output immediately falls without waiting the 5 seconds' time-out. The output is on after about 1 sec, from the controller starting. If the watch-dog is disabled (S4=OFF) the status of the output 14 on JQ-5 terminal depends on its configuration. In case the output 14 is programmed with a specific function and the selector S4 is anyway set to ON (watch-dog output active), the output remains connected to the watch-dog circuit and it will never be activated by the chosen function.
**Using the output as watch-dog the functionality of output 14 is lost.**

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

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

The default functions of the outputs are:

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

### 5.5.6 Digital outputs configuration

All digital output of the controller and those of the additional DITEL modules, are individually totally programmable.

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

As default, all outputs activate when required by the relative function (e.g. the load shedding outputs operates when a load must be disconnected).

Using BoardPrg3 it is possible to invert the activation by simply selecting the box "Inverted polarity", on the top of the configuration page of each output.

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

| Parameter | Outputs |
|---|---|
| P.3000 | 01...16 |
| P.3020 | 17...18 |
| P.3200 | DITEL #01 |
| P.3250 | DITEL #02 |

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

A bit to one means that the output is normally activated. It goes at rest when it is required by the associated function.

The map of the outputs on the controller is:

| BIT | Hexadecimal value | Digital output | Terminal |
|---|---|---|---|
| 1 | 0001 | Output 01 | JD-1 |
| 2 | 0002 | Output 02 | JD-2 |
| 3 | 0004 | Output 03 | JD-3 |
| 4 | 0008 | Output 04 | JD-4 |
| 5 | 0010 | Output 05 | JR-1 |
| 6 | 0020 | Output 06 | JR-2 |
| 7 | 0040 | Output 07 | JR-3 |
| 8 | 0080 | Output 08 | JR-4 |
| 9 | 0100 | Output 09 | JR-5 |
| 10 | 0200 | Output 10 | JQ-1 |
| 11 | 0400 | Output 11 | JQ-2 |
| 12 | 0800 | Output 12 | JQ-3 |
| 13 | 1000 | Output 13 | JQ-4 |
| 14 | 2000 | Output 14 | JQ-5 |
| 15 | 4000 | Output 15 | JJ-1 |
| 16 | 8000 | Output 16 | JJ-3 |

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

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

| Bit | Hexadecimal value | Digital output |
|---|---|---|
| 1 | 0001 | Output 01 |
| 2 | 0002 | Output 02 |
| 3 | 0004 | Output 03 |
| 4 | 0008 | Output 04 |
| 5 | 0010 | Output 05 |
| 6 | 0020 | Output 06 |
| 7 | 0040 | Output 07 |
| 8 | 0080 | Output 08 |
| 9 | 0100 | Output 09 |

| Bit | Hexadecimal value | Digital output |
|---|---|---|
| 10 | 0200 | Output 10 |
| 11 | 0400 | Output 11 |
| 12 | 0800 | Output 12 |
| 13 | 1000 | Output 13 |
| 14 | 2000 | Output 14 |
| 15 | 4000 | Output 15 |
| 16 | 8000 | Output 16 |

Basically, if you want to invert the logic of an output it is necessary to add in the relative parameter its corresponding value: e.g. If you want to invert the outputs 3 and 4 on the controller, it is necessary to set P.3000 = 000C (thus 0004+0008); if you want to invert the outputs 5 and 10 of the DITEL (16 IN + 16 OUT) second group, it is necessary to set P.3250 = 0210 (thus 0010+0200).

By default, all bits are set to zero.

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

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

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

Following the configurable functions on digital outputs.

| Output function xx. | Name | Description |
|---|---|---|
| DOF.0000 | Not used. | Output not used. |
| DOF.0101 | Used by the PLC. | Output used by the internal PLC logic. |
| DOF.0102 | Managed by the serial ports. | The controller does not command the output with own internal logics, but with the commands received by means of the serial ports. |
| DOF.0103 | AND/OR logics. | The output status is the result of the combination of the logics AND/OR, see par. 5.5.7 |
| DOF.1005 | Request to start. | This output is active when the controller needs to start generators. |
| DOF.2001 | Minimum voltage coil for MCB (NC). | See par. 7.8. |
| DOF.2002 | Coil for opening of MCB. | See par. 7.8. |
| DOF.2003 | Coil for closure of MCB. | See par. 7.8. |
| DOF.2004 | Stable opening command for MCB. | See par. 7.8. |
| DOF.2031 | Minimum voltage coil for MGCB. | See par. 7.8. |
| DOF.2032 | Coil for opening of MGCB. | See par. 7.8. |
| DOF.2033 | Coil for closure of MGCB. | See par. 7.8. |
| DOF.2034 | Stable closing command for MGCB. | See par. 7.8. |
| DOF.2251 | Load shedding 1. | This output is related to the “load shedding” function. The output is activated when the load must be disconnected from the generators. See the “load shedding” description for more details. |
| DOF.2252 | Load shedding 2. | This output is related to the “load shedding” function. The output is activated when the load must be disconnected from the generators. See the “load shedding” description for more details. |
| DOF.2253 | Load shedding 3. | This output is related to the “load shedding” function. The output is activated when the load must be disconnected from the generators. See the “load shedding” description for more details. |

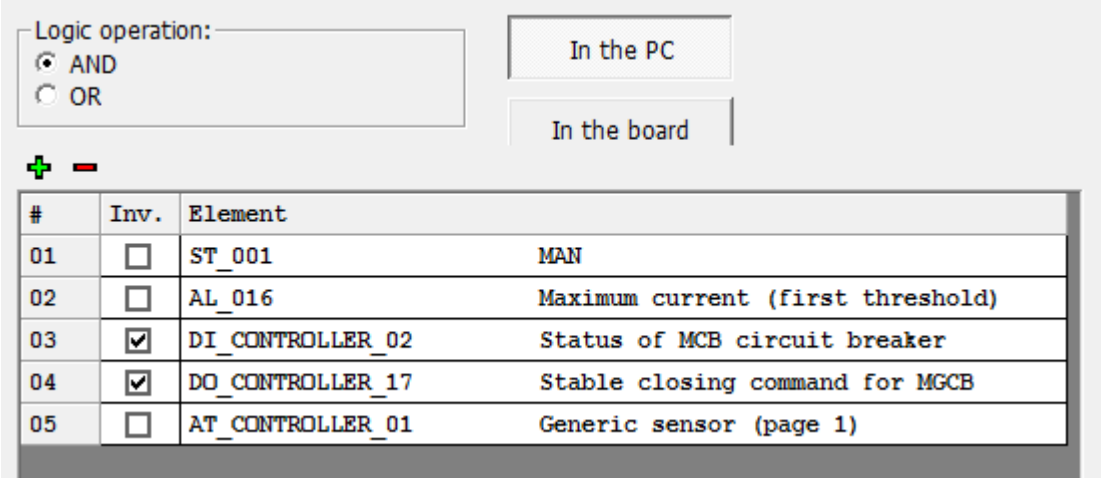
| Output function xx. | Name | Description |
|---|---|---|
| DOF.2254 | Load shedding 4. | This output is related to the “load shedding” function. The output is activated when the load must be disconnected from the generators. See the “load shedding” description for more details. |
| DOF.3001 | Off/Reset. | It activates when the controller is in OFF/RESET mode. |
| DOF.3002 | Manual. | It activates when the controller is in MANUAL mode. |
| DOF.3003 | Automatic. | It activates when the controller is in AUTOMATIC mode. |
| DOF.3004 | Test. | It activates when the controller is in TEST mode. |
| DOF.3005 | Remote start. | It activates when the controller is in REMOTE START mode. |
| DOF.3011 | Not in Off/reset. | It activates when the controller is in MAN or AUTO mode. |
| DOF.3012 | One of the automatic modes. | It activates when a controller is in an automatic operation mode, that is AUTO, TEST, or REMOTE START. |
| DOF.3030 | Voltages on loads. | It activates when there is voltage on the loads. |
| DOF.3031 | Voltage on generators. | It activates when there is voltage on the bars of the generators. |
| DOF.3033 | Mains in tolerance. | It activates when the mains parameters are inside the window “mains live”. |
| DOF.3034 | PPR ok. | This output deactivates when an anomaly is diagnosed on the mains voltage which requires the interruption of the parallel with the mains itself. |
| DOF.3035 | First command for 27Q. | It is the first command of the 27Q protection for the parallel with the mains. |
| DOF.3036 | Second command for 27Q. | It is the second command of the 27Q protection for the parallel with the mains. |
| DOF.3037 | Parallel to mains allowed. | This output activates when the mains status allows the parallel with the mains itself. |
| DOF.3062 | Ready to supply. | This output is active when loads can be connected to generators. |
| DOF.3081 | Ready to close MCB. | This output is activated before the closing of the circuit breaker only if one input is configured as “MCB closure allowed” (DIF.1035): it is deactivated (and so the circuit breaker will be closed) when that input is active or after the delay configured for the input elapses. |
| DOF.3082 | Ready to open MCB. | This output is activated before the opening of the circuit breaker only if one input is configured as “MCB opening allowed” (DIF.1036): it is deactivated (and so the circuit breaker will be opened) when that input is active or after the delay configured for the input elapses. |
| DOF.3083 | Ready to close MGCB. | This output is activated before closing the circuit breaker only if one digital input is configured as “MGCB closure allowed” (DIF.1005): it is deactivated (and so the circuit breaker will be closed) when that input is active or after the delay configured for the input. |
| DOF.3084 | Ready to open MGCB. | This output is activated before opening the circuit breaker only if one digital input is configured as “MGCB opening allowed” (DIF.1006): it is deactivated (and so the circuit breaker will be opened) when that input is active or after the delay configured for the input. |
| DOF.3091 | Synchronisation for MGCB. | It activates during the synchronisation for the closure of the MGCB circuit breaker. |
| DOF.3092 | Synchronisation for MCB. | It activates during the synchronisation for the closure of the MCB circuit breaker. |
| DOF.3093 | Synchronization in progress. | It activates during the synchronisation for the closure of the MCB or MGCB circuit breakers. |
| DOF.3094 | Synchronized. | It activates during the synchronisation for the closure of the MCB or MGCB circuit breakers, when the gensets are synchronous with the mains. |
| DOF.3096 | In parallel with the mains. | It activates when the gensets are supplying in parallel with the mains. |
| DOF.3151 | Reset of the anomalies. | The board activates this output for one second when the internal sequence for the cancellation of anomalies is carried out. |
| DOF.3152 | External horn. | It activates together with the internal siren. |
| DOF.3153 | Lamp test. | It activates in OFF/RESET mode, pressing STOP button; it can be used to turn on internal control lights of the controller, and there is one only procedure to test the control lights. |
| DOF.3154 | Acknowledge of the anomalies. | The board activates this output for one second when the internal sequence for the acknowledge of the anomalies is carried out. |
| DOF.4001 | Warnings. | It activates when there are warnings. |
| DOF.4002 | Unloads. | It activates when there are unloads. |
| DOF.4004 | Alarms. | It activates when there are alarms. |
| DOF.4005 | Alarms and unloads. | It activates when there are alarms or unloads. |
| DOF.4035 | Anomalies of circuit breakers | It activates when there are anomalies on the MGCB or MCB circuit breakers, that is:<br><br>013: MCB not closed.<br>014: MGCB not closed.<br>023: MCB not open.<br>024: MGCB not open. |

### 5.5.7 AND/OR logics

The AND/OR logics are basically a list of boolean conditions (true/false - on/off - 1/0), configurable by the operator (programming), evaluated by the controller and the result of which

can be assigned to a digital output or to a virtual digital input. To use the AND/OR logics with one digital output, use the function DOF.0103.

**Note: the configuration of the AND/OR logics cannot be carried out directly from the controller display, but it must be carried out by PC with the BoardPrg3 software.**




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

Up to 30 conditions can be added. Each condition can be individually denied: in the previous picture, for example, the controller will check the digital input 2 and the digital output 17 to be both **not active**. The following conditions can be added:

- DI_XXX: logic statuses of all digital inputs (physical and virtual).
- DO_XXX: logic statuses of all digital outputs.
- AL_XXX: presence of warning/alarms.
- ST_XXX: internal statuses of the controller.
- AT_XXX: statuses connected to the thresholds on analogue measures (see par. 5.6.4).

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

| Status | Description |
|---|---|
| ST_000 | OFF_RESET. |
| ST_001 | MAN. |
| ST_002 | AUTO. |
| ST_003 | TEST. |
| ST_004 | AVVIAMENTO REMOTO. |
| ST_006 | Acknowledgment of anomalies in progress. |
| ST_007 | Reset of anomalies in progress. |
| ST_008 | Warnings. |
| ST_009 | Unloads. |
| ST_011 | Alarms. |
| ST_012 | Not recognized warnings. |
| ST_013 | Not recognized unloads. |
| ST_015 | Not recognized alarms. |
| ST_016 | Mains present (voltages/frequency). |
| ST_017 | Mains absent or out of thresholds. |
| ST_018 | Delay for mains in thresholds. |
| ST_019 | Mains in thresholds. |
| ST_020 | Delay for mains absent or out of thresholds. |
| ST_048 | Load bus-bars live (voltages). |
| ST_049 | Generators bus-bars live (voltages). |

| Status | Description |
|---|---|
| ST_051 | Protection 27Q activated. |
| ST_052 | Mains fault protections activated (mains absent). |
| ST_053 | Protection 27 activated (U<<, 1° threshold). |
| ST_054 | Protection 59 activated (U>>, 1° threshold). |
| ST_055 | Protection 81< activated (f<<, 1° threshold). |
| ST_056 | Protection 81> activated (f>>, 1° threshold). |
| ST_057 | Protection ROCOF activated. |
| ST_058 | Protection VECTOR JUMP activated. |
| ST_059 | Protection 27 activated (U<, 2° threshold). |
| ST_060 | Protection 59 activated (U>, 2° threshold). |
| ST_061 | Protection 81< activated (f<, 2° threshold). |
| ST_062 | Protection 81> activated (f>, 2° threshold). |
| ST_064 | GCB status. |
| ST_065 | MCB status. |
| ST_066 | MGCB status. |
| ST_068 | MGCB closure command (stable). |
| ST_069 | MCB closure command (stable). |
| ST_070 | MGCB minimum voltage coil. |
| ST_071 | MGCB opening pulse. |
| ST_072 | MGCB closure pulse. |
| ST_073 | MCB minimum voltage coil. |
| ST_074 | MCB opening pulse. |
| ST_075 | MCB closure pulse. |
| ST_080 | Start inhibited by contact. |
| ST_081 | Start inhibited by clock/calendar. |
| ST_083 | Start inhibited because it's not possible to supply without mains and mains is absent. |
| ST_084 | Start inhibited because another genset has the GCB not opened. |
| ST_088 | GCB closure inhibited by contact. |
| ST_089 | GCB closure inhibited because it's not possible to supply without mains and mains is absent. |
| ST_090 | GCB closure inhibited by serial port. |
| ST_091 | GCB closure inhibited because another genset has the GCB not opened. |
| ST_092 | MGCB closure inhibited because MCB parallel failure. |
| ST_093 | MGCB closure inhibited because no gensets available. |
| ST_094 | MGCB closure inhibited by TEST without load. |
| ST_095 | GCB closure inhibited by reverse synchronization. |
| ST_096 | Ready to supply. |
| ST_097 | MCB synchronization in progress. |
| ST_098 | MGCB synchronization in progress. |
| ST_099 | Synchronized. |
| ST_100 | Ramp up in progress. |
| ST_101 | Ramp down in progress. |
| ST_102 | Supplying in parallel with mains. |
| ST_104 | Supplying. |
| ST_108 | Emergency plant. |
| ST_110 | Multiple plant |
| ST_112 | Sync per second. |
| ST_113 | Sync per minute. |
| ST_114 | Sync per hour. |
| ST_127 | Daylight Save Time. |
| ST_128 | Generator automatic start request. |
| ST_129 | Generator automatic start request for MCB closing failure. |
| ST_130 | Generator automatic start request by "peak shaving". |
| ST_136 | Generator stop request for none automatic start request. |
| ST_137 | Generator stop request for unloading. |
| ST_138 | Generator stop request for alarms. |
| ST_139 | Manual stop request. |
| ST_140 | Stop request for island mode inhibit. |
| ST_141 | Stop request for some GCBs "not open". |
| ST_144 | GCB closed on genset 01. |
| ST_145 | GCB closed on genset 02. |
| ST_146 | GCB closed on genset 03. |
| ST_147 | GCB closed on genset 04. |
| ST_148 | GCB closed on genset 05. |
| ST_149 | GCB closed on genset 06. |
| ST_150 | GCB closed on genset 07. |
| ST_151 | GCB closed on genset 08. |
| ST_152 | GCB closed on genset 09. |

| Status | Description |
|---|---|
| ST_153 | GCB closed on genset 10. |
| ST_154 | GCB closed on genset 11. |
| ST_155 | GCB closed on genset 12. |
| ST_156 | GCB closed on genset 13. |
| ST_157 | GCB closed on genset 14. |
| ST_158 | GCB closed on genset 15. |
| ST_159 | GCB closed on genset 16. |
| ST_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_168 | GCB closed on genset 25. |
| ST_169 | GCB closed on genset 26. |
| ST_170 | GCB closed on genset 27. |
| ST_171 | GCB closed on genset 28. |
| ST_172 | GCB closed on genset 29. |
| ST_173 | GCB closed on genset 30. |
| ST_174 | GCB closed on genset 31. |
| ST_175 | GCB closed on genset 32. |
| ST_192 | Unloading on genset 01. |
| ST_193 | Unloading on genset 02. |
| ST_194 | Unloading on genset 03. |
| ST_195 | Unloading on genset 04. |
| ST_196 | Unloading on genset 05. |
| ST_197 | Unloading on genset 06. |
| ST_198 | Unloading on genset 07. |
| ST_199 | Unloading on genset 08. |
| ST_200 | Unloading on genset 09. |
| ST_201 | Unloading on genset 10. |
| ST_202 | Unloading on genset 11. |
| ST_203 | Unloading on genset 12. |
| ST_204 | Unloading on genset 13. |
| ST_205 | Unloading on genset 14. |
| ST_206 | Unloading on genset 15. |
| ST_207 | Unloading on genset 16. |
| ST_208 | Unloading on genset 17. |
| ST_209 | Unloading on genset 18. |
| ST_210 | Unloading on genset 19. |
| ST_211 | Unloading on genset 20. |
| ST_212 | Unloading on genset 21. |
| ST_213 | Unloading on genset 22. |
| ST_214 | Unloading on genset 23. |
| ST_215 | Unloading on genset 24. |
| ST_216 | Unloading on genset 25. |
| ST_217 | Unloading on genset 26. |
| ST_218 | Unloading on genset 27. |
| ST_219 | Unloading on genset 28. |
| ST_220 | Unloading on genset 29. |
| ST_221 | Unloading on genset 30. |
| ST_222 | Unloading on genset 31. |
| ST_223 | Unloading on genset 32. |
| 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. |

| Status | Description |
|---|---|
| ST_237 | Calendar 14. |
| ST_238 | Calendar 15. |
| ST_239 | Calendar 16. |
| ST_240 | Genset 01 available. |
| ST_241 | Genset 02 available. |
| ST_242 | Genset 03 available. |
| ST_243 | Genset 04 available. |
| ST_244 | Genset 05 available. |
| ST_245 | Genset 06 available. |
| ST_246 | Genset 07 available. |
| ST_247 | Genset 08 available. |
| ST_248 | Genset 09 available. |
| ST_249 | Genset 10 available. |
| ST_250 | Genset 11 available. |
| ST_251 | Genset 12 available. |
| ST_252 | Genset 13 available. |
| ST_253 | Genset 14 available. |
| ST_254 | Genset 15 available. |
| ST_255 | Genset 16 available. |
| ST_256 | Genset 17 available. |
| ST_257 | Genset 18 available. |
| ST_258 | Genset 19 available. |
| ST_259 | Genset 20 available. |
| ST_260 | Genset 21 available. |
| ST_261 | Genset 22 available. |
| ST_262 | Genset 23 available. |
| ST_263 | Genset 24 available. |
| ST_264 | Genset 25 available. |
| ST_265 | Genset 26 available. |
| ST_266 | Genset 27 available. |
| ST_267 | Genset 28 available. |
| ST_268 | Genset 29 available. |
| ST_269 | Genset 30 available. |
| ST_270 | Genset 31 available. |
| ST_271 | Genset 32 available. |
| ST_272 | CAN 0 BUS-OFF |
| ST_273 | CAN 0 ERR-PASSIVE |
| ST_274 | CAN 0 ERR-ACTIVE |
| ST_275 | No communication on CAN 0 |
| ST_276 | CAN 1 BUS-OFF |
| ST_277 | CAN 1 ERR-PASSIVE |
| ST_278 | CAN 1 ERR-ACTIVE |
| ST_279 | No communication on CAN 1 |
| ST_280 | CAN 2 BUS-OFF |
| ST_281 | CAN 2 ERR-PASSIVE |
| ST_282 | CAN 2 ERR-ACTIVE |
| ST_283 | No communication on CAN 2 |
| ST_304 | START button |
| ST_305 | STOP button |
| ST_306 | MGCB 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_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_367 | Enable protections 27 for low mains voltage |
| ST_384 | Generator 01 active on PMCB |

| Status | Description |
|---|---|
| ST_385 | Generator 02 active on PMCB |
| ST_386 | Generator 03 active on PMCB |
| ST_387 | Generator 04 active on PMCB |
| ST_388 | Generator 05 active on PMCB |
| ST_389 | Generator 06 active on PMCB |
| ST_390 | Generator 07 active on PMCB |
| ST_391 | Generator 08 active on PMCB |
| ST_392 | Generator 09 active on PMCB |
| ST_393 | Generator 10 active on PMCB |
| ST_394 | Generator 11 active on PMCB |
| ST_395 | Generator 12 active on PMCB |
| ST_396 | Generator 13 active on PMCB |
| ST_397 | Generator 14 active on PMCB |
| ST_398 | Generator 15 active on PMCB |
| ST_399 | Generator 16 active on PMCB |
| ST_400 | Generator 17 active on PMCB |
| ST_401 | Generator 18 active on PMCB |
| ST_402 | Generator 19 active on PMCB |
| ST_403 | Generator 20 active on PMCB |
| ST_404 | Generator 21 active on PMCB |
| ST_405 | Generator 22 active on PMCB |
| ST_406 | Generator 23 active on PMCB |
| ST_407 | Generator 24 active on PMCB |
| ST_416 | MC 01 active on PMCB |
| ST_417 | MC 02 active on PMCB |
| ST_418 | MC 03 active on PMCB |
| ST_419 | MC 04 active on PMCB |
| ST_420 | MC 05 active on PMCB |
| ST_421 | MC 06 active on PMCB |
| ST_422 | MC 07 active on PMCB |
| ST_423 | MC 08 active on PMCB |
| ST_424 | MC 09 active on PMCB |
| ST_425 | MC 10 active on PMCB |
| ST_426 | MC 11 active on PMCB |
| ST_427 | MC 12 active on PMCB |
| ST_428 | MC 13 active on PMCB |
| ST_429 | MC 14 active on PMCB |
| ST_430 | MC 15 active on PMCB |
| ST_431 | MC 16 active on PMCB |
| ST_432 | BTB 01 active on PMCB |
| ST_433 | BTB 02 active on PMCB |
| ST_434 | BTB 03 active on PMCB |
| ST_435 | BTB 04 active on PMCB |
| ST_436 | BTB 05 active on PMCB |
| ST_437 | BTB 06 active on PMCB |
| ST_438 | BTB 07 active on PMCB |
| ST_439 | BTB 08 active on PMCB |
| ST_448 | RN 01 active on PMCB |
| ST_449 | RN 02 active on PMCB |
| ST_450 | RN 03 active on PMCB |
| ST_451 | RN 04 active on PMCB |
| ST_452 | RN 05 active on PMCB |
| ST_453 | RN 06 active on PMCB |
| ST_454 | RN 07 active on PMCB |
| ST_455 | RN 08 active on PMCB |
| ST_464 | Validity of shared digital input 1 |
| … | … |
| ST_719 | Validity of shared digital input 256 |
| ST_720 | Validity of shared analogue input |
| … | … |
| ST_751 | Validity of shared analogue input32 |
| ST_997 | PLC first scan. |
| ST_998 | Always ON. |
| ST_999 | Always OFF. |

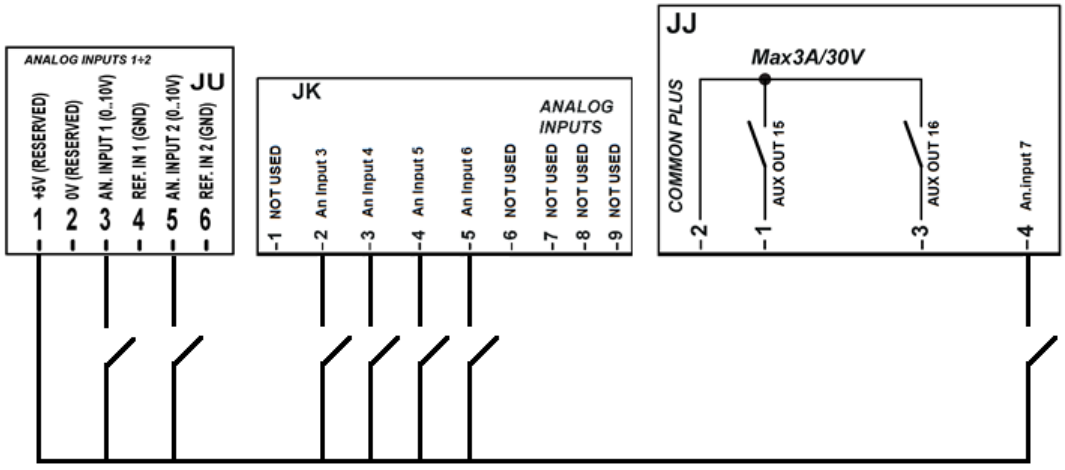
Using the virtual digital inputs, it is possible to create mixed AND/OR logics (composed by AND or OR together). Let's suppose we want to activate the digital output #1 when the digital inputs #1 and #2 are active, or if the digital input #3 is active.

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

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

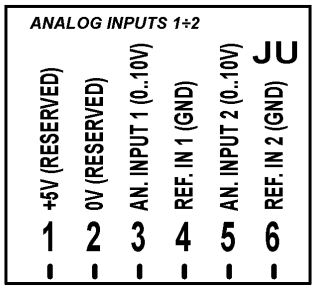
The device is equipped by two differential 0...10V voltage analogue inputs available on terminal **JU**, four inputs in voltage available on terminal **JK** and one in voltage available on terminal **JJ-4**.

All these inputs can also be configured individually as digital inputs (function AIF.0100 in parameter P.4001 or equivalent). In this case, the analogue inputs from 1 to 7 will be additional digital inputs from 19 to 25. The status of the virtual inputs is displayed at page S.11 (0=output not active, 1=output active). The inputs not configured as digital will be displayed with a dash. If set as digital (function AIF.0100 in parameter P.4001 or equivalent), the inputs are considered active when the measured voltage is higher than 4.0Vdc; they are considered not active when the measured voltage is lower than 3.5Vdc. They cannot therefore be activated as the other inputs by connecting it to the mass:




It is also possible to use two DIVIT expansion modules and three DIGRIN or DITHERM optional expansion modules, connected via CAN bus to acquire further 8 signals of voltage/current and up to 9 temperatures.

### 5.6.1 JU - Analogue inputs 1-2



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

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

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

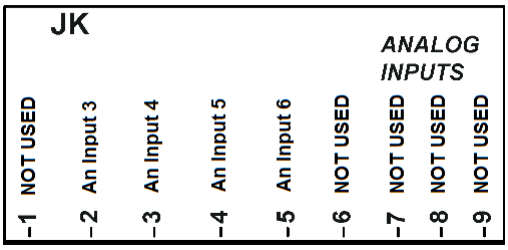
On the same connector **JU,** there are also one regulated +5Vdc output (**JU-1**) and one output connected to the mass inside the device (**JU-2**). This voltage is specific for the use of potentiometers. The total minimum resistance applicable between **JU-1** and **JU-2** is 10KΩ.

For configuration and uses of analogue inputs see par.5.6.4

The default functions of the inputs are:

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

### 5.6.2 JK - Analogue inputs 3-6

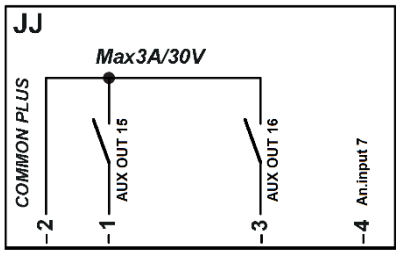



The device is equipped with four programmable inputs (0...10Vdc) **JK-2, JK-3, JK-4, JK-5**. The voltages are measured respect the negative power supply **JC-1 GND**. The four voltage values measured on the terminals are displayed on page S.15.

The default functions of the outputs are:

| Terminal | Analogue input | Type of input | Default function |
|---|---|---|---|
| JK-2 | Analogue input 3 | Voltage analogue inputs | **AIF.0000 - "Not used".** |
| JK-3 | Analogue input 4 | | **AIF.0000 - "Not used".** |
| JK-4 | Analogue input 5 | | **AIF.0000 - "Not used".** |
| JK-5 | Analogue input 6 | | **AIF.0000 - "Not used".** |

### 5.6.3 JJ-4 Analogue input 07




This input acquires a voltage with measurement range from 0 to 32Vdc compared to the supply negative of the controller (GND). Page S.15 shows the measured voltage.

### 5.6.4 Configuration of digital inputs (AI_CONTROLLER)

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

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

To each analogue input (JU, JK, JJ, DIGRIN, DITHERM, DIVIT and virtual) a set of 8 parameters is associated, to define the function type, an alternative denomination and a series of generic thresholds and configurations usable for different functions. Following are listed, as examples, those relative to the JK-2 input. For parameters of other inputs, refer to document [1] or to configuration page I/O of BoardPrg3.

NOTE: On BoardPrg3 the parameters are all displayed only when the input is configured as analogue, and not as digital. The analogue inputs of the expansion modules are only displayed if the module is configured.

You will have:

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

The parameter which contains a message for a given analogue input (in the example parameter P.4018), it is displayed by the controller each time the thresholds are used to activate alarms and/or warnings (see after). It is also used for the following functions of the analogue inputs AIF.2001, AIF.2003 e AIF.2005. In this case, the measurement acquired will be displayed on pages M.14, M.15 and M.16, preceded by the configured message. **NOTE: it is also possible to use function AIF.2051 instead of the three preceding ones. In this case, the measurement acquired will be not displayed; it can be used with the thresholds to manage digital outputs and activate warnings/alarms.**

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

- Bit 0. If this bit is “OFF”, the controller checks if the measurement is higher than the threshold. If this bit is “ON”, the controller checks if the measurement is lower than the threshold.
- Bit 1. If this bit is “OFF”, the controller sets to OFF the internal status related to this analogue measurement, if the measurement is out of threshold. If this bit is “ON”, the controller sets to ON the internal status related to this analogue measurement, if the measurement is out of threshold.
- Bit 3. If this bit is “ON”, the controller transmits the anomaly to generators also.
- Bit 4. If this bit is “ON”, the controller activates a warning if the measurements is out of threshold.
- Bit 5. If this bit is “ON”, the controller commands an unload if the measurements is out of threshold.
- Bit 7. If this bit is “ON”, the controller activates an alarm if the measurements is out of threshold.
- Bit 8. If this bit is “ON”, the controller checks that MCB is closed to activate eventual warnings/alarms configured with the preceding bits.
- Bit 9. If this bit is “ON”, the controller checks that MGCB is closed to activate eventual warnings/alarms configured with the preceding bits.
- Bit 13. If this bit is “ON”, to activate eventual warnings/alarms configured with the preceding bits, the controller checks the status of eventual digital inputs configured with function “DIF.2705 – Disable the protections on analogue measurements”. The warnings/alarms will be activated if no digital input is configured like that, or if they are all OFF.
- Bit 15. If this bit is “ON”, the anomaly is subject to override of the protections.

It is possible to set any combination of these bits.

Using together the two thresholds and the AND/OR logics, it is possible to activate a digital output related to the value of an analogue measurement, with hysteresis. See the example in the next chapter for the virtual analogue inputs.

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

| Analogue Input function xx. | Name | Message | Thres holds | Controller (JU, JK, JJ-4) | DIV IT | DIGRIN / DITHERM |
|---|---|---|---|---|---|---|
| AIF.0000 | Not used. | | | X | X | X |
| AIF.0100 | Used as digital input. | | | X | | |
| AIF.2001 | Generic sensor (page 1). | X | X | X | X | X |
| AIF.2003 | Generic sensor (page 2). | X | X | X | X | X |
| AIF.2005 | Generic sensor (page 3). | X | X | X | X | X |
| AIF.2051 | Generic sensor. | X | X | X | X | X |
| AIF.2101 | Speed offset. | | | X | X | |
| AIF.2103 | External synchronizer. | | | X | X | |
| AIF.2105 | External MCB synchronizer. | | | X | X | |
| AIF.2107 | External MGCB synchronizer. | | | X | X | |
| AIF.2201 | Voltage offset. | | | X | X | |
| AIF.2303 | Power on the mains. | | | X | X | |
| AIF.2307 | Setpoint for system BASE LOAD. | | | X | X | |
| AIF.2309 | Setpoint for system IMPORT/EXPORT. | | | X | X | |

| Analogue Input function xx. | Name | Message | Thres holds | Controller (JU, JK, JJ-4) | DIV IT | DIGRIN / DITHERM |
|---|---|---|---|---|---|---|
| AIF.2405 | Setpoint for system power factor. | | | X | X | |

All the AIF.XXXX odd functions require the use of program BoardPrg3 for the definition or the load of the characteristic curve of the sensor (see par. 0). The measures acquired from DITHERM/DIGRIN modules that are already expressed in °C and don't need any conversion are exceptions.

### 5.6.5 Virtual digital inputs (AI_VIRTUAL)

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

The purpose of the virtual analogue inputs is multiple:

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

It is possible to operate in two ways to assign a value to the virtual analogue inputs:

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

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

  - To set parameter P.4051 (function for virtual analogue input #1) to value 2309 (AIF.2309 – Setpoint for system BASE LOAD). The controller will therefore use the value of virtual analogue input #1 as power setpoint for the parallel with the mains.
  - Using the internal PLC, create a logic which writes into the virtual analogue input #1 the power setpoint corresponding to the external temperature acquired.

- Assigning a value which is major or equal to 4001 (AIF.4001) to the parameter "function" of the virtual analogue input. In this case, the controller "copies" the value of the measurement identified from the previous parameter in the virtual analogue input: on this measurement, it is then possible to manage the thresholds to activate digital outputs and anomalies.

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

| Virtual Analogue Input function xx. | Name | Message | Thresholds |
|---|---|---|---|
| AIF.0000 | Not used | | |
| AIF.2001 | Generic sensor (page 1). | X | X |
| AIF.2003 | Generic sensor (page 2). | X | X |
| AIF.2005 | Generic sensor (page 3). | X | X |
| AIF.2051 | Generic sensor. | X | X |
| AIF.2101 | Speed offset. | | |
| AIF.2103 | External synchronizer. | | |
| AIF.2105 | External MCB synchronizer. | | |
| AIF.2107 | External MGCB synchronizer. | | |
| AIF.2201 | Voltage offset. | | |
| AIF.2303 | Power on the mains. | | |

| Virtual Analogue Input function xx. | Name | Message | Thresholds |
|---|---|---|---|
| AIF.2307 | Setpoint for system BASE LOAD. | | |
| AIF.2309 | Setpoint for system IMPORT/EXPORT. | | |
| AIF.2405 | Setpoint for system power factor. | | |
| | | | |
| AVF.4001 | Generators/bus frequency. | X | X |
| AVF.4006 | Generators/bus voltage L1-L2. | X | X |
| AVF.4007 | Generators/bus voltage L2-L3. | X | X |
| AVF.4008 | Generators/bus voltage L3-L1. | X | X |
| AVF.4009 | Generators/bus voltage L-L average. | X | X |
| AVF.4012 | Mains frequency. | X | X |
| AVF.4017 | Mains voltage L1-L2. | X | X |
| AVF.4018 | Mains voltage L2-L3. | X | X |
| AVF.4019 | Mains voltage L3-L1. | X | X |
| AVF.4020 | Mains voltage L-L average. | X | X |
| AVF.4023 | Current L1. | X | X |
| AVF.4024 | Current L2. | X | X |
| AVF.4025 | Current L3. | X | X |
| AVF.4026 | Auxiliary current (or neutral current). | X | X |
| AVF.4031 | Active power L1. | X | X |
| AVF.4032 | Active power L2. | X | X |
| AVF.4033 | Active power L3. | X | X |
| AVF.4034 | Total active power. | X | X |
| AVF.4041 | Total apparent power. | X | X |
| AVF.4047 | Total reactive power. | X | X |
| AVF.4058 | Total power factor (calculated from kW and kVA). | X | X |
| AVF.4059 | Total cos(Φ) (calculated from kW and kvar). | X | X |
| AVF.4063 | Generators/bus active energy (partial). | X | X |
| AVF.4065 | Generators/bus reactive energy (partial). | X | X |
| AVF.4069 | Mains active imported energy (partial). | X | X |
| AVF.4071 | Mains reactive imported energy (partial). | X | X |
| AVF.4073 | Mains active exported energy (partial). | X | X |
| AVF.4075 | Active power on loads | X | X |
| AVF.4079 | Mains reactive exported energy (partial). | X | X |
| AVF.4105 | Battery voltage. | X | X |

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

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

Let's set the parameters as follows:

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

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

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

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

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

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

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

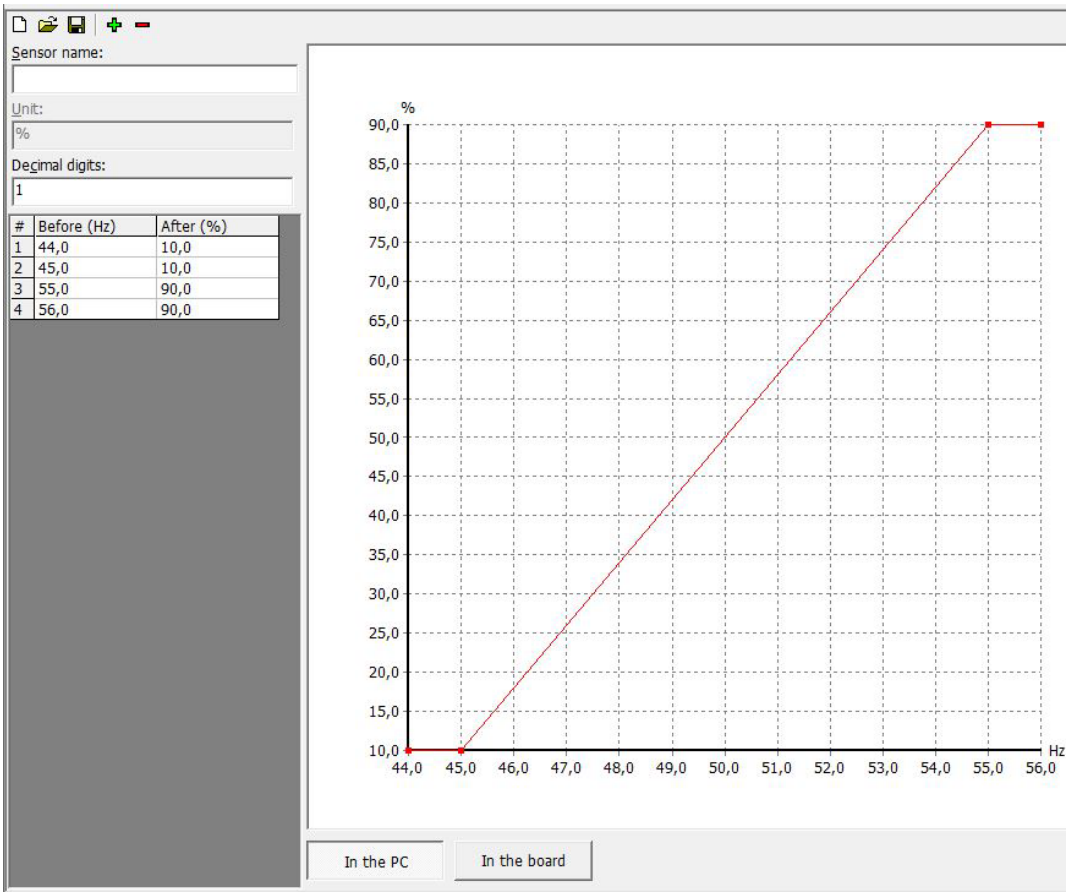
### 5.6.6 Conversion curves

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

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

**Note: the configuration of the AND/OR logics cannot be carried out directly from the controller display, but it must be carried out by PC with the BoardPrg3 software.**

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



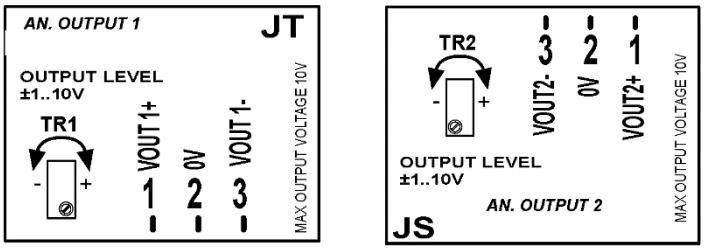

The figure above shows a conversion curve associated to an analogue output. The analogue output has been configured with function AOF.3101 (“Frequency of the generators/bus”). With this configuration, the output will be 10% for a generator’s frequency lower than or equal to 45 Hz, 90% for a frequency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

You can add up to 32 points in the graph, thus creating also non-linear curves. Note, in the example, that the configured curve has two horizontal segments at the beginning and at the end, obtained inserting two equal values in column “After”, corresponding to two different values in column “Before”. This is not mandatory, but it allows you to set a saturation limit on one end or on both ends of the curve. In fact, the controller 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 lower than 45 Hz, the analogue output will be set at 10%. If from the example above you remove 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 BoardPrg3 software allows you (by means of the first buttons on top left) to save the curve on file to be able to use it again in other applications. It is therefore possible to make an archive of the conversions associated to the sensors used.

In case the curve is associated to a physical analogue input configured with functions AIF.2001, AIF.2003 e AIF.2005 (“generic sensor”), the measurement converted will be displayed on pages M.14, M.15 and M.16: in this case, it is also possible to specify (through the conversion curve) how many decimal digits the displayed value and its unit of measure must have.

## 5.7 Analogue outputs (JT, JS)




The analogue outputs 1 and 2 are provided for interfacing external devices equipped with analogue input in voltage or current.

The output voltage can be controlled through TR1 and TR2 potentiometers, between a minimum of ±1VDC and a maximum of ±10VDC. These potentiometers, therefore, define the maximum of the analogue outputs.

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

The outputs are galvanic isolated (floating voltage source).

The minimum load impedance is 10 kOhm.

The default functions of the outputs on the controller are:

| Terminal | Digital output | Type of output | Default function |
|---|---|---|---|
| JT-1 | 01 | **VOUT1+:** Analogue signal in voltage with positive polarity. | **AOF.1000 – "Not used".** |
| JT-2 | | **0V**: Internal GND reference of the isolated output. | |
| JT-3 | | **VOUT1-:** Analogue signal in voltage with negative polarity. | |
| JS-1 | 02 | **VOUT2+:** Analogue signal in voltage with positive polarity. | **AOF.1000 – "Not used".** |
| JS-2 | | **0V**: Internal GND reference of the isolated output. | |
| JS-3 | | **VOUT2-:** Analogue signal in voltage with negative polarity. | |

### 5.7.1 Configuration of the analogue outputs

Each analogue output (the two of MC200 controller and the four of the DANOUT module) are all completely configurable. To each output a parameter is associated (e.g. P.6001 for output 1), which configure the function (see doc.[1]).

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

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

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

The following chart shows the list of functions matchable with the analogue outputs:

| Analogue output function xx. | Name |
|---|---|
| AOF.0000 | Not used. |
| AOF.0101 | Used by the PLC. |
| AOF.0102 | Managed by serial ports. |
| AOF.1000 | Speed governor. |
| AOF.1001 | Speed governor (with curve). |
| AOF.1002 | Voltage regulator. |
| AOF.1003 | Voltage regulator (with curve). |
| AOF.3101 | Frequency of the generators/bus. |
| AOF.3111 | Voltage of the generators/bus. |
| AOF.3121 | Active power of the generators/bus. |
| AOF.3201 | Frequency of the mains. |
| AOF.3211 | Voltage of the mains. |
| AOF.3221 | Active power of the mains. |

When functions AOF.3101 and following are used, you must configure the proportion between the selected measure (voltage, frequency, etc.) and the % value by means of the conversion curves (see par. 5.6.6).

## 5.8 Optional additional modules

Using the connection CAN bus-0 EXBUS (JM) it is possible to connect the following optional additional modules to the device:

- 3 DITHERM/DIGRIN modules:
  - DITHERM: 3 galvanically insulated thermocouples for the temperature measurement.
  - DIGRIN: 3 galvanically insulated Pt100 sensors for the temperature measurement.
- 2 DIVIT modules: 4 galvanically insulated analogue inputs 0...5V/0...10V – 0...10mA/0...20mA
- 1 DANOUT modules: 4 galvanically insulated analogue outputs 0...5V/0...10V – 0...10mA/0...20mA
- 2 DITEL 16IN modules: 16 digital inputs opto-insulated (total 32 inputs). To each DITEL 16IN module it is possible to connect 2 DITEL modules 8 OUT relays for a total of 32 digital outputs. It is not possible to use the output modules without their relative input module.

