MarelliMotori
Powering the future®

MEC-100

Digital Voltage Regulator

MANUALE DELL'UTENTE
USER MANUAL
MANUEL UTILISATEUR
BENUTZERHANDBUCH
MANUAL DELL'USUARIO

963857137_M

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ENGLISH

INTRODUCTION

This document provides general installation and operating instructions for the Marelli Motori MEC-100 regulator. Before starting the generator and performing any kind of operation on the regulator, carefully and thoroughly read the instructions contained in this Technical Note.

IMPORTANT NOTE: This document is not intended to cover all the possible application or installation variants, nor to provide data and information regarding all possible circumstances. The wiring diagrams supplied along with the generator, its User and Maintenance Manual and any additional information provided by qualified Marelli Motori technicians complement this Note and are an integral part of it.
In particular, the diagrams included in this document only provide an example of the device connection and operation modes; they do not cover all the possible applications and do not replace the wiring diagrams normally supplied along with the generator.
Should you need any further information about the application, please contact Marelli Motori Services.

INSTALLATION - SAFETY CAUTIONS

WARNING: Marelli Motori recommends the initial start-up of a plant with MEC-100 regulation unit is carried out by Marelli Motori Services and/or skilled personnel, strictly in accordance with the provided connection diagrams. Any amendments to such diagrams must be either made or approved by Marelli Motori. Marelli Motori is under no liability for any damages which may occur to the AVR, the plant or the persons, or for lost earnings, or financial loss, or system stoppages, due to diagrams' modifications not previously approved by Marelli Motori itself.

WARNING: DO NOT TOUCH THE REGULATOR BOARD WHEN IT IS POWERED.
When the regulator board is powered (that is, when the machine is running) the upper section of the device (connection side) and all the parts electrically connected to it are subject to a voltage that can be lethal to human beings. The board also includes components that during normal operation may reach high temperatures, which are dangerous to human beings in case of direct contact.

Any operation on the wiring and/or any mechanical installation of the regulator must be performed by qualified and informed personnel, with the generator stopped and after waiting for the regulator components to reach a temperature that poses no danger to people safety.

Marelli Motori accepts no liability for any damages to the regulator, to the installations or to people, or for any loss of earnings/money, or for any downtime due to failure to comply with the safety and/or installation/operating instructions contained in this Technical Note.

REVISION HYSTORY

Part Number M71FA300A (out of production)

	Version	Date	Change
Hardware	1st series	07/07	Initial release
	2nd series	09/07	Revised current sensing
	3rd series	09/08	Revised surge suppressors
Firmware	1.01	07/07	Initial release
	1.02	10/07	Improvements to Underfrequency Limiter options
	1.03	08/08	Improvements to transient performances from parallel operation to single unit operation
	1.04	09/08	Decreased time delay of contact PF/VAR
	1.05	10/08	Reviewed START contact
Software	1.0 v5	07/07	Initial release
	1.0 v6	09/07	Added Italian and English language User Manuals
	1.0 v7	11/07	Added auxiliary input display
	1.0 v8	03/08	Revised English language version

Part Number M71FA310A - M71FA320A

	Version	Date	Change
Hardware	3rd series	03/09	Initial release
	3rd series v1	10/12	Improvements to STOP contact
	3rd series v2	01/14	Improvements to IGBT improved
Firmware	2.01	03/09	Initial release
	2.02	12/16	Correction of a bug in the assignment of the output relays to protections
	2.10	06/17	New features of the underexcitation limiter New features of the Droop Compensation function
Software	3.0 v2	03/09	Initial release
	3.0 v3	08/09	New printing tool
	3.0 v4	09/15	Predefined PID settings
	3.0 v6	06/17	Software implementation for new 2.10 firmware features

