mecc alte

POWER FROM WITHIN

RN200 CONTROLLER

SMARTECH

TECHNICAL MANUAL

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Revision	Date	Comment
00	22/07/2020	First version of the manual, prepared for version 01.00 of the controller.
01	05/01/2021	Valid for version 1.02 of the controller. 5.3.5, 7.4, 7.7.2, 7.7.3
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04	26/10/2023	Valid for version 1.08 of the controller. 5.4.7, 6.5.3.2, 6.5.3.17, 6.5.3.18, 8.8.29-211

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1 Introduction

1.1 References.

[1] Mecc Alte EAAM0725xx - RN200 user manual.

[2] Mecc Alte EAAS0726xx - RN200 Modbus registers.

[3] Mecc Alte EAAM0727xx - RN200 parameters table.

[4] Mecc Alte EAAM0199xx – Parallel functions handbook.

[5] Mecc Alte EAAM0458xx – BoardPRG3.xx software manual.

[6] Mecc Alte EAAM0432xx – "PLC Editor" software manual.

[7] Mecc Alte EAAM0412xx - PLC environment description for Mecc Alte controllers.

[8] Mecc Alte EAAP0457xx – USB driver installation guide.

[9] Mecc Alte EAAS0341xx – Serial communication and SMS protocol.

1.2 Introduction and prerequisites

For the appropriate use of this manual, specific knowledge is required in the use and installation of generating sets and photovoltaic systems (or more generally on renewable sources).

ATTENTION!!!

Each operation must be carried out by qualified personnel. Dangerous voltages are present on the terminals of the device; before carrying out any operation on them, make sure to have opened the external circuit breakers and/or to have removed the relative fuses.

Do not remove or modify any connections during the operation of the system.

Under no circumstances disconnect the terminals of the current transformers (C.T.).

Incorrect operations on the connections can cause the disconnection of renewable sources from the loads.

Before using the device, read this manual carefully.

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

This document does not contain a detailed description of all the programming parameters: for this purpose, see [3]; these documents are to be considered an integral part of this manual.

The device is supplied with a generic "default" configuration; it is the task of the installer to adjust the operating parameters to the specific application.

Mecc Alte makes a considerable effort in order to continuously improve and update its products; they are therefore subject to both hardware and software changes without notice. Some functions described in this manual may therefore differ from those present in your device.

1.3 Notes on configuring device parameters

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

It greatly simplifies the configuration of the device and its use is strongly recommended. Furthermore, it allows the existing configuration of the device to be saved to a file, and subsequent reuse on other identical devices.

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

BoardPrg3 can be used with all Mecc Alte devices; the connection to the PC can be made via USB, RS232 or RS485 serial ports, Ethernet or via modem (optional external). For the use of the program refer to the document [5].

1.4 Definitions

In this document, the term "**ALARM**" is used to indicate an anomaly that makes it impossible to use renewable sources, and causes the inverters to automatically shut down.

The term "**WARNING**" is used to indicate an anomaly that requires operator intervention, but which does not prevent the use of renewable sources.

1.4.1 Acronyms

AIF Identifies a function for configuring the analogue inputs ("*Analogue Input Function*"). The number following the wording "AIF." is the code to be set in the parameter that configures the function of the desired analogue input.

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

AVF Identifies a function for configuring the virtual analogue inputs ("*Analogue Virtual Function*"). The number following the wording "AIF." is the code to be set in the parameter that configures the desired virtual analogue input function.

DIF Identifies a function for configuring the digital inputs ("*Digital Input Function*"). The number following the wording "DIF." is the code to be set in the parameter that configures the function of the desired digital input.

DOF Identifies a function for configuring the digital outputs ("*Digital Output Function*"). The number following the wording "DOF." is the code to be set in the parameter that configures the desired digital output function.

DTC Indicates a diagnostic code received from an external device (the photovoltaic inverter for example) through a communication channel (serial or Ethernet ports) ("*Diagnostic Trouble Code*").

EVT Identifies an event stored in the historical archive. The number following the wording "EVT." is the numeric code of the event.

GCB This term identifies the circuit breaker that connects a generator to the generators’ bars (and directly to the loads if there is no MGCB circuit breaker) ("*Generator Circuit Breaker*").

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

MGCB This term identifies the circuit breaker that connects the generators’ bars to the loads ("*Master Generators Circuit Breaker*").

MPM See description of plant types in [4].

MPtM See description of plant types in [4].

MPtM + MSB See description of plant types in [4].

MSB See description of plant types in [4].

MSB + MSTP See description of plant types in [4].

PMCB Identifies the communication bus (Mecc Alte proprietary) through which all devices exchange information to allow the parallel functions described in document [4] ("*Power Management Communication Bus*").

RNCB This term identifies the circuit breaker that connects the renewable sources to the generators' bars or to the loads ("*Renewables Circuit Breaker*").

SPM See description of plant types in [4].

SPtM See description of plant types in [4].

SPtM + SSB See description of plant types in [4].

SSB See description of plant types in [4].

SSB + SSTP See description of plant types in [4].

1.5 Conventions

Within the manual, changes with respect to the previous version are highlighted with a vertical bar located to the right of the paragraphs. Changes to fields in a table are highlighted with a grey background colour.

1.6 Software revisions.

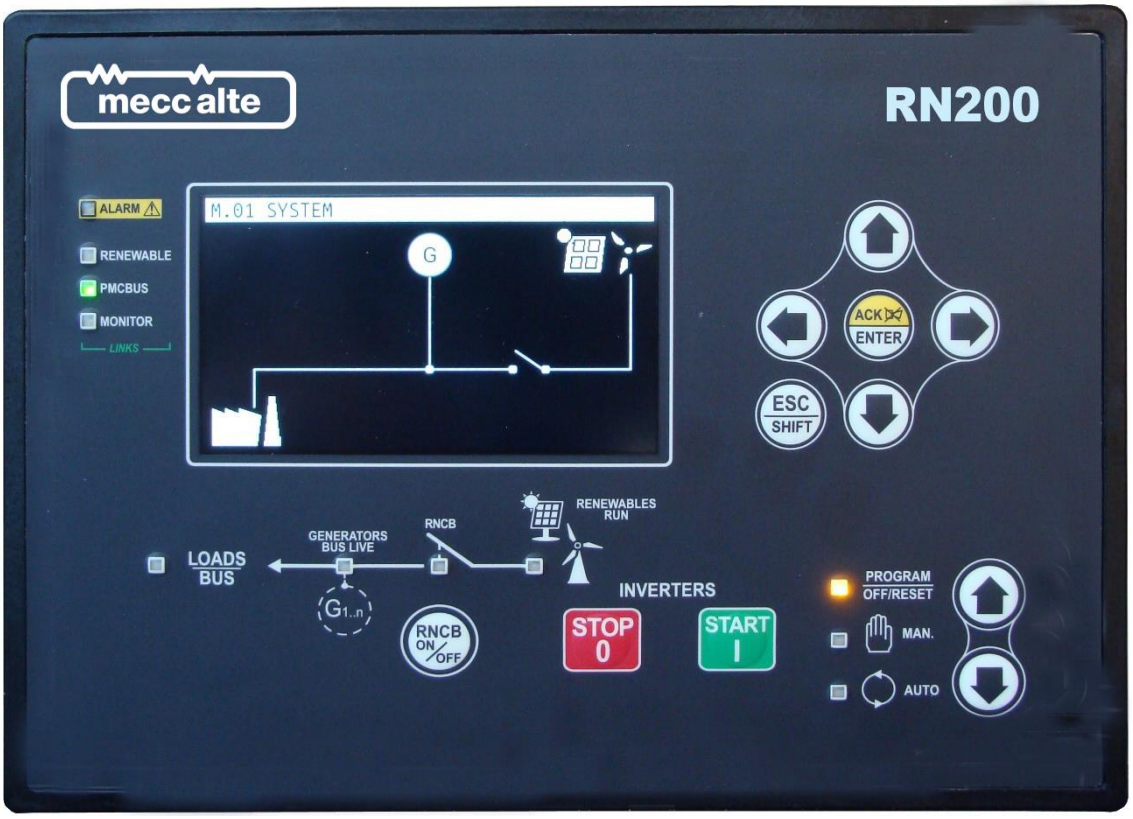
At various points in the manual, reference are made to the revisions of the device software. These revisions are indicated with the Mecc Alte code assigned to them (which is shown on the back panel of the controller). The format of the code is: EB0250289XXYY, where "XX" is the main revision of the software, while "YY" is the minor revision. So, for example, the code EB02502890100 refers to revision "1.00" of the controller software. The revision of the software is also displayed on the "S.03" page of the TFT display.

RN200 is a "dual processor" device and therefore uses two different firmware:

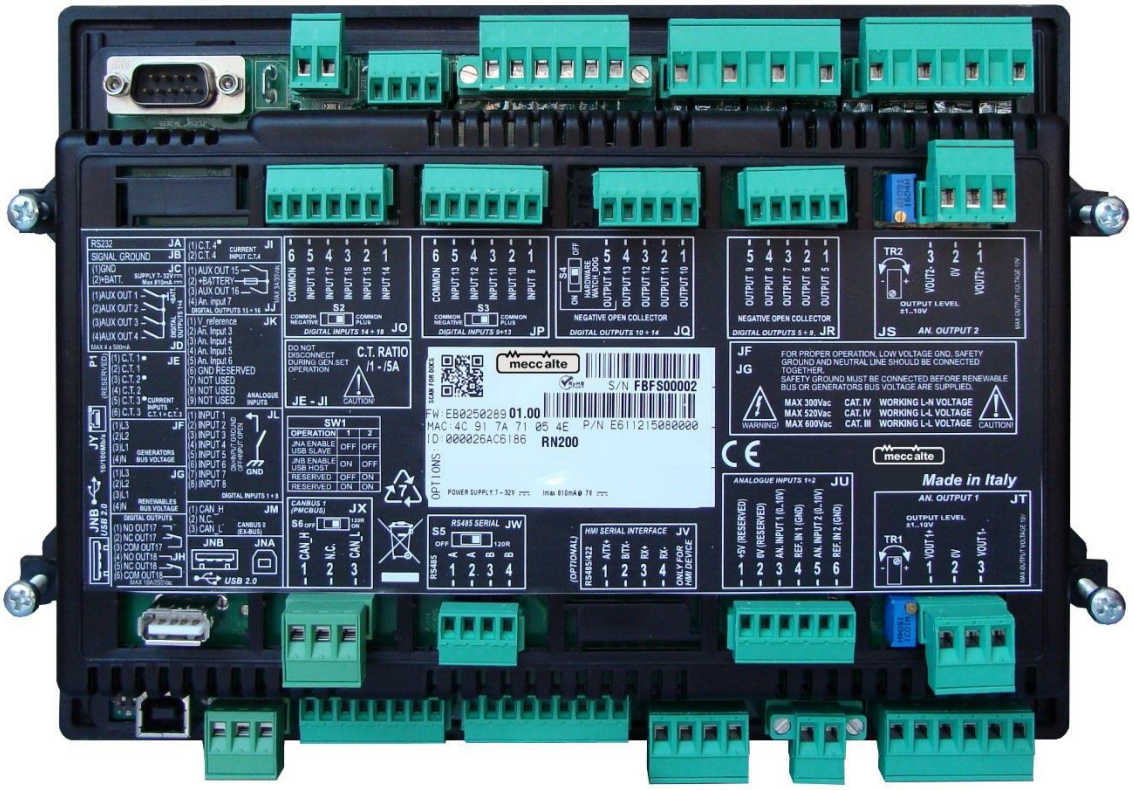
- EB0250289XXYY: for the main processor that deals with functional management and the operator interface.
- EB0250252XXYY: for the secondary processor that takes care of the electrical measurements with the relative protections.

2 Views of the device

RN200 front view



RN200 rear view



RN200 top view

RN200 bottom view

3 Technical features

INFORMAZIONE! **"B-" refers to the potential of the JC-1 terminal.**

Supply voltage +VBATT.	
Rated supply voltage (Vn).	12VDC or 24 VDC.
Operating range (variation of Vn).	From 8 to 32VDC with continuous operation. The device recognizes the rated 12 or 24V voltage of the system (for the management of the related alarms) when it is powered and whenever the OFF/RESET mode is selected. Reverse polarity protection with integrated self-resetting fuse.
Maximum interruption time of the supply voltage without resetting the device.	0 VDC for min. 20 ms from a nominal voltage of 12 VDC (voltage drop).
Insensitivity to transient drops in supply voltage.	Operation with a minimum voltage of 5 VDC is guaranteed for an indefinite time (low voltage transient that can occur during the start of an engine).
Sampling rate	10kHz.
Resolution	12 bits.
Minimum current consumption:	Display brightness at minimum value: 350mA @ 13.5 VDC. 200mA @ 27 VDC. Display brightness at maximum value: 420mA @ 13.5 VDC. 225mA @ 27 VDC.
Maximum current absorption in working condition (relays, horn and digital inputs active; static outputs not active).	Display brightness at minimum value: Max. 670mA @ 7 VDC. 375mA @ 13.5 VDC. 235mA @ 27 VDC. Display brightness at maximum value: Max. 810mA @ 7 VDC. 440mA @ 13.5 VDC. 260mA @ 27 VDC.
Voltmetric measurement inputs for renewable sources and connection bars.	
	Measurement of L-N and L-L voltages. Measurements of the neutral voltages referred to the power supply negative.
Rated voltage (Vn).	400Vac L-L (230Vac L-N). 100Vac L-L (58Vac L-N).
Measurement scale.	400V (HV – High voltage scale). 100V (LV – Low voltage scale). Selectable via device parameter.
Sampling rate	10Khz.
Type of measure	True RMS.

Input impedance	> 0.8 MΩ L-N. > 1.3 MΩ L-N. > 0.8 MΩ L-B-. > 0.5 MΩ N-B-.
Maximum applicable voltages.	Max. 300Vac CAT.IV for L-N measures. Max. 520Vac CAT.IV for L-L measures. Max. 600Vac CAT.III for L-L measures.
Maximum voltages measurable with HV scale.	Max. 448 VAC for L-N measures (with N-B- voltage = 0 VRMS).
Maximum voltages measurable with LV scale	Max. 147 VAC for L-N measures (with N-B- voltage = 0 VRMS).
Maximum common mode voltage from B- with HV scale.	Max. 100 VRMS.
Maximum common mode voltage from B- with LV scale.	Max. 80 VRMS.
Connection method.	3 phases 4 wires. 3 phases 3 wires. Single phase, 2 wires. Aron insertion with 2 voltage transformers.
Resolution.	12 bits.
Accuracy.	<0,5% @ Vn.
Amperometric measurement inputs	
	3 measuring inputs with internal C.T. and same transformation ratio. 1 independent measurement input with internal C.T, usable for measuring the neutral current, or for a generic power measurement. The use of current transformers with secondary current from 1A to 5A is required. **The external C.T. must guarantee at least the BASIC insulation for the use of the device in overvoltage category IV.**
Rated current (In).	1Aac or 5Aac.
Measurement scale.	1Aac rated (low current scale). 5Aac rated (high current scale). Automatic scale change for currents below 1.2Aac and above 1.5Aac.
Sampling rate	10Khz.
Maximum measuring range	Up to 7Aac.
Type of measure	True RMS.
Load per phase (self-consumption)	< 1VA.
Permanent thermal limit.	+40% of the rated current.
Short-term thermal limit.	Transient over currents up to 20Aac sinusoidal with progressive loss of accuracy depending on the amplitude of the overcurrent.
Resolution.	12 bits.
Accuracy.	<0,2%@ In.
Frequency measurement	

<table>
<tr><td></td><td>Rated frequencies 50 or 60Hz, measured by the connected voltages L1-L2, both for the inverter terminals and for the connection bars.
For single-phase systems, the measurement of the frequencies takes place on the voltage L1 with respect to N (connected on L2 terminals too).</td></tr>
<tr><td>Rated frequency (Fn).</td><td>50Hz or 60Hz.</td></tr>
<tr><td>Measuring range.</td><td>From 5 to 80Hz.</td></tr>
<tr><td>Accuracy.</td><td>± 50 mHz</td></tr>
<tr><td>Minimum frequency sensitivity on renewable sources 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>Minimum frequency sensitivity on connection bars voltage input.</td><td>
<table>
<tr><td>Rated voltage 100Vac.</td><td>Rated voltage 400Vac</td></tr>
<tr><td>1 VRMS L1-N @ 10Hz.</td><td>1,2Vrms L1-N @ 10Hz.</td></tr>
<tr><td>1,7 VRMS L1-L2 @ 10Hz.</td><td>2 VRMS L1-L2 @ 10Hz.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>5 VRMS L1-N @ 50Hz.</td><td>13 VRMS L1-N @ 50Hz.</td></tr>
<tr><td>9 VRMS L1-L2 @ 50Hz.</td><td>22 VRMS L1-L2 @ 50Hz.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>6 VRMS L1-L2 @ 50Hz.</td><td>18 VRMS L1-N @ 60Hz.</td></tr>
<tr><td>10 VRMS L1-L2 @ 60Hz.</td><td>31 VRMS L1-L2 @ 60Hz.</td></tr>
</table>
</td></tr>
<tr><td>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 common power supply internally connected to the positive power supply terminal of the device (JC-2 + VBATT).
They are considered active when the input terminal is connected to negative power supply B-. When the terminal is open, the voltage on it is equal to + VBATT.</td></tr>
<tr><td>Activation / deactivation threshold.</td><td>2.5 VDC.</td></tr>
<tr><td>Typical current with active input.</td><td>5.3 mA @ +VBATT= 13.5 VDC.
11.5 mA @ +VBATT= 27 VDC.</td></tr>
<tr><td>Delay of the input signal.</td><td>Can be set by parameter for each individual input.</td></tr>
<tr><td colspan="2">Digital inputs 09-18.</td></tr>
</table>

	Two groups of 5 opto-insulated digital inputs with two common power supply terminals connectable to B- (therefore the inputs are active when connected to +VBATT) or to +VBATT (therefore the inputs are active when connected to B-). Two selectors (S2 and S3) allow to configure the two groups of inputs as "common positive" or "common negative".
Activation / deactivation threshold.	2.5 VDC.
Typical current with active input.	5.3 mA @ VBATT= 13.5 VDC. 11.5 mA @ VBATT= 27 VDC.
Delay of the input signal.	Can be set by parameter for each individual input.
Digital outputs 01-04.	
Type of output.	4 independent static outputs (battery positive). The output current is supplied through the positive power supply terminal of the device JC-2 +VBATT. All outputs are independently configurable by parameter.
Rated current.	500 mA maximum continuous for each output.
ON state output resistance.	Max. 350 mΩ.
OFF state output resistance.	Max. 5 µA @ 32 VDC.
Protections.	Internal current limitation at approx. 4A maximum on transients > 150 µs. Thermal protection, short circuit, over voltage and reverse polarity. **Use suppression diodes on all external relays and other inductive loads.**
Digital outputs 05-13.	
Type of output.	9 independent static outputs (battery negative). The output current is supplied through the negative power supply terminal of the device JC-1 B-. All outputs are independently configurable by parameter.
Rated current.	Max. 280 mA @ 32 VDC continuous for each output. Total maximum current for all activated outputs: 2A @ 50 °C.
ON state output resistance.	Max. 500 mΩ.
OFF state output resistance.	Max. 1 µA @ 32 VDC.
Protections.	Internal current limitation to approximately 2.2A typical. Thermal protection, short circuit, overvoltage with auto reset. Reverse polarity protection **Use suppression diodes on all external relays and other inductive loads.**
Digital output 14 –Hardware Watch Dog output	

Type of output.	1 static output (battery negative). The output current is supplied through the negative power supply terminal of the device JC-1 B-. If enabled via selector S4, the output can be used to manage the status of the independent hardware watch-dog circuit. If the watch-dog is enabled (S4=ON) and the device works correctly, the output is activated. If the device stops and/or does not refresh the watch-dog circuit for more than 5 seconds, the output drops. If the device is turned off, the output drops immediately. If the watch-dog is disabled (S4=OFF) the output status depends on its programming.
Rated current.	Max. 280 mA @ 32 VDC continuous.
ON state output resistance.	Max. 500 mΩ.
OFF state output resistance.	Max. 1 µA @ 32 VDC.
Protections.	Internal current limitation to approximately 2.2A typical. Thermal protection, short circuit, overvoltage with auto reset. Reverse polarity protection **Use suppression diodes on all external relays and other inductive loads.**
Digital outputs 15 and 16	
Type of output.	2 relays with NO contact and only one common positive terminal. The positive common terminal also performs the input function for the emergency stop. The voltage measurement at the common input is shown on page S.15 of the display (EM-S). All outputs are independently configurable by parameter.
Rated current.	Max. 3A @ 30V DC continuous for each output.
Protections.	Self-resetting fuse and integrated diodes for overcurrent opening protection.
Digital outputs 17 and 18	
Type of output.	2 relays with dry contacts (NC, NO; COM). All outputs are independently configurable by parameter.
Rated current.	Max. 10A @ 250 VAC.
Analogue inputs 01-02.	
Type of input.	2 differential analogue inputs 0...10 VDC. Differential measurement available on both inputs, to compensate for differences between the sensor and the negative power supply terminal of the controller (B-). One 5 VDC regulated and protected voltage (JU-1) and an internal B- reference (JU-2) are available as references for external potentiometers for the two analogue inputs. Configurable as digital.
Measuring range.	0 – 10 VDC.
Compensation interval.	From -10 VDC to +6 VDC.
Input impedance.	> 470 kΩ.
Sampling rate.	10 kHz.
Resolution.	12 bits.
Accuracy.	<0,4% F.S.

Analogue inputs 03-06.	
Type of input.	4 0...10 VDC analogue inputs. The measurement is made with respect to the negative power supply terminal B-. Configurable as current inputs (with external resistor) or digital.
Voltage inputs.	Measuring range: 0 – 10 VDC with error < 0,2% Input impedance: >470 kΩ.
Current inputs.	Measuring range: 0 - 20mA with 500Ω external resistor.
Sampling rate.	10 kHz.
Resolution.	12 bits.
Analogue input 07.	
Type of input.	0 ... 32 VDC analogue input. The measurement is made with respect to the negative power supply terminal B-. Configurable as digital input.
Measuring range.	0 – 32 VDC with error < 0.2%.
Sampling rate.	10 kHz.
Resolution.	12 bits.
Analogue outputs 01-02.	
Type of outputs.	2 x ±10VDC voltage outputs galvanically insulated. Each output has an integrated trimmer to reduce the maximum output voltage, while preserving the resolution of the signal.
Adjustment range.	From ±1 VDC to ±10 VDC.
Resolution.	16 bits.
Minimum load impedance.	>10 kΩ.
Rated insulation voltage.	560 VDC maximum continuous. 3 kV DC on transient < 60s.
Insulation resistance.	>1000 MΩ @ 500 VDC.
RS232 communication interface.	
Interface type.	1 standard TIA/EIA not insulated RS232 serial port, on 9-pin male connector CANON type.
Electrical signals.	TX. RX, DTR, DSR, RTS, GND.
Settings.	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps. Parity: **none** *, even, odd. Stop bits: **1***, 2. *** Default setting.**
Supported protocols.	**Modbus RTU Slave***, Modbus RTU Master (for connection to inverters of renewable sources), Modem AT *** Default setting.**
Maximum distance.	The maximum cable length depends on its capacity, inductance and shielding. 15 m (50 ft) @ 9600bps 10 m (33 ft) @ 19200bps 7,5 m (25 ft) @ 38400bps 5,0 m (16 ft) @ 57600bps 2,5 m (8 ft) @ 115200bps

RS485 communication interface.	
Interface type.	1 standard TIA/EIA RS485 serial port with galvanic insulation. Termination resistor connectable with selector S5.
Electrical signals.	DATA+ (A), DATA– (B).
Settings.	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps Parity: **none** *, even, odd. Stops bit: **1***, 2. *** Default setting.**
Supported protocols.	Modbus RTU Slave, **Modbus RTU Master*** (for connection to inverters of renewable sources). *** Default setting.**
Insulation voltage.	560 VDC maximum continuous. 1 kV DC on transient < 60s.
USB 2.0 communication interface.	
Interface type.	1 non-insulated USB2.0 serial port, usable in "function" or "host" mode. Selection of the operating mode by means of selector SW5. *The USB port cannot be used simultaneously as a Function and Host.* **Host functionality is currently unavailable.**
"Function" mode.	Connection to PC through SICES driver. Type B USB connector.
Supported protocols.	Modbus RTU Slave**.**
Maximum distance.	6 m (20 ft).
CAN BUS communication interface.	
Interface type.	2 CAN BUS ports with galvanic isolation. Termination resistors connectable with selector S1 and S6.
Can Bus 0.	Can Bus connection with Mecc Alte EXBUS proprietary protocol, for communication with the input/output expansion modules.
Can Bus 1.	Can Bus connection with Mecc Alte PMCB proprietary protocol for communication with the generator and mains controllers.
Nominal impedance.	120 Ω,
Insulation voltage.	560 VDC maximum continuous. 1 kV DC on transient < 60s.
Ethernet communication interface.	
Interface type.	1 Ethernet interface 10/100Mbps full-duplex 10T/100Tx Auto. HP Auto-Mdix support. Compliant IEE802.3/802.3u (Fast Ethernet). Compliant ISO802-3/IEEE802.3 (10BASE-T).
Insulation voltage.	1500 VRMS.
Supported protocols.	Modbus TCP Slave**.** Modbus TCP Master (for connection to inverters of renewable sources). DHCP, DNS. NTP, SNMP.

Display.	
Display type.	4.3” colour TFT, backlit with white leds.
Resolution.	480 x 272.
Pixel dimension.	0,066 x 0,198 mm.
Visual area size.	95 x 54 mm.
Environmental conditions.	
Operating temperature.	Da -25°C a +60°C.
Storage temperature.	Da -30°C a +80°C.
Humidity.	IEC 60068-2-30. Db Damp Heat Cyclic 20/55°C @ 95% RH 48 Hours. IEC 60068-2-78. Cab Damp Heat steady state 40°C @ 93% RH 48 Hours.
Container.	
Material.	Nylon66 + 30% glass fibre.
Dimensions.	244(L) x 178(H) x 83(P) mm.
Peso.	1100g.
Degree of protection.	IP65 with gasket. IP20 per the complete panel.

3.1 Measurement resolution

AC voltages	1 VRMS
AC currents	Min. 0.1 A (it depends on C.T. ratio).
Frequencies	0.1Hz ± 50ppm, 35ppm/C typical.
Powers	Min. 0.1 kW / kVA / kvar (it depends on C.T. ratio).
Power factors	0.01
Energy	1 kWh / kvarh

4 Installation

4.1 Mounting

The device must be permanently mounted on an electrical panel. The back side of the device must be accessible only through the use of keys or tools, and only by personnel authorized to perform maintenance operations. The device must be mounted so that it cannot be removed without using tools.

The panel cut-out dimensions are 218 x 159mm. 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 Wirings

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

The installation of an overcurrent protection is required for each single phase of the voltage inputs of inverter terminals and connection bars. You can use 1A fuses.

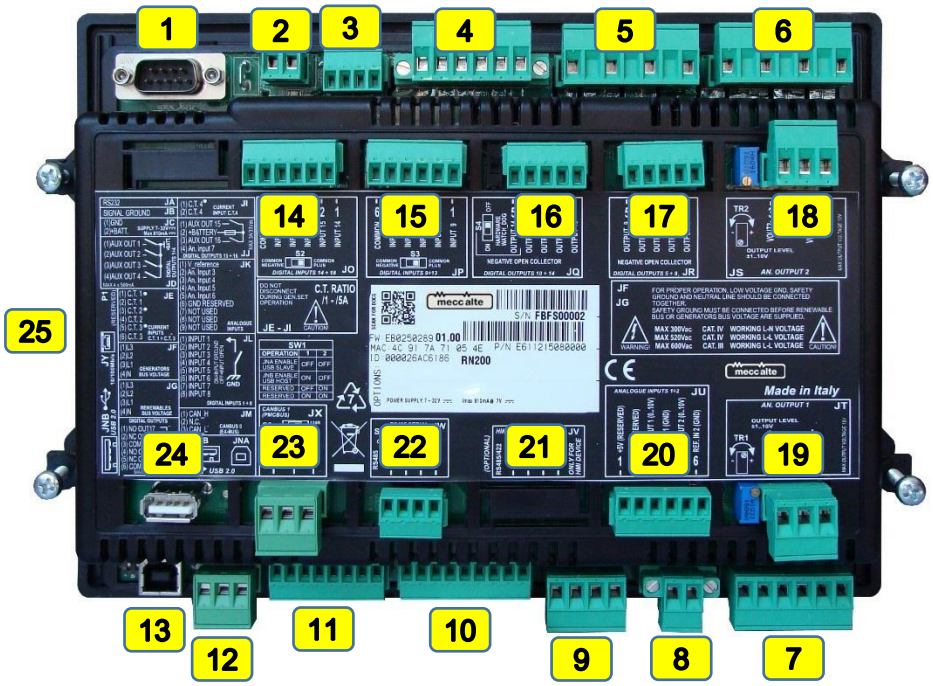
The section of the protective earth conductor of the electrical panel must be at least equal to the section of the wires used to wire the voltages of the inverter terminals or of the connection bars to the panel. It must also comply with the limit value of the overcurrent protection used.

For CAT.IV applications, the maximum allowed phase-neutral voltage is 300 VAC, while the phase-phase voltage is 520 VAC. The maximum voltage with respect to the protective earth is 300 VAC.

For CAT.III applications, the maximum allowed phase-neutral voltage is 345 VAC, while the phase-phase voltage is 600 VAC. The maximum voltage with respect to the protective earth is 600 VAC.

The device can operate in CAT.IV or CAT.III only if the external current transformers (C.T.) guarantee at least a BASIC insulation.

5 IN/OUT connections and configuration



N.	NAME	DESCRIPTION	CONNECTOR
1	JA	RS232 communication interface.	Canon 9 poles male.
2	JC+JB	Power supply + functional earth.	2 poles x 2,5mm² screw terminal + faston.
3	JD	Digital outputs 1-4.	4 poles x 1,5mm² screw terminal.
4	JE	AC currents 1-3.	6 poles x 2,5mm² screw terminal.
5	JF	Connection bars AC voltages.	4 poles x 2,5mm² screw terminal.
6	JG	Inverters terminals AC voltages.	4 poles x 2,5mm² screw terminal.
7	JH	Digital outputs 17-18.	6 poles x 2,5mm² screw terminal.
8	JI	AC auxiliary current.	2 poles x 2,5mm² screw terminal.
9	JJ	Digital outputs 15-16. Analogue input 7.	4 poles x 2,5mm² screw terminal.
10	JK	Analogue inputs 3-6.	9 poles x 1,5mm² screw terminal.
11	JL	Digital inputs 1-8.	8 poles x 1,5mm² screw terminal.
12	JM	Can Bus interface for Mecc Alte I/O expansion modules (EXBUS).	3 poles x 2,5mm² screw terminal.
13	JNA	USB 2.0 “Function” interface.	USB – B.
14	JO	Digital inputs li 14-18.	6 poles x 1,5mm² screw terminal.
15	JP	Digital inputs 9-13.	6 poles x 1,5mm² screw terminal.

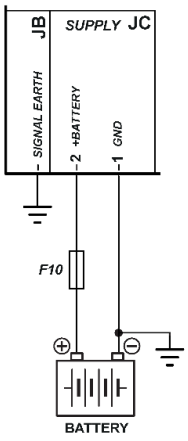
N.	NAME	DESCRIPTION	CONNECTOR
16	JQ	Digital outputs 10-14.	5 poles x 1,5mm² screw terminal.
17	JR	Digital outputs 5-9.	5 poles x 1,5mm² screw terminal.
18	JS	Analogue output 2.	3 poles x 2,5mm² screw terminal.
19	JT	Analogue output 1.	3 poles x 2,5mm² screw terminal.
20	JU	Analogue inputs 1-2.	6 poles x 1,5mm² screw terminal.
21	JV	-	4 poles x 1,5mm² screw terminal.
22	JW	RS485 communication interface.	4 poles x 1,5mm² screw terminal.
23	JX	Can Bus interface for other Mecc Alte controllers (PCMB).	3 poles x 2,5mm² screw terminal.
24	JNB	USB 2.0 “Host” interface (not used).	USB – A.
25	JY	Ethernet interface.	RJ45.

5.1 Functional earth (JB)

The connection of the JB functional earth is mandatory to ensure the correct operation of the device and for compliance with the EU Directive on Electromagnetic Compatibility.

The connection is functional and not protective; the wire section can therefore be smaller. Connect the other end of the cable to a metal screw of the electrical panel (which must be earthed) near JB or to an earth line, using in any case the shortest possible cable length.

5.2 Power supply (JC)



JC is the power supply connector: connect a continuous source (normally the starter battery of an engine) to terminal **1 B-** (negative) and to terminal **2 +BATT** (positive).

The negative terminal **1 (B-)** is the common reference and return of the digital inputs and outputs, and AC voltage and current measurements. **It must be connected to the protective earth**. Systems that require insulation between the power supply negative and the protective earth can still be used, but may require special measures, such as the use of voltmetric insulation transformers for AC voltage measurements.

Although the device is protected by a self-resetting internal fuse, the use of a fuse to protect the positive **2 +BATT** power line is recommended. **All the current supplied by the static outputs JD flows through the positive input 2 +BATT, and therefore attention must be paid to the sizing of the fuse.**

The device automatically recognizes (when powered) whether the rated power supply voltage is 12 or 24 VDC, for the management of the related logics and alarms. The detection is also performed every the **OFF/RESET** mode is selected.

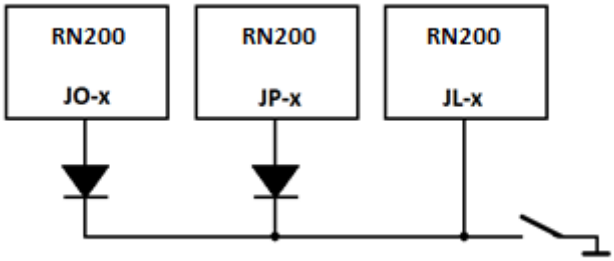
NOTE: during installation, connect the power supply positives as the last step, after opening all the fuses available in the panel.

5.3 Digital inputs 1-18 (JL, JP, JO)

The controller provides as standard 18 fully configurable opto-insulated digital inputs.

In addition to these 18 inputs, the analogue inputs **JK** and **JU** can also be used as digital inputs (if not used as measuring inputs, see par. 0) and, in different ways, also the **JJ-4** terminal (see par. 5.5.3).

It is possible to share the same command signal of an input with several different controllers (for example a single signal connected to three RN200). If the inputs of the **JO** or **JP** connectors are used (with positive common) it is necessary to separate the inputs with diodes as in the picture below. This is to avoid incorrect activation of the input when one of the devices is unsupplied. If the inputs of the **JL** connector are used, the diode can be omitted as it is already provided internally.

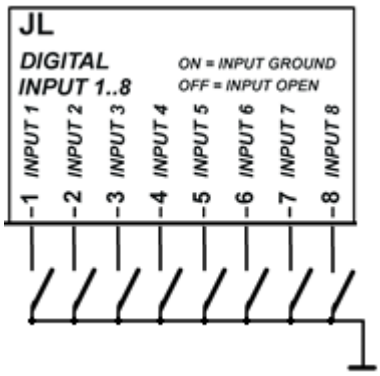


It is possible to increase the number of digital inputs by adding up to two optional DITEL 16 IN modules (connected via Can Bus) for a total of 32 other digital inputs (see par. 5.7).

There are also 16 "virtual" digital inputs, not really existing on the controller or on the expansions, but managed as a result of the logical combination of physical or virtual inputs, outputs, alarms or logic states through appropriate programming via BoardPrg3 or via PLC program. The virtual inputs are configurable as functionality and can be used in the same way as the physical inputs; see par 5.3.4.

The status of the digital inputs of the controller (including the virtual ones) is displayed on page S.11. The status of the digital inputs of the DITEL expansion modules is displayed on page S.12 (0=input not active, 1=input active).

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



They are a group of 8 opto-insulated digital inputs with the common terminal internally connected to the positive power supply terminal of the controller (**+BATT**). The inputs can be activated by connecting them to the negative power supply (**B-**). When left floating, the terminal goes to **+BATT**. Avoid situations where intermediate or undefined voltage levels may occur.

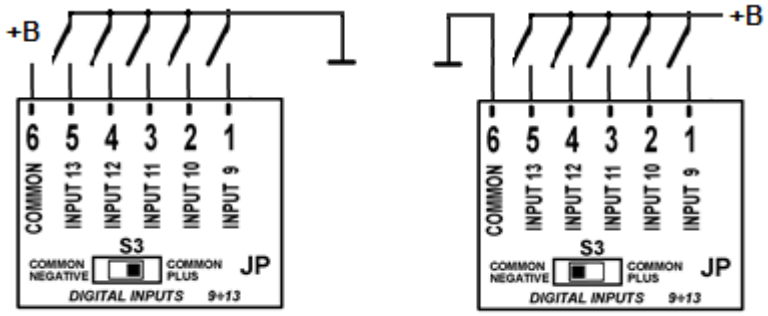
These inputs already have internal diodes in series which allows them to be connected simultaneously to multiple devices (see 5.3).

The inputs are fully configurable (see par.5.3.5).

The default configuration for these inputs is as follows:

Terminal	Digital input	Default function
JL-1	01	DIF.3006 – “Status of RNCB circuit breaker”
JL-2	02	DIF.0000 – “not used”
JL-3	03	DIF.0000 – “not used”
JL-4	04	DIF.0000 – “not used”
JL-5	05	DIF.0000 – “not used”
JL-6	06	DIF.0000 – “not used”
JL-7	07	DIF.0000 – “not used”
JL-8	08	DIF.0000 – “not used”

5.3.2 JP - Digital inputs 9-13 (DI_09-DI_13)



They are a group of five opto-insulated digital inputs with the common terminal available on the connector. The inputs can be activated by connecting the relative terminal to the negative power supply (**B-**): in this case the common terminal **JP-6** must be connected to the positive power supply (**+BATT**) and the selector **S3** must be set to *common positive*.

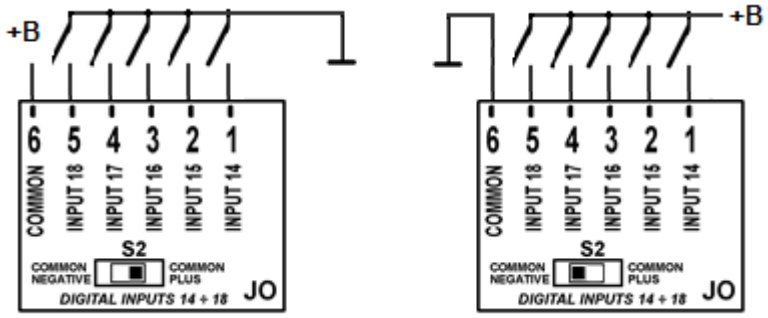
Alternatively, it is possible to activate the inputs by connecting them to the power supply positive (**+BATT**): in this case the common terminal **JP-6** must be connected to the power supply negative (**B-**) and the selector **S3** must be set to *common negative*.

The five inputs are fully configurable (see par.5.3.5).

The default configuration for these inputs is as follows:

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

5.3.3 JO - Digital inputs 14-18 (DI_14-DI_18)



They are a group of five opto-insulated digital inputs with the common terminal available on the connector. The inputs can be activated by connecting the terminal to the power supply negative (**B-**): in this case the common terminal **JO-6** must be connected to the power supply positive (**+BATT**) and the selector **S2** must be set to *common positive*.

Alternatively, the inputs can be activated by connecting them to the power supply positive (**+BATT**): in this case the common terminal **JO-6** must be connected to the power supply negative (**B-**) and the selector **S2** must be set to *common negative*.

The five inputs are fully configurable (see par.5.3.5).

The default configuration for these inputs is as follows:

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

5.3.4 Virtual digital inputs (DI_VIRTUAL)

The controller, in addition to the 18 physical digital inputs and the 32 digital inputs available on DITEL expansion modules, also manages 16 virtual digital inputs. They are managed by the controller exactly as if they were physical inputs (without any limitation), but the status of the virtual inputs is not acquired by the hardware but determined via software. In fact, each virtual digital input can be associated with an AND/OR logic that determines its status (see par. 5.4.7); alternatively, this logic can be made with the integrated PLC functions.

Practical example of using an AND/OR logic. Suppose we want to activate a warning if the voltage of the connection bars is outside the tolerance thresholds. We use virtual digital input #1 (as an 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.017 (“Connection bars out of tolerance”).
  - ST.067 (“RNCB status”)
- The virtual digital input will therefore be active when the RNCB circuit breaker is closed, and the voltage of the connection bars is out of tolerance.
- Set the DIF.4001 function ("Generic warning") in parameter P.2151.
- Set the desired delay (for example 0.5 s) in parameter P.2152.

- Set the warning text (for example " Mains voltage warning") in parameter P.2153.

5.3.5 Digital inputs configuration

By default, a digital input is considered active when the relative terminal is connected to the power supply negative of the controller (the ones on JO and JP terminals may require connection to the power supply positive); it is considered "inactive" when the relative terminal is not connected to anything.