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

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

To use the modules on it is necessary to set the number of modules which are with the parameters.

- P.0141: number of modules DITEL 16 IN (with eventual modules OUT) (max. 2).
- P.0142 the number of DITEMP modules (i.e. DITHERM or DIGRIN) (maximum 3).
- P.0143: the number of DIVIT modules (maximum 2).
- P.0144: the number of DANOUT modules (maximum 1).

Once configured the presence of the modules, they look like digital or analogue inputs or outputs and are managed as those present on the controller.

For the relative parameters see doc [1].

In program BoardPrg3, once the presence of a module is configured, it appears on menu I/O in the left column, with single inputs/outputs ready to be configured.

It is necessary, though, to clarify about DIVIT modules. They can measure any value: it is necessary to convert the measure done (Volt or mA) to the real unit of measure of the acquired value. Such a conversion can be done directly in the module (DIVIT), or on the MC200. Ensure you don't have a double conversion.

It is suggested to:

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

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

- On the MC200, use a conversion curve to convert from a % value to the real unit of measure.

## 5.9 JG/JF – Mains/ generators bus voltage measure inputs

The connection to the public grid happens though the **JG** connector of the controller. The connection to the generators bus happens though the **JF** connector of the controller.

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

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

If working voltages are greater than these values, step-down transformer must be used to respect the specified limits. The nominal voltages on the primary and secondary of the VT are configurable with parameters P.0117 and P.0118 for the mains and parameters P.0103 and P.0104 for the generators bus. It is suggested to use voltage transformers having a nominal voltage of 400V on the secondary (this solution can preserve the best available measurement precision of the board).

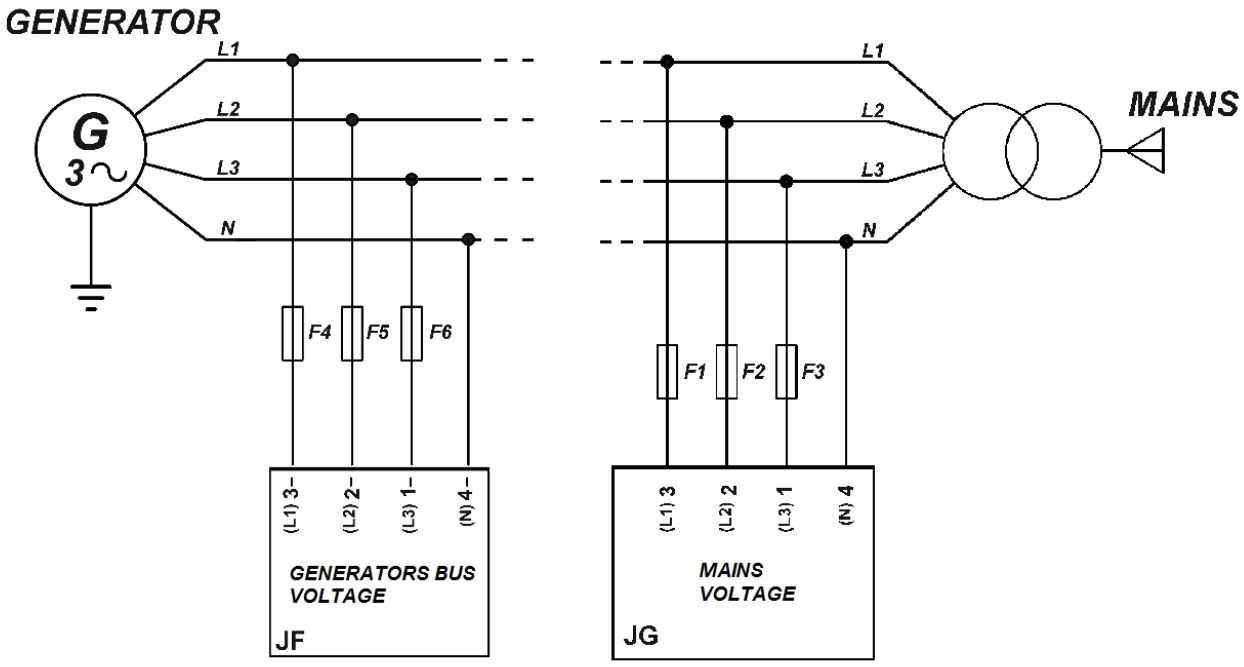
In alternative, it is possible to use VT, with secondary sides of 100V. In this case, it is necessary to configure parameter P.0152 (for the mains) and P.0151 (for the generators bus) for the operation at 100V. The controller will adapt the internal gain to optimize the voltage measurement on the nominal value set in these parameters.

It is also possible to use the Aron insertion of the VTs, which uses only two transformers, instead of three (see par. 5.9.4). In this case, it is necessary not to use the neutral connection.

***Attention! Do not connect JG/JF measurement input to TA with 400V secondary sides or directly to the voltage 400V when the device is configured to read at 100V nominal voltage (parameters P0.152/P.0151 set to 1). The device could be damaged.***

The following chapters show all the possible wirings for the alternator. In the example, it is supposed that each internal winding provides **115 Vac**. The possible connections are:

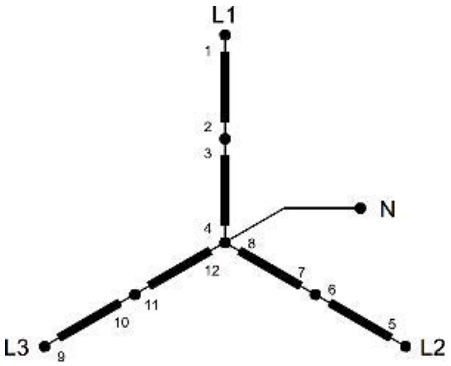
### 5.9.1 Star or Wye (three phases, four wires)



This kind of wiring assumes the presence of the Neutral line. If the alternator is Wye-wired but the neutral line is not distributed, leave terminal JF-4 / JG-4 unconnected: the controller internally creates a virtual Neutral point; in this case, if the L-N voltage measures are not required, set P.0129 or P.0128 to zero.

Pages M.02/M.03 normally show the line-line voltages. Press the ENTER pushbutton to see the line-neutral voltages, press it again to go back to line-line voltages.

#### 5.9.1.1 High Wye



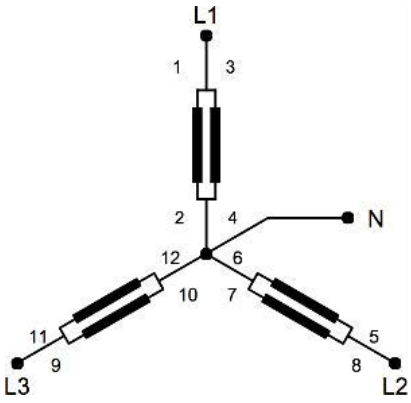

Parameters:

| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 3 | Number of phases |
| P.0129 | P.0128 | 1-Yes | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 400 | Nominal voltage (L-L)<br>$(115 \times 2) \times \sqrt[2]{3}$ |

Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-L2 | 400 | M.02 | M.03 |
| L2-L3 | 400 | M.02 | M.03 |
| L3-L1 | 400 | M.02 | M.03 |
| L1-N | 230 | M.02 | M.03 |
| L2-N | 230 | M.02 | M.03 |
| L3-N | 230 | M.02 | M.03 |
| N-GND | - | M.02 | M.03 |

#### 5.9.1.2 Low Wye



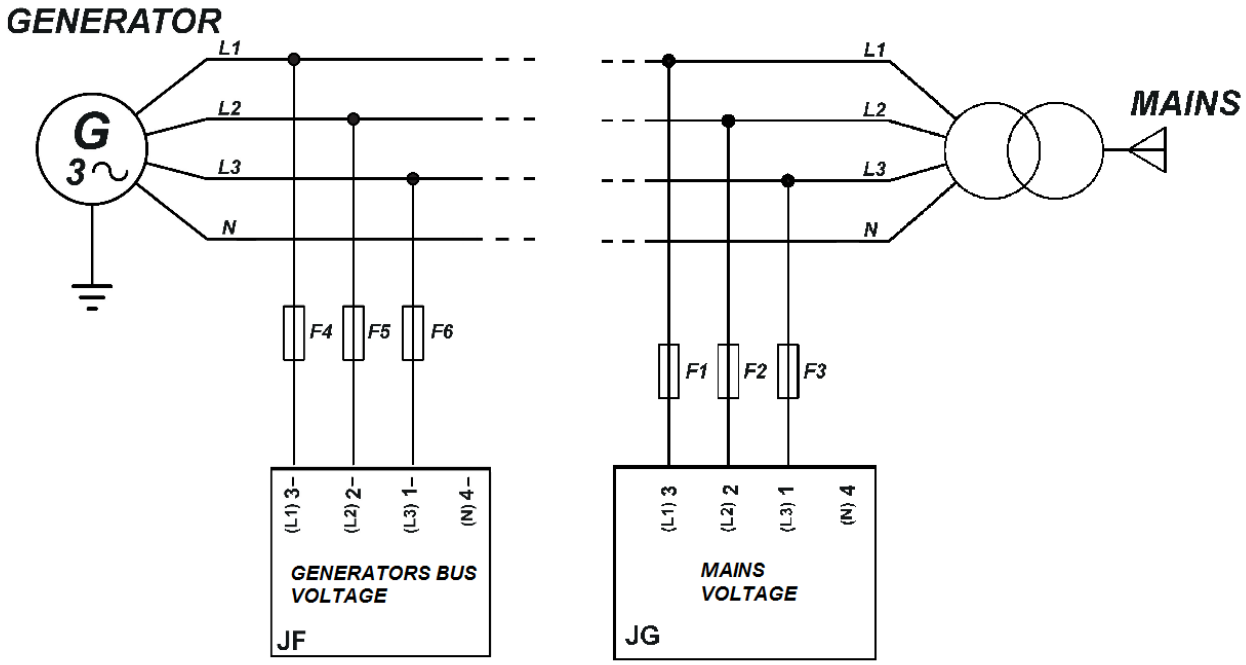

Parameters:

| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 3 | Number of phases |
| P.0129 | P.0128 | 1-Yes | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 200 | Nominal voltage (L-L)<br>$115 \times \sqrt[2]{3}$ |

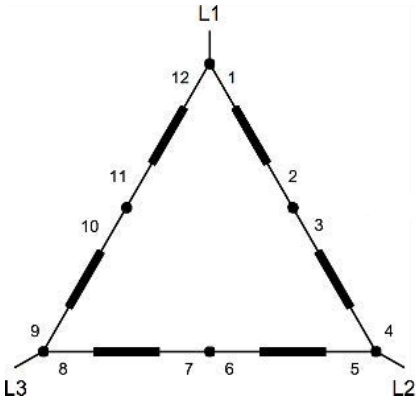
Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-L2 | 400 | M.02 | M.03 |
| L2-L3 | 400 | M.02 | M.03 |
| L3-L1 | 400 | M.02 | M.03 |
| L1-N | 230 | M.02 | M.03 |
| L2-N | 230 | M.02 | M.03 |
| L3-N | 230 | M.02 | M.03 |
| N-GND | - | M.02 | M.03 |

### 5.9.2 Delta (three phases, three wires)




#### 5.9.2.1 High Delta




Parameters:

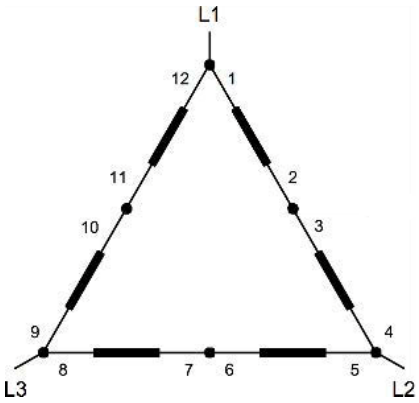
| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 3 | Number of phases |
| P.0129 | P.0128 | 0 - No | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 400 | Nominal voltage (L-L)<br>$(115 \times 2) \times \sqrt[2]{3}$ |

Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-L2 | 400 | M.02 | M.03 |

| | | | |
|---|---|---|---|
| L2-L3 | 400 | M.02 | M.03 |
| L3-L1 | 400 | M.02 | M.03 |

#### 5.9.2.2 Low Delta



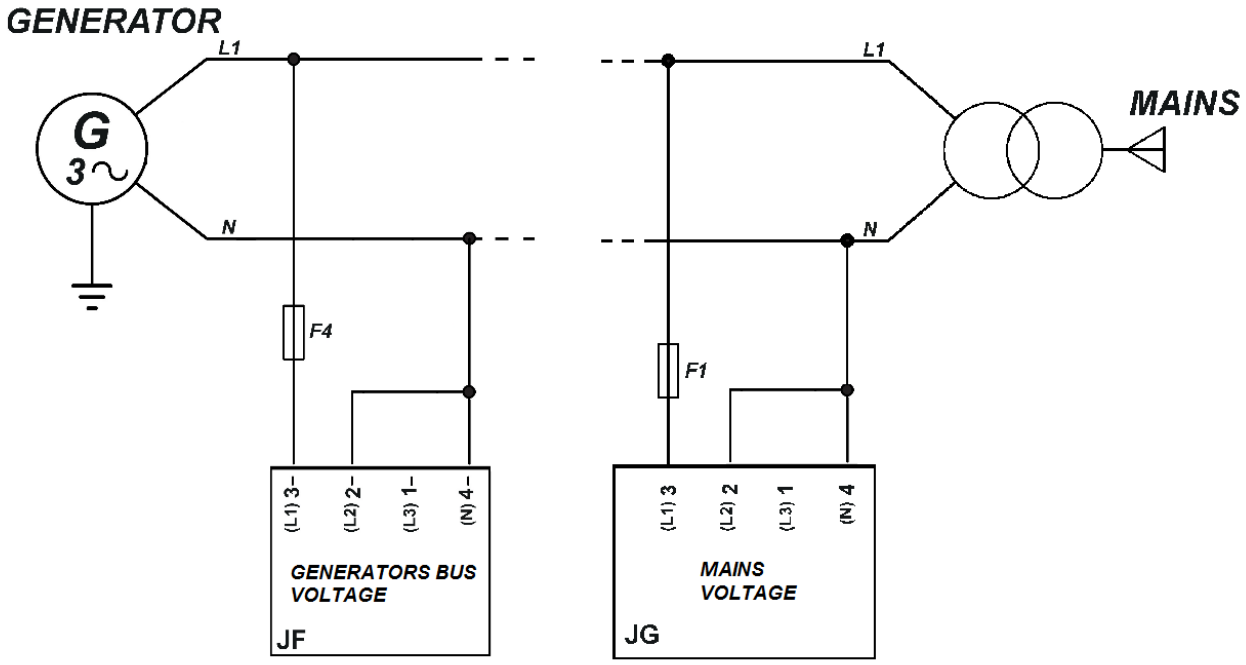

Parameters:

| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 3 | Number of phases |
| P.0129 | P.0128 | 0 - No | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 200 | Nominal voltage (L-L)<br>$115 \times \sqrt[2]{3}$ |

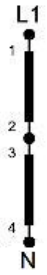
Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-L2 | 200 | M.02 | M.03 |
| L2-L3 | 200 | M.02 | M.03 |
| L3-L1 | 200 | M.02 | M.03 |

### 5.9.3 Single phase (one phase, two wires)




#### 5.9.3.1 High Single Phase




Parameters:

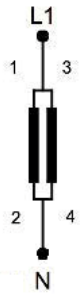
| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 1 | Number of phases |
| P.0129 | P.0128 | 1-Yes | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 230 | Nominal voltage (L-N)<br>$115 \times 2$ |

Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-N | 230 | M.02 | M.03 |

| | | | |
|---|---|---|---|
| N-GND | - | M.02 | M.03 |

#### 5.9.3.2 Low Single Phase




Parameters:

| Mains | Generators bus | Value | Description |
|---|---|---|---|
| P.0119 | P.0101 | 1 | Number of phases |
| P.0129 | P.0128 | 1-Yes | Is the neutral connected to the controller? |
| P.0116 | P.0102 | 115 | Nominal voltage (L-N)<br>115 |

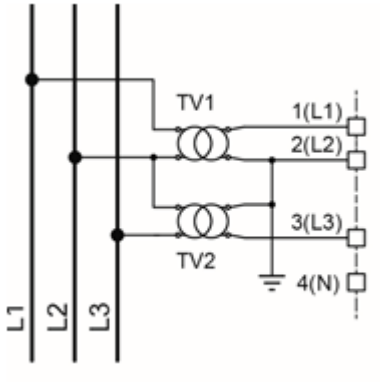
Available voltage measures:

| Measure | Nominal value | Page for mains | Page for generators bus |
|---|---|---|---|
| L1-N | 115 | M.02 | M.03 |
| N-GND | - | M.02 | M.03 |

### 5.9.4 Aron insertion of voltmetric transformers

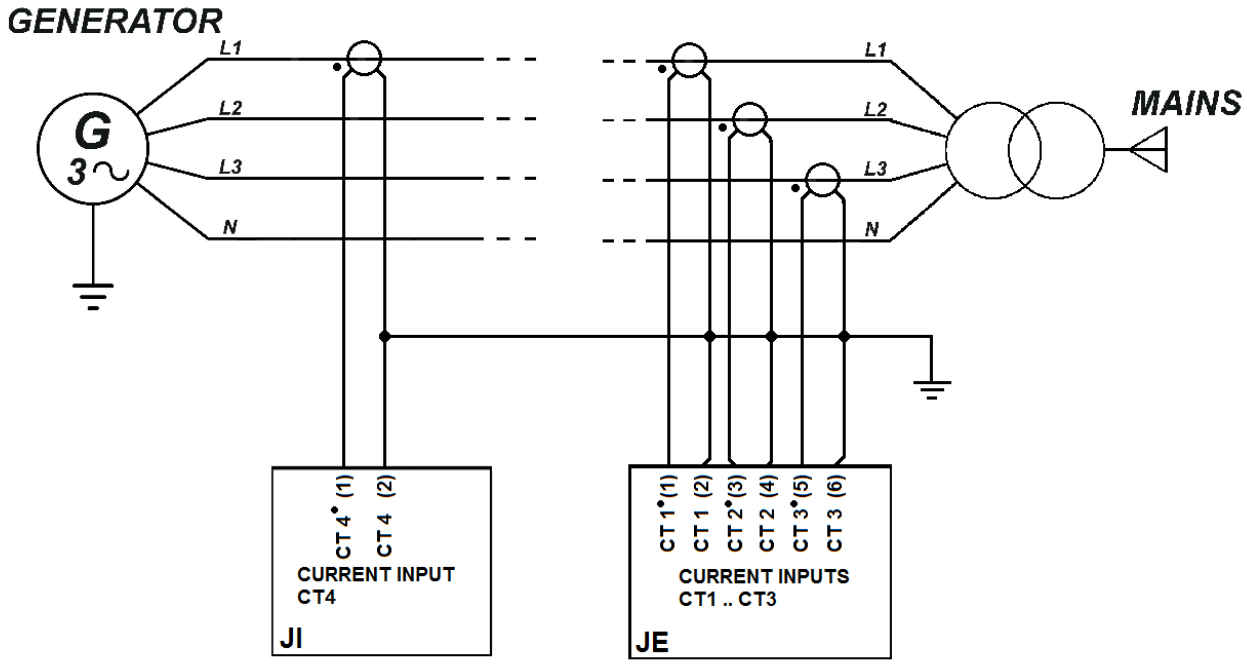
Both for the generators' bus and for the mains voltage measurement inputs, it is possible to use the Aron insertion of the voltmetric transformers; this allows to use two transformers instead of three. The connection is possible both with the measurement inputs set to 100Vac and with 400Vac nominal voltage.

The diagram of the Aron connection is the following:



The diagram is the same both for the generators' bus and for the mains; it is necessary to select the Delta connection mode (see above).

## 5.10 JE-JI Current measurement inputs.




### 5.10.1 JE - Currents measurement inputs 1-3

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

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

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

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

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

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

Normally, JE connector is used for the measurement of the currents (and the powers) on the mains; its use is however configurable by means parameter P.0124:

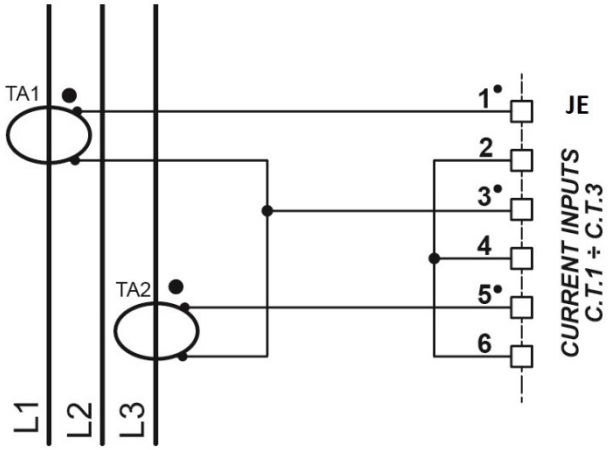
- 0: the CTs are located on the generators' bus.
- 1: the CTs are located on the load's lines.
- 2 (default): the CTs are located on the mains lines.

Parameters P.0107 and P.0139 allows to configure the transformation ratio of the external current transformers. For example, if we use 50/5 current transformers, set P.0107=50 and P.0139=5.

#### 5.10.1.1 Aron insertion of current transformers

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

The diagram of the Aron connection is the following:




### 5.10.2 JI - Currents measurement input 4

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

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

#### 5.10.2.1 Controller without option E620215011000

**Parameter P.0109 must be set to "0 - CT".**

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

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

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

The maximum current measurable directly from the device is 7Aac. Over this threshold the measure circuit saturates. The controller can measure (with progressively decreasing

precision) up to 15Aac though, e.g. to measure overcurrents or short circuit currents on the plant, using an algorithm of compensation of saturation of the circuits of measurement.

To acquire the current the connector JI is used:

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

Parameters P.0108 and P.0135 allows to configure the transformation ratio of the external current transformers. For example, if we use 50/5 current transformers, set P.0108=50 and P.0135=5.

#### 5.10.2.2 Controller with option E620215011000

**Parameter P.0109 must be set to "1 - Toroid".**

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

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

To acquire the current the connector JI is used:

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

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

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

#### 5.10.2.3 Use of the fourth current

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

- 0: the CT is located on the generators' bus.
- 1: the CT is located on the load's lines.
- 2 (default): the CT is located on the mains lines.

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

- P.0131 = 0 ("Not used") The controller disables the measurement of the fourth current, which will not be shown on display.
- P.0131 = 1 ("General purpose"). The controller displays the current measurement done on page M.04 with the lettering "Ax".
- P.0131 = 2 ("Neutral"). The controller displays the current measurement done on page M.04 identifying as "An".
- P.0131 = 4 ("Power measure"). The controller interprets the measurement like the current circulating on L1 phase of the selected source (P.0130) and shows it on page M.04 with the lettering "Ax". The controller also calculates the active power (kW) circulating on L1 phase of the selected source. Finally, for three-phase systems, it

multiplies the calculated power by three, assuming that the load is uniformly shared on the three phases. If it was not like this, it is possible to apply a correction factor (P.0132), which allows to increase the calculated power (if P.0132 > 1) or to decrease it (if P.0132 < 1), to let it the closest to real. The calculated active power is shown on page M.01.

Settings 1 and 2 allow to establish a threshold on the auxiliary current (P.0367 e P.0368). It is possible to configure a digital input with function DIF.2704 - “Disable protections on fourth current”. If the input is active, the thresholds, even if set, are ignored and do not activate anomalies in case of overpassing.

## 5.11 Communication ports

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

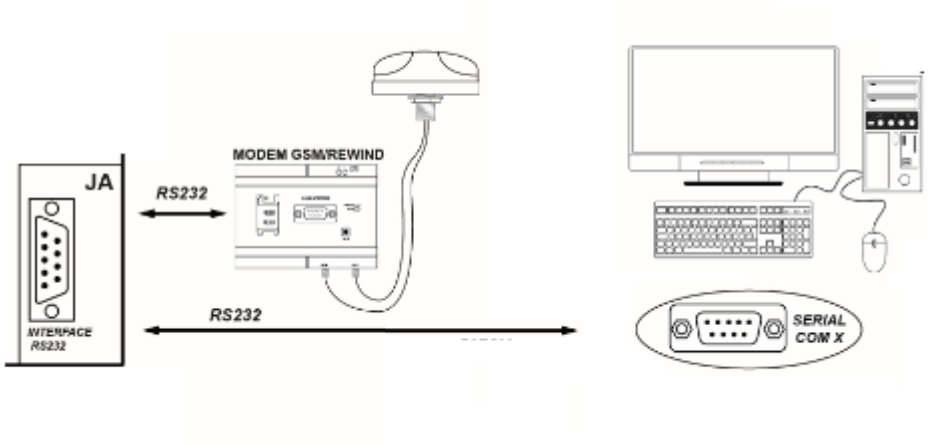
MC200 is provided with:

- One USB 2.0 serial port not insulated, which can be used in Function or Host mode:
  - Function: (JNA, USB B connector): connection with PC for FW update and programming of device parameters.
  - Host (JNB, USB A connector): Pen Drive management (**up to today not available)**
- One RS232 (JA) serial port with DB9 male connector usable for the interfacing with an external device equipped with RS232 interface. The maximum length of the cable is 12 mt.
- One RS485 serial port (JW) with galvanic insulation; the maximum connection length in optimal conditions is 1200 mt. The 120ohm terminal resistor is integrated and can be inserted through S5 selector. The use of a shielded cable with 120ohm impedance is required (e.g. BELDEN 3105A Multi-conductor-EIA Industrial RS-485PLT/CM).
- One CAN bus port (JM) with galvanic insulation for the communication with additional optional modules (DITEL, DITHERM, DIGRIN e DIVIT). The 120ohm terminal resistor is integrated and can be inserted through S1 selector. The specific use of the shielded cable is required (e.g. HELUKABEL 800571).
- One CAN bus port (JX) with galvanic insulation for the communication with other devices for genset/mains/tie breaker control. The 120ohm terminal resistor is integrated and can be inserted through S6 selector. The specific use of the shielded cable is required (e.g. HELUKABEL 800571).
- One Ethernet port (JY) with RJ45 connector for 10/100 Mbps Ethernet nets connections.

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

For CAN bus connections see documents [5] e [6].

### 5.11.1 JA - Serial port 1 RS232




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

The connection can be used for the device parameter programming through BoardPrg3 program or for the connection to a supervision program as SicesSupervisor3.

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

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

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

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

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

#### 5.11.1.1 GSM analogue Modem

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

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

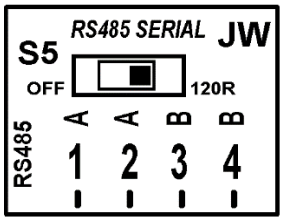
The SIM type to insert depends on the use of the modem:

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

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

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

### 5.11.2 JW - Serial port 2 RS485




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

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

Connections:

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

The RS485 connection needs a 120Ohm termination resistor on both ends of the cable. The device has integrated resistor; to insert it, it is necessary to act on selector S5. The galvanic insulation guarantees the operation security of the connection also among distant devices and with different mass potentials compared with the controller. The maximum connection length is 1200m: it is also function of the set transmission baud rate, though. The use of a special shielded cable is provided (see 4.2) with shielded filter connected to earth.

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

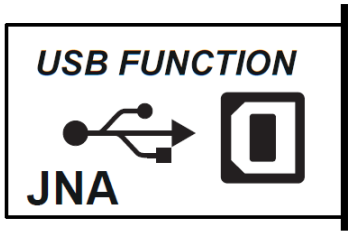
- P.0451: use of serial port 2

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

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

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

### 5.11.3 JNA - USB Serial port: function mode




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

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

- Firmware upgrade.
- Parameter configuration.

Upgrading the device firmware is a specific operation of SICES srl; besides the FW to be inserted, it requires a procedure and special programs. Also, it must not be done by the installer, except for specific cases previously agreed with Sices.

The USB port can be used for the programming of parameters with BoardPrg3 program, in alternative to the RS232/RS485 serial connection or Ethernet.

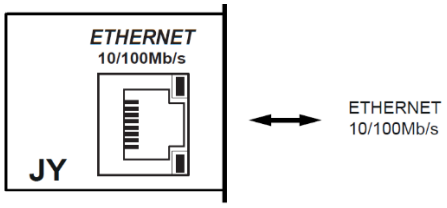
It is necessary that on the PC to be connected the driver **CDC_Sices_Win.inf** supplied by SICES is installed; for the driver installation, refer to document [7].

Once installed the driver, the PC will detect the controller as a new serial port, to be used exactly as it was a RS232 serial port.

The configuration parameters are:

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

### 5.11.4 JY - Ethernet port 10 100Mbps




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

It is possible to connect the device inside a LAN or directly to a PC (point to point connection). The connection makes possible the use of SicesSupervisor3 supervision SW, BoardPrg3 configuration and all available functionalities through the TCP/IP Modbus protocol.

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

Parameters for the configuration.

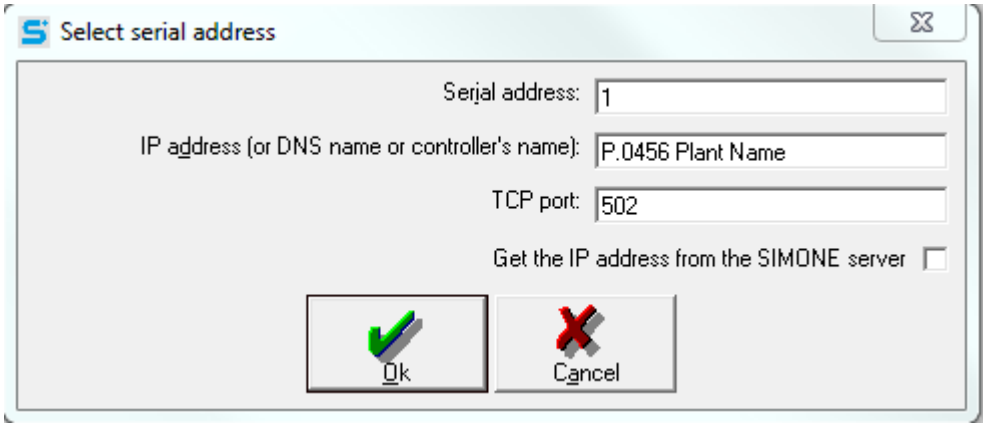
| Parameter | Name | Default |
|---|---|---|
| P.0500 | IP Address. Set it only if DHCP protocol is not required (otherwise this field is filled by the DHCP server): set the IP address assigned to the controller. | 192.168.0.1 |
| P.0501 | Subnet mask. Set it only if DHCP protocol is not required (otherwise this field is filled by the DHCP server): set the value used by the network the controller is connected to. | 255.255.255.0 |
| P.0502 | Network Gateway. Set it only if DHCP protocol is not required (otherwise this field is filled by the DHCP server): set the value used by the network the controller is connected to. | 0.0.0.0 |
| | | |
| P.0503 | Modbus/TCP Port. Indicate the port on which the controller can accept incoming Modbus/TCP communications. The port 502 is standard for Modbus/TCP protocol: change it only when required. | 502 |
| P.0505 | Order of the Modbus registers. When 32-bit information is required, it establishes if the 16 more significant bits must be sent first, or those less significant. | 0-LSWF |
| | | |
| P.0509 | NTP server address. Set the IP address of the server that provides updated date/time. | 0.0.0.0 |
| P.0508 | NTP Server port. Set the port on which the NTP server is listening. The port 123 is standard for NTP protocol: change it only when required. | 123 |
| | | |
| P.0510 | Primary DNS server. Set it only if DHCP protocol is not required (otherwise this field is filled by the DHCP server): set the IP address of the primary DNS server (server who provides the translation service among names and IP addresses). | 0.0.0.0 |
| P.0511 | Secondary DNS server. Set it only if DHCP protocol is not required (otherwise this field is filled by the | 0.0.0.0 |

| | | |
|---|---|---|
| | DHCP server): set the IP address of the secondary DNS server (server who provides the translation service among names and IP addresses). | |
| | | |
| P.0514 | DHCP server address. Set to “255.255.255.255” if DHCP protocol is required (any other value disables that protocol). | 255.255.255.255 |
| P.0513 | DHCP server port. Set the port on which the DHCP server is listening. The port 67 is standard for DHCP protocol: change it only when required. | 67 |
| P.0456 | Plant name. If DHCP protocol is used, the controller can be contacted from the Network using this name. | |

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

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

Once the controller has valid values for parameters P.0500, P.0501 and P.0502 (see page S.05), can be contacted through Modbus-TCP protocol on the assigned IP address and on TCP port configured with P.0503, for example with the supervision SW (SicesSupervisor3) and of configuration (BoardPrg3). When using DHCP protocol, the controller will be reachable through the Modbus-TCP protocol both on IP address and on the configured name, on P.0503 port.




The controller also supports the DNS protocol (Domain Name System). The DNS system is a system used for the conversion of the names of the network knots in IP addresses and vice-versa. To use the DNS system, it is required:

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

- If you use a DHCP server (see above), the IP address of the DNS server is acquired by the controller directly from the DHCP server.

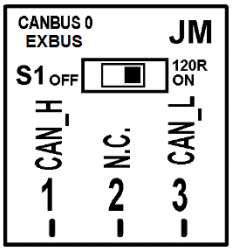
Parameters P.0508 and P.0509 allows to set the IP address and the port to be used to connect to a NTP server (Network Time Protocol), in such way to keep synchronized and updated the internal calendar with date and time of the reference time zone (that is, of the UTC time). Setting one or both parameters to zero the function will be disabled. For more details refer to the document 9.3.1.

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

## 5.12 CAN bus Communication ports

For the connections below mentioned, use a cable suitable for CAN bus (see documents [5] [6]).

### 5.12.1 JM - CAN bus port 0




This interface is used for the connection to expansion modules DITHERM, DIGRIN, DIVIT, DITEL, DANOUT.

The CAN bus interface is galvanically insulated.

Connections:

- Connect terminal JM-1 to terminal CAN_H of the expansion modules.
- Connect terminal JM-3 to terminal CAN_L of the expansion modules.

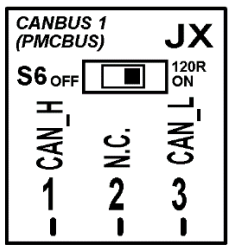
Connect the shielding mesh of the shielded cable to the protective earth or to signal on both sides.

The CAN bus connection needs a 120Ohm termination resistor on both ends of the cable. The terminal resistor is integrated in our controller; to insert it, you need to act on switch S1. NOTE: the termination must always be inserted, unless the connection carries on towards other devices and the controller is not one of the two extremes.

We recommend the use of a proper shielded cable (e.g. HELUKABEL 800571).

For the configuration of the additional expansion modules, see par. 5.8.

### 5.12.2 JX - CAN bus port 1



This CAN bus interface must be used to connect among themselves all SICES genset/mains/bus coupler controllers): through this communication channel (PMCB – Power Management Communication Bus), the controllers exchange all necessary data to manage the parallel functions (see document [8]).

The CAN bus interface is galvanically insulated.

Connections:

- Connect terminal JX-1 to terminal CAN_H of the other SICES controllers.
- Connect terminal JX-3 to terminal CAN_L of the other SICES controllers.

Connect the shielding mesh of the shielded cable to the protective earth or to signal on both sides.

The CAN bus connection needs a 120Ohm termination resistor on both ends of the cable. It is therefore necessary to insert such resistance only on the first and on the last SICES controller. Note: the connection of the controllers can never be star but it must be daisy chain. The terminal resistor is integrated in our controller; to insert it, you need to act on switch S6.

We recommend the use of a proper shielded cable (e.g. HELUKABEL 800571).

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

# 6 Main functions

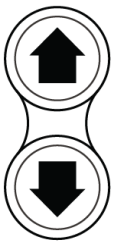
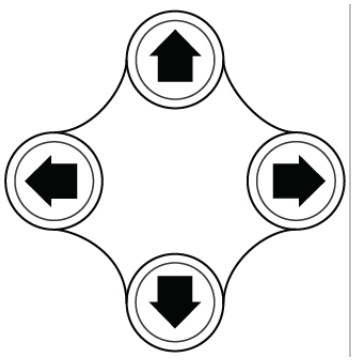
## 6.1 Front panel


*Fig. 1 - Front Panel*

The controls consist of 12 buttons.

The front panel also has some luminous indicators.

## 6.2 Buttons

<table>
<tr><th colspan="2">Pushbutton</th><th>Function</th></tr>
<tr><td rowspan="3">MODE UP<br>  <br>MODE DOWN</td><td><u>OFF/RESET</u><br>PROGRAM</td><td>The controller is disabled; all anomaly signals are disabled. The MGCB circuit breaker is opened (if it exists and is managed by the controller). The MCB circuit breaker is closed (if it exists and is managed by the controller).<br>You can program the parameters.</td></tr>
<tr><td>MAN</td><td>The controller is set for manual generators control.<br>Press the START button to start the generators (if MGCB circuit breaker exists and is opened, the generators close their GCB and work in parallel).<br>Press the STOP button to stop the generators (that will stop after GCB has been opened and the engine has been cooled).<br>Press the MCB button for manual opening/closing of the circuit breakers that connects the mains to the loads.<br>Press the MGCB button for manual opening/closing of the circuit breakers that connects the generators bus to the loads.</td></tr>
<tr><td><u>AUTO</u> TEST</td><td>The controller automatically manages the gensets operation, so they will be started if required by the operating conditions.<br>By pressing the START button it is possible to activate/deactivate the TEST mode. If not otherwise configured, it does not close the MGCB circuit breaker.<br>The STOP button, <u>if not otherwise configured</u>, causes the stop of the gensets and the activation of an alarm.</td></tr>
<tr><td colspan="2">  </td><td>In programming mode, it cancels the changes made to a variable value, brings up the previous menu level, or exits programming mode. If it is pressed for at least two seconds in any menu, you exit the programming mode retaining the current menu position for further programming access.<br>If it is pressed in any window, it displays the status information on the upper line (displaying them cyclically).<br>Depending on the selected page, if pressed together with the ENTER button for at least 5 seconds while in OFF/RESET mode, it can reset counters to zero, reload default values of the programming parameters or cancel history logs, force exit from BUS OFF mode of the CAN bus.<br>When used during the keyboard regulation function, it aborts the function.</td></tr>
<tr><td colspan="2">  </td><td>Navigation buttons of the multifunction display. These buttons let you select the previous or next page on the display in all modes, except in the PROGRAM AND HISTORY LOG mode.<br>Horizontal navigation buttons: in PROGRAM mode, they are used to position the cursor when entering the strings. Used in combination with the ESC/SHIFT button, they allow to adjust the contrast:<br>ESC/SHIFT + LEFT: to decrease the contrast (lighten).<br>ESC/SHIFT + LEFT: to increase the contrast (darken).<br>Vertical navigation buttons: in PROGRAM and HISTORY LOG they allow to scroll the menus and the variables / registrations. You can increase/decrease the value of the variable. Used in combination with ESC/SHIFT button, they allow to scroll through the menus ten entries at a time or increase/decrease the variables ten units at a time.</td></tr>
</table>

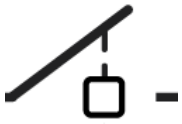
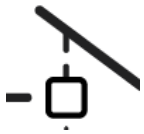
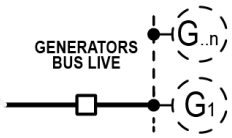
| Pushbutton | Function |
|---|---|
|  | In the PROGRAM menu, you can enter the programming mode and open a submenu, change a variable or parameter, and confirm the operation.<br>In ARCHIVE menu, it allows to activate the HISTORY LOG menu and allows the entrance in the selected archive.<br>It allows to “accept” eventual anomaly signalling on the memory while turning on.<br>When there is an alarm, by pressing the button you deactivate the siren. A further press of the button recognises the presence of an anomaly and resets any alarm signals if the operating conditions have returned to normal. Alarms can only be reset by activating the "OFF/RESET" mode. |
|  | <u>The pushbutton only works in manual.</u><br>It allows to command the opening and the closing of the MCB circuit breaker (if it exists and is managed by the controller). If the synchronization is required for closing, by pressing the pushbutton the synchronization sequence is activated. By pressing it during the paralleling with the mains, it allows to open the MCB circuit breaker: if it is possible, the controller transfers the load to the gensets before opening of the circuit breaker. |
|  | <u>The pushbutton only works in manual.</u><br>It allows to command the opening and the closing of the MGCB circuit breaker (if it exists and is managed by the controller). If the synchronization is required for closing, by pressing the pushbutton the synchronization sequence is activated. By pressing it during the paralleling with the mains, it allows to open the MGCB circuit breaker: if it is possible, the controller transfers the load to the mains before opening of the circuit breaker.<br>If MGCB does not exist or is externally managed, it is possible to use this button for opening /closing the GCB circuit breakers of the generators: this function must be enabled by means bit 3 of parameter P.0495. |
|  | In MAN mode, it can be used to start all the gensets “controlled by MC200”.<br>In AUTO mode, if automatic gensets start is not required, it changes the operating mode to TEST. If automatic gensets start is required, it can be used to restart gensets controlled by MC200 that are stopped for a low load condition.<br>In TEST mode, it changes the operating mode from TEST to AUTO.<br>Together with the STOP pushbutton, at the power up it allows entering the controller special functions. |
|  | In OFF/RESET mode, the pushbutton turns all leds on (to check if there are any faults).<br>In MAN mode, it is used to stop all the gensets “controlled by MC200”.<br>In AUTO, TEST and REMOTE START modes, the controller normally issues an alarm (A007) and stops all gensets “controlled by MC200” (this behaviour can be disabled by means bit 0 of parameter P.0495).<br>Together with the START pushbutton, at the power up it allows entering the controller special functions. |

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

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

| LED OFF | LED steady ON | LED flashing |
|---|---|---|
| □ | ▣ | ⧈ |

| Signalling | | Function |
|---|---|---|
| □ PROGRAM / OFF/RESET | ▣ | The controller is in the OFF/RESET operating mode. |
| | ⧈ | Flashing at 50% on: it indicates that you are accessing the PROGRAMMING menu. |
| | □ | The controller is in another operating mode. |
| □ MAN. | ▣ | The controller is in the MANUAL operating mode. |
| | □ | The controller is in another operating mode. |
| □ AUTO / TEST | ▣ | The controller is in the AUTOMATIC operating mode. |
| | ⧈ | Flashing at 50% on: the controller is in the TEST operating mode. |
| | | Flashing at 90% on: the controller is in the REMOTE START operating mode. |
| | □ | The controller is in another operating mode. |
| □ ALARM | ▣ | There is at least one active alarm or unload. |
| | ⧈ | Flashing at 50% on: there is at least one active warning. |
| | □ | There are no anomalies. |
| □ AUX. LINK | ▣ | At least one Modbus or Modbus/TCP communication is running over the serial ports, the USB port or the ETHERNET port. |
| | □ | No Modbus nor Modbus/TCP communications are running. |
| □ PMCBUS | ▣ | The CAN bus interface is active and in ERROR-ACTIVE mode. |
| | ⧈ | Flashing at 25% on: there are communication errors, the CAN bus interface is in ERROR-PASSIVE mode. |
| | | Flashing at 75% on: there are communication errors, the CAN bus interface is in BUS-OFF mode. |
| □ LOAD SHEDDING | ▣ | The load shedding function is enabled, and at least one load has been disconnected. |
| | □ | The load shedding function is disabled or no loads have been disconnected. |
| | ▣ | Mains voltages are steadily within the tolerance range. |

| Signalling | | Function |
|---|---|---|
| MAINS LIVE  | ☐ | No mains voltages. |
| | ▣ | Flashing at 50% on: during transition between the previous two statuses. |
| | | Flashing at 25% on: mains voltages under tolerance thresholds. |
| | | Flashing at 75% on: mains voltages above tolerance thresholds. |
| MCB  | ☐ | The MCB circuit breaker is opened (or it does not exist). |
| | ■ | The MCB circuit breaker is closed. |
| | ▣ | Flashing at 25% on: MCB opened after a closing command. |
| | | Flashing at 75% on: MCB closed after an opening command. |
| | | Flashing at 50% on: during synchronization (it flashes in alternation with the BUS LIVE). |
| BUS LIVE  | ■ | Voltages are present on the loads. |
| | ☐ | No voltages on the loads. |
| | ▣ | Flashing at 50% on: during the synchronization (it flashes in alternance with MGCB during the direct synchronization, flashes in alternance with MCB during the reverse synchronization). |
| MGCB  | ☐ | The MGCB circuit breaker is opened. |
| | ■ | The MGCB circuit breaker is closed (or it does not exist). |
| | ▣ | Flashing at 25% on: MGCB opened after a closing command. |
| | | Flashing at 75% on: MGCB closed after an opening command. |
| | | Flashing at 50% on: during synchronization (it flashes in alternation with the BUS LIVE). |
|   | ■ | Voltages are present on the generators' bus. |
| | ☐ | No voltages on the generators' bus. |

## 6.4 Multifunctional display

### 6.4.1 LCD lighting

The back-light lamp is managed by the controller, which switches it off the after a programmable time (P.0492) if no buttons are pressed in the meantime. Press any button to switch the lamp on again, (we recommend using the ESC/SHIFT button as it has no function when used alone). This function can be disabled by setting parameter P.0492 to 0.