MEC-100 Series - Software compatibility – Part Numbers

RELEASE	M71FA300A	M71FA310A	M71FA320A
1.0 v5	●	-	-
1.0 v6	●	-	-
1.0 v7	●	-	-
1.0 v8	●	-	-
3.0 v2	-	●	●
3.0 v3	-	●	●
3.0 v4	-	●	●
3.0 v6	-	●	●

1. GENERAL INFORMATION

1.1. INTRODUCTION – MEC-100 SERIES

The Marelli Motori Digital Regulation Systems included in MEC-100 series are microprocessor-based electronic devices for the set-up and monitoring of the excitation system of Marelli Motori generators.
The configurability of the system and control parameters makes the MEC-100 series regulators flexible and suitable for a wide range of applications. These regulators are completely resin-bonded and isolated to keep a high operating reliability even in difficult working conditions (high levels of humidity, dust, salty atmosphere) and in presence of vibrations.

1.2. MEC-100 SERIES CHARACTERISTICS

1.2.1. Functions

- Four operating modes:
  - Automatic voltage regulation (AVR Mode).
  - Power Factor Regulation (PF Mode).
  - Reactive Power Regulation (VAR Mode).
  - Field Current Regulation (FCR Mode).
- Stability parameters which can be individually set (P.I.D.) or predefined standard parameterizations.
- Soft start with a ramp which can be set, in AVR Mode.
- Generators parallel operation by means of Reactive Droop Compensation.
- Generator protections:
  - Field over-voltage.
  - Field over-current.
  - Generator over-voltage.
  - Generator under-voltage.
  - Generator over-current.
  - Loss of voltage sensing.
  - Diode Failure Monitoring.
- Excitation limiters (over-excitation and under-excitation).
- Under-frequency limiter.
- Internal Inrush Current limiter.

1.2.2. Inputs

- Generator voltage single-phase or three-phase sensing.
- Current sensing on single phase (1A or 5A).
- Network voltage single-phase sensing.
- 2 auxiliary analogue inputs (4-20mAdc) for the setpoint remote control.
- 8 contacts for external interface.

1.2.3. Outputs

- PWM output up to a maximum of 10A in continuous current.
- 2 programmable output relays for signalling the occurred alarm.

1.2.4. Human-Machine Interface

- An RS-232 communication port to interface with PC through MEC-100 Interface System software.
- MEC-100 Interface System software for Windows® to set the generator adjustment and control parameters.

1.3. DEVICE SELECTION

The part number and the name, together with the proper suffix, describe the options included in the specific device. Here below the selection table:

OPTIONS GUIDE			Vieux No. Pièce
FEATURE	**M71FA310A**	**M71FA320A**	**M71FA300A**
AVR mode	●	●	●
FCR mode	●	●	
PFR mode	●	●	●
VAR mode	●	●	●
P.I.D. setup	●	●	●
Soft start	●	●	●
Reactive droop compensation	●	●	●
Field overvoltage	●	●	●
Field overcurrent	●	●	●
Generator overvoltage	●	●	●
Generator undervoltage	●	●	●
Generator overcurrent	●	●	●
Loss of sensing	●	●	●
Diode monitoring		●	
Overexcitation limiter	●	●	●
Underexcitation limiter	●	●	●
Underfrequency limiter	●	●	●
Internal Inrush Current Lim.	●	●	●
2 analog inputs 4-20mA	●	●	●
8 digital inputs	●	●	●
Human Machine Interface	●	●	●

STYLE NUMBER SELETION

DEVICE MODEL	NAME	SUFFIX	PART NUMBER
Basic	MEC-100	B	M71FA310A
With diode monitoring (DM)	MEC-100	D	M71FA320A

Example: to order a MEC-100 with diode monitoring, the following model must be required:

MEC-100 D M71FA320A

2. TECHNICAL SPECIFICATIONS

2.1. SUPPLY AND POWER

Connection type	• Single-phase • Three-phase
Supply type	• Auxiliary winding • Mains • PMG
Supply voltage type	AC: 50 to 277Vac (@ 50 to 400Hz)
Voltage build-up	≥5Vac