The "logical" state of the input can be inverted with respect to the physical state by ticking the "reverse polarity" box on the configuration page of this input on BoardPrg3. The box appears only if the selected function is different from DIF.0000 - “Not used”.

It is also possible to invert the logical state (always individually for each input), operating directly on the controller using the parameters:

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

These parameters have a bit for each input:

- A **zero** bit means that the relative input is considered "active" when the terminal is connected to the power supply negative (optionally to the positive for JO and JP) of the controller.
- A **one** bit means that the relative input is considered "active" when the terminal is not connected to anything (it will become "inactive" when connected t to the power supply negative of the controller (optionally to the positive for JO and JP).

By default, all bits are zero.

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

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

See document [3] for the list of parameters.

The management of the physical inputs and the virtual inputs is identical except for the fact that the virtual inputs cannot be inverted logically.

The parameters that configure the delay and the message for an input are used by the controller only for some functions of the inputs. The following table highlights when they are used.

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

The following function, which is not directly related to the controller's operating sequences, can be selected for any digital input:

- DIF.0101 - “Used by the PLC”. It is possible to use the digital inputs of the controller only for PLC logics, without using them for the normal operating sequence of the controller. In these cases, it is possible to leave the inputs configured as DIF.0000 ("Not used"). There is however the risk to forget they are used and reuse them for other purposes (since they seem to be free): for this reason, the DIF.0101 function is provided (to indicate that the input is used, even if not directly from the controller).

Input function	Function name	Delay	Message	Description
DIF.0000	Not used			Input not used.
DIF.0101	Used by the PLC			Input used by internal PLC logic.
DIF.1031	Request for RNCB closure (MAN)			It acts only in MAN mode, used to control the manual closing of the RNCB circuit breaker. If there is no input configured with the DIF.1032 function, this input works as a toggle: it commands the closing of the circuit breaker when it is open, it commands the opening when it is closed.
DIF.1032	Request for RNCB opening (MAN)			It acts only in MAN mode, used to control the manual opening of the RNCB circuit breaker.
DIF.1033	RNCB controlled externally			Indicates that the circuit breaker will temporarily be controlled by external logic: the controller will take note of the situation without activating alarms.
DIF.2001	Command for resetting anomalies			When the input becomes "active", the controller performs a complete reset of all alarms. This operation is equivalent to putting the controller in OFF/RESET mode and putting it back in the desired operating mode.
DIF.2002	Command for acknowledging anomalies			When the input becomes "active", the controller silences the acoustic signals and recognizes the alarms, as if the ACK button on the device was pressed.
DIF.2032	Request for REMOTE START mode	Si		When the input is "active" the operating mode changes from AUTO to REMOTE START (the input does nothing if the controller is in OFF/RESET or MAN modes). When the input is deactivated, the controller returns to the AUTO mode.
DIF.2063	Full protections override			When the input is active, all the alarms (except for some, see [3]) become warnings.
DIF.2271	Remote OFF			When this input is active, the controller's operating mode is forced to OFF/RESET, and it is not possible to use the controller's buttons to modify it. **Note: when this input is deactivated, if there are no inputs configured with the DIF.2272 and DIF.2273 functions, the operating mode returns to what it was before the input was activated.**
DIF.2272	Remote MAN			When this input is active, the controller's operating mode is forced to MAN, and the controller's buttons cannot be used to change it.
DIF.2273	Remote AUTO			When this input is active, the controller's operating mode is forced to AUTO, and the controller's buttons cannot be used to change it.
DIF.2501	Inhibition of start for inverters			With the controller in AUTO mode, when this input is active, RN200 stops the inverters, removing the renewable contribution to production. Note: the DIF.2032 function has more priority than this.
DIF.2503	RNCB closure inhibition			With the controller in AUTO mode, when this input is active, RN200 forces the opening of the RNCB circuit breaker, removing the renewable contribution to production.
DIF.2701	Enables REMOTE START requests			**If there is an input configured with this function,** when this input is not active, the controller will not accept to go into "REMOTE START" mode.
DIF.2704	Disables protections on 4th current			When this input is "active" the protection on the auxiliary AC current is disabled.

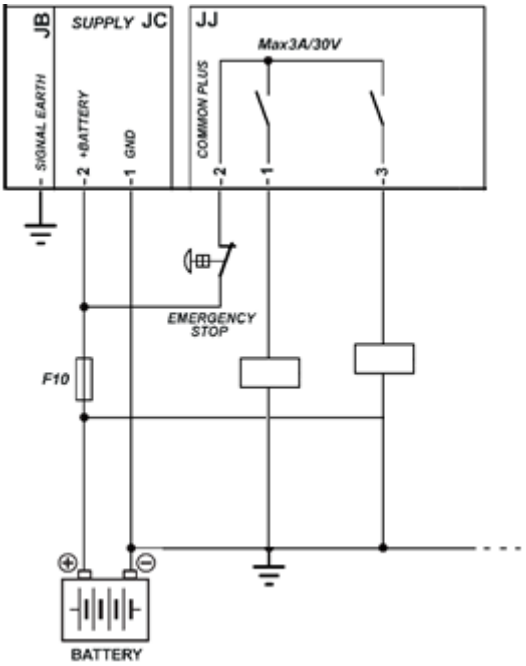
Input function	Function name	Delay	Message	Description
DIF.2705	Disables protections on analogue measures			When this input is "active", the thresholds set on analogue measurements having bit 14 ON in the third configuration parameter (see par.5.5.4) do not trip the relative protections.
DIF.2706	Enables the commands through the communication ports			**If there is an input configured with this function,** when the input is not active, the commands sent through the Modbus HOLDING REGISTER 101 and 102 registers are not accepted.
DIF.2741	Enables active power controls on inverters			**If there is an input configured with this function**, any limitation of the active power supplied by renewable sources is managed only when the input is activated (if the input is not active, the inverters always generate the maximum active power).
DIF.2742	Enables reactive power controls on inverters			**If an input configured with this function exists**, the reactive power setpoint for the inverters is managed only when the input is activated (if the input is not active, the inverters manage the reactive power independently).
DIF.3002	Status of MCB circuit breaker			Acquires the status of the circuit breaker that connects the mains to the loads. Used only if working with mains not controlled by Mecc Alte controllers, otherwise the information is available on Can Bus. It is used for active and reactive power management.
DIF.3003	Status of MGCB circuit breaker			Acquires the status of the circuit breaker that connects the generators' bars to the loads. Used only if working with mains not controlled by Mecc Alte controllers, otherwise the information is available on Can Bus. It is used for active and reactive power management.
DIF.3004	Status of GCB of other gen-sets			Acquires the cumulative status of the GCB circuit breakers of the individual generators (OR logic). Used only if working with generators not controlled by Mecc Alte controllers, otherwise the information is available on Can Bus It is used for active and reactive power management.
DIF.3006	Status of RNCB circuit breaker	Si		Acquires the status of the circuit breaker that connects the renewable sources to the connection bars. It is used to manage the start and stop of the inverters, for the circuit breaker commands and for active and reactive power management.
DIF.3101	External voltage sensor for renewable sources			**If an input configured with this function exists**, when the input is "active", the voltage and frequency of renewable sources are considered "In tolerance". Use it only when the real voltage of renewable sources is not connected to the device's AC sensor.
DIF.3102	No voltages on generators' bars			**If an input configured with this function exists**, when the input is "active", the controller considers that there is no voltage on the generator's bars. Use it only when the real voltage of the generator's bars is not connected to the AC sensor of the device.
DIF.3103	External protections for parallel to mains			**This function is used only if no MC200 controllers are present in the system.** When the input is "active", the controller considers that there is voltage on the mains.
DIF.3104	No voltages on loads			**If an input configured with this function exists**, when the input is "active", the controller considers that there is no voltage on the users.

Input function	Function name	Delay	Message	Description
DIF.3121	Inverters running			**This function is used only if no communication with the inverters has been configured, and no digital output is used to start/stop the inverters (function DOF.3063).** When the input is "active", the controller considers that the inverters are running.
DIF.3202	Important status (page 1)		Si	When this input is "active" the controller displays the text set in the parameters associated with the input on page S.08; the display is forced on that page.
DIF.3203	Generic status (page 2)		Si	When this input is "active" the controller displays the text set in the parameters associated with the input on page S.09.
DIF.3204	Important status (page 2)		Si	When this input is "active" the controller displays the text set in the parameters associated with the input on page S.09; the display is forced on that page.
DIF.3205	Generic status (page 3)		Si	When this input is "active" the controller displays the text set in the parameters associated with the input on page S.10.
DIF.3206	Important status (page 3)		Si	When this input is "active" the controller displays the text set in the parameters associated with the input on page S.10; the display is forced on that page.
DIF.4001	Generic warning	Si	Si	When the input is "active", a warning is activated: the displayed text is the one set in the parameters associated with the input.
DIF.4004	Generic alarm	Si	Si	When the input is "active" an alarm is activated: the displayed text is the one set in the parameters associated with the input.
DIF.4025	Warning (forces RNCB opening)	Si	Si	When the input is "active", a warning is activated: the displayed text is the one set in the parameters associated with the input. In addition, the controller forces the opening of the RNCB circuit breaker while this warning is active.
DIF.4028	Alarm (forces RNCB opening)	Si		When the input is "active", an alarm is activated: the displayed text is the one set in the parameters associated with the input. In addition, the controller forces the opening of the RNCB circuit breaker while this alarm is active.

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

The controller has eighteen digital outputs as standard: 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 16 IN expansion modules, each of which manages up to two DITEL 8 OUT relay modules, for a total of 32 additional outputs.

5.4.1 JJ – Digital outputs 15-16



JJ-2 terminal (common positive).

Common positive input for outputs 15 and 16, internally protected by a self-resetting fuse: it is however recommended to protect it with an external fuse of adequate capacity for the current to be supplied.
It must be connected to the positive supply voltage through a contact of the emergency button: this connection must be interrupted by the emergency button pressed. The use of multiple emergency buttons is possible by connecting them in series with each other.

⚠ Attention: do not use this terminal as “common negative” for the two relay outputs. In fact, inside the outputs there are damping diodes for the opening over voltages that would enter conduction and could be immediately damaged.

In there is no voltage on this terminal (for example by pressing the emergency button) the device activates the alarm AL.048 "A048 Emergency stop". The controller cannot be configured to disable this block.
The voltage at terminal **JJ-2** is measured for managing the related alarm, and is displayed on page S.15 under the item “EM-S”.

JJ-1 terminal.

Positive relay output with maximum capacity of 3 A @ 30 VDC. Integrated internal diode for damping opening over voltages. The voltage present on terminal JJ-2 is reported on this terminal; although it is already present internally, with particularly inductive loads (contactors, electromagnets, etc.) it is recommended to use a diode to dampen the opening over voltages.

⚠ Attention: for currents higher than the nominal, use an external relay.

JJ-3 terminal.

Positive relay output with maximum capacity of 3 A @ 30 VDC. Integrated internal diode for damping opening over voltages. The voltage present on terminal JJ-2 is reported on this terminal; although it is already present internally, with particularly inductive loads (contactors, electromagnets, etc.) it is recommended to use a diode to dampen the opening over voltages.

⚠ Attention: for currents higher than the nominal, use an external relay.

By default, the **JJ** connector outputs are not associated with any function. They are therefore freely configurable to adapt to the needs of the system. The status of these outputs is displayed on page S.13 (0=output not active, 1=output active).

The factory default functions of the JJ outputs are:

Terminal	Digital output	Type	Default function
JJ-1	15	Normally open contact.	DOF.0000 – "Not used".
JJ-2	-	Positive common input terminal.	-
JJ-3	16	Normally closed contact.	DOF.0000 – "Not used".

5.4.2 JH – Digital outputs 17-18

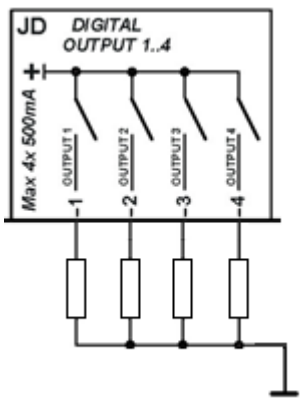
They are implemented through two 10A @ 250VAC relays. On the JH connector, dry contacts are available for each relay.

The factory default functions of the JH outputs are:

Terminal	Digital output	Type	Default function
JH-1	17	Normally open contact for relay 17.	DOF.2003 – "Coil for closure of RNCB".
JH-2		Normally closed contact for relay 17.	
JH-3		Common contact for relay 17	
JH-4	18	Normally open contact for relay 18.	DOF.2002 – "Coil for opening of RNCB".
JH-5		Normally closed contact for relay 18.	
JH-6		Common contact for relay 18	

By default, therefore, they are configured to act on the opening and closing coils of the RNCB motorized circuit breaker. They are however configurable at will.

5.4.3 JD - Digital outputs 1-4 (DO_01-DO_04)



They are four digital outputs, fully programmable. When activated, they go to the positive supply voltage present on terminal **JC-2**. The nominal current of each output is 500mA; the total current is therefore 2A. When **fully operational, never exceed these values**.

The outputs are independent and individually protected against overloads, short circuits, polarity reversal and overheating. The overload protection intervenes by limiting the peak current to an instantaneous value of 4 A, to allow activating loads that need a transient inrush current greater than the nominal. When this condition persists, after 150 µs the progressive intervention of the thermal protection begins until the output is turned off.

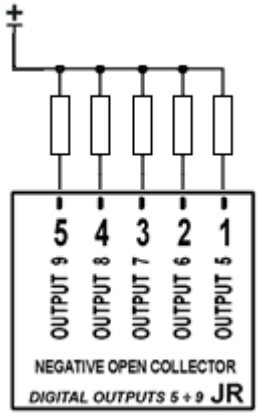
With inductive loads (power relays, electromagnetic actuators), although they are already internally present, **it is necessary to use diodes for damping the opening over voltages, especially in the case of highly inductive loads.**

All the current supplied by the outputs is taken by the **JC-2 +BATT** terminal; **ensure that any fuse on the positive power supply has adequate capacity and trip time to power and protect both the outputs and the device, in any operating conditions.**

The factory default functions of the JD outputs are:

Terminal	Digital output	Type	Default function
JD-1	01	Static positive output.	DOF.3063 – “Start command for the inverters”.
JD-2	02		DOF.0000 – “not used”.
JD-3	03		DOF.0000 – “not used”.
JD-4	04		DOF.0000 – “not used”.

5.4.4 JR - Digital outputs 5-9 (DO_05-DO_09)



They are five digital outputs, fully programmable. When activated, they provide the negative supply voltage present on terminal **JC-1** (**B-**). All the current supplied by the active outputs flows through this terminal. The rated current of each output is 280 mA while the overall current (with all the outputs of JR and JQ activated) must be kept below 2A. **When fully operational, never exceed these values.**

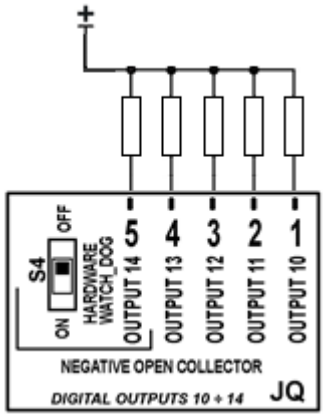
The outputs are independent and individually protected against overloads, short circuits, polarity reversal and overheating. The overload protection intervenes by limiting the peak current to an instantaneous value of 2.2 A. When this condition persists, the thermal protection starts and gradually reduces the current to keep the temperature of the output driver within its maximum limit.

With inductive loads (power relays, electromagnetic actuators), although they are already internally present, **it is necessary to use diodes for damping the opening over voltages, especially in the case of highly inductive loads.**

The factory default functions of the JR outputs are:

Terminal	Digital output	Type	Default function
JR-1	05	Static negative output.	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”

5.4.5 JQ – Digital outputs 10-14 (DO_10-DO_14)



They are five digital outputs, fully programmable. When activated, they provide the negative supply voltage present on terminal **JC-1** (**B-**). All the current supplied by the active outputs flows through this terminal. The rated current of each output is 280 mA while the overall current (with all the outputs of JR and JQ activated) must be kept below 2A. **When fully operational, never exceed these values.**

The JQ-5 terminal can be used, as an alternative to the function of output 14, as an independent hardware watch-dog output. Enabling occurs via the selector S4; if set to ON, it connects the output to the internal watch-dog circuit. If the device works correctly, the output always remains activated (output connected to the negative power supply voltage). If the device stops due to a malfunction and/or it does not refresh the watch-dog circuit for more than 5 seconds, the output drops automatically. If the device is turned off, the output drops immediately without waiting for the 5-second time-out. The output is activated within one second after the controller is turned on. If the watch-dog is disabled (S4=OFF) the state of output 14 on terminal JQ-5 depends only on its programming. In the event that output 14 is programmed with a specific function and selector S4 is still set to ON (watch-dog output active), the output remains connected to the watch-dog circuit and will never be activated by the chosen function.
By using the output as a watchdog, the functionality of output 14 is lost.

The outputs are independent and individually protected against overloads, short circuits, polarity reversal and overheating. The overload protection intervenes by limiting the peak current to an instantaneous value of 2.2 A. When this condition persists, the thermal protection starts and gradually reduces the current to keep the temperature of the output driver within its maximum limit.

With inductive loads (power relays, electromagnetic actuators), although they are already internally present, **it is necessary to use diodes for damping the opening over voltages, especially in the case of highly inductive loads.**

The factory default functions of the JQ outputs are:

Terminal	Digital output	Type	Default function
JQ-1	05	Static negative output.	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”

5.4.6 Digital outputs configuration

All the digital outputs of the controller (JJ, JH, JD, JR and JQ) and those of the DITEL expansion modules are individually and fully configurable.

The status of the digital outputs is displayed on pages S.13 (controller) and S.14 (DITEL) (0=output not active, 1=output active).

By default, all outputs are activated when the relative function requires it (for example, the closing coil for the RNCB circuit breaker is activated when the circuit breaker must be closed). Using BoardPrg3, it is possible to invert the activation logic, simply by selecting the "Reverse polarity" box at the top of the configuration page of each individual output. By operating directly on the controller, it is however possible to invert the logic of the outputs (always individually for each output) using the parameters:

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

A **zero** bit means that the output is normally deactivated, it is activated when the associated function requires it.

A **one** bit means that the output is normally activated, it is deactivated when the associated function requires it.

The mapping of the controller’s outputs 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

BIT	Hexadecimal value	Digital output	Terminal
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 mapping 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 9
10	0200	Output 10
11	0400	Output 11
12	0800	Output 12
13	1000	Output 13
14	2000	Output 14
15	4000	Output 15
16	8000	Output 16

Basically, if you want to invert the logic of an output, you need to add the corresponding value to the relative parameter: for example, if you want to invert controller's outputs 3 and 4, set P.3000 = 000C (0004 + 0008); if you want to invert outputs 5 and 10 of the second DITEL module (16 IN + 16 OUT) you need to set P.3250 = 0210 (0010 + 0200).

By default, all bits are zero.

The digital outputs can be used directly as a command for external devices, or as a remote signal for particular operating conditions.

The following three functions, not directly related to the controller's operating sequences, are selectable for any digital output:

- DOF.0101 - "Used by the PLC". This function combines the digital output with the internal PLC program of the controller: in this way, it is the PLC logic that controls the output and not the normal operating logic of the controller. Note: if the PLC program uses outputs but these outputs are not configured with the DOF.0101 function, the outputs will not be controlled (but the controller signals this situation with a pre-alarm).
- DOF.0102 - "Managed by the communication ports". The controller does not control the output with its own internal logics, but with the commands it receives through the communication ports.
- DOF.0103 - "AND/OR logics". See 5.4.7.

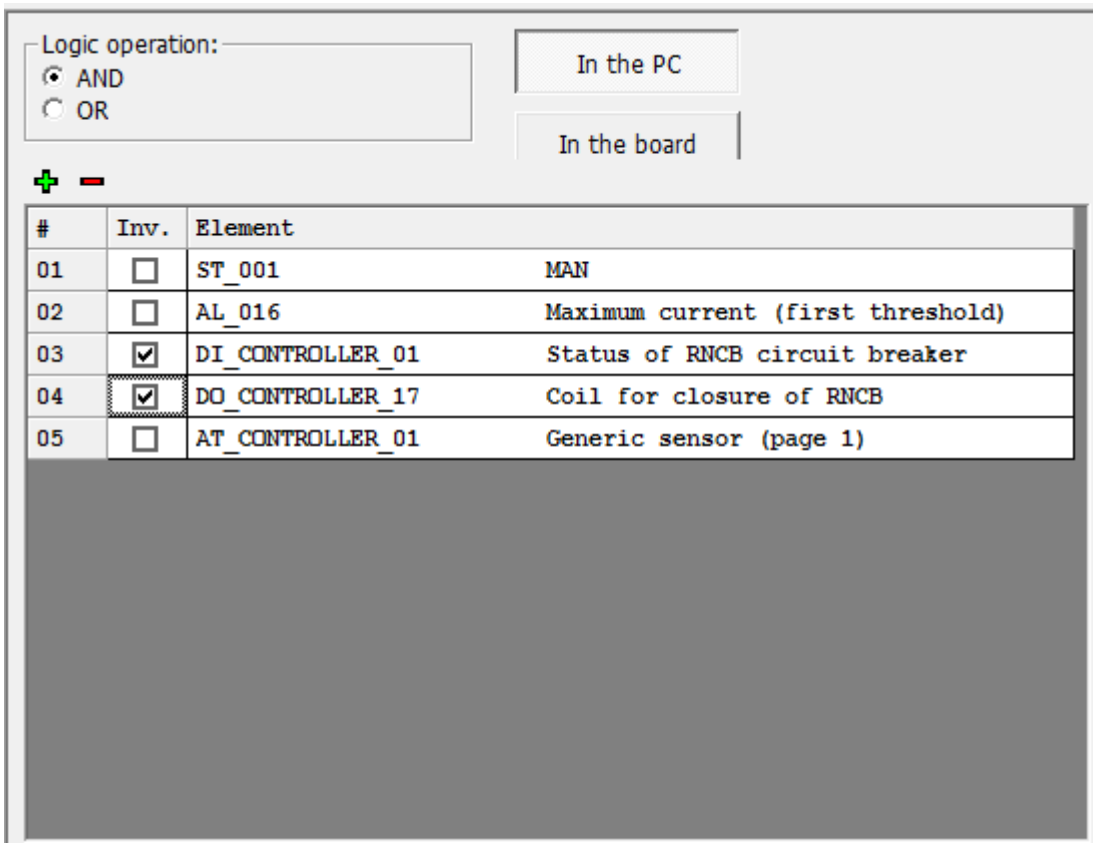
The functions configurable on the digital outputs are shown below:

Function	Function name	Description
DOF.0000	Not used	Output not used.
DOF.0101	Used by the PLC	Output used by the internal PLC.
DOF.0102	Managed by the communication ports	The controller does not manage the output with its own internal logics, but with the commands it receives through the communication ports.
DOF.0103	AND/OR logics	The output status is the result of the combination of the AND/OR logics, see par. 5.4.7.
DOF.2001	Minimum voltage coil for RNCB	See par. 7.4.
DOF.2002	Coil for opening of RNCB	See par. 7.4.
DOF.2003	Coil for closure of RNCB	See par. 7.4.
DOF.2004	Stable closing command for RNCB	See par. 7.4.
DOF.3001	Off/reset	It is activated when the controller is in OFF/RESET mode.
DOF.3002	Manual	It is activated when the controller is in MAN mode.
DOF.3003	Automatic	It is activated when the controller is in AUTOMATIC MODE.
DOF.3005	REMOTE START	It is activated when the controller is in REMOTE START mode.
DOF.3011	Not in Off/reset	It is activated when the controller is in MAN, AUTO or REMOTE START mode.
DOF.3012	One of the automatic modes	It is activated when the controller is in AUTO or REMOTE START mode.
DOF.3030	Voltages on loads	It is activated if there is voltage on the loads.
DOF.3031	Voltage on connection bars	It is activated if there is voltage on the connection bars.
DOF.3033	Voltages on renewable sources	It is activated if there is voltage on the renewable sources.
DOF.3063	Start command for the inverters	Command used to start the inverters of the renewable sources, if these inverters do not accept a command via Modbus.
DOF.3151	Reset of the anomalies	It is activated for one second when the internal alarms reset sequence is performed.
DOF.3152	External horn	It is activated together with the internal siren.
DOF.3153	Lamp test	It is activated in OFF/RESET mode by pressing the STOP button: it can be used to turn on any external lamp, and have a single procedure for testing the lamps.
DOF.3154	Acknowledge of the anomalies	It is activated for one second when the internal alarms acknowledgment sequence is performed.
DOF.4001	Warnings	It is activated if warnings are present.
DOF.4004	Alarms	It is activated if alarms are present.
DOF.4035	Anomalies of circuit breakers	It is activated if RNCB circuit breaker warnings/alarms are present: 013: RNCB circuit breaker not closed. 023: RNCB circuit breaker not open.

5.4.7 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); the controller evaluates them and the result can be assigned to a digital output or to a virtual digital input (see paragraph 5.4.6 and par. 5.3.5). Use the DOF.0103 function to bind AND/OR logics to a digital output,

Note: the configuration of the AND/OR logics cannot be done directly by the controller's panel, but must be done via a PC with the BoardPrg3 software.



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

Up to 30 conditions can be added. Each condition can be individually reversed: in the previous picture, for example, the controller will verify that digital input 1 and digital output 17 are both **not active**. The following conditions can be added:

- DI_XXX: logical states of all digital inputs (physical and virtual).
- DO_XXX: logic states of all digital outputs.
- AL_XXX: presence of warnings/alarms.
- ST_XXX: internal states of the controller.
- AT_XXX: internal status related to the thresholds on analogue measurements (see par.5.5.4).

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

State	Description
ST.000	OFF_RESET
ST.001	MAN
ST.002	AUTO
ST.004	REMOTE START
ST.006	Acknowledgment of anomalies in progress
ST.007	Reset of anomalies in progress
ST.008	Warnings
ST.011	Alarms
ST.012	Not recognized warnings
ST.015	Not recognized alarms
ST.016	Voltage/frequency presence on connection bars
ST.017	Connection bars out of tolerance

State	Description
ST.018	Delay for connection bars in tolerance
ST.019	Connection bars in tolerance
ST.020	Delay for connection bars out of tolerance.
ST.048	Presence of voltage on the loads
ST.049	Presence of voltage on the renewable sources
ST.050	Presence of voltage on the generators' bars
ST.064	GCB status
ST.065	MCB status
ST.066	MGCB status
ST.067	RNCB status
ST.069	RNCB closure command (stable)
ST.073	RNCB minimum voltage coil
ST.074	RNCB opening pulse
ST.075	RNCB closure pulse
ST.080	Start of inverters inhibited by contact
ST.081	Start of inverters inhibited by clock/calendar
ST.112	Sync per second
ST.113	Sync per minute
ST.114	Sync per hour
ST.127	Daylight Save Time
ST.128	Start request for inverters
ST.136	Inverters stop request (not required)
ST.138	Inverters stop request (alarms)
ST.139	Inverters stop request (MAN)
ST.144	GCB closed on genset 01
ST.145	GCB closed on genset 02
ST.146	GCB closed on genset 03
ST.147	GCB closed on genset 04
ST.148	GCB closed on genset 05
ST.149	GCB closed on genset 06
ST.150	GCB closed on genset 07
ST.151	GCB closed on genset 08
ST.152	GCB closed on genset 09
ST.153	GCB closed on genset 10
ST.154	GCB closed on genset 11
ST.155	GCB closed on genset 12
ST.156	GCB closed on genset 13
ST.157	GCB closed on genset 14
ST.158	GCB closed on genset 15
ST.159	GCB closed on genset 16
ST.160	GCB closed on genset 17
ST.161	GCB closed on genset 18
ST.162	GCB closed on genset 19
ST.163	GCB closed on genset 20
ST.164	GCB closed on genset 21
ST.165	GCB closed on genset 22
ST.166	GCB closed on genset 23
ST.167	GCB closed on genset 24
ST.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

State	Description
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
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

State	Description
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	CANBUS 0 (EXBUS) BUS-OFF
ST.273	CANBUS 0 (EXBUS) ERR-PASSIVE
ST.274	CANBUS 0 (EXBUS) ERR-ACTIVE
ST.275	No communication on CANBUS 0 (EXBUS)
ST.276	CANBUS 1 (PMCB) BUS-OFF
ST.277	CANBUS 1 (PMCB) ERR-PASSIVE
ST.278	CANBUS 1 (PMCB) ERR-ACTIVE
ST.279	No communication on CANBUS 1 (PMCB)
ST.280	CANBUS 2 (INT) BUS-OFF
ST.281	CANBUS 2 (INT) ERR-PASSIVE
ST.282	CANBUS 2 (INT) ERR-ACTIVE
ST.283	No communication on CANBUS 2 (INT)
ST.304	START button
ST.305	STOP button
ST.307	RNCB 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_384	Generator 01 active on PMCB
ST_385	Generator 02 active on PMCB
ST_386	Generator 03 active on PMCB
ST_387	Generator 04 active on PMCB
ST_388	Generator 05 active on PMCB
ST_389	Generator 06 active on PMCB
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

State	Description
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 of AND & OR together). Suppose we want to activate digital output #1 when digital inputs #1 and #2 are both active, or if digital input #3 is active.

We must first associate the virtual digital input #1 (for example) with an AND/OR logic configured as AND, which verifies that the first two digital inputs are both active. Then we must associate to the digital output #1 an AND/OR logic configured as OR which verifies that virtual digital input #1 or digital input #3 is active. In practice, virtual digital input #1 is used as a "temporary storage" for the AND condition. In this case, it is not necessary to associate any function with the virtual digital input.

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

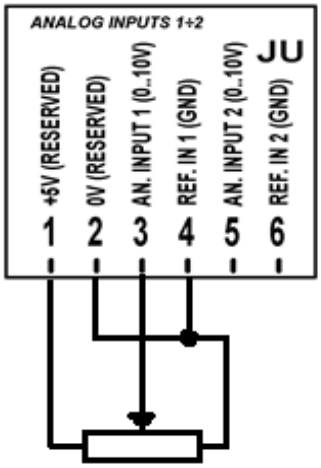
The device is equipped with two differential analogue inputs 0...10 VDC available on connector **JU**, four analogue inputs 0...10 VDC available on connector **JK** and one analogue input 0…32 VDC available on terminal **JJ- 4.**

Each of these inputs, if not used as analogue, can be configured as digital (function AIF.0100 in parameter P.4001 or equivalent). In this case, the analogue inputs AI_1 to AI_7 will be managed as additional digital inputs (DI_19 to DI_25). Their status is displayed on page S.11 (0=input not active, 1=input active).

It is also possible to use two DIVIT expansion modules and five DIGRIN or DITHERM expansion modules connected via Can Bus to acquire additional 8 voltage/current signals and up to 15 temperatures.

There are also 8 "virtual" analogue inputs, not really existing on the controller or on the expansions, but whose value is determined by the software via AND/OR logics or via a PLC program. The virtual inputs are configurable as functionality and can be used in the same way as the physical inputs.

5.5.1 JU – Analogue inputs 1-2 (AI_01-AI_02)



They are two inputs for measuring voltage signals 0...10 VDC.

The two inputs are not galvanically insulated but provide the possibility of measuring differential signals, in order to compensate for any differences between the negative pole of the signal and the negative power supply of the controller **B-**. The compensation range is -10/+6 VDC.

The reference terminals REF.IN1 (**JU-4**) and REF.IN2 (**JU-6**) are internally connected to **B-** by means of 1 kΩ resistors; this allows to avoid their connection to the ground of the voltage signal sources for short connections internal to the electrical panel.

There is also on the same **JU** connector a regulated +5 VDC output (**JU-1**) and an output connected to the ground inside the controller (**JU-2**). These voltages are specifically intended for the use of potentiometers. The minimum overall resistance applicable between **JU-1** and **JU-2** is 10 kΩ.

If configured as digital (function AIF.0100 in parameter P.4001 or equivalent), the inputs are considered active when the measured voltage is greater than 4.0 VDC, they are considered not active when the measured voltage is less than 3.5 VDC. They therefore cannot be activated like the other inputs by connecting it to **B-**.

For configuration and uses of analogue inputs see par. 5.5.4

The factory default for the input functions are:

Terminal	Analogue input	Input type	Default setting
JU-1	-	-	+5 VDC reference output reserved only for the connection of trimmers/potentiometers for analogue inputs 1 and 2.
JU-2	-	-	Output B- reserved only for the connection of trimmers/potentiometers for analogue inputs 1 and 2.
JU-3	Analogue input 1	Voltage measurement input 0...10 VDC	AIF.0000 – "not used"
JU-4		Reference ground input of JU-3	
JU-5	Analogue input 2	Voltage measurement input 0...10 VDC	AIF.0000 – "not used"
JU-6		Reference ground input of JU-5	

5.5.2 JK – Analogue inputs 3-6 (AI_03-AI_06)

The device has four programmable inputs that can be used for 0-10 VDC voltage measurements **JK-2, JK-3, JK-4, and JK-5**. The measurement is made with respect to the power supply negative of the controller (**B-**).

Measured voltages are shown on page S.15.

If configured as digital (function AIF.0100 in parameter P.4001 or equivalent), to activate an input it must be connected to **B-**, to deactivate it just leave it floating. These inputs will then appear in the digital inputs configuration menu (DI_21, DI_22, DI_23 and DI_24) and will be manageable exactly like the other inputs; see par. 5.3.5.

The factory default for the input functions are:

Terminal	Analogue input	Input type	Default setting
JK-2	Input 3	Voltage input 0-10 VDC	AIF.0000 – "not used"
JK-3	Input 4		AIF.0000 – "not used"
JK-4	Input 5		AIF.0000 – "not used"
JK-5	Input 6		AIF.0000 – "not used"

5.5.3 JJ-4 Analogue input 07 (AI_07)

Analogue input 7, available on terminal **JJ-4,** has a measuring range from 0 to 32 VDC with respect to the negative power supply of the controller (**B-**).

If configured as digital (function AIF.0100 in parameter P.4001 or equivalent), it is considered active when the measured voltage is greater than 4.0 VDC, it is considered inactive when the measured voltage is less than 3.5 VDC. It therefore cannot be activated like the other inputs by connecting it to **B-**.

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

5.5.4 Configuration of the analogue inputs

The analogue inputs can be used for the acquisition of various predefined quantities, or to acquire generic sensors (and therefore customizable). Some quantities can only be acquired from some specific inputs (see the following table in this paragraph).

For all these measurements, through the BoardPrg3 program it is possible to define conversion curves, known at least two pairs of voltage/value points of the quantity to be measured, see paragraph 5.5.6.

A conversion curve can be applied to all the physical analogue inputs (JU, JK, JJ and DIVIT) (not to the virtual analogue inputs and to the DIGRIN and DITHERM inputs).

Each analogue input (including virtual ones) is associated with a set of 8 parameters to define the function, an alternative denomination and a series of generic thresholds and configurations that can be used for different functions.

The following are examples of those relating to input JK-2. For the parameters of the other inputs, refer to document [3] or to the I/O configuration page of BoardPrg3.

NOTE: on BoardPrg3 the parameters are displayed only when the input is actually configured as an analogue input and not for example as digital. The analogue inputs of the expansion modules are displayed only if the expansion module itself has been previously enabled.

There are:

- A parameter that configures the function (P.4017 for input JK-2).
- A parameter that configures a possible message to be shown on the display (P.4018 for input JK-2).
- Two thresholds made up of three parameters each:
  - A parameter that configures the threshold value (P.4019 and P.4022 for input JK-2).
  - A parameter that configures the delay for managing the "out of threshold" condition (P.4020 and P.4023 for input JK-2).
  - A parameter that configures the checking options and the actions in case of "out of threshold" condition (P.4021 and P.4024 for input JK-2)

The parameter that contains the message for a given analogue input (in the example the parameter P.4018) is displayed on the controller every time the thresholds are used to activate warnings and or alarms (see below).

It is also used for the following functions of the analogue inputs: AIF.2001, AIF.2003 and AIF.2005. In this case, the acquired measurement will be displayed on pages M08, M09 and M10, preceded by the configured message. **Note: the AIF.2051 function can also be used instead of the previous three. In this case the acquired measurement will not be shown on the display; it can however be used with the thresholds to manage digital outputs and activate warnings/alarms.**

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

- Bit 0:
  - If this bit is "OFF", the controller checks whether the measurement is greater than the threshold
  - If this bit is "ON", the controller checks whether the measurement is lower than the threshold
- Bit 1:
  - If this bit is "OFF", the controller sets the internal status related to this analogue measurement to OFF if the measurement is "out of range".
  - If this bit is "ON", the controller sets the internal status related to this analogue measurement to ON if the measurement is "out of range".
- Bit 4. If this bit is "ON", the controller activates a warning if the measurement is "out of range".
- Bit 7. If this bit is "ON", the controller activates an alarm if the measurement is "out of range".

- Bit 8. If this bit is "ON", the controller verifies that the RNCB circuit breaker is closed to activate any warning/alarm configured with the previous bits.
- Bit 9. If this bit is "ON", the controller verifies that the MGCB circuit breaker is closed to activate any warning/alarm configured with the previous bits.
- Bit 13. If this bit is "ON", to activate any warning/alarm configured with the previous bits, the controller checks the status of any digital inputs configured with the "DIF.2705 -" Disables protections on analogue measures "function. The warning/alarm will be activated if no digital input is so configured, or if they are all OFF.
- Bit 15. If this bit is "ON" the anomaly is subject to the protections OVERRIDE (digital input configured with the DIF.2063 function).

Any combination of these bits can be set.

By using the two thresholds and the AND/OR logic together, it is possible to activate a digital output with respect to the value of an analogue measurement, with hysteresis. Suppose we want to activate a digital output if the frequency of renewable sources exceeds 50.5 Hz. We must first manage a minimum hysteresis on the threshold, otherwise when the frequency is close to the threshold, the output would continue be activated and deactivated for minimum variations of the frequency itself. Suppose therefore we want to activate the output if the frequency exceeds 50.5 Hz, and turn off the output if the frequency is lower than 50.3 Hz. To do this we use, for example, the virtual analogue input #1 (see par. 5.5.5) which has been configured to contain the frequency of renewable sources.

Set the parameters as follows:

- P.4051 (function #1): 4012 (AIF.4012).
- P.4052 (message #1): “”.
- P.4053 (threshold #1): 50.5 Hz
- P.4054 (delay #1): 0.5 sec
- P.4055 (configuration #1): 0002 (bit 0 OFF, bit 1 ON)
- P.4056 (threshold #2): 50.3 Hz
- P.4057 (delay #2): 0.5 sec
- P.4058 (configuration #2): 0001 (bit 0 ON, bit 1 OFF)

The first threshold is used to activate the internal state associated with the analogue input. Looking at the configuration parameter, you can see that:

- Bit 0 OFF (it verifies that the measurement is greater than the threshold).
- Bit 1 ON (it activates the internal state in "out of threshold" condition).

The second threshold is used to deactivate the internal state associated with the analogue input. Looking at the configuration parameter, you can see that:

- Bit 0 ON (it verifies that the measurement is lower than the threshold).
- Bit 1 OFF (it deactivates the internal state in "out of threshold" condition).

With the previous programming, therefore, the controller will activate the internal status associated with the analogue input when the frequency is greater than 50.5 Hz for 0.5 seconds; will reset the internal state when the frequency is lower than 50.3 Hz for 0.5 seconds.

Using the AND/OR logic (see par. 5.4.7), it is possible to "copy" the internal state on a physical output.

The following table shows the list of functions that can be associated with the physical analogue inputs:

Function	Function name	Message	Thresholds	Controller	DIVIT	DIGRIN / DITHERM
AIF.0000	Not used			Yes	Yes	Yes
AIF.0100	Used as digital input			Yes		
AIF.2001	Generic sensor (page 1)	Yes	Yes	Yes	Yes	Yes
AIF.2003	Generic sensor (page 2)	Yes	Yes	Yes	Yes	Yes
AIF.2005	Generic sensor (page 3)	Yes	Yes	Yes	Yes	Yes
AIF.2051	Generic sensor	Yes	Yes	Yes	Yes	Yes
AIF.2311	Active power from renewable sources			Yes	Si	
AIF.2313	Reactive power from renewable sources			Yes	Si	
AIF.2315	Active power setpoint for renewable sources			Yes	Si	
AIF.2317	Reactive power setpoint for renewable sources			Yes	Si	
AIF.2319	Spinning reserve for generators			Yes	Si	

All odd AIF.XXXX functions require the use of the BoardPrg3 program to define or load the sensor characteristic curve (see par.5.5.6). Exceptions are the measurements acquired by the DITHERM/DIGRIN modules, which are already expressed in °C and do not require any conversion.

5.5.5 Virtual analogue inputs (AI_VIRTUAL)

In addition to the physical analogue inputs, the controller also manages 8 virtual analogue inputs. They are managed by the controller exactly as if they were physical inputs (without any limitation), but the status of the virtual inputs is not acquired by the hardware but determined via software.

The purpose of the virtual analogue inputs is multiple:

- Allows to activate warning/alarms related to the internal measures available.
- To activate digital outputs based on the value of the internal measurements available.
- To “drive” some controller’s functions of by the PLC.