Using parameter P.0493 it is possible to force the lamp always on when at least one generator is running.

### 6.4.2 Contrast adjustment

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

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

### 6.4.3 Colours scheme

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

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

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

### 6.4.4 Mode navigation

The display has different visualization modes composed by different pages.

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

Generally, the navigation among the modes happens through UP and DOWN buttons.

To view the pages inside the mode, use the LEFT and RIGHT buttons.

In some modes (P.XX and H.XX), to view the pages press the ENTER button first, and then use the UP and DOWN buttons to navigate between pages.

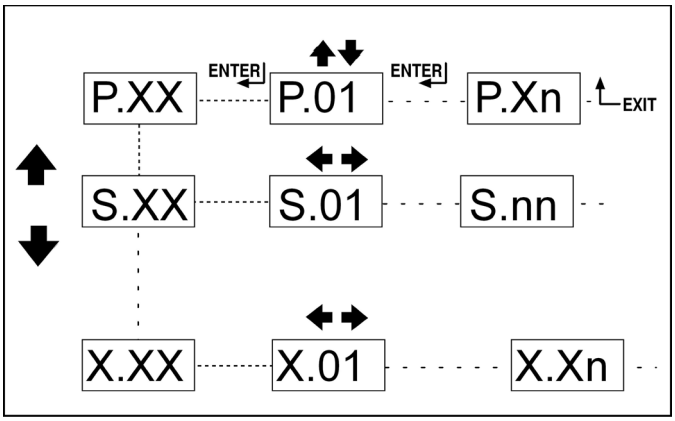



*Fig. 3 - Mode navigation*

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

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

**KEY:**
**1 - Status bar**
**2 - Data area**

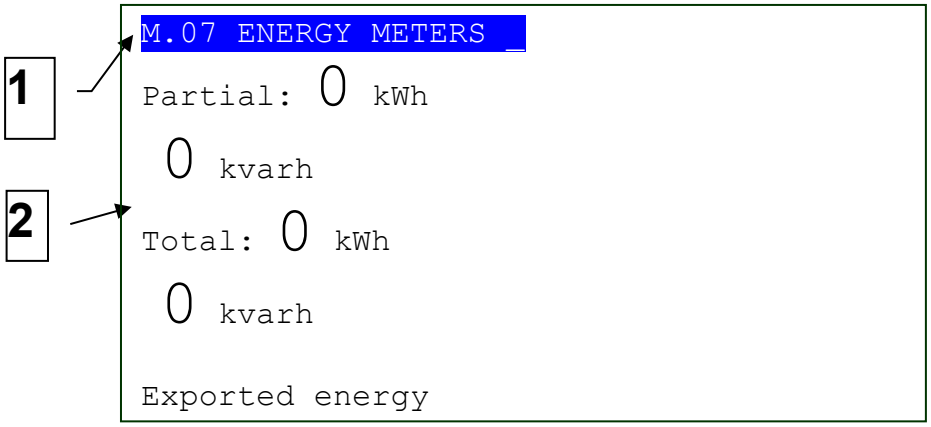



*Fig. 4 - Display areas*

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

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

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

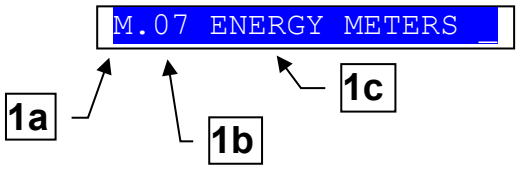



*Fig. 5 - Top status bar*

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

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

## 6.5 Display mode

### 6.5.1 Programming (P.XX)

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

To access the parameter modification mode, select page P.02 with **UP** and **DOWN** vertical scroll buttons, then press **ACK/ENTER** to activate it.

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

**WARNING: Assigning an incorrect value to one or more parameters can cause malfunctions, damage to things or injury to people. The parameters must only be changed by qualified personnel. Parameters may be password protected (see par. 6.5.1.2).**

#### 6.5.1.1 Organization

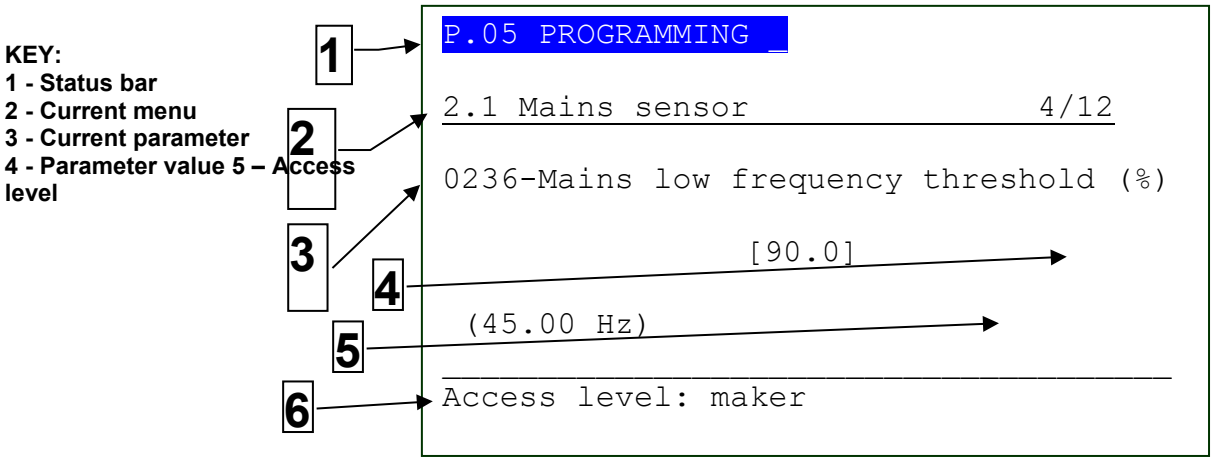



*Fig. 6 - Display areas*

The first line under the top status bar identifies the current menu (2) with the menu number and the relevant text. A pair of numbers is displayed on the right of this line (4/12 in the example). The first indicates which entry of the menu is selected or which page is displayed, the second indicates how many entries or pages can be displayed in the present menu/submenu.

Each programming parameter (3) has a 4-digit numeric code (e.g. P.0236) to identify the variables regardless of the language used. The current value of the parameter is displayed below the description (4), between brackets. If the parameter configures a value that is a percentage of another item, the controller shows the equivalent value in the measurement unit of the reference item (5).

The last row shows the access level currently acknowledged to the operator (6).

#### 6.5.1.2 Protection password

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

- SICES password.
- MAKER password.
- INSTALLER password.
- USER password.

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

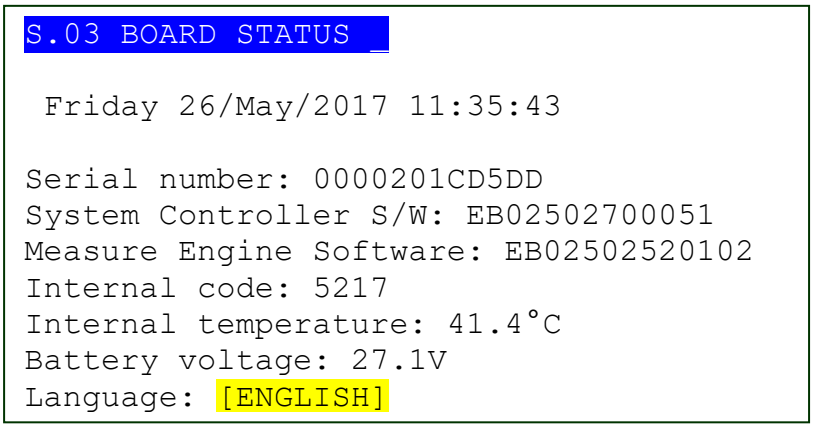
A parameter associated to SICES level is modifiable only setting SICES password. A parameter associated to the maker level can be modified only by the maker himself (or with the SICES password). A parameter associated to the installer level can be modified by the maker and the installer (or with the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

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

The operator who should modify a parameter, must first let the controller recognise him as “SICES”, “maker”, “installer” or “user”, dialling the right password in parameter P.0000 (menu “1.1.1 - Authentication”). After this operation, he will be able to modify the parameters. The set access code remains in P.0000 memory for about 10 minutes after programming has been completed. After this time, it will be automatically reset and it should be set again to enter a new programming.

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

To obtain the password, the operator should ask SICES, indicating the “Serial number” of the controller, together with the “Internal code” displayed on page S.03, as shown below:




**If a password gets lost, it is possible to reconfigure it by logging in with the higher-level password. For this reason, we advise against not setting at least the “maker” password (P.0001): is, in effect, someone else sets it or another lower password (even only for distraction) without communicate it, it will no longer be possible to modify any**

**parameter. By knowing the "maker" password, it will be possible to nullify or modify the other passwords. Contact our service centre if the "maker" password is lost.**

The following examples show all combinations of password assignment.

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

Any operator is considered "maker", without setting anything in P.0000. Therefore, all parameters, except for the special ones, can be changed by anyone (this is the default mode).

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

No parameter is modifiable. When the user enters the "UUU" code in P.0000, he would be considered "user", but as no password is associated to the "installer" and the "maker", the controller considers him as "maker". After entering this code, all parameters, except for the special ones, can be modified.

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

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

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

No parameter is modifiable. When the user enters "UUU" in P.0000, he is considered "user" and can modify only the parameters associated to "user". If the user enters "III", he can modify all parameters associated to "installer" and "user". When entering "CCC", the operator is identified as "maker" and can modify all parameters, excluding the critical ones of the controller.

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

No passwords are associated to the user and the installer. The parameters associated to user and installer are free programmable, without entering any code in P.0000. To modify maker associated parameters you must enter "CCC" in P.0000.

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

As no password is associated to the user, the parameters associated are freely programmable, without entering any code in P.0000. When the user enters "III" in P.0000, he can modify all parameters because there is no password for "maker". After entering this code, all parameters, except for the special ones, can be modified.

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

As no password is associated to the user, the parameters associated are freely programmable, without entering any code in P.0000. When the user enters "III" in P.0000, he can modify all parameters associated to "installer" and "end user". When entering "CCC" in P.0000, the operator is identified as "maker" and can modify all parameters, excluding critical ones.

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

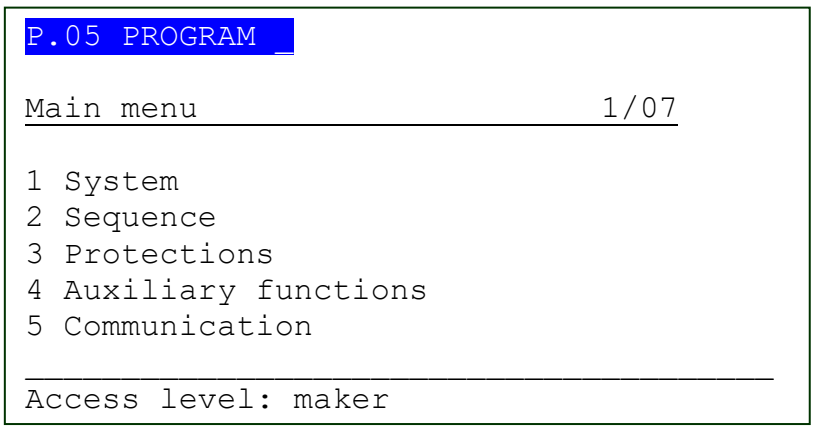
No parameter is modifiable. When the user enters the "UUU" code in P.0000, the controller considers him "user", but as no password is associated to "installer", it considers him "installer". He can modify all parameters associated to the end user and the installer. When entering "CCC" in P.0000, the operator is identified as "maker" and can modify all parameters, excluding critical ones.

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

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

#### 6.5.1.3 Operating procedure

This procedure will describe the keyboard and display use.




- **1 (SYSTEM).** The menu 1-SYSTEM allows first to indicate how the controller is connected to the mains and to the generator bus, and the plant type. It is most important to correctly set these parameters as nearly all thresholds for the protection activation are expressed in percentage compared to them.
- **2 (SEQUENCE).** Working sequence configuration can be modified through the menu 2-SEQUENCE. In this menu, the threshold percentages can be set, the time of acquisition and enabling/disabling of the functions related to the operation sequences.
- **3 (PROTECTIONS).** Protections management is accessible through the menu 3-PROTECTION. As to this, it is important to know that, to enable/disable a protection, you may simply modify the associated time, leaving the threshold unchanged: by setting the time to zero, the protection is disabled. However, this general rule provides some exceptions. Refer to the chapter dedicated to the anomalies, par. 0, which describes each disabling mode.
- **4 (AUXILIARY FUNCTIONS).** All that is not about the configuration of the system, the sequence and protections is configurable from menu 4-AUXILIARY FUNCTIONS. In this menu are other menus which configure calendars and history logs.
- **5 (COMMUNICATION):** In this menu are the communication settings for the serial ports, for the ETHERNET port, for the USB port and the configuration for the modem.
- **6 (PLC):** The menu 6 - PLC Shows the setpoints defined in the currently loaded PLC program. If no PLC program is loaded, or if it does not define any setpoint, this menu is hidden.

- **8 (PARALLEL):** The menu 8-PARALLEL allows to configure all the functions related to the parallel with the mains or among gensets.

#### 6.5.1.3.1 Access to programming

The programming is accessible in any operation status of the controller, while the parameter modification is generally possible only with the controller in OFF/RESET. To enter in programming mode, it is required to act on ▲ and ▼ pushbuttons until the programming screen appear (P.02).

If you are in a mode which puts some limitation in the use of the vertical scroll pushbuttons, it might be necessary to press one or more times the **ESC/SHIFT** pushbutton (e.g. when viewing history logs or during operations).

Then press **ENTER** to enter programming.

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

#### 6.5.1.3.2 Menu selection

The name of the current menu is always shown in the first line, followed by the numeric ID of the selected item and the number of menu items. The further lines of the display are used to view the menu items, that is, the submenus. The item selected is drawn in REVERSE. Using ▲ and ▼ pushbuttons, the menu scrolls respectively towards the top or bottom index items, in a cyclical way (that is, pressing ▲ from the first item you pass to the last and vice-versa).

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

#### 6.5.1.3.3 Parameters selection

The name of the current menu is always shown in the first line, followed by the numeric Id of the selected item and the number of menu items. The next display lines are all used to view a single parameter:

- Fourth and fifth rows show the univocal parameter code (four decimal digits) followed by the description in the current language.
- The seventh line shows, aligned on the right, the value of the variable, enclosed between square brackets or “< >”.
- For some parameters, on the ninth line, a value someway connected to the current value of the parameter is shown. For example, in the case of the low mains frequency threshold (P.0236), the equivalent voltage is shown, calculated from the mains nominal voltage (P.0116) and by the parameter itself (%). This additional value is often displayed when the parameter is expressed as percentage compared to some other value to show the absolute value.
- The last line of the display shows the protection level given to the operator (SICES, maker, installer or user).

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

#### 6.5.1.3.4 Modification of a parameter

A parameter can be modified only if shown between squared brackets ([]); if between “<>”, it cannot be modified. In this case, it could be necessary to set a suitable password or to put the controller in OFF/RESET mode.

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

There are the following types of parameter:

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

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

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

  If the operator wants to:

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

- **Numeric**: the value is modifiable using ▲▼ buttons, respectively to increase or decrease the value of one unit (if these buttons are pressed together with **ESC/SHIFT**, the value will be increased or decreased of ten units at a time). The modification is cyclical: trying to increase the value when it is already at the maximum, it passes to the minimum, and vice-versa.
- **Numerical with selection among a default list** (e.g. the number of phases of the mains): it is valid what said for the numerical parameters, considering that the ▲▼ buttons allows to pass to the following /previous value in the default list (pressed with

**ESC/SHIFT** button, allow to pass to the value which follows/precedes the current one of ten positions).

- **Numeric selected in a number-string couples list** (e.g. the function of a digital input): same as the previous point.
- **Time**: it is valid what said for the numeric parameter, except for the fact that the controller manages the increasing/decreasing keeping valid values (e.g. increasing from 00.59" to "01.00" and not to "00.60").
- **Strings** (e.g. phone numbers): in this case the visualizer highlights (in reverse) the character selected on the string. The ▲▼ pushbuttons work on the selected character (passing to next/previous character of the ASCII table or jumping by ten positions ahead/back if **ESC/SHIFT** is pressed too), whereas ◄► pushbuttons allow selecting the character to modify. **Characters ASCII from 32 (space) to 127 (escape) are settable. Characters ASCII (over 127) and those of control (from zero to 31) are not settable.**
- **Hexadecimal strings** (e.g. the bit polarity of the outputs): as for string parameters, but the selectable parameters are only "0-9" and "A-F" (these last in capital letters only).

#### 6.5.1.3.5 Set up limits

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

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

#### 6.5.1.3.6 Exit from programming

There are three ways to exit the programming:

- Press **ESC/SHIFT** n times to climb up again to the main menu and then press it again to exit the programming. Coming a next time into programming, it will be show main menu.
- Keep **ESC/SHIFT** pressed for two seconds from any position: you will exit immediately the programming and you will find yourself exactly at the same point at the next entrance.
- Changing the controller mode to AUTO or MAN: next entry will be exactly in same point.

### 6.5.1.4 Loading default values

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

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

### 6.5.2 PLC (L.XX)

Pages from L.01 to L.07 contain the information related to the PLC logic and are only displayed if on the controller is installed a valid PLC program. Refer to [10] for information on PLC.