2.2. GENERATOR VOLTAGE SENSING

Connection type	• Single-phase • Three-phase
Voltage Range	From 110Vac to 480Vac± 15%, at 50/60Hz

2.3. NETWORK VOLTAGE SENSING

Connection type	Single-phase
Voltage Range	From 110Vac to 480Vac± 15%, at 50/60Hz

2.4. GENERATOR CURRENT SENSING

Generator current sensing on W phase	Available inputs	1 channel with 2 optional ranges
	Current range	• 1Aac (@ 50/60Hz) • 5Aac (@ 50/60Hz)

2.5. ANALOGUE AUXILIARY INPUTS

Auxiliary inputs	Available inputs	2 channels
	Range	4 to 20 mAdc

2.6. EXCITER FIELD

Field resistance	Minimum value	2Ω
Field voltage	Voltage range	0 to 250 Vdc maximum
Continuative operation	Current range	0 to 10 Adc
10 seconds forcing	Current range	0 to 20 Adc

2.7. ACCURACY

AVR Mode	Voltage regulation accuracy	±0.25% over load range at rated power factor and constant generator frequency
	Steady state stability	±0.1% at constant load and generator frequency
	Thermal drift	±0.5% for a 30°C change in 10 minutes
	V/Hz: voltage accuracy	±2%
	Response time	<1 cycle
FCR Mode	Accuracy	±2%

PF Mode	Accuracy	±2% (accuracy % referred to the reactive power)
VAR Mode	Accuracy	±2%
Voltage matching	Accuracy	±0,5%

2.8. LIMITERS AND OTHER FUNCTIONS

Soft start	Time adjust range	• 1 to 3600s • 1s increment
Voltage matching	Minimum threshold	• 90 to 100% of the rated generator voltage • 1% increment
	Maximum threshold	• 100 to 110% of the rated generator voltage • 1% increment
Parallel operation	Type	Reactive droop compensation
	Range	0 to 10%
Over-excitation limiter	Type	Inverse time curve
	Thresholds	• 1 maximum threshold • Range from 0 to 25A with 0.1A increment • Time delay from 0 to 600s with 0.1s increment • 1 maximum continuative threshold • Range from 0 to 15A • 0.1A increment
Under-excitation limiter	Range	Leading power curve with two settable points
Under-frequency limiter	Corner frequency	• 40 to 60Hz • 0.1Hz increment
	Zero Volt frequency	• 0 to 40Hz • 0.1Hz increment

2.9. PROTECTIONS

Field over-voltage	Range of voltage threshold	• 0 to 200Vdc • 1Vdc increment
	Alarm time delay	• 0 a 300s • 0.1s increment
Field over-current	Range of current threshold	• 0 to 15Adc • 0.1Adc increment
	Alarm time delay	• 0 to 10s • 0.1s increment
Generator over-voltage	Range of voltage threshold	• 100 to 150% of the rated generator voltage • 1% increment
	Alarm time delay	• 0 to 300s • 0.1s increment
Generator under-voltage	Range of voltage threshold	• 0 to 100% of the rated generator voltage • 1% increment
	Alarm time delay	• 0 to 300s • 0.1s increment
Generator over-current	Type	Inverse time curve
	Thresholds and alarm time delay	• 1 maximum threshold • Range from 0 to 120% of the rated stator current • 1% increment • Time delay from 0 to 3600s • 1s increment • 1 maximum continuative threshold • Range from 0 to 110% of the rated stator current • 1% increment

Loss of sensing	Alarm time delay	<1s
Diode Monitoring	Excitation current ripple levels and time delays	• 1 low failure level • Range from 0 to 100% of the rated excitation current • 1% increment • Time delay from 0 to 100s • 1s increment • 1 high failure level • Range from 0 to 100% of the rated excitation current • 1% increment • Time delay from 0 to 10s • 1s increment