There are 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 less than AIF.4001). For example, we can use the PLC program to change the setpoint for the "SPINNING RESERVE" of the generators, based on the temperature of the photovoltaic panels, acquired with an external sensor:
  - Set parameter P.4051 (function for virtual analogue input # 1) to the value AIF.2319 ("Spinning reserve for generators"). The controller will then use the value of the virtual analogue input # 1 as the setpoint.
  - Using the internal PLC, build a logic that writes the setpoint corresponding to the acquired external temperature to the virtual analogue input # 1.
- By assigning a value greater than or equal to 4001 (AIF.4001) to the "function" parameter of the virtual analogue input. In this case the controller "copies" the quantity identified by the previous parameter in the virtual analogue input: you can then manage thresholds for activating digital outputs and anomalies on this measure.

The following table shows the list of functions that can be associated with the virtual analogue inputs of the controller:

Function	Function name	Message	Thresholds
AIF.0000	Not used		
AIF.0100	Used as digital input		
AIF.2001	Generic sensor (page 1)	Yes	Yes
AIF.2003	Generic sensor (page 2)	Yes	Yes
AIF.2005	Generic sensor (page 3)	Yes	Yes
AIF.2051	Generic sensor	Yes	Yes
AIF.2311	Active power from renewable sources		
AIF.2313	Reactive power from renewable sources		
AIF.2315	Active power setpoint for renewable sources		
AIF.2317	Reactive power setpoint for renewable sources		
AIF.2319	Spinning reserve for generators		
AVF.4001	Connection bars frequency	Yes	Yes
AVF.4006	Connection voltage L1-L2	Yes	Yes
AVF.4007	Connection voltage L2-L3	Yes	Yes
AVF.4008	Connection voltage L3-L1	Yes	Yes
AVF.4009	Connection voltage L-L average	Yes	Yes
AVF.4012	Renewable sources frequency	Yes	Yes
AVF.4017	Renewable sources voltage L1-L2	Yes	Yes
AVF.4018	Renewable sources voltage L2-L3	Yes	Yes
AVF.4019	Renewable sources voltage L3-L1	Yes	Yes
AVF.4020	Renewable sources voltage L-L average	Yes	Yes
AVF.4023	Current L1	Yes	Yes
AVF.4024	Current L2	Yes	Yes
AVF.4025	Current L3	Yes	Yes
AVF.4026	Auxiliary current (or neutral current)	Yes	Yes
AVF.4031	Active power L1	Yes	Yes
AVF.4032	Active power L2	Yes	Yes
AVF.4033	Active power L3	Yes	Yes
AVF.4034	Total active power	Yes	Yes
AVF.4041	Total apparent power	Yes	Yes
AVF.4047	Total reactive power	Yes	Yes
AVF.4058	Total power factor (calculated from kW and kVA)	Yes	Yes
AVF.4059	Total cosfi (calculated from kW and kvar)	Yes	Yes
AVF.4075	Active power on loads	Yes	Yes
AVF.4099	Renewable sources active energy (partial)	Yes	Yes
AVF.4101	Renewable sources reactive energy (partial)	Yes	Yes
AVF.4105	Battery voltage	Yes	Yes

Functions greater than 4000 cannot be used to configure the physical analogue inputs.

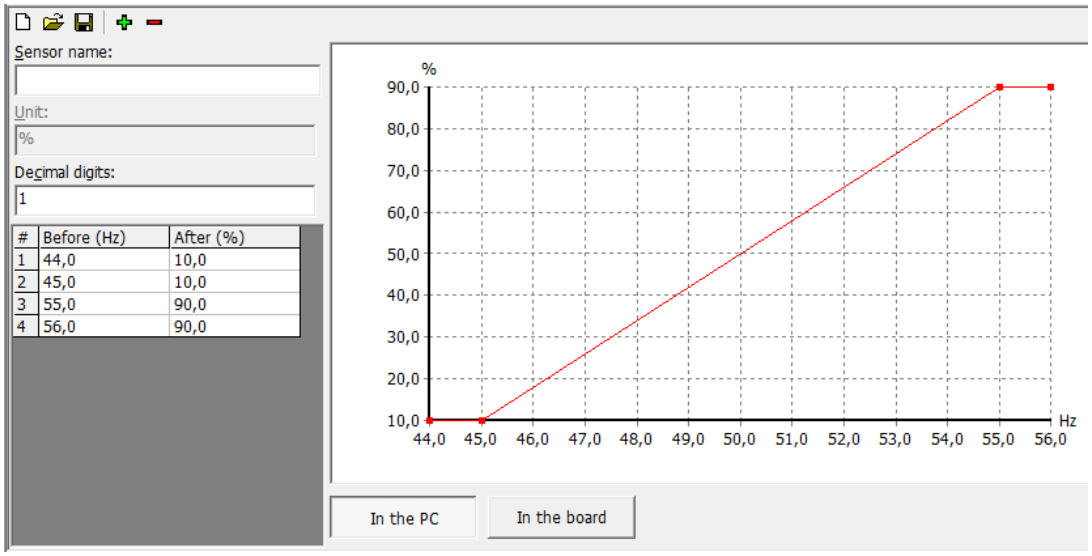
5.5.6 Conversion curves

Conversion curves are a tool that allows you to convert a numeric value to another numeric value. They can be used for two purposes, for analogue inputs and for analogue outputs for:

- Convert the measurement acquired from an analogue (physical) input (controller or expansion modules), from the electrical value to the real measurement unit of the sensor.

- Convert an internal measurement of the controller into a percentage value, before "writing" it on an analogue output.

Note: the configuration of the conversion curves cannot be made directly from the controller, but must be done via a PC with the BoardPrg3 software.



The previous pictures shows a conversion curve associated with an analogue output. The analogue output has been configured with the AOF.3201 function ("Frequency of the renewable sources"). With this configuration, the output will be 10% for a frequency less than or equal to 45 Hz, 90% for a frequency greater than or equal to 55 Hz; for frequency values between 45 Hz and 55 Hz, the output will assume a value between 10% and 90%.

Up to 32 points can be added to the graph, thus also creating nonlinear curves. Note in the example that the configured curve has two horizontal segments at the beginning and at the end, obtained by placing two equal values in the "After" column corresponding to two different values in the "Before" column. This is not mandatory, but allows you to impose a saturation limit on one end or on both ends of the curve. The controller, in fact, infinitely extends the first and last segments of the curve. Being horizontal, any value for the "to be converted" measure will correspond to the same value as the "converted" measure. In the previous example, for any frequency less than 45 Hz, the analogue output will be set to 10%. If the first point was removed from the previous example (44 Hz 10%), there would be no horizontal segment at the beginning of the curve: in this case if the frequency dropped below 45 Hz, the analogue output would drop below 10%.

The BoardPrg3 software allows (through the first buttons on the top left) to save the curve on a file, to then be able to reuse it in other applications. It is therefore possible to make an archive of the conversions associated with the commonly used sensors.

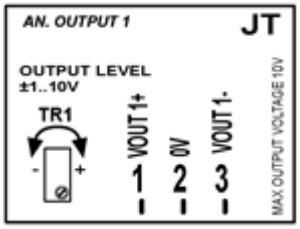
If the curve is associated with a physical analogue input configured with the functions AIF.2001, AIF.2003 and AIF.2005 ("Generic sensor"), the converted measurement will be displayed on pages M08, M09 and M10: in this case it is It is also possible to specify (through the conversion curve) the number of decimal digits and the measurement unit.

5.6 Analogue outputs 1-2 (JT, JS)

The device is equipped with two insulated analogue outputs -10...10 VDC, available on terminals **JT** and **JS**.

It is also possible to use an expansion module connected via Can Bus to manage further 4 analogue outputs.

5.6.1 JT – Analogue output 1 (AO_01)



Analogue output intended for interfacing external devices with analogue voltage or current input.

The output voltage can be adjusted through the potentiometer TR1 between a minimum of ± 1 VDC and a maximum of ± 10 VDC. The TR1 potentiometer therefore defines the maximum of the analogue output.

The output can be positive and negative (symmetrical type) if you connect VOUT1+ and VOUT1-, or only positive (asymmetrical type) if you connect between VOUT1 + and 0V.

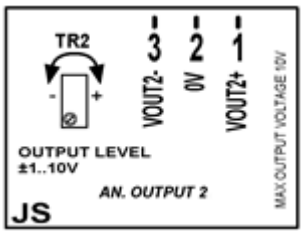
The output is galvanically insulated.

The minimum load impedance is 10 kΩ.

The factory default functions for the output is are:

Terminal	Output	Type	Default function
JT-1	01	**VOUT1+:** analogue voltage signal with positive polarity.	AOF.0000 – "Not used"
JT-2		**0V**: internal reference (B-) of the isolated output.	
JT-3		**VOUT1-:** analogue voltage signal with negative polarity.	

5.6.2 JS - Analogue output 2 (AO_01



Analogue output intended for interfacing external devices with analogue voltage or current input.

The output voltage can be adjusted through the potentiometer TR2 between a minimum of ± 1 VDC and a maximum of ± 10 VDC. The TR2 potentiometer therefore defines the maximum of the analogue output.

The output can be positive and negative (symmetrical type) if you connect VOUT2+ and VOUT2-, or only positive (asymmetrical type) if you connect between VOUT2 + and 0V.

The output is galvanically insulated.

The minimum load impedance is 10 kΩ.

The factory default functions for the output is are:

Terminal	Output	Type	Default function
JS-1	01	**VOUT2+:** analogue voltage signal with positive polarity.	AOF.0000 – "Not used"

JS-2		**0V**: internal reference (B-) of the isolated output.	
JS-3		**VOUT2-:** analogue voltage signal with negative polarity.	

5.6.3 Configuration of the analogue outputs

All analogue outputs (the two on the RN200 controller and the four on the DANOUT module) are fully configurable. Each output is associated with a parameter (for example P.6001 for output 1) which configures its function (see document [3]).

A conversion curve can be applied to all analogue outputs.

The following functions, which are not directly related to the controller's operating sequences, can be selected for any analogue output:

- AOF.0101 - “Used by the PLC”. This function combines the analogue output with the internal PLC program of the device: in this way, it is the PLC logic that controls the output and not the normal operating logic of the controller. Note: if the PLC program uses outputs but these outputs are not configured with the AOF.0101 function, the outputs will not be controlled (but the controller signals this situation by activating a warning).

- AOF.0102 - "Managed by serial ports". The controller does not command the output with its own internal logics, but with the commands it receives through the serial ports.

The following table shows the list of functions that can be associated with the analogue outputs:

Function	Function name
AOF.0000	Not used
AOF.0101	Used by the PLC
AOF.0102	Managed by the communication ports
AOF.3101	Frequency of the connection bars
AOF.3111	Voltage of the connection bars
AOF.3201	Frequency of the renewable sources
AOF.3211	Voltage of the renewable sources
AOF.3221	Active power of the renewable sources

When using the AOF.3101 and following functions, the proportionality between the selected quantity (voltage, frequency, etc.) and the % value with respect to the output full scale must be defined through the use of the conversion curves (see par.5.5.6).

5.7 Optional additional modules

Using the Can Bus 0 (EXBUS) connection, the following optional additional modules can be connected to the device:

- 3 DITHERM/DIGRIN modules:
  - DITHERN: 3 galvanically insulated thermocouples for measuring temperatures.
  - DIGRIN: 3 galvanically insulated Pt100 sensors for measuring temperatures.
- 2 DIVIT modules: 4 analogue inputs 0...5/0…10 VDC or 0...10/0...20 mA galvanically insulated.
- 1 DANOUT module: 4 analogue outputs 0...5/0...10 VDC or 0...10/0...20 mA galvanically insulated.
- 2 DITEL 16IN modules: 16 opto-insulated digital inputs (for a total of 32 inputs). 2 DITEL 8 OUT relay modules can be connected to each DITEL 16IN module for a total of 32 digital outputs. It is not possible to use the output modules without a corresponding input module.

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

The term DITEMP will refer to a module (DITHERM or DIGRIN) for measuring temperature.

To use the modules on the RN200 it is necessary to set their number with the parameters:

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

For related parameters see document [3]. In the BoardPrg3 program, once the presence of a module has been configured, it appears in the I/O menu in the left column, with the individual inputs/outputs ready to be configured.

However, it is necessary to make a clarification as regards DIVIT modules. They are able to measure any quantity: it is necessary to convert the measurement made (Volt or mA) into the real measurement unit of the quantity acquired. This conversion can be done directly in the module (DIVIT) or on the RN200. Be careful not to have a double conversion.

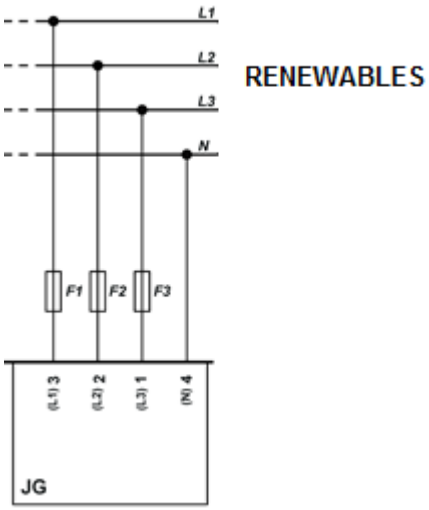
It is advisable:

- Configure the DIVIT module to transmit a percentage value. In the following example, a channel configured to acquire a 0-10 mA signal 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

- On the RN200, use a conversion curve to convert from a % value to the real measurement unit.

5.8 JG – Voltage measurement input for renewable sources



RENEWABLES

The connection to the AC voltage produced by the inverters connected to renewable sources takes place via the **JG** connector on the controller.

Three phase connection:

- Connect phase L1 (or R) to terminal 3 of the JG connector.
- Connect phase L2 (or S) to terminal 2 of the JG connector.
- Connect phase L3 (or T) to terminal 1 of the JG connector.

- Connect the neutral (if present) (N) to terminal 4 of the JG connector.

Single phase connection:

- Connect phase (L) to terminal 3 of the JG connector.
- Connect the neutral (N) to terminals 2 & 4 of the JG connector.

The three-phase/single-phase selection is made with parameter P.0119.

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

For use in CAT.III the maximum applicable voltage is 300 VAC (phase-neutral) and 520 VAC (concatenated). The maximum voltage with respect to the protective earth is 300 VAC.

If it is necessary to connect higher voltages, voltage transformers (V.T.) must be used with a voltage on the secondary side that does not exceed the previous limits. The nominal voltages on the primary and secondary of the V.T. can be configured with parameters P.0117 and P.0118. It is recommended to use V.T. which, at the nominal voltage of the system, supply about 400 VAC on the secondary (in order not to reduce the measurement accuracy of the controller).

Alternatively, V.T. with 100 VAC rated secondary can be used. In this case, parameter P.0152 must be configured for 100 VAC operation. The controller will adapt the internal measurement circuit to optimize the voltage measurement on the nominal value set in parameter P.0152.

It is also possible to use the Aron insertion of the voltage transformers, which involves the use of only two transformers instead of three (see paragraph 5.10). In this case, use P.0129 to select that the neutral is not connected.

Attention! Do not connect the measurement input JG to a V.T. with 400 VAC secondary voltage or directly to the 400 VAC voltage when the device is configured to read a nominal voltage of 100 VAC (parameter P.0152 set to 1). It is possible to damage the device.

5.8.1 Measurement of the neutral of renewable sources

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

If the system is configured with the neutral connection, the neutral voltage is measured with respect to "B-" (negative supply).

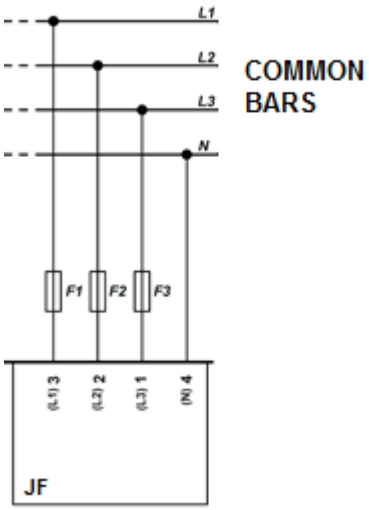
The values of the three phase voltages (and of the neutral voltage with respect to B-) are displayed on page M.02.

By pressing the **ACK/ENTER** button it is possible to change the display mode of these measures between two different modes:

- Measurement of the connected voltages L1-L2, L2-L3, L3-L1 and the neutral voltage with respect to the negative supply N-B.
- Measurement of the phase voltages L1-N, L2-N, L3-N and of the neutral voltage with respect to the negative power supply N-B.

If the device is configured not to measure the neutral voltage, only the measurements of the line voltages L1-L2, L2-L3, L3-L1 will be displayed on page M.02, without the neutral voltage with respect to the supply negative N-B. It will not be possible to display the phase voltages L-N.

5.9 JF - Voltage measurement input for connection bars



The term “connection bars” refers to the point where the RNCB circuit-breaker connects the renewable source inverters to the rest of the plant. Depending on the parameter P.0808 and the presence or not of an MGCB switch, they can be:

- The loads.
- The generators’ bars.

The connection to the AC voltage of the connection bars takes place via the **JF** connector on the controller.

Three phase connection:

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

Single phase connection:

- Connect phase (L) to terminal 3 of the JF connector.
- Connect the neutral (N) to terminals 2 & 4 of the JF connector.

The three-phase/single-phase selection is made with parameter P.0101

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

For use in CAT.III the maximum applicable voltage is 300 VAC (phase-neutral) and 520 VAC (concatenated). The maximum voltage with respect to the protective earth is 300 VAC.

If it is necessary to connect higher voltages, voltage transformers (V.T.) must be used with a voltage on the secondary side that does not exceed the previous limits. The nominal voltages on the primary and secondary of the V.T. can be configured with parameters P.0103 and P.0104. It is recommended to use V.T. which, at the nominal voltage of the system, supply about 400 VAC on the secondary (in order not to reduce the measurement accuracy of the controller).

Alternatively, V.T. with 100 VAC rated secondary can be used. In this case, parameter P.0151 must be configured for 100 VAC operation. The controller will adapt the internal measurement circuit to optimize the voltage measurement on the nominal value set in parameter P.0151.

It is also possible to use the Aron insertion of the voltage transformers, which involves the use of only two transformers instead of three (see paragraph 5.10). In this case, use P.0128 to select that the neutral is not connected.

Attention! Do not connect the measurement input JF to a V.T. with 400 VAC secondary voltage or directly to the 400 VAC voltage when the device is configured to read a nominal voltage of 100 VAC (parameter P.0151 set to 1). It is possible to damage the device.

5.9.1 Measurement of the neutral of connection bars

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

If the system is configured with the neutral connection, the neutral voltage is measured with respect to "B-" (negative supply).

The values of the three phase voltages (and of the neutral voltage with respect to B-) are displayed on page M.03.

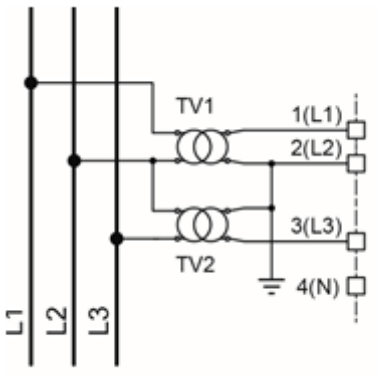
By pressing the **ACK/ENTER** button it is possible to change the display mode of these measures between two different modes:

- Measurement of the connected voltages L1-L2, L2-L3, L3-L1 and the neutral voltage with respect to the negative supply N-B.
- Measurement of the phase voltages L1-N, L2-N, L3-N and of the neutral voltage with respect to the negative power supply N-B.

If the device is configured not to measure the neutral voltage, only the measurements of the line voltages L1-L2, L2-L3, L3-L1 will be displayed on page M.03, without the neutral voltage with respect to the supply negative N-B. It will not be possible to display the phase voltages L-N.

5.10 Aron insertion of voltage transformers

Both for the renewable sources and connection bars inputs, it is possible to use the Aron insertion of the voltage transformers; this allows to use two transformers instead of three. The connection is possible both with the measurement inputs set at nominal voltage 100 VAC and at 400 VAC.

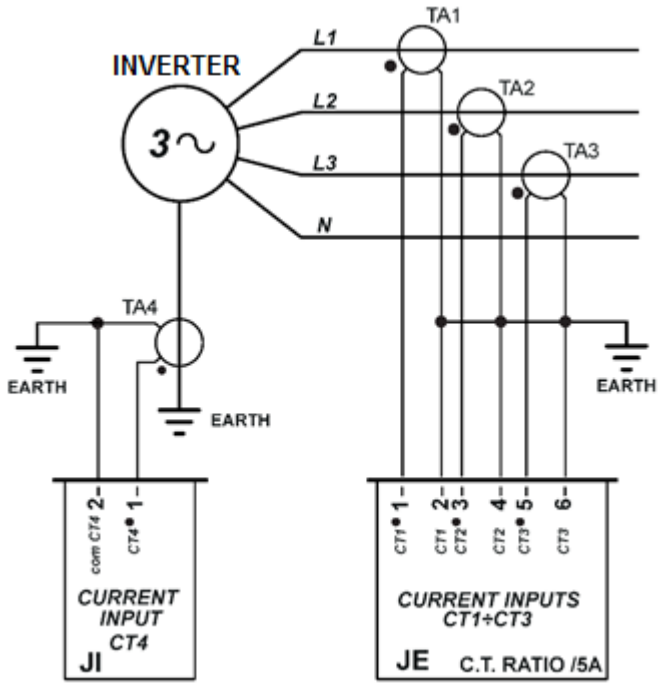


The basic diagram of the Aron connection is as follows:

The diagram is the same for both voltages; it is necessary to set parameters P.0128 (for the connection bars) or P.0129 (for the renewables sources) or both to indicate to the controller that the neutral connection is not used.

5.11 Current measurement inputs (JE-JI).

5.11.1 JE – Current measurement inputs 1-3



Attention! Do not connect the measuring inputs JI and JE the AC voltage conductors.

The measurement of the currents must take place exclusively by means of external current transformers (C.T.) characterized by a level of insulation consistent with the system in which the device is installed: at least BASIC insulation is required for the use of the device in the overvoltage category IV

The secondary of the current transformers must be connected to earth near the C.T. themselves. Internally the device is equipped with additional current transformers which provide additional galvanic insulation.

The external current transformers can have a 5 AAC or 1 AAC secondary winding: the controller internally manages an automatic scale change which guarantees the same accuracy with both types of transformers.

Each current measurement requires a power of approximately 1 VA; however, 5 VA C.T. are recommended, to compensate for losses along the connection cables.

The maximum current measurable directly from the device is 7 AAC; over this threshold, the measurement circuit saturates. The controller is however able to measure up to about 15 AAC (but with progressively decreasing precision) **exclusively for transitory situations**, for example to measure over currents or short-circuit currents on the system, using an algorithm to compensate for the saturation of the measurement circuits.

The JE connector is used to acquire the currents of the three phases of renewable sources:

- Connect the hot pole of the C.T. connected on phase L1 to the JE-1 terminal.
- Connect the cold pole of the C.T. connected on phase L1 to the JE-2 terminal.
- Connect the hot pole of the C.T. connected on phase L2 to the JE-3 terminal.
- Connect the cold pole of the C.T. connected on phase L2 to the JE-4 terminal.

- Connect the hot pole of the C.T. connected on phase L2 to the JE-5 terminal.
- Connect the cold pole of the C.T. connected on phase L2 to the JE-6 terminal.

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

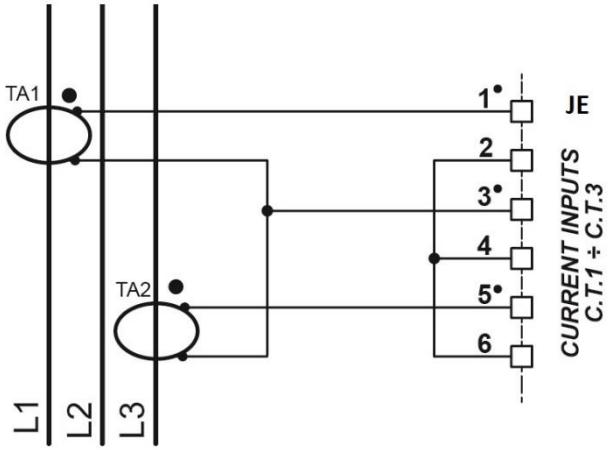
Parameters P.0107 and P.0139 allow to configure the transformation ratio of the external C.T. For example, if C.T. 50/5 are used, set P.0107=50 and P.0139=5.

It is possible (through parameter P.0124) to define whether the C.T. on the three phases are positioned on the renewable sources (as in the drawing above) or on the loads.

5.11.1.1 Aron insertion for current transformers

It is possible, regardless of the connection of the voltage transformers, to connect the current transformers configured as Aron insertion. This allows you to use only two current transformers instead of three.

The connection diagram is as follows:



5.11.2 JI – Current measurement input 4

The device allows to acquire a fourth current measurement, usable for example for earth fault protection. By default, the fourth measure is not used.

The type of JI input depends to whether the controller has been ordered with or without the toroid option (code E620215011000). The option is provided only on request.

5.11.2.1 Controller without the option E620215011000

Parameter P.0109 must be set to "0".

The measurement of the current must be carried out exclusively by means of an external current transformer (C.T.). **Do not connect voltage conductors to JI and JE**. The measurement takes place by means of an amperometric transformer inside the device

An external current transformer with a 5 AAC or 1 AAC secondary winding can be connected to these terminals: the controller internally manages an automatic scale change which guarantees the same measurement accuracy with both types of transformer.

The current measurement requires a power of about 1 VA; however, 5 VA C.T. are recommended, to compensate for losses along the connection cables.

The maximum current measurable directly from the device is 7 AAC; over this threshold, the measurement circuit saturates. The controller is however able to measure up to about 15 AAC (but with progressively decreasing precision)

exclusively for transitory situations, for example to measure over currents or short-circuit currents on the system, using an algorithm to compensate for the saturation of the measurement circuits.

The JI connector is used to acquire the current:

- Connect the hot pole of the external C.T. to the **JI-1** terminal.
- Connect the cold pole of the external C.T. to the **JI-2** terminal.

Parameters P.0108 and P.0135 allow you to configure the transformation ratio of the external C.T. For example, if a C.T. 50/5 is used, set P.0108=50 and P.0135=5.

5.11.2.2 Controller with the option E620215011000

Parameter P.0109 must be set to "1".

The measurement of the current must take place exclusively by means of an external toroid. **Do not connect voltage conductors to JI and JE.**

The maximum current measurable directly from the device is 0.1 AAC: over this threshold, the measurement circuit saturates. Use a toroid with a transformation ratio that guarantees currents below this threshold on the secondary.

The JI connector is used to acquire the current:

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

Parameters P.0108 and P.0135 allow you to configure the transformation ratio of the external toroid. For example, if a 500/1 toroid is used, set P.0108=500 and P.0135=1.

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

5.11.2.3 Uses of the fourth current

Parameter P.0130 allows to select the position of the transformer that acquires this current:

- P.0130 = 1. The transformer is connected to the loads.
- P.0130 = 2. The transformer is connected to the renewable sources.

However, the most important parameter to configure is parameter P.0131 which allows to establish what type of current measurement you want to perform:

- P.0131 = 0 (“Not used”). The controller disables the measurement of the fourth current, which will therefore not be shown on the display.
- P.0131 = 1 (“General purpose”). The controller displays the current measurement on page M.04 with the wording "Ax".
- P.0131 = 2 (“Neutral”). The controller displays the current measurement on page M.04, identifying it as "An".
- P.0131 = 4 (“Power measure”). The controller manages the measurement as the current flowing on phase L1 of the configured source (renewable sources or loads), and displays it on the page "M.04" with the wording "Ax". If one of its three-phase sensors is configured to measure the same voltages, the controller also calculates the active power that circulates on phase L1. Finally, for three-phase systems, it multiplies the calculated power by three, assuming that the load is uniformly distributed over the three phases. If not, it is possible to apply a correction factor (P.0132), which allows to increase the calculated power (if P.0132> 1) or to reduce it (if P.0132 <1) to make sure that it is as close as possible to the real one

Settings 1 and 2 allow to manage a threshold on the auxiliary current (P.0367 and P.0368) and to define what action to take when it is exceeded.

It is possible to configure a digital input with the DIF.2704 function - "Disable protections on the 4th current". If the input is active, the thresholds, even if set, are ignored and do not generate anomalies if exceeded.

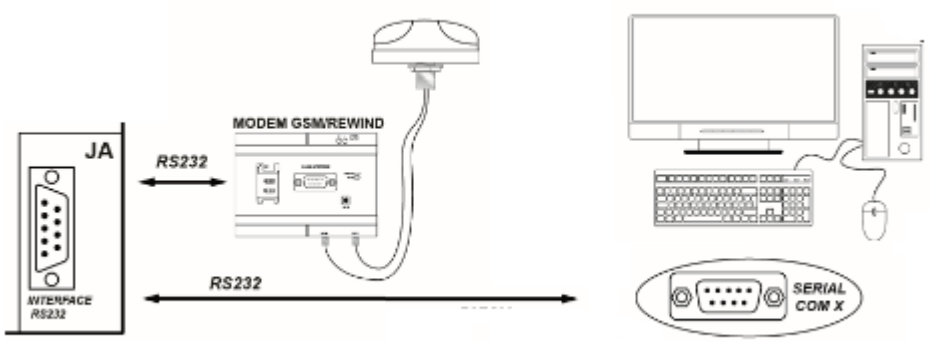
5.12 Communication ports

The device is equipped with many communication ports for connection to PCs, modems, networks, etc.:

- One USB 2.0 not insulated serial port, usable in Function or Host mode:
  - Function (USB TYPE-B connector): connection with the PC for FW updating and programming of device parameters.
  - Host (USB TYPE-A connector): pen drive management (currently not available).
- One RS232 serial port with male DB9 connector that can be used for interfacing with an external device equipped with an RS232 interface. The maximum cable length is 12 meters. See par. 5.12.1.
- One RS485 serial port with galvanic insulation; the maximum connection length in optimal conditions is 1200m. The 120 Ohm termination resistor is integrated and can be added via the S5 selector. The use of shielded cable with an impedance of 120 Ohms is required (e.g. BELDEN 3105A Multi-conductor-EIA Industrial RS-485PLT / CM). See par. 5.12.2
- One Can Bus port with galvanic insulation for communication with the optional expansion modules (DITEL, DITHERM, DIGRIN and DIVIT). The 120 Ohm termination resistor is integrated and can be added via selector S1. The use of a specific shielded cable is required (e.g. HELUKABEL 800571). See par.5.12.5
- One Can Bus port with galvanic isolation for communication with other Mecc Alte control devices (GC600, MC200 etc.). The 120 Ohm termination resistor is integrated and can be added via the S6 selector. The use of a specific shielded cable is required (e.g. HELUKABEL 800571). See par. 5.12.6.
- One Ethernet port with RJ45 connector for connection to 10/100 Mbps Ethernet networks.

For details on communications, see the specific paragraphs and documents [8] e [9].

5.12.1 JA – Serial port 1 RS232 (JA)



The RS232 JA connector (serial port 1) can be used for interfacing with an external device equipped with an RS232 interface such as a modem or a PC. The maximum connection distance is 12m.

The port can be used with the **Modbus RTU slave** protocol for programming device parameters through the BoardPrg3 program or for connection to a supervision program such as Mecc Alte SS3.

It can also be used with the **Modbus RTU master** protocol to acquire data and send commands to external devices such as inverters for renewable sources.

It can also manage the **AT** protocol for connection to an external GSM modem (in this case it supports the management of SMS messages).

For the functions and protocols implemented, refer to document [9]. Connector diagram 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 then serial port 1 it is necessary to set the parameters:

- P.0451: use of the serial port (slave, master, modem).
- P.0452: Modbus address.
- P.0453: baud rate.
- P.0454: settings.
- P.0470: Modbus registers order.
- P.0476: delay between messages.

The description of these parameters is reported in the document [3].

5.12.1.1 Analogue/GSM modem

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

For the use of a GSM modem, the operator must insert a SIM card of any mobile operator. It is important that the PIN code verification is disabled on the SIM card: insert the SIM in a phone and disable the PIN code before inserting it into the controller.

The type of SIM to be inserted depends on the intended use of the modem:

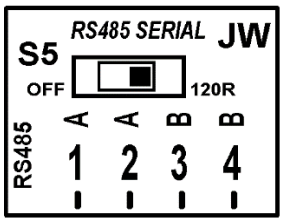
- If you only want to use SMS messages, any SIM is fine.
- If you want to use data exchange with a PC via an analogue modem (the classic 56K modem for example), you need a SIM that provides this type of data. The data exchange takes place through the voice channel, but mobile operators can enable/disable the passage of data on voice both on the calls made and received. As a rule, the transfer of data on voice is available on M2M SIM (Machine to Machine), but it is better to check with your operator

Attention: if you talk about data with a mobile operator, it will mean data on TCP/IP protocol (those of Smartphones to be clear), but they are not what is needed here.

In all cases, the GSM antenna connection is required.

For the use of SMS or data transmission via voice see the document [9].

5.12.2 Serial port 2 RS485 (JW)



The device is equipped with an RS485 serial port (serial port 2) galvanically insulated and independent from serial port 1 (RS232).

The port can be used with the **Modbus RTU slave** protocol for programming device parameters through the BoardPrg3 program or for connection to a supervision program such as Mecc Alte SS3.

It can also be used with the **Modbus RTU master** protocol to acquire data and send commands to external devices such as inverters for renewable sources.

For details on the RS485 connection, its use and parameter programming, refer to the documents [9] e [3].

Connections:

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

The RS485 connection requires a 120 Ohm termination resistance on the two ends of the cable. The device has an integrated resistor; to insert it, simply use the selector S5.

Galvanic insulation ensures the safe operation of the connection even between distant devices and having different ground potentials than the controller.

The maximum connection length is 1200m; however, it also depends on the transmission baud rate set. The use of a special shielded cable (see [9]) with shielding connected to earth is suggested.

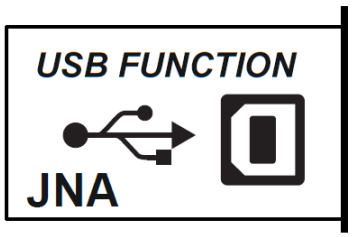
To configure the use of serial port 2 it is necessary to set the parameters:

- P.0471: serial port usage (slave, master).
- P.0472: Modbus address.
- P.0473: baud rate.
- P.0474: settings.
- P.0475: Modbus registers order.
- P.0477: delay between messages.

The description of these parameters is reported in the document [3].

A modem cannot be connected to serial port 2; for the rest it can be used for the same connections that can be made on the RS232 serial port, by using RS485/S232 or RS485/USB adapters when necessary.

5.12.3 USB serial port (JNA): Function mode



The specifications of the USB protocol do not allow its use in a permanent industrial environment due to the limited cable length and the relatively high sensitivity to electrical noise, also on the PC side**. For this reason, the USB connection cable must be inserted only when it is necessary to operate on the device and must be removed from the JNA connector when the operation is finished.**

USB connection with a PC is used for two purposes:

- Firmware upgrade of the controller.
- Parameters setting.

The upgrade of the device firmware is a specific operation of Mecc Alte requires a special procedure and specific programs and normally should not be performed by the installer except in specific cases previously agreed with Mecc Alte.

The USB port can be used for programming parameters with the BoardPrg4 program as an alternative to the RS232/RS485 serial connections, or Ethernet.

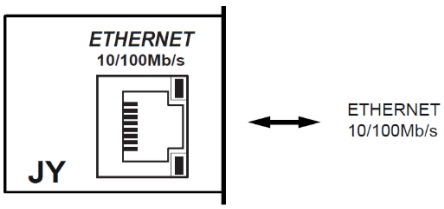
The CDC_Sices_Win.inf driver supplied by Mecc Alte must be installed on the PC to be connected; for driver installation refer to the document [8].

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

The configuration parameters are:

- P.0478: Modbus address
- P.0479: Modbus registers order

5.12.4 Ethernet 10/100Mbps (JY)



The Ethernet port with RJ45 connector is supplied as standard for data connection via LAN. For details on the network connection and the protocol, refer to document [9].

It is possible to connect the device within a LAN or directly to a PC (point-to-point connection). The connection makes it possible to use the Mecc Alte SS3 monitoring, BoardPrg4 configuration and all the functions available through the Modbus TCP/IP protocol.

Connecting the device within a LAN also allows you to keep the internal clock/calendar synchronized with a network server.

Parameters for configuration:

Parameter	Name	Default
P.0500	IP address	192.168.0.1
P.0501	Subnet Mask	255.255.255.0
P.0502	Network gateway	0.0.0.0
P.0503	Modbus/TCP port. Specify the port to be used for Modbus TCP communication	502
P.0505	Order of Modbus registers. When 32-bit information is required, it establishes whether the most significant or least significant 16 bits are sent first.	0-LSWF
P.0508	NTP server port	123
P.0509	NTP server address	0.0.0.0
P.0510	Primary DNS server	0.0.0.0
P.0511	Secondary DNS server	0.0.0.0
P.0513	DHCP server port	67
P.0514	DHCP server address	255.255.255.255

To reach the device within a LAN, it is necessary to configure at least the parameters P.0500, P.0501 and P.0502. You can proceed in two ways:

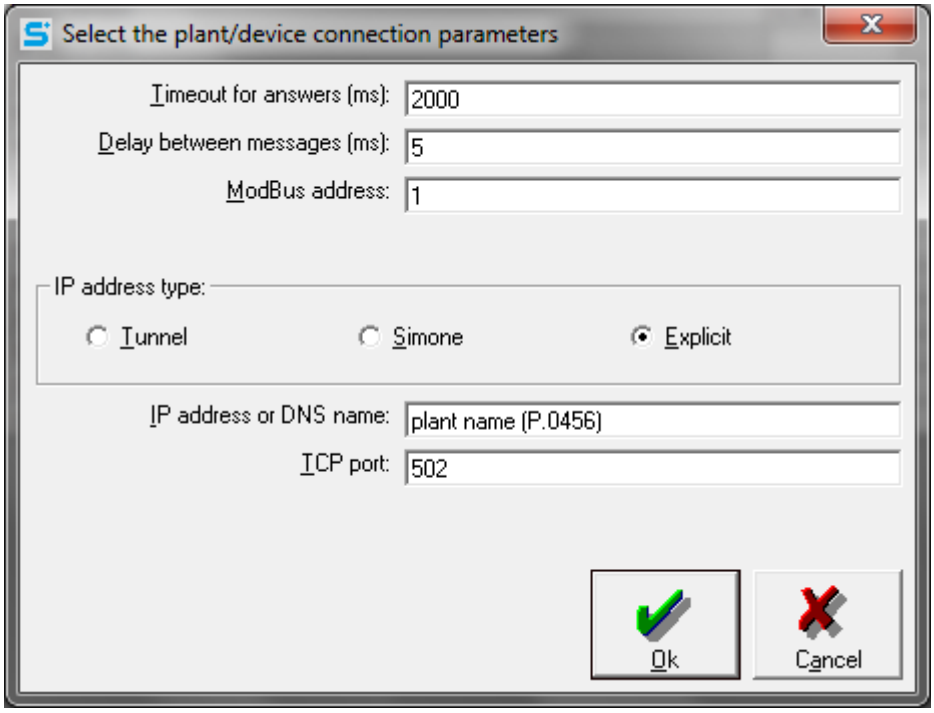
- You can manually configure the three mentioned parameters, with values consistent with the network you are connecting to (the sub-net mask and the router/gateway address are specific to each network, the IP address must be a unique address in the network). To proceed in this way, parameter P.0514 must be set to 0.0.0.0 or parameter P.0513 must be set to zero.
- The values for the three above parameters can be acquired dynamically from the network. To do this, the controller must be able to connect to a Dynamic Host Configuration Protocol (DHCP) server. To proceed in 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 TCP port for the DHCP server, if your server uses a port different, set it in P.0513).

Once the controller has valid values for parameters P.0500, P.0501 and P.0502 (visible on page S.05), it can be contacted via Modbus-TCP protocol on the assigned IP address and on the configured TCP port with P.0503, for example with the supervision (Mecc Alte SS3) and configuration (BoardPrg4) SWs.

The controller also supports the Domain Name System (DNS) protocol. DNS is a system used for converting the names of network nodes to IP addresses and vice versa. The controller uses this function to register on the network with a name. The name must be configured via P.0456 and must be unique in the network. To use the DNS system, you need:

- If you are not using a DHCP server (see above), you need to set the IP address of the DNS server in P.0510 (you can set the address of a secondary DNS server in P.0511).
- If you are using a DHCP server (see above), the IP address of the DNS server is acquired directly by the DHCP server.

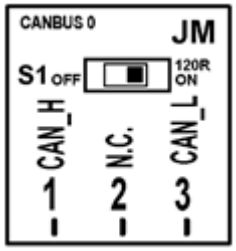
If the DNS server is reachable on the network, the controller registers its name (P.0456) on the network, and from that moment it will be reachable via Modbus-TCP protocol both on the IP address and on the configured name, on port P.0503.