#### 6.5.2.1 L.01 PLC

```
L.01 PLC

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

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

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

#### 6.5.2.2 L.02 PLC LOGIC

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

This page shows information about a single PLC block.

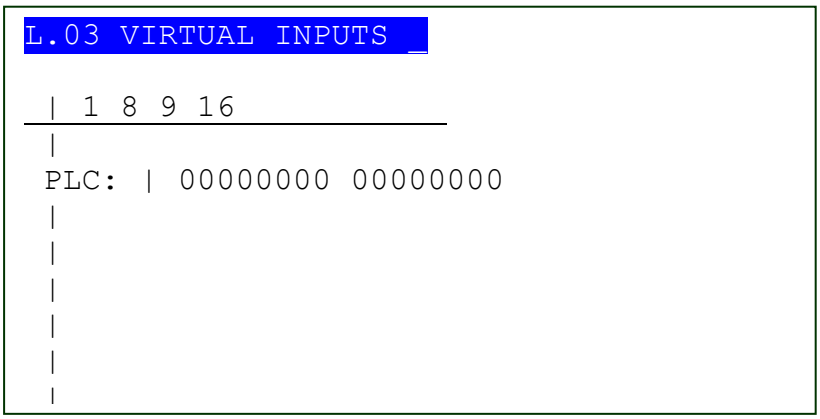
In the second row on the right the selected block is shown, with format “TYPE-NUMBER”. To select the PLC block, press **ACK/ENTER**, then use ▲▼ buttons to search for the PLC block wanted; confirm by pressing **ACK/ENTER** again.

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

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

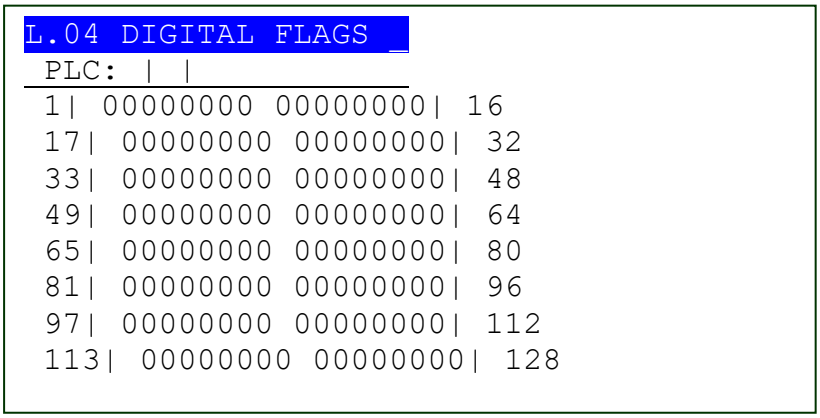
- The second column identifies the resource associated to the parameter. The resources are normally shown with SICES codification (e.g. the digital input 1 is identified as DI_CONTROLLER_01). In the PLC program, it is possible to associate symbols (nicknames) to the resources. It is possible to view the symbols in the second column, in place of SICES codes: press **ACK/ENTER** (as to select a different PLC block) and press ◄►; confirm with **ACK/ENTER** button.
- The third column shows the current value of the resource. For digital resources, if the viewed value is in REVERSE, it means that the relative parameter is denied.

#### 6.5.2.3 L.03 VIRTUAL INPUTS



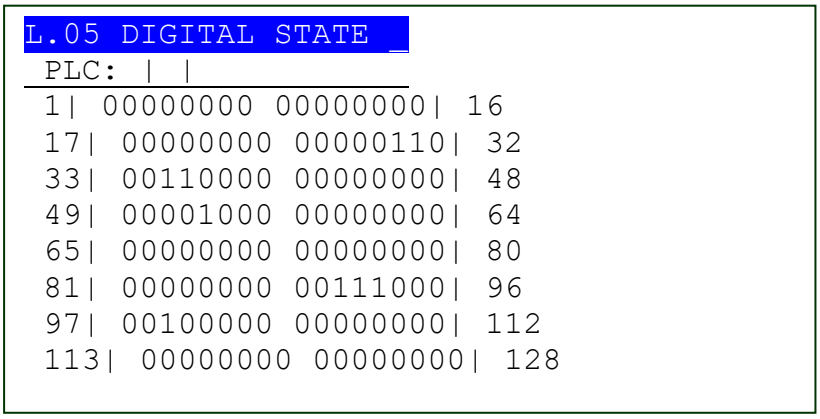

This page shows to status of all virtual digital inputs (that is, those inputs the status of which has not been acquired by the hardware, but is determined by the PLC program).

#### 6.5.2.4 L.04 DIGITAL FLAGS



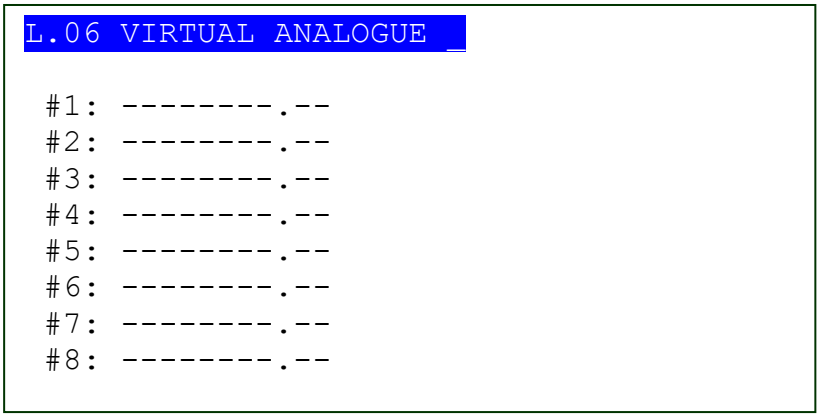

This page shows the status of all temporary digital variables (DT_XXX) available for the PLC program. Many pages which alternate every 2 seconds are available to view all digital flags. Keeping **ESC/SHIFT** pressed, you can stop the rotation of the pages (keeping on the display the page currently viewed).

#### 6.5.2.5 L.05 DIGITAL STATUSES



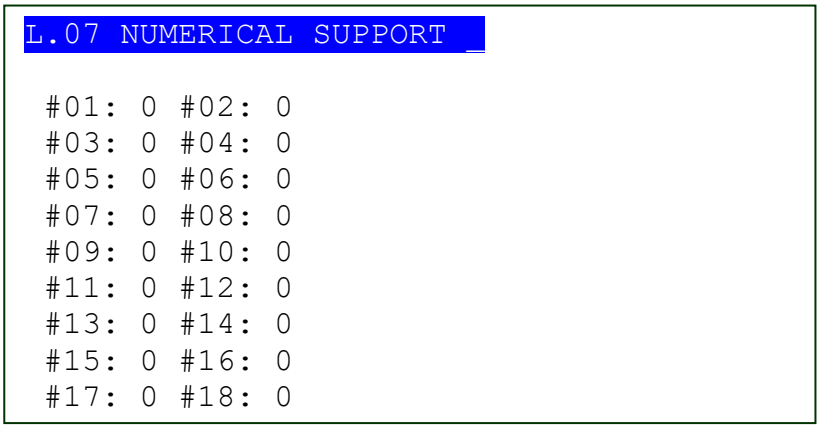

This page shows the value of all internal status of the controller (ST.XXX) available for the PLC program). Many pages which alternate every 2 seconds are available to view all digital statuses. Keeping **ESC/SHIFT** pressed, you can stop the rotation of the pages (keeping on the display the page currently viewed).

#### 6.5.2.6 L.06 VIRTUAL ANALOGUE




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

#### 6.5.2.7 L.07 NUMERICAL SUPPORT




This page shows the status of all temporary numeric variables (AT_XXX) available for the PLC program. Many pages which alternate every 2 seconds are available to view all numeric

supports. Keeping **ESC/SHIFT** pressed, you can stop the rotation of the pages (keeping on the display the page currently viewed).

### 6.5.3 Status information (S.XX)

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

#### 6.5.3.1 S.01 STATUS

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

- Working mode of the controller (MAN, AUTO, etc.).
- The status of the operation sequence (idle, starting the gensets etc.).
- The status of protections for the parallel with the mains.
- The electric mains status (absent, low, high, etc.).
- The eventual presence of inhibition to start the generators.
- The eventual presence of inhibition to connect the loads to the generators.
- The eventual activation of protections' override.
- The signalling of some genset in condition of "GCB not open".

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

#### 6.5.3.2 S.02 ANOMALIES

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

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

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

- Press the **ACK/ENTER** pushbutton.
- Use the ▲▼ pushbuttons to scroll the anomalies.
- Press **ESC/SHIFT** to leave the mode.

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

information regarding the selected anomaly. The anomalies with additional diagnostic information are:

- 211 ("PMCB: shared input written by multiple devices"). It shows an additional message that identifies the type, the number of the shared input and the PMCB address of the controller that is writing it. See document [8].
- 273 (Parameters not coherent or not set). It shows an additional message helping to understand the problem.
- 252 (EXBUS: some modules are missing). It shows an additional message that identifies the configured expansion module, that does not communicate with MC200.
- 253: (EXBUS: some measures are missing). It shows an additional message that identifies the acquisition channel and the expansion module from which we expect to receive a measure, which is lacking instead.
- 254 (EXBUS: duplicated address). It shows an additional message that identifies the type and the address of the expansion module that is connected twice to MC200.
- 255 (EXBUS: sensor disconnected). It shows an additional message that identifies the channel of acquisition and the expansion module which is sending the information of “broken wire”.
- 900 (PLC parameters not coherent or not set). It shows an additional message helping to understand the problem.

#### 6.5.3.3 S.03 BOARD STATUS

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

- The current date and hour in extended format (flashing if the clock is not valid).
- The serial number univocal for the controller.
- The codes of the software currently uploaded on the controller (see par. 1.6).
- The internal code necessary to obtain a temporary SICES level password (see 6.5.1.2).
- The internal temperature of the controller.
- The power supply voltage.
- The language currently used by the device. It is also possible to select a different language: press **ACK/ENTER** button, select the language with buttons ▲ and ▼ and confirm with **ACK/ENTER** button. Note: MC200 is supplied only with ENGLISH, ITALIAN and PORTUGUESE languages. With BoardPrg3 program it is possible to transfer other languages to the controller.

#### 6.5.3.4 S.04 SERIAL COMMUNICATION

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

For each port the status (stand-by, communicating, etc.) and the counter of receiving errors are displayed. To reset an error counter, you must:

- Press **ACK/ENTER**: the controller highlights the error counter of the serial port COM1.
- Use the vertical arrows to highlight the counter to be reset.

- Press **ACK/ENTER** + **ESC/SHIFT** for 5 seconds: at the end, the controller resets the counter.
- Press **ESC/SHIFT**.

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

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

#### 6.5.3.5 S.05 NETWORK

This page is dedicated to the status of the connection and communication on the ETHERNET interface.

The controller shows:

- The status of the connection:
  - “idle”: no communication running, and Ethernet cable disconnected.
  - “idle-linked”: no communication running, and Ethernet cable connected.
  - “Communic. In progress”: communication running.
- The MAC address of the physical net interface.
- The IP address of the controller, the address of the router/gateway, the Subnet-mask and the DNS server address. Those values can be the ones set with the parameters of the controller, or those dynamically acquired by server DHCP (see 5.11.4).

#### 6.5.3.6 S.07 CAN bus

This page displays the status of the CAN bus interfaces of the controller. MC200 has two interfaces. Each interface displays

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

#### 6.5.3.7 S.08-09-10 GENERIC STATUS

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

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

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

If you use functions DIF.3202, DIF.3204 and DIF.3206, when the input changes from non-active to active, the controller forces the view of the relative page.

#### 6.5.3.8 S.11 DIGITAL INPUTS

This page shows the status of:

- Digital inputs of the controller.
- Analogue inputs used as digital (if they are not used as digital, they are displayed with dashes).
- Virtual digital inputs.

Pressing **ACK/ENTER** button, it is possible to change (cyclically) the ways the controller shows the inputs:

- **LOGICAL STATE:** the controller shows the input's logic level (active or inactive) used in the management of the operating sequence.
- **PHISICAL STATE:** the controller shows the electrical level (active or inactive, or high or low) present on the input; this can be the opposite in comparison to the corresponding logic state. Displayed in REVERSE.
- **FOR FUNCTION:** the controller shows a list of functions associated to the digital inputs, showing the logic status (1/0) relative to each function, independently from the input associated to the functions. If more than 9 functions are configured, the controller will display all of them in rotation (9 at a time) every 2 seconds: keeping **ESC/SHIFT** button pressed you stop the rotation.

#### 6.5.3.9 S.12 DIGITAL INPUTS

This page is only shown if some DITEL modules have been configured (see 5.8). It displays the status of the digital inputs acquired from DITEL digital modules. If a DITEL module does not communicate correctly, the controller will display some dashes in place of the input's status. Pressing **ACK/ENTER** button, it is possible to change (cyclically) the ways the controller shows the inputs:

- **LOGICAL STATE:** the controller shows the input's logic level (active or inactive) used in the management of the operating sequence.
- **PHISICAL STATE:** the controller shows the electrical level (active or inactive, or high or low) present on the input; this can be the opposite in comparison to the corresponding logic state. Displayed in REVERSE.

#### 6.5.3.10 S.13 DIGITAL OUTPUTS

This page shows the status of the digital outputs of the controller. Pressing the **ACK/ENTER** button, it is possible to change (cyclically) the ways the controller shows the outputs:

- **LOGICAL STATE:** the controller shows the output's logic level (active or inactive) used in the management of the operating sequence.

- **PHISICAL STATE:** the controller shows the electrical level (active or inactive, or high or low) present on the output; this can be the opposite in comparison to the corresponding logic state. Displayed in REVERSE.
- **FOR FUNCTION:** the controller shows a list of functions associated to the digital outputs, showing the logic status (1/0) relative to each function, independently from the output associated to the functions. If more than 9 functions are configured, the controller will display all of them in rotation (9 at a time) every 2 seconds: keeping **ESC/SHIFT** button pressed you stop the rotation.

#### 6.5.3.11 S.14 DIGITAL OUTPUTS

This page is only shown if some DITEL modules have been configured (see 5.8). It displays the status of the digital outputs acquired from DITEL digital modules. If a DITEL module does not communicate correctly, the controller will display some dashes in place of the output's status. Pressing **ACK/ENTER** button, it is possible to change (cyclically) the ways the controller shows the outputs:

- **LOGICAL STATE:** the controller shows the output's logic level (active or inactive) used in the management of the operating sequence.
- **PHISICAL STATE:** the controller shows the electrical level (active or inactive, or high or low) present on the output; this can be the opposite in comparison to the corresponding logic state. Displayed in REVERSE.

#### 6.5.3.12 S.15 ANALOGUE INPUTS

The page shows the value of the analogue inputs of the controller (connectors JU, JK and JJ), of the emergency stop (EM-S) and of the terminal JK-1. Pressing **ACK/ENTER** button, it is possible to change (cyclically) the ways the controller shows the inputs:

- **PHYSICAL STATE**: Foe each input a measure in Volt is displayed.
- **FOR FUNCTION:** the controller shows a list of functions associated to the analogue inputs, showing the real acquired value, independently from the input associated to the functions. If more than 9 functions are used for the analogue inputs, the controller will display all of them in rotation (9 at a time) every 2 seconds: keeping the **ESC/SHIFT** button pressed you stop the rotation.

#### 6.5.3.13 S.16 ANALOGUE INPUTS

This page is only shown if some DITHERM or DIGRIN modules have been configured (see 5.8).

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

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

#### 6.5.3.14 S.17 ANALOGUE INPUTS

This page is only shown if some DIVIT modules have been configured (see 5.8).

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

- "------": if the expansion module does not transmit the measurement.

- "OPEN": if the module signals that the sensor is disconnected.
- "+OVER": if the module signals that the input signal has a too high value, symptom of a fault.
- "-OVER": if the module signals that the input signal has a too low value, symptom of a fault.

#### 6.5.3.15 S.18 ANALOGUE OUTPUTS

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

Pressing **ACK/ENTER** you arrive to a view per function: the controller shows a list of the functions associated to the analogue outputs, displaying the analogue value relative to each function, independently from the output associated to the functions. If more than 9 functions are used for the digital outputs, the controller will display all of them in rotation (9 at a time) every 2 seconds: keeping the **ESC/SHIFT** button pressed you stop the rotation.

#### 6.5.3.16 S.19 ANALOGUE OUTPUTS

This page is only shown if some DANOUT modules have been configured (see 5.8).

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

#### 6.5.3.17 S.20 MAINS PROTECTIONS

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

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

Possible codes are: "27<<", "27<", "27Q", "59>", "59>>", "81<<", "81<", "81>", "81>>", "81R", "VJ", "DI" (by contact). See document [8].

#### 6.5.3.18 S.21 SHARED DIGITAL INPUTS

This page displays the status of the controller's shared digital inputs They are displayed in groups of 16 inputs and only those used (by the controller or received via PMCB). See document [8].

#### 6.5.3.19 S.22 SHARED ANALOGUE INPUTS

This page displays the status of the controller's shared analogue inputs. Only those used (by the controller or received via PMCB) are displayed. See document [8].

### 6.5.4 Electrical measurements (M.XX)

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

#### 6.5.4.1 M.01 SYSTEM

This page displays a wiring diagram of the system, highlighting:

- The mains, the generators bus and the loads. The background colour of the symbols indicated the status of the voltage on the mains, on the generators' bus or on the loads:
  - White: voltage/frequency off.
  - Yellow: voltage/frequency on out of tolerance.
  - Green: voltage/frequency on and in tolerance.
- The GCB, MCB and MGCB circuit breakers. The symbol of the circuit breaker shows:
  - The open/close status.
  - The discrepancy between the status and the circuit breaker command (in this case, the two circuit breaker's points of contacts flash).
  - The possibility to use the synchronization to close the circuit breaker (if the synchronization can be used, the two circuit breaker's points of contacts are empty squares, otherwise they are full).
- The power flows, displayed as arrows, in all the parts of the plant. Each arrow points to the power direction. The arrow flashes (to indicate an anomaly) of negative power on the loads and on the generators' bus.
- The active power measurement and of the power factor in the different parts of the plant.
- The active power and the power factor setpoints for the operation in parallel with the mains.

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

#### 6.5.4.2 M.02 MAINS

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

- Three phase system (P.0119=3) with neutral connected to the controller (P.0129=1). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage. Pressing the **ACK/ENTER** button, in place of the concatenated voltages, the phase voltages are displayed (press the **ACK/ENTER** button again to go back to concatenates).
- Three-phase system (P.0119=3) without neutral (P.0129=0). The controller displays the three concatenated voltages, the frequency and the sense of rotation.
- Single-phase system (P.0119=1). The controller displays the phase voltage, the frequency and the neutral-battery voltage.

Under each concatenated or phase voltage, the controller also displays a bar showing graphically the current voltage with respect to the nominal voltage: on the bar are also

represented eventual thresholds. The colour with which the bar is filled is green if the voltage is in tolerance, yellow if it is out of tolerance.

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

#### 6.5.4.3 M.03 GENERATORS BUS

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

- Three phase system (P.0101=3) with neutral connected to the controller (P.0128=1). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage. Pressing the **ACK/ENTER** button, in place of the concatenated voltages the phase voltages are displayed (press the **ACK/ENTER** button again to go back to the concatenated).
- Three-phase system (P.0101=3) without neutral (P.0128=0). The controller displays the three concatenated voltages, the frequency, the sense of rotation.
- Single-phase system (P.0101=1). The controller displays the phase voltage, the frequency and the neutral-battery voltage.

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

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

#### 6.5.4.4 M.04 CURRENTS

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

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

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

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

- Ax: auxiliary current (visible if P.0131=1 or P.0131=4).
- An: neutral current (visible if P.0131=2).

#### 6.5.4.5 M.05 POWERS

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

At the bottom-right corner, the controller shows one symbol which immediately permits to identify the real source of the powers (mains, loads or generators bus).

#### 6.5.4.6 M.06 POWERS

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

At the bottom-right corner, the controller shows one symbol which immediately permits to identify the real source of the powers (mains, loads or generators bus).

#### 6.5.4.7 M.07 ENERGY METERS

In this page the active and reactive energy counters (partial and total) **exported** by the plant to the mains are shown.

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

- Press the **ACK/ENTER** button: one of the counters will result highlighted.
- Use the vertical scrolling UP and DOWN buttons to select the counter to be reset.
- Press the **ACK/ENTER** button and **ESC/SHIFT** buttons for 5 seconds.
- Press the **ESC/SHIFT** pushbutton.

From version 1.10, the reset of the counters is subordinate to the "user" access level: if a password has been configured in parameter P.0001, it must be entered (login) in parameter P.0000 in order to reset the counters.

At the bottom to the right, the display shows an icon which identifies the mains, to allow you to easily distinguish this page from the next, which have an identical structure.

#### 6.5.4.8 M.08 ENERGY COUNTERS

In this page the active and reactive energy counters (partial and total) **imported** from the mains to the plant are shown.

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

- Press the **ACK/ENTER** button: one of the counters will result highlighted.
- Use the vertical scrolling UP and DOWN buttons to select the counter to be reset.
- Press the **ACK/ENTER** button and **ESC/SHIFT** buttons for 5 seconds.
- Press the **ESC/SHIFT** pushbutton.

From version 1.10, the reset of the counters is subordinate to the "user" access level: if a password has been configured in parameter P.0001, it must be entered (login) in parameter P.0000 in order to reset the counters.

At the bottom to the right, the display shows an icon which identifies the mains, to allow you to easily distinguish this page from the next, which have an identical structure.

#### 6.5.4.9 M.09 ENERGY METERS

In this page the active and reactive energy counters (partial and total) **exported** by the generators to the plant are shown.

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

- Press the **ACK/ENTER** button: one of the counters will result highlighted.
- Use the vertical scrolling UP and DOWN buttons to select the counter to be reset.
- Press the **ACK/ENTER** button and **ESC/SHIFT** buttons for 5 seconds.
- Press the **ESC/SHIFT** pushbutton.

From version 1.10, the reset of the counters is subordinate to the "user" access level: if a password has been configured in parameter P.0001, it must be entered (login) in parameter P.0000 in order to reset the counters.

At the bottom to the right, the display shows an icon which identifies the generators, to allow you to easily distinguish this page from the previous, which have an identical structure.

#### 6.5.4.10 M.10 ENERGY METERS

In this page the reactive energy counters (partial and total) **imported** by the generators from the plant are shown.

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

- Press the **ACK/ENTER** button: one of the counters will result highlighted.
- Press the **ACK/ENTER** button and **ESC/SHIFT** buttons for 5 seconds.
- Press the **ESC/SHIFT** pushbutton.

From version 1.10, the reset of the counters is subordinate to the "user" access level: if a password has been configured in parameter P.0001, it must be entered (login) in parameter P.0000 in order to reset the counters.

At the bottom to the right, the display shows an icon which identifies the generators, to allow you to easily distinguish this page from the previous, which have an identical structure.

#### 6.5.4.11 M.11 REGULATIONS

This page is useful in the parallel applications. It displays the generators bus and mains voltages and frequencies at the same time. It is then possible to modify the offsets for the speed and voltage:

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

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

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

#### 6.5.4.12 M.12 SYNCHRONISATION

This page shows the necessary information for the synchronization.

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

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

status of the system is correct to close the circuit breaker: so, the fifth rectangle becomes green and the board controls the closing of the circuit breaker.

Still on the left side, the controller displays numerically the difference of phase, frequency and voltage between gensets and mains.

On the bottom of the page there are offsets for the speed and voltage. If these values are not related to an analogue input, it is possible to directly modify them from this page (see previous paragraph). In this way, it is possible to make a manual synchronization.

#### 6.5.4.13 M.13 SETPOINTS

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

- Offset of speed (P.0840).
- Offset of voltage (P.0867).
- Setpoint of active power for the SYSTEM BASE LOAD (P.0858) and for the SYSTEM IMPORT EXPORT (P.0859) modes.
- Setpoint of power factor for the SYSTEM BASE LOAD and for the SYSTEM IMPORT EXPORT modes (P.0860).

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

#### 6.5.4.14 M.14-15-16 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 controller, and to show them on the display. It can also group them (by any standard), and display them on one of the 3 available pages.

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

- AIF.2001: page M.14.
- AIF.2003: page M.15.
- AIF.2005: page M.16.

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

### 6.5.5 Measurement from CAN bus PMCB (B.XX)

These pages show the measurement and the statuses acquired by the CAN bus PMCB, which connects among them all SICES devices.

#### 6.5.5.1 B.01 DEVICES ON PMCB

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

The board shows the message "Mains controllers on the PMCB" in “reverse” if is working on MC200 mode (P.9606 = 1).

#### 6.5.5.2 B.02-03 MAINS

These pages show the significant data of each MC controller working on the PMCB CAN bus. Each page shows up to eight MC controllers, only the necessary pages are displayed. A line is used for each controller, which contains the active and reactive powers imported or exported on the mains.

#### 6.5.5.3 B.04 RENEWABLES

This page shows the significant data of each RN controller working on the PMCB CAN bus. A line is used for each controller, which contains the active and reactive powers produced by the renewable sources.

#### 6.5.5.4 B.05-06-07-08 GENSETS

These pages show the significant data of each genset controller that operates on the PMBC CAN bus. Each page shows up to 8 gensets. Only the relevant pages are shown. It is used one line for each genset, which contains:

- The PMCB address of the genset. MC200 shows the PMCB address in “reverse” if, now, it is not able to manage this genset (for example if the related genset controller is in OFF_RESET mode or has some alarms).
- The nominal power of the genset.
- The active and reactive power supplied by the genset.
- The working hours of the engine.
- The status of the generator (stopped, load sharing etc.).

If the parameter P.9606 is set to zero, MC200 acts as the old MC100 controller:

In AUTO mode, MC200 starts and stops the generators as required by the loads. Using these pages, the operator can modify this behaviour. For each generator, the operator can select one of these operating modes:

- Automatic management (default). MC200 starts/stops the generator as required by load. In this case, a “**blank field**” is shown on the display between PMCBUS address and nominal power of the selected generator.
- Generator always working. Whatever the load is, this generator must work. In this case, a “**full square**” is shown on the display between the genset address and the nominal power of the selected genset.
- Generator always stopped. Whatever the load is, this generator must be stopped. In this case, an “**empty square**” is shown on the display between the genset address and the nominal power of the selected genset.

It is possible to choose the desired operating mode for each generator directly from these pages:

- Press **ACK/ENTER** pushbutton:
- By using ▲▼pushbuttons, select the desired genset.
- Change the desired operating mode using ◄►pushbuttons.
- Press **ESC/SHIFT** to exit selection mode.

Note: if no buttons are pressed for 60 seconds, the selecting procedure is automatically finished.

#### 6.5.5.5 B.09 TOTALS ON PMCB

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

- The total nominal power of the supplying gensets (MDPt, kW).
- The current load ratio of the generators' bus (DPRt, %).
- The total active power supplied (kW).
- The total reactive power supplied (kvar).
- The total active energy (kWh, sum of energy counters of all genset control boards).
- The total reactive energy (kvar, sum of energy counters of all genset control boards).

#### 6.5.5.6 B.10 LOAD FUNCTION

This page is dedicated to the functions of "load management" (see [8]). By the term "load management" is intended the capacity of the system to start/stop the gensets to only have the strictly necessary gensets running to supply the load (with a small margin, but not too much). This page shows some information relevant for this function.

The information shown is:

- The enabling for this controller of the "load management" function.
- The "load management" mode currently selected (it establish the criteria with which the genset to be started are chosen).
- The "master" (it is the primary genset, the one which would not be ever stopped). For some "load management" modes this information is not displayed.
- Based on the selected mode, the controller can show in how many hours (or at which time) the system will select a new "master" genset.
- The list of the genset controllers, ordered based on the priority (first the genset with major priority, the last to be stopped). For some "load management" modes this information is not displayed.

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

- Press the **ACK/ENTER** button.
- Use ▲▼buttons to select the address of the "master" genset selected.
- Confirm with **ACK/ENTER** button.

#### 6.5.5.7 B.11 LOAD MANAGEMENT

This page is dedicated to the functions of “load management” (see [8]). By the term “load management” is intended the capacity of the system to start/stop the gensets to only have the strictly necessary gensets running to supply the load (with a small margin, but not too much). This page shows some information relevant for this function.

The information shown is:

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

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

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

#### 6.5.5.8 B.12 LOAD SHEDDING

This page is dedicated to the functions of “load shedding”. By the term “load shedding” is intended the capacity of the system to disconnect/re-connect part of the loads if the generators are not able to supply them. This page shows some information relevant for this function:

- The status of each group of loads (connected/disconnected). The function can manage up to four groups.
- The status of this function (enabled/disabled).
- The power (%) supplied by the gensets, related to the thresholds for the disconnection and re-connections of the groups of loads.

Some of these measurements can be shown in reverse to indicate an “out of threshold” situation (which can require the disconnection or the re-connection of a group of loads).

When possible, the controller displays also the remaining time to the disconnection or the re-connection of a group of loads.

#### 6.5.5.9 B.13 PEAK SHAVING

This page is dedicated to the functions of “peak shaving” or “peak lopping”. By these terms is intended the capacity of the system to start/stop the gensets when the consumption of the loads from the mains is too high, in a way to limit the loads consumption from the mains. This page shows some information relevant for this function:

- The status of this function (enabled/disabled).
- The power (%) of the loads, related to the thresholds for starting/stopping the generators.

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

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

#### 6.5.5.10 B.14 LOADS’ VOLTAGES REGUL.

This page is dedicated to the "loads’ voltage regulations" function (7.18). This term refers to the controller's ability to modify the voltage command to the generators, in order to align the loads voltage to a pre-set setpoint. This page shows some information relevant to this function:

- The status of this function (enabled / disabled).
- The setpoint acquired by parameter.
- The setpoint possibly acquired from an analogue input (show dashes if it is not available).
- The setpoint currently in use (one of the previous two, possibly limited by the ramp).
- The voltage measured on the loads.

### 6.5.6 History logs (H.xx)

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

The controller manages three types of archive:

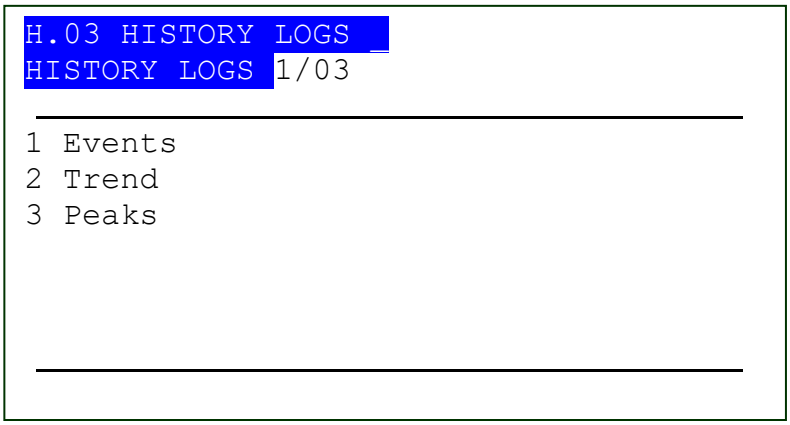
1. Events.
2. Analogue measures.
3. Maximum peaks.

These archives can be accessed in any function mode and status of the controller. To select the function, use the buttons ▲ and ▼ until the HISTORY ARCHIVE (H.01) base page is shown.

**If you are in a mode which limits the use of vertical scrolling buttons, it might be necessary to press ESC/SHIFT button one or more times.**

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

#### 6.5.6.1 Archive selection



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

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

### 6.5.6.2 Pages for events

In the moment in which some events happen (previously configured), the controller adds a registration in this archive. The registration always contains date/hour, numeric code which identifies the event and the controller status. Through BoardPrg3 program, it is possible to select which other information must be registered at every event. It is possible to add maximum 44 information. The capacity of the archive depends on how many information are memorized at every event: with default configuration, by the way, the total capacity is 523 registrations. If the archive is full and a new event occurs, the less recent is overwritten.

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

| Bit | Hexadecimal value | Firmware version | Description |
|---|---|---|---|
| 0 | 01 | 01.00 | Board operating mode. |
| 1 | 02 | 01.00 | Mains status. |
| 2 | 04 | 01.00 | Generators bus status. |
| 3 | 08 | 01.00 | Mains fault protections. |
| 4 | 10 | 01.00 | Circuit breakers status. |
| 5 | 20 | 01.00 | Circuit breakers commands. |
| 6 | 40 | 1.00 | Start/stop requests. |
| 7 | 80 | 01.00 | Load disconnect. |
| 8 | 100 | 01.00 | Diagnostics. |

A chart follows with the codes for all possible events.

| Code | Version | Even if blocked. | Registration cause. |
|---|---|---|---|
| EVT.1001 | 01.00 | Yes | OFF_RESET. |
| EVT.1002 | 01.00 | Yes | MAN. |
| EVT.1003 | 01.00 | Yes | AUTO. |
| EVT.1004 | 01.00 | Yes | TEST. |
| EVT.1005 | 01.00 | Yes | REMOTE START. |
| | | | |
| EVT.1010 | 01.00 | | Mains not present. |
| EVT.1011 | 01.00 | | Mains present. |
| EVT.1012 | 01.00 | | Mains in tolerance. |
| | | | |
| EVT.1013 | 01.00 | | Inhibition for start active (from configurable input). |
| EVT.1014 | 01.00 | | Inhibition for start not active (from configurable input). |
| | | | |
| EVT.1020 | 01.00 | | Genset not present. |
| EVT.1021 | 01.00 | | Genset present. |
| EVT.1022 | 01.00 | | Generator in tolerance. |
| | | | |
| EVT.1030 | 01.00 | | MGCB close command. |
| EVT.1031 | 01.00 | | MGCB open command. |
| EVT.1032 | 01.00 | | MGCB closed. |
| EVT.1033 | 01.00 | | MGCB open. |

| | | | |
|---|---|---|---|
| EVT.1035 | 01.00 | | MCB close command. |
| EVT.1036 | 01.00 | | MCB open command. |
| EVT.1037 | 01.00 | | MCB closed. |
| EVT.1038 | 01.00 | | MCB open. |
| | | | |
| EVT.1050 | 01.00 | | Manual start command. |
| EVT.1051 | 01.00 | | Manual stop command. |
| EVT.1052 | 01.00 | | Automatic start command. |
| EVT.1053 | 01.00 | | Automatic stop command. |
| EVT.1054 | 01.00 | | TEST start command from digital input. |
| EVT.1055 | 01.00 | | TEST stop command from digital input. |
| EVT.1056 | 01.00 | | TEST start command from communication port. |
| EVT.1057 | 01.00 | | TEST stop command from communication port. |
| EVT.1058 | 01.00 | | TEST start command from clock/calendar. |
| EVT.1059 | 01.00 | | TEST stop command from clock/calendar. |
| EVT.1060 | 01.00 | | TEST start command from SMS. |
| EVT.1061 | 01.00 | | TEST stop command from SMS. |
| EVT.1062 | 01.00 | | Automatic start command for failure to close MCB. |
| | | | |
| EVT.1074 | 01.00 | Yes | Reset |
| EVT.1075 | 01.00 | | Not valid clock (but used by some functions). |
| EVT.1076 | 01.00 | Yes | Update clock/calendar. |
| EVT.1077 | 01.00 | Yes | New power on of the controller. |
| EVT.1078 | 01.00 | Yes | Default values of parameters reloaded. |
| | | | |
| EVT.1080 | 01.00 | | Inhibition for supply activated (from configurable input). |
| EVT.1081 | 01.00 | | Inhibition for supply not activated. |
| | | | |
| EVT.1082 | 01.00 | | Protection override activated. |
| EVT.1083 | 01.00 | | Protection override deactivated. |
| | | | |
| EVT.1086 | 01.00 | Yes | Clock updated for daylight saving time. |
| EVT.1087 | 01.00 | Yes | Clock updated for standard time. |
| | | | |
| EVT.1091 | 01.00 | | Mains loss protection “27 U<<” tripped. |
| EVT.1092 | 01.00 | | Mains loss protection “59 U<<” tripped. |
| EVT.1093 | 01.00 | | Mains loss protection “81 f<<” tripped. |
| EVT.1094 | 01.00 | | Mains loss protection “81 f<<” tripped. |
| EVT.1095 | 01.00 | | Mains loss protection “81 R” (Df/Dt) tripped. |
| EVT.1096 | 01.00 | | Mains loss protection “Vector Jump” tripped. |
| EVT.1098 | 01.00 | | Mains loss protection (from contact) tripped. |
| EVT.1099 | 01.00 | | Mains loss protection restored. |
| EVT.1100 | 01.00 | | Mains loss protection “27 U<” tripped. |
| EVT.1101 | 01.00 | | Mains loss protection “59 U>” tripped. |
| EVT.1102 | 01.00 | | Mains loss protection “81 f<” tripped. |
| EVT.1103 | 01.00 | | Mains loss protection “81 f>” tripped. |
| EVT.1104 | 01.00 | | Protections 27 enabled. |
| EVT.1105 | 01.00 | | Mains loss protection “27 U<& Q?" tripped. |
| EVT.1105 | 01.14 | | Opening of a circuit breaker as backup for the mains failure on another mains transformer, in parallel with this one. |
| | | | |
| EVT.1151 | 01.00 | | Mains loss protection “27 U<” restored. |
| EVT.1152 | 01.00 | | Mains loss protection “59 U>>” restored. |
| EVT.1153 | 01.00 | | Mains loss protection “81 f<<” restored. |

| | | | |
|---|---|---|---|
| EVT.1154 | 01.00 | | Mains loss protection “81 f>>” restored. |
| EVT.1155 | 01.00 | | Mains loss protection “81 R” (Df/Dt) restored. |
| EVT.1156 | 01.00 | | Mains loss protection “Vector Jump” restored. |
| EVT.1158 | 01.00 | | Mains loss protection (by contact) restored. |
| EVT.1160 | 01.00 | | Mains loss protection “27 U<” restored. |
| EVT.1161 | 01.00 | | Mains loss protection “59 U>” restored. |
| EVT.1162 | 01.00 | | Mains loss protection “81 f<” restored. |
| EVT.1163 | 01.00 | | Mains loss protection “81 f>” restored. |
| EVT.1164 | 01.00 | | Protections 27 disabled. |
| EVT.1165 | 01.00 | | Mains loss protection “27 U<& Q?” restored. |
| EVT.1165 | 01.14 | | End of opening condition of a circuit-breaker as backup for the mains failure on another mains transformer in parallel with this one. |
| | | | |
| EVT.1191 | 01.16 | | The parallel with the mains is allowed |
| EVT.1192 | 01.16 | | The parallel with the mains is not allowed |
| | | | |
| EVT.1201 | 01.00 | | Inhibition for supply activated (from mains out of thresholds). |
| | | | |
| EVT.1202 | 01.00 | | Inhibition for supply activated (from communication ports). |
| EVT.1203 | 01.00 | | Inhibition for supply activated (for some GCB not opened). |
| EVT.1204 | 1.00 | | Inhibition for supply activated (for reverse synchronization). |
| | | | |
| EVT.1221 | 01.00 | | Inhibition for start active (from clock/calendar). |
| EVT.1222 | 01.00 | | Inhibition for start not active (from clock/calendar). |
| EVT.1223 | 01.00 | | Inhibition for start active (for mains out of tolerance for SPtM and MPtM plants). |
| EVT.1224 | 01.00 | | Inhibition for start not active (for mains out of tolerance for SPtM and MPtM plants). |
| EVT.1225 | 01.00 | | Inhibition for start active (for GCB not opened). |
| EVT.1226 | 01.00 | | Inhibition for start not active (for GCB not opened). |
| | | | |
| EVT.1291 | 01.00 | | Load function: new master genset. |
| | | | |
| EVT.1321 | 01.00 | | Load shedding: load #1 disconnected. |
| EVT.1322 | 01.00 | | Load shedding: load #1 re-connected. |
| EVT.1323 | 01.00 | | Load shedding: load #2 disconnected. |
| EVT.1324 | 01.00 | | Load shedding: load #2 re-connected. |
| EVT.1325 | 01.00 | | Load shedding: load #3 disconnected. |
| EVT.1326 | 01.00 | | Load shedding: load #3 re-connected. |
| EVT.1327 | 01.00 | | Load shedding: load #4 disconnected. |
| EVT.1328 | 01.00 | | Load shedding: load #4 re-connected. |
| | | | |
| EVT.1321 | 01.00 | | Number of gensets connected to bus PMCB varied |
| | | | |
| EVT.1331 | 01.00 | | Peak shaving: request to start the generators. |
| EVT.1332 | 01.00 | | Peak shaving: request to stop the generators. |

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

All the anomalies are recorded into the events log. They are recorded with their own numerical code, added to:

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

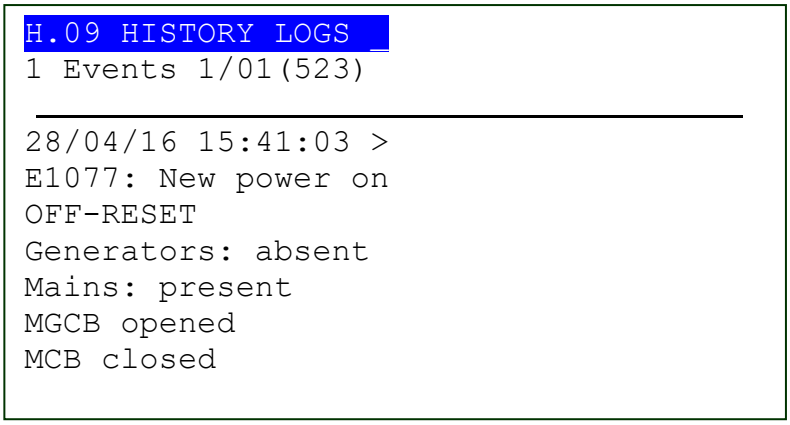
For example, anomaly 273 will be recorded as "2273" when it is activated as a warning, as "5273" if it is activated as an alarm. By viewing the event directly from the controller, the event code "2273" is automatically displayed as "W273", the code 5273 is displayed as "A273".

With the default configuration, each time that an event is recorded, the controller also records the following info (this list can be modified by means of the BoardPrg3 program):

- Date/Time.
- Event code.
- Operating mode of the controller.
- Presence of voltage on the generators' bus.
- Mains status.
- MGCB circuit breaker command and status.
- MCB circuit breaker command and status.
- Mains phase-to-phase voltages and frequency.
- Generators bus phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The nominal power, the active power and the reactive power of the generators with GCB closed (totals).
- The power supply voltage.

Using the ▲▼ buttons to scroll cyclically trough all recordings. Each event has many information pages (depending on the configuration). Pressing the ◄► buttons allows you to scroll through the pages related to the event.

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




The common part 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, five pages are used:

**Page 1.** It shows the statutes of the system at the time when the event was recorded: the controller operating mode and the statutes of the generators, of the mains and of the circuit breakers.

**Page 2.** It shows the frequency and the voltages of the mains. It also shows the frequency and the L1-L2 voltage of the generators' bus.

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

**Page 4.** It shows the total active power (kW), the total reactive power (kvar) and the total power factor. It also shows the nominal power, the active power and the reactive power of the supplying generators.

**Page 5.** It shows the power supply voltage.

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

#### 6.5.6.3 Pages for analogues

MC200 records a series of analogue measurements and statuses at regular intervals. The recording interval is configurable, and different intervals can be configured for when at least one generator has its GCB closed and for when all generators have their GCB opened:

- P.0442: interval (in seconds) for the recording into the archive of analogue measurements, used when at least one generator has its GCB closed.
- P.0443: interval (in seconds) for the recording into the archive of analogue measurements, used when all generators have their GCB opened.

Each record always contains the date/time and the status of the controller. By means of the BoardPrg3 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 523 records. If the archive is full and a new event occurs, the oldest is overwritten.

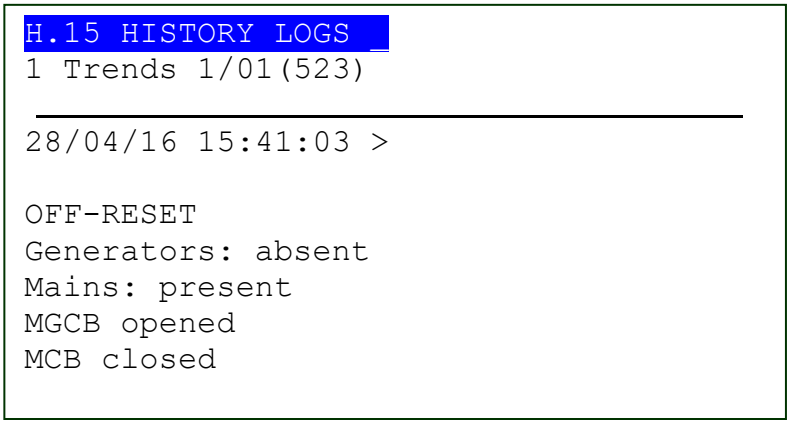
With default configuration, the values recorded are:

- Date/Time.
- Event code.
- Operating mode of the controller.
- Presence of voltage on the generators' bus.
- Mains status.
- MGCB circuit breaker command and status.
- MCB circuit breaker command and status.

- Mains phase-to-phase voltages and frequency.
- Generators bus phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The nominal power, the active power and the reactive power of the generators with GCB closed (totals).
- The power supply voltage.

Using the ▲ and ▼ buttons to scroll cyclically trough all recordings. Each record has a variable number of information pages (based on the configuration). By pressing ◄► buttons it is possible to navigate on the 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 contains:

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

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

**Page 1.** It shows the statutes of the system at the time when the event was recorded: the controller operating mode and the statutes of the generators, of the mains and of the circuit breakers.

**Page 2.** It shows the frequency and the voltages of the mains. It also shows the frequency and the L1-L2 voltage of the generators' bus.

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

**Page 4.** It shows the total active power (kW), the total reactive power (kvar) and the total power factor. It also shows the nominal power, the active power and the reactive power of the supplying generators.

**Page 5.** It shows the power supply voltage.

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

#### 6.5.6.4 Locked recordings

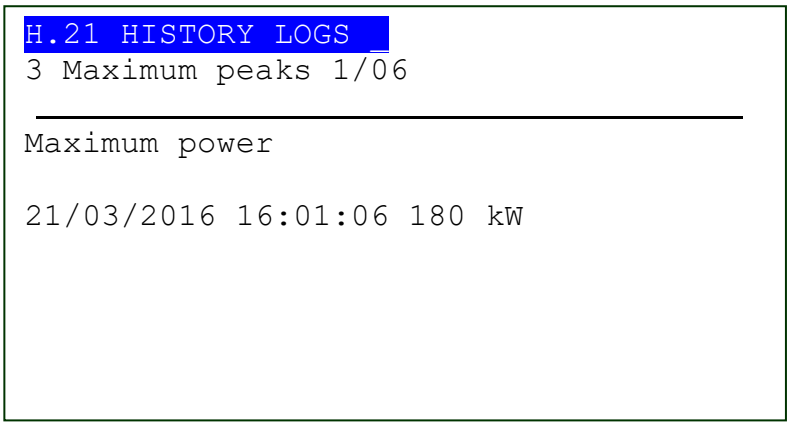
The controller does not perform recordings in the archive of analogues and in the archive of events if it is in OFF/RESET mode and when a shutdown or an unload have been activated. Exceptions are some event codes (highlighted by the wording “Yes” in the column “even if blocked” of the table in 6.5.6.2)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

#### 6.5.6.5 Pages for peaks

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

- Total active power: the maximum peak is recorded, having the date/time and the measure of the engine coolant temperature (if available) associated.
- Currents: the maximum peaks of individual phases are recorded, having the date/time and power factor of that phase associated.
- Controller temperature: the minimum and the maximum peaks are recorded, with date/time associated.

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




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

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

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

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

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

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

**Using the ▲ and ▼ pushbuttons it is possible to scan all the records. The buttons ◄ and ► are not used because the controller uses only one page of the display.**

#### 6.5.6.6 Exit from archives visualization

There are two ways to exit from archive visualization:

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

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

#### 6.5.6.7 Reset of archives

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

## 6.6 Language selection

The device allows to select the language to use for all writings displayed on the multifunctional viewer. Currently, 5 languages are supported: Italian, English, Portuguese, French and Spanish (English as default). The directly available languages are only: English, Italian and Portuguese. The others can be transferred to the controller (one at a time) though BoardPrg3 software. See 6.5.3.3 for the language selection procedure.

# 7 Operation sequence

The rest of the chapter will describe the actions of MC200 on the MCB and MGCB circuit breakers and the commands sent to the gensets controllers via CAN bus PMCB.

MC200 can send some commands (via CAN bus PMCB) to the gensets controllers. Almost these commands are sent to the genset controllers only if they are "**managed by MCxxx**".

MC200 uses a different way (respect the old MC100) for starting and stopping the generators through the PMCB CAN bus. The new system provides more functionalities, but requires an updated firmware also an all the genset controllers (GCxxx or DSTxxxx). For this reason, MC200 can emulate the old MC100.

- P.9506 = 1. In this configuration, MC200 emulates the old MC100.

  A controller is "**managed by MCxxx**" if:

  - It doesn't have alarms, deactivations or unloads.
  - It is not in OFF/RESET, MAN or TEST mode.
  - The contact "inhibition for start" is active.
  - It does not have requests of "inhibition for supply the loads" (by contact or by communication ports).
  - It does not have REMOTE START requests, if not received by MCxxx.
  - It does not have the contact to enable the REMOTE START mode, or it is active.

  To request the start of a genset, MCxxx sends a "REMOTE START" request to the related genset controller (for this reason a controller must have the "REMOTE START" function enabled to be "managed by MCxxx").

  To request the stop of a genset, MCxxx removes the request of "REMOTE START" to the related controller. The controller will stop the genset if:

  - There are no requests of REMOTE START and TEST.
  - There are no requests of automatic intervention, or the request of "automatic start inhibition" by contact is active.

  The two previous conditions are necessary to get the genset controller "managed by MCxxx".

  In some conditions, and only if MGCB is present, MCxxx can request the opening of the GCB circuit breakers of the gensets controllers. To do this, MCxxx sends a command of "load inhibition" to the genset controllers. When the opening of the GCB circuit breakers is not required, MCxxx removes the request of "load inhibition": the genset controllers will close the GCB circuit breakers only if there are no requests of "load inhibition" (necessary condition to get the genset controller "managed by MCxxx").

- P.9506 = 0. In this configuration, MC200 uses the new command system, that provides enhanced functionalities.

  A controller is "**managed by MCxxx**" if:

  - It doesn't have alarms, deactivations or unloads.
  - It is in AUTO mode (not in TEST or in REMOTE START mode).

- It does not have requests of “inhibition for start” (by contact or by Modbus).
- It does not have requests of “inhibition for supply the loads” (by contact or by Modbus).

To request the start of the gensets (all controlled ones), MC200 sends an “automatic start request” over the CAN bus. In the same way, to stop the gensets (all controlled ones), it removes the “automatic start request” from the CAN bus. The genset will stop if:

- Its controller is in AUTO mode.
- There are no requests of automatic intervention, or the request of “start inhibition” by contact or Modbus is active.

In some conditions, and only if MGCB is present, MC200 can request the opening of the GCB circuit breakers of the gensets controllers. To do this, MC200 sends a command of “inhibition for supply the loads” to the genset controllers. When the opening of the GCB circuit breakers is not required, MC200 removes the request of “inhibition for supply the loads”: the genset controllers will close the GCB circuit breakers only if there are no requests of “inhibition for supply the loads”.

## 7.1 Operation mode

Five modes are available for the device management.

- **OFF_RESET**: the MGCB is open to disconnect the gensets from the loads and/or the mains (if it exists and if it is commanded by MC200). The MCB is closed to connect the loads to the mains (if it exists and if it is commanded by MC200). MC200 removes all the requests of gensets start. All anomalies are cancelled and it is possible to access the programming to modify the parameters.
- **MAN:** the start and the stop of the gensets are managed by the operator. The opening/closing of the two circuit breakers (if they are present and commanded by MC200) are managed by the operator. The controller automatically activates the synchronization procedure (if required) following the manual command of a circuit breaker closing by the operator. The protections are active: MC200 is always able to open the MGCB circuit breaker (if present) and remove the requests of gensets start. The access to programming is allowed, but only some parameters can be modified.
- **AUTO**: the start and the stop of the gensets and the opening/closing of the MGCB and MCB circuit breakers are managed by the controller (the operator cannot intervene). All the protections are enabled. The access to programming is allowed, but only some parameters can be modified.
- **TEST**: this operating mode differs from AUTO, as MC200 still requires the start of the gensets, without considering that the conditions of the plant require the automatic intervention of the gensets or not (the “automatic intervention inhibition” are ignored in this mode). By parameter P.0222, it is possible to choose if the controller has or has not to connect the load to generators. When the controller goes back to AUTO (when the test ends), the loads are automatically switched on the mains and the gensets are stopped with the normal procedure. If possible, the switch of the loads between mains and gensets is carried out by avoiding their black-out. The controller will pass automatically from TEST to AUTO if the conditions for an automatic gensets intervention are verified. The access to programming is allowed, but only some parameters can be modified.
- **REMOTE START**: this operating mode differs from AUTO, as MC200 still requires the start of the gensets, without considering that the conditions of the plant require the automatic intervention of the gensets or not (the “automatic intervention inhibition” are ignored in this mode). If there are no requests of “inhibition to take the load”, the loads are switched on the gensets. The operator cannot command the circuit breakers

manually. When this operating mode is deactivated, the controller goes back to AUTO and, if the automatic intervention of the gensets is not requested, the controller opens the MGCB circuit breaker and removes the start requests of the gensets. The access to programming is allowed, but only some parameters can be modified.

The operation mode can be selected in three different ways:

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

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

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

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

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

  **If it is used only the input to force OFF/RESET mode, the controller acts differently: when the input is active, the controller is always in OFF/RESET mode, and when the input goes back on standby, the controller goes back to the mode it was in prior to input activation.**
- By Modbus commands. The commands are only managed if none of the above described inputs is active. The commands can be protected by a password (P.0004) which must be entered before any command, and they can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: write the value:
    - “1” to require the OFF/RESET mode.
    - “2” to require the MAN mode.
    - “3” to require the AUTO mode.

To enable the **TEST** mode requires the controller being first set to AUTO without any automatic start request. All possible TEST activation modes are described below. If in TEST mode, the AUTO/TEST indicator flashes at a duty of 50%. You can shift to TEST mode as follows:

- Pressing the START pushbutton. Shifting to TEST mode is immediate. To return to AUTO mode, press again the START pushbutton. If the TEST duration (P.0420) is

configured (different from zero), this test ends automatically after the time indicated. Parameter P.0222 establishes if the generators are connected to the loads or not.

- When a digital input configured with function DIF.2031 “Request of Test mode” activates, the controller shifts to TEST and returns to AUTO when it deactivates. Parameter P.0222 establishes if the generators are connected to the loads or not.
- 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 this input activates and goes back to AUTO at the end of the time configured in P.0420 (if P.0420 is set to zero, the test is not carried out). If there is a second activation of the input during the test, the test is immediately stopped. During this test, the controller doesn’t connect the generators to the loads, 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 this input activates and goes back to AUTO at the end of the time configured in P.0420 (if P.0420 is set to zero, the test is not carried out). If there is a second activation of the input during the test, the test is immediately stopped. During this test, the controller connects the generators to the loads, independently from the value configured in P.0222.
- By properly configuring the parameters:
  - P.0418: Test enable days.
  - P.0419: Test start time.
  - P.0420: Test duration.

  They allow selecting the days of the week and a time slot within which the working mode switches from AUTO to TEST. In this case, the passage to TEST is automatic in the scheduled days and hour. The controller returns to AUTO when the TEST time interval ends. Parameter P.0222 establishes if the generators are connected to the loads or not.
- By means of a proper command via SMS (see [3]). To use this feature, the parameter P.0420 “Test duration” shall not be set to zero (it indicates in effect the duration of the test). In this case, the controller shifts from TEST after receiving the SMS and returns to AUTO after the time P.0420. Parameter P.0222 establishes if the generators are connected to the loads or not.
- From a Modbus command. The controller shifts to TEST when it receives the command, returns to AUTO when it receives the opposite command or when it considers the connection interrupted (60 seconds without messages). The commands can be protected by a password (P.0004) which must be entered before any command, and they can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: write the value:
    - “12” to require the vacuum TEST mode.
    - “14” to require the load TEST mode.
    - "21" to return to AUTO.

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