2.10. CONTACTS

Input contacts	Type	Dry contacts, only for devices equipped with galvanically insulated outputs
	Function	• START (excitation start contact) • STOP (excitation stop contact) • UP (increase setpoint) • DOWN (decrease setpoint) • PAR (enable par. operation with gen.) • PF/VAR (enable VAR/PF regulation) • VMATCH (enable voltage matching) • FCR (enable FCR mode)
Output relays	Function	Relays individually associated to alarm functions
	Rated data	1A @ 120Vac / 24Vdc resistive
	Max switched voltage	• AC: 120V • DC: 60V
	Max switched current	1A
	Max switched power	120VA, 30W

2.11. ENVIRONMENT

Operating temperature	Range	Da -30 a +70°C
Storage temperature	Range	Da -40 a +80°C

2.12. PHYSICAL SPECIFICATIONS

Weight	Total weight	2000g
Dimensions	Length	353.0mm
	Width	183.5mm
	Height	52.5mm

2.13. TYPE TEST

2.13.1. EMC – Emissions

Emission: Reference standard EN 61000-6-3 (2001) + EN 61000-6-3/A11 (2004)

Test specifications	*Environmental Phenomena*	*Result*
EN 55022	Conducted disturbance	Complies
EN 55022	Radiated disturbance	Complies
EN 55014-1	Discontinuous disturbance voltage	Complies
EN 61000-3-2	Harmonic current emissions	Complies
EN 61000-3-3	Voltage fluctuations and flicker	Complies

2.13.2. EMC – Immunity

Immunity: Reference standard EN 61000-6-2 (2005)

Test specifications	*Environmental Phenomena*	*Result*
EN 61000-4-2	Electrostatic discharge	Complies
EN 61000-4-3	Radiated electromagnetic field	Complies
EN 61000-4-4	Electrical fast transients	Complies
EN 61000-4-5	Surge	Complies
EN 61000-4-6	Injected currents	Complies
EN 61000-4-8	Power frequency magnetic field	N.A. (+)
EN 61000-4-11	Dips/short interruptions	Complies

(+) *Apparatus does not contain devices susceptible to magnetic fields*

The compatibility test results according to the 89/336 EEC and 2004/108 EC Directives and subsequent amendments.

2.13.3. Climatic

Reference standard DNV No. 2.4 – 2006

Test specifications	*Environmental Phenomena*	*Result*
Class: C (-25°C / +55°C) Standard IEC 60068-2-2	Dry Heat	Complies
Class: C (-25°C / +55°C) Standard IEC 60068-2-2	Cold	Complies
Class: C (-25°C / +55°C / 100% R.H.) Standard IEC 60068-2-30	Damp Heat	Complies

2.13.4. Vibrations

Reference standard DNV No. 2.4 – 2006

Test specifications	*Environmental Phenomena*	*Result*
Class: B Standard IEC 60068-2-6	Vibration	Complies

2.13.5. Shock & Bump

Test specifications	*Environmental Phenomena*	*Result*
IEC 60255-21-2	Shock response test (Class 2 – 10g, 11ms, 3*3) Shock withstand test (Class 22 – 30g, 11ms, 3*3) Bump test (Class 22 – 20g, 16ms, 1000*3)	Complies
IEC 60068-2-27	Shock response test (+/-5g, 10ms, 10*3)	Complies

2.14. AGENCY RECOGNITION

DNV (Reference standard DNV No. 2.4 – 2006)

Application	
Temperature	C
Humidity	B
Vibration	B
EMC	A
Enclosure	IP00

Certificate No. A-12190

3. FUNCTIONAL DESCRIPTION

3.1. INTRODUCTION

In the following section a description of the functions implemented by the MEC-100 and the relevant limits of use is provided. Before using the MEC-100 on any generator, make sure to read carefully and be familiar with all instructions contained in this documentation. For more information, please contact the Marelli Motori Services (Sect. 6).