Parameters P.0508 and P.0509 allow you to set the IP address and the port of the NTP (Network Time Protocol) server to be used to keep the internal date synchronized and updated with the date and the time of the server. Setting one of both parameters to zero the function will be disabled. For more details see chapter 9.2.1)

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

5.12.5 Can Bus 0 port (JM)



This Can Bus interface is used to connect the optional expansion modules (DITHERM, DIGRIN, DIVIT, DITEL and DANOUT) to the RN200.

The Can Bus interface is galvanically insulated.

Connections:

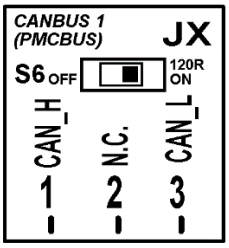
- Connect the JM-1 terminal to the CAN_H terminal of the expansion modules.
- Connect the JM-3 terminal to the CAN_L terminal of the expansion modules.
- Connect the shield of the shielded cable to the protective or signal earth on both sides.

The Can Bus requires a 120 Ohm termination resistance on the two ends of the cable. The termination resistor is integrated in our controller; to insert it, simply use the selector S1.

NOTE: the termination must always be inserted unless the connection continues to other devices and the controller is not one of the two ends.

For the configuration of the additional expansion modules, see par.5.7.

5.12.6 Can Bus 1 port (JX)



This Can Bus interface is used to connect together all the Mecc Alte control units for generating sets, mains and renewable sources (not necessarily only RN200): through this communication channel (PMCB - Power Management Communication Bus) all controllers exchange the data necessary for the application.

The Can Bus interface is galvanically insulated.

Connections:

- Connect the JX-1 terminal to the CAN_H terminal of the other Mecc Alte controllers.
- Connect the JX-3 terminal to the CAN_L terminal of the other Mecc Alte controllers.
- Connect the shield of the shielded cable to the protective or signal earth on both sides.

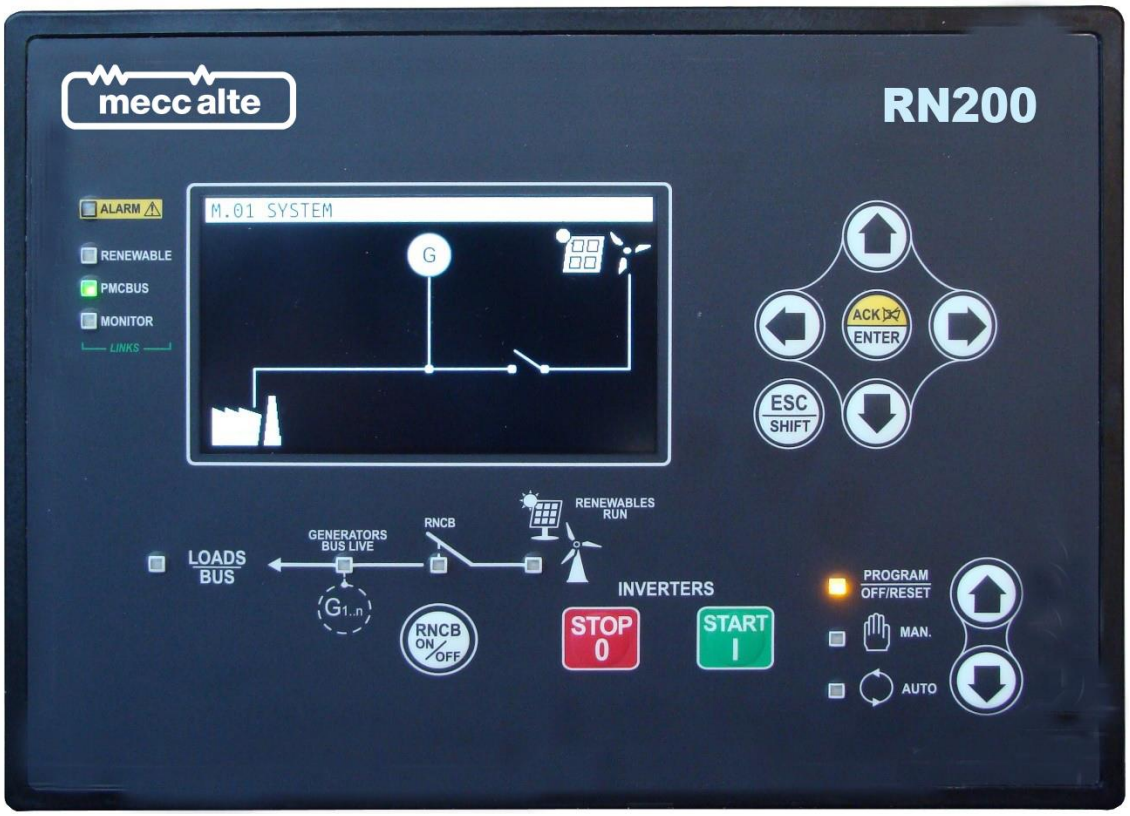
The Can Bus requires a 120 Ohm termination resistance on the two ends of the cable. It is therefore necessary to insert this resistance only on the first and last Mecc Alte controllers. Note: the connection of the controllers can never be as star but must be linear.

The termination resistor is integrated in our controller; to insert it, simply use the selector S6.

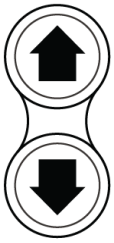
The communication speed on this interface is usually 250 Kbit/s. This speed allows connecting 32 devices to the CANBUS line, and a total length of 125 meters. If a longer wiring is required, setting P.0800 to “3” reduces the speed to 50 Kbit/s: however, you can connect maximum four devices, and the maximum length becomes 800 metres. All devices connected to the CANBUS line must operate at the same speed.

6 Main functions

6.1 Front panel



6.2 Buttons

<table>
<tr><th colspan="2">Button</th><th>Function</th></tr>
<tr><td rowspan="3">MODE UP
 
MODE DOWN</td><td>OFF/RESET
<u>PROGRAM</u></td><td>The inverters for the renewable sources are stopped. The RNCB circuit breaker is open. Parameters can be changed.</td></tr>
<tr><td>MAN (Manual)</td><td>The controller is ready for manual use of renewable sources.
Press the START button to start the inverters.
Press the STOP button to stop the inverters.
Press the RNCB button to open/close the RNCB circuit breaker.</td></tr>
<tr><td>AUTO (Automatic)</td><td>The controller is ready for the automatic management of the inverters for the renewable sources, which will be started when the conditions of the system allow/require it.</td></tr>
<tr><td colspan="2"> 
ESC/SHIFT</td><td>Allows to cancel the modification in progress on a parameter, go back to the upper menu, and exit programming. If pressed for two seconds from any menu, it allows to exit programming by storing the position, for a subsequent return to the same position.

When pressed in any window it provides status information in the top row (alternating it cyclically).

In the display pages which provide for timed rotation of the information displayed, it prevents rotation (keeps current information visible).

Pressed together with the button ACK/ENTER:

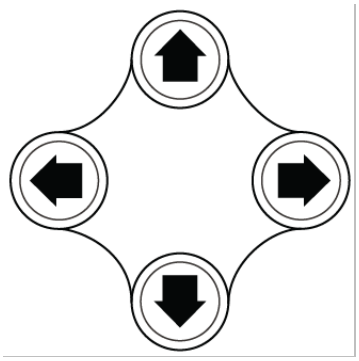
Allows you to "accept" any anomalies on the non-volatile memory at power up.
Allows to perform a pending firmware update at power up.
According to the selected page, if pressed for at least 5 seconds it allows you to reset the counters, reload the default values for the parameters, delete the historical archives, force the exit from the BUS OFF mode of the Can Bus etc.

Used in combination with the LEFT or RIGHT button, it allows contrast adjustment:

ESC/SHIFT + LEFT: to decrease the contrast (lighten).
ESC/SHIFT + RIGHT: to increase the contrast (darken).

Pressed together with the button UP and DOWN:

Allows to change the brightness of the lamps.
Allows to change the parameters of 10 units at a time</td></tr>
</table>

Button	Function
	**Horizontal navigation buttons**: They allow to select the previous or next display page. When editing a text type parameter, they are used to position the cursor under the character to be edited. In the display pages dedicated to the PLC, they allow to switch the display of resources between user-defined symbols and predefined symbols. Used in combination with the **ESC/SHIFT** button, they allow contrast adjustment: **ESC/SHIFT** + **LEFT**: to decrease the contrast (lighten). **ESC/SHIFT** + **RIGHT**: to increase the contrast (darken). **Vertical navigation buttons**: They allow to select the previous or next display mode (intended as a group of pages). Pressed together with the **ESC/SHIFT** button, they allow to change the brightness of the lamps. They allow to scroll through the anomalies if they are not on the display. During the modification of a parameter, they are used to increase / decrease the value (or the selected character) of a unit (if pressed with the **ESC/SHIFT** button, the value is modified by 10 units). While viewing the parameter menus or the historical archive, they allow you to go to the previous/next item.
 **ACK/ENTER**	When an alarm or a warning occurs, a first press of the button deactivates the siren. A further press of the button recognizes the presence of anomalies and automatically removes the warnings (if the operating conditions have returned to normal). If kept pressed for 5 seconds, it performs a complete reset of the anomalies (including alarms). In the pages that display the board's analogue/digital inputs and outputs, it allows you to switch the display between logical, physical or function-related states. Activates the alarms scrolling mode if they do not fit in the display. While viewing the parameter menus or the historical archive, it allows to enter a submenu. While viewing the parameters, it allows to start and confirm a change operation. Pressed together with the button **ESC/SHIFT:** Allows you to "accept" any anomalies on the non-volatile memory at power up. Allows to perform a pending firmware update at power up. According to the selected page, if pressed for at least 5 seconds it allows you to reset the counters, reload the default values for the parameters, delete the historical archives, force the exit from the BUS OFF mode of the Can Bus etc.
 **RNCB**	In the "**OFF/RESET**" and "**AUTO**" modes, the button is disabled. In "**MAN**" it is used to open and/or close the **RNCB** circuit breaker. When you want to open the circuit breaker, a single press first involves transferring the loads from the renewable sources to the generators or to the mains and then opening it; if you want to open RNCB immediately, press and hold the button for 1 second.

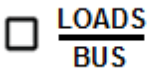
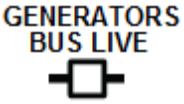
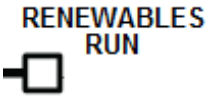
Button	Function
 **START**	In MAN mode it can be used to control the start-up of the inverters for the renewable sources. Note: starting of the inverters is only possible if **RNCB** is closed and the voltage on the connection bars is present and within tolerance. When the controller is turned on: Holding it together with the **STOP** button allows access to special functions.
 **STOP**	In **MAN** mode it is used to stop the inverters for the renewable sources. In **OFF/RESET** mode, it turns on all the lamps in order to check their efficiency (in this phase, the controller also activates the outputs configured with the DOF.3153 function, allowing you to also test the lamps on the panel). When the controller is turned on: Allows to repeat the test of the non-volatile memory if there are errors. Ignores any pending firmware update. Holding it together with the **START** button allows access to special functions.

6.3 Indicators

It is possible to change the brightness of the indicators (all together) using parameter P.0496: the greater the value of the parameter, the greater the brightness of the lamps. The value can be set between 1 and 10 (default value = 5).

Led off	Led on	Led blinking
☐	▣	⧈

Icon		Function
PROGRAM / OFF/RESET	▣	Indicates that the operating mode is OFF/RESET.
	⧈	Indicates that the PROGRAMMING menu is being accessed.
	☐	The controller is in another operating mode.
MAN.	▣	Indicates that the operating mode is MANUAL.
	☐	The controller is in another operating mode.
AUTO / TEST	▣	Indicates that the operating mode is AUTOMATIC.
	⧈	Flashing 90% on: indicates that the operating mode is REMOTE START.
	☐	The controller is in another operating mode.
ALARM	▣	Indicates the presence of at least one alarm.
	⧈	Indicates the presence of at least one warning.
	☐	There are no anomalies.
RENEWABLE	▣	Indicates that at least one external device (inverter) is communicating correctly with RN200.
	☐	Indicates that no external device (inverter) is communicating correctly with RN200.
PMCBUS	▣	Indicates that the Can Bus interface is active, functioning and in **ERROR-ACTIVE** mode.
	⧈	Flashing 25% on: indicates a communication anomaly: the interface is in **ERROR-PASSIVE** mode.
		Flashing 75% on: indicates a communication anomaly: the interface is in **BUS-OFF** mode.
	☐	Indicates that the Can Bus interface is disabled.
MONITOR	▣	Indicates that a Modbus slave connection is active (serial ports, Ethernet or USB).

Icon		Function
	☐	Indicates that no Modbus slave connection is active (serial ports, Ethernet or USB).
	▣	Presence of voltage on the loads.
	☐	No voltage on the loads.
	▣	The voltages on the generators' bars are present and within the tolerance range.
	☐	No voltage on the generators' bars.
	⧈	Flashing at 50%: in the transients between the two previous states.
		Flashing 25% on: the voltages on the generators' bars are present but below the tolerance range.
		Flashing 75% on: the voltages on the generators' bars are present but above the tolerance range.
	☐	The RNCB circuit breaker is open.
	▣	The RNCB circuit breaker is closed.
	⧈	Flashing 25% on: when open with closing command.
		Flashing 75% on: when closed in the presence of an opening command.
	☐	All inverters are stopped.
	▣	At least one inverter is running.
	⧈	Flashing 25% on: no inverter running in the presence of a start command.
		Flashing 75% on: at least one inverter running in the presence of a stop command.

6.4 Multifunctional display

6.4.1 Backlighting

The backlighting lamp is managed by the controller, which switches it off if no button is pressed within a configurable time (P.0492). To turn it back on, just press any button (it is advisable to use the **ESC/SHIFT** button which, when alone, does not perform any operation). It is possible to disable automatic shutdown by setting parameter P.0492 to 0.

By using parameter P.0493, it is possible to force the lamp always on when the inverters for the renewable sources are running.

6.4.2 Contrast adjustment

For a correct view of the display, depending on the ambient temperature conditions, the contrast adjustment may be necessary.

Press the **ESC/SHIFT +** ◄ button in sequence to decrease the contrast (lighten), press the **ESC/SHIFT +** ► button to increase the contrast (darken).

6.4.3 Colour scheme

By factory default, the controller shows information on the display using a blue background colour. However, this behaviour can be changed 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 selected and the type of information displayed.

6.4.4 Navigation between modes

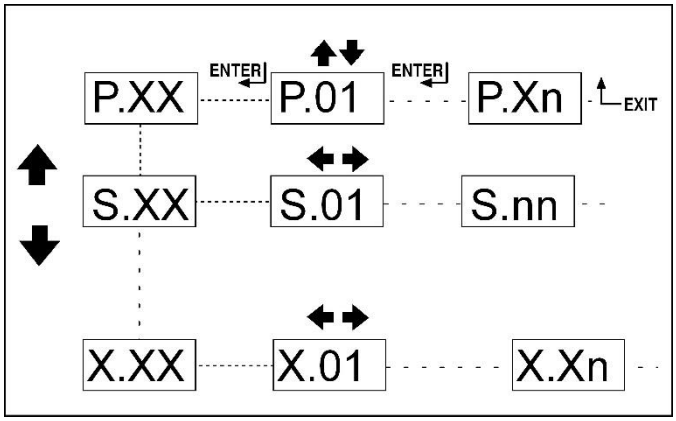
The display has different viewing modes, each consisting of several pages.

Mode	Description	Page identifier
PROGRAMMING	Programming.	P.XX
PLC	Information on the PLC program.	L.XX
STATES	Status information.	S.XX
MEASURES	Electrical measurements.	M.XX
RENEWABLES	Measurements from the inverters for the renewable sources.	R.XX
PMCB	Pages related to the Can Bus PMCB communication interface	B.XX
HISTORY LOGS	Historical archives	H.XX

Generally, the navigation between the modes is done using the ▲ and ▼ buttons. To view the pages within a mode, use the ◄ and ► buttons. Some modes are organized in menus (P.XX and H.XX): in these cases, to view the pages, it is necessary to press the **ACK/ENTER** button and then the ▲ and ▼ buttons.

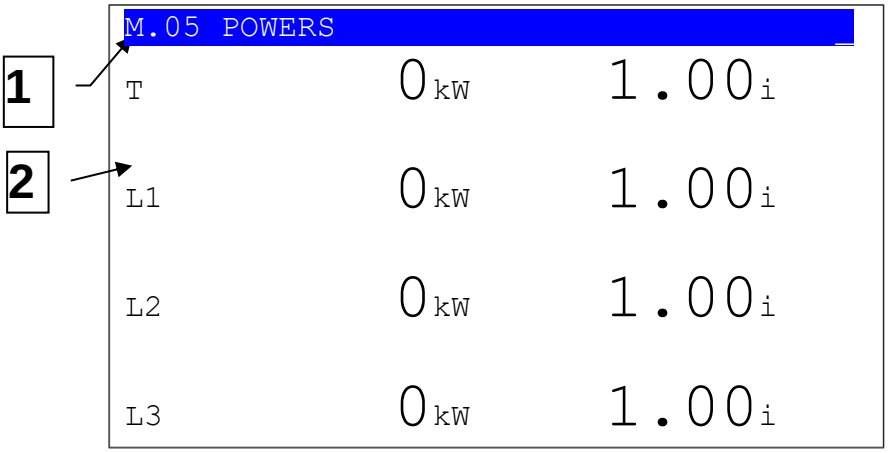
In the event that the ▲ and ▼ buttons are to be used to manage specific functions within a page, the **ACK/ENTER** buttons are required to activate these functions, the **ESC/SHIFT** buttons to deactivate them.

Parameters P.2991…P.2995 allow hiding the not interesting pages, respectively in the L, S, M, R, B modes.



6.4.5 Structure of display areas

LEGEND:
1 – Status bar
2 – Data area



6.4.6 Upper status bar

The upper status bar contains navigation, time and/or some status information.

From left it contains:

- The current mode identifier ("**M**" in the example ").
- The current page identifier, in the selected mode ("**02**" in the example ").
- A title ("**POWERS**" in the example) that briefly describes the content of the page. The title is translated into the language selected by the operator.

The mode identifier, together with the page identifier ("**M.02**" in the example) allows to refer unambiguously to a page.

The title can be replaced with information relating to the status of the system. You can do it in three ways:

- By holding down the **ESC/SHIFT** button. The title will be shown again when you release the button.
- With a double click of the **ESC/SHIFT** button. The title will be shown again when selecting a new page or a new display mode.
- By activating bit 6 of parameter P.0495. If there are status messages that contain a waiting time (countdown), the controller always displays these messages instead of the title; in case of page change (user manual navigation), the title of the new page will be displayed for two seconds and then return to display the status message requested by the sequence.

6.5 Display modes

6.5.1 Programming (P.XX)

The controller manages a significant number of parameters that allow the manufacturer, the installer or the end user to adapt it to the specific needs of the system. This document does not contain the list of parameters (although many of them are mentioned in the description of the various functions of the controller), but please refer to document [3]] which describes them in detail. Here, on the other hand, the general structure of the programming and the operating procedure that allows to read and/or modify the parameters are described.

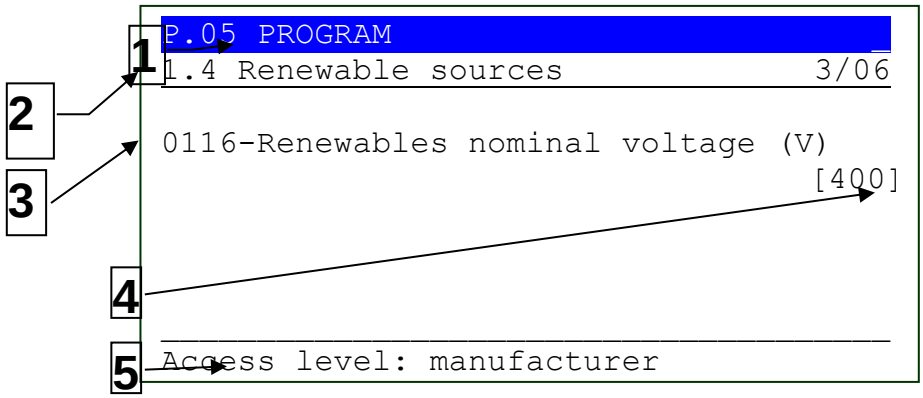
To access the programming menus, select the page "P.02-PROGRAM with the vertical scroll buttons ▲ and ▼ on and activate it with the **ACK/ENTER** button.

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

⚠ WARNING: incorrect programming of one or more parameters can cause malfunctions or damage to things and/or people. Parameter changes must only be carried out by qualified personnel. The parameters can be password protected (see par. 6.5.1.2).

6.5.1.1 Organization

LEGEND:
1 – Title bar
2 – Current menu
3 – Current parameter
4 – Parameter value
5 – Access level



Each parameter (3) is associated with a 4-digit numeric code ("0116" in the example) which allows to identify it regardless of the language used. The current value of the parameter ("400") is shown in brackets below the description ("Renewables nominal voltage (V)").

The first line below the title bar (2), allows you to identify the current menu by means of a numeric identifier ("1.4") and a language-dependent description ("Renewable sources"). In this row a pair of numbers (“3/06”) is displayed on the right. The first number indicates which menu item is selected, the second indicates how many items are present in the menu.

6.5.1.2 Protection passwords

Changing the parameters can be limited by means of four different protection levels, listed in order of priority.

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

Each parameter of the controller is associated with a protection level (in document [3] this association is indicated in the "ACC" column with a letter "S" to indicate the Mecc Alte level, "C" for the manufacturer, "I" for the 'installer and "U" for the user).

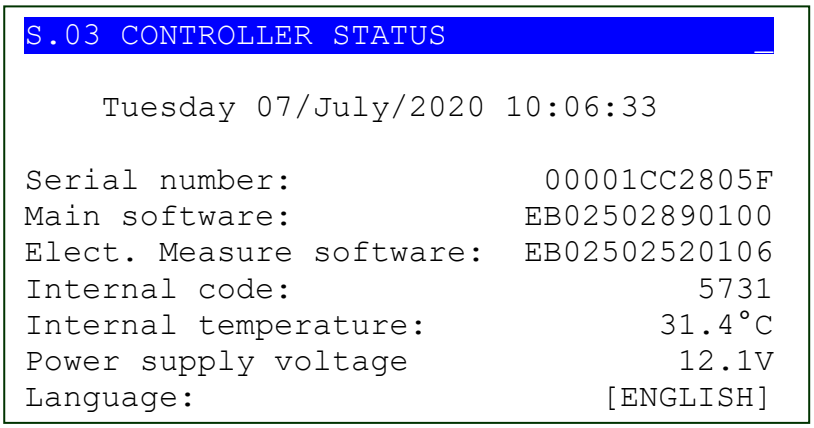
A parameter associated with the Mecc Alte level can only be changed by setting the Mecc Alte password. A parameter associated with the manufacturer level can be modified by the manufacturer himself (or with the Mecc Alte password). A parameter associated with the installer level can be changed by the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

The general rule states that the parameters can only be changed with the controller in "OFF/RESET" mode. Some parameters are exceptions and can be modified independently of the state of the controller, even when the inverters are running. In general, if a parameter cannot be modified, its value will be enclosed in "<" and ">", while if it is modifiable it is enclosed in "[" and "]": this is also valid for password restrictions.

The operator who has to change a parameter must first be recognized by the controller as "Mecc Alte", "manufacturer", "installer" or "user" by entering the appropriate password in parameter P.0000 (menu "1.1.1 - Authentication ", Path" PROGRAM\1 System\1.1 Security\1.1.1 Authentication"). After this operation, he/she can modify the required parameters. The code entered will remain stored in P.0000 for about 10 minutes from the end of programming. After this time, it will be automatically reset and must be set again to access programming.

Passwords can be customized using parameters P.0001 (manufacturer), P.0002 (installer) and P.0003 (user), available in the menu "1.1.2 Password configuration", path "PROGRAM\1 System\1.1 Security\1.1.2 Configuration of passwords". The value "0" for these parameters indicates password not set. The Mecc Alte password, on the other hand, is a special password, pre-assigned at the factory and supplied with the controller. The password supplied with the controller is always valid. Upon request, Mecc Alte can supply a second password, valid only for two hours of operation of the inverters. After this time, a new password must be requested from Mecc Alte.

To obtain the password, the operator must request it from Mecc Alte indicating the serial number of the controller together with the "Internal code" displayed on page S.03, as shown below.



If a password is lost, you can reconfigure it by logging in with the higher-level password. For this reason, it is not advisable not to set at least the "manufacturer" password (P.0001): in fact, if someone else sets it or a lower password (even just for distraction) without communicating it, it will no longer be possible to change any parameter. On the other hand, if the "manufacturer" password is known, it will in any case be possible to cancel or change the other passwords. In case of loss of the "manufacturer" password, contact support.

The following examples show all password assignment combinations. The values "111", "222" and "333" are only examples.

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

Any operator is considered a "manufacturer", without having to set anything in P.0000. So, all the parameters, except the critical ones, can be modified by anyone (this is the default situation of the controller).

Example 2: P.0001=0 P.0002=0 P.0003=111

No parameters are editable. By typing the password "111" in P.0000, the operator identifies himself as "user", but since no password is associated with the installer and the manufacturer, the controller still considers him "manufacturer". After entering this code, all the parameters, except the critical ones, can be modified.

Example 3: P.0001=0 P.0002=222 P.0003=111

No parameters are editable. By typing "111" in P.0000, the operator is recognized as "user", and thus obtains permission to modify all the parameters associated with the user. By typing "222" instead, the operator is recognized as "installer", but since no password is associated with the manufacturer, the controller still considers it "manufacturer". After entering this code, all the parameters, except the critical ones, can be modified.

Example 4: P.0001=333 P.0002=222 P.0003=111

No parameters are editable. By typing "111" in P.0000, the operator is recognized as "user", and thus obtains permission to modify all the parameters associated with the user. By typing "222" the operator is recognized as an "installer", and thus obtains permission to modify all the parameters associated with the installer and the user. By typing "333", the operator identifies himself as "manufacturer", and thus obtains permission to modify all parameters, except the critical ones of the board.

Example 5: P.0001=333 P.0002=0 P.0003=0

Since no password is associated with the user and the installer, the parameters associated with them are freely programmable, without typing anything in P.0000. To modify the parameters associated with the manufacturer, type "333" in P.0000.

Example 6: P.0001=0 P.0002=222 P.0003=0

Since no password is associated with the user, the parameters associated with it are freely programmable, without typing anything in P.0000. By typing "222" in P.0000, the operator is recognized as an "installer", but since no password is associated with the manufacturer, the controller still considers it "manufacturer". After entering this code, all the parameters, except the critical ones, can be modified.

Example 7: P.000=333 P.0002=222 P.0003=0

Since no password is associated with the user, the parameters associated with it are freely programmable, without typing anything in P.0000. By typing "222" in P.0000, the operator is recognized as an "installer" and thus obtains permission to modify all the parameters associated with the installer and the user. By typing "333" in P.0000, the operator identifies himself as "manufacturer" and obtains permission to modify all parameters, except the critical ones.

Example 8: P.0001=333 P.0002=0 P.0003=111

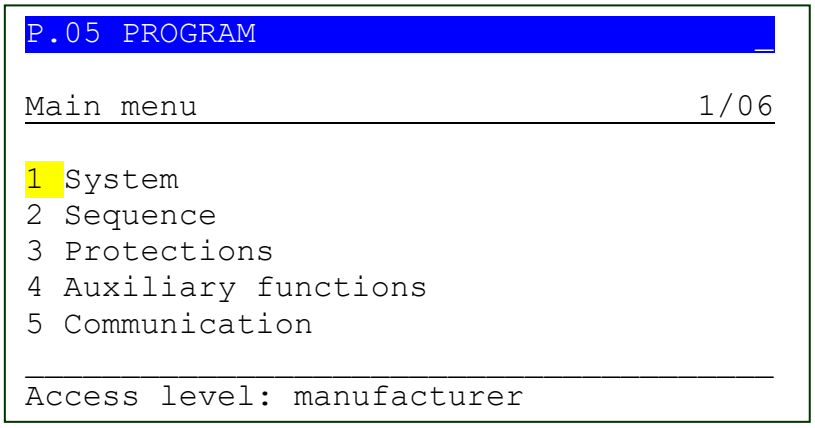
No parameters are editable. By typing "111" in P.0000, the operator identifies himself as "user", but since no password is associated with the installer, the controller still considers him "installer". He is therefore able to modify the parameters associated with the user and the installer. By typing "333" in P.0000, the operator identifies himself as "manufacturer" and obtains permission to modify all parameters, except the critical ones.

The value of a parameter is always readable, but the change is feasible only if P.0000 contains an adequate password. Exceptions are the parameters P.0001, P.0002, P.0003 and P.0469: in fact, they are not even displayed if P.0000 does not contain an adequate password.

Parameter P.0469 (password for communication ports) can be viewed and/or modified only on the controller's panel, and at least with installer rights.

6.5.1.3 Operating procedure

In this procedure the use of the keyboard and the display will be described.



- **1 (SYSTEM):** first of all, it allows to indicate how the controller is connected to the inverters, to the connection bars, to the circuit breakers (more generally to the system). It is essential to set these parameters correctly because almost all the thresholds for activating the protections are expressed as a percentage of them. From this menu you can also configure the inputs and outputs, both digital and analogue, both of the controller and of the expansion modules individually
- **2 (SEQUENCE): it** allows to adapt the operating sequence to the specific system. In this menu you can set the percentages of thresholds, the acquisition times, and enable/disable the functions related to the operating sequences. The inverters of renewable sources are also configured individually.
- **3 (PROTECTIONS):** allows you to enable, disable and configure all the protections. It is important to know that to enable/disable a protection it is sufficient to modify its delay, leaving the threshold unchanged: setting the delay to zero the protection is disabled. There are some exceptions to this general rule. Please refer to the chapter dedicated to anomalies (8), which describes the disabling mode for each.
- **4 (AUXILIARY FUNCTIONS):** it allows to configure the clock/calendar of the controller and all the schedules associated with it. Allows configuration of historical archives. Finally, it allows to (partially) customize the use of the display and keyboard of the controller.
- **5 (COMMUNICATION):** contains the settings for all communication interfaces (except Can Bus interfaces); USB, RS232, RS485, Ethernet. It also allows the configuration of any external modem.
- **8 (PMCB):** allows to configure the address of this controller for communication on the PMCB Can Bus.

6.5.1.3.1 Accessing the program function

Programming is accessible in any operating state of the controller, while parameter modification is generally only possible with the controller in **OFF/RESET**. To enter programming, use the ▲ and ▼ buttons until the basic screen P.02 appears ("PROGRAM").

If you are in a mode that limits the use of the vertical scroll buttons, it may be necessary to press the **ESC/SHIFT** button once or several times (this situation can occur when viewing historical archives or during particular operations such as, for example, the selection on the display of a specific inverter).

Then press **ACK/ENTER** to enter the programming menus.

At the start of the procedure, the menu or variable used at the last access is automatically shown (the first entry shows the main menu).

6.5.1.3.2 Menu selection

The third line always shows the code and description of the current menu, followed by the indication of the selected menu item and the number of items in the menu. The following lines of the display are used to view the menu items,

i.e. the submenus. The selected item is displayed in REVERSE. Using the ▲ and ▼ buttons scrolls the menu respectively towards the lower and upper index items, cyclically (i.e. pressing ▲ from the first item goes to the last and vice versa).

By pressing the **ACK/ENTER** buttons, you enter the selected submenu (the highlighted one), by pressing the **ESC/SHIFT** buttons you exit the menu (returning to the previous menu or exiting programming if you were already in the main menu).

6.5.1.3.3 Parameter selection

The third line always shows the code and description of the current menu (for example the "1-SYSTEM" menu), followed by the indication of the selected menu item and the number of items in the menu. The following lines of the display are all used to view a single parameter. In particular:

- The fifth and sixth lines show the unique code of the parameter (four decimal digits) followed by the description in the current language.
- The seventh line shows, aligned to the right, the value of the parameter, enclosed in square brackets or between the symbols "<>".
- For some parameters, on the ninth line, a value is shown which is somehow related to the current value of the parameter. Often this additional value is displayed when the parameter is expressed as a percentage of some other value, to show its absolute value. For example, in the case of the threshold for the low power supply warning, the threshold in VDC is shown, obtained from the nominal supply voltage (12/24 VDC) and from the parameter itself (P.0362).
- The last line of the display shows the level of protection for the operator (Mecc Alte, manufacturer, installer or user).

Using the ▼ and ▲ buttons, the menu is scrolled respectively towards the upper and lower index items, cyclically (i.e. pressing ▲ from the first item it goes to the last and vice versa). Pressing the **ACK/ENTER** button activates the parameter modification procedure (see next paragraph), pressing the **ESC/SHIFT** button exits the menu (returning to the previous menu).

6.5.1.3.4 Changing a parameter

A parameter can be modified only if displayed enclosed in square brackets ([]); if enclosed in "<>", it cannot be modified. In this case it may be necessary to set an appropriate password, or put the controller in **OFF/RESET**.

If the parameter displayed is modifiable, press the **ACK/ENTER** button to start flashing the square brackets that enclose the value, indicating that the modification phase is in progress. To confirm the new value, press the **ACK/ENTER** button; to abort the change and return to the original value, simply press the **ESC/SHIFT** button.

The following types of parameters are managed:

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

In the description of these parameters you will have a table like the following:

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

9	0100	It enables the function 9
10	0200	It enables the function 10
11	0400	It enables the function 11
12	0800	It enables the function 12
13	1000	It enables the function 13
14	2000	It enables the function 14
15	4000	It enables the function 15
16	8000	It enables the function 16

If the operator wishes:

- Disable all functions: must set 0000 in the relative parameter.
- Enable 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.
- For example, enable functions 3, 4, 6 and 8: the value to be set is the sum of 0004 + 0008 + 0020 + 0080 = 00AC.
- **Numeric**: the value can be changed using the ▲ ▼ buttons, respectively to increase or decrease it by one unit (if these buttons are pressed together with **ESC/SHIFT**, the value will be increased or decreased by ten units at a time). The change is cyclical: trying to increase the value when it is already at the maximum, we pass to the minimum and vice versa
- **Numerical with selection among a default list** (for example, the number of phases of the renewable sources): the same applies as for the numeric parameters, considering that the ▲ ▼ buttons allow you to go to the next/previous value in the predefined list (with the **ESC/SHIFT** T button you scroll by 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 display highlights (in reverse) the character selected on the string. The ▲▼ buttons 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 ◄► buttons 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 Parameter 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 go 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 values for 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 L.01 to L.07 contain information related to PLC logic and they are displayed only if a valid PLC program has been downloaded to the controller. Refer to [6] and [7] for information on the PLC.

6.5.2.1 L.01 PLC

```
L.01 PLC

PLC version:                          1.01
Compiler version:                     2.01
Editor version:                       2.0B
Last modification:  07-07-2020 10:17:06
PLC avg/max time:     0.002ms     0.003ms
Title:                          PLC example
Description:
Example of PLC program
```

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

- The title and description of the PLC program.
- The date of the last modification.
- The firmware version of PLC, compiler and editor.
- The average and maximum execution time. These times are automatically reset when the PLC program is transmitted to the controller, or it is possible to force the reset by pressing the **ACK/ENTER** + **ESC/SHIFT** buttons simultaneously for 5 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 related to a single PLC block.

The second row (on the right) shows the selected block, with the format "TYPE-NUMBER". To select a block, press the **ACK/ENTER** button, then use the ▲ ▼ buttons to search for the desired block; confirm again with **ACK/ENTER**.

The following rows show all the parameters of the selected block (one row for each parameter):

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

- The second column identifies the resource associated to the parameter. The resources are normally shown with Mecc Alte codification (e.g. the digital input 1 is identified as 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 Mecc Alte codes: press **ACK/ENTER** (as to select a different PLC block) and press ◄►; confirm with **ACK/ENTER** button. See [7] for the description of the Mecc Alte codes for the identification of the PLC resources.
- The third column shows the current value of the resource. For digital resources, if the value is shown in REVERSE, it means that the relative parameter is denied.

6.5.2.3 L.03 VIRTUAL INPUTS

```
L.03 VIRTUAL INPUTS

         | 1       8 9       16
         |
 PLC:    | 00000000 00000000
         |
         |
         |
         |
         |
         |
```

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 TEMPORARY

```
L.04 DIGITAL TEMP.
 PLC:    |                     |
       1| 00000000 00000000|  16
      17| 00000000 00000000|  32
      33| 00000000 00000000|  48
      49| 00000000 00000000|  64
      65| 00000000 00000000|  80
      81| 00000000 00000000|  96
      97| 00000000 00000000| 112
     113| 00000000 00000000| 128
```

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 STATE

```
L.05 DIGITAL STATE
 PLC:    |                   |
       1| 00000000 00000000|  16
      17| 00000000 00000110|  32
      33| 00110000 00000000|  48
      49| 00001000 00000000|  64
      65| 00000000 00000000|  80
      81| 00000000 00111000|  96
      97| 00100000 00000000| 112
     113| 00000000 00000000| 128
```

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

6.5.2.6 L.06 VIRTUAL ANALOGUE

```
L.06 VIRTUAL ANALOGUE

 #1: --------.--
 #2: --------.--
 #3: --------.--
 #4: --------.--
 #5: --------.--
 #6: --------.--
 #7: --------.--
 #8: --------.--
```

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

6.5.2.7 L.07 NUMERICAL TEMPORARY

```
L.07 NUMERICAL TEMP.

 #01:            0 #02:            0
 #03:            0 #04:            0
 #05:            0 #06:            0
 #07:            0 #08:            0
 #09:            0 #10:            0
 #11:            0 #12:            0
 #13:            0 #14:            0
 #15:            0 #16:            0
 #17:            0 #18:            0
```

This page shows the status of all numeric temporary variables (AT_XXX) available for the PLC program. Several pages are available which alternate every 2 seconds to display all the numerical data. Pressing and holding the **ESC/SHIFT** button prevents pages from rotating (keeping the page currently displayed on the display).

6.5.3 Status information (S.XX)

This mode provides information on the system status. The different pages can be scrolled using the horizontal navigation buttons ◄ and ►.

6.5.3.1 S.01 STATO

The **S.01 (STATUS)** page displays system status information. Part of this information is also displayed on the top title bar if you hold down the **ESC/SHIFT** key. It Contains:

- The operating mode of the controller (MAN, AUTO etc.).
- The state (absent / present / in tolerance) of the voltages/frequency of renewable sources.
- The state (absent / present / in tolerance) of the voltages/frequency of connection bars.
- The reasons that prevent the closure or force the opening of the RNCB circuit breaker.
- The status of the command sequence of the RNCB circuit breaker
- The reasons prevent starting or which force the inverter to stop.
- The status of the command sequence of the inverters.
- The possible activation of the OVERRIDE of the protections.

For some of this information, a time is also shown; for example, during the stop cycle of the inverters the time remaining at the end of this cycle is shown.

6.5.3.2 S.02 ANOMALIES

The S.02 (ANOMALIES) page is automatically displayed in case of a new anomaly. For each anomaly, the following is shown:

- The date/time on which the anomaly was activated.
- A letter identifying its type:
  - “A”: alarm.
  - “W”: warning.
- A three-digit numeric code that uniquely identifies the anomaly. This code flashes if the anomaly has not yet been recognized with the **ACK/ENTER** button.
- An alphanumeric description, which depends on the language currently selected and which in some cases can be customized using the parameters of the controller.

Each anomaly uses at least two lines of the display. The anomaly shown above is the most recent in chronological order. If there is not enough space to view all the anomalies, only the most recent ones are shown. To see the others, you need:

- Press **ACK/ENTER button.**
- Use ▲▼ buttons to scroll among the anomalies.
- When finished, press the button **ESC/SHIFT**.

Some anomalies may show additional diagnostic information. This information is automatically displayed if only one anomaly is active: if there are more active anomalies, use the procedure described above to select the individual anomalies and view any additional diagnostic information relating to it. The anomalies that have 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 [4].
- 273 (“incoherent parameters”). It also displays a message that helps understanding the problem.
- 252 (“missing expansion module”). It also displays a message identifying the expansion module which is not communicating with the RN200.
- 253 (“missing analogue measurement”). It also displays a message that identifies the acquisition channel and the expansion module from which it is expected to receive a measurement that is missing.
- 254 (“duplicate address on EXBUS”). It also displays a message that identifies the type and address of the expansion module which is connected twice to RN200.
- 255 (“connection broken with a sensor”). It also displays a message that identifies the acquisition channel and the expansion module that is transmitting the information of "BROKEN WIRE".
- 900 (“incoherent parameters on PLC”). It also displays a message that helps understand the problem.
- 198 e 199 (“yellow lamp” and “red lamp”). In this case, the controller also shows the diagnostic codes received from the external device (inverter). For each diagnostic code is shown:

  - The sender (which inverter reported the problem).
  - The SPN code if it exists (it is a code defined by the SAE J1939 standard that identifies the mechanical component that has the problem).
  - The FMI code if it exists (it is a code defined by the SAE J1939 standard that identifies the type of problem).
  - How many times this diagnostic code has been activated (OC).
  - The specific numeric code of the connected device (DTC).
  - An alphanumeric description (always in English) of the problem (if available).