- By means of the digital input configured with the function DIF.2032 (“remote start request”). If input is active, the REMOTE START mode is entered and it is leaved deactivating the input.
- By means of a proper command via SMS (see [3]). In this case, the controller shifts to REMOTE START as soon as it receives the SMS and returns to AUTO when it receives the opposite command. In this case, it is mandatory to configure an input with function DIF.2701 (“enable remote start request”): the input must be active (normally wired on a switch at control panel front to enable the remote commands).
- By properly configuring the parameters P.0426, P.0427 and P.0428, it is possible to define an hour range within which the working mode automatically switches to REMOTE START. Parameter P.0426 allows to establish in which days of the week this function is active. The remaining two allow to set an hour range valid for all selected days. The range start time (P.0427) refers to the days set in P.0426, while the range end time (P.0428) refers to the same day, if its value is higher than P.0427, or to the following day if lower (across midnight). Moreover, setting P.0427 and P.0428 to the same value, you define a full day range.
- By a Modbus command. The controller shifts to REMOTE START once it receives the command, returns to AUTO when it receives the opposite one (it remains in REMOTE START if the connection interrupts before receiving the opposite command). In this case, it is mandatory to configure an input with function DIF.2701 (“enable remote start request”): the input must be active (normally wired on a switch at control panel front to enable the remote commands). The commands can be protected by a password (P.0004) which must be entered before any command, and they can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: write the value:
    - “13” to require the REMOTE START mode.
    - "21" to return to AUTO.

### 7.1.1 Events and signalling

The controller 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”.

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

- DOF.3001 - “OFF/RESET”. The board activates this output when in OFF/RESET mode.
- DOF.3002 - “Man”. The board activates this output when in MAN mode.
- DOF.3003 - “Auto”. The board activates this output when in AUTO mode.
- DOF.3004 - “Test”. The board activates this output when in TEST mode.
- DOF.3005 - “REMOTE START”. The board activates this output when in REMOTE START mode.
- DOF.3011 - “Not in OFF/RESET”. The board activates this output when in AUTO or MAN mode.
- DOF.3012 - “One of the automatic modes”. It activates when a controller is in an automatic operation mode, that is AUTO, TEST, or REMOTE START.

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

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

## 7.2 Generators bus voltage detection

The controller needs to know if there are voltages on the generators bus to enable or not the synchronization when it must close a circuit breaker. The following terms are used:

- “Dead” bus: no voltages on generators bus.
- “Live” bus: voltages on generators bus.

The controller can detect the presence of voltage on the generators bus through its three-phase sensor (JF) or through an external sensor.

**Note: if there is an external sensor, the internal one is ignored.**

**Note: if the controller must synchronize the gensets with the mains, it is necessary to use the internal sensor (or an external synchronizer).**

The gensets bus status is displayed by means of the led GENERATORS BUS LIVE.

### 7.2.1 External sensor

Use a digital input configured with the function DIF.3102 (“No voltages on gensets”): when the input is active, the generators bus is considered “without voltage”.

### 7.2.2 Internal sensor

The controller uses the parameters to configure the sensor:

- P.151: it indicates whether the full-scale voltage is 400V or 100V.
- P.0101: it indicates if the generators bus is three-phase (3) or single-phase (1).
- P.0102: gensets nominal voltage. Its value must be the nominal phase-to-phase voltage for three-phase systems and phase–to–neutral voltage for single-phase systems.
- P.0103: primary value (Vac) of possible voltage transformers connected to the JF connector.
- P.1104: secondary value (Vac) of possible voltage transformers connected to the JF connector.
- P.0128: it indicates whether the neutral line is connected to the JF terminal.

For the connection of the voltage lines, see paragraph 5.9.

Note: set the nominal voltage to a value different from zero.

The controller uses a fixed threshold, 9% of nominal voltage (with a 3% hysteresis). Generators bus is considered “dead” if all voltages (P.0101) are below the 9% threshold, it is “live” if at least one voltage is above 12% (9 + 3). With default parameters, generators bus is “dead” if all voltages are lower than 36 V; it is “live” if at least one voltage is greater than 48 V.

For three-phases system, the previous tests are performed on the phase-phase voltages. If enabled with P.0328 (<> 0) the same tests are performed on the phase-neutral voltages also.

### 7.2.3 Events and signalling

The controller records the following events if the working mode changes (if enabled with bit 2 of P.0441 parameter):

- EVT.1020: no voltages on the generators’ bus.

- EVT.1022: voltages on the generators' bus.

The following functions, for the configuration of the digital outputs, are related to the generators' bus voltage:

- DOF.3031 ("Voltage on gensets"): the output is active when there are voltages on the generators' bus.

## 7.3 Load bus voltage detection

The controller needs to know if there are voltages on loads bus to enable or not the synchronization when it must close the circuit breakers. The following terms are used:

- "Dead" bus: no voltages on loads bus.
- "Live" bus: voltages on loads bus.

The controller is not able to directly detect voltages on the loads (except when MGCB is not used or always closed). Usually, it recreates this status according to the voltage detected on the mains and on the generators' bus, and to the circuit breakers status.

If preferred (and for safety reasons also), it is possible to use one digital input configured with the function DIF.3104 ("No voltage on loads") to acquire this information. Loads bus is "live" if this input is "not active" (logical state).

The loads status is displayed by means of the signal led BUS LIVE.

### 7.3.1 Signalling

The following functions for the configuration of the digital outputs are related to loads bus voltage:

- DOF.3030 ("Voltage on loads"): the output is active when there are voltages on the loads.

## 7.4 Mains

The controller acquires mains voltages and frequency, for three main purposes:

- "**AMF**". The controller must detect all anomalies about the mains to start the generators and make them supply the loads. In the same way, the controller detects when mains voltages and frequency are back to their operating values to connect loads to mains and stop the generators.
- **"Protections for the parallel with the mains (PPR)"**. The controller must detect the "loss of mains" while generators are in parallel with mains, to disconnect them from the mains (generator can in this case supply loads or not depending on plant configuration). In the same way, when generators are disconnected from the mains, the controller detects when mains voltages and frequency are back to their operating values to put generators in parallel with mains again.
- For **synchronization** purpose.

The controller uses different sets of parameters for these purposes.

Normally, the controller uses its internal sensor (JG) to measure the mains. For the first two functions, it's possible to use an external sensor alternatively (for the synchronization you must use the internal sensor).

There are some parameters for the configuration of the internal sensor that do not depend on its use:

- P.0105: nominal frequency (Hz).
- P.0152: it indicates if the full scale for the inputs is 400V or 100V.
- P.0119: it indicates if the mains is three-phase (3) or single-phase (1).
- P.0116: nominal voltage. Its value must be the nominal phase-to-phase voltage for three-phase systems and phase–to–neutral voltage for single-phase systems.
- P.0117: primary value (Vac) of possible voltage transformers connected to the JG connector.
- P.0118: secondary value (Vac) of possible voltage transformers connected to the JG connector.
- P.0129: it indicates whether the neutral line is connected to the JG connector or not.

For the connection of the voltage lines, see paragraph 5.9.

Note: set the nominal voltage to a value different from zero.

The mains status is displayed by means of the signal led MAINS LIVE.

### 7.4.1 Automatic Mains Failure

This function must detect all anomalies on the mains voltage, to start the gensets and connect the loads to them.

Usually, this function is not used if the gensets are in parallel with the mains, Anyhow, if the parallel protections trip while the gensets are in parallel with the mains, the mains is considered "off" for AMF purpose too.

The parameter P.9504 allows to set whether to use the internal sensor ("0") or the external one ("1").

#### 7.4.1.1 External sensor

To use an external mains sensor, P.9504 must be set to 1.

The external mains sensor must be connected to a digital input configured with the function DIF.3101 (“External sensor for mains”). Mains is “in tolerance” when this input is “active” (logical state), is “Absent” when the input is “not active”.

#### 7.4.1.2 Internal sensors

To define the mains status, the controller can carry out up to four different checks. They are described below one by one (with examples).

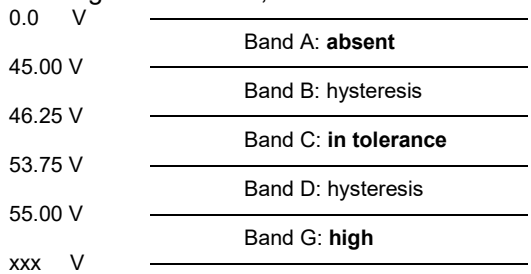
##### 7.4.1.2.1 Frequency check

| Parameter | Description | Default value | Frequency (Hz) |
|---|---|---|---|
| P.0105 | Nominal 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 | Hysteresis | 2.5 % | 1.25 |

The hysteresis is applied:

- Upwards the low frequency threshold (so, with parameters default values, between 45.00 Hz and 46.25 Hz).
- Downwards the high frequency threshold (so, with parameters default values, between 53.75 Hz and 55.00 Hz).

Considering these values, we can detect the following bands:




If the frequency is in the B or D bands, the controller maintains its previous status (hysteresis). For example, if the voltage was in C band and now it is in D band, it is considered “in tolerance” anyway. If instead, the frequency was in A band and now it is in B band, it is considered “off”.

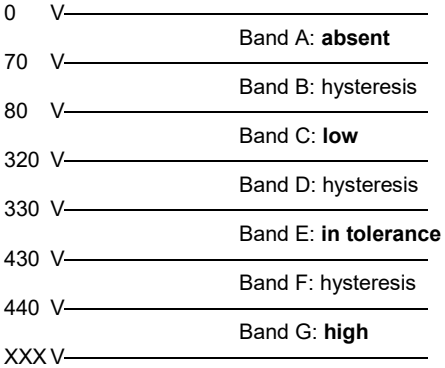
##### 7.4.1.2.2 Voltages check

| Parameter | Description | Default value | Voltage (Vac) |
|---|---|---|---|
| P.0119 | Number of phases | 3 | - |
| P.0116 | Nominal voltage | 400 Vac | 400 |
| P.9505 | Presence threshold | 17.5 % | 70 |
| P.0203 | Low voltage threshold | 80.0 % | 320 |
| P.0204 | High voltage threshold | 110.0 % | 440 |
| P.0201 | Maximum hysteresis | 2.5 % | 10 |

The hysteresis is applied:

- Upwards the mains presence threshold (so, with parameters default values, between 70 Vac and 80 Vac).
- Upwards the low voltage threshold (so, with parameters default values, between 320 Vac and 330 Vac).
- Upwards the high voltage threshold (so, with parameters default values, between 430 Vac and 440 Vac).

Considering these values, we can detect the following bands:




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

Such statuses are managed for each phase.

For three-phases system, the previous tests are performed on the phase-phase voltages. If enabled with P.0244 (<> 0) the same tests are performed on the phase-neutral voltages also.

#### 7.4.1.2.3 Asymmetry check

| Parameter | Description | Default value | Voltage (Volt) |
|---|---|---|---|
| P.0116 | Nominal voltage | 400 Vac | 400 |
| P.0238 | Voltage unbalance threshold | 10.0 % | 40 |

On three-phase systems, it is possible to consider the mains "out of tolerance" if the three phase-to-phase voltages differs from each other (in absolute value) more than the threshold set. The check is disabled for single-phase systems.

Note: MC200 does not carry out any check on the phase angles, but only on the phase-to-phase voltages.

This threshold does not use any hysteresis. With the parameters default values, if the difference between two phase-to-phase voltages in absolute value is higher than 40 Vac, the mains is considered out of tolerance; otherwise, it is considered in tolerance.

#### 7.4.1.2.4 Cycling sense

| Parameter | Description | Default value |
|---|---|---|
| P.0239 | Required phase sequence | 0-Nothing |

In three-phase systems, it is possible to consider the mains "out of tolerance" if the phases cycling sense is different from what specified in the parameter P.0239. In single-phase system, this control is disabled.

To disable this control, simply set the parameter P.0239 to "0-None".

With the parameter P.0239, it is possible to select the cycling sense required by the mains: “1-Clockwise” or “2-Counter-clockwise” The mains is considered “out of tolerance” if the cycling sense is different from the one set.

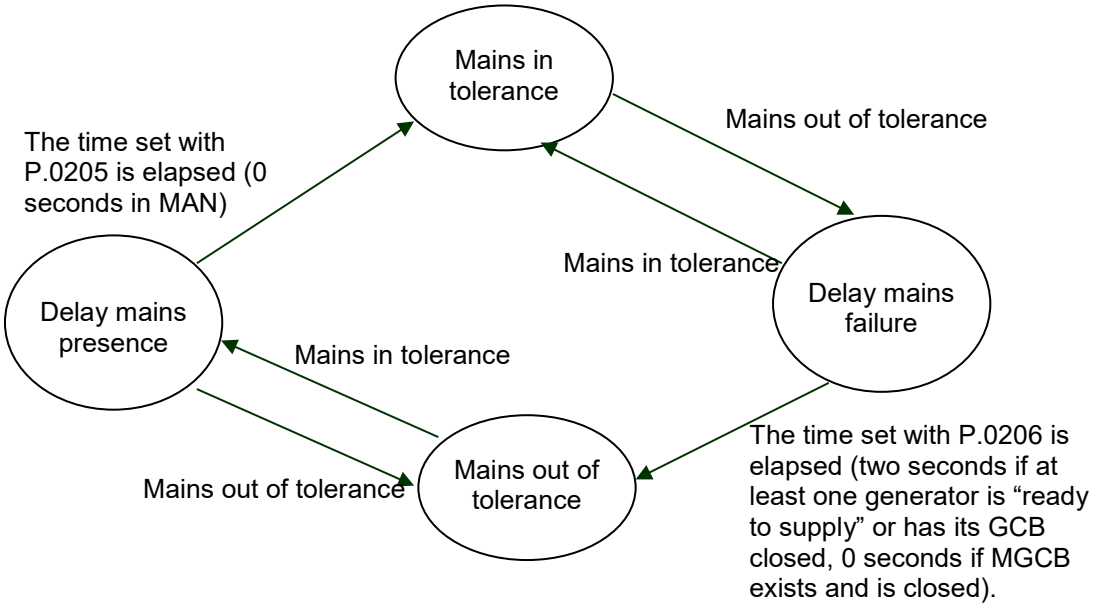
#### 7.4.1.2.5 Internal sensor status

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

- If **frequency and all voltages** are in the “Off” status, the general status is “Off” too.
- If **frequency and all voltages** are in the “In tolerance” status, the general status is “In tolerance” too. In this case, if the cycling sense or unbalance checks don’t give positive results, the mains is considered “Low”.
- If **frequency or at least one voltage** is in the “High” status, the general status is “High” too.
- If no one of the previous conditions is verified, the global status is “Low”.

### 7.4.1.3 Mains general status

Whatever method is used to acquire the instantaneous status of the mains (internal or external sensor), for the operating logics of the plant the general status of the mains is described in four phases:




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

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

- At least one generator supplying the loads: the duration of the “mains presence delay” is set by parameter P.0205.
- No generator supplying the loads and bit 1 of P.0250 is “1”: the duration of the “mains presence delay” is set by parameter P.0205.
- No generator supplying the loads and bit 1 of P.0250 is “0”: the duration of the “mains presence delay” is 0 seconds.

#### 7.4.1.4 Events

The controller records the following events if the mains status changes (if enabled with bit 1 in P.0441):

- EVT.1010: the new mains status is permanently “off or out of tolerance”.
- EVT.1011: the new mains status is “present or in tolerance”.
- EVT.1012: the new mains status is permanently “in tolerance”.

#### 7.4.1.5 Signals

The following functions for the configuration of the digital outputs are connected to the mains status:

- DOF.3033 (“Mains in tolerance)”): the output is activated if the mains is permanently in tolerance, or during the delay for the “mains out of tolerance”.

### 7.4.2 “Loss of mains” protection

This function must detect an anomaly on the mains voltage while the gensets are in parallel with the mains (or while another mains transformer is in parallel with this one), in order to disconnect the transformer from other active sources.

It is possible to use the internal sensor of the controller or an external protection.

See document [8] for the description of these protections.

From version 1.14, the controller manages simultaneous parallel with multiple mains transfromers. It can therefore happen that two mains transformers are in parallel through their respective MCB circuit breakers (and MGCB if they exist). Under these conditions, each MC controller manages the “loss of mains” protection on its own mains transformer. If, for any reason, following a mains failure, an MC controller fails to isolate its own mains transformer from the common bars, the other MC controllers connected to the same bars will open their own circuit breaker, to isolate themselves from the disconnected mains transformer: each MC will open the MGCB circuit breaker if it exists, otherwise it will open the MCB circuit breaker. Events EVT_1106 and EVT_1166 report this condition in the historical archive.

## 7.5 Synchronization

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

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

The controller can handle both functions, but, if needed, allows one or both to be managed externally.

### 7.5.1 Synchro-check

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

The controller performs these checks if:

- It directly manages frequency and phase regulations.
- Frequency and phase regulations are managed externally, but the parameter P.0846 forces MC200 to manage the synchro-check.

In these cases, the circuit breaker closure command (MCB o MGCB) is issued only when the “synchronized” status is detected.

The controller does not perform these checks if frequency and phase regulations are managed externally, and parameter P.0846 configures the controller not to manage the synchro-check. In this case, the circuit breaker closing command is immediately issued, as MC200 supposes that an external synchro-check inhibits the physical closing of the circuit breaker if not synchronized.

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

Parameter P.0846 allows forcing the use of the MC200 synchro-check with externally managed frequency and phase regulations (its value is ignored if the controller manages the regulation processes). It allows to force the MC200 synchro-check of the circuit breakers (MCB or MGCB) individually or together (if preferred). By default, MC200 synchro-check is always forced by the parameter P.0846.

If the internal synchro-check is forced, but the controller cannot perform it, the warning W273 (incoherent parameter) is issued.

MC200 performs six different checks before allowing the circuit breaker closure: only when all checks are correct, the circuit breaker will be closed.

**Voltages in tolerance check**

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

- P.0301: minimum voltages threshold (%).
- P.0303: maximum voltages threshold (%).

These thresholds are displayed in percentage. These thresholds are percentage of P.0116 for mains voltages, and of P.0102 for genset voltages).

Each voltage measure is compared with these thresholds: if at least one of them is out of thresholds, the circuit breaker cannot be closed (this situation is shown on display page M.12 by an empty rectangle).

**Voltage differences check**

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

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

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

The result of this check (and of the one described above) is displayed in page M.12 by the rectangle that indicates the voltage difference:

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

**Frequency in tolerance check**

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

- P.0305: minimum frequency threshold (%).
- P.0307: maximum frequency threshold (%).

These thresholds are percentage of P.0105.

Mains and generators frequency are compared with these thresholds: if at least one of them is out of thresholds, the circuit breaker cannot be closed (this situation is shown on display page M.12 by an empty rectangle).

**Frequency difference check**

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

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

The frequency status (the results of this check and of the previous one) is shown on the display page M.12, by the second small rectangle from the left (the one identified by the “Hz” label):

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

**Phase difference check**

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

The result of this check is shown on the display page M.12, by the third small rectangle from the left (the one identified by the “°” label):

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

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

**Phases sequence check.**

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

The result of this check is shown on the display page M.12, by the fourth small rectangle from the left (the one identified by two arrows):

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

**Circuit breaker closing enabled.**

MC200 detects a “synchronized” status only when all previous checks (or all the ones applicable) give correct results, consecutively for the time configured by parameter P.0844. When MC200 removes its consent, it does not reactive it for at least one second.

The “closure enable” condition is shown on the display page M.12, by the fifth small rectangle from the left (the one identified by two arrows):

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

**Protection against incorrect wiring.**

To protect itself from possible wiring errors, to activate the enable to closing of the circuit breaker, the controller first wants to see a "non-synchronism" condition followed by a "synchronism" condition. If, at the instant in which the synchronism check is requested, all the controls give an immediate positive result, the controller will automatically provide for a possible decrease in frequency on the generators to force the exit from the "synchronism" condition, and then resume with the adjustment and return to the "synchronism" situation.

This safety check can be deactivated with bit 5 and parameter P.0807.

The control is automatically deactivated if the public mains is connected on both sides of the circuit breaker to be closed (because obviously there is no way to change the phase).

#### 7.5.1.1 Signals

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

### 7.5.2 Voltages, frequency and phase regulations

To synchronize generators with mains, it is needed to work on:

- On generator voltages, to make them equal to mains: this avoids current circulation (reactive) when the circuit breaker will be closed. Normally, the gensets voltages should be a little bit higher than mains voltages, to supply (little) reactive power from gensets while closing.
- On generators frequency, to minimize differences on phase and frequency from mains.

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

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

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

It is not mandatory using MC200 for this function: if preferred (or if it is needed because, for example, mains voltages are not acquired by MC200), an external analogue synchronizer can be used (GAC or other).

#### 7.5.2.1 Using external synchronizer

Analogue synchronizers act on generator frequency by a command signal. It is possible to connect this signal directly to an analogue input of all genset controllers. Alternatively, (suggested option), it is possible to connect this signal to an analogue input of the controller, which will transfer it via CAN bus to the genset controllers.

Each synchronizer has its own signal type. MC200 can interact only with signals in direct voltages 0-10 Vdc. Some synchronizers have different command signals:

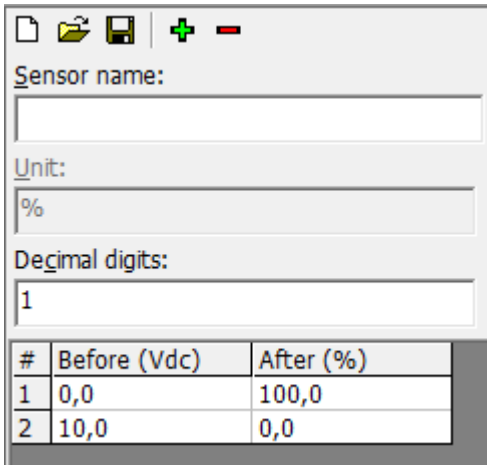
- Current signals (4-20 mA, +/-10 mA). It is simple to convert these signals in Volts DC applying a resistor on them.
- PWM. Not managed by MC200.
- Up/Down. These synchronizers use two digital outputs to request an increase or a decrease of speed. They can be managed using PLC function, with the DIPOT block that converts up/down commands into a virtual analogue input.

Within the 0-10 Vdc range, MC200 is fully configurable: for example, MC200 can acquire a 3 to 6 Vdc signal and convert it to -4 to +4 Hz change on gensets. MC200 can be also configured to decrease generators frequency when the synchronizer signal increases (and vice-versa).

To use an external synchronizer, an analogue input of MC200 must be correctly configured. For example, let's suppose to use a GAC synchronizer and connect it to the analogue input 1 (see paragraph [1] for parameters related to analogue inputs):

- P.4001 - “Function of analogue input 1”. This parameter allows selecting the analogue input function. For external synchronizers, three functions are available:
    - AIF.2105: if the external synchronizer should be used for the MCB closing only (MGCB synchronization is managed by MC200).
    - AIF.2107: if the external synchronizer should be used for MGCB closing only (MCB synchronization is managed by MC200).
    - AIF.2103: if the external synchronizer should be used for the closing of both MCB and MGCB circuit breakers.
- P.1842 - “Analogue input 1 minimum value”. GAC synchronizer works between 0 and 10 V, so this parameter must be set to 0%.
- P.1843 - “Analogue input 1 maximum value”. GAC synchronizer works between 0 and 10 V, so this parameter must be set to 100%.

In this way, we configured the input. Now, we must configure the conversion of the measurement from Vdc to Hz. The speed regulation command over CAN bus is a percentage value: 0% corresponds to 4 Hz less then nominal frequency, 100% corresponds to 4 Hz over nominal frequency (so 50% corresponds to nominal frequency). So, it is necessary to convert the signal 0-10 Vdc in a percentage value. GAC synchronizer decreases its command signal to speed-up generators. So, the following conversion curve must be linked to the analogue input 1:




In the previous example, the GAC synchronizer can change generators frequency of +/- 4 Hz. If in the previous table we replace the 100% with 75% and the 0% with 25%, the maximum change of frequency should be +/- 2 Hz. By setting the curve in an asymmetric way, it is possible to compensate electrical offsets (GAC should give a 5 Vdc signal to request the nominal frequency, it may be 5.1 or 4.9).

During the synchronization phase, the controller will change the gensets frequency as required by the external synchronizer.

Note: now, there is no support for the genset voltage regulation by an external synchronizer. This function, if it is enabled, is always managed by MC200.

Note: it is possible to use two different external synchronizers for MCB and MGCB, by wiring them to two different analogue inputs configured with codes DIF.2105 and DIF.2107. For each input is possible to set a specific conversion curve.

#### 7.5.2.2 Using internal synchronizer

**Phase/Frequency regulation**

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

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

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

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

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

**Voltage regulation**

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

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

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

#### 7.5.2.2.1 PI regulator

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

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

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

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

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

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

The PI regulator parameters can be modified even if the plant is working, by the user panel. It is suggested to carry out the modifications by using the BoardPrg3 program, which is available for free on our SICES website.

##### 7.5.2.2.1.1 Complete method

1) Set “P” at an initial value (0,100) and “I” at 0,000.
2) Increase “P” until the adjusted measurement start to oscillate (for example, if you are adjusting the PI that manages the speed during the synchronization, increase “P” until it seems to hear that the engines accelerate / slow down). Decrease/increase the value “P” until an oscillation point is determined (a good estimate is sufficient).

3) Measure the oscillation period (the time between two consecutive peaks of speed).

4) Set “P” at a slight lower value than the one resulted by the division of the current value by 2.2.

5) Set “I” at the value calculated by dividing 1.2 for the period of oscillation measured before (in seconds). A lower value can be set at a lower value, decreasing its performance but increasing the stability range.

6) Further adjustments could be necessary. Check how the system reacts in case of low, medium or high load. In case there still is a system instability, reduce the “P” value again.

#### 7.5.2.2.1.2 Simplified method

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

#### 7.5.2.2.1.3 General notes

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

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

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

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

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

### 7.5.3 Digital inputs for synchronization

MC200 allows configuring digital inputs with two special functions related to synchronization:

- DIF.1034 (“Synchronization request for MCB”).
- DIF.1004 (“Synchronization request for MGCB”).

These inputs must be used when the related circuit breaker is not managed by MC200, but you want to use PI regulators of MC200 for synchronization. When the input is “active” (logical state), if all necessary conditions for synchronization are present, MC200 starts the synchronization process and signals it to external devices using up to four digital outputs (see next paragraph).

### 7.5.4 Digital outputs for synchronization

MC200 allows configuring digital outputs with the following special functions related to synchronization:

- DOF.3091 (“Synchronization for MGCB”). It is used when MGCB is managed by MC200 but an external synchronizer must be used. When MC200 starts synchronization process, this output become “active” and can be used to supply/enable the external synchronizer. When synchronization ends, the output become “not active”.
- DOF.3092 (“Synchronization for MCB”). It is used when MCB is managed by MC200 but an external synchronizer must be used. When MC200 starts synchronization process, this output become “active” and can be used to supply/enable the external synchronizer. When synchronization ends, the output become “not active”.
- DOF.3093 (“Synchronization in progress”). It is used when MCB/MGCB is managed by MC200 but an external synchronizer must be used. When MC200 starts synchronization process, this output become “active” and can be used to supply/enable the external synchronizer. When synchronization ends, the output become “not active”.
- DOF.3094 (“Synchronized”). This output can be used in case the synchro-check of the controller is used for a circuit breaker closing (MCB or MGCB), which is commanded by an external logic. This output can be “active” only during synchronization process, when MC200 detects the “synchronized” status between mains and generators. Outside synchronization process, or when generators are not synchronized with mains, this output is “not active”. This output should be wired to the external logic that physically closes the circuit breaker (be aware that the output become “not active” after circuit breaker has been closed).
- DOF.0103 (AND/OR logics) with the status:
    - ST.097: synchronization in progress for **MCB** closure.
    - ST.098: synchronization in progress for **MGCB** closure.
    - ST.099: synchronized status detected.

### 7.5.5 Automatic synchronization

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

If the internal synchronizer is used, the controller regulates voltage and frequency to get the “synchronized” status: if the “synchronized” status persists for 10 seconds and the circuit breaker doesn’t close, MC200 changes generators frequency to force a “not synchronized” status, then starts to synchronize again. This avoids problems when using external synchro-checks in addition to the MC200 one: it is possible that some external synchro-checks don’t allow the closure because they haven’t detected any “unsynchronized” status before.

MC200 allows configuring the maximum duration of synchronizations for the two circuit breakers:

- P.0852: MGCB synchronization maximum time.
- P.0853: MCB synchronization maximum time.

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

- W272 – “MCB synchronization failure”. It is always a warning. The controller can decide to close MCB without synchronization (opening MGCB or GCB), depending on the type of plant and on the configuration (P.9515).
- X271 – “MGCB synchronization failure”. If MGCB is directly managed from MC200, it is an alarm, otherwise it is a warning.

### 7.5.6 Manual synchronisation

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

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

MC200 provides two parameters that allow voltages and frequency regulations on the generators:

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

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

These parameters can be directly changed on display page M.12 (provided for synchronization). It is possible to simplify the procedure using two potentiometers instead of the parameters. The following is needed:

**Voltage**

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

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

**Frequency.**

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

After these configurations, you can change the speed offset between 0 and 100% by moving the potentiometer between 0 and 10 Vdc (the current speed offset is shown on page M.12), and consequently you can change the gensets frequency. Note: once you have configured an analogue input with the function AIF.2101, the parameter P.0840 is no more used.

Manual synchronization procedure is:

- Start the gensets (by pressing the START button on the panel).
- Select the page M.12 on the display (this can be carried out also by giving a manual closing command of the circuit breaker – MCB/MGCB pushbutton or digital inputs configured for MCB/MGCB).
- Use parameters P.0868 and P.0840 (or the related potentiometer, if configured) to synchronize the gensets to the mains. When MC200 signals a synchronism status, send a new closing command (pushbutton or related digital input): the circuit breaker will be closed.

### 7.5.7 MCB synchronization failure

Parameter P.9515 configures the actions of the controller in case of failure of the synchronization for the MCB circuit breaker closing.

- “0 – No blackout”. By setting this value, you configure the controller to avoid any blackout on the loads (in AUTO modes). After having activated the warning of MCB synchronization failure (W272), the controller keeps the loads connected to the gensets. When the operator will acknowledge the warning, MC200 will try again to close MCB through the synchronization.
- “1 – Short blackout”. By setting this value, you allow a short blackout on the loads when the mains is back. Basically, after having activated the warning of MCB synchronization failure (W272), the controller opens the MGCB circuit breaker (or it forces the opening of the GCB circuit breakers) to be able to close MCB without synchronization. Once MCB is closed, if the gensets intervention is still required, MC200 will try to close MGCB with synchronization (or it will allow again the GCB closing - with synchronization).

## 7.6 Inhibition to genset automatic intervention

In automatic mode, MC200 determines, based on the type of system and the current conditions, whether to start the generators. In these conditions, it is possible to force the stopping of the generators by using the "inhibition to automatic intervention" function.

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

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

The “INHIBIT” lock symbol (🔒) is shown on the up-right corner of the display, when an inhibition is active.

### 7.6.1 Inhibition from contact

The controller can use a digital input programmed for inhibiting the gen-sets automatic operation (function DIF.2501 – “Inhibition of start”). In case of an “active” input, the generators are never automatically started, not even if the plants condition requires it.

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

Use parameter P.0208 to set a delay between input's physical de-activation and this function's logic de-activation: in case at least one generator is already running, the delay is two seconds (fixed); in case at least one GCB is closed, the delay is null.

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

The board records any status variation of this inhibition to start in the event log (if enabled with bit 6 of P.0441 parameter):

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

#### 7.6.1.1 Differences between “External sensor for mains” and “Inhibition of start”

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

### 7.6.2 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 interval during which the generators are enabled to work. Outside this time interval (and during not-selected days), the “inhibition to automatic intervention” function of the generators is active (and then the generators will be stopped).

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

The board records any status variation of this inhibition to start in the event log (if enabled with bit 6 of P.0441 parameter):

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

### 7.6.3 Inhibition to load management

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

### 7.6.4 Inhibition due to mains failure

In systems where the generators work only in parallel with the mains, should the mains fail, the controller would force the opening of the MGCB circuit breaker and, after a configurable waiting time (P.0899), it would activate the “inhibition to automatic intervention” to stop the generators until the mains is again "within tolerance".

The controller records every variation of this specific inhibition:

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

### 7.6.5 Inhibition due to “GCB circuit breaker not open”

In systems where more generators work in parallel, a generator's GCB circuit breaker might not open when the generator must be stopped. 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 inhibit the closure of MGCB (P.0805), and to force its opening in case it is already closed: the generators are stopped (by means of the “inhibition to automatic intervention”) waiting until the problem is solved.

The controller records every variation of this specific inhibition:

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

### 7.6.6 Signalling

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

- ST.080: from contact.
- ST.081: from clock/calendar.
- ST.083: it’s not possible to work in island mode and mains failure.
- ST.084: for GCB circuit breaker not open.

## 7.7 Inhibition to supply the loads

In automatic mode, once the generators have been started, the controller normally tries to close the MGCB circuit breaker (if it exists). In these conditions, it is possible to force the opening of the MGCB by using the “inhibition to supply the loads” function. Note: if the MGCB circuit breaker is not present in the plant, these inhibitions will act on the GCBs of the generators.

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

If the "inhibition to supply the loads" is activated when MGCB is already closed, the controller tries to open it, by carrying out generators 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 supply the loads" is deactivated:

- EVT.1081: inhibition deactivated

### 7.7.1 Inhibition from contact

It is possible to configure a digital input through DIF.2502 function (“inhibition to supply loads”). When this input is active, the inhibition to supply the loads is active.

The controller records an event when this inhibition is activated:

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

### 7.7.2 Modbus commands

These commands can be enabled by a digital input configured with function DIF.2706 ("Enables serial ports commands": if this input exists, it should be active. The commands can be protected with a password (P.0004) which must be entered before any command. To send the command it is necessary to write in sequence (within 5 seconds):

- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102:
  - “31” or “32” inhibition to supply the loads (it forces MGCB open).
  - “33” to deactivate the inhibition to the automatic supply.

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

The controller records an event when this inhibition is activated:

- EVT.1202: inhibition activated.

### 7.7.3 Due to mains failure

In systems where the generators work only in parallel with the mains, (see [8]), if the mains fail, the controller will force the immediate opening of the MGCB circuit breaker, and will activate the “inhibition to supply the loads” to avoid its closure. The inhibition will be cancelled when the mains is "within tolerance" again.

The controller records an event when this inhibition is activated:

- EVT.1201: inhibition activated

### 7.7.4 Inhibition due to “GCB circuit breaker not open”

In systems where more generators work in parallel, a generator's GCB circuit breaker might not open when the generator must be stopped. 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 inhibit the closure of MGCB (P.0805), and to force its opening in case it is already closed: the controller activates the “inhibition to supply the loads” to impede the closure (or force the opening) of MGCB.

The controller records an event when this inhibition is activated:

- EVT.1203: inhibition activated

### 7.7.5 Inhibition for “synchronization on MCB in progress”

In a system composed of more than one generator, that can supply both in island mode and in parallel with the mains (MSB + MSTP or MPtM + MSB), some external logics (among which another MC200) can act on generators voltage and frequency to synchronize the generators bus to the mains, to close the MCB or MGCB circuit breakers. At this stage, the controller activates the “inhibition to supply the loads” if its own MGCB is open: in this way, it avoids its closure, in order not to disturb the ongoing synchronization.

The controller records an event when this inhibition is activated:

- EVT.1204: inhibition activated

### 7.7.6 Inhibition for MCB synchronization failure

If the parameter P.9515 allows a short blackout on the loads in case of MCB synchronization failure, the controller must open MGCB to close MCB without synchronization: to force the opening of MGCB, it uses an “inhibition to supply the loads”.

### 7.7.7 Inhibition for “no supplying generators”

If parameter P.9503 configures the MGCB circuit breaker as “powered by the generators”, if there are no voltages un the generators bus and there are no GCB closed (detected by the CAN bus), the controller must open MGCB: to force its opening, it uses an “inhibition to supply the loads”.

### 7.7.8 Inhibition for “TEST without load”

If the controller is in TEST mode, and the “TEST without load” has been selected, the controller must open MGCB: to force its opening, it uses an “inhibition to supply the loads”.

### 7.7.9 Signalling

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

- ST.088: from contact.
- ST.089: it’s not possible to work in island mode and mains failure.
- ST.090: for commands from the serial port.
- ST.091: for GCB not opened.
- ST.092: for MCB synchronization failure.
- ST.093: for “no supplying generators”.
- ST.094: for “TEST without load”.

## 7.8 Power measurements

The controller has four channels for the measurement of the currents (three main channels and one auxiliary). The operator can specify the electrical lines they are connected to:

- P.0124: it selects the electrical lines to which the three main channels are connected.
- P.0130: it selects the electrical line to which the auxiliary channel is connected.

Both parameters support the following values:

- 0: on the electrical lines of the generators (MGCB).
- 1: on the electrical lines of the loads.
- 2: on the electrical lines of the mains (MCB).

The controller can perform power measurements, using all four channels. For the auxiliary channel, the controller assumes that it is connected to the line L1 of the source selected by the parameter P.0130; if such source is three-phases, the controller multiplies the calculated powers by 3, assuming the loads are correctly shared among the electrical lines. If it is not, the operator can correct the calculations using parameter P.0132:

total kW = L1 kW * 3 * P.0132.

Depending on what configured by means parameters P.0124 and P.0130, the controller assigns the calculated powers to the mains, to the loads or to the generators (MGCB).

### 7.8.1 Power measurements on the generators

The controller calculates (from the data received through the CAN bus link) the total active and reactive powers supplied by the generators. Then, it calculates the power factor and the load type from these powers. This information is shown on page M.01 under the icon of the GCB circuit breaker (if closed).

### 7.8.2 Power measurements on the mains

The controller can acquire the active power measurement of the mains in different ways, evaluated in that order:

a) From an analogue input configured with the function AIF.2303 (“Power on the mains”).

b) By the three main current measurement channels, if P.0124 is set to 2.

c) By the auxiliary current measurement channel, if P.0130 is set to 2.

It is possible to use a digital input configured with the function DIF.2716 (“Enables the acquisition of the mains kW from analogue input”). If this input exists and is active, the mains power on the connection point is acquired with method a). If it exists and is not active, the power is measured by methods b) or c).

The controller can acquire the reactive power measurement of the mains in different ways, evaluated in that order:

- By the three main current measurement channels, if P.0124 is set to 2.
- By the auxiliary current measurement channel, if P.0130 is set to 2.

The controller can acquire the power factor and the load type measurement of the mains in different ways, evaluated in that order:

- Measured by the controller using the three main current measurement channels, if P.0124 is set to 2.

- Calculates from the active and reactive power on the mains (if both available).

This information is shown on page M.01 under the icon of the MCB circuit breaker (if closed).

### 7.8.3 Power measurements on MGCB

The controller can acquire the active and reactive power measurements on the MGCB in different ways, evaluated in that order:

- By the three main current measurement channels, if P.0124 is set to 0. In this case, the controller also measures the power factor and the load type.
- By the auxiliary current measurement channel, if P.0130 is set to 2. In this case the controller calculates the power factor and the load type from the active and reactive power on the MGCB (if both available).

This information is shown on page M.01 under the icon of the MGCB circuit breaker (if closed).

### 7.8.4 Power measurements on the loads

The controller can acquire the active and reactive power measurements on the loads in different ways, evaluated in that order:

- By the three main current measurement channels, if P.0124 is set to 1. In this case, the controller also measures the power factor and the load type.
- By the auxiliary current measurement channel, if P.0130 is set to 1. In this case the controller calculates the power factor and the load type from the active and reactive power on the MGCB (if both available).

This information is shown on page M.01 near the icon of the loads.

### 7.8.5 Calculated powers

The controller can so manage up to four power measurements (mains, loads, MGCB and generators) but it can measure only two of them (one more is calculated from the data received from the CAN bus link). So, the fourth one must be calculated from the others.

If the controller cannot acquire the powers on the MGCB, it can “copy” them from the powers supplied by the generators, if MGCB is closed and no other MCxxx controller has its own MGCB closed (thus, all the power supplied by the generators is flowing through this MGCB).

If the controller cannot acquire the powers on the loads, it can get them in the following ways:

- If MCB is opened and MGCB is closed: the powers on the loads is the same as the power on the MGCB.
- If MCB is closed and MGCB is opened: the powers on the loads is the same as the power on the mains.
- If MCB is closed and MGCB is closed: if the powers on the mains and on the MGCB are both available, the controller can calculate the power on the loads as their sum. It can then calculate the power factor and the load type from the calculated active and reactive power.

## 7.9 Circuit breakers management

The controller can manage both MCB and MGCB circuit breakers. Anyway, it accepts that these circuit breakers could be controlled by external logics (steadily or temporarily).

MGCB circuit breaker is optional for all kinds of plant:

- If it exists, the related lamp shows its status.
- If it does not exist, the controller considers it existent, externally managed and always closed. In this case, the related lamp is always switched on.

MCB circuit breaker is never optional.

- For “island” only plants (“MPM”) it is not managed. The related lamp is always switched off.
- For all other plant types, MCB always exists, and the related lamp shows its status. If it is configured as not existing, the controller signals a wrong configuration by the warning 237 and it considers it existent, externally managed and always opened. In this case, the related lamp is always switched off.

Both circuit breakers can be managed by the controller or by external devices. If they are managed by external devices, their statuses must be connected to MC200 (otherwise, it will signal again a wrong configuration by the warning 273).

Through the P.0854 parameter it is possible to configure the way MC200 must manage the MGCB circuit breaker:

- 0: not managed.
- 0: the circuit breaker is managed by the controller, that cannot use synchronization to close it.
- 1: the circuit breaker is managed by the controller, that can use synchronization to close it
- 2: the circuit breaker is controlled by an external device, and the controller cannot use synchronization to close it.
- 3: the circuit breaker is controlled by an external device, and the controller can use synchronization to close it.

At the same way, through P.0855 parameter, it is possible to configure the way the controller must manage MCB circuit breaker (see previous description).

### 7.9.1 Digital outputs

#### 7.9.1.1 Circuit breakers commands

Four different commands can be used for the management of the **MCB** breakers:

- DOF.2001 - “Minimum voltage coil for MCB (NC)”. This function can be used to supply the minimum voltage coil (if any) of the circuit breaker. The controller enables this output when it wants to open the breaker, and disables it when it wants to close the breaker: the real closing command will be activated with at least 0.5 seconds after the disabling of this output. A contact which is **normally closed** should therefore be used, so that when the controller is not supplied, the minimum voltage coil is enabled and the breaker can be closed. If the breaker should open without any explicit command from the controller (for example for the trip of its protections), it is possible to configure a delay between the breaker opening and the activation of this command (P.0246, for default set to zero): this function is useful for some small size breakers to acquire the

TRIP contact (which resets immediately as soon as the breaker is commanded in opening).

- DOF.2002 - "Coil for opening of MCB". The controller enables this output when it wants to open the circuit breaker: the output goes back in standby once the circuit breaker feedback indicates that it is open (or when the opening time-out expires).
- DOF.2003 - "Coil for closing MCB". The controller enables this output when it wants to close the circuit breaker (ensuring that the function DOF.2001 has been active for at least 0.5 seconds): the output goes back in standby once the circuit breaker indicates that it is closed (or when the closing time-out expires, or the synchronism condition no longer exists).
- DOF.2004 - "Stable opening command for MCB". The controller activates this output when it wants to open the circuit breaker: the output remains activated even with the circuit breaker is opened. The controller disables this output when it wants to close the breaker (by assuring that the possible DOF.2001 function is active for at least 0.5 seconds): the output remains disabled even when the circuit breaker is closed. Therefore, for the MCB breaker to close with the controller unpowered, the **normally closed** contact must be used. Use this function with contactors, not with the motorized breakers.

Four different commands can be used for the management of the **MGCB** breakers:

- DOF.2031 - "Minimum voltage coil for MGCB". This function can be used to supply the minimum voltage coil (if any) of the circuit breaker. The controller enables this output when it wants to close the breaker, and disables it when it wants to open the breaker: the real closing command will be activated with at least 0.5 seconds after the enabling of this output. If the breaker should open without any explicit command from the controller (for example for the trip of its protections), it is possible to configure a delay between the breaker opening and the activation of this command (P.0247, for default set to zero): this function is useful for some small size breakers to acquire the TRIP contact (which resets immediately as soon as the breaker is commanded in opening).
- DOF.2032 - "Coil for opening of MGCB". The controller enables this output when it wants to open the circuit breaker: the output goes back in standby once the circuit breaker feedback indicates that it is open (or when the opening time-out expires).
- DOF.2033 - "Coil for closing MGCB". The controller enables this output when it wants to close the circuit breaker (ensuring that the function DOF.2031 has been active for at least 0.5 seconds): the output goes back in standby once the circuit breaker indicates that it is closed (or when the closing time-out expires, or the synchronism condition no longer exists).
- DOF.2034 - "Stable closing command for MGCB". The controller activates this output when it wants to close the circuit breaker (by assuring that the possible DOF.2031 function is active for at least 0.5 seconds): the output remains activated even with the circuit breaker is closed. The controller disables this output when it wants to open the breaker: the output remains disabled even when the circuit breaker is opened. Use this function with contactors, not with the motorized breakers.

Of course, it is not necessary to use all possible commands for the circuit breakers. It is important that the controller, if it must command the circuit breaker, manages both the opening and the closing command. The possibilities are:

- Only the stable command.

- The stable command and the minimum voltage coil.
- The closure command and the minimum voltage coil.
- The closure command and the opening command.
- The closure command, the opening command and the minimum voltage coil.

It is possible to use different commands for the two circuit breakers.

The following table shows the statuses of all commands, during each phases of the circuit breaker management. It is referred to MGCB circuit breaker: remember that “minimum voltage coil” and “static command” works in the opposite way for MCB circuit breaker.

| Circuit breaker | Minimum voltage coil | Opening coil | Closing coil | Stable command |
|---|---|---|---|---|
| Opened | | | | |
| Closing | X | | X | X |
| Closed | X | | | X |
| Opening | | X | | |

As in the previous table, the controller activates different commands when the circuit breaker is “open” or “closed”. If the circuit breaker status changes, the controller should change some of its commands to follow the new status. This is dangerous because the circuit breaker status is acquired by a digital input, and so possible problems could bring to faulty statuses:

- If circuit breaker status changes from “closed” to “opened”, the controller can follow the new status without big problems. In fact, even if the “opened” status is a “wrong” information (due to disturbs, broken wires and so on), the only problem is an unnecessary opening of the circuit breaker: in AUTO mode, the controller will re-close the circuit breaker if required by plant status. In this case, the controller does not activate anomalies.
- If the controller detects the closed status of the circuit breaker while it is open, the actions depend on the fact that there is an output for “stable command”.
    - **“Stable command” not used.** To adjust the commands, the controller would only have to activate the “minimum voltage coil”. This operation alone does not generate the circuit breaker closing, so it can be carried out without problems. In this case, the controller does not activate anomalies.