3.2. OPERATING MODES

3.2.1. AVR (Automatic Voltage Regulation) Mode

In this operating mode, the MEC-100 allows to adjust the generator voltage. At the *START* (see Par. 3.5.1), and FCR contact open (C8 contact, see Par. 3.5.8), the MEC-100 always operates in AVR Mode and in this mode all the provided functions are active, excepted for the *Under-excitation Limiter* (see Par. 3.7.3).

3.2.2. PF (Power Factor Regulation) Mode

In this operating mode, the MEC-100 allows to adjust the power factor. The activation of the PF Mode is obtained by closing the PF/VAR contact (C6 contact, see Par. 3.5.6), after enabling the same mode during the first configuration step (Par. 5.7.1). In the PF Mode also the *Under-excitation Limiter* is active (see Par. 3.7.3).

3.2.3. VAR (Reactive Power Regulation) Mode

In this operating mode, the MEC-100 allows to adjust the reactive power. The activation of the VAR Mode is obtained by closing the PF/VAR input contact (C6 contact, see Par. 3.5.6), after enabling the same mode during the first configuration step (see Par. 5.7.1). In the VAR Mode also the *Under-excitation Limiter* function is active (see Par. 3.7.3).

3.2.4. FCR (Field Current Regulation – only P.N. M71FA310A, M71FA320A) Mode

In this operating mode, the MEC-100 allows to adjust the excitation current. The activation of the FCR Mode can be obtained by closing the FCR input contact (C8 contact, see Par. 3.5.8).

3.3. POWER AND CARD SUPPLY (P1-P2-P3)

The MEC-100 accepts (terminals P1-P2-P3) a supply single-phase or three-phase alternating voltage ranging between 50 and 277V approximately with a frequency from 50 to 400Hz. The voltage can be obtained from the main machine terminals, the auxiliary winding or the PMG: it is rectified, filtered and used to energize the internal card circuitry and provide, through the chopper output stage, the power necessary for the appropriate generator excitation.

3.4. ANALOGUE INPUTS

3.4.1. Generator Voltage Sensing (S1-S2-S3)

The MEC-100 offers a wide range of measurement for the generator voltage. You can connect the three sensing terminals (S1-S2-S3) directly to the main machine terminals for the following range: from 100Vac to 480Vac ± 15%, at 50 - 60Hz frequencies (see Par. 2.2). For applications with rated generator voltages higher than 480Vac ± 15% you need to interpose a step-down transformer, with rated secondary voltage included in the ranges indicated in the relevant specifications. For the sensing both the single-phase and three-phase connection configurations are provided. In the case of single-phase sensing, the voltage sensed is the line-to-line voltage between the phases U and V (U_{UV}). This input is internally insulated.

3.4.2. Generator Current Sensing (A1-A5-B)

The MEC-100 is equipped with a double channel for the sensing of the generator current: a 1A channel (A1-B) and a 5A channel (A5-B), at 50-60Hz frequency, to be connected to a current step-down transformer with a transformation ratio I_N/1 or I_N /5, where I_N is the rated generator current. The phase whose current value is measured is the W phase. This input is internally insulated.

3.4.3. Network Voltage Sensing (L1-L2)

The MEC-100 offers a wide range of measurement for the network voltage. The two sensing terminals (L1-L2) can be directly connected to the supply voltage for the following range: from 100Vac to 480Vac ± 15%, at 50 - 60Hz frequencies (see Par. 2.3).

For applications with supply voltages higher than 480Vac ± 15% a step-down transformer must be interposed, with rated secondary voltage included in the ranges indicated in the relevant specifications. The only single-phase connection configuration is provided. This input is internally insulated.