  If one or more of the above information is not available, it is replaced by dashes or not displayed. If there are several diagnostic codes active at the same time, they are cyclically alternated on the display every 2 seconds (hold **ESC/SHIFT** to stop the rotation). The diagnostic codes remain stored (even if the external device deactivates them) until the “yellow/red lamps” warnings are acknowledged with the **ACK/ENTER** button.

6.5.3.3 S.03 CONTROLLER STATUS

This page is dedicated to device information and contains:

- The current date and time in extended format (flashing if the clock is not valid, in REVERSE if summer time is active).
- The unique serial number of the controller (ID).
- The codes of the currently loaded software on the controller. If the main software code is displayed in REVERSE it means that a new version has been downloaded and the controllers is waiting to install it: to install it, you must disconnect the power to the controller, wait a few seconds, power it up again and follow the instructions on the display.
- The internal code required to obtain a temporary Mecc Alte 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 the **ACK/ENTER** button, select a language with the ▲ and ▼ buttons and confirm with the **ACK/ENTER button**. Note: RN200 is provided as

standard only with the languages ENGLISH, ITALIAN. With the BoardPrg3 program it is possible to transfer other languages to the controller.

6.5.3.4 S.04 SERRIAL COMMUNICATION

This page displays the communication status on the two serial ports and on the USB interface. In the event of communication problems, check the information on this page.

The status (idle, communication in progress, etc.) and the reception error counter are displayed for each communication interface. To reset an error counter, you need to:

- Press the **ACK/ENTER** button: the controller highlights the error counter of the first communication interface.
- Use ▲ and ▼ to highlight the counter you wish to reset.
- Press **ACK/ENTER** + **ESC/SHIFT** for 5 seconds: at the end the controller resets the counter.
- Press **ESC/SHIFT**.

If an external modem is connected to the controller, the following is also displayed:

- The model of the modem.
- In case of GSM modem:
  - The name of the mobile operator.
  - The level of the GSM signal.

6.5.3.5 S.05 NETWORK

This page is dedicated to the communication status of the Ethernet interface.

La controller shows:

- The connection status:
  - *"Idle"*: cable disconnected from the Ethernet network.
  - *"idle-linked"*: cable connected to the Ethernet network, but no communication in progress.
  - "*Communication in progress"*.
- The MAC address of the physical network interface.
- The name under which the controller registered on the network (if using DHCP).
- The IP address assigned to the controller.
- The address of the router/gateway of the network.
- The subnet-mask of the network.
- The address of the DNS server.
- The number of active "incoming" TCP connections (Modbus TCP slave).
- The number of active "outgoing" TCP connections (Modbus TCP master to inverter).

Some of these values can be set with the controller parameters, or acquired dynamically by the DHCP server (see 5.12.4).

6.5.3.6 S.07 CANBUS

This page displays the status of the Can Bus interfaces. RN200 has two interfaces. For each interface are displayed:

- The communication status. There are three possible indications:
  - ERROR-ACTIVE: normal operation
  - ERROR-PASSIVE: there are anomalies (errors) but the communication is still working.
  - BUS-OFF: the board has disconnected from the bus due to too many errors.
- The communication error counters. The instantaneous counters of transmission/reception errors and the maximum values reached by them are displayed. It is possible to reset the maximum values (and at the same time force the exit from the BUS-OFF state) by pressing the **ACK/ENTER** and **ESC/SHIFT** buttons simultaneously for 5 seconds. Since there are two CAN interfaces, you must first select the desired CAN interface and then reset the counters: to select an interface press the **ACK/ENTER** key and use the ▲ and ▼ keys.

Internally, RN200 uses a third CAN interface for communication between its microcontrollers. If necessary, the status of the third interface can also be displayed by activating bit 8 of parameter P.0495.

6.5.3.7 S.08-09-10 SYSTEM STATUS

These pages are dedicated to the display of the generic states acquired through the digital inputs, configured with the 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 row for each configured input. If more than 9 inputs are configured on each page, the controller displays them all by rotating them (9 at a time) every two seconds: holding the **ESC/SHIFT** button stops rotation. If there are no inputs configured on a page, the page is not displayed.

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

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

6.5.3.8 S.11 DIGITAL INPUTS

This page displays the status of:

- The digital inputs of the controller.
- The analogue inputs used as digital (dashes are displayed if they are not used as digital inputs).
- Virtual digital inputs.

By pressing the **ACK/ENTER** button, the inputs can be shown in three different ways:

- **LOGICAL STATE**: the controller shows the logic level of the input (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) actually present on the input; it can be opposite to the corresponding logical state. It is displayed in REVERSE.
- **BY FUNCTION**: the controller shows a list of the functions actually associated with the digital inputs, displaying the logical status (1/0) relating to each function, regardless of the input actually associated with the functions. If more than 8 functions are used for the digital inputs, the controller displays them all by rotating them (8 at a time) every two seconds: holding the **ESC/SHIFT** button stops rotation.

6.5.3.9 S.12 DIGITAL INPUTS

This page is displayed only if DITEL modules have been configured (see 5.7). It displays the status of the digital inputs acquired by the DITEL modules. If a DITEL module does not communicate correctly, the controller displays dashes instead of the state of the inputs. By pressing the **ACK/ENTER** button you can view the inputs in two different ways:

- **LOGICAL STATE**: the controller shows the logic level of the input (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) actually present on the input; it can be opposite to the corresponding logical state. It is displayed in REVERSE.

6.5.3.10 S.13 DIGITAL OUTPUTS

This page displays the status of the digital outputs of the controller. By pressing the **ACK/ENTER** button, the inputs can be shown in three different ways:

- **LOGICAL STATE**: the controller shows the logic level of the output (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) actually present on the output; it can be opposite to the corresponding logical state. It is displayed in REVERSE.
- **BY FUNCTION**: the controller shows a list of the functions actually associated with the digital outputs, displaying the logical status (1/0) relating to each function, regardless of the output actually associated with the functions. If more than 8 functions are used for the digital outputs, the controller displays them all by rotating them (8 at a time) every two seconds: holding the **ESC/SHIFT** button stops rotation.

6.5.3.11 S.14 DIGITAL OUTPUTS

This page is displayed only if DITEL modules have been configured (see 5.7). It displays the status of the digital outputs of the DITEL modules. If a DITEL module does not communicate correctly, the controller displays dashes instead of the state of the outputs. By pressing the **ACK/ENTER** button you can view the outputs in two different ways:

- **LOGICAL STATE**: the controller shows the logic level of the output (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) actually present on the output; it can be opposite to the corresponding logical state. It is displayed in REVERSE.

6.5.3.12 S.15 ANALOGUE INPUTS

The page displays the electrical value of the analogue inputs of the controllers (connectors JU, JK and JJ), including the emergency stop (EM-S). By pressing the **ACK/ENTER** button you can view the inputs in two different ways:

- **PHISICAL STATE**: the measurement in VDC is displayed for each input.
- **PER FUNZIONE**: the controller shows a list of the functions actually associated with the analogue inputs, displaying the relative value acquired in VDC, regardless of the input actually associated with the functions. If more than 8 functions are used for the analogue inputs, the controller displays them all by rotating them (8 at a time) every two seconds: holding the **ESC/SHIFT** button stops rotation.

6.5.3.13 S.16 ANALOGUE INPUTS

This page is displayed only if DITHERM or DIGRIN modules have been configured (see 5.7).

In the left part it shows the type of module actually connected (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 expansion module signals that the sensor is disconnected.
- "+OVER": if the module signals that the input signal is too high, a symptom of a fault.
- "-OVER": if the module signals that the input signal has a too low value, a symptom of a fault.

6.5.3.14 S.17 ANALOGUE INPUTS

This page is displayed only if DIVIT modules have been configured (see 5.7).

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

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

6.5.3.15 S.18 ANALOGUE OUTPUTS

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

Pressing the **ACK/ENTER** button, the controller shows the outputs by function: the controller shows a list of the functions actually associated with the analogue outputs, displaying the analogue value for each function, regardless of the output actually associated with the functions. If more than 8 functions are used for the analogue outputs, the controller displays them all by rotating them (8 at a time) every two seconds: holding down the **ESC/SHIFT** key stops rotation.

6.5.3.16 S.19 ANALOGUE OUTPUTS

This page is displayed only if DANOUT modules have been configured (see 5.7).

It shows the percentage value currently associated with the four analogue outputs of each DANOUT module (the real corresponding electrical measurement depends on the configuration made within the DANOUT module). The values are displayed in REVERSE if the DANOUT module is not communicating correctly.

6.5.3.17 S.20 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 [4].

6.5.3.18 S.21 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 [4].

6.5.4 Electrical measures (M.XX)

In this mode, the measurements made by the controller on the electrical lines are fully displayed. The different pages can be scrolled using the horizontal navigation buttons ◄ and ►.

6.5.4.1 M.01 SYSTEM

It shows the layout of the system in a single-line format, highlighting:

- Renewable sources, generators, loads and mains. The background colour of the symbols indicates the status of the relative voltage:
  - White: no voltage/frequency.
  - Yellow: voltage/frequency present but out of tolerance.
  - Green: voltage/frequency present and within tolerance
- The RNCB, GCB (cumulative), MGCB and MCB circuit breakers. The circuit breaker symbol shows:
  - The open/closed state.
  - The discrepancy between the state and the command of the circuit breaker (in this case the two contact points of the circuit breaker flash).
- The power flows, displayed with arrows in the various parts of the plant. The arrow points in the direction of the power. The arrow flashes to indicate an anomalous situation (for example in case of inversion of energy on generators or renewable sources).
- The measurement of active and reactive power in the various parts of the plant. Normally the power is displayed in kW or kvar, they automatically switch to MW or Mvar if 4 digits are exceeded. Using bit 25 of parameter P.0494, it is possible to display the power factor instead of the reactive power. By using bit 24 of the same parameter, it is possible to increase the displayed decimal places.

  This page is automatically adapted to the real conditions of the system. For example, the mains and the MCB circuit breaker are automatically hidden if there are no MC200 controllers connected via Can Bus PMCB. With parameter P.0494 it is however possible to hide one or more of the information displayed.

6.5.4.2 M.02 RENEWABLE SOURCES

This page displays the voltages, frequency and phase's sequence of the renewable sources. The information really 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 L-L voltages, the frequency, the phases sequence and the neutral-B- voltage. By pressing the **ACK/ENTER** button, the L-N voltages are displayed instead of the L-L voltages (press **ACK/ENTER** again to return to the L-L)
- Three-phase system (P.0119=3) without neutral (P.0129=0). The controller displays the three L-L voltages, the frequency, the phase's sequence.
- Single phase system (P.0119=1). The controller displays the L-N voltage, frequency and neutral-B- voltage.

  Under each L-L or L-N voltage, the controller also displays a bar that graphically shows the current voltage with respect to the nominal one: on the bar there are also one or more ticks that represent any thresholds. The bar is filled by green if the voltage is within tolerance, by yellow if the voltage is out of tolerance.

  At the bottom right, an icon for the RENEWABLE SOURCES is shown, allowing you to immediately detect which is the source of the shown measurements.

6.5.4.3 M.03 BARS

This page displays the voltages, frequency and phase's sequence of the connection bars. The information really 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 L-L voltages, the frequency, the phases sequence and the neutral-B- voltage. By pressing the **ACK/ENTER** button, the L-N voltages are displayed instead of the L-L voltages (press **ACK/ENTER** again to return to the L-L)
- Three-phase system (P.0101=3) without neutral (P.0128=0). The controller displays the three L-L voltages, the frequency, the phase's sequence.
- Single phase system (P.0101=1). The controller displays the L-N voltage, frequency and neutral-B- voltage.

Under each L-L or L-N voltage, the controller also displays a bar that graphically shows the current voltage with respect to the nominal one: on the bar there are also one or more ticks that represent any thresholds. The bar is filled by green if the voltage is within tolerance, by yellow if the voltage is out of tolerance.

At the bottom right, an icon for the BARS is shown, allowing you to immediately detect which is the source of the shown measurements.

6.5.4.4 M.04 CURRENTS

This window displays the phase currents (one or three) measured by the controller. Note: normally these currents are those supplied by the renewable sources, but other currents can be selected with parameter P.0124. The symbol of the RENEWABLE SOURCES or of the LOADS is displayed at the bottom right in order to identify the real source.

Under each phase current the controller also displays a bar that graphically shows the measured current with respect to the rated one: the bar also shows one or more ticks that represent any thresholds. The bar is filled by green if the current is within tolerance, by red if the voltage is out of tolerance.

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

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

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

6.5.4.5 M.05 POWERS

This page shows the active powers (kW), the power factors and the load types for the single phases and total (for single-phase systems, the information relating to phases 2 and 3 are replaced by dashes). Normally the powers are displayed in kW, they automatically switch to MW if 4 digits are exceeded

The symbol of the RENEWABLE SOURCES or LOADS is shown at the bottom right in order to identify the real source (see note in 6.5.4.4).

6.5.4.6 M.06 POWERS

This page shows the reactive (kvar) and apparent (kVA) powers, on the single phases and total (for single-phase systems, the information relating to phases 2 and 3 are replaced by dashes). Normally the powers are displayed in kvar and kVA, they automatically switch to Mvar and MVA if 4 digits are exceeded

The symbol of the RENEWABLE SOURCES or LOADS is shown at the bottom right in order to identify the real source (see note in 6.5.4.4).

6.5.4.7 M.07 ENERGY METERS

This page shows the meters for exported energy (produced) from the renewable sources (active and reactive, partial and total meters).

Partial counters can be reset individually from this page. To do this you need to:

- Press the **ACK/ENTER** button: one of the counters will be highlighted.
- Use the vertical scroll buttons ▲ and ▼ to select the counter you wish to reset.
- Press the **ACK/ENTER** and **ESC/SHIFT** buttons for five seconds.
- Press the **ESC/SHIFT** button.

These counters are protected with the password configured with parameter P.0001 (protection level: user). If a password has been configured in P.0001, in order to reset the counters, you must first enter it (login) in parameter P.0000 ("access code").

6.5.4.8 M.08-09-10 EXTERNAL MEASURES

These pages are dedicated to displaying the measurements acquired by the analogue inputs configured as a "generic sensor". The operator has the right to acquire measures that are in no way related to the functioning of the controller, and to view them on the display. It can also group them (with any criteria), displaying them on one of the three available pages.

The subdivision of the measurements on the different pages is done through the function configured in the analogue inputs:

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

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

6.5.5 Renewable sources (R.XX)

This mode displays all the information relating to the management of the inverters for the renewable sources. The different pages can be scrolled using the horizontal navigation buttons ◄ and ►.

6.5.5.1 R.01 COMM. WITH INVERTERS

It shows the status of the communication to the configured inverters. It uses one display line for each inverter. If more than 8 inverters are configured, the controller shows them all, rotating them on the display every two seconds: keep the **ESC/SHIFT** button pressed to stop the rotation on the current display.

For each inverter it shows:

- Its numeric ID (2 digits).
- When the communication is in progress:
  - Counter of messages correctly exchanged with the inverter.
  - Communication errors counter.
  - Cyclically:
    - The IP address of the inverter (only if connected via Ethernet).
    - The inverter manufacturer
    - The inverter model
    - Some options read by the inverter.
- When the communication is not in progress:
  - It shows the status (port opening, address acquisition etc.).

The communication counters can be reset (all together) by holding down the **ACK/ENTER** and **ESC/SHIFT** buttons for 5 seconds:

6.5.5.2 R.02 kW INVERTER

It shows information regarding the active power for the configured inverters. It uses one display line for each inverter. If more than 7 inverters are configured, the controller shows them all, rotating them on the display every two seconds: keep the **ESC/SHIFT** button pressed to stop the rotation on the current display. If some measures are not available, they are displayed with dashes.

The upper part contains the total information (sum of all inverters). This information is always present, even if the communication with the inverters is set in BROADCAST mode. It contains:

- The total rated active power of the running inverters (W).
- The total active power supplied by the inverters (W and %).
- The total active power setpoint (W and %).

The following lines are related to the individual inverters. The specific information of an inverter is available only if the communication is set in NON-BROADCAST mode. For each inverter it shows:

- Its numeric ID (2 digits).
- The rated active power (W).
- The active power supplied (W and %).
- The active power setpoint (W).

The information of an inverter is shown in red if the inverter signals a serious anomaly, in yellow if it signals a warning.

The active power setpoints (both the total and that of the individual inverters) are displayed with dashes if at that moment the inverter is unable to supply the required active power (i.e. it is producing the maximum possible, which, based on the environmental conditions, it is lower than the required setpoint). So, the dashes indicate that no active power limitation is active on the inverter.

6.5.5.3 R.03 kvar INVERTER

It shows information regarding the reactive power for the configured inverters. It uses one display line for each inverter. If more than 7 inverters are configured, the controller shows them all, rotating them on the display every two seconds: keep the **ESC/SHIFT** button pressed to stop the rotation on the current display. If some measures are not available, they are displayed with dashes.

The upper part contains the total information (sum of all inverters). This information is always present, even if the communication with the inverters is set in BROADCAST mode. It contains:

- The total nominal reactive power of the running inverters (var). The nominal of quadrant 1 is shown if the total reactive is positive, otherwise the nominal of quadrant 4.
- The total reactive power supplied by the inverters (var and %).
- The total reactive power setpoint (var and %).

The following lines are related to the individual inverters. The specific information of an inverter is available only if the communication is set in NON-BROADCAST mode. For each inverter it shows:

- Its numeric ID (2 digits).
- The nominal reactive power (var). The nominal of quadrant 1 is shown if the reactive power supplied by him is positive, otherwise the nominal of quadrant 4.
- The reactive power supplied (var and %).
- The reactive power setpoint (var).
- The information of an inverter is shown in red if the inverter signals a serious anomaly, in yellow if it signals a warning.

The reactive power setpoints (both the total and that of the individual inverters) are displayed with dashes if at that moment the inverter is unable to supply the required reactive power (i.e. it is producing the maximum possible, which, based on the environmental conditions, it is lower than the set point). So, the dashes indicate that no reactive power limitation is active on the inverter.

6.5.5.4 R.04 INVERTER DETAILS

It shows in detail all the information about an inverter. In the upper part it is possible to select the desired inverter: press **ACK/ENTER**, use ▲ and ▼ to select the inverter, confirm with **ACK/ENTER**.

If the communication is set in NON-BROADCAST mode, much of the following information is read directly by the inverters. Otherwise, as far as possible, operator configurations are shown. The information shown is:

- The inverter manufacturer.
- The inverter model.
- Some specific inverter options.
- The presence and status of the grid relay inside the inverter that connects the voltage generated to the external terminals.
- The active (W), reactive (var) and apparent (VA) powers supplied by the inverter.
- The nominal powers of the inverter: active (W), apparent (VA), reactive quadrant 1 (var), reactive quadrant 4 (var).
- The active (W) and reactive (var) power setpoints. They are displayed with dashes if at that moment the inverter is not able to supply the required powers (i.e. it is producing the maximum possible, which, based on the environmental conditions, is lower than the expected setpoint). Therefore, the dashes indicate that no power limitation is active on the inverter.

6.5.6 Measurements from Can Bus PMCB (B.XX)

In this mode, the measurements and states acquired by the Can Bus PMCB, which connects all the Mecc Alte controllers, are displayed in a complete way.

6.5.6.1 B.01 DEVICES ON PMCB

This page shows the list of the controllers recognized on the Can Bus PMCB. It is useful for diagnostic purposes. For each controller, it shows its unique address.

The screen is organized into four bands, placed one above the other:

- MC (mains controllers).
- GC and DST (genset controllers).
- BTB (bus tie breaker controllers).
- RN (renewable sources controllers).

For each band, it shows the list of addresses of the relative controllers that communicate on PMCB. Therefore, some bands can also be empty.

6.5.6.2 B.02 generators

This page shows the significant data of each GC (genset controller) that communicates over the PMCB can bus. It uses one display line for each GC. If there are more than 7 GC, it shows them all, rotating them on the display every two seconds: press and hold the **ESC/SHIFT** button to stop the rotation on the current display. If some measures are not available, they are displayed with dashes.

The page is hidden if there are no GC controllers.

The upper part contains the total information (sum of all GC controllers). It is shown only if there are at least two GC controllers. It contains:

- The total rated active power of the running generators (kW).
- The total active power supplied by the generators (kW).
- The total reactive power supplied by the generators (kvar).

The following lines are related to the individual generators. For each generator it shows:

- Its address on PMCB (2 digits).
- Its rated active power (kW).
- The supplied active power (kW).
- The supplied reactive power (kvar).
- The engine operating hours.

6.5.6.3 B.03 MAINS

This page shows the significant data of each MC (mains controller) that communicates over the PMCB can bus. It uses one display line for each MC. If there are more than 7 MC, it shows them all, rotating them on the display every two seconds: press and hold the **ESC/SHIFT** button to stop the rotation on the current display. If some measures are not available, they are displayed with dashes.

The page is hidden if there are no MC controllers.

The upper part contains the total information (sum of all MC controllers). It is shown only if there are at least two MC controllers. It contains:

- The total active power imported or exported (kW).
- The total reactive power imported or exported (kvar).

The following lines are related to the single MC controller. For each MC it shows:

- Its address on PMCB (2 digits).
- The imported or exported active power (kW).
- The imported or exported reactive power (kvar).

6.5.6.4 B.04 RENEWABLES

This page shows the significant data of each RN (renewables controller) that communicates over the PMCB can bus. It uses one display line for each RN. If there are more than 7 RN, it shows them all, rotating them on the display every two seconds: press and hold the **ESC/SHIFT** button to stop the rotation on the current display. If some measures are not available, they are displayed with dashes.

The page is hidden if there are no RN controllers.

The upper part contains the total information (sum of all RN controllers). It is shown only if there are at least two RN controllers. It contains:

- The total active power supplied (kW and %).
- The total reactive power imported or exported (kvar and %).

The following lines are related to the single RN controller. For each RN it shows:

- Its address on PMCB (2 digits).
- The active power generated (kW and %). The measurement is followed by a "*" if the RN controller is limiting the active power production of its inverters.
- The imported or exported reactive power (kvar and %). The measurement is followed by a "*" f the RN controller is limiting the reactive power production of its inverters.

6.5.7 History logs (H.XX)

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

The controller manages four types of archive:

1. Event recordings.
2. Periodic recordings.
3. Recordings of peaks.
4. Diagnostic codes (DTC) of external devices (inverters).

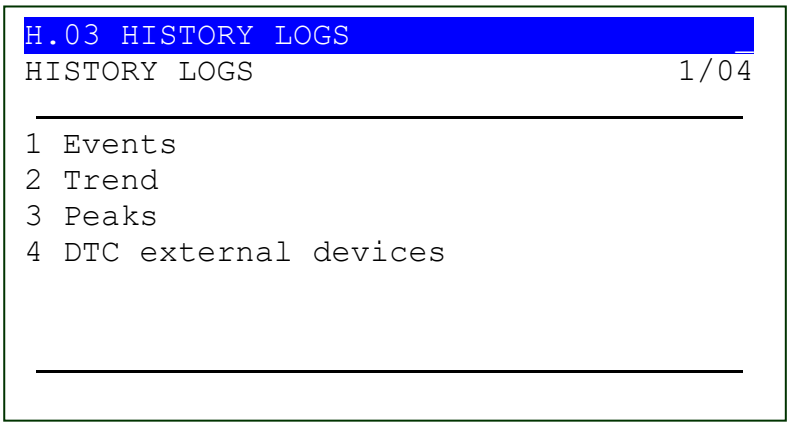
The historical archives are accessible in any operating state of the controller. To view the archives, use the ▲ and ▼ buttons until the basic page of the HISTORY LOGS (H.01) is displayed.

If you are in a mode that limits the use of the vertical scroll buttons, it may be necessary to press the ESC/SHIFT button once or several times.

Then press **ACK/ENTER** to view the archives (go to page "H.03").

When the procedure starts, the main menu is displayed.

6.5.7.1 Archive selection



The second line always shows the index of the selected menu item and the total number of items available ("1/04" in the example). The following lines of the display show the menu items. The selected item is shown in REVERSE.

Using the ▲ and ▼ buttons you can scroll the menu respectively towards the lower and upper index items, cyclically (i.e. pressing ▲ from the first item it goes to the last and vice versa).

By pressing the **ACK/ENTER** button, you enter the selected submenu, by pressing the **ESC/SHIFT** button you return to the "H.01" page.

6.5.7.2 Archive of event recordings

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 you to select which events are to be recorded. It is a configurable bit parameter:

Bit	Hexadecimal value	Firmware version	Description
0	01	01.00	Controller's operating mode
1	02	01.00	Renewable sources status
2	04	01.00	Connection bars status
3	08	01.00	-
4	10	01.00	Circuit breakers status
5	20	01.00	Circuit breakers commands
6	40	01.00	Start/stop requests for inverters

Below is a table showing the codes for all possible events.

Code	Firmware version	Even if locked	Bit of P.0441	Description
EVT.1001	1.00	Si	0	Controller in OFF-RESET mode.
EVT.1002	1.00	Si	0	Controller in MAN mode.
EVT.1003	1.00	Si	0	Controller in AUTOMATIC mode.
EVT.1005	1.00	Si	0	Controller in REMOTE START mode.
EVT.1010	1.00		1	No voltage on renewable sources.
EVT.1011	1.00		1	Voltage out of tolerance on renewable sources.
EVT.1012	1.00		1	Voltage in tolerance on renewable sources.
EVT.1013	1.00		6	Inverter start inhibition from contact - active.
EVT.1014	1.00		6	Inverter start inhibition from contact – not active.
EVT.1015	1.00		6	Inverter start inhibition from clock/calendar - active.
EVT.1016	1.00		6	Inverter start inhibition from clock/calendar – not active.
EVT.1020	1.00		2	No voltage on connection bars.
EVT.1021	1.00		2	Voltage out of tolerance on connection bars.
EVT.1022	1.00		2	Voltage in tolerance on connection bars.
EVT.1035	1.00		4	RNCB circuit breaker closing command.
EVT.1036	1.00		4	RNCB circuit breaker opening command.
EVT.1037	1.00		5	RNCB circuit breaker closed.
EVT.1038	1.00		5	RNCB circuit breaker open.
EVT.1050	1.00		6	Manual request for starting inverters.
EVT.1051	1.00		6	Manual request for stopping inverters.
EVT.1052	1.00		6	Automatic request for starting inverters.
EVT.1053	1.00		6	Automatic request for stopping inverters.
EVT.1054	1.00		6	Request for starting inverters from contact.
EVT.1055	1.00		6	Request for stopping inverters from contact.
EVT.1056	1.00		6	Request for starting inverters from communication port.
EVT.1057	1.00		6	Request for stopping inverters from communication port.
EVT.1058	1.00		6	Request for starting inverters from clock/calendar.
EVT.1059	1.00		6	Request for stopping inverters from clock/calendar
EVT.1060	1.00		6	Request for starting inverters from SMS.

EVT.1074	1.00	Si	-	Device RESET.
EVT.1075	1.00		-	Date/time not valid.
EVT.1076	1.00	Si	-	Date/time modified
EVT.1077	1.00	Si	-	New power on of the device.
EVT.1078	1.00	Si	-	The default values for parameters have been reloaded.
EVT.1082	1.00		-	Protections OVERRIDE - active.
EVT.1083	1.00		-	Protections OVERRIDE - not active.
EVT.1086	1.00	Si	-	Summer time activated.
EVT.1087	1.00	Si	-	Legal time activated.
EVT.1410	1.00		6	RNCB closure inhibition from contact – active.
EVT.1411	1.00		6	RNCB closure inhibition from contact – not active.
EVT.1412	1.00		6	RNCB closure inhibition from communication port – active.
EVT.1413	1.00		6	RNCB closure inhibition from communication port – not active.
EVT.1414	1.00		6	RNCB closure inhibition from “GCB not open” – active.
EVT.1415	1.00		6	RNCB closure inhibition from “GCB not open”– not active.

The "even if blocked" column indicates which events are still recorded, even if the history logs are blocked (see 6.5.7.4)

All anomalies are recorded in the event archive. They are registered with their own numerical code, added to:

- 2000: for warnings.
- 5000: for alarms.

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

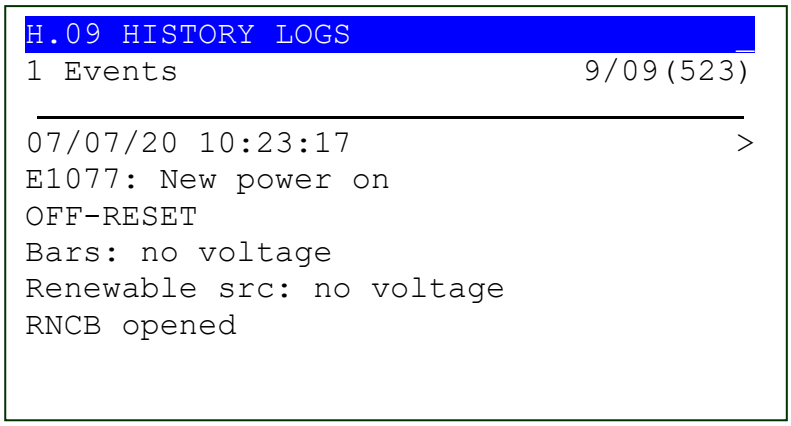
With the default configuration, each time an event is recorded, the controller also records the following information (this list can be edited with the BoardPrg3 program):

- Date/time.
- The event code.
- The presence of voltage on the connection bars.
- The presence of voltage on the loads.
- The state of the voltages of the renewable sources.
- The states of the RNCB and MGCB circuit breakers.
- The current command for the RNCB circuit breaker.
- The L-L voltages and the frequency of the renewable sources.
- The L-L voltages and the frequency of the connection bars.
- The three phase currents.

- The total powers (apparent, active and reactive) and the total power factor.
- The nominal power of the running generators.
- The total active and reactive power of the running generators.
- The power supply voltage.

By using the ▲ and ▼ buttons, all recordings are cyclically scanned. Each event has a variable number of pages (it depends on how much information is stored for each event). By pressing the ◄ and ► buttons you can navigate between the various pages related to the event.

The structure of the top of the pages is identical for all pages. The first page is shown in the following figure.



The common part contains:

- The 2nd row highlights which event is currently displayed, the total number of events stored and the maximum size of the archive. The most recent event is the one associated with the highest number.
- The next row shows the recording date/time.
- The next row shows the numeric code of the event and the description of the event itself (variable according to the selected language).

The content of the remainder depends on the information configured for recording; 5 pages are used with the default configuration:

Page 1. It shows the states of the system at the instant the event was recorded: operating mode of the controller, states of voltages on renewables and connection bars and state of the circuit breakers.

Page 2. It shows the frequency and voltages of renewable sources. It also shows the frequency and the L1-L2 voltage of the connection bars.

Page 3. It shows the L2-L3 and L3-L1 voltages of the connection bars, 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 total nominal power of the running generators, their active and reactive power.

Page 5. It shows the power supply voltage.

Information that was not available at the time of registration is displayed with dashes.

6.5.7.3 Archive of periodic registrations

The controller records a series of analogue measurements and states at regular intervals. The recording interval is configurable, and different intervals can be configured for when the inverters are running and for when they are stopped:

- P.0442: interval (in seconds) for recording analogue measurements in the archive, used when the inverters are running.
- P.0443: interval (in seconds) for recording analogue measurements in the archive, used when the inverters are stopped.

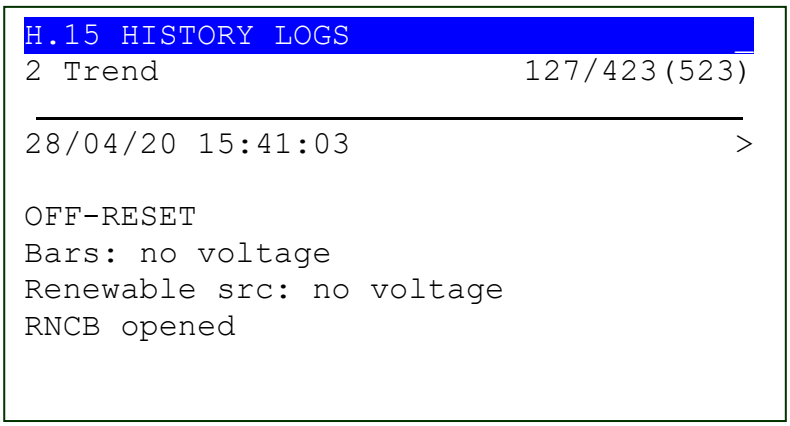
Each recording always contains the date/time and the status of the controller. Through the BoardPrg3 program it is possible to select which other information should be recorded. A maximum of 44 information can be added. The archive capacity depends on how much information is stored at each registration: with the default configuration, however, the total capacity is 523 registrations. If the archive is full, each new event overwrites the oldest one.

With the default configuration, each time an event is recorded, the controller also records the following information (this list can be edited with the BoardPrg3 program):

- Date/time.
- The presence of voltage on the connection bars.
- The presence of voltage on the loads.
- The state of the voltages of the renewable sources.
- The states of the RNCB and MGCB circuit breakers.
- The current command for the RNCB circuit breaker.
- The L-L voltages and the frequency of the renewable sources.
- The L-L voltages and the frequency of the connection bars.
- The three phase currents.
- The total powers (apparent, active and reactive) and the total power factor.
- The nominal power of the running generators.
- The total active and reactive power of the running generators.
- The power supply voltage.

By using the ▲ and ▼ buttons, all recordings are cyclically scanned. Each registration has a variable number of pages (it depends on how much information is stored for each registration). By pressing the ◄ and ► buttons you can navigate through the various pages related to the recording.

The structure of the top of the pages is identical for all pages. The first page is shown in the following figure.



The common part contains:

- The 2nd row highlights which record is currently displayed, the total number of records stored and the maximum size of the archive. The most recent record is the one associated with the highest number.
- The next row shows the recording date/time.

The content of the remainder depends on the information configured for recording; 5 pages are used with the default configuration:

Page 1. It shows the states of the system at the instant the record was stored: operating mode of the controller, states of voltages on renewables and connection bars and state of the circuit breakers.

Page 2. It shows the frequency and voltages of renewable sources. It also shows the frequency and the L1-L2 voltage of the connection bars.

Page 3. It shows the L2-L3 and L3-L1 voltages of the connection bars, 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 total nominal power of the running generators, their active and reactive power.

Page 5. It shows the power supply voltage.

Information that was not available at the time of registration is displayed with dashes.

6.5.7.4 Locked recordings

The controller does not make periodic or “on event” recordings if it is in OFF/RESET mode or if an alarm is active. Some event codes are exceptions (highlighted by the wording "Yes" in the "Even if blocked" column of the table in6.5.7.2) and all anomalies. When the recordings are blocked, an intermittent message with the word "Locked" is displayed in all the windows of the historical archive. To unlock the recordings, it is necessary to cancel all the anomalies and put the controller back into MAN or AUTO.

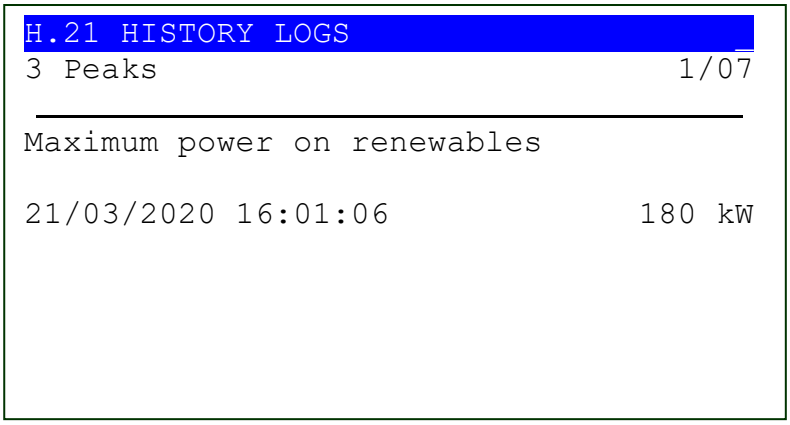
6.5.7.5 Archive of peak registrations

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

- Maximum active power on renewable sources.
- Maximum active power on connection bars.
- Maximum current (on the three phases) with the combined power factor.
- Minimum and maximum internal temperature of the controller.

Whenever a measurement exceeds the previous peak value, it is overwritten, also storing the date/time.

For showing the peaks, the controller uses only one page of the display for each peak.



The 2nd row highlights which peak is currently selected, compared to the total number of peaks. The fourth row shows a description of the currently selected peak:

The sixth row 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.

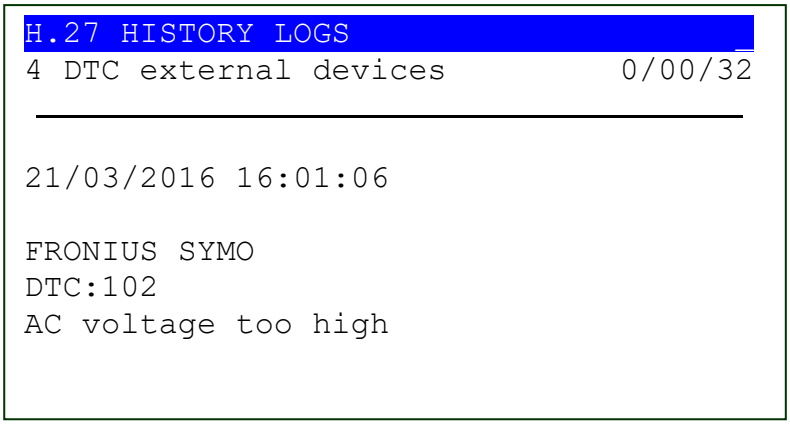
By using the ▲ and ▼ buttons, all recordings are cyclically scanned. The ◄ and ► buttons are not used because the controller uses only one page of the display.

6.5.7.6 Archive of diagnostic codes (DTC) of external devices (inverters).

The controller registers the diagnostic codes read by external devices (inverters) via the communication interfaces (RS232, RS485, ETHERNET).

Generally, depending on the type of inverter, the diagnostic message is composed of the DTC, and the description of the anomaly. This archive has a capacity of 32 recordings. At each subsequent registration, the oldest one is overwritten

For showing each recording, the controller uses only one page of the display.



The 2nd row highlights which registration is currently displayed with respect to the total number of registrations (there are a maximum of 32 registrations).

The fourth row shows the date and time of registration.

The sixth line shows which external device (inverter) generated the diagnostic code.

The seventh line shows the diagnostic code. It contains:

- SPN (Suspect Parameter Number): is a numeric code that identifies the mechanical component on which the problem occurred (in the "100" example, identifies the measurement of the oil pressure).
- FMI (Fault Mode Identifier): it is a numeric code between 0 and 31 that identifies the type of problem (in the "1" example it indicates a too low value of the measurement).

In addition, if the combination of the SPN and FMI codes is known by the controller, a textual description of the problem is displayed. Finally, if this combination is known to the controller in relation to the type of external device selected, the specific diagnostic code provided by the device manufacturer is also displayed (in the example, the code "102").

A textual description of the problem is shown on the seventh and eighth lines, if available.

The most recent registration is the one associated with the highest number. By using the ▲ and ▼ buttons, all recordings are cyclically scanned. The ◄ and ► buttons are not used because the controller uses only one page of the display.

6.5.7.7 Exit from archives visualization

There are two ways to exit the archive visualization:

- Press the **ESC/SHIFT** button n times to go back to page H.01.
- Change the controller's operating mode.

In both cases, page H.01 will be displayed, from which it is possible to switch to the other display modes with the ▲ and ▼ buttons.

6.5.7.8 Reset of archives

To clear an archive, you must first view it and then hold down the **ACK/ENTER** and E **ESC/SHIFT** buttons for 5 seconds, until the controller shows a message on the display that the reset has been carried out. The archive of maximum peaks does not actually reset: when you press the mentioned buttons for five seconds on this archive, the controller forces the current measurements as the maximum peak.

6.6 Selecting the language

The device allows you to select the language to be used for all the texts that appear on the multifunctional display. Currently, two languages are supported: Italian and English (the default is English). To select the desired language, act on the display page S.03 (see 6.5.3.3).

7 Operational sequence

7.1 Operating mode

Four modes can be used in device management:

- **OFF_RESET:** the inverters for the renewable sources are stopped (or in the shutdown phase), the anomalies are all cancelled and programming can be accessed to modify the parameters. The RNCB circuit breaker is open to insulate the inverters from the connection bars.
- **MAN**: the start and stop of the inverters for the renewable sources, and the management of the RNCB circuit breaker (if present) are the responsibility of the operator (the controller does not automatically perform these operations): since the protections are activated, the controller can however automatically open RNCB and/or stop the inverters if necessary. Access to programming is allowed, but only some parameters can be changed.
- **AUTO:** the start and stop of the inverters for the renewable sources, and the management of the RNCB circuit breaker (if present) are the responsibility of the controller (the operator cannot intervene). All protections are enabled. Access to programming is allowed, but only some parameters can be changed.
- **AVVIAMENTO REMOTO**: this mode of operation is almost identical to the AUTO. It differs only in the fact that the inverters are in any case started (automatically) even in the presence of start inhibitions; the controller automatically closes the RNCB circuit breaker (obviously if the system allows the connection of renewable sources). This mode has priority over AUTO (once REMOTE START is activated, any requests for automatic intervention are ignored). The operator does not have the right to manually operate the RNCB circuit breaker. Access to programming is allowed, but only some parameters can be changed.