    - **“Stable command” used.** To adjust the commands, the controller would have to activate the “stable command”. This operation generates the circuit breaker closing (without any control), so it cannot be carried out. In this case, the controller activates an anomaly.

#### 7.9.1.1.1 Minimum delays between commands

The controller grants that the following delays between commands are respected:

- Half second between minimum voltage coil and any closure commands.
- The delay configured by parameter P.0220 (“Contactors holding time”) between an opening command and the next closure command (if set to zero 0.5 seconds are used).
- The delay configured by parameter P.0220 (“Contactors holding time”) between a closure command and the next opening command (if set to zero 0.2 seconds are used).

- The delay configured by parameter P.0219 (“Contactors swap delay”) between the opening command of one circuit breaker and the closure command of the other circuit breaker.

Moreover, opening and closure commands are never set together.

#### 7.9.1.2 External consents

Two functions are provided, related to the **MCB** circuit breaker management:

- DOF.3081 - “Ready to close MCB”. This function allows an external logic to prevent or to delay the circuit breaker closure. This output is activated before the closing of the circuit breaker only if one input is configured as “MCB closure allowed” (DIF.1035): it is deactivated (and so the circuit breaker will be closed) when that input is active or after the delay configured for the input elapses.
- DOF.3082 - “Ready to open MCB”. This function is used only when the opening of the circuit breaker will result in a blackout on the loads, and allows an external logic to prevent or to delay the circuit breaker opening. This output is activated before the opening of the circuit breaker only if one input is configured as “MCB opening allowed” (DIF.1036): it is deactivated (and so the circuit breaker will be opened) when that input is active or after the delay configured for the input elapses.

Two functions are provided, related to the **MGCB** circuit breaker management:

- DOF.3083 - “Ready to close MGCB”. This function allows an external logic to prevent or to delay the circuit breaker closure. This output is activated before the closing of the circuit breaker only if one input is configured as “MGCB closure allowed” (DIF.1005): it is deactivated (and so the circuit breaker will be closed) when that input is active or after the delay configured for the input elapses.
- DOF.3084 - “Ready to open MGCB”. This function is used only when the opening of the circuit breaker will result in a blackout on the loads, and allows an external logic to prevent or to delay the circuit breaker opening. This output is activated before the opening of the circuit breaker only if one input is configured as “MGCB opening allowed” (DIF.1006): it is deactivated (and so the circuit breaker will be opened) when that input is active or after the delay configured for the input elapses.

#### 7.9.1.3 Request for synchronization

If a circuit breaker is managed by the controller, but an external synchronizer should be used, it is possible to use some digital outputs of the controller to enable the external synchronizer. The following functions are available for the configuration of the digital outputs:

- DOF.3091 - “Synchronization for MGCB”.
- DOF.3092 - “Synchronization for MCB”.
- DOF.3093 - “Synchronization in progress”.

On the contrary, if a circuit breaker is externally managed but the internal synchronizer should be used, the following function can be used to signal the “synchronized” status:

- DOF.3094 - “Synchronized”.

For more details see document [8].

### 7.9.2 Digital inputs

The digital inputs of the controller can be used for various purposes, within the scope of the management of the circuit breakers.

#### 7.9.2.1 Acquiring breakers status

Three functions are available to get the feedback of the circuit breakers:

- DIF.3002 - “Status of MCB circuit breaker”. Use this function to get the feedback of the circuit breaker (active input when the circuit breaker is closed).
- DIF.3003 - “Status of MGCB circuit breaker”. Use this function to get the feedback of the circuit breaker (active input when the circuit breaker is closed).

It isn’t always mandatory to connect the feedback of the circuit breakers to the controller: it depends on the type of plant (see the document [8]). If the controller gets the feedbacks, it will use them to:

- Issuing failed opening or failed closing warnings (MCB and MGCB).
- For its own operating sequence.
- It is also used to detect the status of the circuit breakers when they are commanded by external devices.
- To show the status of the circuit breakers on the front panel LEDs.

The delay associated to the input (P.2002 for input 1 or equivalent parameter for the other inputs) is used as maximum time for opening or closing the breaker.

In theory, for those plants that don’t do the parallel with the mains, the controller might also operate without these feedbacks. In this case, the controller considers that the breaker is closed as soon as the closure command is activated; it considers that it is open as soon as the opening command is activated. As a matter of facts, it is always better to connect the feedback.

Through parameter P.0847 it is possible to define if the MCB breaker is supplied by mains voltage. In this case, with mains off, MCB opens, but the controller does not activate the relative warning of MCB closure failed. In the same way, through parameter P.9503 it is possible to define if the MGCB breaker is supplied by the generators’ bus voltage. In this case, with generators bus off, MGCB opens, but the controller does not activate the relative warning of MGCB closure failed

#### 7.9.2.2 Temporary override of the management of the circuit breakers

It is possible to use some digital inputs to communicate to the controller that the management of one or both circuit breakers is temporarily managed by an external device (even if P.0854 and P.0855 parameters indicate that the circuit breaker is controlled by the controller):

- DIF.1003 - “MGCB controlled externally”.
- DIF.1033 - “MCB controlled externally”.

Until the input is active, the board never tries either to open or close the circuit breaker: but, if the circuit breaker is externally opened/closed, the controller will adapt its own commands to the new status of the circuit breaker, in order not to cause any unwanted opening/closure when the input is deactivated.

#### 7.9.2.3 Manual controls for the circuit breakers

It is possible to connect to the digital inputs of the controller some external buttons to open/close the circuit breakers. The controller will use these inputs (only in MAN) exactly in the same way as the MCB and MGCB buttons present on the panel.

- DIF.1001 - “Request for MGCB closure”.
- DIF.1002 - “Request for MGCB opening”.

- DIF.1031 - “Request for MCB closure”.
- DIF.1032 - “Request for MCB opening”.

#### 7.9.2.4 Request for synchronization

If a circuit breaker isn’t managed by the controller, it will be anyway possible to take advantage of the internal synchronization function (see document [8]). When the external logic wants to close a circuit breaker and synchronization is required, it should ask the controller for the synchronization, by activating a digital input. The following functions are available to configure the digital input:

- DIF.1004 - “Synchronization request for MGCB”.
- DIF.1034 - “Synchronization request for MCB”.

For more details refer to the document [8].

#### 7.9.2.5 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 main is present**.

#### 7.9.2.6 External consents

The controller, before opening/closing the circuit breakers, can accept consents from outside. The following functions are available to configure the digital input:

- DIF.1005 - “MGCB closure allowed”.
- DIF.1006 - “MGCB opening allowed”.
- DIF.1035 - “MCB closure allowed”.
- DIF.1036 - “MCB opening allowed”.

See the description in **Errore. L'origine riferimento non è stata trovata.**.

### 7.9.3 Management logic

#### 7.9.3.1 MCB command logic

The controller always allows the opening of MCB.

The closing of MCB is possible only if all the following conditions are checked:

- MCB is not forced to open as “interface device”.
- Only in AUTO, if MCB is configured as “supplied by mains” (P.0847 = 0).
  - The mains must be live and in tolerance per the AMF thresholds.
  - If the plant requires the parallel with the mains and it is configured as interface device, the mains must be in tolerance per the parallel thresholds.

The parameter P.0248 allows to select the timing for MCB opening, when the controller is in AUTO mode (for the emergency service to the mains):

- P.0248=0.
  - Plant without MGCB: following a mains failure, the controller will open MCB when at least one generator is “ready to supply”.

- Plant with MGCB: following a mains failure, the controller will open MCB just before closing MGCB.

- P.0248=1: following a mains failure, the controller will open MCB as soon as the “mains failure delay” is elapsed.

If the MCB closing is possible, the controller can carry it out in three ways, as described below.

**With synchronization.** This happens if all the following conditions are checked:

- Only in MAN and AUTO.
- If the plant requires the parallel with the mains (P.0802 >= 7).
- If the synchronization on MCB is enabled (P.0855 = 2 or 4).
- If the mains is in tolerance per the parallel thresholds. Note: in MAN, it is enough that the mains is in tolerance; in AUTO, it must be in the time configured in P.0903 or P.0930.
- If there is voltage on the loads’ bus.
- If MGCB exists, it must be closed.
- If there is voltage on the generators’ bus.
- At least a GCB circuit breaker must be closed. Alternatively, another MC controller is connecting the mains to the generator bar.
- If MCB is externally managed (P.0855 = 4), the digital input that requires the synchronization must be active (function DIF.1034).

**Directly without synchronization.** This happens if all the following conditions are checked:

- If it is not possible to close the circuit breaker with the synchronization (see above).
- If MCB is managed by the controller.
- If there is no voltage on the loads’ bus.
- If MGCB does not exist, or if it exists but it is closed:
  - If there is no voltage on the generators’ bus.
  - If there are no gensets with GCB closed.
  - If no other MC controller is connecting the mains to the generators’ bus.

**With changeover (opening MGCB).** This happens if all the following conditions are checked:

- If it is not possible to close the circuit breaker with the synchronization (see above).
- If it is not possible to close the circuit breaker without synchronization (see above).
- If MCB is managed by the controller (P.0855 = 1 or 2).
- If MGCB exists (P.0854 <> 0):
  - MGCB must be managed by the controller (P.0854 = 1 or 2).
- If MGCB does not exist (P.0854 <> 0):

- If P.9506 is set to one, all controllers with GCB closed must be “managed by MCxxx”, so that MC200 can force the opening of GCB.
- There shouldn’t be gensets with GCB closed, managed by controllers that are not connected to CAN bus PMCB.
- The generators (of which you would like to force the opening of the GCB) must not be used by other MC controllers at the moment.

If none of the three ways can be used, MCB cannot be closed.

#### 7.9.3.2 MGCB command logic

The controller always allows the opening of MGCB.

The closing of MGCB is possible only if all the following conditions are checked:

- MGCB is not forced to open as “interface device”.
- Only in AUTO, if MGCB is configured as “supplied by gensets” (P.9503 = 0).
  - There must be voltage on the generators’ bus.
  - At least one GCB must be closed.

If the MGCB closing is possible, the controller can carry it out in three ways, as described below.

**With synchronization.** This happens if all the following conditions are checked:

- Only in MAN and AUTO.
- If the plant requires the parallel with the mains (P.0802 >= 7).
- If the synchronization on MGCB is enabled (P.0854=2 or 4).
- If there is voltage on the loads’ bus.
- If MCB is closed.
- If the mains is in tolerance according to the mains parallel thresholds.
- If there is voltage on the generators’ bus.
- At least a GCB circuit breaker must be closed. Alternatively, another MC controller is connecting the mains to the generator bar.
- If MGCB is externally managed (P.0855 = 4), the digital input that requires the synchronization must be active (function DIF.1004).
- If the warning W271 is not active (“MGCB synchronization failure”).

**Directly without synchronization.** This happens if all the following conditions are checked:

- If it is not possible to close the circuit breaker with the synchronization (see above).
- If MGCB is managed by the controller.
- If there is no voltage on the loads’ bus, or on the generators bus and there are no gensets with GCB closed.
- If MCB is closed:

- If there is no voltage on the loads' bus.
- If there are no gensets with GCB closed.
- If no other MC controller is connecting the mains to the generators' bus.
- If the plant requires the parallel with the mains (otherwise, the controller does not allow the simultaneous closing of MCB and MGCB).
- The protections for the parallel with the mains must not be active.

- If MCB is open:
  - If the plant allows to supply the loads in island mode (P.0802 <> 8).

**With changeover (opening MGCB).** This happens if all the following conditions are checked:

- If it is not possible to close the circuit breaker with the synchronization (see above).
- If it is not possible to close the circuit breaker without synchronization (see above).
- If MGCB is managed by the controller (P.0854 = 1 or 2).
- If MCB is managed by the controller (P.0855 = 1 or 2).
- If the plant allows to supply the loads in island mode (P.0802 <> 8).

If none of the three ways can be used, MGCB cannot be closed.

#### 7.9.3.3 Management logic in OFF/RESET mode

If there is a MGCB circuit breaker managed by the controller, and it is closed, the controller commands its opening.

If there is an MCB circuit breaker managed by the controller, and it is open, in OFF/RESET mode it can be closed without synchronization only: the controller waits for the gensets to be disconnected from the loads and then it commands its closing. To have MCB closed, all the following conditions must be checked:

- There must be no voltage on the bus of both loads and mains; otherwise, it's impossible to close without synchronization.
- If there is a MGCB circuit breaker and it is commanded by the controller, it must be open.
- If there is not a MGCB circuit breaker, or it is closed but it is externally managed, all GCB circuit breakers must be open.

The controller removes the request of start for the gensets: this usually causes the immediate opening of the GCB circuit breakers. This opening may happen after the phase of fast unload of the power if the following condition are met:

- MGCB does not exist, or it is closed (externally managed or in case of opening failure): the load is still connected to the gensets.
- There are some gensets "not managed by MCxxx" with GCB closed, which must stay in parallel.

#### 7.9.3.4 Management logic in MAN mode

The command of all circuit breakers is possible only if there are no active alarms and unloads (otherwise, the controller acts as in OFF/RESET).

If the MCB circuit breaker exists and it is managed by the controller, it is possible to request its manual opening and closing in different ways:

- By using the MCB button on the controller panel. This command works as a toggle: it commands the opening if the circuit breaker is closed, it commands the closing if the circuit breaker is open.
- By using the digital inputs of the controller (to connect external buttons that allow the manual opening/closing of the circuit breakers). It is possible to use the following functions to configure the digital inputs:
    - DIF.1032 - “Request for MCB opening”.
    - DIF.1031 - “Request for MCB closing”.

  These commands act on shifting the input from “not active” to “active”, not on the steady “active” state. It is possible to use both opening/closing commands or just the closing one. If only the closing command is used, it acts as “toggle”: it commands the breaker opening if it is closed, or its closing if it is open.
- By Modbus commands. The commands can be protected by a password (P.0004) which must be entered before any command, and they can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
    - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: write the value:
        - “41”: it requires the immediate opening of MCB (without the loads transfer from the mains to the generators).
        - “42”: it requires the opening of MCB (with the loads transfer from the mains to the generators).
        - “43”: it requires the closure of MCB (with or without the synchronization).
- By using a proper “SMS” (see document [3]).

If the MGCB circuit breaker exists and it is managed by the controller, it is possible to request its manual opening and closing in different ways:

- By using the MGCB button on the controller panel. This command works as a toggle: it commands the opening if the circuit breaker is closed, it commands the closing if the circuit breaker is open.
- By using the digital inputs of the controller (to connect external buttons that allow the manual opening/closing of the circuit breakers). It is possible to use the following functions to configure the digital inputs:
    - DIF.1002 - “Request for MGCB opening”.
    - DIF.1001 - “Request for MCGB closing”.

  These commands act on shifting the input from “not active” to “active”, not on the steady “active” state. It is possible to use both opening/closing commands or just the closing one. If only the closing command is used, it acts as “toggle”: it commands the breaker opening if it is closed, or its closing if it is open.

- By Modbus commands. The commands can be protected by a password (P.0004) which must be entered before any command, and they can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
    - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: write the value:
        - "31": it requires the immediate opening of MGCB (without the loads transfer from the generators to the mains).
        - "32": it requires the opening of MGCB (with the loads transfer from the generators to the mains).
        - "33": it requires the closure of MGCB (with or without the synchronization).
- By using a proper "SMS" (see document [3]).

**Note: if MGCB does not exist, or if it is managed by the controller, the manual commands described previously works on the GCB circuit breakers of the controllers that are "managed by MCxxx" (if enabled by bit 3 of parameter P.0495).**

It is always possible to command the manual opening of the circuit breakers.

If the MCB opening is required while the gensets are in parallel with the mains, the controller tries to transfer the loads from the mains to the gensets, then opens MCB. If, during the loads transfer, the opening of the circuit breaker is required again (button or active digital input for a second), the MCB circuit breaker is immediately open.

If the MGCB opening is required while the gensets are in parallel with the mains, the controller tries to transfer the loads from the gensets to the mains (by setting 0 kW as power setpoint), then opens MGCB. If, during the unload ramp, the opening of the circuit breaker is required again (button or active digital input for a second), the MGCB circuit breaker is immediately open.

Normally, it is always possible to command the manual closing of the circuit breakers. As described in the previous paragraphs, the controller checks if it can close the circuit breaker with the synchronization or directly without synchronization. If it cannot close it in these ways, check if it can close it with the switch: so, it is possible that the controller opens MCB to be able to close MGCB or vice versa (this behaviour must be enabled by the bit 2 of the parameter P.0495).

The controller activates some warnings for opening or closing failure of the circuit breakers if it acquires their feedback. In case of MCB circuit breaker opening failure, the controller activates the warning W023. In case of MGCB circuit breaker opening failure, the controller activates the warning W024. If the controller commands the closing of MCB without synchronization, and MCB does not close, the controller activates the warning W013. If the controller commands the closing of MGCB without synchronization, and MGCB does not close, the controller activates the warning W013.

#### 7.9.3.5 Management logic in AUTO mode

In automatic modes, the controller autonomously decides if it should start/stop the gensets and open/close the circuit breakers, according to the type of plant, the mains voltage and the status of the digital inputs.

In the **automatic** management of the circuit breakers (not in manual), even if the circuit breakers are managed by the controller, it is possible to limit the opening/closing externally. In details:

**MCB circuit breaker**

- If there is a digital input configured with the function DIF.1036 (“MCB opening allowed”), normally the controller waits for this digital input to be activated before opening the circuit breaker.

  The controller ignores the approval if at least one of the following conditions is checked:

  - The controller is in OFF/RESET mode.
  - The controller is in MAN mode.
  - The MGCB circuit breaker does not exist, or it exists but it is closed.
  - The MCB circuit breaker must be opened immediately after the trip of the protections for the parallel with the mains.

  In the other cases, the procedure followed by the controller is:

  - It activates a possible configured output with the function DOF.3082 (“Ready to open MCB”), to signal the external logic its need to open the circuit breaker.
  - It waits that the configured digital input with the function DIF.1036 becomes active; this wait lasts for the time configured for the input (P.2001 for input 1). If the time configured is 0, the wait lasts forever.
  - It commands the opening of the circuit breaker.

- If there is a digital input configured with the function DIF.1035 (“MCB closing allowed”), normally the controller waits for this digital input to be activated before closing the circuit breaker.

  The controller ignores the approval if at least one of the following conditions is checked:

  - The controller is in OFF/RESET mode.
  - The controller is in MAN mode.
  - There are active alarms or unloads.
  - The intervention of the gensets is not required and MCB has not been opened by the controller (so MC200 should close it again).

  In the other cases, the procedure followed by the controller is:

  - It activates a possible configured output with the function DOF.3081 (“Ready to close MCB”), to signal the external logic its need to close the circuit breaker.
  - It waits that the configured digital input with the function DIF.1035 becomes active; this wait lasts for the time configured for the input (P.2001 for input 1). If the time configured is 0, the wait lasts forever.
  - It commands the closing of the circuit breaker (with or without synchronization).

**MGCB circuit breaker**

- If there is a digital input configured with the function DIF.1006 (“MGCB opening allowed”), normally the controller waits for this digital input to be activated before opening the circuit breaker.

The controller ignores the approval if at least one of the following conditions is checked:

- The controller is in OFF/RESET mode.
- The controller is in MAN mode.
- The MGCB circuit breaker must be opened immediately after the trip of the protections for the parallel with the mains.
- There are active alarms or unloads.
- The intervention of the gensets is not required and MGCB has not been closed by the controller (so MC200 should open it again).

In the other cases, the procedure followed by the controller is:

- It activates a possible configured output with the function DOF.3084 (“Ready to open MGCB”), to signal the external logic its need to open the circuit breaker.
- It waits that the configured digital input with the function DIF.1006 becomes active; this wait lasts for the time configured for the input (P.2001 for input 1). If the time configured is 0, the wait lasts forever.
- It commands the opening of the circuit breaker.

- If there is a digital input configured with the function DIF.1005 (“MGCB closing allowed”), normally the controller waits for this digital input to be activated before closing the circuit breaker.

  The controller ignores the approval if at least one of the following conditions is checked:

  - The controller is in OFF/RESET mode.
  - The controller is in MAN mode.

  In the other cases, the procedure followed by the controller is:

  - It activates a possible configured output with the function DOF.3083 (“Ready to close MGCB”), to signal the external logic its need to close the circuit breaker.
  - It waits that the configured digital input with the function DIF.1005 becomes active; this wait lasts for the time configured for the input (P.2001 for input 1). If the time configured is 0, the wait lasts forever.
  - It commands the closing of the circuit breaker (with or without synchronization).

**Notes MCB**

If this circuit breaker exists and is managed by the controller, it is normally kept closed. The controller opens it only in some cases, depending on plant configuration:

- **Parallel to mains.** MCB is opened only if the mains fails and if MCB is configured as interface device. Additionally, it can be opened if the “transfer to gensets” mode is selected after the loads are entirely moved to the gensets.
- **Stand-by supply.** MCB is opened before the MGCB closing (or GCB closing in case MGCB does not exist), to manage the load switch between mains and gensets. In the same way, MCB is closed after MGCB has been opened (or GCB if MGCB does not

exist); if configured as “synchronizable”, the controller will try to close it with synchronization, before opening MGCB.

**Notes MGCB**

If this circuit breaker exists and it is managed by the controller, the controller closes it (if required) with different time, depending on conditions and plant configuration.

- **Parallel to mains**. Normally the controller closes MGCB (without synchronization) before generator’s GCB. This is the best solution, because it avoids multiple synchronization on each genset. This cannot be done if:
    - For any reason, at least one GCB is already closed when the controller must close MGCB.
    - MGCB is supplied by the gensets bus (P.9503=0).
    - The operator has selected to close GCB before MGCB by parameter P.9513.
    - If MGCB cannot be closed without synchronization, the controller waits that at least one GCB is closed, and then closed MGCB with synchronization.

    Pay attention to wrong configurations: if MGCB is configured as “not synchronized” and “supplied by generators bus”, the controller will never be able to close it in parallel with grid (it will be necessary to open MCB, close MGCB without synchronization and then close MCB with synchronization).
- **Stand-by supply.** The controller closes MGCB (without synchronization) after the gensets GCB are closed. Parameter P.0806 allows configuring the timings for MGCB closure:
    - By setting it to 0, the controller closes MGCB after the first circuit breaker GCB has been closed (“immediate supply”).
    - By setting it to 30000, the controller waits the closing of GCB of all the available gensets “managed by MC200”, then it closes MGCB (“end parallel supply”). In this case, the nominal power of generators is not checked.
    - By setting it to an intermediate value, the controller waits that the nominal power of all gensets with GCB closed is greater than the set value, and then closes MGCB. Note: if all GCB are closed, the available power is lower than the threshold, the controller activates a warning (W008) and then closes MGCB.
    - It is also possible to use a digital input configured with the function DIF.2181 (“Immediate supply”), to force the MGCB closing after the first GCB, whatever is the value set in parameter P.0806.

### 7.9.4 Events and signalling

The controller will record any variation of the command and of the status of the circuit breakers in the event archive, if it is enabled respectively through the bits 4 and 5 of P.0441 parameter:

- EVT.1030: MGCB close command
- EVT.1031: MGCB open command
- EVT.1032: MGCB closed.
- EVT.1033: MGCB open.
- EVT.1035: MCB close command
- EVT.1036: MCB open command

- EVT.1037: MCB closed.
- EVT.1038: MCB open.

The controller makes commands and statuses of the circuit breakers available, for AND/OR logics, through the following internal statuses:

- ST.065 - "MCB status"
- ST.066 - "MGCB status"
- ST.068 - “MGCB closure command (stable)”.
- ST.069 - “MCB closure command (stable)”.
- ST.070 - “MGCB minimum voltage coil”.
- ST.071 - "MGCB opening pulse”.
- ST.072 - "MGCB closure pulse”.
- ST.073 - “MCB minimum voltage coil”.
- ST.074 - "MCB opening pulse”.
- ST.075 - "MCB closure pulse”.

## 7.10 Gensets supplying

The controller, for its operating sequences, must know if there are gensets that have their GCB closed. Usually, the controller acquires this information via CAN bus PMCB. In case there are gensets that are not connected to the CAN bus link, it is possible to use a digital input configured with the function DIF.3004 (“Status of GCB of other gensets”): if this input is active, the controller considers there is at least one genset with GCB closed.

## 7.11 Active power management

The controller does not implement any regulations on active power. No PI regulators are provided for active power: the controller selects the power setpoint for generators, and the power regulation task is performed by each genset controller.

The controller can adjust the active power setpoint for generators through the CAN bus link. This setpoint is used by the genset controllers only when generators are in parallel with mains. When they are in “island mode”, the genset controllers automatically manage load sharing (without MC200) between available generators, as a percentage of their nominal power.

**Important note:**

- P.9506 = 1: only the controllers “managed by MCxxx” use the power setpoint transmitted by MC200. The controllers not “managed by MCxxx” use the proper local setpoint. The controller considers this info when calculating the power setpoint transmitted to the genset controllers.
- P.9506 = 0: the MC200 controller transmits its power setpoint as “SYSTEM BASE LOAD”. It is automatically managed by the genset controllers, taking care of the ones that are working in a different mode.

**Important note:** if a plant is composed by more MCxxx, the system allows the parallel with the mains only on one of them. If the circuit breakers would be all managed externally, there could be more MCxxx managing the parallel with the mains: in this case, the power setpoint used by the gensets is the one transmitted from the MCxxx controller with minor PMCB address.

There are three different operating modes for the parallel with the mains, described in the following.

**Important note:** whatever is the mode selected on the controller, it corresponds to a power setpoint for the genset controllers.

### 7.11.1 BASE LOAD

This term is used to indicate the working mode where the power setpoint for generators is selected by the operator and it is not influenced by the local loads.

To select this mode, set parameter P.0880 to “1”.

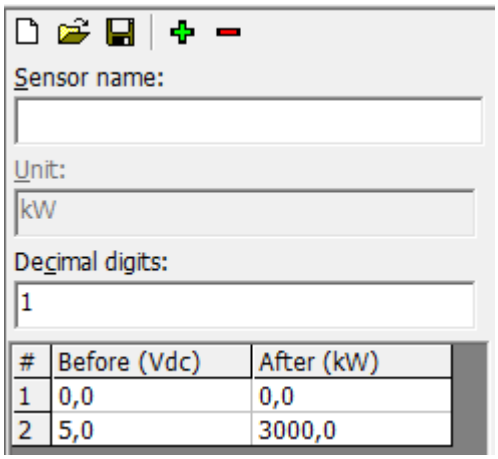
In this mode, the operator selects the power setpoint for the plant using parameter P.0858, directly as kW. Values up to 30 MW can be selected. The parameter can be modified also in MAN o AUTO modes, and directly from display page M.01.

Alternatively, it is possible to use a controller analogue input to configure the setpoint. This input can be connected to a potentiometer, or any external device that should adjust the power setpoint of the plant.

To use the analogue input, do the following:

- Configure an analogue input with the function AIF.2307 (“Setpoint for system BASE LOAD”) (parameter P.4001 for analogue input 1).

- Associate a conversion curve to the analogue input, to convert the acquired voltage to a kW setpoint. For example:




After this configuration, by moving the potentiometer between 0 and 5 Vdc the power setpoint varies between 0 and 3000 kW (the setpoint is displayed on page M.01 but cannot be modified from the controller panel). **Note: once you have configured an analogue input with the function AIF.2307, the parameter P.0858 is no more used.**

### 7.11.2 IMPORT/EXPORT

This term indicates the working mode in which the power setpoint configured by the operator is referred to the interconnection point with the mains and not to the gensets: the setpoint for the gensets is calculated from the selected setpoint and the current power on mains. It is mandatory that the controller can measure the power on mains.

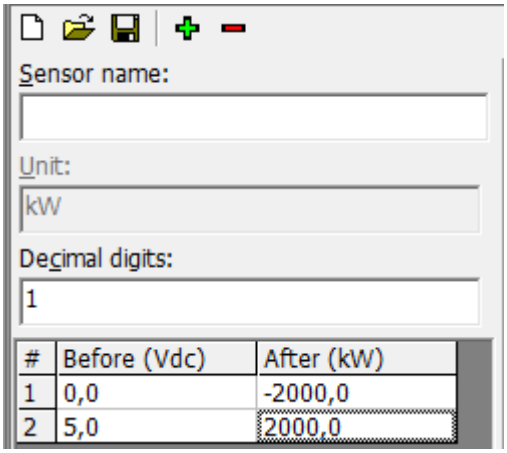
To select this mode, set parameter P.0880 to “2”.

Otherwise you can set the parameter P.0880 to “1” (“BASE LOAD”) and use a digital input to switch the working mode between “BASE LOAD” and “IMPORT/EXPORT”. The input must be configured with the function DIF.2093 (“Selects the import-export mode”): when the input is “active” (logical status) the working mode is “IMPORT/EXPORT”, when it is “not active” the working mode is “BASE LOAD”.

The operator can select the power setpoint on mains by using parameter P.0859, directly as kW. It allows setting values up to +/-10 MW. A positive value means that the plant should import power from mains, while a negative value indicates that power should be exported to mains. A setpoint equal to zero selects no power transfers over mains: generators should supply only local loads. The parameter can be modified also in MAN o AUTO modes, and directly from display page M.01.

Alternatively, it is possible to use a controller analogue input to acquire the setpoint. This input can be connected to a potentiometer, or any external device that must adjust the power setpoint of the plant. To use the analogue input, do the following:

- Configure an analogue input with the function AIF.2309 (“Setpoint for system IMPORT/EXPORT”) (parameter P.4001 for analogue input 1).
- Associate a conversion curve to the analogue input, to convert the acquired voltage to a kW setpoint. For example:




After this configuration, by moving the potentiometer between 0 and 5 Vdc the power setpoint varies between -2000 kW (exported) and 2000 kW (imported) (the setpoint is displayed on page M.01 but cannot be modified from the controller panel). **Note: once you have configured an analogue input with the function AIF.2309, the parameter P.0859 is no more used.**

The power setpoint for the gensets depends on the loads connected. So, it may happen that with few loads, the gensets should supply a very low power. In this case, the engines do not work well and if the situation does not change for a long time, they can get damaged. With the parameter P.0904, it is possible to configure a minimum value of power that the controller should require from gensets when they are in parallel with the mains in IMPORT/EXPORT mode.

### 7.11.3 Transfer to generators

This term indicates a temporary mode that consists in configuring the power currently consumed by the loads as power setpoint for the gensets. Once the gensets reach the setpoint (so the mains is no more supplying the loads), the controller opens the mains circuit breaker (MCB) and the loads are supplied by the gensets.

To select this mode, set parameter P.0880 to “3”. Otherwise you can set this parameter to “1” (“BASE LOAD”) or “2” (“IMPORT/EXPORT”) and use a digital input to switch the working mode to “Transfer to generators”. This input must be configured with the function DIF.2096 “Transfer to gensets”: when the input is “active” (logical status) the working mode is “Transfer to generators”, when it is “not active” the working mode is the previous one.

This working mode is different if the controller acquires the power on mains or not:

- If the controller acquires the power on mains, the power setpoint for the generators is calculated as in “IMPORT/EXPORT” mode, assuming 0 kW setpoint on mains. When generators reach the setpoint no power is flowing on the mains: the MCB circuit breaker can be opened without load transients on generators.
- If the controller does not acquire the power on mains, the operator must set the power value required by the loads with the parameter P.0858 (or act on the related analogue input). This setpoint will be transmitted to the gensets. Once generators reach this setpoint, MCB circuit breaker will be opened: if setpoint is near actual loads, no load transients will happen on generators.

Note: if generators are not able to reach the setpoint (because too loads are applied) MCB circuit breaker will never be opened.

This temporary phase ends when the gensets reach the setpoint or after the configured maximum delay (unless the gensets cannot supply the power required): the duration of the ramp (P.0879) is considered as maximum delay for this management (anyhow, MCB is open

only if the gensets can take the load). It is also possible to add a delay by means parameter P.9517: the controller opens MCB only when the power supplied by the generators reached the setpoint continuously for this delay. The default value for this parameter is zero.

### 7.11.4 Load and unload ramps

The controller does not manage directly the load ramps, but this function is managed by the gensets controllers.

When the gensets are supplying in parallel with the mains and the MGCB circuit breaker should be opened, the controller commands the unloading process to gensets (if no alarms are activated).

The command consists in setting a power reference to the gensets. This reference is calculated in different ways for the two following conditions:

- There is another MCxxx with MGCB closed. In this case, the gensets are supplying the loads of more than one MCxxx simultaneously. So, the controller cannot bring the gensets power to zero, because it would connect the loads of all MCxxx with MGCB closed to only one mains transformer, which could be overcharged. The controller can proceed in two ways:
  - The controller measures the power that flows through its own MGCB. In this case, the controller calculates the power setpoint for the gensets to bring to zero the power that flows through the MGCB. When the power is close to zero, the controller opens the MGCB, avoiding load transfers on both gensets and mains transformers.
  - The controller does not measure the power that flows through its own MGCB. In this case, it simply opens its own MGCB: anyhow, this leads to a load transfer on both gensets and mains transformers.
- There are no other MCxxx with MGCB closed. In this case, the controller requests to gensets an active power reference equal to 0%. When the gensets power is close to zero, the controller opens the MGCB, avoiding load transfers on both gensets and mains transformers.

Then the generator control devices manage by itself the unload ramp for their generators. The controller waits for the end of the unloading process and then opens the MCB circuit breaker. The unloading process is terminated when:

- In case there are other MCxxx with MGCB closed and this MC200 does not measure the power on the MGCB circuit breaker. In this case, the unload ramp is not carried out.
- In case there are no gensets with GCB closed, the controller stops the unload ramp.
- If the parallel with the mains is not allowed: the unload ramp can last maximum 0.5 seconds.
- If you have configured a maximum duration for the parallel with the mains (parameter P.0890): the unload ramp is immediately stopped after the gensets are in parallel as per the time configured.
- If the power supplied by the gensets “managed by MCxxx” is lower than the threshold set in P.0878 (the power is calculated as sum of the active powers divided by the sum of the nominal powers of all gensets supplying). **The power supplied by the gensets not “managed by MCxxx” is ignored.** In case the controller measures the power on MGCB and there are other MCxxx with MGCB closed, the controller checks that the power on MGCB is lower than P.0878. It is also possible to add a delay by means parameter P.9517: the controller opens MGCB only when the power supplied by the

generators reached the setpoint continuously for this delay. The default value for this parameter is zero.

Note: if P.9605 is set to 1, the active power setpoint for the unloading procedure is managed through the SYSTEM BASE LOAD mode. The genset controllers manage this setpoint by themselves, taking care of the ones that are working in different modes; however, the setpoint is probably near to zero and, if there are gensets working in a different mode, it is possible that the system can't reach it: this is the reason for which, to detect the end of the unload, only the generators "managed by MCxxx" are considered.

- After the time configured with parameter P.0879 is elapsed from the start of the process (this is only a timeout, normally MGCB is opened early for the reaching of power setpoint).

The controller does not change the setpoint for the reactive power (see paragraph below) during the unload ramp. Whatever is the cos(ϕ) required to the controllers, this corresponds in a null value of reactive power when the active power supplied by a genset tends to zero: so, the reactive power unload is indirectly managed by the genset controllers.

## 7.12 Reactive power management

The controller does not implement any regulations on reactive power. No PI regulators are provided for reactive power: the controller selects the reactive power setpoint for generators, and the voltage and reactive power regulation tasks are performed by each genset controller.

The reactive power setpoint is not expressed as kvar, it is set as a "power factor", called also cos(Φ).

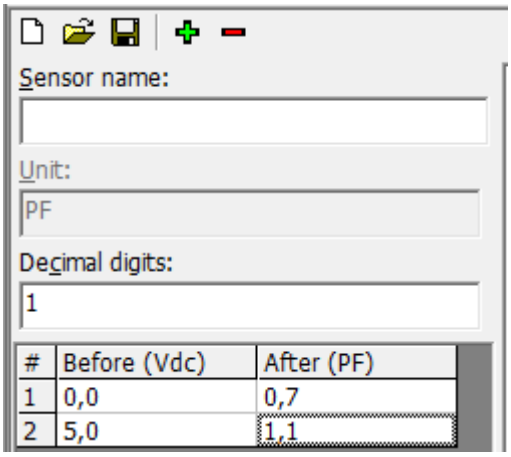
The controller can select the cos(Φ) setpoint for generators through the CAN bus link. This setpoint is used by the genset controllers only when generators are in parallel with mains. When they are in "island mode", the genset controllers automatically manage reactive power sharing (without MC200) between available generators, as a percentage of their nominal power.

The setpoint sent by MC200 over the CAN bus is the same for all generators: each genset controller will convert this setpoint to kvar (based on current active power of that generator); then it will provide voltage control loop to move generator reactive power to the required kvar.

On MC200, operator selects the setpoint for cos(Φ) using parameter P.0860 ("Reference for system cos(Φ)"). It allows selecting values between "0.7 inductive" and "0.9 capacitive". The parameter can be modified also in MAN o AUTO modes, and directly from display page M.01. To set a capacitive cos(Φ), the formula "2 - cos(Φ)" must be used. For example, to select a cos(Φ) equal to 0.95c, the real number is 2.00 – 0.95 → 1.05.

Alternatively, it is possible to use a controller analogue input to configure the setpoint. This input can be connected to a potentiometer, or to any external device that must adjust the cos(Φ) setpoint of the plant. To use the analogue input, do the following:

- Configure an analogue input with the function AIF.2405 ("Setpoint for system power factor") (parameter P.4001 for analogue input 1).
- Associate a conversion curve to the analogue input, to convert the acquired voltage to a kW setpoint. For example:




After this configuration, by moving the potentiometer between 0 and 5 Vdc the cos(Φ) setpoint varies between 0.70 inductive and 0.90 capacitive (the setpoint is displayed on page M.01 but cannot be modified from the controller panel). **Note: once you have configured an analogue input with the function AIF.2405, the parameter P.0860 is no more used.**

**Important note:**

- P.9506 = 1: only the controllers “managed by MCxxx” use the cos(Φ) setpoint transmitted by MC200. The controllers not “managed by MCxxx” use the proper local setpoint.
- P.9506 = 0: MC200 transmits the cos(Φ) setpoint for the SYSTEM BASE LOAD mode. The genset controllers manage this setpoint by themselves, taking care about the ones that are working in a different mode. In this way, the total system cos(Φ) will be the one required by MC200.

## 7.13 Commands for gensets

Usually, the controller can start/stop the gensets and eventually force the opening of the GCB circuit breakers through commands on the CAN bus PMCB line. It is possible to use also some digital outputs for this purpose. The controller has the following two functions for the configuration of the digital outputs:

- DOF.1005 (“Request to start”). The controller activates this output each time the intervention of the gensets is required (both in MAN and AUTO). It deactivates this output when the intervention of the gensets is no longer required. It is possible to wire this output on the digital inputs of the gensets controllers to command the start/stop of the engines.
- DOF.3062 (“Ready to supply”). The controller activates this output to signal that it is possible to connect the loads to the gensets. The output activates only in AUTO, TEST and REMOTE START, if there are no “load inhibitions” in the following cases:
    - If there is a MGCB circuit breaker:
        - If MGCB is closed, the output is active.
        - If MGCB is open, the output is active when the nominal power of the gensets with GCB closed is enough to supply the loads.
    - If there is not a MGCB circuit breaker:
        - If at least one GCB is closed, the output is active.
        - if no GCB is closed:
            - If there is an MCB circuit breaker but it is externally managed, and the plant does not consider the parallel with the mains:
                - If MCB is closed: the output activates when all gensets “managed by MCxxx” are started; if there are no gensets “managed by MCxxx”, the output activates when at least one genset is started.
                - If MCB is open, the output is active when the nominal power of the gensets with GCB closed is enough to supply the loads.
            - In other cases, the output activates when the nominal power of the gensets with GCB closed is enough to supply the loads.

Usually, the controller can modify the speed and voltage of the gensets through commands on the CAN bus PMCB line. It is possible to use also some analogue outputs for this purpose. The controller has the following functions for the configuration of the analogue outputs:

- AOF.1000 (“Speed regulator”). The controller manages this output for sending speed commands to the genset controllers. The output can be adjusted by the following parameters:
    - P.0831: if set to zero, the output increases to request an increase of the speed. If set to 1, the output decreases to request an increase of the speed.
    - P.0856: it allows to specify the minimum value for the output (%).
    - P.0857: it allows to specify the maximum value for the output (%).

- AOF.1001 (“Speed regulator (with curve)”). The controller manages this output for sending speed commands to the genset controllers. The output can be adjusted by means a conversion curve.

- AOF.1002 (“Voltage regulator”). The controller manages this output for sending voltage commands to the genset controllers. The output can be adjusted by the following parameters:
    - P.0861: if set to zero, the output increases to request an increase of the voltage. If set to 1, the output decreases to request an increase of the voltage.
    - P.0862: it allows to specify the minimum value for the output (%).
    - P.0863: it allows to specify the maximum value for the output (%).
- AOF.1003 (“Voltage regulator (with curve)”). The controller manages this output for sending voltage commands to the genset controllers. The output can be adjusted by means a conversion curve.

## 7.14 Plant types

This paragraph describes all the plant types managed by MC200, selectable by parameter P.0802. The controller manages only plant types with more than one genset; anyhow, it is possible to work (with this plants) even with only one genset. The following notes are valid for all types of plant:

- See paragraph 7 for the list of the conditions, so that a genset controller is considered “managed by MCxxx” (remember that, in any case, the genset controllers should be at least in AUTO to be “managed by MCxxx”).
- The gensets “managed by MCxxx” can be started only if MC200 is not in OFF/RESET and if there are no blocks and/or unloads.
- In MAN, the operator can start/stop the gensets “managed by MCxxx” with the buttons START and STOP. To start/stop the gensets not “managed by MCxxx”, use the related controllers.
- See paragraph 7.9 for a list of the minimum conditions that allow the closing of the MCB circuit breaker.
- See paragraph 7.9 for a list of the minimum conditions that allow the closing of the MGCB circuit breaker.
- See paragraph 7.9 for the description of the manual commands for the circuit breakers.
- See paragraph 7.9 for the anomalies of the circuit breakers opening/closing failure.
- See paragraph 7 for the anomalies of the circuit breakers synchronization failure.

The plants are divided according to the necessary conditions for the automatic intervention of the gensets. From this point of view, there are three types of plant:

- “Island mode” production plant. The term “island mode” indicates the situation in which one or more gensets supply a load, without being in parallel with the mains. The automatic intervention of the plant is always required, independently from the mains status. The parallel with the mains is not allowed.
- “Emergency” plant. The automatic intervention of the gensets is required in case of anomalies of the mains. The parallel with the mains is allowed, even if it is not the normal operation for this type of plant.
- Plant for the production “in parallel with the mains”. The automatic intervention of the plant is required only if the mains is live and in tolerance. The supply in “island mode” is not allowed.

The following table shows a recap of all types of plant, according to what has been said:

| P.0802 | Production in island mode | AMF | Production in parallel with the mains | Parallel with the mains allowed | Supply in island mode allowed |
|---|---|---|---|---|---|
| **MPM** | X | | | No | Yes |
| **MSB** | | X | | No | Yes |
| **MSB + MSTP** | | X | X | Yes | Yes |
| **MPtM** | | | X | Yes | No |
| **MPtM + MSB** | X | | X | Yes | Yes |

The acronyms indicated in the first column will be described in detail below. It is important to understand well the difference between the plants "**MSB + MSTP**" e "**MPtM + MSB**": they allow, in fact, both the supply in "island mode" and the supply in "parallel with the mains". The difference consists in the mode in which the automatic intervention of the genset is required:

- The plant "**MSB + MSTP**" is an "emergency" plant and so the gensets will be started (automatically) only in case of mains anomaly. To put the gensets in parallel with the mains, you need to force the start when the mains is live (through the REMOTE START or TEST mode).
- The plant "**MPtM + MSB**" is both a "supply in island" and production "in parallel with the mains" plant. Automatically, the gensets are started when the mains is in tolerance and when it is out of tolerance or off: in the first case, the plant will be "in parallel with the mains", in the second case, it will be "in island mode".

The different types of plant will be described in detail below. Gensets automatic start inhibition

### 7.14.1 MPM (Multiple Prime Mover)

This type of plant requires the production in "island mode". They are the typical gensets of the building sites, where the operator decides when the gensets must supply or not. The parallel with the mains is not allowed.

| Parallel functions | Available |
|---|---|
| Synchronization for MGCB. | Not available. |
| Synchronization for MCB. | Not available. |
| Protections for the parallel with the mains. | Not available. |
| Management of the active power in parallel with the mains. | Not available. |
| Management of the power factor in parallel with the mains. | Not available. |
| Function "transfer to gensets". | Not available. |

In this type of plant, the controller ignores the mains and MCB status. It is not possible to close the MGCB circuit breaker with synchronization: this means that the controller does not allow the MGCB closing if, in case of wrong wiring, it detects the simultaneous presence of voltage on both sides of the circuit breaker.

**Automatic sequence**

The automatic intervention of the genset is required in the following conditions:

- In AUTO: if no "inhibition to start" is active.
- In TEST and REMOTE START: always, ignoring the "inhibition to start".

When there are gensets ready to supply, the controller must decide if closing the MGCB circuit breaker or not (if it exists). The circuit breaker should be always closed, except for the following cases:

- There are active alarms or unloads.
- The stop of the gensets is required.
- There is an active "inhibition to supply the load".

If the opening of MGCB is not required, the controller must decide in which moment to close the circuit breaker: see the description of the parameter P.0806 at paragraph 7.9.3.5.

The logic of normal operation in AUTO (**if the controller manages the MGCB circuit breaker**) will be:

1. **MGCB open, gensets "managed by MCxxx" stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.
2. **MGCB open, gensets "managed by MCxxx" starting.** If there are no gensets "managed by MCxxx", the procedure skips to point 3. Otherwise, the controller waits that at least one genset "managed by MCxxx" is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 8.
3. **MGCB opened.** If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 8. If there are requests of "inhibition to supply the load", the procedure stays at this point. Otherwise, it continues:
    - To point 4, if there is no voltage on loads bus.
    - Stay in this point if there is voltage on the loads' bus (rare, as MGCB is opened and MCB does not exist).
4. **MGCB open, waiting for gensets.** The controller checks if the number of gensets with GCB closed and their nominal power correspond to what has been configured in parameter P.0806. If they correspond (or if there are no other genset "managed by MCxxx" that could close their GCB), the procedure skips to point 5. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 8.
5. **Closing without synchronization of MGCB** (three attempts). In case of closing failure, the alarm A014 is activated (MGCB not closed) and the procedure skips to point 8. Otherwise, the procedure continues to point 6.
6. **MGCB closed.** In case of alarms or deactivations, or if there are requests of "inhibition to supply the loads", the procedure skips to point 7. If the automatic intervention of the genset is no longer required, the procedure skips to point 7.
7. **Opening of MGCB** (three attempts): if MGCB opens, the procedure skips to point 3. If MGCB does not open, the alarm A024 is activated (MGCB not closed) and the procedure skips to point 8.
8. **Stopping.** The controller removes the start request for the gensets "managed by MCxxx". If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

The logic of normal operation in AUTO (**if the controller does not command the MGCB circuit breaker**) will be:

1. **Gensets "managed by MCxxx" stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.

2. **Gensets "managed by MCxxx" starting.** If there are no gensets "managed by MCxxx", the procedure skips to point 3. Otherwise, the controller waits that at least one genset "managed by MCxxx" is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 4.

3. **Supplying**. In case of alarms or deactivations, or if the automatic intervention of the gensets is no longer required, the procedure skips to point 4. If there are requests for "inhibition to supply the loads", the procedure stays in this status: if MGCB is closed, the requests of inhibition are transformed in opening commands of the GCB circuit breakers of the controllers "managed by MCxxx".

4. **Stopping.** The controller removes the start request for the gensets "managed by MCxxx". If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

### 7.14.2 MSB (Multiple Stand By)

This type of plant requires one or more gensets to carry out the emergency to mains service. The controller starts the gensets if the mains is "out of tolerance" with respect to the time configured; it stops them if the mains is "in tolerance". If configured by means parameter P.9514, the controller can require the intervention of the gensets even in case of closing failure of the MCB circuit breaker. The parallel with the mains is not allowed.

| Parallel functions | Available |