3.4.4. Analogue Auxiliary Inputs (E1-E2-M)

The MEC-100 is provided with two auxiliary inputs to control the voltage, power factor, reactive power and excitation current setpoints by means of an external device (1st In.: terminals E1-M; 2nd In.: terminals E2-M).
These inputs can be used by applying a 4-20mA current and they can be individually associated to two regulation Modes. To the control current range corresponds the range established during set-up for the relative associated setpoint (see Par. 5.7.3).

For example, if voltage setpoint limits are set to 80 and 120% of the generator rated voltage, 4mA will be associated to the minimum limit (80%) and 20mA to the maximum limit (120%), and all the intermediate values of the generator voltage setpoint will proportionally correspond to the current values between 4 and 20mA.

WARNING: THESE INPUTS ARE NOT INTERNALLY INSULATED. The external device to which these inputs should be connected must be equipped with a galvanically insulated output.

3.5. INPUT CONTACTS

The MEC-100 is equipped with 8 input contacts for the operational control of the regulation modes. Here below the description of the functions related to these contacts is provided.

WARNING: THESE INPUTS ARE NOT INTERNALLY INSULATED. The external device to which these inputs should be connected must be equipped with a galvanically insulated output.

WARNING: MEC-100 CAN BE PERMANENTLY DAMAGED IN CASE OF VOLTAGE APPLIED TO THE CONTACT TERMINALS, E.G. (BUT NOT EXCLUSIVELY) DUE TO INTERFERENCES ENTERING THE CONNECTIONS. In detail, **it is compulsory to avoid voltage peaks higher than 40V**.In case of doubt about interference peak values on the contact terminals, the user is bound to install dry contacts (relays) near to the regulator (distance ≤ 50cm); suitable cabling (shielded and twisted cables) between dry contacts and MEC-100 must not be longer than 2m.

3.5.1. START (C1 Contact)

Excitation start contact (normally open, switch logic): when this contact is closed, the MEC-100 supplies power to the exciter field and continues to do so until the contact remains closed. When this contact is opened, the power supply to the exciter field is stopped. If the excitation is present (*START* contact closed) and the temporary STOP contact is closed (see Par. 3.5.2), the *START* contact is disabled and to supply the excitation power again it is necessary first to open and then re-close the *START* contact (with *STOP* opened). When the *START* contact is closed, the LED corresponding to the *Excitation State* item in the system status window in *System Monitoring* becomes green.

WARNING: *START* CONTACT MUST NOT BE CONSIDERED OR USED AS EMERGENCY AND/OR SAFETY DEVICE. *START* contact has only an operating function, it can not be considered or used as emergency and/or safety device.

3.5.2. STOP (C2 Contact)

Excitation stop contact (normally open, momentary pushbutton logic): when this contact is temporarily closed, the MEC-100 stops the power supply to the exciter field. When the stop command is given, the MEC-100 does not supply the exciter field e the contact can be left again. This input is priority to the *START* contact. If the excitation is present (*START* contact closed) and the temporary STOP contact is temporarily closed, the *START* contact is disabled and to supply the excitation power again it is necessary first to open and then re-close the *START* contact (with *STOP* opened). When the *STOP* contact is closed, the LED corresponding to the *Operating Status* item in the system status window in *System Monitoring* (see Par. 5.8.2) turns off. *STOP* can be associated to the de-excitation (shutdown) contact (see Par. 3.12).

WARNING: *STOP* CONTACT MUST NOT BE CONSIDERED OR USED AS EMERGENCY AND/OR SAFETY DEVICE. *STOP* contact has only an operating function, it can not be considered or used as emergency and/or safety device.

3.5.3. UP (C3 Contact)

Active operational setpoint increasing contact (normally open, momentary pushbutton logic):

- AVR Mode: increases the generator voltage setpoint.
- PF Mode: if the power factor setpoint is of inductive type, decreases the power factor; if the setpoint is of capacitive type, increases the power factor.
- VAR Mode: increases the reactive power setpoint.
- FCR Mode: increases the excitation current setpoint.