The operating mode can be selected in three different ways:

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

  When one of these inputs is active, the operating mode is forced, and it is no longer possible to use the buttons on the panel or even the commands from the communication interfaces to change it (on the first line of the display a flashing icon is shown in the shape of key)

  When none of these inputs are active, it becomes possible to use the buttons and commands from the communication interfaces again to change the operating mode

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

  It is not mandatory to use all three inputs. For example, only one input can be used to force the AUTO status: when the input is active the controller is always in AUTO, when the input is deactivated the controller remains in AUTO, but you can use the buttons to switch to MAN or to OFF/RESET.

  If a single input is used, to force the OFF/RESET, the controller behaves differently: when the input is active the controller is always OFF/RESET, when the input returns to rest the controller returns to the mode in which it was before the input was activated.
- By sending Modbus commands through the communication interfaces. The commands are managed only if none of the inputs described above is active. The commands can be protected with a password (P.0004) which must be sent before

each command, and can be disabled via a digital input (DIF.2706). To send the command, write in sequence (within 5 seconds)

- HOLDING REGISTER 101: write the password configured with parameter P.0004.
- HOLDING REGISTER 102: write the value:
- “1” to switch in OFF/RESET mode.
- “2” to switch in MAN mode.
- “3” to switch in AUTO mode.

To activate the “**REMOTE START”** mode, instead, the controller must first be in AUTO. Furthermore, if an input is configured as function DIF.2701 - "Remote start enable", this input must be active. You can switch to REMOTE START in these ways:

- By configuring a digital input on the controller to acquire the "Remote start request" contact, function DIF.2032. If this input is active, the controller switches to REMOTE START, when deactivated it returns to AUTO.
- Through a suitable command via SMS (see [9]). In this case the controller switches 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 necessary to configure an input to acquire the "Remote start enable" contact with the DIF.2701 code and it is necessary that this input is active (normally wired on a switch on the front of the panel to enable remote commands).
- Using parameters P.0426, P.0427 and P.0428 it is possible to define weekly time bands in which the controller automatically switches to REMOTE START mode. In particular, with parameter P.0426 it is established on which days of the week this function is active and with the other two you select a time slot, valid for all the selected days. The band start time (P.0427) refers to the days indicated in P.0426, while the band end time (P.0428) refers to the same day if higher as a value than P.0427, to the day later if lower (around midnight). Furthermore, setting P.0427 equal to P.0428 defines a band that covers the whole day.
- By sending Modbus commands through the communication interfaces. The controller switches to REMOTE START as soon as it receives the command, returns to AUTO when it receives the opposite one (remains in REMOTE START if the serial connection is interrupted before receiving the opposite command). In this case, an input must be configured to acquire the "Remote start enable" code, DIF.2701, and this input must be active (normally wired on a switch on the front of the panel to enable remote commands). The commands can be protected with a password (P.0004) which must be sent before each command, and can be disabled via a digital input (DIF.2706). To send the command, write in sequence (within 5 seconds):

- HOLDING REGISTER 101: write the password configured with parameter P.0004.
- HOLDING REGISTER 102: write the value:
- “13” to switch in REMOTE START mode.
- “21” to switch back in AUTO mode.

The controller records any change in the operating mode in the event archive, if enabled via bit 0 of parameter P.0441:

- EVT.1001: records any switches to OFF/RESET mode.
- EVT.1002: records any switches to MAN mode.
- EVT.1003: records any switches to AUTO mode.
- EVT.1005: records any switches to REMOTE START mode.

Some functions are available for configuring the digital outputs, related to the operating mode:

- DOF.3001 - “Off/reset”. The controller activates this output when it is in OFF/RESET mode.
- DOF.3002 - “Man”. The controller activates this output when it is in MAN mode.
- DOF.3003 - “Auto”. The controller activates this output when it is in AUTO mode.
- DOF.3005 - “REMOTE START”. The controller activates this output when it is in REMOTE START mode.
- DOF.3011 - “Not in Off/reset”. The controller activates this output when it is in MAN, AUTO or REMOTE START mode.
- DOF.3012 - “One of the automatic modes”. The controller activates this output when it is in AUTO or REMOTE START mode.

Furthermore, the controller makes its own operating mode available for the AND/OR logics and for the PLC through the following internal states:

- ST.000 - “OFF/RESET”.
- ST.001 - “MAN”.
- ST.002 - “AUTO”.
- ST.004 - “REMOTE START”.

7.2 Status of the renewable sources

RN200 evaluates the "general" state of the voltage at the inverter terminals of the renewable sources for various purposes, including preventing the inverters from starting if this voltage is outside a pre-established tolerance range.

For general management purposes, the trend of renewable sources can be described in three phases:

- **Absent**: the voltages **and** the frequency **are all** in the "absent" state (see below). On page M.01 of the graphic display (single-line diagram) renewable sources are drawn in white.
- **In tolerance**: the voltages **and** the frequency **are all** in the "in tolerance" state (see below). On page M.01 of the graphic display (single-line diagram) renewable sources are drawn in green.
- **Out of tolerance**: the status of at least one voltage **and/or** frequency of renewable sources is different from "in tolerance" state (see later). On page M.01 of the graphic display (single-line diagram) renewable sources are drawn in yellow.

To evaluate the status of renewable sources, RN200 can use its three-phase sensor (JG) or an external sensor connected to a digital input.

7.2.1 Status acquired by a digital input

It is possible to configure a digital input with the DIF.3101 function (“External voltage sensor for renewable sources”). If there is a digital input configured with this function, it is used instead of the internal sensor (whatever the voltage measured). RN200 considers renewable sources:

- "Present and in tolerance" if the digital input is active.
- "Absent" if the input is not active.

With the external sensor, the "out of tolerance" state does not exist, it is considered "absent".

7.2.2 Status acquired by the internal sensor

RN200 has a three-phase sensor dedicated to voltages on renewable sources. This sensor is available on the JG connector. For the connection, see the paragraph 0.

The measurements made on this sensor are used for displaying and calculating the powers; they are also used for protections.

The controller uses parameters to configure the sensor:

- P.0105: rated frequency (Hz).
- P.0116: rated voltage (VAC). It is necessary to set the L-L rated voltage for three-phase systems, the L-N rated voltage for single-phase systems.
- P.0119: indicates whether the measurement is three-phase (3) or single-phase (1).
- P.0129: indicates whether the neutral line is connected to the controller (1) or not (0). If the neutral is not connected to the controller, RN200 does not display the L-N voltages and the Neutral-B- voltage. For single-phase systems, the parameter must be set to 1.
- P.0117: primary value (VAC) of the voltage transformers connected to connector JG.
- P.0118: secondary value (VAC) of the voltage transformers connected to connector JG.

Note: the controller has a double internal measurement scale, suitable for voltages of 100 and 400 VAC. Use parameter P.0152 to select the most suitable scale for your signals.

To determine the status of renewable sources, the controller checks both the voltage and the frequency.

7.2.2.1 Frequency check

Parameter	Description	Default value	Frequency (Hz)
P.0105	Nominal frequency	50 Hz	50.00
P.0305	Threshold for minimum frequency (81<<)	90.0 %	45.00
P.0307	Delay for minimum frequency (81>>)	110.0 %	55.00
P.0202	Hysteresis for renewable sources measures	2.5 %	1.25

The hysteresis on the various thresholds is set with parameter P.0202. If this value is greater than (P.0307 - P.0305 - 1%), the calculated value is used instead of P.0202. The hysteresis applies:

- Upwards for the minimum frequency threshold (therefore, with the default values of the parameters, between 45.00 Hz and 46.25 Hz).
- Downwards for the maximum frequency threshold (therefore, with the default values of the parameters, between 53.75 Hz and 55.00 Hz).

Considering these values, the following bands are identified:

0.00 ——————————.
Band A: **absent**
0.01 ——————————.
Band B: **low**
45.00 ——————————.
Band C: hysteresis
46.25 ——————————.
Band D: **in tolerance**
53.75 ——————————.
Band E: hysteresis
55.00 ——————————.
Band F: **high**
XXX ——————————.

If the frequency is in the "C" or "E" bands, it maintains the state it previously had (hysteresis). For example, if the frequency was in the "F" range and is now in the "E" range, it is still considered "High". If, on the other hand, it was in band "D" and is now in band "E", it is considered "in tolerance".

The P.0305 and P.0307 thresholds are also used to manage the protections on the frequency. These protections can be disabled individually by setting the relative delay to zero (respectively P.0306 and P.0308). Even if the protections are disabled, the thresholds are still used in order to establish the status of the frequency.

7.2.2.2 Voltage check

Parameter	Description	Default value	Voltage (VAC)
P.0116	Nominal voltage of the renewable sources.	400 V	400
P.9505	Voltage presence threshold.	17.5 %	70
P.0301	Threshold for minimum voltage (27<<)	75.0 %	300
P.0303	Threshold for maximum voltage (59>>)	112.5 %	450

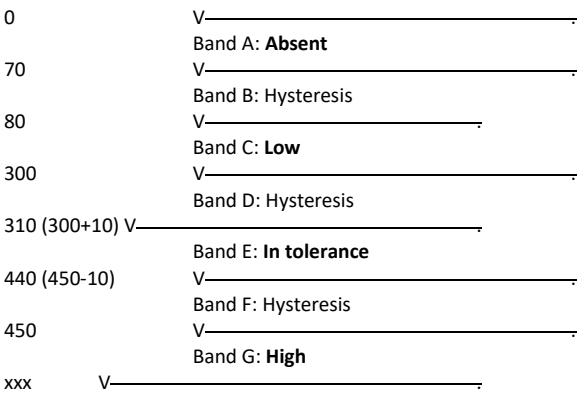
P.0202	Hysteresis for renewable sources measures	2.5 %	10

Parameter P.9505 is shared with the measurements of the connection bars.

The hysteresis on the various thresholds is set with parameter P.0202. If this value is greater than (P.0303 - P.0301 - 1%), the calculated value is used instead of P.0202.

The configured hysteresis s applied to the two configurable thresholds (P.0301 and P.0303) entirely in the direction for threshold entry. This means that the voltage is out of tolerance if outside the P.0301 and P.0303 thresholds, it is within tolerance if inside the P.0301+hysteresis and P.0303-hysteresis thresholds, otherwise it maintains the previous state.

Considering these values, the following bands are identified:



If the voltage is in bands "B", "D", "F" it maintains the state it had previously (hysteresis). For example, if the voltage was in band "E" and is now in band "D", it is still considered "In tolerance". If, on the other hand, it was in band "C" and is now in band "D", it is considered "Low".

These controls are managed for each individual phase. L-L voltages are used in three-phase systems, L-N voltage in single-phase systems. On three-phase systems, if parameter P.0328 is set to "1", the same checks are also performed on the L-N voltages (the nominal L-N voltage is calculated by dividing the nominal L-L voltage P.0116 by 1.73 (square root of 3).

The P.0301 and P.0303 thresholds are also used to manage the protections. These protections can be disabled individually by setting the relative delay to zero (respectively P.0302 and P.0304). The thresholds are however used in order to establish the voltage status, even if the protections are disabled.

7.2.2.3 Voltage unbalance check

Parameter	Description	Default value	Voltage (VAC)
P.0116	Nominal voltage of the renewable sources	400 VAC	400
P.0315	Threshold for voltage unbalance (47)	10%	40
P.0202	Hysteresis for renewable sources measures	2.5 %	10

On three-phase systems, it is possible to consider the renewable sources "out of tolerance" if the three L-L voltages differ in absolute value by a quantity greater than the set threshold. If parameter P.0328 is set to "1", the same checks are also carried out on the L-N voltages (the nominal L-N voltage is calculated by dividing the nominal L-L voltage P.0116 by 1.73 (square root of 3).

This control is disabled on single phase systems. To disable this control on three-phase systems, just set parameter P.0315 to zero.

Note: RN200 does not verify the phase angle of the three phases, but only the amplitude of the voltages.

With the default values of the parameters, if the difference in absolute value between any two L-L voltages is greater than 40 VAC, renewable sources are considered out of tolerance. If the differences in absolute value between the L-L voltages are all less than 30 VAC (threshold - hysteresis), renewable sources are considered to be within tolerance.

7.2.2.4 Phase's sequence check

Parameter	Descriptions	Default value
P.0239	Required phase's sequence.	2-Nothing

Parameter P.9505 is shared with the measurements of the connection bars.

On three-phase systems, it is possible to consider renewable sources "out of tolerance" if the phase's sequence differs from that specified with parameter P.0239.

On single-phase systems this control is disabled. To disable this control on three-phase systems, just set parameter P.0239 to "2-Nothing ".

With parameter P.0239 it is possible to select the required direction of rotation: "1-clockwise" or "0-counterclockwise". Renewable sources are considered "out of tolerance" if the real phase's sequence differs from that.

7.2.2.5 Overall

In order to diagnose the "global" state of renewable sources, the following algorithms are used, computed in the order in which they are presented:

- If **all** voltages and frequencies are in the "Absent" state, the global state is also "Absent".
- If **all** the voltages and the frequency are in the "In tolerance" state, the global state is also "In tolerance". In this case, if checking the phase's sequence or checking the voltage unbalance does not give a positive result, the voltage is considered "Low".
- If **at least one** voltage **or** frequency is in the "High" state, the global state is also "High".
- If none of the above conditions are met, the global status is "Low".

7.2.3 Events and signalling

The controller records every change in the status of renewable sources in the event archive, if enabled via bit 1 of parameter P.0441:

- EVT.1010: No voltages.
- EVT.1011: Voltage present but "out of tolerance".
- EVT.1012: Voltage present and "within tolerance".

The following function is also available for configuring the digital outputs, related to the state of the renewable sources:

- DOF.3033 - "Voltages on renewable sources". The controller activates this output when the state of the renewable sources is different from "absent" (as long as there is voltage, even if out of tolerance).

Furthermore, the controller makes the voltage states of the renewable sources available for the AND/OR logic and for the PLC through the following internal states:

- ST.049 - " Presence of voltages on renewable sources "

The following functions for configuring the analogue outputs are related to the management of renewable sources. The outputs are driven based on the value of a measure relating to renewable sources. Use the "conversion curves" to adapt the single quantity to the output (0-100%):

- AOF.3201 (“frequency of renewable sources”).
- AOF.3211 (“average voltage of renewable sources”).
- AOF.3221 (“active power of renewable sources”).

7.3 Status of the connection bars

From version 1.06, RN200 allows you to indicate whether the RNCB circuit-breaker connects the inverters of the renewable sources to the generators' bars or to the loads. For this purpose, parameter P.0808 has been added:

- If set to "0" (default value), it means that RNCB connects the renewable sources to the generators' bars.
- If different from "0", it means that RNCB connects the renewable sources to the loads of one of the MC200 controllers. The value of P.0808 identifies which MC200 controller is being referred to: values 1…16 correspond to MC200 controllers with addresses 65…80.

Therefore, the term "connection bars" identifies the loads or the generators' bars according to the setting of P.0808. **Note: if the MGCB circuit breaker does not exist on this MC200, the loads coincide with the generator bar**.

RN200 evaluates the "general" state of the voltage on the connection bars for various purposes, including preventing the RNCB circuit breaker from closing if this voltage is outside a pre-established tolerance range.

To evaluate the status of the connection bars, RN200 can use its three-phase sensor (JF) or an external sensor connected to a digital input. Parameter P.9504 selects which sensor to use.

7.3.1 Status acquired by a digital input.

Based on whether the connection bars correspond to the generators' bars or to the loads, it is possible to configure a digital input with the DIF.3102 function ("No voltage on the generators' bars") or with the DIF.3104 function ("No voltage on the loads"). If there is a digital input configured with this function, it is used instead of the internal sensor (whatever the voltage measured). RN200 considers the connection bars:

- "Present and in tolerance" if the digital input is not active (or even if it is not configured).
- "Absent" if the input is active.

With the external sensor, the "out of tolerance" state does not exist, it is considered "absent".

7.3.2 Status acquired by the internal sensor.

RN200 has a three-phase sensor dedicated to the voltages on the connection bars. This sensor is available on the JF connector. For the connection, see the paragraph 0.

The controller uses parameters to configure the sensor:

- P.0105: nominal frequency (Hz).
- P.0102: nominal voltage (VAC). It is necessary to set the rated L-L voltage for three-phase systems, the rated L-N voltage for single-phase systems.
- P.0101: indicates whether the measurement is three-phase (3) or single-phase (1).
- P.0128: indicates whether the neutral line is connected to the controller (1) or not (0). If the neutral is not connected, RN200 does not display the L-N voltages and the Neutral-B- voltage. For single-phase systems, the parameter must be set to the value 1.
- P.0103: primary value (VAC) of the voltage transformers connected to the JF connector.
- P.0104: secondary value (VAC) of the voltage transformers connected to the JF connector.

Note: the controller has a double internal measurement scale, suitable for voltages of 100 and 400 VAC. Use parameter P.0151 to select the scale best suited to your signals.

To determine the status of the connection bars, the controller checks both the voltage and the frequency.

7.3.2.1 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 on measures	2.5 %	1.25

The hysteresis on the various thresholds is set with parameter P.0201. If this value is greater than (P.0237 - P.0236 - 1%), the calculated value is used instead of P.0201. The hysteresis applies:

- Upwards for the minimum frequency threshold (therefore, with the default values of the parameters, between 45.00 Hz and 46.25 Hz).
- Downwards for the maximum frequency threshold (therefore, with the default values of the parameters, between 53.75 Hz and 55.00 Hz).

Considering these values, the following bands are identified:

0.00 ——————————.
Band A: **absent**
0.01 ——————————.
Band B: **low**
45.00 ——————————.
Band C: hysteresis
46.25 ——————————.
Band D: **in tolerance**
53.75 ——————————.
Band E: hysteresis
55.00 ——————————.
Band F: **high**
XXX ——————————.

If the frequency is in the "C" or "E" bands, it maintains the state it previously had (hysteresis). For example, if the voltage was in the "F" band and is now in the "E" band, it is still considered "High". If, on the other hand, it was in "D" band and is now in "E" band, it is considered "in tolerance".

7.3.2.2 Voltage check

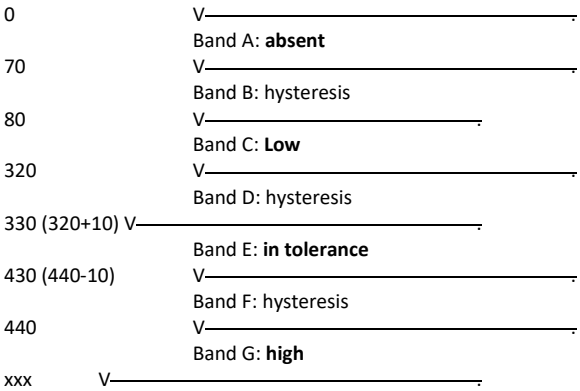
Parameter	Description	Default value	Voltage (VAC)
P.0102	Nominal voltage of the connection bars	400 V	400
P.9505	Voltage presence threshold	17.5 %	70
P.0203	Low voltage threshold	80.0 %	320
P.0204	High voltage threshold	110.0 %	440
P.0201	Hysteresis on measures	2.5 %	10

Parameter P.9505 is shared with the measures of renewable sources.

The hysteresis on the various thresholds is set with parameter P.0201. If this value is greater than (P.0203 - P.0204 - 1%), the calculated value is used instead of P.0201.

The hysteresis applies to the two configurable thresholds (P.0203 and P.0204) entirely in the direction for threshold entry. This means that the voltage is out of tolerance if outside the P.0203 and P.0204 thresholds, it is within tolerance if inside the P.0203+hysteresis and P.0204-hysteresis thresholds, otherwise it maintains the previous state.

Considering these values, the following bands are identified:



If the voltage is in bands "B", "D", "F" it maintains the state it had previously (hysteresis). For example, if the voltage was in band "E" and is now in band "D", it is still considered "In tolerance". If, on the other hand, it was in band "C" and is now in band "D", it is considered "Low".

These controls are managed for each single phase. L-L voltages are used in three-phase systems, L-N voltage in single-phase systems. On three-phase systems, if parameter P.0244 is set to "1", the same checks are also performed on the L-N voltages (the nominal L-N voltage is calculated by dividing the nominal L-L voltage P.0102 by 1.73 (square root of 3).

7.3.2.3 Voltage unbalance check

Parameter	Description	Default value	Voltage (VAC)
P.0102	Nominal voltage of the connection bars	400 VAC	400
P.0238	Voltages unbalance threshold	10%	40
P.0201	Hysteresis on measures	2.5 %	10

On three-phase systems, it is possible to consider the connection bars "out of tolerance" if the three L-L voltages differ in absolute value by a quantity greater than the set threshold. If parameter P.0244 is set to "1", the same checks are also carried out on the L-N voltages (the nominal L-N voltage is calculated by dividing the nominal L-L voltage P.0102 by 1.73 (square root of 3).

This control is disabled on single phase systems. To disable this control on three-phase systems, just set parameter P.0238 to zero.

Note: RN200 does not verify the phase angle of the three phases, but only the amplitude of the connected voltages.

With the default values of the parameters, if the difference in absolute value between any two L-L voltages is greater than 40 VAC, the connection bars are considered out of tolerance. If the differences in absolute value between the L-L voltages are all less than 30 VAC (threshold - hysteresis), the connection bars are considered to be within tolerance.

7.3.2.4 Phase's sequence check

Parameter	Description	Default value
P.0239	Required phases sequence	2-Nothing

Parameter P.9505 is shared with the measures of renewable sources.

On three-phase systems, it is possible to consider the connection bars "out of tolerance" if the phase's sequence differs from that specified with parameter P.0239.

On single-phase systems this control is disabled. To disable this control on three-phase systems, just set parameter P.0239 to "0-None".

With parameter P.0239 it is possible to select the required phase's sequence: "1-clockwise" or "0-counterclockwise". Connection bars are considered "out of tolerance" if the real phase's sequence differs from that.

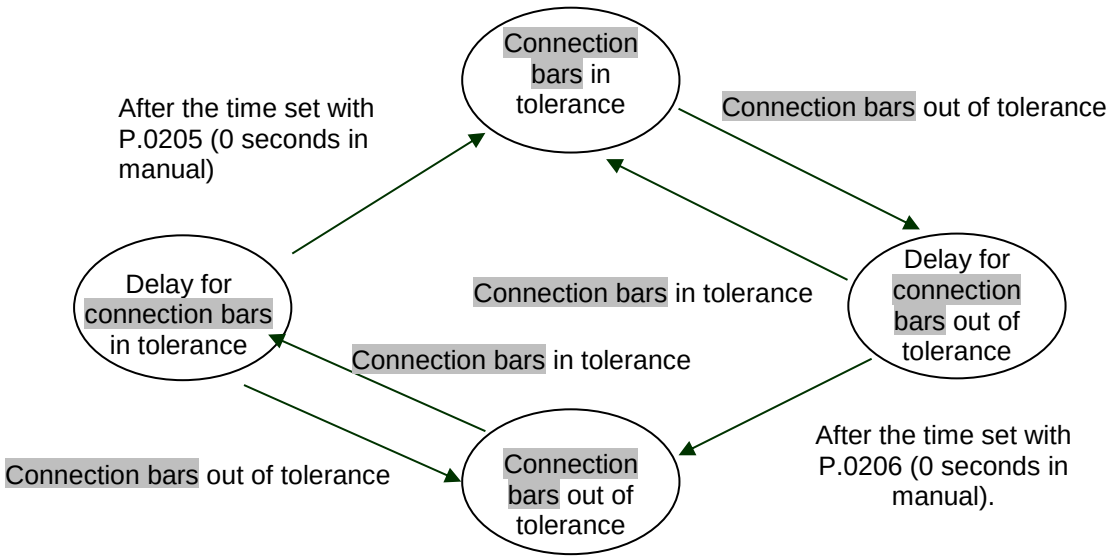
7.3.2.5 Overall

In order to detect the "global" state of the connection bars, the following algorithms are used, computed in the order in which they are presented:

- If **all** the voltages **and** the frequency are in the "Absent" state, the global state is also "Absent".
- If **all** the voltages **and** the frequency are in the "In tolerance" state, the global state is also "In tolerance". In this case, if checking the phase's sequence or checking the voltage unbalance does not give a positive result, the voltage on the connection bars is considered "Low".
- If **at least one** voltage **or** the frequency is in the "High" state, the global state is also "High".
- If none of the above conditions are met, the global status is "Low".

7.3.3 Global status of connection bars

Whatever the method used to acquire the instantaneous status of the connection bars, for the system's operating logic, the global status is described with four phases:



On page M.01 of the graphic display (single-line diagram) the connection bars are drawn in:

- White, if the status is "absent". The "GENERATORS BUS LIVE" LED is off.
- Green, if the state is " in tolerance". The "GENERATORS BUS LIVE" LED is on.
- Yellow, if voltage is present but "out of tolerance". The "GENERATORS BUS LIVE" LED flashes.

7.3.4 Events and signalling

The controller stores any change in the state of the voltages of the connection bars in the event log, if enabled by bit 2 of parameter P.0441:

- EVT.1020: No voltage on connection bars.
- EVT.1021: Voltage present but "out of tolerance" on connection bars.

- EVT.1022: Voltage present and "in tolerance" on connection bars.

The following function is also available for configuring the digital outputs, related to the status of the connection bars:

- DOF.3031 - “Voltages on connection bars”. The controller activates this output when the voltages and the frequency of the connection bars are within tolerance of the configured time.

In addition, the controller makes the states of the connection bars available for AND/OR logics and for the PLC through the following internal states:

- ST.016 - "Voltage/frequency presence on the connection bars".
- ST.017 - "Connection bars out of tolerance",
- ST.018 - "Delay for connection bars in tolerance".
- ST.019 - "Connection bars in tolerance "
- ST.020 - " Delay for connection bars out of tolerance "

The following functions for configuring the analogue outputs are related to the management of the connection bars. The outputs are driven based on the value of an analogue quantity of the connection bars. Use the "conversion curves" to adapt the single quantity to the output (0-100%):

- AOF.3101 (“Frequency of the connection bars”).
- AOF.3111 (“Voltage of the connection bars”).

7.4 Status of the mains

RN200 allows the use of the inverters also in parallel to the mains. However, it does not have sensors of any kind that allow it to evaluate the state of the mains itself. It must therefore be based on the information received via CANBUS from any mains controller (MC200) present in the system.

Only if no MC200 controllers are present in the system, it is possible to use a digital input configured with the function DIF.3103 to acquire the status of the mains: if the input is active, the mains is considered present and in tolerance, if the input is not active, the mains is considered absent.

From these controllers it also acquires the status of the mains circuit breaker (MCB) and of the master genset circuit breaker (MGCB). Similarly, if there are no MC200 controllers, digital inputs can be used to acquire the status of MCB and MGCB. See paragraph 7.7.

On page M.01 of the graphic display (single-line diagram) the mains is drawn in:

- White, if the status is "absent".
- Green, if the state is " in tolerance".
- Yellow, if voltage is present but "out of tolerance".

7.5 Status of the loads

For its internal sequences, RN200 must also know the state of the voltages on the loads. Among other things, it uses it to manage the "LOADS / BUS" lamp. On page M.01 of the graphic display (single-line diagram) the loads are displayed in white (absent) or green (present) according to this status.

If the connection bars correspond to the loads (P.0808), see 7.3.

If, on the other hand, the connection bars correspond to the generators' bars, then the RN200 has no sensors allowing to evaluate the status of the loads themselves.

It is possible to configure a digital input with the DIF.3104 function ("No voltage on loads"). If there is a digital input configured with this function, RN200 considers the loads:

- "Present" if the digital input is not active.
- "Absent" if the input is active.

If no digital input is configured with the DIF.3104 function, then RN200 builds the state of the loads based on:

- Voltage status of the connection bars and relative MGCB circuit breaker. This state also includes the status of renewable sources and the relative RNCB circuit breaker.
- Voltage status of the mains and relative MCB circuit breaker.

7.5.1 Events and signalling

The following function is available for configuring the digital outputs, related to the state of the users:

- DOF.3030 - "Voltages on loads". The controller activates this output when there is voltage on the loads.

In addition, the controller makes available the voltage states of the loads for the AND/OR logics and for the PLC through the following internal states:

- ST.048 - "Presence of voltages on the loads".

7.6 Status of the generators' bars

For its internal sequences, the RN200 must also know the state of the voltages on the generators' bars. For example, it uses this information to manage the "GENERATORS BUS LIVE" lamp. On page M.01 of the graphic display (single-line diagram) the generator is displayed in white (absent) or in green (present) based on this status.

If the connection bars match the generator bars (P.0808), see 7.3.

If instead the connection bars correspond to the loads, then RN200 has no sensors allowing to evaluate the status of the loads themselves.

It is possible to configure a digital input with the DIF.3102 function ("No voltage on the generators' bars"). If there is a digital input configured with this function, the RN200 considers the generators' bars:

- "Present" if the digital input is not active.
- "Absent" if the input is active.

If no digital input is configured with the DIF.3104 function, then RN200 builds the loads status based on the information received from the GC controllers over the CAN BUS.

7.6.1 Events and signalling

The controller makes available the voltage states of the generators for the AND/OR logics and for the PLC through the following internal states:

- ST.050 - "Presence of voltage on the generators' bars".

7.7 Circuit breakers management

In an application that includes renewable sources, up to four types of circuit breakers can be found:

- One or more MCBs. They connect the mains to the loads. An MCB is required for each mains. They are managed by MC200 controllers. RN200 acquires only their status to correctly manage the power supplied by the inverters.
- One or more MGCBs. They connect the generators' bars (where the generators and some renewable sources are connected) to the loads. They are not mandatory, there are applications without MGCB. If they exist, they are normally managed by MC200 controllers. In the simplest configurations they are controlled by the GC600 (or DST4602 Evolution) controllers. RN200 acquires only their status to correctly manage the power supplied by the inverters.
- One or more GCB. They connect every single generator to the generators' bars. They are mandatory, one for each generator. They are managed by the GC600 (or DST4602 Evolution) controllers. RN200 acquires only their status to correctly manage the power supplied by the inverters.
- One or more RNCB. They connect a group of inverters for the renewable sources to the connection bars. They are not mandatory. They are managed by the RN200 controllers.

  The only circuit breaker directly managed by RN200 is RNCB. RN200 can manage only one RNCB: if there are multiple RNCB circuit breakers in an application, multiple RN200 controllers must be used. As said, it is not mandatory to have an RNCB circuit breaker: RN200 can work without, acting only on the inverters.

  However, RN200 accepts that RNCB can be controlled by external logic (permanently or temporarily).

  With parameter P.0855 you configure how RN200 must manage the RGCB circuit breaker:

- 0: the circuit breaker does not exist in the application.
- 1: the circuit breaker is controlled by RN200.
- 3: the circuit breaker is controlled by an external device.

7.7.1 Digital outputs

Four different commands are available for managing the RNCB circuit breaker:

- DOF.2001 - "Minimum voltage coil for RNCB". This function can be used to power the possible minimum voltage coil of the circuit breaker. The controller deactivates this output when it wants to open the circuit breaker, activates it when it wants to close the circuit breaker: the real closing command will be activated with at least 0.5 seconds delay from the activation of this output. If the circuit breaker opens without an explicit command from the controller (for example for the tripping of its protections), it is possible to configure a delay between opening the circuit-breaker and deactivating this command (P.0246, by default set to zero): this function is useful for some small circuit breakers in order to acquire the TRIP contact (which resets immediately as soon as the circuit breaker is commanded to open).
- DOF.2002 - "Coil for opening of RNCB". The controller activates this output when it wants to open the circuit breaker: the output resets as soon as the circuit breaker feedback indicates that it is open (or when the opening time-out expires).
- DOF.2003 - "Coil for closing of RNCB". The controller activates this output when it wants to close the circuit breaker (ensuring that any DOF.2001 function has been active for at least 0.5 seconds): the output resets as soon as the circuit breaker feedback indicates that it is closed (or when the closing time-out expires).
- DOF.2004 - " Stable closing command for RNCB ". The controller activates this output when it wants to close the circuit breaker (ensuring that any DOF.2001 function has been active for at least 0.5 seconds): the output remains active even with the circuit breaker is closed. The controller deactivates this output when it wants to open the circuit breaker: the output remains inactive even with the circuit breaker is open. Use this output with contactors, not with motorized circuit breakers.

7.7.2 Digital inputs

The digital inputs of the controller can be used for various purposes, in the context of circuit breakers management.

7.7.2.1 Acquisition of the status of the switches

Four functions are available for acquiring feedbacks from circuit breakers:

- DIF.3002 - “Status of MCB circuit breaker”. Use this function to acquire the feedback (input active when the circuit breaker is closed). Normally, however, the status of the MCB circuit breaker is automatically acquired via CANBUS from the MC200 controllers.
- DIF.3003 - “Status of MGCB circuit breaker”. Use this function to acquire the feedback (input active when the circuit breaker is closed). Normally, however, the status of the MGCB circuit breaker is automatically acquired via CANBUS from the MC200 controllers.
- DIF.3004 - “Status of GCB of other gensets”. Use this function to acquire the feedback (input active when the circuit breaker is closed). Normally, however, the state of the GCB circuit breakers is automatically acquired via CANBUS from the GC600 and/or the DST4602 Evolution controllers.
- DIF.3006 - “Status of RNCB circuit breaker”. Use this function to acquire the feedback (input active when the circuit breaker is closed).

It is not mandatory to connect the feedback of the RNCB circuit breaker to the controller. If acquired, RN200 uses the feedback for:

- For its operating sequence.
- To know the status of the circuit breaker when it is externally controlled.
- To show the status of the circuit breaker on the front panel lamp and on the single-line diagram (page M.01).

If it does not acquire the feedback, the uses its command as feedback. It is always better to connect the feedback.

The delay associated with the digital input (P.2002 for input 1 or equivalent parameter for the other inputs) is used as the maximum time for opening or closing the circuit breaker.

7.7.2.2 Temporary override of the controls

It is possible to use digital inputs to indicate to RN200 that "temporarily" the circuit breaker commands are managed by an external device (even if parameter P.0855 indicates that the circuit breaker is managed by the controller):

- DIF.1033 - “RNCB controlled externally”.

As long as the input is active, the controller never tries to open or close the circuit breaker: however, if the circuit breaker moves (following external commands), the controller adjusts its commands to the new state, in a way not to cause any unwanted opening/closing when the input will be deactivated.

7.7.2.3 Manual commands

External opening/closing buttons (for the circuit breaker) can be connected to the digital inputs of the controller. The controller will use these inputs (only in MAN) exactly like the RNCB button on the front panel.

- DIF.1031 - “Request for RNCB closure (MAN)”.
- DIF.1032 - “Request for RNCB opening (MAN)”.

7.7.3 Management logic

7.7.3.1 Opening forces

RNCB must always be open if:

- If the controller is in OFF/RESET mode.
- If alarms are active.
- If the voltages and the frequency of the connection bars have been out of tolerance for an appropriate delay. In fact, **is never allowed to close the circuit breaker with voltages out of tolerance on the Connection bars**. Note: this condition prevents closing, does not force opening: opening is possibly forced by the tripping of the protections, which generate an alarm.
- If there is a request to open the RNCB due to a " GCB not open" condition (parameter P.0805).
- If there is no other active source (mains or generator) supplying the connection bars.

The first three causes already involve a registration in the event log. For the fourth, however, the controller records two specific events, but only if enabled with bit 6 of parameter P.0441:

- EVT.1414: RNCB closing inhibition for "GCB not open" activated.
- EVT.1415: RNCB closing inhibition for "GCB not open" deactivated.

When one of the above conditions occurs while RNCB is closed, it is immediately opened, without any transfer of power to the generators or to the mains.

7.7.3.2 Automatic closing inhibitions

If there are no "opening forces", in AUTOMATIC it is still possible to request the opening of the RNCB circuit breaker in different ways:

- With a digital input configured with the DIF.2503 function ("RNCB closure inhibition"). While the input is active, the controller opens or keeps the RNCB circuit breaker open. The controller stores two events related to this inhibition, but only if enabled with bit 6 of parameter P.0441:
  - EVT.1410: RNCB closure inhibition "from contact" activated.
  - EVT.1411: RNCB closure inhibition "from contact" deactivated.
- Using the commands received from the communication ports. To send the commands it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102:
    - “41” to inhibit the closing or force the opening of RNCB.
    - “43” to remove the closing inhibition for RNCB.

Note: this command must be confirmed periodically: after 30 seconds, in fact, it is automatically deactivated.

The controller stores two events related to this inhibition, but only if enabled with bit 6 of parameter P.0441:

- EVT.1412: RNCB closure inhibition "from communication port" activated.
- EVT.1413: RNCB closure inhibition "from communication port" deactivated.

When one of the previous conditions occurs while RNCB is closed, it is opened after transferring the power to the generators or to the mains.

7.7.3.3 Management logic in OFF/RESET

In this mode, the controller always opens RNCB, as described in 7.7.3.1.

7.7.3.4 Management logic in MAN

It is always possible to open RNCB. The circuit breaker can instead be closed only if there are no "opening forces" (see 7.7.3.1). The "closure inhibitions" (7.7.3.2) are instead ignored in MAN.

The controller always and immediately executes the manual closing commands (if conditions allows this).

For opening commands, however, it always tries to open the circuit breaker with no loads. Therefore, it tries to transfer the power from the inverters to the generators (or to the mains) before opening the circuit breaker. This "transfer" phase is described in automatic logic. Here it is important to know that if you want to open RNCB immediately, just keep the command active for at least 1 second (RNCB button for example). If, on the other hand, a closing command is sent while the controller is transferring the load to the generators or to the mains, the previous closing command is simply cancelled.

The following describes the ways in which it is possible to send manual opening/closing commands to the controller.

- Using the buttons of the controller. With the RNCB button, the operator has the possibility to open/close the RNCB circuit breaker. It acts as a "toggle": it opens the circuit breaker when closed, and vice versa.
- Using the digital inputs of the controller (to connect external push buttons that allow you to manually open/close the circuit breaker). See paragraph 7.7.2.3 for the list of available functions.

  You can use both commands or only the closing one. If only the closing command is used, it acts as a "toggle": it opens the circuit breaker when closed, and vice versa.
- Using the commands received from the communication ports. To send the commands it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102:
  - “41” for opening RNCB.
  - “43” for closing RNCB.

7.7.3.5 Management logic in AUTO

This paragraph refers to the AUTO and REMOTE START modes.

The RNCB circuit breaker is automatically closed if all the following conditions are met:

- It is required to start the inverters (see 7.8).
- There is no opening force (see 7.7.3.1).
- No automatic closing inhibition is active (see 7.7.3.2).

Likewise, it is opened if at least one of the previous conditions is not verified.

After each closing of RNCB, and before each opening (except when an "opening forcing" occurs), RN200 transfers the loads to or from the inverters with a programmable ramp. This is to avoid transients in power management. The transfer can be configured with parameters P.0874 ("Load ramp for the inverter") and P.0875 ("Unload ramp for the inverter"). RN200 uses the first one after RNCB closes, the last one before opening it. The two parameters are expressed as

"percentage of the nominal power of the running inverters" per second. Any opening of the RNCB circuit breaker will only occur when the power setpoint for the inverters has been gradually reduced to zero.

7.7.4 Events and signalling

The controller store every change in the command and status of the RNCB circuit breaker in the event log, if enabled respectively through bits 4 and 5 of parameter P.0441:

- EVT.1035: RNCB closure command.
- EVT.1036: RNCB opening command.
- EVT.1037: RNCB closed.
- EVT.1038: RNCB open.

It also makes the circuit breaker commands and status available, for the AND/OR logics and for the PLC, through the following internal states:

- ST.064 - “GCB status".
- ST.065 - "MCB status".
- ST.066 - "MGCB status".
- ST.067 - "RNCB status".
- ST.069 - "RNCB closure command (stable)".
- ST.073 - "RNCB minimum voltage coil".
- ST.074 - "RNCB opening pulse”.
- ST.075 - " RNCB closing pulse".

7.8 Starting & stopping the inverters

RN200 is able to start/stop the inverters for renewable sources. It is able to do this by sending commands via the communication interfaces, or by using digital outputs.

It is also able to activate warnings in case of failure to start (if no inverter starts) or failure to stop (if at least one inverter does not stop).

7.8.1 Digital outputs

RN200 allows you to use a digital output configured with the DOF.3063 function ("Start command for the inverters") to start/stop the inverters. The output is activated every time a start is required, and remains active as long as a stop is required.

7.8.2 Digital inputs

The starting/stopping state of the inverters is usually acquired directly via the communication interfaces. Only if no communication has been configured, it is possible to use a digital input configured with function DIF.3121 to acquire the running/stopped status of the inverters.

7.8.3 Management logic

The starting and stopping of the inverters are managed by RN200, both in MAN and in AUTO mode. If no communication with inverters has been configured, and if no output is configured with the function DOF.3063, RN200 has no way of starting/stopping the inverters: it therefore assumes that they are controlled externally and follows their status (acquired from a digital input configured with function DIF.3121).