|---|---|
| Synchronization of MGCB. | Not available |
| Synchronization for MCB. | Not available |
| Protections for the parallel with the mains. | Not available |
| Management of the active power in parallel with the mains. | Not available |
| Management of the power factor in parallel with the mains. | Not available |
| Function "transfer to gensets". | Not available |

It is not possible to close MCB and MGCB with synchronization: this means that the controller does not allow the circuit breaker closing if the other is closed. Moreover, it does not allow the closing of any circuit breaker if, for a wrong wiring, it detects the simultaneous presence of voltage on both sides of the circuit breaker.

**Automatic sequence**

The automatic intervention of the gensets is required in the following conditions:

- In AUTO: if no "inhibition to start" is active and if:
  - The mains is "out of tolerance".
  - The mains is live but the controller is not able to close the MCB circuit breaker (if configured by means parameter P.9514).

- In TEST and REMOTE START: always, ignoring the “inhibition to start”.

When there are gensets ready to supply, the controller must decide if let the gensets supply the load. This should be always done except when:

- There are active alarms or unloads.
- The stop of the gensets is required.
- There is an active “inhibition to supply the loads”.

If the supply of the load from the gensets is required, the controller must decide when to carry out the switch. The controller never closes MGCB before GCB. Parameter P.0806 allows configuring when to close the circuit breaker (see 7.9.3.5).

The logic of normal operation in AUTO (**if MC200 manages both MCB and MGCB circuit breakers**) will be:

1. **MCB closed, MGCB open, gensets “managed by MCxxx” stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.
2. **MCB closed, MGCB open, gensets “managed by MCxxx” starting.** If there are no gensets “managed by MCxxx”, the procedure skips to point 3. Otherwise, the controller waits that at least one genset “managed by MCxxx” is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 12.
3. **MCB closed, MGCB open.** If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 12. If there are requests of “inhibition to supply the loads”, the procedure stays at this point. Otherwise, the procedure continues to point 4.
4. **Gensets wait.** The controller checks if the number of gensets with GCB closed and their nominal power correspond to what has been configured in parameter P.0806. If they correspond (or if there are no other genset “managed by MCxxx” that could close their GCB), the procedure skips to point 5. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 12.
5. **MCB opening** (three attempts) In case of opening failure, the alarm A023 is activated (MCB not opened) and the procedure skips to point 12. Otherwise, the procedure continues to point 6.
6. **MCB open, MGCB closed.** The controller waits for the time configured with parameter P.0219, then it continues to point 7. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 11. If there is an inhibition to supply the loads, the procedure skips to point 11.
7. **MGCB closing** (three attempts). In case of closing failure, the alarm A014 is activated (MGCB not closed) and the procedure skips to point 11. Otherwise, the procedure continues to point 8.
8. **MCB open, MGCB closed.** In case of alarms or deactivations, or if there are no requests of “inhibition to supply the loads”, the procedure skips to point 9. If the automatic intervention of the genset is no longer required, the procedure skips to point 9.

9. **Opening of MGCB** (three attempts): if MGCB opens, the procedure skips to point 10. If MGCB does not open, the alarm A024 is activated (MGCB not opened) and the procedure skips to point 12.

10. **MCB open, MGCB closed.** The controller waits for the time configured with parameter P.0219, then it continues to point 11.

11. **MCB closing** (three attempts) In case of closing failure, the alarm A013 is activated (MCB not closed) and the procedure skips to point 12. Otherwise, the procedure continues to point 3.

12. **Stopping.** The controller removes the start request for the gensets "managed by MCxxx". If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

The logic of normal operation in AUTO (**if MC200 manages the MCB circuit breaker only**) will be:

1. **MCB closed, gensets "managed by MCxxx" stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.

2. **MCB closed, gensets "managed by MCxxx" starting.** If there are no gensets "managed by MCxxx", the procedure skips to point 3. Otherwise, the controller waits that at least one genset "managed by MCxxx" is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 8.

3. **MCB closed**. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 8. If there are requests of "inhibition to supply the loads", the procedure stays at this point. If MGCB is closed, the procedure continues to point 5 to open the MCB circuit breaker immediately (otherwise, the controllers cannot close GCB because the plant does not require the parallel with the mains). Otherwise, the procedure continues to point 4.

4. **Gensets waiting (MGCB open).** The controller checks if the number of gensets with GCB closed and their nominal power correspond to what has been configured in parameter P.0806. If they correspond (or if there are no other genset "managed by MCxxx" that could close their GCB), the procedure skips to point 5. If the external logic closes MGCB, the procedure immediately skips to point 5. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 8.

5. **MCB opening** (three attempts) In case of opening failure, the alarm A023 is activated (MCB not opened) and the procedure skips to point 8. Otherwise, the procedure continues to point 6.

6. **MCB open**. In case of alarms or deactivations, or if the automatic intervention of the genset is no longer required, the procedure skips to point 7. If there are requests for "inhibition to supply the loads" and MGCB is closed, the requests of inhibition are transformed in opening commands of the GCB circuit breakers of the controllers "managed by MCxxx".

7. **MCB closing** (three attempts) In case of closing failure, the alarm A012 is activated (MCB not closed) and the procedure skips to point 8. Otherwise, the procedure continues to point 3.

8. **Stopping.** The controller removes the start request for the gensets "managed by MCxxx". If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

Note: the described sequences are valid if the parameter P.0248 is set to zero. If it is set to 1, the MCB circuit breaker will be opened as soon as the mains become steadily "out of thresholds", to protect the loads against wrong voltages/frequency.

### 7.14.3 MSB+MSTP (Multiple Stand By + Multiple Short Time Parallel)

This type of plant is like the previous one: it requires one or more gensets to carry out the emergency service to mains. The controller starts the gensets if the mains is "out of tolerance" with respect to the time configured; it stops them if the mains is "in tolerance". If configured by means parameter P.9514, the controller can require the intervention of the gensets even in case of closing failure of the MCB circuit breaker.

With respect to the MSB plant, the controller allows the parallel with the mains.

Usually, the parallel with the mains is temporary (P.0880=0): it is used to avoid a black-out on the loads during their switch from gensets to mains (when it is back) or from mains to gensets (in case of forced intervention in TEST or REMOTE START). In this case, the maximum duration for the parallel with the mains is 1 second: anyhow, it can be configured with the parameter P.0890. Please read the description of the warning W207 that is related with this parameter.

This type of plant allows also the parallel with the mains (if P.0880 is different from zero). Usually, you use this function to test the gensets (TEST) without disconnecting the loads from the mains. In this case, there is no limit in the parallel duration.

| Function | Available |
|---|---|
| Synchronization of MGCB. | **Available.** |
| Synchronization for MCB. | **Available.** |
| Protections for the parallel with the mains. | **Available.** |
| Management of the active power in parallel with the mains. | **Available.** |
| Management of the power factor in parallel with the mains. | **Available.** |
| Function "transfer to gensets". | **Available.** |

**Automatic sequence**

The automatic intervention of the gensets is required in the following conditions:

- In AUTO: if no "inhibition to start" is active and if:
  - The mains is "out of tolerance".

- The mains is live but the controller is not able to close the MCB circuit breaker (if configured by means parameter P.9514).

- In TEST and REMOTE START: always, ignoring the “inhibition to start”.

When there are gensets ready to supply, the controller must decide if let the gensets supply the load. This should be always done except when:

- There are active alarms or unloads.
- The stop of the gensets is required.
- There is an active “inhibition to supply the loads”.

If the supply of the loads from the gensets is required, the controller must decide when to carry out the switch. The controller never closes MGCB before GCB. Parameter P.0806 allows configuring when to close the circuit breaker (see 7.9.3.5).

The logic of normal operation in AUTO (**if MC200 manages both circuit breakers**) will be:

1. **MCB closed, MGCB open, gensets “managed by MCxxx” stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.
2. **MCB closed, MGCB open, gensets “managed by MCxxx” starting.** If there are no gensets “managed by MCxxx”, the procedure skips to point 3. Otherwise, the controller waits that at least one genset “managed by MCxxx” is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 17.
3. **MCB closed, MGCB open.** If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 17. If there are requests of “inhibition to supply the loads”, the procedure waits in this point. Otherwise, it continues:
    - To point 12 if it is possible to close MGCB with the synchronization and the parallel with the mains is allowed (P.0880 > 0).
    - To point 4 in other cases.
4. **MCB closed, MGCB open, genset waiting.** The controller checks if the number of gensets with GCB closed and their nominal power correspond to what has been configured in parameter P.0806. If they correspond (or if there are no other genset “managed by MCxxx” that could close their GCB), the procedure skips to point 5 and it is not possible to close MGCB with synchronization; otherwise, to point 12. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 17. If there are inhibitions, the procedure skips to point 3.
5. **MCB opening, MGCB open** (three attempts). In case of opening failure, the alarm A023 is activated (MCB not opened) and the procedure skips to point 17. Otherwise, the procedure continues to point 6.
6. **MCB open, MGCB closed.** If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 10. If there is an inhibition to supply the loads, the procedure skips to point 10. Otherwise, the controller waits for the time configured with parameter P.0219, then it continues to point 7.

7. **MGCB closing without synchronization** (three attempts). In case of closing failure, the alarm A014 is activated (MGCB not closed) and the procedure skips to point 10. Otherwise, the procedure continues to point 8.

8. **MCB open, MGCB closed.** If there are alarms or unloads, requests of inhibition to supply the loads or the automatic intervention of the gensets is no longer required, the procedure continues:

    - To point 9 if it is not possible to close MCB with synchronization.
    - To point 11 if it is not possible to close MCB with synchronization.

9. **Opening of MGCB, MCB open** (three attempts): if MGCB opens, the procedure skips to point 6. If MGCB does not open, the alarm A024 is activated (MGCB not opened) and the procedure skips to point 17.

10. **MCB closing without synchronization** (three attempts) In case of closing failure, the alarm A013 is activated (MCB not closed) and the procedure skips to point 17. Otherwise, the procedure continues to point 3.

11. **MCB closing with synchronization.** This phase lasts maximum P.0853 seconds. If during this time MCB closes, the procedure skips to point 13. Otherwise, the controller activates the warning W272 (“synchronization failure on MCB”): the controller will not allow the synchronization for the MCB closing if the operator does not “acknowledge” this warning. The procedure goes back to point 8.

12. **MGCB closing with synchronization** This phase lasts maximum P.0852 seconds. If during this time MGCB closes, the procedure skips to point 13. Otherwise, the controller activates the warning W271 (“synchronization failure on MGCB”): the controller will not allow the synchronization for the MGCB closing if the operator does not “acknowledge” this warning. The procedure goes back to point 3.

13. **MCB closed, MGCB closed** If the gensets must be stopped for an alarm, the procedure skips to point 16. If some unloads are activated, the automatic intervention is no longer required, or some requests of “inhibition to supply the loads” are activated, the procedure continues to point 15. If the parallel with the mains is not allowed (or the maximum time allowed for the parallel with the mains expires), the procedure continues to point 14. If the “transfer to gensets” mode is active, when the gensets reach the power setpoint configured by MC200, the procedure continues to point 14.

14. **MCB opening, MGCB closed** (three attempts). In case of opening failure, the alarm A023 is activated (MCB not opened) and the procedure skips to point 17. Otherwise, the procedure continues to point 8.

15. **MCB closed, MGCB closed, power unload** If the parallel with the mains is not allowed (or the maximum time allowed for the parallel with the mains expires), the procedure continues to point 16. During this phase, the controller establishes a power setpoint equal to 0 kW for the gensets. Then, it controls the active power supplied by the gensets “managed by MCxxx”: when it goes under the threshold P.0878, the procedure continues to point 16. In any case, the maximum duration of this phase can be configured with the parameter P.0879: when the time is up, whatever the power supplied by the gensets is, the procedure continues to point 16. If there are not alarms or unloads, the requests of “inhibition to power load” are not activated and the automatic intervention is required, the procedure continues to point 13.

    Note: if P.9605 is set to 1, the active power setpoint for the unloading procedure is managed through the SYSTEM BASE LOAD mode. The genset controllers manage this setpoint by themselves, taking care of the ones that are working in different modes; however, the setpoint is probably near to zero and, if there are gensets working in a different mode, it is possible that the system can’t reach it: this is the

reason for which, to detect the end of the unload, only the generators “managed by MCxxx” are considered.

16. **Opening of MGCB, MCB closed** (three attempts): if MGCB opens, the procedure skips to point 3. If MGCB does not open, the alarm A024 is activated (MGCB not opened) and the procedure skips to point 17.

17. **Stopping.** The controller removes the start request for the gensets “managed by MCxxx”. If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

The logic of automatic normal operation (**if MC200 manages MCB only**) will be:

1. **MCB closed, gensets “managed by MCxxx” stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.

2. **MCB closed, gensets “managed by MCxxx” starting.** If there are no gensets “managed by MCxxx”, the procedure skips to point 3. Otherwise, the controller waits that at least one genset “managed by MCxxx” is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 9.

3. **MCB closed**. If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 9. If there are requests for “inhibition to supply the loads”, the procedure stays in this status: if MGCB is closed, the requests of inhibition are transformed in opening commands of the GCB circuit breakers of the controllers “managed by MCxxx”; the gensets will download the power before opening GCB.

   **MGCB opened**. The controller checks if the number of gensets with GCB closed and their nominal power correspond to what has been configured in parameter P.0806. If they correspond (or if there are no other genset “managed by MCxxx” that could close their GCB):

   - If there is a digital input to require the synchronization of MGCB, the procedure stays in this status waiting for the request. When the request is active, the procedure skips to point 8.

   - If there is no digital input (and MGCB cannot be closed with synchronization), the procedure continues to point 4.

   **MGCB closed:** the controller checks:

   - There are gensets with GCB closed. If the parallel with the mains is not allowed (or the maximum time allowed for the parallel with the mains expires), the procedure continues to point 4. If the “transfer to gensets” mode is active, when the gensets reach the power setpoint configured by MC200, the procedure continues to point 4.

   - There are no gensets with GCB closed. If there are gensets ready to supply, but the mains is out of tolerance (so, the gensets cannot close their GCB with synchronization), the procedure continues to point 4.

4. **MCB opening** (three attempts). In case of opening failure, the alarm A023 is activated (MCB not opened) and the procedure skips to point 9. Otherwise, the procedure continues to point 5.

5. **MCB open**. The actions depend on the MGCB status.

   **MGCB opened**. If there are alarms or unloads, requests of “inhibition to supply the loads” or the automatic intervention of the genset is no longer required, the procedure continues to point 6. Otherwise, the procedure stays in this status.

   **MGCB closed**. If there are alarms or unloads, the procedure skips to point 9. If there are “inhibition to supply the loads”, or the automatic intervention is not required, the controller continues to point 7 if it is possible to use the synchronization for the closing of MCB; otherwise, it waits for MGCB or GCB to open.

6. **MCB closing without synchronization** (three attempts) In case of closing failure, the alarm A013 is activated (MCB not closed) and the procedure skips to point 9. Otherwise, the procedure continues to point 3.

7. **MCB closing with synchronization** This phase lasts maximum P.0853 seconds. If during this time MCB closes, the procedure skips to point 3. Otherwise, the controller activates the warning W272 (“synchronization failure on MCB”): the controller will not allow the synchronization for the MCB closing if the operator does not “acknowledge” this warning. The procedure goes back to point 5.

8. **MGCB closing with synchronization** This phase lasts maximum P.0852 seconds. If during this time MGCB closes, the procedure skips to point 13. Otherwise, the controller activates the warning W271 (“synchronization failure on MGCB”): the controller will not allow the synchronization for the MGCB closing if the operator does not “acknowledge” this warning. The procedure goes back to point 5.

9. **Stopping.** The controller removes the start request for the gensets “managed by MCxxx”. If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

Note: the described sequences are valid if the parameter P.0248 is set to zero. If it is set to 1, the MCB circuit breaker will be opened as soon as the mains become steadily “out of thresholds”, to protect the loads against wrong voltages/frequency.

### 7.14.4 MPTM (Multiple Parallel to Mains)

This is a plant for the production in parallel with the mains. The controller starts the gensets if the mains status allows the parallel; it disconnects the gensets from the mains if the protections of parallel with the mains are activated (see 7.4.2); it stops the gensets if the mains status does not allow the parallel for P.0899 seconds.

The supply in “island mode” is not allowed: so, if the protections of parallel with the mains are activated, the controller opens the MGCB circuit breaker anyway (if it exists), whatever is the interface device selected with parameter P.0900. We suggest to select MGCB as interface device (P.0900=2).

The parallel with the mains must be continue, so the parameter P.0880 must be set at a value different from zero.

| Parallel functions | Available |
|---|---|

| | |
|---|---|
| Synchronization for MGCB. | **Available.** |
| Synchronization for MCB. | Not available. |
| Protections for the parallel with the mains. | **Available.** |
| Management of the active power in parallel with the mains. | **Available.** |
| Management of the power factor in parallel with the mains. | **Available.** |
| Function “transfer to gensets”. | Not available. |

**Automatic sequence**

The automatic intervention of the gensets is required in the following conditions:

- In AUTO: if there is no “inhibition to start” and the mains status allows the parallel with the mains.
- In TEST and REMOTE START: always, ignoring the “inhibition to start” and the mains status.

When there are gensets ready to supply, the controller must decide if connect the gensets to the mains. This should be always done except when:

- There are active alarms or unloads.
- The stop of the gensets is required.
- There is an active “inhibition to supply the loads”.

The logic of normal operation in automatic mode (**if the controller manages both circuit breakers and if MGCB is the interface device**) will be:

1. **MCB closed, MGCB open, gensets “managed by MCxxx” stopped.** If the automatic intervention of the plant is required, the procedure skips to point 2.
2. **MCB closed, MGCB open, gensets “managed by MCxxx” starting.** If there are no gensets “managed by MCxxx”, the procedure skips to point 3. Otherwise, the controller waits that at least one genset “managed by MCxxx” is ready to supply and then the procedure skips to point 3. It is possible to set a maximum duration for the gensets starting with the parameter P.9511. If this parameter is different from zero, and the starting phase lasts more than the value configured, the controller activates the warning W022. During the waiting, in case of alarms or unloads, or if the automatic intervention is no longer required, the procedure skips to point 9.
3. **MCB closed, MGCB open.** If the gensets must be stopped (alarms or unloads, or if the automatic intervention is no longer required), the procedure skips to point 9. If there are requests of “inhibition to supply the loads”, the procedure waits in this point. If the mains is out of tolerance, the procedure waits in this point (after P.0899 seconds, an “inhibition to start” is activated to automatically removes the request of intervention). Otherwise, it continues:
    - To point 4, if you decided to close the MGCB circuit breaker before the GCB one (by means of the parameter P.9513) and if there are no GCB closed.
    - To point 5 if it is not possible to close MGCB with synchronization.
    - In the other cases, it stays in this status.

4. **MGCB closing without synchronization** (three attempts). In case of closing failure, the alarm A014 is activated (MGCB not closed) and the procedure skips to point 9. Otherwise, the procedure continues to point 6.

5. **MGCB closing with synchronization.** This phase lasts maximum P.0852 seconds. If during this time MGCB closes, the procedure skips to point 6. Otherwise, the controller activates the warning W271 ("synchronization failure on MGCB"): the controller will not allow the synchronization for the MGCB closing if the operator does not "acknowledge" this warning. The procedure goes back to point 3. If during the waiting the mains is out of tolerance, the procedure goes back to point 3.

6. **MCB closed, MGCB closed.** If alarms or the protections for the parallel with the mains are activated, the procedure continues to point 8. If some unloads are activated, the automatic intervention is no longer required, or some requests of "inhibition to supply the loads" are activated, the procedure continues to point 7.

7. **MCB closed, MGCB closed, power unload.** During this phase, the controller selects a power setpoint equal to 0 kW for the gensets. Then, it controls the active power supplied by the gensets "managed by MCxxx" (expressed in percentage): when it goes under the threshold P.0878, the procedure continues to point 8. In any case, the maximum duration of this phase can be configured with the parameter P.0879: when the time is up, whatever the power supplied by the gensets is, the procedure continues to point 8. If there are no alarms or unloads, there are no requests of "inhibition to supply the loads", the mains is permanently in tolerance and the automatic intervention is required, the procedure goes back to point 6.

   Note: if P.9605 is set to 1, the active power setpoint for the unloading procedure is managed through the SYSTEM BASE LOAD mode. The genset controllers manage this setpoint by themselves, taking care of the ones that are working in different modes; however, the setpoint is probably near to zero and, if there are gensets working in a different mode, it is possible that the system can't reach it: this is the reason for which, to detect the end of the unload, only the generators "managed by MCxxx" are considered.

8. **Opening of MGCB, MCB closed** (three attempts): if MGCB opens, the procedure skips to point 3. If MGCB does not open, the alarm A024 is activated (MGCB not opened) and the procedure skips to point 9.

9. **Stopping.** The controller removes the start request for the gensets "managed by MCxxx". If there are other MCxxx requiring the use of the gensets, the procedure ends at point 1. Otherwise, the controller waits for the gensets stopping. It is possible to set a maximum duration for this waiting: if the parameter P.9512 is set to a value different from zero, the controller waits in this status for the time configured. If the gensets do not stop within this time, the controller activates a warning W021 and the procedure ends at point 1. If the automatic intervention of the genset is required again, the procedure continues from point 2.

### 7.14.5 MPTM+MSB (Multiple Parallel to Mains + Multiple Stand By)

In this type of plant, the gensets can supply both in "island" and in "parallel with the mains" mode. it is like the MSB + MSTP plant. The differences are:

- This plant is not an emergency plant; so, the request of the gensets automatic intervention is not related to the mains status.
- The parallel with the mains must be allowed (P.0880 > 0).

As the supply in island mode is allowed, it is suggested (but not compulsory) to select MCB as interface circuit breaker (P.0900 = 2).

| Parallel functions | Available |
|---|---|

| | |
|---|---|
| Synchronization of MGCB. | **Available.** |
| Synchronization for MCB. | **Available.** |
| Protections for the parallel with the mains. | **Available.** |
| Management of the active power in parallel with the mains. | **Available.** |
| Management of the power factor in parallel with the mains. | **Available.** |
| Function “transfer to gensets”. | **Available.** |

**Automatic sequence**

The automatic intervention of the gensets is required in the following conditions:

- In AUTO: if no “inhibition to start” is active.
- In TEST and REMOTE START: always, ignoring the “inhibition to start”.

When there are gensets ready to supply, the controller must decide if let the gensets supply the load. This should be always done except when:

- There are active alarms or unloads.
- The stop of the gensets is required.
- There is an active “inhibition to power load”.

See 7.14.3 for an example of operating logic.

## 7.15 Load function

**Note: this description is valid only if the parameter P.9506 is set to one. If it is set to 1, see the document [8].**

"Load function" is the ability of MC200 to automatically start/stop the gensets "managed by MCxxx" according to the power required by the load or by the setpoint for the parallel with the mains. The display pages B.10 and B.11 are related to this function.

**Note: the gensets controllers have their own "load function", but it is disabled when they are managed by MCxxx. If, at a precise moment, the gensets "managed by MCxxx" are in parallel with the gensets not "managed by MCxxx", all with the load function enabled, the two managements may conflict.**

Load function, if enabled, works on all plant types:

- In parallel with mains, load function starts the correct number of generators to allow the system supplying power as requested by the setpoint, starting/stopping additional generators if setpoint changes. Note: in "BASE LOAD" mode, the setpoint can only be changed by the operator, while in "IMPORT/EXPORT" mode it changes also if some loads are added or removed.
- In "island mode", load function starts the generator as required by current loads, starting/stopping additional generators on changes.

Load function is enabled only in AUTO and REMOTE START modes. So, in MAN or TEST modes generators are never stopped due to load (switching from AUTO or REMOTE START to MAN or TEST the currently started generators are kept running).

In AUTO and REMOTE START modes, load function is normally enabled. It is possible, but not compulsory, to configure an input with the function DIF.2702 "Enables the load function" If this input is configured, load function is disabled when the input is "not active" (logical state). If the input is not configured or if it is "active", load function is enabled.

If a MGCB circuit breaker exists, load function is disabled if this circuit breaker is opened: in this situation, no loads are connected to generators and load function could stop them.

The main purposes of the load function are:

- Start the correct number of generators to supply the required power.
- Grant that all generators will be used, not always the same ones.

### 7.15.1 Starting/stopping generators to meet power requests

MC200 allows configuring two thresholds (%) related to load function:

- P.0826 - "Activation load threshold".
- P.0828 - "Deactivation load threshold".

The second threshold must be lower than the first one. They should be set to quite the same value; the purpose of difference is only to define a hysteresis, to avoid unnecessary start/stop if active power changes around the thresholds.

MC200 calculates the system total power % dividing the sum of active powers of each generator by the sum of their nominal powers (both are transmitted by the genset controllers over the can bus):

$$DPRt = \frac{\sum_{x=1}^{n} ADP_x}{\sum_{x=1}^{n} MDP_x}$$

n: number of generators with GCB closed.

ADPx: generator x active power.

MDPx: generator x nominal power.

DPRt: System total power %.

**Note: these calculations are carried out on all genset supplying, not only on those managed by MCxxx.**

When the total percentage power (DPRt) is higher than the threshold P.0826 for the time set with the parameter P.0827 (“Activation load delay”), MC200 must start one new genset “managed by MCxxx”.

To decide to stop one genset “managed by MCxxx”, MC200 first selects the genset to be stopped (hereinafter identified as genset y) and then it calculates the percentage power ratio % the system will supply if the generator would be stopped.

$$DPRtn = \frac{\sum_{x=1}^{n} ADP_x}{\sum_{x=1}^{n} MDP_x - MDP_y}$$

n: number of generators with GCB closed.

y: generator to be stopped.

X: it indicates any genset, except for the genset y.

ADPx: generator x active power.

MDPx: generator x nominal power.

MDPy: generator y nominal power.

DPRtn: system total power ratio % if generator y is stopped.

**Note: these calculations are carried out on all genset supplying, not only on those managed by MCxxx.**

When this system total power (DPRtn) is lower than threshold P.0828 for the time set by parameter P.0829 (“Deactivation load delay”), MC200 stops the generator y.

Parameter P.0820 (“Minimum number of gensets started”) allows selecting the minimum number of started generators, whatever is the load: MC200 never stops generators (indeed it may start some of them) if currently started generators are less or equal to the desired number. Note that minimum value for this parameter is “1”, so at least one generator is always running.
**Note: these calculations include all genset supplying, not only on those managed by MCxxx.**

Every time a GCB circuit breaker is opened or closed, MC200 stops checking the power (and so no genset will be started/stopped) for the time set with the parameter P.0830 (“Initial delay”): in this way, the system has time for stabilization.

If automatic genset supply is required when all generators are stopped (for example when mains become “absent” in emergency plants), MC200 always starts all available generators.

Note: by pressing START on MC200, the load function is temporary suspended, by forcing the start of all available gensets “managed by MCxxx”. Once all generators are supplying, load function will stop unnecessary ones. This possibility is useful each time the operator knows in advance that an increase of power is needed: he can start all generators and, when all are supplying, new loads can be added or the power setpoint can be increased. In this way, you will have the necessary power whenever you need it, even in AUTO mode and with the load function enabled.

### 7.15.2 Selecting generators

The gensets “not managed by MCxxx” are always “excluded” from the load function.

Normally, instead, all generators “managed by MCxxx” are involved in load function. It is possible to manual exclude some “managed” generators from load function (forcing them always stopped or always running). This manual operation must be performed on display pages from B.05 to B.08, which show details about each generator (see description in 6.5.5.2). Note: the manually excluded generators list is not saved on non-volatile memory. At power on, all “managed” generators are included in load function.

Note: MC200 can stop all generators involved in load function. This happens when at least P.0820 “not managed” generators are running, and there is no power request for other gensets.

The logics described below work only on gensets that, at a given time, are included in the load function (and so implicitly “managed by MCxxx”).

To ensure that all generators are used (not always the same ones), MC200 assigns a priority to them:

- Low priority generators are started for last and stopped for first.
- High priority generators are started for first and stopped for last.
- The highest priority generator, at a given time, is called “master”.

MC200 implements three different techniques for assigning priorities to generators, selectable by parameter P.0822 (“Load function mode”).

#### 7.15.2.1 Manual “master” genset selection

Set “1” in parameter P.0822 to select this mode.

In this mode, the operator manually selects the “master” genset using parameter P.0823 (“Master genset address”). Other gensets priorities are automatically assigned depending on addresses. Suppose generators 1 to 8 are present on the plant. Suppose also that generators 3, 4 and 7 are excluded from load function (see previous paragraph). The remaining gensets are:

1, 2, 5, 6, 8.

If the operator selects the genset “5” as “master”, the priority list will be:

5, 6, 8, 1, 2.

If the operator selects the genset “8” as “master”, the priority list will be:

8, 1, 2, 5, 6.

If the operator selects the genset “1” as “master”, the priority list will be:

1, 2, 5, 6, 8.

The priority list is made by following the order address of gensets (increase order) starting from the “master” up to the highest one; then starting from the lowest to the one preceding the “master”.

#### 7.15.2.2 Automatic “master” generator selection at fixed time

Set “2” in parameter P.0822 to select this mode.

In this mode, the operator can always manually select the “master” genset using parameter P.0823. At the time configured by the parameter P.0824 (“Master genset change time”), however, MC200 will select a new “master”. The new “master” selected is the one following the old “master” in the priority list (obviously among the gensets included in the load function).

Let’s suppose that the priority list set in P.0823 is “5,6,7,1,2”; the new “master” genset will be the genset “6”.

You can assign priorities to the following gensets as described above.

In this mode, the “rotation” of generators happens once a day.

#### 7.15.2.3 Automatic “master” generator selection every x hours

Set “3” in parameter P.0822 to select this mode.

In this mode, the operator can always manually select the “master” genset using parameter P.0823. After the number of hours configured with parameter P.0825 “Master genset batch hours”, MC200 will select a new “master”. The new “master” is the one following the old “master” in the priority list (obviously among the generators included in load function).

Let’s suppose that the priority list set in P.0823 is “5,6,7,1,2”; the new “master” genset will be the genset “6”.

You can assign priorities to the following gensets as described above.

In this mode, the “rotation” of generators happens every x hour.

#### 7.15.2.4 Actions on “master” change

When a new “master” is selected, a new priority list is built. At this time, it is possible that some lower priority generators are running, while some high priority generators are stopped. In this case, MC200 grants that first the high priority generators will be started and loaded, and then the low priority ones will be stopped. In this way, there will be no problems on power supply.

#### 7.15.2.5 Events

The controller records the event EVT.1291 when the master genset is changed (if configured with the bit 8 of the parameter P.0441).

## 7.16 Load shedding

The purpose of “load shedding” function is to manage some digital outputs of MC200, to connect/disconnect part of loads from the generators, when generators are not able to supply all loads. Display page B.12 is related to this function.

This function is normally enabled; it is disabled in the following situations:

- If the controller is in MAN or OFF/RESET mode.
- In parallel to mains operations (the eventually extra loads are supplied by mains).
- If a digital input is configured with the function DIF.2721 “Enable load shedding” and the input is “not active” (logical status). If the input is not configured, or if it is “active”, the function is enabled.
- If no digital outputs of MC200 are configured for “load shedding”. Four functions are available for digital outputs configuration:
    - DOF.2251 (“Load-shedding 1”).
    - DOF.2252 (“Load-shedding 2”).
    - DOF.2253 (“Load-shedding 3”).
    - DOF.2254 (“Load-shedding 4”).

It is possible to manage up to four groups of loads. Remember that the same function (DOF.2251 - DOF.2254) can be assigned to more than one output: in this way, a single logical group of loads can be connected/disconnected from the gensets by using more than one circuit breaker at the same time.

Outputs are “active” when MC200 needs to disconnect loads from generators, they are “not active” when loads can be re-connected.

If less than four outputs are used, configure them continuously starting with function DOF.2251. For example, if you would like to use two outputs, configure them with the functions DOF.2251 and DOF.2252. If you accidentally use the functions DOF.2251 and DOF.2253, only the first output configured with the function DOF.2251 will be used. If you use the functions DOF.2252 and DOF.2253, no output will be associated to the function “load shedding” (because the function DOF.2251 is missing).

Loads must be assigned to outputs depending on their priority:

- The output configured with the function DOF.2251 should be used for lowest priority loads: it is the first activated (to disconnect a load) and the last deactivated (to re-connect a load).
- The output configured with the function DOF.2254 should be used for highest priority loads: it is the last activated (to disconnect a load) and the first deactivated (to connect a load).

If “load shedding” function is disabled and some of its digital outputs are configured, these outputs are “not active” to avoid disconnection of loads.

### 7.16.1 All loads management

Normally MC200 can connect or disconnect one group of loads at a time. There are some situations, however, where all loads are connected or disconnected at the same time. Loads are all disconnected (independently by actual power) when:

- In “island mode”, in the moment the MGCB circuit breaker closes.

- In “island mode”, if the MGCB circuit breaker does not exist or it is closed but no GCB are closed, in the moment the first GCB circuit breaker closes.
- When passing from “parallel to mains” to “island mode” (at the opening time of MCB).

In the same way, all outputs are deactivated at the same time when:

- Each time loads are separated from generators by any circuit breakers.

### 7.16.2 Single load management

MC200 provides two thresholds (%) related to “load shedding”:

- P.1181 - “Load disconnect threshold”.
- P.1183 - “Load re-connect threshold”.

The second threshold must be lower than the first one. P.1181 threshold must be set at the maximum allowed power per generator (%). P.1183 threshold must be calculated depending on loads connected/disconnected, to avoid that when a load is connected the total power becomes greater than P.1181 and so load is disconnected again, and so on.

MC200 calculates the system total power % by dividing the sum of active powers supplied by all the gensets (included the ones not “managed by MCxxx”) by the sum of their nominal powers (both pieces of information are transmitted by the gensets controllers on CAN bus):

$$DPRt = \frac{\sum_{x=1}^{n} ADP_x}{\sum_{x=1}^{n} MDP_x}$$

n: number of generators with GCB closed.

ADP: generator x active power.

MDP: generator x nominal power.

DPRt: System total power %.

When the system total power (DPRt) is higher than the threshold P.1181 for the time set by parameter P.1182 (“Load disconnect delay”), MC200 disconnects the lowest priority loads (see above for load priorities).

MC200 can be configured to automatically or manually re-connect the loads. This choice is available by parameter P.1186 (“Load re-connect mode”):

- 0 – “Automatic”. MC200 checks system power before allowing loads connection. The system total power (%) must be less than the P.1183 threshold, for the time set by parameter P.1184 (“Load re-connect delay”).
- 1 – “Manual”. Note: this option needs for a digital input configured for “load connection command” (see in the following).

Each time a group of loads is connected/disconnected from generators, MC200 stops monitoring the power (and so no other loads can be connected/disconnected) for the time set by parameter P.1185 (“Initial delay”), to allow system stabilization.

### 7.16.3 Manual commands

MC200 allows configuring two digital inputs to be used for “load shedding” manual commands. Functions to be used for the inputs’ configuration are:

- DIF.2251 (“Manual disconnection of loads”).
- DIF.2252 (“Manual disconnection of loads”).

Note: these inputs are managed both in MAN and AUTO modes.

Both inputs work on activation and not on the state of the input (the function related to the input is executed once when input state changes form “not active” to “active” – logical state).

The activation of input configured as DIF.2251 will result in the disconnection of the lowest priority load (the next activation will disconnect the next load and so on until all loads are disconnected).

The activation of input configured as DIF.2252 will result in the re-connection of the highest priority load (the next activation will re-connect the next load and so on until all loads are connected).

### 7.16.4 Notes about “load shedding”

If “not-motorized” circuit breakers are used to connect/disconnect loads, MC200 is not able to automatically re-connect loads. In this case parameter P.1186 must be set to “0”: when MC200 detects that a group of loads can be re-connected, it automatically deactivates its output and the circuit breaker is no more forced “open”. The operator can then manually close the circuit breaker.

### 7.16.5 Events

If it is configured with the bit 7 of the parameter P.0441, the controller records the following events related to the unload function:

- EVT.1301: load #1 has been disconnected.
- EVT.1302: load #1 has been connected.
- EVT.1303: load #2 has been disconnected.
- EVT.1304: load #2 has been connected.
- EVT.1305: load #3 has been disconnected.
- EVT.1306: load #3 has been connected.
- EVT.1307: load #4 has been disconnected.
- EVT.1308: load #4 has been connected.

## 7.17 “Peak shaving/lopping”

These names identify the function available in MC200 that allows to monitor the active power on the loads; when it becomes greater than a threshold, MC200 starts the generators and connects them to the loads: the loads will be partly or totally supplied by the generators (MCB opening is also available). When the active power on the loads falls below a second threshold, MC200 connects the loads to the mains, transfers the loads from the generators to the mains and stops the generators.

The function must be enabled by means parameter P.1171 (different from zero).

Moreover, it is possible to use a digital input (physical or virtual) to dynamically enable this function: use the function DIF.2722 for configuring the digital input. If such an input exists, it must be activated (logic status) to enable the “peak shaving/lopping” function.

The “peak shaving/lopping” function monitors the active power on the loads; the controller, this, must be able to measure this power (or to calculate it, see 7.8.4). If this measure is not available, the function is disabled.

Finally, the thresholds P.1172 and P.1174 must be carefully configured (the second one must be greater than the first one), otherwise the “peak shaving/lopping” function is disabled,

If the function is enabled, MC200 starts the generator if the active power on the loads is higher than the threshold P.1172 consecutively for the time P.1173. In the same way, MC200 stops the generator if the active power on the loads is lower than the threshold P.1174 consecutively for the time P.1175.

The page B.13 shows details for this function (the page is visible only if the function is enabled).

### 7.17.1 Power management

Once the gensets have been started and the MGCB has been closed, MC200 actions depend on the “active power management” configuration (P.0880, see 7.11).

#### 7.17.1.1 SYSTEM BASE LOAD (“peak lopping”)

In this case, MC200 keeps the generators in parallel to the mains. The generators will provide a fixed power (as set by parameter P.0858 or acquired by means an analogue input configured as AIF.2307); the remaining part of the loads will be supplied by the mains. Attention: if the SYSTEM BASE LOAD setpoint should be greater than the loads, the generators will export active power on the mains.

#### 7.17.1.2 SYSTEM IMPORT EXPORT (“peak shaving”)

In this case, MC200 keeps the generators in parallel to the mains. A fixed power will be imported from the mains to supply the loads (setpoint set by parameter P.0859 or acquired by means an analogue input configured as AIF.2309); this setpoint could also be 0. The remaining part of the loads will be supplied by the generators. In this case, if the power on the loads should be less than the setpoint, the generators will supply 0 kW.

#### 7.17.1.3 Transfer to the generators

In this case, MC200 does not keep the generators in parallel to the mains. After closing MGCB, MC200 will transfer the loads from the mains to the generators (see 7.11.3) and then it will open MCB circuit breaker.

### 7.17.2 Events

If it is configured with the bit 6 of the parameter P.0441, the controller records the following events related to the “peak shaving/lopping” function:

- EVT.1331: “peak shaving/lopping” function requires the starting of the generators.

- EVT.1332: “peak shaving/lopping” function does not require the starting of the generators.

## 7.18 “Loads’ voltages regulation”

Through this function, MC200 continuously regulates the voltages of the generators, in order to keep the measured voltage on the loads as close as possible to the indicated setpoint. It is useful when there are transformers between the generators and the loads, and when the loads are very variable, both as active power and as power factor.

It applies only to "Multiple Prime Mover" (MPM) applications (only production in island mode).

The loads’ voltages must, in fact, be connected to the MC200 JG terminals, where the mains voltages are normally connected. For MPM applications, these terminals are not used (unless this function is enabled).

The function is configured with the following parameters:

- P.9531 "Enable loads’ voltages regulation".
- P.9532 "Loads’ voltages regulation set-point".
- P.9533 "Loads’ voltages regulation ramp".
- P.9534 "Loads’ voltages regulation gain ".
- P.9535 "Loads’ voltages regulation integrative factor".
- P.9536 "Loads’ voltages regulation dead band".

**Enabling.**

The function is enabled by setting parameter P.9531 to "1". Once enabled by parameter, it is possible to use a digital input (physical or virtual) to enable/disable it dynamically: use the DIF.2731 function for configuring the digital input. If there is an input configured with this function, then the function is enabled when the input is active (logical state).

**Setpoint.**

The voltage reference for the loads can be acquired in two ways:

- Using the parameter P.9532.
- Via an analogue input, configured with the AIF.2421 function. The conversion of the acquired measurement into the setpoint is done through a conversion curve.

If there is an analogue input configured in this way, it takes precedence over the parameter P.9532. However, it is possible to use a digital input (physical or virtual) to decide whether to acquire the setpoint from the analogue input or whether to use the parameter P.9532. Configure the digital input with the DIF.2732 function:

- If the input is active, the setpoint is acquired by the analogue input.
- If the input is not active, the setpoint is the parameter P.9532.

If the function is enabled, the setpoint is displayed on the display page that shows the single-line diagram of the system. If the setpoint is acquired directly from the parameter P.9532, it is also possible to modify it from this page.

**Operation.**

If the function is enabled, MC200 uses a PID control loop (configured with parameters P.9534 and P.9535) to change the voltages command sent via CanBus to the generators, to align the measured voltage on the JG terminals to the selected setpoint.

It is possible to select a minimum acceptable error (dead band - parameter P.9536): if the difference between the voltage measured on the JG terminals and the setpoint is less (percentage) than the indicated setpoint, the voltages command sent to the generators is kept constant. This increases the stability of the system.

If the operator modifies the setpoint, MC200 follows the change with a configurable ramp (parameter P.9533, %/s): this also serves to increase the stability of the system and avoid introducing transients.

Page B.14 of the display shows all the details of this function; the page is visible only if the function is enabled.

# 8 Anomalies

This chapter describes all the anomalies managed by the controller. Some of these acts as protections for the loads or for the generators. There are also signalling of specific events in the plant management. Before describing them in detail, some definitions are required.

We define three typologies of anomaly:

- **Warnings**: these anomalies do not require stopping the generators. They point out to situations that are not dangerous at the moment, but the operator must take some action because, if ignored, they could degenerate in one of the following categories.
- **Unloads:** these anomalies require stopping the generators. As they do not create problems for the loads and the gensets, in parallel operations opening of the power connection is preferably performed after power unloading. This is performed by unloading ramp. However, it is not possible to restart the generators until the anomaly has not been acknowledged.
- **Alarms**: these anomalies require stopping the generators. They create hazards for the loads and/or for the generators. For this reason, the controller opens immediately the MGCB circuit breaker (without discharging the power from the generator), and stops the generators with standard procedure, i.e. with the cooling cycle. It is not possible to restart the generators until the anomaly is acknowledged.

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

For activating unloads, alarms or other unloads should not be present. Some other warnings can be active.

For activating a warning, alarms or unloads should not be present. Some other warnings can be active.

When an anomaly activates, the controller performs the following:

- It activates the internal horn and, if configured, also the external one. To this purpose, it is possible to configure an output of the controller with function DOF.3152 (“External horn”). The output is controlled together with the internal acoustic signalling; the aim is to use a more powerful signalling or a lamp.
- Prompts the page S.02 ANOMALIES on the multifunction display. This page shows the fault numeric code and the current language text related to the anomaly. The numeric code flashes to indicate that the anomaly hasn't been recognized by the operator yet.
- It activates the flashing of the “ALARM” light, if the anomaly belongs to the warning category, or it switches that light fixed on in case of unloads and alarms.
- If the anomaly isn't a warning, it disconnects the generators from users or from the parallel bars (with or without power discharge) and it stops the generators (with or without cooling cycle).

The following operations can be carried out on an anomaly:

- **Silence** the horn.
- **Acknowledge** it: this informs the controller that the operator has acknowledged the event.

- **Reset:** this informs the controller that the anomaly is no longer active.

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

## 8.1 Silence the horn

The horn can be silenced in three ways:

- Pressing the ACK/ENTER pushbutton. **This operation does not acknowledge the anomaly, which continues to flash on the display**.
- With a digital input configured with DIF.2002 function (“Command for alarm acknowledgement”). The acoustic signalling is silenced when the input passes from “not active” to “active”.
- Using a Modbus command. The commands can be protected by a password (P.0004) which must be entered before any command and can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “51”.

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

- If set to zero, the horn will be never activated.
- If set to 999, the horn will be activated when a new anomaly arises and deactivated through the above-described procedure.
- If set to a value between 1 and 998, the horn will be activated when a new anomaly arises and deactivated through the described procedure above, or when the configured time has elapsed.

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

## 8.2 Acknowledge the anomaly

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

- By pressing the ACK/ENTER button on the board panel. If you push this key when the horn is on, it stops the horn: it should be pressed a second time to “recognize” the anomaly.
- With a digital input configured with DIF.2002 function (“Command for alarm acknowledgement”). It is acknowledged when the input passes from “not active” to “active”.
- Using a Modbus command. The commands can be protected by a password (P.0004) which must be entered before any command and can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.

- HOLDING REGISTER 102: enter the value “52”. NB: this control also silences the horn (in case it is active).

When the anomaly has been acknowledged, it stops flashing on page S.02 ANOMALIES. After being identified, if it is a warning, it is automatically cancelled if the cause is no more present.

Otherwise, if the cause disappears before the anomaly has been acknowledged, it remains on the display.

## 8.3 Cancel the anomaly

An anomaly can be cancelled only when the cause that activated it is no more present.

The controller automatically resets all the acknowledged warnings when their cause is no longer active.

On the contrary, to cancel unloads 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 - “Command for resetting alarms”. When the input becomes “active”, the controller carries out a reset of all faults.
- Using a Modbus command. The commands can be protected by a password (P.0004) which must be entered before any command and can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “53”.
- By using an “SMS” command (see document [3]).

## 8.4 Events and signalling

Each anomaly is registered (with its own code) in the event log.