The setpoint increase is strictly related to the range established for the setpoint (see Par. 5.7.3) and the variation speed (or traverse rate, see Par. 5.7.4).

It is assumed that the inductive reactive power is of positive sign and the capacitive reactive power of negative sign. In parallel with the network (PF Mode or VAR Mode active) the UP contact increases the reactive power value so as to obtain the desired power factor or reactive power setpoint depending on the selected regulation Mode.

WARNING: ONLY FOR MEC-100 P.N. M71FA300A: THE UP CONTACT CAN NOT BE USED FOR ENDLESS REPETITIVE PURPOSES. The *UP* contact can only perform a current setpoint change for spot operations; the endless repetitive use of the contact is forbidden. If a continuous setpoint matching is required, the auxiliary analogue inputs E1-E2-M must always be used (see Par. 3.4.4).

3.5.4. DOWN (C4 Contact)

Active operational setpoint decreasing contact (normally open, momentary pushbutton logic):

- AVR Mode: decreases the generator voltage setpoint.
- PF Mode: if the power factor setpoint is of inductive type, increases the power factor; if the setpoint is of capacitive type, decreases the power factor.
- VAR Mode: decreases the reactive power setpoint.
- FCR Mode: decreases the excitation current setpoint.

The setpoint decrease is strictly related to the range established for the setpoint (see Par. 5.7.3) and the variation speed (traverse rate, see Par. 5.7.4).

It is assumed that the inductive reactive power is of positive sign and the capacitive reactive power of negative sign. In parallel with the network (PF Mode or VAR Mode active) the DOWN contact decreases the reactive power value so as to obtain the desired power factor or reactive power setpoint depending on the selected regulation Mode.

WARNING: ONLY FOR MEC-100 P.N. M71FA300A: THE DOWN CONTACT CAN NOT BE USED FOR ENDLESS REPETITIVE PURPOSES. The *DOWN* contact can only perform a current setpoint change for spot operations; the endless repetitive use of the contact is forbidden. If a continuous setpoint matching is required, the auxiliary analogue inputs E1-E2-M must always be used (Par. 3.4.4).

3.5.5. PAR (C5 Contact)

Generators parallel enabling contact (normally open, switch logic): this input activates the *Droop* mode for paralleling one or more generators (for the *Droop* function see Par. 3.9). When this contact is closed the excitation limiters, provided for the operating mode in parallel, are enabled and the voltage matching function is disabled (see Par. 3.5.7). When the *PAR* contact is closed, the LED corresponding to the *Reactive Droop Compensation* item in the system status window in *System Monitoring* becomes green.

3.5.6. PF/VAR (C6 Contact)

PF/VAR Mode enabling contact (normally open, switch logic): this input activates the PF (Power Factor) or VAR (Reactive Power) regulation Mode (depending on the previously selected Mode, see Par. 5.7.1), for the mains parallel operations. When this contact is closed the excitation limiters, provided for the operating mode in parallel, are enabled and the voltage matching function is disabled (see Par. 3.5.7). When the *PF/VAR* contact is closed, the LED corresponding to the *Parallel with Line* item in the system status window in *System Monitoring* becomes green.

3.5.7. VMATCH (C7 Contact)

Voltage matching enabling contact (normally open, switch logic): this input enables the voltage matching function from the MEC-100; if the network voltage value measured by the MEC-100 is included in the range of set values (values referred to the generator rated voltage, see Par. 5.7.4), the generator voltage setpoint is automatically modified from the pre-established value to the network voltage value in a fixed time interval of 10-15 seconds approximately.
When the *PAR* or the *PF/VAR* contact is closed the voltage matching function is disabled and remains disabled until both the *PAR* and *PF/VAR* contacts are opened. When the *VMATCH* contact is closed (and both the *PAR* and *PF/VAR* contacts are disabled), the LED corresponding to the *Voltage Matching* item in the system status window in *System Monitoring* becomes green.