7.8.3.1 Stop forces

RN200 always stops the inverters if:

- The controller is in OFF/RESET mode.
- Alarms are present.
- If the RNCB circuit breaker is open. **The inverters, in fact, can only supply power in parallel to another source, which does not happen if RNCB is open.**
- If the connection bars are not supplied (see note in the previous point), that is if:
  - If the connection bars are the generators' bars:
    - No generator is running (all GCB circuit breakers are open).
    - No mains is connected to the generators' bars (no MC200 has both MCB and MGCB closed).
  - If the connection bars are the loads:
    - No mains is connected to the loads (no MC200 has MCB closed).
    - No generator is connected to the loads (no GCB closed, or no MGCB closed).
- If the voltage on renewable sources is out of tolerance (see 7.2).

In these cases, RN200 does not wait for the power to be transferred to the mains or to the other generators before stopping the inverters.

7.8.3.2 Automatic start inhibitions

In automatic mode, RN200 determines, based on current conditions, whether to start the inverters of renewable sources. Even if the conditions of the system require the use of renewable sources, it is always possible to inhibit the start of the inverters (and consequently force their stop) using the "automatic start inhibition" function.

Once activated, this internal function has priority over any other function: the inverters will be stopped and it will not be possible to restart them. The function works in the AUTO mode, but not in the REMOTE START mode. Activating this function does not lead to the activation of alarms.

In these cases, RN200 waits for the power to be transferred to the mains or to the generators before stopping the inverters.

This function can be activated in various ways, described in the following paragraphs. When there is an active inhibition, a flashing padlock is displayed (🔒) in the upper right corner of the display.

7.8.3.2.1 Automatic start inhibition from contact

The controller can use a digital input programmed with the DIF.2501 function ("Inhibition of start for inverters"). If the input is "active", the inverters are never started automatically, even if the conditions of the system require it (they are stopped if they were running).

With parameter P.0207 it is possible to set a delay between the physical activation of the input and the logical activation of this function. Similarly, with parameter P.0208 it is possible to set a delay between the physical deactivation of the input and the logical deactivation of this function. The acquisition time related to the digital input is ignored.

The controller stores every variation of this inhibition in the events log, if enabled through bit 6 of parameter P.0441:

- EVT.1013: start inhibition “from contact” activated.
- EVT.1014: start inhibition “from contact” deactivated.

It also makes the status of this inhibition available for AND/OR logics and for the PLC, through the following internal status:

- ST.080: “Start of inverters inhibited by contact”.

7.8.3.2.2 Automatic start inhibition from clock/calendar

Using parameters P.0421, P.0422 and P.0423 it is possible to define weekly time bands in which the inverters are enabled for operation. Outside this range (and on days not selected), the "automatic start inhibition" function is active (and therefore the inverters will be stopped).

In particular, with parameter P.0421 it is established on which days of the week the inverters can operate and with the other two you select a time band, valid for all the selected days. The band start time (P.0422) refers to the days indicated in P.0421, while the band end time (P.0423) refers to the same day if higher in value than P.0422, to the next day if lower (across midnight). Furthermore, setting P.0422 equal to P.0423 defines a band that covers the entire day.

The controller stores every variation of this inhibition to start in the events log, if enabled through bit 6 of parameter P.0441:

- EVT.1015: start inhibition “from clock/calendar” activated.
- EVT.1016: start inhibition “from clock/calendar” deactivated

It also makes the status of this inhibition available for AND/OR logics and for the PLC, through the following internal status:

- ST.081: “Start of inverters inhibited by clock/calendar”.

7.8.3.2.3 Automatic start inhibition for “GCB not open”

In systems allowing parallel between generators (or between generators and renewable sources), it may happen that the GCB circuit breaker of a generator does not open when that generator must be stopped. This is a dangerous situation, because the voltage of the other generators that are running drags the alternator of that generator. In this condition, despite the stop command, the engine would continue its rotation with any external services (oil pumps or other) disconnected.

In these conditions, it is possible to prevent the closure of RNCB (P.0805=1), or even force its opening if it was already closed (P.0805=2): when RNCB is open, the inverters are stopped (via the "automatic start inhibition") waiting for the problem to be solved. The events related to this inhibition are described in 7.7.3.2

7.8.3.3 Management logic in OFF/RESET

In this operating mode, the controller keeps the inverters always stopped, as described in 7.8.3.1.

7.8.3.4 Management logic in MAN

Inverters can always be stopped. Instead, they can only be started if there is no "stop forcing" (see 7.8.3.1). The "automatic star inhibitions” (7.8.3.2) are instead ignored in MAN (except that for "GCB not open").

The following describes the ways in which manual start/stop commands can be sent to the controller.

- Using the buttons of the controller. With the START button, the operator has the option to start the inverters. With the STOP button he can stop them.
- With a command through the communication ports. These commands can be enabled by a digital input configured with the DIF.2706 function - "Enable the commands through the communication ports": if this input exists, it must be active. To start/stop the inverters, the Modbus registers must be written in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102:
    - Write “11” to start.
    - Write “22” to stop.

The controller stores the following events following the manual start/stop requests (if enabled with bit 7 of parameter P.0441):

- EVT.1050: manual start request.
- EVT.1051: manual stop request.
- EVT.1057: manual stop request (from communication ports).

7.8.3.5 Management logic in AUTO

This paragraph refers to the AUTO and REMOTE START modes.

Inverters are automatically started if all the following conditions are met:

- There is no stop forcing (see 7.8.3.1).
- No automatic start inhibition is active (see 7.8.3.2).

Likewise, they are stopped if at least one of the previous conditions is not verified.

The controller stores the following events when the start/stop requests change (if enabled with bit 7 of parameter P.0441):

- EVT.1052: automatic start request.
- EVT.1053: automatic stop request.
- EVT.1054: automatic start request (REMOTE START mode required by contact).
- EVT.1056: automatic start request (REMOTE START mode required by communication ports).
- EVT.1058: automatic start request (REMOTE START mode required by clock/calendar).
- EVT.1060: automatic start request (REMOTE START mode required by SMS).

7.8.4 Signalling

The following functions for configuring the digital outputs are related to the management of the inverters:

- DOF.0103 (AND/OR logics)
  - ST.128: start request for inverters.
  - ST.136: inverters stop request (not required).
  - ST.139: inverters stop request (MAN).

7.9 Communication with the inverters

RN200 is able to exchange data with the inverters for the renewable sources, using the Modbus protocol. This is a binding limit: the inverters must implement this protocol.

RN200 can acquire the following measurements from the inverters:

- Manufacturer, model, options.
- Nominal powers (apparent, active, and reactive in the quadrants Q1 and Q4).
- Supplied powers (apparent, active, and reactive).
- Status of the grid relay (started/stopped).
- Diagnostics.

It can send the following commands:

- Start/stop.
- Limitation for the active power.
- Setpoint for the reactive power
- Alarms reset.

The inverters can be connected to the RN200 with three different communication interfaces:

- The RS232 serial port (JA, Modbus RTU).
- The RS485 serial port (JW, Modbus RTU).
- The ETHERNET port (JY, Modbus TCP).

The serial ports allow the connection of multiple inverters (an external RS232/RS485 converter is required on the RS232 port): being able to choose, however, in the case of multiple inverters it is advisable to connect them to the Ethernet port, because on this port RN200 is able to communicate simultaneously with all inverters. On the serial ports, instead, due to the nature of the Modbus protocol, RN200 must scan the inverters, exchanging data with one of them at a time: this slows down communication.

RN200 supports the communication with up to 16 inverters, which can be freely connected to the three communication interfaces listed above.

The parameters included in menu 2.5 (and in the related submenus) allow you to configure the inverters and the communication with them. For each inverter, you can first select the communication interface to be used (parameter P.9031 for inverter 1, menu 2.5.1):

- 0 –JA serial port.
- 1 –JW serial port.
- 2 – Ethernet.

7.9.1 Serial ports

If serial ports are used, the communication speed, the number of bits per byte, the parity and the number of stop bits must also be established. These configurations are related to the communication interface, not to the individual inverter. The parameters included in menu 5.1 (JA) and 5.2 (JW) are therefore used:

JA	JW	Description	Value
P.0451	P.0471	Usage of the serial port	2-Modbus master
P.0453	P.0473	Baudrate	*
P.0454	P.0474	Settings (n° bit, parity, n° of stop bits)	*
P.0470	P.0475	Order of the Modbus registers	*
P.0476	P.0477	Delay between messages	*

All the inverters connected to the same serial port must share the previous settings (for example, it is not possible to communicate at 9600 baud with one inverter and at 115200 baud with another inverter connected to the same serial port). The configuration must be congruent between all inverters and RN200. Finally, all inverters must have a different Modbus address (so that RN200 can send messages individually to each specific inverter).

7.9.2 Ethernet port

If you use the Ethernet port, you only need to configure some basic parameters of the network to which you are connected, which must be common to both inverters and RN200:

- The “subnet mask” (parameter P.0501 for RN200, menu 5.5).
- The IP address of the network router (or gateway) (parameter P.0502 for RN200, menu 5.5).

It is necessary to verify that all inverters share these values with RN200. Within the network, RN200 and the inverters must have unique IP addresses. The IP address of RN200 can be configured with parameter P.0500 (menu 5.5).

RN200 also supports DHCP protocol: it accepts that the IP address is assigned to it by a server, rather than configured manually. This function is enabled by default (parameter P.0514="255.255.255.255" and P.0513="67"): to disable it, set P.0514 to "0.0.0.0". The IP address assigned by the server to RN200 is visible on page S.05.

To communicate with an inverter, RN200 must know the IP address and the TCP port on which the inverter is listening. For this purpose, two parameters are available for each inverter (example for inverter 1, menu 2.5.1):

- P.9033: allows you to configure the IP address of the inverter.
- P.9034: allows you to configure the TCP port of the inverter.

Note: the TCP port associated with the Modbus protocol is 502 (standard value). Change this value only if explicitly requested by the inverter documentation.

Inverters can also support DHCP, and therefore may have IP addresses that are not known a priori. Normally, in these cases, the inverters also support the DNS protocol: they register a known name on the server that assigns them the IP addresses. Any other device can ask the server (called DNS server) for the IP address currently associated with the known name, and then use it to connect to the inverter. RN200 supports the DNS protocol: it is therefore possible to associate names to inverters instead of IP addresses (always via parameter P.9033 or equivalent). Obviously, the name configured in P.9033 and the name configured in the inverter must coincide (attention to capital letters).

In this case, RN200 must know the IP address of the DNS server in order to query it. As a rule, it obtains the DNS server address directly from the DHCP server: if the DHCP protocol is disabled, use parameter P.0510 to configure the IP address of the DNS server. Note: the name of RN200 which is associated with its IP address is configured with parameter P.0456.

7.9.3 Common configurations

Whatever the communication interface used, there are some parameters that allow you to further configure communication with the inverters. The parameters relating to inverter 1 are shown below as an example:

- P.9032 ("Modbus address"). Here you must report the Modbus address associated with the inverter (verify that there is the same address both in the inverter and in RN200). **Note: it is used also with Ethernet network, although the IP address already identifies a specific inverter**.
- P.9035 ("Maximum time for answers"). Allows you to configure a maximum time in milliseconds. RN200 waits for the Modbus response from the inverter for this time: if it does not receive it, it increases the communication errors counter and repeats the query (after a few attempts it passes to the next inverter). There are no particular risks to increase this value: if communication works properly it is not used
- P.9036 ("Maximum number of tries per message"). In case of missing answer, RN200 retransmits a message at most P.9036 times, then goes on to interrogate the next inverter

7.9.4 Communication management

In normal operation, RN200 continuously reads measurements and states from the inverters. This information is shown on the display and is used for internal logics.

When needed, RN200 also sends commands: they have higher priority than normal messages. They therefore interrupt the normal query cycle: in this way the inverters are more responsive.

Commands are sent only when they are needed, i.e. only when a change is required (starting a stopped inverter or vice versa, changing a power setpoint). This minimizes traffic on the communication channel.

If serial ports are used, if an inverter has a communication problem, its priority decreases: communication to the other inverters will be privileged. RN200 will continue to exchange messages with the inverter that has problems, but will do it more slowly, so as not to worsen the rate of information gathering from the other inverters. In practice, for these inverters RN200 will no longer make P.9036 attempts per message: it will make only one, and, if it is not successful, it will pass to the next inverter.

7.9.5 BROADCAST and UNICAST

The Modbus protocol is a master/slave protocol. The slaves (inverters) never transmit anything spontaneously, but only answer to queries from the master (RN200).

As a rule, therefore, RN200 periodically sends messages to the inverters (which may be information requests or commands) and waits for the response from them.

On serial communication ports, this type of query can be very penalizing, especially if the inverters support very low communication speeds. Considering an average of 5 messages per inverter, with 16 inverters we are about 80 messages. If RN200 took 1 second for each message, it would take more than one minute for the complete scan of the inverters. This problem does not arise for the Ethernet port, because RN200 communicates simultaneously with all inverters.

This communication system is known as UNICAST. There is also the BROADCAST system (foreseen by Modbus) which allows to solve the problem of the communication speed, but introduces restrictions.

Modbus has a particular address (255): any message transmitted to this address is received and processed by all the slaves (inverters): none of them, however, respond to this message. The BROADCAST system is therefore very useful for sending commands: RN200 with a single message is able to start or stop all inverters at the same time, or is able to change the power percentage setpoint at all.

On the other hand, using BROADCAST, RN200 is not able to get any measurement from inverters.

With parameter P.9001 (menu 2.5.0), select UNICAST (0) or BROADCAST (1):

7.9.5.1 BROADCAST

If the BROADCAST system is used, the RN200 has no information either on the nominal powers or on the current powers supplied by the inverters. It doesn't even have any command feedback.

Two parameters are provided for each inverter (P.9022 and P.9023 for inverter 1, menu 2.5.1) that allow you to set the nominal active and reactive power for each inverter. For the reactive power, in this case, it is assumed to be the same in quadrants 1 and 4 (capacitive and inductive). If not, set the more restrictive value between the two. RN200 uses these parameters both when working in BROADCAST and when the communication protocol of the specific inverter does not provide this information.

For the measures of the supplied powers (both active and reactive), instead of the measurements acquired by the inverters, it is possible to use the measurements made by RN200 through its voltage (JG) and current (JE) sensors. Check that the external current transformers are wired on the lines coming from renewable sources and that parameter P.0124 is set to "2-On renewable sources".

Alternatively, it is possible to use external power meters connected to RN200 analogue inputs, configured with the functions:

- AIF.2311 (“Active power from renewable sources”).
- AIF.2313 (“Reactive power from renewable sources”).

It is even possible to use just one of the two inputs. If an input exists, it has priority over the voltage/current sensors on the controller, but not over the communication with the inverters.

However, it is not possible to have any feedback on the commands: in this case RN200 trusts its own commands. For example, if it has given a start command to the inverters, it assumes that they are actually started.

Note: in the BROADCAST system RN200 it is not able to detect and show the inverter faults (diagnostic codes).

7.9.6 Type of inverter

RN200 is able to communicate with multiple inverters. The description of the Modbus communication protocol towards a specific inverter is made through an external file which is transferred to the RN200 during configuration: Mecc Alte is thus able to add support to new inverters (or correct any errors on existing inverters) without updating the firmware of RN200.

Different types of inverters can potentially coexist in a system (although it is not recommended): for each possible inverter a parameter is provided (F.9021 for inverter 1, menu 2.5.1) that allows you to select the model of the inverter among those provided. **Note: this operation requires a PC with the BoardPrg3 software**. The parameter is also visible and modifiable from the controller’s display: from the controller, however, it is only possible to select one of the previously downloaded files, not to select a new model.

7.10 Active power management

In a mixed plant with renewable sources and generators, the purpose of RN200 is to ensure maximum use of renewable sources, while keeping the plant and generators safe. As a rule, therefore, the inverters are free to produce as much active power as possible.

The generators are designed to work at a minimum active power (typically over 50% of the nominal). For relatively short periods, they can also work at very low powers, but in the long term this type of operation wears them more.

In order to keep the generators efficient and reduce periodical maintenance, RN200 is able to limit the power supplied by the inverters (if needed), to keep the generators at an adequate power level. This function is configured with the following parameters (menu 2.2):

- P.9811 (“Minimum power for the generators”). It is a percentage value. It is applied to the nominal power of all the running generators. Let's take an example:
  - Island application with 120 kW loads.
  - There are two generators of rated 100 kW each, which are sharing the load (60 kW each).
  - P.9811 is set to 40%.
  - RN200 will ensure that inverters supply a maximum of 40 kW, leaving 40 kW each to the two generators (40%).

  The P.9811 value must be much lower than the thresholds used in the generator controllers (GC) for the "load function" (which are typically around 80%), so that generators can be turned off when "not necessary".

  In the previous example, the two GC controllers "see" a total load of 80 kW (the part supplied by renewable sources is subtracted from the total load and is not seen by the GC controllers). One of the generators will be stopped if, after stopping, the other one will supply less than the set threshold (80%).

  In the previous example, the generators are supplying 40 kW each, so if one stops the other one will supply 80 kW: when this happens, RN200 detects the situation and adjusts the power setpoint for renewable sources. Now, in fact, it can be increased up to 80 kW, because it is only necessary to guarantee that the only one running generator works at powers not lower than 40 kW.
- P.9812 “Hysteresis on the minimum power for the generators” (%). This parameter is used to avoid continuous actions on the inverters if the power of the generators is exactly the value specified in P.9811. The active power limitation on the inverters is changed only when the generator powers exit the hysteresis band (inside it remains constant)
- P.9813 “Activation delay for power limitation on inverters” (s).
- P.9814 “Deactivation delay for power limitation on inverters” (s).

  The last two parameters configure delays and are used to avoid continuous actions on the inverters. If at any given moment RN200 is not limiting the active power of the inverters, it will begin to limit it only if the generators produce less than P.9811 for P.9813 seconds. In the same way, it will remove all limitations only when the generators produce more than P.9811 (with hysteresis) for P.9814 seconds.

  When RN200 activates the active power limitation on the inverters, it manages a percentage setpoint towards them. This setpoint is gradually changed over the time, to avoid sudden changes in power that could be reflected on the generating sets. Parameters P.0874 and P.0875 (menu 2.2) allow you to specify the rate of change, expressed as %/ s (meaning the percentage of the nominal power of the running inverters) respectively increasing or decreasing the power. Normally P.0875 must be quite high: in case of a drastic load drop, a slow unload ramp could put the generators in a " energy reverse" condition. From version 1.06, RN200 by-passes the ramp to avoid sending the generators into an "active energy inversion" condition.

7.10.1 Active power management while supplying to the mains without generators.

If P.0808 is different from “0”, the RN200 connection bars coincide with the loads of a MC200 controller. If mains is present on this MC200, the MCB is closed and the MGCB is open, then the RN200 starts the inverters and ensures that they feed the loads, limiting only the active power to avoid exporting to the mains.

7.10.2 Active power management in island mode

If the generators and renewable sources are supplying the loads (not in parallel to the mains), the total active power is imposed by the loads themselves. RN200 calculates the active power absorbed by the loads by adding the active powers supplied by all generators and all renewable sources (all data available aver CANBUS). From this setpoint it subtracts the minimum power that must be guaranteed to the running generators (P.9811): the result is the total setpoint for all the renewable sources.

7.10.3 Active power management in parallel to the mains

This function requires the presence of an MC200 controller (or more than one). When the generators and renewable sources supply in parallel to the mains, the power setpoint is established by the MC200 controller on the basis of various criteria (BASE LOAD, IMPORT/EXPORT etc.).

RN200 subtracts from this setpoint the minimum power that must be guaranteed to the running generators (P.9811): the result is the total setpoint for all the renewable sources.

The generators (GC controllers), in the same way, subtract from the MC200 setpoint the real active power supplied by renewable sources: the difference is shared between them.

7.10.4 External setpoint

RN200 is able to accept an external active power setpoint for renewable sources. An analogue input configured with the AIF.2315 function (“Active power setpoint for renewable sources”) must be used. The analogue input is used only if there is a digital input configured with the DIF.2741 function ("Enables active power controls on the inverter") and if this input is active. **Note: a virtual analogue input can also be used: in this way it is possible to create a PLC logic that calculates this setpoint, offering maximum flexibility**.

7.10.5 Active power sharing among RN200 controllers

Several RN200 controllers can be present in a system. Each of them controls one or more inverters, of various nominal active powers. Therefore, each RN200 has a different rated active power, equal to the sum of the rated active powers of its inverters (those started).

The RN200 controllers communicate via CANBUS and are able to calculate a "total" active power setpoint (see previous paragraphs) which must be supplied from all renewable sources. This global setpoint is then automatically divided among the various RN200s, on the basis of their nominal active powers.

For example:

- RN200#1 manages inverters for total 100 kW.
- RN200#2 manages inverters for total 100 kW.
- RN200#3 manages inverters for total 50 kW.
- The power setpoint calculated for renewables (to leave a minimum power to the generators) is 100 kW.
- The setpoint for RN200 #1 will be 40 kW.
- The setpoint for RN200 #2 will be 40 kW.
- The setpoint for RN200 #3 will be 20 kW.

Each RN200 will act on its inverters to ensure that they produce this power.

However, it could happen that some RN200 is not able to supply the required power (for example because part of its solar panels are covered by clouds). Each RN200 that is unable to supply the requested power, reports it on CANBUS, and the other RN200, if possible, compensate for this situation.

Let's assume that, in the previous example, the RN200 #2 can supply a maximum of 27kW. He reports it on CANBUS and the other two RN200 will know that the total setpoint (100 kW) must be shared minus the production of the RN200 #2:

- The setpoint for RN200 #1 will be 48.66 kW.
- The setpoint for RN200 #2 will be 24.33 kW.

The total will therefore be 27 + 48.66 + 24.33 →100.

7.10.6 Active power sharing among inverters

What said in the previous chapter also applies to the individual inverters managed by an RN200. Each RN200 must divide its active power setpoint among the individual inverters. However, if some inverter is unable to produce what is requested, RN200 will compensate, making others do more (if possible).

Note: if the BROADCAST communication system is used, this optimization is not possible, because RN200 does not know the active power of each individual inverter, but only the total one. There is therefore the possibility that the total production is lower than the request, because some inverters are not able to produce as required, even if there are others that could supply more.

7.11 Reactive power management

In a mixed plant with renewable sources and generators, the aim of RN200 is to share the reactive power between generators and renewable sources (both inductive and capacitive).

Note: unlike active power, for reactive power RN200 always keeps control over the inverters, which are never free to produce all the reactive they could.

There are two operating modes, selectable with parameter P.9831.

7.11.1 Fixed power factor on generators

This mode is selected by setting the value 0 in parameter P.9831.

With parameters P.9832 and P.9833 it is possible to specify the "minimum" power factor for the generators, respectively when they are supplying (inductive) or importing (capacitive) reactive power.

This mode is normally used during island operation, but also works when working in parallel to the mains:

- Island operation: the total reactive power is imposed by the loads. RN200 calculates the total reactive power by adding the reactive power supplied/imported by all generators and all renewable sources. This value will be used as a reactive power setpoint for the whole plant.
- Parallel to mains operation. In this case, there must be at least one MC200 controller that establishes (with various methods), for the entire system, an active power setpoint and a setpoint for the power factor. RN200 calculates the total reactive power setpoint (kvar) from the two global setpoints of MC200 (the result can be a capacitive or inductive setpoint, it depends on the MC200 power factor setpoint).

  The total setpoint in kvar can be inductive or capacitive; based on this, P.9832 or P.9833 will be used as the minimum power factor for the generators.

  Then, knowing the active power supplied by the generators, RN200 can calculate the maximum reactive power that they will have to supply/import to stay within the limit set by the previous parameter: if they are importing/supplying less, RN200 maintains this value as a setpoint for the generators.

  The setpoint for the renewable sources will be the total setpoint for the plant minus the setpoint for the generators. **Note: in this way the inverters for renewable sources can also be used as power factor correctors.**

7.11.2 Reactive power sharing with generators

This mode is selected by setting the value 1 in parameter P.9831.

The inverters for the renewable sources must participate in the supply/importing of the reactive power, based on their nominal reactive power.

This mode can also be used both during the island and the parallel to the mains operations. As seen in the previous paragraph, during island operation, the total "reactive power setpoint" for the entire system is imposed by the loads; during parallel to the mains operation, instead, it is calculated starting from the active power and power factor setpoints of MC200.

Knowing this total reactive power setpoint for the system, knowing the nominal power of all generators and of all inverters, RN200 is able to calculate the total reactive power setpoint for all renewable sources, ensuring a percentage distribution of the reactive between generators and renewables themselves.

7.11.3 External setpoint

RN200 is able to accept an external reactive power setpoint for renewable sources. An analogue input configured with function AIF.2317 ("Reactive power setpoint for renewable sources") must be used. The analogue input is used only if there is a digital input configured with the DIF.2742 function ("Enable reactive power controls on the inverter") and if

this input is active. **Note: a virtual analogue input can also be used: in this way it is possible to create a PLC logic that calculates this setpoint, offering maximum flexibility**.

7.11.4 Reactive power sharing among RN200 controllers

Several RN200 controllers can be present in a system. Each of them controls one or more inverters, of various nominal reactive powers. Therefore, each RN200 has a different nominal reactive power, equal to the sum of the nominal reactive powers of its inverters (those started).

The RN200 controllers communicate via CANBUS and are able to calculate a "total" reactive power setpoint (see previous paragraphs) which must be supplied by all renewable sources. This global setpoint is then automatically divided among the various RN200, based on their nominal reactive powers. See as an example what is reported in 7.10.5

Each RN200 will act on its inverters to ensure that they produce this power.

However, it could happen that some RN200 is not able to produce the required power (for example because part of its solar panels are covered by clouds). Each RN200 that is unable to supply the required power, reports it on CANBUS, and the other RN200, if possible, compensate for this situation.

7.11.5 Reactive power sharing among inverters

What said in the previous chapter also applies to the individual inverters managed by an RN200. Each RN200 must divide its reactive power setpoint among the individual inverters. However, if some inverter is unable to produce what is requested, RN200 will compensate, making others do more (if possible).

Note: if the BROADCAST communication system is used, this optimization is not possible, because RN200 does not know the reactive power of each individual inverter, but only the total one. There is therefore the possibility that the total production is lower than the request, because some inverters are not able to produce as required, even if there are others that could supply more.

7.11.6 Reactive power management during grid delivery without generators

If P.0808 is different from “0”, the RN200 connection bars coincide with the loads of a MC200 controller. If mains is present on this MC200, the MCB is closed and the MGCB is open, then the RN200 starts the inverters and ensures that they feed the loads, limiting only the reactive power to avoid exporting/importing from the mains.

7.12 SPINNING RESERVE

Renewable sources are not considered stable and safe sources. Their production capacity is influenced by external factors (clouds, wind etc.). For this reason, they are never used alone, but always in combination with other sources of energy (generators, mains), which can integrate their production if it is not sufficient.

The production of a renewable source can also drop very quickly (for example in the case of a cloud that covers the photovoltaic panels). In these situations, there is no physical time to start up new generators to supply the loads: there is a risk of overloading the running generators and inverters, and therefore generating a black-out.

The concept of SPINNING RESERVE does this. It is basically a "power reserve" that must be guaranteed by the generators: they, as a whole, must be able to supply a further amount of active and reactive power (in addition to what they are already supplying), just as backup for sudden decreases in renewable sources.

The difficulty is to estimate the maximum drop that the renewable sources can suffer. Theoretically, they could go from maximum production to zero power in a matter of seconds. However, it is not possible to maintain a power reserve on the generators to support a total loss of renewable sources: it would mean keeping all the generators running at all times. This would be uneconomical from the point of view of fuel, but also from the point of view of the use of the renewables, which should necessarily be limited to maintain a minimum power level on the generators.

RN200 provides two parameters, which allow the operator to set a SPINNING RESERVE for the generators in two different situations:

- P.9821: used when generators and renewable sources operate in island mode.
- P.9822: used when generators and renewable sources operate in parallel to the mains.

Normally P.9822 can be set to a value lower than P.9821, because the mains should always be able to transiently supply the power "lost" from renewable sources (waiting for the start of the generators). In the reality, there may be limitations related to the power of the mains transformer.

Both parameters are expressed as a percentage of the active power supplied by renewable sources. For example, if you set P.9821 to 50%, it means estimating that, in the worst situation, renewable sources can halve their production (in the time required to start up new generators).

Example:

- Island operation with 250 kW loads.
- Parameter P.9821 is set at 50%.
- A rated 100 kW generator is running, for which a minimum supply of 50% (50 kW) is guaranteed:
  - Renewable sources are therefore supplying 250-50 → 200 kW.
  - RN200 therefore requires a SPINNING RESERVE equal to 50% of 200 kW (100 kW).
  - Generators, on the whole, must be able to supply 100 kW more than they already do (100 + 50 = 150 kW).
  - The only one running generator is not capable of supplying 150 kW: a second one will be started (assume it is 100 kW rated too).
- Two 100 kW rated generators are now running, for which a minimum power of 50% (50 kW each) is guaranteed:
  - The renewable sources are therefore supplying 250-100 → 150 kW.
  - RN200 therefore requires a SPINNING RESERVE equal to 50% of 150 kW (75 kW).
  - Generators, on the whole, must be able to supply 75 kW more than they already do (75 +50 + 50 = 175 kW).

- As a whole they can supply up to 200 kW: the power reserve is therefore satisfied.

7.12.1 External setpoint

RN200 is able to accept an external SPINNING RESERVE setpoint for the generators. An analogue input configured with function AIF.2319 ("Spinning reserve for generators") must be used.

If there is an analogue input configured with this function, it will always be used instead of parameters P.9821 and P.9822.

Note: a virtual analogue input can also be used: in this way it is possible to create a PLC logic that calculates this setpoint, offering maximum flexibility.

7.12.2 Weather forecast

By interfacing with a weather forecast system, it is possible to maintain a significantly lower SPINNING RESERVE value. In fact, large variations in the production of renewable sources can be expected with a reasonable advance: this advance gives the opportunity to safely start new generators, waiting for the drop in production.

The SPINNING RESERVE function therefore remains enabled only to manage small fluctuations in the power supplied by renewable sources.

At the moment RN200 does not support interfacing with external weather forecasting tools.

8 Anomalies

This chapter describes all the anomalies managed by the controller. Some of them act as protection for renewable sources (for inverters). Others are reports of particular events in the management of the plant. Before describing them in detail, some definitions should be given.

Two types of anomaly are defined:

- **Warnings**: these anomalies do not cause the inverters to stop. They therefore indicate situations which at the moment are not dangerous, but which must be considered because, if ignored, they could degenerate into the next category.
- **Alarms**: these anomalies cause the inverters to stop. They are dangerous for the loads and/or for the inverters. For this reason, the controller immediately opens the RNCB circuit breaker (without transferring the power from the inverters), and immediately stops the inverters. It is impossible to restart the inverters until the anomaly has reset.

If bit 0 of parameter P.0249 is set to zero, the controller uses the following logics:

- To activate an alarm, there must be no other alarms already active (there are some exceptions, they will be highlighted below). However, warnings may be present.
- To activate a warning, there must be no alarms. However, other warnings may be present.

If bit 0 of parameter P.0249 is set to one, the controller does not use the previous logics, and therefore any anomaly can be activated regardless of the presence of other anomalies.

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

- It activates the internal buzzer and, if configured, also the external one. For this purpose, in fact, it is possible to configure a digital output of the controller with the DOF.3152 ("External horn") function. The output is controlled together with the internal buzzer; the aim is to use a more powerful indicator or a lamp.
- It forces the page S.02 ANOMALIES on the multifunction display. This page shows the numeric code and the text, in the selected language, of all active anomalies. The numeric code flashes to indicate that the anomaly has not yet been recognized by the operator.
- It activates the flashing of the "ALARM" lamp, if the anomaly belongs to the warning category, or lights it steadily if the anomaly belongs to the alarm category.
- If the fault is not a warning, it disconnects the inverters from the connection bars (without power transfer) and stops the inverters.

Three operations can be performed on an anomaly:

- **Silence** the buzzer.
- **Acknowledge** the anomaly: it means indicating to the controller that the operator has taken note of it.
- **Reset** the anomaly: it means indicating to the controller to behave as if this anomaly had never been activated.

Until an anomaly has been acknowledged, it remains on the multifunctional display, even if the cause that activated it is no longer present (ISA2C sequence). The warnings are automatically cancelled by the controller (after being acknowledged) when the triggering cause is no longer present

8.1 Silencing the buzzer

The operator can silence the buzzer in three ways:

- By pressing the **ACK/ENTER** button on the controller's panel. This operation does not acknowledge the anomaly, which therefore continues to flash on the display.
- Via a digital input configured with the DIF.2002 function ("Command for acknowledging anomalies"). The acoustic signal is silenced when the input changes from "inactive" to "active.
- Using a command from the communication ports. The commands can be protected with a password (P.0004) which must be sent before each command, and can be disabled via a digital input (DIF.2706). To send the command, write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102: write "51".

Parameter P.0491 ("Horn duration") influences the management of the buzzer.

- If set to zero, the buzzer will never be activated.
- If set to 999, the buzzer will be activated when a new anomaly occurs and deactivated with the procedure described above.
- If set to a value between 1 and 998, the buzzer will be activated when a new anomaly occurs and deactivated with the procedure described above, or when the configured time has elapsed.

Silencing the buzzer does not mean recognizing the anomaly: it remains flashing on page S.02 ANOMALIES.

8.2 Acknowledging the anomalies

The operator can "acknowledge" the anomaly (ISA2C sequence) in three ways:

- By pressing the **ACK/ENTER** button on the controller's panel. **If you press this button with the buzzer on, it silences the buzzer**: you have to press it a second time to "acknowledge" the anomaly.
- Via a digital input configured with the DIF.2002 function ("Command for acknowledging anomalies"). The acoustic signal is silenced when the input changes from "inactive" to "active.
- Using a command from the communication ports. The commands can be protected with a password (P.0004) which must be sent before each command, and can be disabled via a digital input (DIF.2706). To send the command, write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102: write "52". Note: this command also silences the buzzer, if it is active.

When the anomaly has been acknowledged, it stops flashing on page S.02 ANOMALIES. After being acknowledged, if it is a warning, it is automatically cancelled if the cause is no longer present.

If, on the other hand, the cause disappears before the anomaly has been recognized, it remains on the display.

8.3 Resetting the anomalies

An anomaly can be cancelled only if the cause that triggered it is no longer present.

The warning are automatically cancelled by the controller (after being recognized) when the triggering cause is no longer present.

To cancel the alarms, instead, you need to do one of the following:

- Select the OFF/RESET mode.
- Using a digital input configured with the DIF.2001 function - "Command for resetting anomalies". When the input becomes "active", the controller performs a complete reset of all anomalies.

- Using a command from the communication ports. The commands can be protected with a password (P.0004) which must be sent before each command, and can be disabled via a digital input (DIF.2706). To send the command, write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with parameter P.0004.
  - HOLDING REGISTER 102: write “53”.
- Using an "SMS" command (see document [9]).

8.4 Events and signalling

All anomalies are recorded (with their own code) in the event log.

Some functions (related to the anomalies) are available for configuring the digital outputs:

- DOF.3151 ("reset of the anomalies"). The controller activates this output for one second when the internal anomaly reset sequence is performed. You can use this procedure to also cancel any anomalies managed externally by other devices.
- DOF.3152 (“external horn”). This output is activated and deactivated together with the internal buzzer. It can be used to control a more powerful buzzer and/or a lamp.
- DOF.3154 (“acknowledge of the anomalies”). The controller activates this output for one second when the internal anomaly acknowledgment sequence is performed. You can use this procedure to also recognize any anomalies managed externally by other devices.
- DOF.4001: the output is "active" if there is at least one warning.
- DOF.4004: the output is "active" if there is at least one alarm.
- DOF.4035: the output is "active" if there is at least one anomaly related to the circuit breaker. In the following, the list of the anomalies that activate this output:
  - 013 (“RNCB not closed”).
  - 023 (“RNCB not open”).

Furthermore, the controller makes the states of the anomalies available for AND/OR logics through the following internal states:

- ST.006: it activates for a second following an alarm acknowledgment command.
- ST.007: it activates for a second following an alarm reset command.
- ST.008: it activates if there is at least one warning.
- ST.011: it activates if there is at least one alarm.
- ST.012: it activates if there is at least one not acknowledged warning.
- ST.015: it activates if there is at least one not acknowledged alarm.

8.5 Protection OVERRIDE.

ATTENTION: the use of this function can cause serious damage. Mecc Alte cannot in any case be held responsible for malfunctions and damage to property and/or people occurring following the use of the OVERRIDE function

This term defines the ability of the controller to temporarily disable (in particular conditions and upon explicit request) a whole series of protections. The OVERRIDE function, when activated, transforms a series of alarms into simple "warnings": in this way, the controller still signals the presence of problems, but does not limit the supply capacity of the renewable sources. In some situations, in fact, the power supply for the loads is privileged to safeguard the inverters themselves.

This function can be activated with a digital input configured with the DIF.2063 function ("Full protections override"). The document [3] shows a table with all the anomalies of the controller: the "OVER" column indicates, for each anomaly, if it is subject to the OVERRIDE function.

In addition to what is shown in the table, the OVERRIDE function also influences the "generic" anomalies associated with the analogue inputs. For the protections activated through the analogue measurement thresholds, it is possible to make these anomalies subject to the OVERRIDE of the protections via bit 15 of the threshold configuration parameter (P.4005 for the first threshold on the first analogue input).

The controller shows a message on the "S.01" page when the OVERRIDE function is active (and forces the display on that page when the OVERRIDE is activated).

The controller stores an event each time an OVERRIDE request is activated (EVT.1082). In addition, it records an event in the history logs every time the OVERRIDE request cease (EVT.1083).

8.6 Anomalies related to digital inputs

The controller manages a considerable number of digital inputs, also taking into account the expansion modules (DITEL). Each input can be used to trigger anomalies. These anomalies are configured with the functions from DIF.4001 to the DIF.4028. For these anomalies, the operator must configure the message that has to be shown on the display. In addition, using the appropriate functions, the controller is instructed on how to manage the anomaly.

These anomalies will not be described in the following paragraphs, because they would be infinite repetitions of the same description for each input. Instead, they are described here, citing the parameters for input # 1 of the controller.

The controller assigns numerical codes from 701 to 774 to the anomalies related to the digital inputs (document [3] contains a table showing the code for each input). Using the parameter that configures the function (P.2001), it is possible to select the type of anomaly (warning or alarm) and also define the conditions in which the anomaly must be managed. Warning: by setting the delay to "0", the anomaly is disabled. The following list shows the functions for configuring the digital inputs used to manage anomalies. They are grouped in blocks of two: the two functions for each group define the type of anomaly (see document [3] for the list of functions).

- DIF.4001, DIF.4004. The controller activates this anomaly if the digital input remains active consecutively for the configured time (P.2002).
- DIF.4025, DIF.4028. The controller activates this anomaly if the digital input remains active consecutively for the configured time (P.2002). When one of these anomalies is active, the controller opens the RNCB circuit breaker and prevents it from being closed again.

8.7 Anomalies related to analogue inputs

The controller is able to manage a large number of analogue inputs, also considering those acquired by the DIGRIN, DITHERM and DIVIT expansion modules.

For each analogue input, it allows to set two thresholds on the acquired measurement, and each threshold can trigger an anomaly. These anomalies are generic, as the controller does not know how to handle them and does not have

predefined messages. They will not be described in the following paragraphs, because they would be infinite repetitions of the same description for each analogue input. Instead, they are described here, citing the parameters for input 1.

The controller assigns numerical codes from 301 to 554 to the generic anomalies related to the analogue inputs (document [3] contains a table showing the code for each input).

The operator must first configure the error message that will be shown on the controller's display when the anomaly is active. Must use parameter P.4002, unique for the two thresholds. The controller will add an initial text to the configured message:

- "High value:" if the anomaly is activated when the measurement is higher than the threshold.
- "Low value:" if the anomaly is activated when the measurement is lower than the threshold.

For each analogue input, six parameters are then available to manage the thresholds, three for each threshold (P.4003, P.4004 and P.4005 for the first threshold of the first analogue input; P.4006, P.4007 and P.4008 for the second threshold of the first analogue input).

In addition to the threshold value (P.4003 or P.4006) and the delay (P.4004 or P.4007), the operator must configure the operations related to the threshold (P.4005 or P.4008). The parameter that configures the actions is managed by bit (each bit enables/disables a function related to the threshold). For a description of these parameters, see 5.5.4.

⚠ Attention: setting the delay to "0" **does not disable** the anomaly.

8.8 List of the anomalies

NOTE: since without knowing the configuration it is not possible to define which digital or analogue inputs (of the controller or on the additional modules) will be used, and not even what function they will perform, in the list below we refer, by way of example, to the parameters of the first configurable input. The presence of the symbol (*) or the indication "or equivalent for the other inputs" next to a parameter indicates that it varies according to the particular input configured.

In the following, the words **enable** and **activation** will be used:

- "Enabling an anomaly" means the occurrence of the minimum conditions necessary for the controller to observe the triggering cause.
- "Activation of an anomaly" means the occurrence of the triggering cause, after successful enabling.