Some functions are available for the configuration of the digital outputs related to the anomalies:

- DOF.3151 (“Reset of anomalies”). The controller 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 horn. It can be used to control a more powerful horn and/or a lamp.
- DOF.3154 (“Acknowledge of the anomalies”). The controller activates this output for one second when the internal sequence of faults acknowledgement is carried out. This procedure can be used to acknowledge also some possible faults managed by other devices externally.
- DOF.4001: the output will be activated if at least a warning is active.
- DOF.4002: the output will be activated if at least an unload is active.
- DOF.4004: the output will be activated if at least an alarm is active.
- DOF.4005: the output will be activated if at least an alarm or an unload are active.

- DOF.4035: the output will be activated if at least an anomaly linked to circuit breakers is active. What follows is the list of anomalies that activate this output:
  - 013 (“MCB not closed”).
  - 014 (“GCB not closed”).
  - 023 (“MCB not open”).
  - 024 (“GCB not open”).

The board makes available the following internal statuses, related to anomalies, for AND/OR logics:

- ST.006: the output will be activated for a second after a command of faults acknowledgement.
- ST.007: the output will be activated for a second after a command of faults reset.
- ST.008: Warnings cumulative.
- ST.009: Unload cumulative.
- ST.011: Alarm cumulative.
- ST.012: Non-acknowledged warnings cumulative.
- ST.013: Non-acknowledged unloads cumulative.
- ST.015: Non-acknowledged alarms cumulative.

## 8.5 OVERRIDE of protections

**WARNING: the use of this function can cause serious damages to the generators. SICES cannot be considered anyway liable due to malfunctioning and damages to things and/or people occurred because of the utilization of the OVERRIDE function.**

This term defines the capacity of the controller of temporarily disabling (in particular conditions and on specific request) a series of protections. The OVERRIDE function, when is activated, turns a set of alarms and unloads into simple “warnings”: in this way, the board indicates, anyway, the presence of problems, but doesn't reduce the supplying capacity of the generators. In some situations, in fact, supply to users is put before the preservation of the engines. You should consider, for example, hospitals: there are situations in which it is preferable to damage the engines, and supply power for the longest period possible, rather than safeguarding the engines, but leaving operating rooms without light.

The board manages the protections OVERRIDE request through digital inputs. Use the following function to configure the digital inputs:

- DIF.2063 (“Full protections Override”).

The OVERRIDE function turns a specific set of alarms/unloads into "warnings". The document [1] has a table indicating all the controller anomalies: the column “OVER” indicates, for each anomaly, if it is subject to the OVERRIDE functions.

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 protections OVERRIDE too:

- DIF.4062 - “Unload (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 protections OVERRIDE 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 the OVERRIDE function is activated.

The board records an event each time an OVERRIDE request is activated (EVT.1082). Moreover, it records an event among the records, whenever the OVERRIDE request ceases (EVT.1083).

## 8.6 Anomalies connected to digital inputs

The board manages a significant number of digital inputs, by considering also the expansion modules (DITEL) that it can manage. Every input can be used to activate anomalies. These anomalies are divided into two kinds:

- **Specific.** They are configured with functions DIF.4261 and following. The board knows the modes through which these anomalies should be managed, and already has some default error messages (that cannot be configured) connected to each anomaly.
- **Generic**. They are configured through DIF.4001 through DIF.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, the board will be instructed regarding the way it should manage the anomaly.

Specific anomalies will be described in the following paragraphs: in the description, the parameters relevant to the digital input #1 (P.2001, P.2002 e P.2003) will be always referred to. The document [1] has a table that shows the parameters to be used for every digital input.

What stated above is true also for generic anomalies. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each input. On the contrary, they are described here, by indicating parameters for input #1 of the controller.

The board assigns numeric codes 701 through 806 to generic anomalies linked to digital inputs (the document [1] has a table that shows the code for each input). By utilizing the parameter that configures the function (P.2001), it is possible to select the type of anomaly (warning, unload or alarm) and to define the conditions for the anomaly management. Warning: by setting the delay to “0”, the anomaly is disabled. In the list below, the functions for the configuration of digital inputs, used to manage generic anomalies, are indicated. They are grouped three by three: the three functions for each group define the type of anomaly (see document [1] for the list of functions).

- DIF.4001, DIF.4002, DIF.4004. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4005, DIF.4008. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. An anomaly of the same type is also activated by all the genset controllers connected through the CAN bus link.
- DIF.4021, DIF.4022, DIF.4024. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. These anomalies force the opening of the MCB circuit breaker.
- DIF.4062, DIF.4064. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly is subject to the engine protections OVERRIDE and to total OVERRIDE, too (see 8.5).

## 8.7 Anomalies connected to analogue inputs

The board can manage a high number of analogue inputs, also considering those acquired by DIGRIN, DITHERM and DIVIT expansion modules.

For each analogue input, it allows setting two thresholds on the acquired measure, and each threshold can activate an anomaly. These are generic anomalies, since the controller doesn't know how to manage them and hasn't default warning messages. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each analogue input. On the contrary, they are described here, by indicating parameters for input 1.

The controller assigns numeric codes 301 through 554 to generic anomalies linked to analogue inputs (the document [1] has a table that shows the code of each input).

First, the operator should configure the error message that will be shown on the board display when the anomaly is activated. It should use P.4002 parameter, the only one for the two thresholds. The controller will add an initial wording to the configured message:

- “High value:” if the anomaly is activated when the measure is higher than the threshold.
- “Low value:” if the anomaly is activated when the measure is lower than the threshold.

For each analogue input, there are six parameters available for the management of thresholds, three for each threshold (P.4003, P.4004 and P.4005 for the first threshold of the first analogue input; P.4006, P.4007 and P.4008 for the second threshold of the first analogue input).

Besides the threshold value (P.4003 or P.4006) and the delay to be managed (P.4004 or P.4007), the operator must configure the operations connected to the threshold (P.4005 o P.4008). The parameter that configures the actions is managed through bits (every bit enables/disables a function connected to the threshold). For the description of these parameter, see 5.6.4.

Warning: by setting the delay to “0”, the anomaly isn't disabled.

## 8.8 Faults list

**NOTE**: as it is not possible to define either which digital or analogue inputs (of the controller or on additional modules) will be used or which function they are going to perform, refer to the following list as an example of the first configurable input. The presence of symbol (*) or the indication “or equivalent for the other inputs” aside a parameter indicates that it varies according to the configured input.

From this point on, words **enabling** and **activation** will be utilized:

- Enabling an anomaly means that the minimum necessary conditions that the controller should verify to observe the provoking cause.
- Activating an anomaly means the verification of the provoking cause, after the enabling has happened.

### 005 - At least one GCB is not opened

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.0805** |
| To disable: | **-** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly when it detects (from information sent over CAN bus PMCB) that at least one genset is in a “GCB not opened” condition (GCB closed while an opening command is active). In this situation, the parameter P.0805 selects the actions on the MGCB circuit breaker:

- “0”. This setting forces an MGCB opening (and obviously avoids next MGCB closures).
- “1”. This setting avoids MGCB closures (but doesn’t force MGCB opening if already closed).
- “2”. Use this setting when you want that the “GCB not open” condition is not involved in the MGCB management.

**Note: the gensets controllers have its own equivalent parameter to configure actions on GCB.**

## 007 – Manual STOP pressed in automatic mode

| | |
|---|---|
| Typology: | **Alarm** |
| Related parameters: | **P.0495** |
| To disable: | **Bit 0 of P.0495=1** |
| Enabled if: | **AUTO, TEST, REMOTE START.** |

The protection is enabled if bit 0 of parameter P.0495 is set to 0. It is activated when pressing the STOP button on MC200, or if a stop command is received from Modbus.

## 008 - Power required for supply not reached

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.0806** |
| To disable: | **P.0806 = 0 o P.0806 = 30000** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

This anomaly is enabled only if MGCB circuit breaker exists, and if it is managed by MC200. Moreover, it is enabled only when generators must supply in “island” mode. MC200 activates this anomaly before MGCB closure, if all available generators are supplying but the sum of their nominal powers is lower than the power requested with parameter P.0806. It signals that generators may be unable to supply all loads. Values “0” and “30000” of P.0806 are special; they disable this anomaly. The value “0” configures MC200 to close MGCB as soon as one GCB is closed; the value “30000” forces MC200 to wait for all available generators are supplying (whatever their power is).

## 013 - MCB not closed

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.2001 (or equivalent for other inputs)** |
| To disable: | **P.2001 <> DIF.3002** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly after three consecutive closing commands without results (in MAN after the first attempt). It cannot be directly disabled: it can be disabled only by not configuring an input to acquire the circuit breaker status (but this is possible only in certain situations).

## 014 - MGCB not closed

| | |
|---|---|
| Typology: | **Warning / alarm** |

| | |
|---|---|
| Related parameters: | **P.2001 (or equivalent for other inputs)** |
| To disable: | **P.2001 <> DIF.3003** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly after three closing commands of the circuit breaker without result (in MAN mode after the first attempt): it is a warning in MAN mode and an alarm in the other modes. It cannot be directly disabled: it can be disabled only by not configuring an input to acquire the circuit breaker status (but this is possible only in certain situations).

## 016 – Maximum current (#1)

| | |
|---|---|
| Typology: | **Warning / unload / alarm** |
| Related parameters: | **P.9502 P.9521 P.9522 P.9523 P.9524** |
| To disable: | **P.9502 = 0 o P.9522 = 0 o P.9523 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly when at least one of the mains currents is higher than the configured threshold.

The threshold (P.9521) is a percentage of the nominal current of the system, set by parameter P.9502. The threshold can be configured between 0% and 999%, with 0.1% resolution.

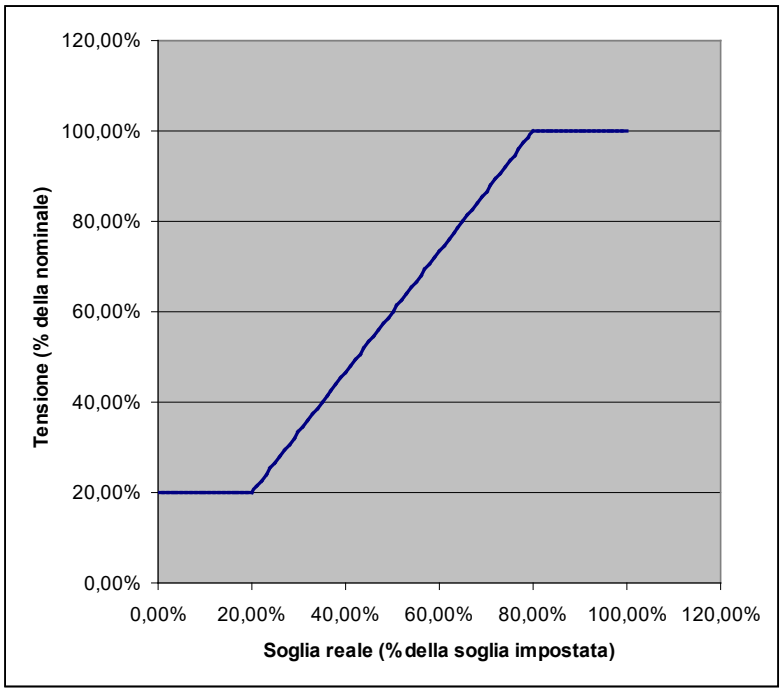
The delay (P.9522) of the protection can be set between 0 and 4000 seconds, with 0.1 seconds' resolution. If the delay is set to zero, the protection is disabled: so, the minimum delay is 0.1 seconds.

Parameter P.9524 selects the typology:

- 1: Warning.
- 2: Unload.
- 4: Alarm.
- 8: Alarm sent also to all gensets.
- 9: Warning, it forces MCB opening.
- 10: Unload, it forces MCB opening.
- 12: Alarm, it forces MCB opening.

The protection can work in four different ways, as selected by parameter P.9523:

1. This value selects a "fixed time" protection. The anomaly is activated when at least one current is higher than the threshold P.9521 for the time P.9522. Note: the check is made both on instantaneous and average current values; if one or both is higher than the threshold the protection can be activated.
2. This value selects the same protection of the previous one: the only difference is that the real threshold is decreased respect to the configured one if the voltages are lower than the nominal.




3. This value selects a time-related maximum current protection (it activates so much more quickly how much higher is the overload). The used curve is named EXTREMELY INVERSE, and implements an I2t function.

   We define a maximum current threshold (P.9521), and the maximum time the generator can work with this current (P.9522). If the current is lower than the defined threshold, the protection is not activated. If the current become greater than the threshold, the protection is activated with a time inversely proportional with the entity of the over current. To correctly set the thresholds, follow the following steps:

   - You must set the nominal current of the system (P.9502).
   - Configure the maximum current threshold by the P.9521 parameter, as a percentage of the nominal current.
   - Configure the intervention time for the protection in the P.9522 parameter: the protection will be activated exactly after the time you've configured if the current is constantly equals to the P.9521 threshold multiplied by $\sqrt{2}$ .

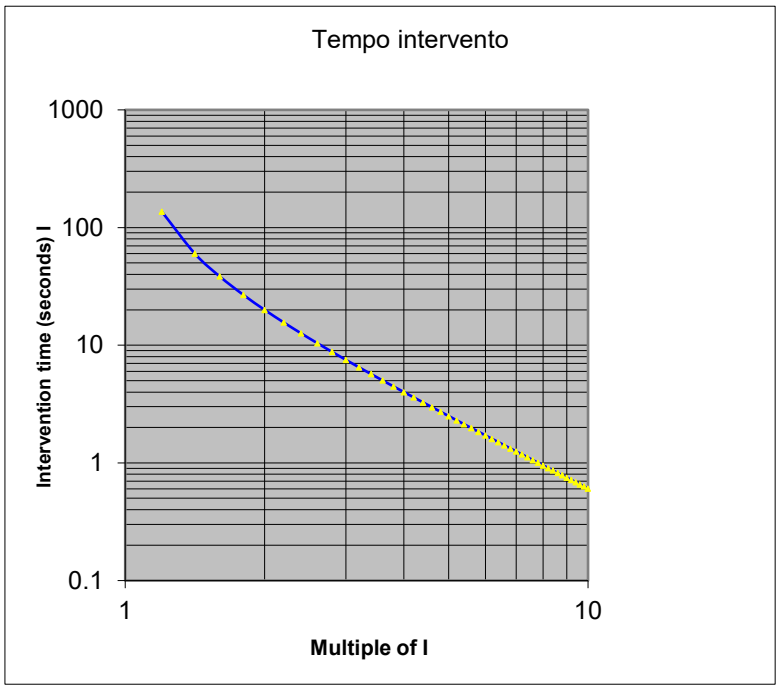
   To calculate the intervention time for a preferred current, please use the following formula:

$$t_I = \frac{P.9522}{\left(\frac{I}{P.9521}\right)^2 - 1}$$

   *"I"* is the current in the circuit.

   You must keep in mind that the board calculates the integral value of the current in the time, so all the current samples over the threshold concur to determine the intervention time, with their instantaneous weight as defined in the previous formula. The only way to verify exactly this formula is thus to switch instantaneously from a normal load situation to an over load situation.

The following graph shows the used curve, with P.9522 set to 60 seconds (I is the maximum current):




4. This value selects the same protection of the previous one: the only difference is that the real threshold is decreased respect to the configured one if the voltages are lower than the nominal (see description for value 2).

## 017 – Maximum current (#2)

| | |
|---|---|
| Typology: | **Warning / unload / alarm** |
| Related parameters: | **P.9502 P.9525 P.9526 P.9527 P.9528** |
| To disable: | **P.9502 = 0 o P.9526 = 0 o P.9527 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

The same as anomaly “016”, with the parameter listed above.

## 021 – Time-out for stopping generators

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.9512** |
| To disable: | **P.9512 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

This anomaly is activated when at least one genset managed by MC200 is still running after the delay set in the parameter P.9512 from the stop command.

## 022 – Time-out for starting generators

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.9511** |
| To disable: | **P.9511 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

This anomaly is activated when none of the gensets managed by MC200 is running after the delay set in the parameter P.9511 from the start command.

## 023 – MCB opening failure

| | |
|---|---|
| Typology: | **Warning / alarm** |
| Related parameters: | **P.2001 (or equivalent for other inputs)** |
| To disable: | **P.2001 <> DIF.3002** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly in the following situations:

- If MC200 manages the circuit breaker, but it is closed by an external logic (not in MAN mode). The anomaly is set only if the “static command” is used to manage the circuit breaker. In this case the controller activates an alarm with a delay of 0.5 seconds.
- After three opening commands of the circuit breaker without result (only one attempt in MAN mode): in this case, it is a warning in MAN mode and an alarm in the other modes.

It cannot be directly disabled: it can be disabled only by not configuring an input to acquire the circuit breaker status (but this is possible only in certain situations).

## 024 – MGCB opening failure

| | |
|---|---|
| Typology: | **Warning / alarm** |
| Related parameters: | **P.2001 (or equivalent for other inputs)** |
| To disable: | **P.2001 <> DIF.3003** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly in the following situations:

- If MC200 manages the circuit breaker, but it is closed by an external logic (not in MAN mode). The anomaly is set only if the “static command” is used to manage the circuit breaker. In this case the controller activates an alarm with a delay of 0.5 seconds.
- After three opening commands of the circuit breaker without result (only one attempt in MAN mode): in this case, it is a warning in MAN mode and an alarm in the other modes.

It cannot be directly disabled: it can be disabled only by not configuring an input to acquire the circuit breaker status (but this is possible only in certain situations).

## 037 – Low power supply voltage

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.0362 P.0363** |
| To disable: | **P.0363 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly when power supply voltage drops down under the threshold P.0362 for the time set with parameter P.0363. Note: the threshold P.0362 is expressed as a percentage of the supply rated voltage, which is configurable but it is automatically selected by the controller between 12 and 24 Vdc. Selection is made when the controller is powered and every time it is forced in OFF/RESET mode. A nominal voltage of 12 V is selected if power supply voltage is lower than 17 V.

## 038 – High power supply voltage

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.0364 P.0365** |

To disable: **P.0365 = 0**
Enabled if: **MAN, AUTO, TEST, REMOTE START.**

MC200 activates this anomaly when power supply voltage grows up over the threshold P.0364 for the time set with parameter P.0365. Note: the threshold P.0364 is expressed as a percentage of the supply rated voltage, which is configurable but it is automatically selected by the controller between 12 and 24 Vdc. Selection is made when the controller is powered and every time it is forced in OFF/RESET mode. A nominal voltage of 12 V is selected if power supply voltage is lower than 17 V.

## 045 – Maximum auxiliary current

Type: **Alarm**

Parameters connected: **P.0108 P.0135 P.0131 P.0367 P.0368**

To disable: **P.0368 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if a valid current measure is configured. Both P.0108 and P.0135 should be different from zero, and P.0131 should be set to 1 or 2. 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, per the previous conditions, the measure of current stays above P.0367 threshold uninterruptedly for the time P.0368.

## 048 – Emergency stop

Type: **Alarm**

Parameters connected: **P.0361**

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if, per the previous conditions, the input dedicated to the emergency stop (JJ 2) remains idle, continuously for the configured time (P.0361).

Note: this anomaly can be activated also with an already active shutdown.

## 051 – High internal board temperature

Typology: **Warning**
Related parameters: **P.0366**
To disable: **P.0366 = 255.0**
Enabled if: **MAN, AUTO, TEST, REMOTE START.**

MC200 activates this anomaly when its internal temperature is greater than the threshold P.0366, even for a very little time.

## 057 – Clock not valid

Type: **Warning**

Parameters connected: **P.0418 P.0421 P.0422 P.0423 P.0426**

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It is activated if the controller recognizes the clock status as not valid and the functions related to the clock, such as the weekly test (P.0418), the time to enable operations (P.0421, P.0422, P.0423) or the time to force intervention (P.0426) have been configured.

To deactivate it, you need to set the clock.

## 062 – Faulty CAN bus 0 link

Type: **Warning**

Parameters connected: **P.0141 P.0142 P.0143 P.0144**

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 <> 0).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

## 200 – CAN bus PMCB faulty connection

Typology: **Warning**
Related parameters: **-**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START.**

This anomaly is activated each time the CAN bus internal interface of the controller switches to the BUS-OFF status. Normally the “BUS-OFF” condition is related to wiring problems (short circuits between CAN-H and CAN-L lines, for example).

## 201 – Duplicated address over the PMCB

Typology: **Warning**
Related parameters: **P.9501**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START.**

This anomaly is activated when two or more MCxxx devices are connected to the same can bus line, and they have the same address for PMCB (parameter P.9501).

## 202 – Wrong number of generators over the PMCB

Typology: **Warning**
Related parameters: **P.0803**
To disable: **P.0803 = 0**
Enabled if: **MAN, AUTO, TEST, REMOTE START.**

MC200 activates this anomaly if the number of genset controllers communicating over the can bus PMCB is different from what configured by parameter P.0803. In this case, parameter P.0804 can be used to inhibit MGCB closure (but not to force its opening). By setting the parameter P.0803 to “0”, you disable this command.

## 207 – Maximum time in parallel to the grid.

Typology: **Warning**
Related parameters: **P.0890**
To disable: **P.0890 = 0**
Enabled if: **MAN, AUTO, TEST, AVVIAMENTO REMOTO.**

MC200 activates this anomaly if P.0890 has been set to a value different from zero, and the duration of the parallel to the grid was longer than this parameter. MC200 opens the MGCB circuit breaker and doesn't allow its closure until the operator acknowledges this warning. MC200 can activate this warning even when the function "transfer to gensets" is enabled, if at the end of the configured delay the power is not yet transferred to the gensets (because the nominal power of the gensets is not enough for the loads): in this case, if the power on the loads would decrease (or if new gensets became available), MC200 will close again MGCB circuit breaker even if the warning has not been acknowledged.

The parameter P.0897 is a bit-field parameter, allowing the operator to select in which conditions MCB opening as to be allowed at the end of configured time:

- Bit 0: in MAN mode.
- Bit 1: in AUTO mode.
- Bit 2: in TEST mode.
- Bit 3: in REMOTE START mode.
- Bit 7: in case of failure in opening MGCB.

## 211 – Shared input written by multiple devices CAN-BUS (PMCB)

Type: **Warning**

Parameters connected: **-**

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated when one or more boards communicating on the PMCB CAN-BUS are using the same shared input. On page S.02, by selecting this warning, the board shows the type and the number of the shared input and the address of the controller that is writing it. See document [8].

## 252 – CAN bus (EXBUS) expansion modules missing

Type: **Warning**

Parameters connected: **P.0141 P.0142 P.0143 P.0144**

To disable: **P.0141=0** and **P.0142=0** and **P.0143=0** and **P.0144=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN bus is activated (P.0141 or P.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 (EXBUS) missing measure

Type: **Warning**

Parameters connected: **P.0141 P.0142 P.0143 P.0144**

To disable: **P.0142=0** and **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN bus for the expansion modules is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It will be activated when the controller doesn't receive an analogue measure from the CAN bus. The board verifies the sole presence of the utilized analogue measures (those that have a function different from zero in P.4001 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 (EXBUS) duplicate address

Type: **Warning**

Parameters connected: **P.0141 P.0142 P.0143 P.0144**

To disable: **P.0141=0** e **P.0142=0** e **P.0143=0** e **P.0144=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN bus for the expansion modules is activated (P.0141 or P.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 sensor (EXBUS)

Type: **Warning**

Parameters connected: **P.0142 P.0143**

To disable: **P.0142=0** and **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN bus for the expansion modules is activated (P.0141 or P.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 – MGCB synchronization failure

Typology: **Warning / alarm**
Related parameters: **P.0852**
To disable: **P.0852 = 0**
Enabled if: **AUTO, TEST, REMOTE START.**

This anomaly is activated only during automatic synchronization, for MGCB closure. If the circuit breaker is not closed after the P.0852 delay, MC200 activates the anomaly: it's a warning in MAN mode, an alarm in all other modes.

## 272 – MCB synchronization failure

| | |
|---|---|
| Typology: | **Warning** |
| Related parameters: | **P.0853** |
| To disable: | **P.0853 = 0** |
| Enabled if: | **AUTO, TEST, REMOTE START.** |

This anomaly is activated only during automatic synchronization, for MCB closure. If the circuit breaker is not closed after the P.0852 delay, MC200 activates the anomaly.

## 273 – Incoherent parameters

| | |
|---|---|
| Typology: | **Warning / alarm** |
| Related parameters: | **-** |
| To disable: | **-** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly to signal a “wrong configuration” of parameters. In the “S.02” display page, a detailed description shows the real cause of the anomaly. Possible causes are:

- The parameters which require the “SICES” password are never been set after the first factory configuration. It’s an alarm.
- Selected plant type (P.0802) is different from “MPM”, and the MCB circuit breaker is configured as “not managed” (P.0855). It’s an alarm.
- MCB circuit breaker is configured as “external” (P.0855) and no digital input is configured to acquire its status (function DIF.3002). It’s an alarm.
- MCB circuit breaker is managed by MC200 without static commands, and no digital input is configured to acquire its status (function DIF.3002). It’s an alarm.
- MCB circuit breaker is configured as “external synchronizable” (P.0855), and no digital input is configured to acquire external synchronization requests (function DIF.1034). It’s an alarm.
- MGCB circuit breaker is configured as “external” (P.0854) and no digital input is configured to acquire its status (function DIF.3003). It’s an alarm.
- MGCB circuit breaker is managed by MC200 without static commands, and no digital input is configured to acquire its status (function DIF.3003). It’s an alarm.
- MGCB circuit breaker is configured as “external synchronizable” (P.0854), and no digital input is configured to acquire external synchronization requests (function DIF.1004). It’s an alarm.
- The parameter P.9506 is programmed to zero, but in the plant is present at least one controller that does not support MC200 mode. Function available by DST4602 starting from version 00.87 and GC600 from version 1.04; but not by the MC100. It’s a warning.

## 274 – Production line open

| | |
|---|---|
| Typology: | **Alarm** |
| Related parameters: | **P.2001 (or equivalent for other inputs)** |
| To disable: | **P.2001 <> DIF.4261** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

MC200 activates this anomaly if the digital input configured with the function DIF.4261 ("production line open") is activated (even for a very small time). **Note: this alarm forces the opening of all generator circuit breakers GCB; this function is directly managed by the genset controllers after receiving a proper message over the PMCB bus.**

## 275 – Interface device not opened

| | |
|---|---|
| Typology: | **Alarm** |
| Related parameters: | **P.0900** |
| To disable: | **P.0900 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

This anomaly is used only for parallel to mains operations. MC200 activates it when the circuit breaker configured as "interface device" (P.0900) does not open in 0.5 seconds from the "loss of mains". Set P.0900 to zero do disable this control: **ensure some external logic can disconnect generators from mains in case of loss of mains.**

## 279 – Inconsistent bar voltage

| | |
|---|---|
| Type: | **Warning/Alarm** |
| Parameters connected: | **-** |
| To disable: | **Bit 7, P.0807** |
| Enabled in: | **MAN, AUTO, TEST, REMOTE START** |

The board will activate this warning before closing MGCB, if it notices a divergence between the effective presence of voltage on parallel bars and what it expects per the statuses of the switches, mains and any other generator control boards connected on PMCB. The anomaly is activated only if there isn't voltage on bars when, on the contrary, it should be present. For example, if at least a generator has closed GCB, there should be voltage on parallel bars: if the board doesn't detect it (through the three-phase sensor or through a contact), after two seconds the signalling is activated. Usually the signal is a warning, it becomes an alarm (only in case of automatic procedures) after 60 seconds if the board needs to close the MGCB.

## 281 – Maximum power exported to the mains.

| | |
|---|---|
| Typology: | **Warning / alarm** |
| Related parameters: | **P.0384, P.0385, P.0386** |
| To disable: | **P.0385 = 0** |
| Enabled if: | **MAN, AUTO, TEST, REMOTE START.** |

This anomaly is activated when the active power measured on the mains is negative (exported) and is greater (absolute value) than the threshold P.0384 continuously for the time P.0385. The action related to the protection can be configured by P.0386:

- 1 – Warning. The controller activates the warning but keeps the generators in parallel to the mains,
- 4 – Alarm. The controller activates the alarm, opens MGCB (when present), forces the genset controllers to open their GCB and to stop the engines with the standard procedure (with the cool down cycle).
- 9 – Warning (MCB). If this value is selected, when the protection trips the controller opens MCB and keeps the gensets running for supply the load in island mode. The controller will try to close MCB only after the warning has been acknowledged. Note: using this value, the protection works in OFF/RESET mode also (it opens MCB). In this way, the mains is protected against manual parallel performed on the genset controllers when MC200 is in OFF/RESET mode.

## 301...554 - Generic anomalies linked to analogue inputs

See 8.6.

## 701...774 - Generic anomalies linked to digital inputs

See 8.7.

## 900 – Incoherent PLC Parameters

| | |
|---|---|
| Type: | **Warning** |
| Parameters connected: | **-** |
| To disable: | **-** |
| Enabled in: | **MAN, AUTO, TEST, REMOTE START** |

The protection is enabled only when a valid PLC program has been transferred to the board. It reports possible problems during the running of the PLC:

- The PLC program uses more FLASH memory than available.
- The PLC program uses more RAM memory than available.
- The PLC program has an invalid control check-sum.
- The PLC program is developed with a version not supported by this board.
- A digital or analogue output controlled by the PLC is not configured with DOF.0101 or AOF.0101 function (“used by the PLC”).
- The PLC program uses a resource (of any kind) not available on this board (for example, a digital input of a non-connected expansion module).
- An invalid parameter has been specified for one of PLC blocks.
- An invalid type of block has been specified.
- Calculation error during the running of the program.

On S.02 page, by selecting this early warning, the board shows additional information to help solving the problem.

## 901...964 - Anomalies connected to the PLC

The PLC program, through one of its blocks, can activate anomalies. Codes 901 through 964 are connected to such anomalies. Anomalies triggered by the PLC can be alarms, unloads or warnings.

# 9 Other functions

## 9.1 PLC logic

The MC200 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 “SicesPlcEditor” software to create and fulfil the PLC program. Use the “BoardPrg3” software to transfer the compiled PLC program to MC200 or to read it again from the board [2].

The PLC program is run every 100ms. This time span could not be adequate to manage protections that should intervene very quickly.

## 9.2 Loads protection from mains breaker damages

This function is used for “emergency” plants (MSB or MSB+MSTP). Normally, in case of mains live, the controller connects the load to the mains. For stand-by application, MCB must be usually closed to connect the loads to the mains. Using this function is possible to automatically start the gensets and supply the loads in case of MCB failure.

To use this function, carry out following configuration:

- MCB feedback must be connected to a digital input of the controller.
- Set parameter P.9514 to 1.

With such configuration, MCB status is continuously monitored. When MCB is commanded closed but remains opened for more than the programmed time (mains should be present if MCB is supplied by mains – P.0847), the following actions are carried out:

- It tries to close the MCB circuit breaker.
- In case if failure, warning W013 is issued.
- All available engines are started.
- Loads are connected to generators.

Now, the loads won’t be switched automatically on the mains until the operator “acknowledges” the warning W013. After this operation, the controller will try again to close MCB: if it does not close, the warning will be issued again and the load will stay switched on gensets.

In MAN mode (or with start inhibitions activated) the function is disabled; it is also disabled if a “inhibition to start” is activated,

The controller starts the generators (if P.9514 is set to 1) even when is activated the generic warning related to a digital input configured with the functions DIF.4021, DIF.4022, DIF.4024 (these anomalies force the opening of MCB). Even in this case, the controller will try to close MCB (and then will stop the generators) only when the operator will acknowledge and reset that warning.

## 9.3 Clock

The board is provided with a hardware clock. It is shown in details on page S.03. It is possible to set the clock through 4.7.1 menu or serial ports. It is used for several functions:

- History logs recordings.
- TEST weekly planning.

- Weekly planning of time intervals in which the gensets can start automatically.
- Weekly plan of periods in which the gensets automatic activation must be forced

The clock is equipped with a rechargeable battery and can work for some months even if the controller is not supplied. After a long time in which the controller is not used (no supply), even if the clock reactivates immediately when the supply comes back, a few hours are necessary to guarantee to full recharge of the internal battery.

### 9.3.1 Clock automatic update

In case the controller has an Ethernet connection, the clock can be automatically updated through the connection towards an NTP server (see par. 5.11.4). 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 TNP (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).
- 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.

### 9.3.2 Weekly planning for TEST.

The starting test plans is made on weekly base. That is, it is possible to indicate in which days of the week the generators must be started in test and in which not.

The parameters related to this function are the following:

- **P.0418**: allows to specify in which days of week the TEST will be performed. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.

| Bit | Hexadecimal value | Day |
|---|---|---|
| 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+02).

- **P.0419**: allows to set start time for the TEST (Hours and minutes).
- **P.0420**: allows to configure the TEST duration (in minutes).

P.0420 allows to configure the TEST duration (in minutes). This is because the same parameter is used also for the TEST activated by an SMS command.

### 9.3.3 Weekly planning for working days.

In some applications, it is useful to inhibit the automatic intervention of the gensets for mains failure in hours or days where the mains is not used. For example, if a factory is closed on Sunday, the gensets should never start in this day for mains failure (because it consumes unnecessary fuel). With this function, you can select in which days and in which time intervals the gensets 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 gensets can start automatically. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.
-

| Bit | Hexadecimal value | Day |
|---|---|---|
| 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 gensets can start automatically (in hours and minutes).
- **P.0423**: allows to configure the end of the time interval during which the gensets 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 gensets start is required only Monday through Friday, between 08:00 and 18:00, you must set:

P.0421 = 3E (02+04+08+10+20)

P.0422 = 08:00

P.0423 = 18:00

### 9.3.4 Weekly planning of intervention forcing.

The planning of intervention forcing is performed weekly. That is, it is possible to indicate on which days of the week the generators 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 should 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 generators must be forced. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value to be set for the parameter is the sum of the value fields in the following table related to the days needed.

| Bit | Hexadecimal value | Day |
|---|---|---|
| 0 | 01 | Sunday |
| 1 | 02 | Monday |
| 2 | 04 | Tuesday |
| 3 | 08 | Wednesday |
| 4 | 10 | Thursday |
| 5 | 20 | Friday |
| 6 | 40 | Saturday |

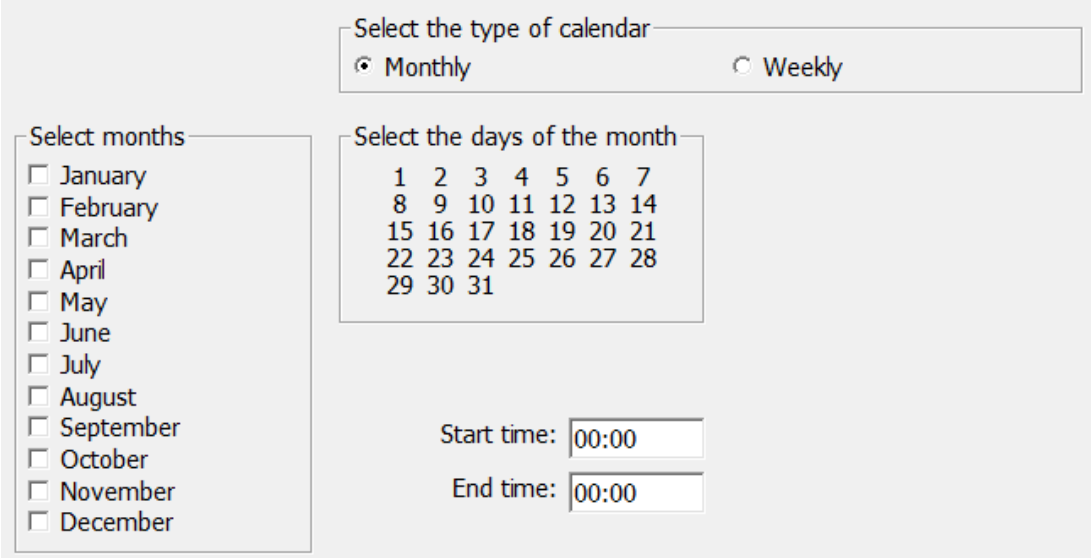
  For example, to configure the forcing of the intervention only on Monday and Thursday, it is necessary to set 12 (10+02).

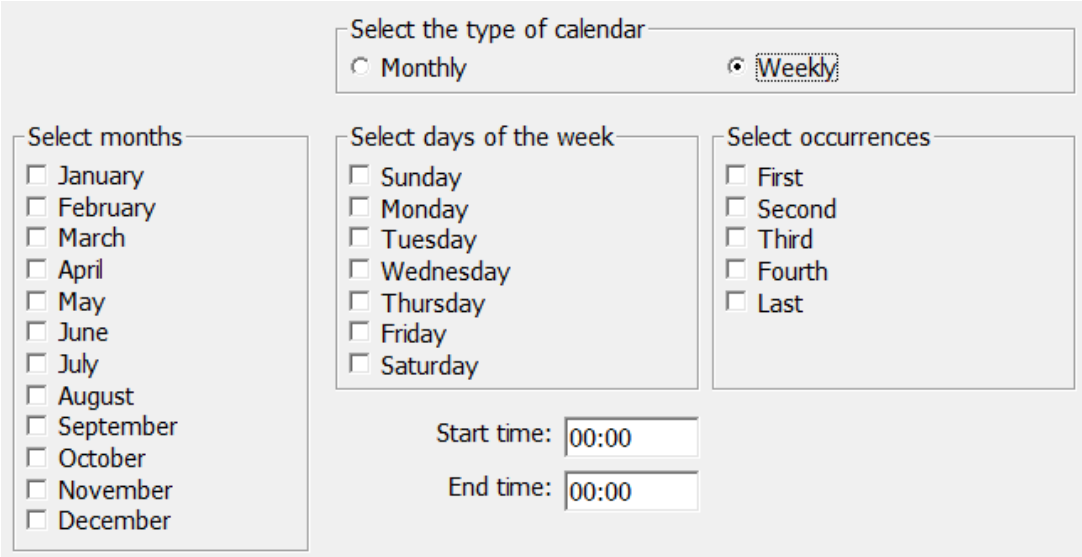
- **P.0427**: it allows setting the starting time of the forcing (in hours and minutes).
- **P.0428**: it allows setting the ending time of the forcing (in hours and minutes).

### 9.3.5 Configurable calendars

The controller provides 16 calendars fully configurable. They allow to select days and time-slots, inside which the controller activates an internal bit. This bit could then be used by AND/OR logics to activate a digital output or to create more complex logics. All calendars are identical: calendars 15 and 16, however, can be used for the activation/deactivation of the daylight save time (if parameter P.0409 is set to “3”).

Each calendar can be individually selected as “monthly” or “weekly”:






Using BoardPrg3 software, it is very easy to select whether a calendar is “weekly” or “monthly”. If you want to use the parameters of the controller, you must act on the parameter P.1900. It is a bit-field parameter; one bit is provided for each calendar:

| BIT | Value | Hexadecimal | Calendar |
|---|---|---|---|
| 0 | 1 | 0001 | Calendar 1 |
| 1 | 2 | 0002 | Calendar 2 |
| 2 | 4 | 0004 | Calendar 3 |
| 3 | 8 | 0008 | Calendar 4 |
| 4 | 16 | 0010 | Calendar 5 |
| 5 | 32 | 0020 | Calendar 6 |
| 6 | 64 | 0040 | Calendar 7 |
| 7 | 128 | 0080 | Calendar 8 |
| 8 | 256 | 0100 | Calendar 9 |
| 9 | 512 | 0200 | Calendar 10 |
| 10 | 1024 | 0400 | Calendar 11 |
| 11 | 2048 | 0800 | Calendar 12 |
| 12 | 4096 | 1000 | Calendar 13 |
| 13 | 8192 | 2000 | Calendar 14 |
| 14 | 16384 | 4000 | Calendar 15 |
| 15 | 32768 | 8000 | Calendar 16 |

The parameter must be set with the sum of the values for all the calendars that must be selected as “weekly” (in hexadecimal notation). In fact, a bit set to “1” selects the “weekly” mode.

Both calendar types allow to select in which months the controller activates the internal bit (at least one month must be selected, it is even possible to select all months). Using the parameters of the controller, this selection is done by means parameter P.1901 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

| BIT | Value | Hexadecimal | Month |
|---|---|---|---|
| 0 | 1 | 0001 | January |
| 1 | 2 | 0002 | February |
| 2 | 4 | 0004 | March |
| 3 | 8 | 0008 | April |
| 4 | 16 | 0010 | May |

| | | | |
|---|---|---|---|
| 5 | 32 | 0020 | June |
| 6 | 64 | 0040 | July |
| 7 | 128 | 0080 | August |
| 8 | 256 | 0100 | September |
| 9 | 512 | 0200 | October |
| 10 | 1024 | 0400 | November |
| 11 | 2048 | 0800 | December |

The parameter must be set with the sum of the values of the required months (in hexadecimal notation).

For “monthly” calendars, is then possible to select the days of the month for the activation of the internal bit (at least one day must be selected, it is even possible to select all days). Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

| BIT | Value | Hexadecimal | Day of month |
|---|---|---|---|
| 0 | 1 | 00000001 | 1 |
| 1 | 2 | 00000002 | 2 |
| 2 | 4 | 00000004 | 3 |
| 3 | 8 | 00000008 | 4 |
| 4 | 16 | 00000010 | 5 |
| 5 | 32 | 00000020 | 6 |
| 6 | 64 | 00000040 | 7 |
| 7 | 128 | 00000080 | 8 |
| 8 | 256 | 00000100 | 9 |
| 9 | 512 | 00000200 | 10 |
| 10 | 1024 | 00000400 | 11 |
| 11 | 2048 | 00000800 | 12 |
| 12 | 4096 | 00001000 | 13 |
| 13 | 8192 | 00002000 | 14 |
| 14 | 16384 | 00004000 | 15 |
| 15 | 32768 | 00008000 | 16 |
| 16 | 65536 | 000100000 | 17 |
| 17 | 131072 | 00020000 | 18 |
| 18 | 262144 | 00040000 | 19 |
| 19 | 524288 | 00080000 | 20 |
| 20 | 1048576 | 00100000 | 21 |
| 21 | 2097152 | 00200000 | 22 |
| 22 | 4194304 | 00400000 | 23 |
| 23 | 8388608 | 00800000 | 24 |
| 24 | 16777216 | 01000000 | 25 |
| 25 | 33554432 | 02000000 | 26 |
| 26 | 67108864 | 04000000 | 27 |
| 27 | 134217728 | 08000000 | 28 |
| 28 | 268435456 | 10000000 | 29 |
| 29 | 536870912 | 20000000 | 30 |
| 30 | 1073741824 | 40000000 | 31 |

The parameter must be set with the sum of the values of the required days (in hexadecimal notation).

For “weekly” calendars, is then possible to select the days of the week for the activation of the internal bit (at least one day must be selected, it is even possible to select all days). Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

| BIT | Value | Hexadecimal | Day of week |
|---|---|---|---|
| 16 | 65536 | 00010000 | Sunday |
| 17 | 131072 | 00020000 | Monday |
| 18 | 262144 | 00040000 | Tuesday |
| 19 | 524288 | 00080000 | Wednesday |
| 20 | 1048576 | 00100000 | Thursday |
| 21 | 2097152 | 00200000 | Friday |
| 22 | 4194304 | 00400000 | Saturday |

The parameter must be set with the sum of the values of the required days (in hexadecimal notation).

Selecting a day of the week (Sunday for example), it is then possible to select if all “Sundays” in the month must be used or only some of them. Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

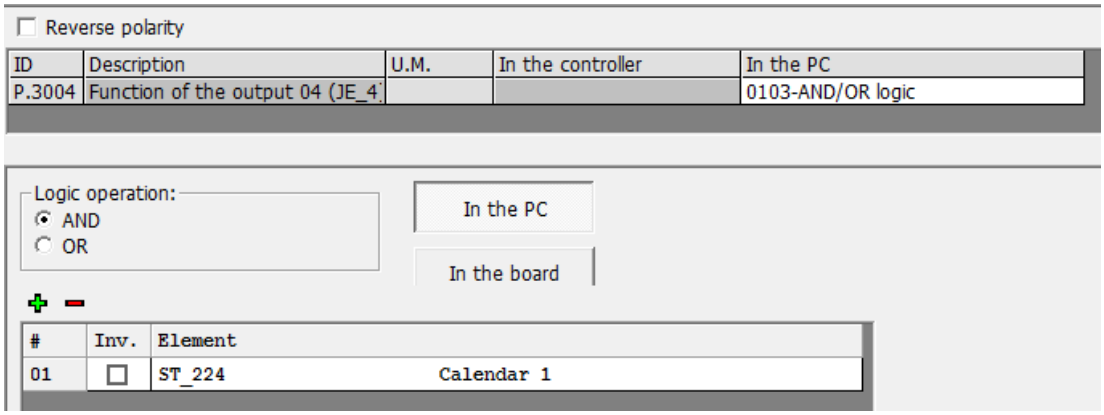
| BIT | Value | Hexadecimal | Occurrence |
|---|---|---|---|
| 0 | 1 | 00000001 | First occurrence |
| 1 | 2 | 00000002 | Second occurrence |
| 2 | 4 | 00000004 | Third occurrence |
| 3 | 8 | 00000008 | Forth occurrence |
| 4 | 16 | 00000010 | Last occurrence |

The parameter must be set with the sum of the values of the required occurrences (in hexadecimal notation). **Note: for “weekly” calendars, the days of week and their occurrences in the month are selected by the same parameter, using different bits.**

If the “occurrence” bits are all “0”, then the selected days of week will be managed in any week of the month; otherwise they will be managed for the selected occurrences only. The “last” option is useful because, depending on the month and on the year, a certain day of the week can be present 4 or 5 times in a month: using the “last” option you can do an action exactly in the last occurrence in the month. A typical example is the management of the daylight save time; in Italy, it is activated on the last Sunday of October, and deactivated on the last Sunday of March. Those Sundays can be the 4° or the 5° occurrence in the month, depending on the first day of the month. Using the “last” option, the problem is solved.

Finally, for both “weekly” and “monthly” calendars, it is possible to select a time-slot (valid for all selected days). The controller will activate the internal bit only inside the selected time-slot. Using the parameters of the controller, the time-slot can be selected by means P.1903 and P.1904 (for the calendar 1 or equivalent for other calendars). If those parameters are set with the same values, the full day is selected. If the start time is lower than the end time, the time-slot is not across midnight; otherwise, the internal bit is activated after the start time of the selected days, and it is deactivated after the end time of the day after the selected one.

Using the AND/OR logics, it is possible to activate a digital output into selected days and time-slot (selected using a calendar):




This is an example for the configuration of the daylight save time for Italy, using calendars 15 and 16:

- Calendar 15.
  - Select “weekly” (bit 14 of P.1900 = “1”).
  - Last Sunday of October:
    - Select “October” (P.1957 = “0200”).
    - Select “Sunday”, “Last” (P.1958 = “00010010”).
  - The activation should happen at 02:00:
    - Select “2:00” as start time (P.1959).
    - Select “2:01” as end time (P.1960).
- Calendar 16.
  - Select “weekly” (bit 15 of P.1900 = “1”).
  - Last Sunday of March:
    - Select “March” (P.1961 = “0004”).
    - Select “Sunday”, “Last” (P.1962 = “00010010”).
  - The activation should happen at 03:00:
    - Select “3:00” as start time (P.1963).
    - Select “3:01” as end time (P.1964).

## 9.4 Thermometer

The controller is provided with a hardware thermometer, for measuring its internal temperature. The temperature is shown at page S.03, multifunction display. It is used for many functions:

- At very low temperatures information display slows down. By utilizing the thermometer, when the temperature falls under a very low threshold, the board keeps always the backlighting lamp on, that contributes to heat the display and therefore to increase its efficiency.
- The electronic components inside the controller have an extended working temperature range. Despite this, it is possible in critical ambient conditions that

temperature goes out of this range. The controller uses the thermometer to activate a warning if the ambient temperature goes over a threshold configurable with parameter P.0366. This serves to alert the operator, but it is also possible, by using AND/OR logics, to ensure that, when the early warning is active, also an output is activated, output that therefore can be used to start cooling the mechanisms.

## 9.5 Counters

The controller manages internally the following counters:

- Working time with MGCB closed (hours) counter (resettable to zero)
- Working time with MGCB closed (hours) counter (total)

- Active energy counter (kWh) exported by the generators (resettable to zero).
- Active energy counter (kWh) exported by the generators (total).
- Reactive energy counter (kvarh) exported by the generators (resettable to zero).
- Reactive energy counter (kvarh) exported by the generators (total).

- Active energy counter (kWh) imported by the generators (resettable to zero).
- Active energy counter (kWh) imported by the generators (total).
- Reactive energy counter (kvarh) imported by the generators (resettable to zero).
- Reactive energy counter (kvarh) imported by the generators (total).

- Active energy counter (kWh) exported on the mains (resettable to zero).
- Active energy counter (kWh) exported on the mains (total).
- Reactive energy counter (kvarh) exported on the mains (resettable to zero).
- Reactive energy counter (kvarh) exported on the mains (total).

- Active energy counter (kWh) imported from the mains (resettable to zero).
- Active energy counter (kWh) imported from the mains (total).
- Reactive energy counter (kvarh) imported from the mains (resettable to zero).
- Reactive energy counter (kvarh) imported from the mains (total).

- Controller total power supply time (hours) counter

Almost all these counters and meters are displayed on the controller's front panel. However, all can be read via the serial port (with the Modbus protocol). Some of these counters can be reset by the operator following a proper procedure, or via the serial port (they are marked in the list with “resettable to zero”). All these counters are saved in a non-volatile memory; therefore, they store their values also when the controller is powered off. Since non-volatile memories “consume” themselves writing in them, it is necessary to reduce at the minimum the number of writings. For this reason, a counter is not immediately saved as its value changes,

and it is then important to know when values are saved and how to be sure that they are saved before removing supply from the board.

Counters are saved (all together and in the same time) in the following conditions:

- Each time the working hours counter (with MGCB closed) is increased (both total and partial, also if the gensets have been started for instance six times for ten minutes each time).
- Each time the operating mode is switched to OFF_RESET.
- Each time a “parallel to the pains” protection trips.
- For each hour of working of the controller.

Furthermore, counters are saved when they are reset to zero (individually or globally) via front panel or serial port. Note that some counters have a decimal part (for example the minutes-counters associated to hours-counters), which is also saved in a non-volatile memory. Powering off the controller in an uncontrolled way can cause the loss of the decimal part. You will need to switch the key to OFF-RESET to force the controller to save data, before switching off the power.

### 9.5.1 Counters reset

The reset procedure is common to all counters, but it works only on some of them based on the page shown on the multifunctional viewer. See in par. **Errore. L'origine riferimento non è stata trovata.** the description of the displayed page containing the counter to be reset

## 9.6 Alternative parameters configurations.

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

**Alternative configurations can be programmed only using the BoardPrg3xx.**

**You cannot program or modify the configurations from the controller.**

The parameters present in each alternative group are the following:

- P.0101: Generators bus number of phases.
- P.0102: Generators bus nominal voltage
- P.0103: Primary of generators bus voltmeter transformers.
- P.0104: Secondary generators bus voltmeter transformers.
- P.0128: Is the neutral of the generators’ bus connected to the controller?

- P.0119: Mains phases number.
- P.0116: P.0116: nominal voltage.
- P.0117: Primary of mains voltmeter transformers.
- P.0118: Secondary of mains voltmeter transformers.
- P.0129: Is the neutral of the generator connected to the controller?

- P.0105: Generator nominal frequency.

- P.0124: Connection of current transformers
- P.0107: Primary of the current transformer.
- P.0139: Secondary of current transformer.

- P.0109: Transformer type for auxiliary current.
- P.0130: Auxiliary current connection.
- P.0108: Primary of the current transformer or toroid ratio for auxiliary power.
- P.0135: Secondary of current transformer or toroid ratio for auxiliary current
- P.0131: Auxiliary current use.

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

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

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

**Remark: copying an alternative set in working configuration causes the loss of the previous loaded parameters. The only way to restore them is to save them in another alternative configuration and recall it.**

This function is usually used with multi-voltage and/or multi-frequency panel: cabling the cams in a panel selector on the inputs of the controller it is possible to switch manually voltages and frequency without using the parameter of the controller.

**NB. The change of parameters happens only with the controller in OFF_RESET.**

## 9.7 Non-volatile memory

The controller has a non-volatile memory inside (with no need to be supplied), used to store different information as parameters, counters or other. The memory is divided into different zones. When the controller is powered, it performs a check on the data stored in each area: if even just one area is incorrect, it displays an error message. This message contains a numeric code (hexadecimal note); each bit if this code corresponds to a non-valid memory zone. A chart follows with the zones and relative bits.

| Area | Version | Bit | Value | Description |
|---|---|---|---|---|
| 1 | 1.00 | 1 | 0001 | Coefficients for the calibration of the measuring inputs of the controller. |
| 2 | 1.00 | 2 | 0002 | Different information (selected languages, LCD display contrast, maintenance request). |
| 3 | 1.00 | 3 | 0004 | Counters |
| 4 | 1.00 | 4 | 0008 | History log of the maximum peaks. |
| 5 | 1.00 | 5 | 0010 | Parameters alternative configurations. |
| 6 | 1.00 | 6 | 0020 | Setpoint for the PLC |
| 7 | 1.00 | 7 | 0040 | Parameter: |
| 8 | 1.00 | 8 | 0080 | Parameters in text form (E.g. Configurable messages connected to inputs) |

If for example the value between brackets was “0004”, this means that the only counter zone is not valid. If the value was “0041”, this means that the parameters zones (0040) and the calibration zones (0001) are not valid.

If a zone is not valid, the normal operation sequences are not performed until when the operator does not press **ACK/ENTER** + **ESC/SHIFT**: it is, in effect, necessary that the situation is clear also because it might cause malfunctions (e.g. If the non-valid zone was the one of the parameters). Only when the operator presses **ACK/ENTER** + **ESC/SHIFT**, the controller recharges the default data for the data stored in non-valid zones: this means that if you turn off the controller without pressing **ACK/ENTER** + **ESC/SHIFT**, in a subsequent start there will be a signalling of not valid memory.

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ENGLISH

## MECC ALTE SPA (HQ)

Via Roma
20 – 36051 Creazzo
Vicenza – ITALY

T: +39 0444 396111
F: +39 0444 396166
E: info@meccalte.it
aftersales@meccalte.it

## MECC ALTE PORTABLE

Via A. Volta
1 37038 Soave
Verona – ITALY

T: +39 0456 173411
F: +39 0456 101880
E: info@meccalte.it
aftersales@meccalte.it

## MECC ALTE POWER PRODUCTS

Via Melaro
2 – 36075 Montecchio
Maggiore (VI) – ITALY

T: +39 0444 1831295
F: +39 0444 1831306
E: info@meccalte.it
aftersales@meccalte.it

## ZANARDI ALTERNATORI

Via Dei Laghi
48/B – 36077 Altavilla
Vicenza – ITALY

T: +39 0444 370799
F: +39 0444 370330
E: info@zanardialternatori.it

## UNITED KINGDOM

Mecc Alte U.K. LTD
6 Lands' End Way
Oakham
Rutland LE15 6RF

T: +44 (0) 1572 771160
F: +44 (0) 1572 771161
E: info@meccalte.co.uk
aftersales@meccalte.co.uk

## SPAIN

Mecc Alte España S.A.
C/ Rio Taibilla, 2
Polig. Ind. Los Valeros
03178 Benijofar (Alicante)

T: +34 (0) 96 6702152
F: +34 (0) 96 6700103
E: info@meccalte.es
aftersales@meccalte.es

## CHINA

Mecc Alte Alternator
(Nantong) Ltd
755 Nanhai East Rd
Jiangsu Nantong HEDZ 226100
People's Republic of China

T: +86 (0) 513 82325758
F: +86 (0) 513 82325768
E: info@meccalte.cn
aftersales@meccalte.cn

## INDIA

Mecc Alte India PVT LTD
Plot NO: 1, Talegaon
Dhamdhere S.O.
Taluka: Shirur,
District: Pune - 412208
Maharashtra, India

T: +91 2137 673200
F: +91 2137 673299
E: info@meccalte.in
aftersales@meccalte.in

## U.S.A. AND CANADA

Mecc Alte Inc.
1229 Adams Drive
McHenry, IL, 60051

T: +1 815 344 0530
F: +1 815 344 0535
E: info@meccalte.us
aftersales@meccalte.us

## GERMANY

Mecc Alte Generatoren GmbH
Bucher Hang 2
D-87448 Waltenhofen

T: +49 (0)831 540755 0
E: info@meccalte.de
aftersales@meccalte.de

## AUSTRALIA

Mecc Alte Alternators PTY LTD
10 Duncan Road, PO Box 1046
Dry Creek, 5094, South
Australia

T: +61 (0) 8 8349 8422
F: +61 (0) 8 8349 8455
E: info@meccalte.com.au
aftersales@meccalte.com.au

## FRANCE

Mecc Alte International S.A.
Z.E. la Gagnerie
16330 St. Amant de Boixe

T: +33 (0) 545 397562
F: +33 (0) 545 398820
E: info@meccalte.fr
aftersales@meccalte.fr

## FAR EAST

Mecc Alte (F.E.) PTE LTD
10V Enterprise Road, Enterprise 10
Singapore 627679

T: +65 62 657122
F: +65 62 653991
E: info@meccalte.com.sg
aftersales@meccalte.com.sg


mecc alte

www.meccalte.com

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