8.8.1 01 – Minimum voltage on renewable sources (27<<)

Typology:	**Alarm**
Related parameters:	**P.0119** Number of phases of the renewable sources' voltage. **P.0116** Nominal voltage of the renewable sources. **P.0301** Threshold for minimum voltage (27<<). **P.0302** Delay for minimum voltage (27<<). **P.0328** Apply thresholds also to phase-neutral voltages?
To disable:	**P.0302=0**
Enabled if:	**MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if at least one of the voltages of the renewable sources falls below the threshold P.0301 (percentage of P.0116) consecutively for the time P.0302.

For three-phase systems, the protection normally works on the L-L voltages: by setting P.0328 to 1, the protection also considers the L-N voltages.

This protection is subject to the OVERRIDE function.

8.8.2 02 – Maximum voltage on renewable sources (59>>)

Typology: **Alarm**

Related parameters: **P.0119** Number of phases of the renewable sources' voltage.
P.0116 Nominal voltage of the renewable sources.
P.0303 Threshold for maximum voltage (59>>).
P.0304 Delay for maximum voltage (59>>).
P.0328 Apply thresholds also to phase-neutral voltages?

To disable: **P.0304=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if at least one of the voltages of the renewable sources rises above the threshold P.0303 (percentage of P.0116) consecutively for the time P.0304.

For three-phase systems, the protection normally works on the L-L voltages: by setting P.0328 to 1, the protection also considers the L-N voltages.

This protection is subject to the OVERRIDE function.

8.8.3 03 – Minimum frequency on renewable sources (81<<)

Typology: **Alarm**

Related parameters: **P.0105** Nominal frequency.
P.0305 Threshold for minimum frequency (81<<).
P.0306 Delay for minimum frequency (81<<).

To disable: **P.0306=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if the frequency of the renewable sources falls below the threshold P.0305 (percentage of P.0105) consecutively for the time P.0306.

This protection is subject to the OVERRIDE function.

8.8.4 04 – Maximum frequency on renewable sources (81>>)

Typology: **Alarm**

Related parameters: **P.0105** Nominal frequency.
P.0307 Threshold for maximum frequency (81>>).
P.0308 Delay for maximum frequency (81>>).

To disable: **P.0308=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if the frequency of the renewable sources rises above the threshold P.0307 (percentage of P.0105) consecutively for the time P.0308.

This protection is subject to the OVERRIDE function.

8.8.5 05 – At least one GCB not open.

Typology: **Warning**

Related parameters: **P.0805** Action when there is a genset with "GCB not open"

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

This anomaly is activated when RN200 detects (from the information transmitted on the CAN bus PMCB) that at least one generator is in the "GCB not open" condition (GCB closed with open command). In this situation, through parameter P.0805 the possible actions on the RNCB circuit breaker are selected:

- “0”. The controller opens RNCB (and obviously prevents further closings).
- “1”. The controller prevents RNCB closings, but if it is already closed, does not open it.
- “2”. The “GCB not open" condition is not considered.

NB: the genset controllers have an equivalent parameter that establishes what to do on their GCB circuit breakers.

8.8.6 07 – Manual STOP command in AUTO

Typology: **Alarm**

Related parameters: **P.0495** Keyboard/display options.

To disable: **Bit 0 di P.0495=1**

Enabled if: **AUTO, REMOTE START**

The protection is enabled if bit 0 of parameter P.0495 is set to 0. It is activated if, in AUTO and REMOTE START modes, the operator presses the STOP button on the panel or if the controller receives the stop command from the communication ports or via SMS command.

8.8.7 13 – RNCB circuit breaker not closed

Typology: **Warning**

Related parameters: **P.2001** Function of the input 1 or equivalent for other inputs
P.2002 Delay for the input 1 or equivalent for other inputs

To disable: **P.2002 =0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled if the controller acquires the feedback of the RNCB circuit breaker (function DIF.3006 in parameter P.2001 or equivalent) and if the delay associated with the input is different from 0 (P.2002 or equivalent).

The controller activates the protection when it commands the closure of RNCB, but it does not close within the time associated with the input (in AUTO, the controller makes three closing attempts before activating the protection).

Note: this protection can trip even if other alarms are still active.

8.8.8 16 – Maximum current (#1)

Typology: **Warning / 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, REMOTE START.**

This anomaly is activated when at least one of the three measured currents is greater than the set threshold.

The threshold (P.9521) is set as a percentage of the rated current, configurable with parameter P.9502. The threshold can be set between 0% and 999%, with a resolution of 0.1%.

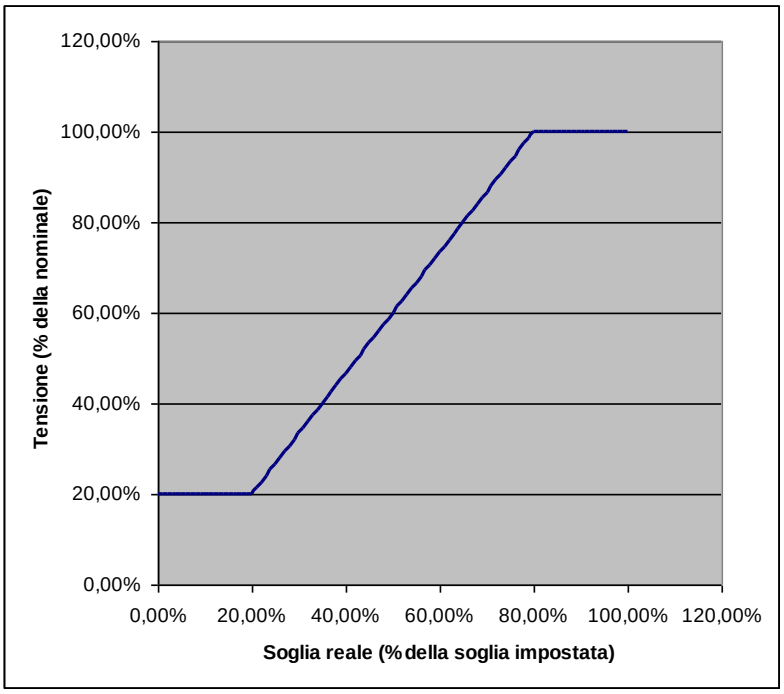
The delay (P.9522) associated with the protection can be set between 0 and 4000 seconds, with a resolution of 0.1. Setting the delay to zero disables the protection, therefore the minimum value is 0.1 seconds.

Through parameter P.9524 the type of anomaly is selected:

- 1: Warning.
- 4: Alarm.
- 9: Warning, it forces the opening of RNCB.
- 12: Alarm, it forces the opening of RNCB.

The protection can work in four different ways, selectable with the parameter P.9523:

1. This code configures fixed-time protection. The protection trips when the current on at least one phase remains above the threshold P.9521 consecutively for the time P.9522. NB: the check is made on both the instantaneous and the average current; as long as at least one of the two is above the threshold.
2. This code configures the protection as in the previous point, with the difference that the real current threshold is decreased if the reference voltage decreases:



3. This code configures a time-dependent current protection (which therefore intervenes faster the higher the current overload). The curve used is called EXTREMELY INVERSE with I^2t function.

   A maximum current value (P.9521) and a maximum time for this current (P.9522) are defined. If the current remains below the selected threshold, the protection never trips. If it rises above the threshold, it trips with a time inversely proportional to the extent of the exceedance. To establish the thresholds, proceed as follows:

- Set the system nominal current (P.9502).
- Set the maximum current threshold with parameter P.9521, as a percentage of the rated current.
- Set the trip time in P.9522: the protection will trip in the time indicated if the current is constantly equal to the threshold P.9521 multiplied by $\sqrt{2}$.

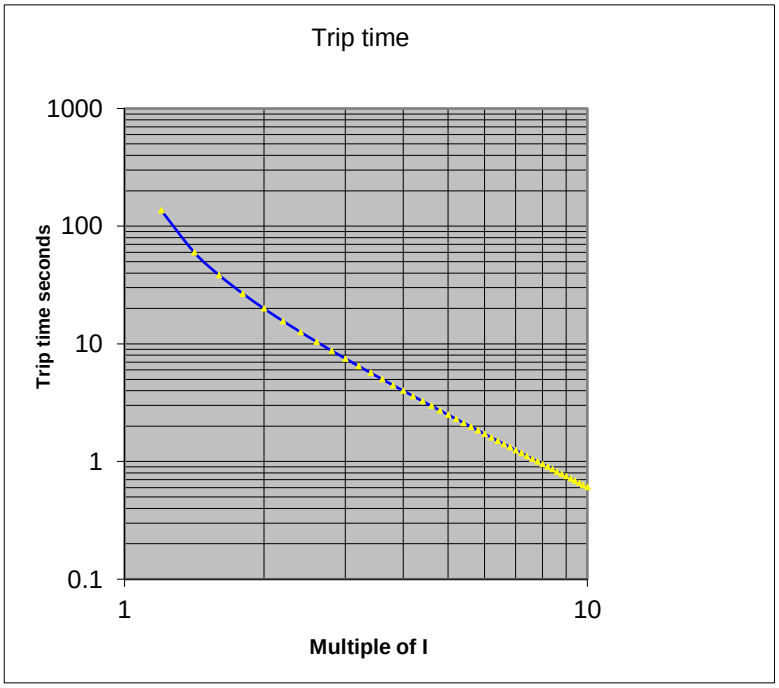
To calculate the tripping time with a given current, use the following formula:

$$t_I = \frac{P.9522}{\left(\frac{I}{P.9521}\right)^2 - 1}$$

Where *I* represents the current flowing in the circuit.

It should be remembered that the protection is carried out by integrating the value of the current over time, so that all the current values above the nominal threshold contribute to determining the tripping time, with their instantaneous weight given by the relationship shown above. The relationship can therefore be verified experimentally by instantly passing from a normal load condition to an overload condition.

Below is a graph showing the curve used by the controller to activate the protection with a value of P.9522 equal to 60 seconds (I indicates the maximum current):



4. This protection is like the previous one, with the difference that the real current threshold is decreased with respect to the one set if the reference voltage decreases (see description in point 2).

8.8.9 017 - Maximum current (#2)

Typology: **Warning / 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, REMOTE START.**

The same applies to anomaly "016", using the parameters of this protection.

8.8.10 21 – Inverters not stopped

Typology: **Warning**

Related parameters: **P.9512 Maximum time for stopping inverters (s)**

To disable: **P.9512 = 0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if, following a stop command, one or more inverters do not stop within the time configured in P.9512 (from the stop command).

The "inverter started/stopped" status is acquired directly from the inverter via Modbus; **if the BROADCAST communication mode is used, this warning will never be activated because the RN200 does not receive the "start/stop" status from the inverters.**

8.8.11 22 – Inverters not started

Typology: **Warning**

Related parameters: **P.9511 Maximum time for starting inverters (s)**

To disable: **P.9511 = 0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if, following a start request, no inverter has started within the time configured in P.9511 (from the start command).

The "inverter started/stopped" status is acquired directly from the inverter via Modbus; **if the BROADCAST communication mode is used, this warning will never be activated because the RN200 does not receive the "start/stop" status from the inverters.**

8.8.12 23 – RNCB circuit breaker not open

Typology: **Warning**

Related parameters: **P.2001** Function of the input 1 or equivalent for other inputs
P.2002 Delay for the input 1 or equivalent for other inputs

To disable: **P.2002 =0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled if the controller acquires the feedback of the RNCB circuit breaker (function DIF.3006 in parameter P.2001 or equivalent) and if the delay associated with the input is different from 0 (P.2002 or equivalent).

The controller activates the protection when it commands the opening of RNCB, but it does not open within the time associated with the input (in AUTO, the controller makes three opening attempts before activating the protection).

Note: this protection can trip even if other alarms are still active.

8.8.13 37 – Low power supply voltage

Typology: **Warning**

Related parameters: **P.0362** Low power supply voltage threshold. (%)
P.0363 Low power supply voltage delay

To disable: **P.0363 = 0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if the power supply voltage remains below the threshold P.0362 consecutively for the time P.0363. The threshold is expressed as a percentage with respect to the nominal supply voltage, which cannot be set but is automatically selected by the controller between 12 and 24 VAC. The selection is made when the controller is powered

and every time the operating mode is changed to OFF/RESET. The controller considers to be powered by 12V if in the previous situations it measures a voltage on the power supply not higher than 17V, otherwise it considers a nominal voltage of 24V.

8.8.14 38 – High power supply voltage

Typology: **Warning**

Related parameters: **P.0364** High power supply voltage threshold (%)
P.0365 Delay for emergency button

To disable: **P.0365 = 0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if the power supply voltage remains above the threshold P.0364 consecutively for the time P.0365. The threshold is expressed as a percentage with respect to the nominal supply voltage, which cannot be set but is automatically selected by the controller between 12 and 24 VDC. The selection is made when the controller is powered and every time the operating mode is changed to OFF/RESET. The controller considers to be powered by 12V if in the previous situations it measures a voltage on the power supply not higher than 17V, otherwise it considers a nominal voltage of 24V.

8.8.15 45 - Maximum auxiliary current

Typology: **Alarm**

Related parameters: **P.0109** Transformer type for auxiliary current.
P.0130 Connection for auxiliary current.
P.0108 Primary of C.T. or toroid ratio for auxiliary current
P.0135 Secondary of C.T. or toroid for auxiliary current
P.0131 Usage of auxiliary current
P.0367 Maximum auxiliary/neutral current threshold
P.0368 Maximum auxiliary/neutral current delay

To disable: **P.0368 =0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled if a valid current measurement is configured. Specifically, P.0108 and P.0109 must both be non-zero, and P.0131 must be set to one or two. The protection can also be disabled through a digital input configured with the DIF.2704 function ("Disables protections on the 4th current"): if the digital input exists and is active, the protection is disabled.

The protection is activated if, in the previous conditions, the current measurement remains higher than the threshold P.0367 consecutively for the time P.0368.

This protection is subject to the OVERRIDE function.

8.8.16 48 – Emergency stop

Typology: **Alarm**

Related parameters: **P.0361** Delay for emergency button

To disable: **-**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if, in the previous conditions, the input dedicated to the emergency stop (JJ_2) remains not active consecutively for the configured time (P.0361).

Note: this protection can trip even if other alarms are still active.

8.8.17 51 – High controller temperature

Typology: **Warning**

Related parameters: **P.0366** High board temperature threshold

To disable: **P.0366 = 255 (maximum value)**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if the internal temperature rises above the P.0366 threshold, even for a single instant.

8.8.18 52 – Voltage unbalance on renewable sources (47)

Typology: **Alarm**

Related parameters: **P.0119** Number of phases of the renewable sources' voltage.
P.0116 Nominal voltage of the renewable sources.
P.0315 Threshold for voltage unbalance (47)
P.0316 Delay for voltage unbalance (47)
P.0328 Apply thresholds also to phase-neutral voltages?

To disable: **P.0316 =0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is enabled only for three-phase systems (P.0101=3). It is activated when the difference between any two L-L voltages exceeds in absolute value the threshold P.0315 (percentage of P.0116) consecutively for the time P.0316. By setting P.0328 to 1, the protection also considers the unbalances of the L-N voltages.

This protection is subject to the OVERRIDE function.

8.8.19 56 – Low voltage on renewable sources (27<)

Typology: **Warning**

Related parameters: **P.0119** Number of phases of the renewable sources' voltage.
P.0116 Nominal voltage of the renewable sources.
P.0391 Threshold for low voltage (27<)
P.0392 Delay for low voltage (27<)
P.0328 Apply thresholds also to phase-neutral voltages?

To disable: **P.0392=0**

Enabled if: **MAN, AUTO, REMOTE START**

Protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if at least one of the voltages of renewable sources falls below the threshold P.0391 (percentage of P.0116) consecutively for the time P.0392.

For three-phase systems, the protection normally works on the L-L voltages: by setting P.0328 to 1, the protection also considers the L-N voltages.

8.8.20 57 – Clock not valid

Typology: **Warning**

Related parameters: **P.0421** Weekly work calendar.
P.0422 Work start time.

P.0423 Work stop time.
P.0426 Weekly REMOTE START calendar.

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if the controller detects the status of " clock not valid" and there are functions that use the clock, such as the work enable time (P.0421, P.0422, P.0423), the time forcing intervention (P.0426, P.0427 and P.0428) or the configurable calendars

To disable it, set the clock.

8.8.21 58 – Low frequency on renewable sources (81<)

Typology: **Warning**

Related parameters: **P.0105** Nominal frequency.
P.0395 Threshold for low frequency (81<).
P.0396 Delay for low frequency (81<).

To disable: **P.0396=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if the frequency of renewable sources falls below the threshold P.0395 (percentage of P.0105) consecutively for the time P.0396.

8.8.22 59 - High voltage on renewable sources (59>)

Typology: **Warning**

Related parameters: **P.0119** Number of phases of the renewable sources' voltage.
P.0116 Nominal voltage of the renewable sources.
P.0393 Threshold for high voltage (59>).
P.0394 Delay for high voltage (59>).
P.0328 Apply thresholds also to phase-neutral voltages?

To disable: **P.0394=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if at least one of the voltages of the renewable sources rises above the threshold P.0393 (percentage of P.0116) consecutively for the time P.0394.

For three-phase systems, the protection normally works on the L-L voltages: by setting P.0328 to 1, the protection also considers the L-N voltages.

This protection is subject to the OVERRIDE function.

8.8.23 60 – High frequency on renewable sources (81>)

Typology: **Warning**

Related parameters: **P.0105** Nominal frequency.
P.0397 Threshold for high frequency (81>).
P.0398 Delay for high frequency (81>).

To disable: **P.0398=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled only if the RNCB circuit breaker is closed, and the inverters are running. It is activated if the frequency of the renewable sources rises above the threshold P.0397 (percentage of P.0105) consecutively for the time P.0398.

8.8.24 62 –Can Bus o (EXBUS) link fault

Typology: **Warning**

Related parameters: -

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled. It is activated if the internal CAN controller goes into the BUS-OFF state due to communication errors on the bus.

8.8.25 198 – Warnings (yellow lamp) from external devices

Typology: **Warning**

Related parameters: -

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled. It is activated if an external device (inverter) signals the presence of a warning.

8.8.26 199 – Alarms (red lamp) from external devices

Typology: **Warning**

Related parameters: -

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled. It is activated if an external device (inverter) signals the presence of an alarm.

8.8.27 200 –Can Bus 1 (PMCB) link fault

Typology: **Warning**

Related parameters: -

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled. It is activated if the internal CAN controller goes into the BUS-OFF state due to communication errors on the bus.

8.8.28 201 – Duplicated address on Can Bus 1 (PMCB)

Typology: **Warning**

Related parameters: **P.9501** Controller address for PMCB.

To disable: -

Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled. It is activated if two or more RN200 controllers connected on PMCB have the same address (configured in P.9501).

8.8.29 211 – 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 [4].

8.8.30 252 – Missing expansion module on Can Bus (EXBUS)

Typology: **Warning**

Related parameters: **P.0141** Number of DITEL modules.
P.0142 Number of DITEMP modules.
P.0143 Number of DIVIT modules.
P.0144 Number of DANOUT modules.

To disable: **P.0141=0** and **P.0142=0** and **P.0143=0** and **P.0144=0**

Enabled if: **MAN, AUTO, 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 other than zero).

It is activated if one or more modules configured with the previous parameters are not communicating on the Can Bus. On page S.02, by selecting this warning, the controller shows which module is not communicating.

8.8.31 253 – Missing measure on Can Bus (EXBUS)

Typology: **Warning**

Related parameters: **P.0142** Number of DITEMP modules.
P.0143 Number of DIVIT modules

To disable: **P.0142=0** e **P.0143=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled if the Can Bus for the expansion modules is activated (P.0142 or P.0143 other than zero).

It is activated if the controller does not receive an analogue measurement from the Can Bus. The controller verifies the presence of only the analogue measurements really used (those that have a function other than zero in parameter P.4131 or equivalent for the other analogue inputs). On page S.02, by selecting this warning, the controller shows which channel of which module is not making the measurement.

8.8.32 254 – Duplicated address on Can Bus (EXBUS)

Typology: **Warning**

Related parameters: **P.0141** Number of DITEL modules.
P.0142 Number of DITEMP modules.
P.0143 Number of DIVIT modules.
P.0144 Number of DANOUT modules.

To disable: **P.0141=0** e **P.0142=0** e **P.0143=0** e **P.0144=0**

Enabled if: **MAN, AUTO, 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 other than zero).

It is activated if two or more expansion modules are configured with the same address. On page S.02, selecting this warning, the controller shows which module has the duplicate address.

8.8.33 255 – Sensor failure on expansion module on Can Bus (EXBUS)

Typology: **Warning**

Related parameters: **P.0142** Number of DITEMP modules.
P.0143 Number of DIVIT modules

To disable: **P.0142=0** e **P.0143=0**

Enabled if: **MAN, AUTO, REMOTE START**

The protection is enabled if the Can Bus for the expansion modules is activated (P.0142 or P.0143 other than zero).

It is activated if a DIGRIN, DITHERM or DIVIT module signals the "sensor disconnected" condition. On page S.02, selecting this warning, the controller shows which channel of which module the sensor has disconnected.

8.8.34 273 – Incoherent parameters

Typology: **Warning/Alarm**
To disable: **-**
Enabled if: **MAN, AUTO, REMOTE START**

The protection is always enabled.

It is activated if the system configuration parameters are not consistent with each other and/or the defaults of all parameters have been reloaded. On page S.02, selecting this anomaly, the controller shows a description of the problem.

8.8.35 279 – Connection bars voltage not coherent

Typology: **Warning**
Related parameters: -
To disable: **bit 7, P.0249 = 1**
Enabled if: **MAN, AUTO, REMOTE START**

The controller activates this warning if it detects a discrepancy between the real presence of voltage on the connection bars and what would be expected based on the states of the circuit breakers, voltage sources and any other controllers connected on PMCB. The anomaly is activated only if there is no voltage on the bars when it should be. For example, if at least one generator has the GCB closed, there must be voltage on the connection bars: if the controller does not detect it (via the three-phase sensor or via a contact), after two seconds it activates the warning.

8.8.36 301...554 – Generic anomalies related to analogue inputs

See 8.7.

8.8.37 701...774 - Generic anomalies related to digital inputs

See 8.6.

8.8.38 900 – PLC parameters not coherent

Typology: **Warning**
Related parameters: -
To disable: **-**
Enabled if: **MAN, AUTO, REMOTE START**

The Protection is enabled only if a valid PLC program has been transferred to the controller. It reports possible problems in the execution of the PLC:

- The PLC program uses more FLASH memory than is available.

- The PLC program uses more RAM than is available.
- The PLC program has an invalid check-sum.
- The PLC program is developed with a version not supported by this controller.
- A digital or analogue output driven by the PLC is not configured with the DOF.0101 or AOF.0101 function ("used by the PLC").
- The PLC program uses a resource (of any type) not available on this controller (for example, a digital input of an expansion module not connected).
- An invalid parameter was specified for one of the PLC blocks.
- An invalid block type was specified.
- Calculation error during program execution.

On the S.02 page, selecting this warning, the controller shows additional information to help solve the problem.

8.8.39 901...964 – Anomalies activated by the PLC

The PLC program, through one of its blocks, is able to activate anomalies. The codes from 901 to 964 are associated with these anomalies. The anomalies activated by the PLC can be alarms or warnings.

9 Other functions

9.1 PLC logics

RN200 provides a PLC environment (acronym for "Programmable Logic Controller"), which performs a sequence of functions previously loaded in a special memory.

Use the " Mecc Alte PlcEditor" software to build and compile the PLC program. The same software can also be used to transfer the PLC program to and from the controller; it also works in real time, allowing the debugging of the PLC program itself. To transfer the PLC program to and from the controller, you can alternatively use the BoardPrg3 software.

The PLC program runs every 100ms. This time may not be adequate to manage protections that must intervene very quickly.

9.2 Clock/calendar

The controller is equipped with a hardware clock/calendar. It is shown in detail on page S.03. It can be configured from menu 4.7.1 or from the communication ports, and is used for various functions:

- Recordings on history logs.
- Weekly planning of the periods in which RN200, in AUTO mode, **can** use the inverters.
- Weekly planning of the periods in which RN200, in AUTO mode, **must** use the inverters (even in the presence of start inhibitions).

The clock is equipped with a rechargeable backup battery and is able to remain updated for a few months even if the controllers remains unsupplied. After a very long period of non-use of the controller (without power), even if the clock is immediately reactivated as soon as it is re-powered, it takes a few hours to ensure full recharging of the internal battery.

9.2.1 Automatic update of the clock/calendar.

In the controller is connected to an Ethernet network, the clock/calendar can be automatically updated by connecting to an NTP server (see par. 5.12.4). The controller stores the event "EVT.1076 - Date and Time modified" in the history log, only if the difference between the new received time and the current one is greater than one minute.

The NTP server (queried by the controller every 5 minutes) returns the date and time of the reference time zone (i.e. of the UTC time "Coordinated Universal Time") from which the controller can calculate and update the internal date taking into account its own time zone and possible summer time. The following parameters are available for this:

- P.0409: Daylight Save Time mode.
- “0-No” summer time not in effect (leave time unchanged).
- “1-Si” summer time in effect (adds one hour to the one received).
- “2-Automatic (only Europe)”: automatically calculates whether summer time is in effect or not. Applies only to Europe as it has been unified since 2002 (activated at 02:00 on the last Sunday in March and deactivated at 02:00 on the last Sunday in October).
- “3-Automatic (from calendar)”: automatically calculates whether summer time is in effect or not based on the status of calendars 15 and 16 appropriately configured for the country
- P.0408: Daylight Save Time offset (1=15 min., 4= 1 hour). It establishes the difference between summer time and standard time, expressed in quarters of an hour. In practice, the value 4 indicates that there is a difference of one hour between summer time and standard time

- P.0410: Time Zone x4 (-47...+48) (1=15 min., 4=1 hour). The setting limits are from -47 to + 48 and allow you to manage all time slots on Earth with the resolution of the quarter of an hour.

9.2.2 Weekly planning of the working timer of the inverters.

In some applications, it may be useful to inhibit the automatic operation of the inverters at times or days where they are not necessary. For example, if there is no one on Sunday in a factory, it is useless to start the inverters (as well as the generators). This function is used to establish on which days and in which time bands the inverters can be used. The planning is weekly. In addition to the days, it is possible to establish a single time band, which will be common to all the selected days.

The parameters that allow making these configurations are:

- **P.0421**: allows to specify the days. It is a bit configurable parameter; each bit corresponds to a day of the week. To obtain the value for the parameter, add the "value" field of the following table for the days concerned.

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 set the beginning of the time-band in which inverters can be used, in hours and minutes.
- **P.0423**: allows to set the end of the time-band in which inverters can be used, in hours and minutes.

Normally P.0422 will be set to a value lower than P.0423. If, on the other hand, it contains a greater value, the controller assumes that the selected band is across midnight: in this case the time set in P.0422 refers to the days selected with P.0421, while the time set in P.0423 refers to the following days.

For example, if you want to enable the use of the inverters from Monday to Friday from 08:00 to 18:00, you need to set:

P.0421 = 3E (02+04+08+10+20)

P.0422 = 08:00

P.0423 = 18:00

9.2.3 Weekly planning of intervention forcing.

The planning of the intervention forcing is done weekly. That is, it is possible to indicate on which days of the week the inverters must be started, even if the conditions of the plant do not require their use. In addition to the days, it is also possible to specify from what time to what time the inverter must be used. This time slot is unique for all the selected days.

The parameters that allow making these configurations are:

- **P.0426:** allows to specify which days of the week the inverters must be started. It is a bit configurable parameter; each bit corresponds to a day of the week. To get the value for the parameter, add the value fields (hexadecimal) of the following table for the days concerned.

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

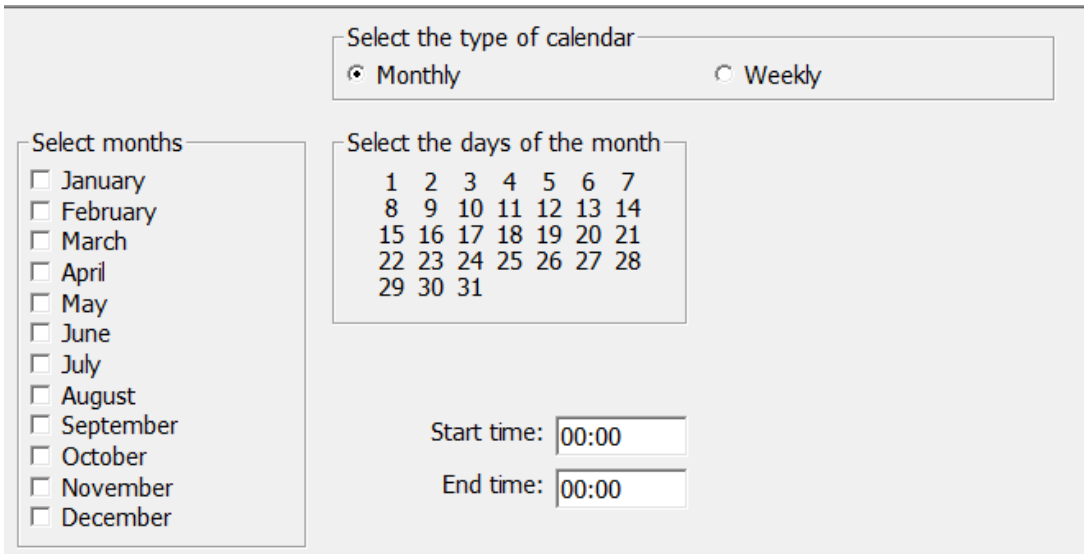
For example, to force the inverter working on Monday and Thursday, set 12 (10 + 02).

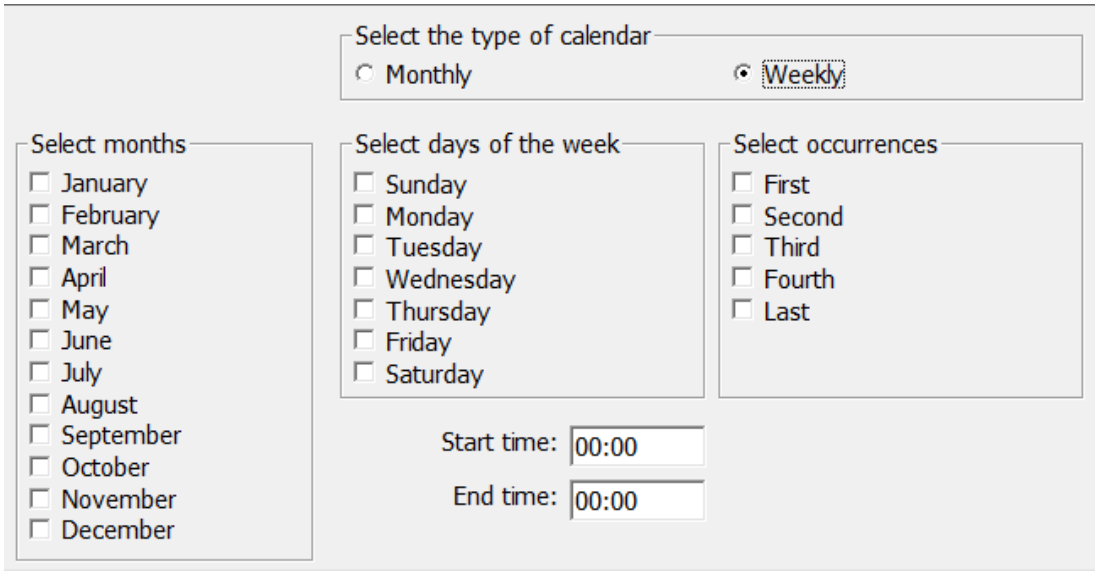
- **P.0427:** allows you to set the start time of the forcing band (in hours and minutes).
- **P.0428:** allows you to set the end time of the forcing band (in hours and minutes).

9.2.4 Configurable calendars

The controller provides 16 fully configurable calendars. They allow to select days and time slots, within which the controller activates an internal bit. This bit can then be used by the AND/OR logics to activate outputs or to create more complex logic. The calendars are all identical to each other: calendars 15 and 16 can however be linked to the activation and deactivation of summer time (if P.0409 is set to "3").

For each calendar it is possible to select the monthly or weekly mode:





Using the BoardPrg3 software, the selection between "weekly" and "monthly" is intuitive. If the controller's parameters are used, then it is necessary to act on parameter P.1900. It is a bit-settable parameter, and a 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 associated with the bits to be activated (in hexadecimal). If the bit relating to a calendar is set to "0" then the calendar is "monthly", otherwise it is "weekly".

Both types of calendar allow you to select in which months of the year the internal bit will be activated (at least one month must be selected, you can also choose all of them). Using the parameters of the controller, this selection is made with parameter P.1901 (for calendar 1 or equivalent for the other calendars). This is also a bit parameter:

BIT	Valore	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 associated with the months to be activated (in hexadecimal).

For "monthly" calendars it is then possible to select which days of the month the internal bit will be activated (at least one day must be selected, you can also choose all). Using the parameters of the controller, this selection is made with parameter P.1902 (for calendar 1 or equivalent for the other calendars). This is also a bit parameter:

BIT	Value	Hexadecimal	Day
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 associated with the days to be activated (in hexadecimal).

For "weekly" calendars it is then possible to select which days of the week the internal bit will be activated (at least one day must be selected, you can also choose all). Using the parameters of the controller, this selection is made with parameter P.1902 (for calendar 1 or equivalent for the other calendars). This is also a bit parameter:

BIT	Value	Hexadecimal	Day
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 associated with the days to be activated (in hexadecimal).

By selecting a day of the week (for example Sunday), it is then possible to indicate to the controller whether you want to use all the Sundays of the month or only some of them. Using the parameters of the controller, this selection is made with parameter P.1902 (for calendar 1 or equivalent for the other calendars). This is also a bit parameter:

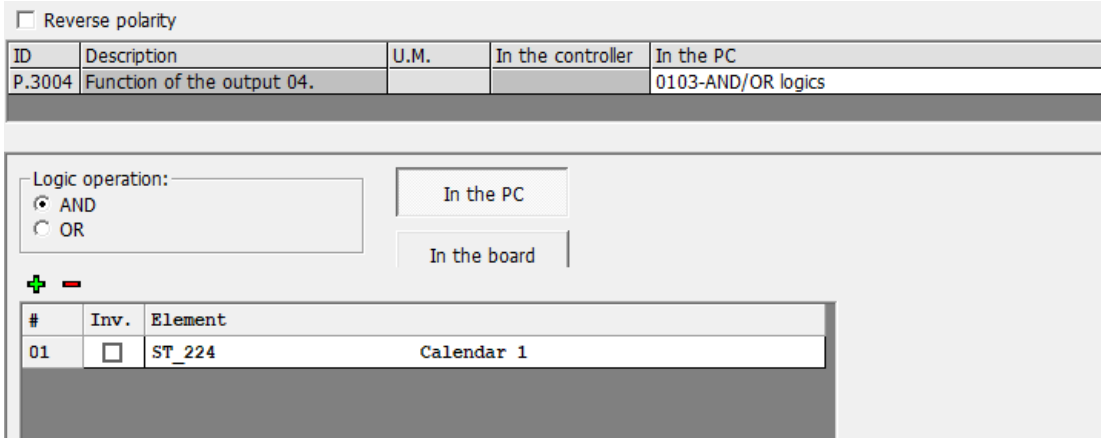
BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence
3	8	00000008	Fourth occurrence
4	16	00000010	Last occurrence

The parameter must be set with the sum of the values associated with the occurrences to be activated (in hexadecimal). **Note: for weekly calendars the days of the week and the occurrences in the month are configured on the same parameter, with different bits.**

If these bits are all zero, then the selected days will be valid in any week of the month, otherwise they will be valid only in the selected occurrences. The "last occurrence" option is useful because, depending on the month and year, a given day of the week can repeat 4 or 5 times within the month: in this way, regardless of the month, you can make an action linked to the last occurrence of that day in the month. A classic example is the management of summer time, which in Italy must be activated on the last Sunday of October and must be deactivated on the last Sunday of March: these Sundays can be the 4th or 5th Sunday of the month based on the start day of the month. Selecting the "last occurrence" option solves the problem.

Finally, both for "weekly" and "monthly" calendars, it is possible to establish a time slot, valid for all the selected days. The controller will activate the internal bit only within the selected time slot. Using the parameters of the controller, this selection is made with parameters P.1903 and P.1904 (for calendar 1 or equivalent for the other calendars). Setting them to the same value selects the whole day. If the starting time is less than the final time, then the selected time range is not across midnight; otherwise the bit is activated after the initial time of the selected days and is deactivated after the final time of the days following the selected days.

Using the AND/OR logics, it is possible to command an output based on the days/hours selected with a calendar:



If you want to manage summer time in Italy, you have to use the calendars 15 and 16 configured as follows:

- Calendar 15.
  - Select “weekly” (bit 14 di P.1900 = “1”).

- Last Sunday of October:
  - Select “October” (P.1957 = “0200”).
  - Select “Sunday”, “Last” (P.1958 = “00010010”).
- The time change takes place at 02:00:
  - Set “2:00” as start timer (P.1959).
  - Set “2:01” as end timer (P.1960).
- Calendar 16.
- Select “weekly” (bit 15 di P.1900 = “1”).
- Last Sunday of March:
  - Select “March” (P.1961 = “0004”).
  - Select “Sunday”, “Last” (P.1962 = “00010010”).
- The time change takes place at 03:00:
  - Set “3:00” as start timer (P.1963).
  - Set “3:01” as end timer (P.1964).

9.3 Thermometer

The controller is equipped with a hardware thermometer, for detecting the temperature inside. The temperature is shown on page S.03 of the multifunctional display. It is used for various functions:

- At very low temperatures, the display becomes slow in showing information. Taking advantage of the thermometer, when the temperature drops below a very low threshold, the controller always keeps the backlight lamp on, which helps to heat the display and therefore improve its efficiency.
- The electronic components inside the controller have a very wide working temperature range. Despite this, it is still possible, in critical environmental conditions, that the temperature leaves this working range. The controller uses the thermometer to activate a warning if the internal temperature rises above a threshold configurable with parameter P.0366. This is already used to alert the operator, but it is also possible, using the AND/OR logic, to activate an output when the warning is active, which can then be used to activate cooling mechanisms.

9.4 Counters

The controller internally manages the following counters:

- Resettable total active energy meter (kWh) produced from renewable sources.
- Total active energy meter (kWh) produced from renewable sources.
- Resettable total reactive energy meter (kvarh) produced from renewable sources.
- Total reactive energy meter (kvarh) produced from renewable sources.

Almost all of these counters can be viewed on the front panel of the controller. All are however readable through the communication ports (with the Modbus protocol). Some of these meters can be reset by the operator with an appropriate procedure or through the communication ports. All these counters are saved in a non-volatile memory and therefore retain their value even by removing power from the controller. Since non-volatile memories are "consumed" by writing them, it is necessary to minimize the writes. For this reason, a meter is not always immediately saved when

its value changes, and it is therefore important to know when they are saved and how to be sure they are before removing power from the controller.

The counters are saved (all together and simultaneously) in the following conditions:

- Whenever you put the controller in OFF_RESET.
- Once per hour.

They are also saved when they are reset (individually or globally) from the front panel or from the communication ports. It is however sufficient to put the controller in OFF-RESET to force a save, before removing the power supply.

9.4.1 Clearing the counter

The reset procedure is common to all meters but only acts on some of them according to the page shown on the multifunctional display. See paragraph 6.5.4.7 for the description of the display page which contains the counter to be reset.

9.5 Non-volatile memory

The controller has a non-volatile memory inside (which does not require any power), used to store various information such as parameters, counters and more. Memory is divided into various areas. When the controller is powered, it checks the data stored in each zone: if even one zone is incorrect, an error message is shown on the display. This message contains a numeric code (expressed in hexadecimal notation); each set bit of this code corresponds to an invalid memory zone. Below is a table with the zones and their bits.

Zone	Version	Bit	Value	Description
1	1.00	0	0001	Coefficients for the calibration of the measurement inputs of the controller.
2	1.00	1	0002	Various information (selected language, contrast of the LCD display).
3	1.00	2	0004	Counters.
4	1.00	3	0008	Historical archive of the diagnostic codes of external devices.
5	1.00	4	0010	Historical archive of the maximum peaks.
6	1.00	5	0020	Setpoints for the PLC.
7	1.00	6	0040	Parameters.
8	1.00	7	0080	Unique ID of the controller.
9	1.00	8	0100	Unique MAC address of the controller’s Ethernet port
10	1.00	9	0100	Parameters in text format (Es. configurable messages related to the inputs)

If for example the value between the parentheses was "0004", it means that only the counters area is not valid. If the value was “0101” it means that the parameter zone (0100) and the calibration zone (0001) are not valid.
If any zone is not valid, the normal operating sequences are not performed until the operator presses the "ENTER+ESC" keys: it is, in fact, necessary to take note of the situation because it could cause malfunctions (think for example if the invalid zone was the parameters one). Only when the operator presses "ENTER+ESC", the controller reloads the factory defaults for the data stored in the invalid zones: this means that if the controller is turned off without pressing "ENTER+ESC", the next time it is turned on you will get the bad memory message again.

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