3.5.8. FCR (C8 Contact - only P.N. M71FA310A, M71FA320A)

FCR enabling contact (normally open, switch logic): this input enables the FCR Mode for excitation current regulation (Field Current Regulation, see Par. 3.4.4). FCR Mode can be automatically selected in case of loss of sensing and *Shutdown* Mode enabled (see. Par. 5.7.8), and it does not depend on the status of FCR contact. When the FCR function is operating, the LED corresponding to the *Field Current Regulation FCR* item in the system status window in *System Monitoring* becomes green.

WARNING: BE CAREFUL IN THE USE OF THE FCR MODE. The excitation current value in FCR mode must be chosen considering the generator specifications and the operations to do: a too high excitation current value can lead to over-excitation and/or overvoltage conditions dangerous for the generator and/or the plant (incautious use). **A initial low value is suggested, not higher than the excitation current in no load condition**.

3.5.9. RESET (C8 Contact – only for P.N. M71FA300A)

Alarm reset contact (normally open, momentary pushbutton logic): this input allows to reset all active alarms as a result of the intervention of one or more protections or limitations.

The alarm reset should usually be operated after the intervention on the system to remove the causes of the alarm condition. If the system is still working and the alarm causes have not been removed, the RESET *contact interrupts the alarms for about a second, after which they are reactivated.*

3.6. MEC-100 PROTECTIONS

The MEC-100 offers 7 protection functions which consist in transmitting externally a warning, of visual type, through MEC-100 Interface System, and/or of signal type, by associating this last to a relay.

3.6.1. Field Over-voltage Protection

When the measured field voltage increases above a value threshold which can be set, for a time interval whose length can be established, the field over-voltage protection is activated. The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Field Overvoltage Protection* item flashing, see Par. 5.8.3) and optionally can be associated to one of the two programmable output relays.The activation voltage threshold can be set between 0 and 200Vdc with increases of 1Vdc and the operation time (measured by an internal timer) between 0 and 300s with increases of 0.1s. When the voltage falls below the defined threshold, the protection timer is reset to zero. This function can be enabled/disabled.

3.6.2. Field Over-current Protection

When the measured field current increases above a value threshold which can be set, for a time interval whose length can be established, the field over-current protection is activated. The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Field Overcurrent Protection* item flashing, see Par. 5.8.3), and optionally can be associated to one of the two programmable output relays. The activation current threshold can be set between 0 and 15Adc with increases of 0.1Adc and the operation time (measured by an internal timer) between 0 and 10s with increases of 0.1s. When the current falls below the defined threshold, the protection timer is reset to zero. This function can be enabled/disabled.

3.6.3. Generator Over-voltage Protection

When the measured generator voltage increases above a value threshold which can be set, for a time interval whose length can be established, the generator over-voltage protection is activated. The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Generator Overvoltage Protection* item flashing, see Par. 5.8.3), and optionally can be associated to one of the two programmable output relays. The activation voltage threshold can be set in the form of percentage of the generator rated voltage, between 100 and 150% with increases of 1%, the operation time (measured by an internal timer) can be determined between 0 and 300s with increases of 0.1s. When the voltage falls below the defined threshold, the protection timer is reset to zero. This function can be enabled/disabled.

3.6.4. Generator Under-voltage Protection

When the measured generator voltage falls below a value threshold which can be set, for a time interval whose length can be established, the generator under-voltage protection is activated.
The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Generator Undervoltage Protection* item flashing, see Par. 5.8.3), and optionally can be associated to one of the two programmable output relays. The activation voltage threshold can be set in the form of percentage of the generator rated voltage, between 0 and 100% with increases of 1%, the operation time (measured by an internal timer) can be determined between 0 and 300s with increases of 0.1s. When the voltage increases above the defined threshold, the protection timer is reset to zero. This function can be enabled/disabled.

3.6.5. Generator Over-current Protection

The MEC-100 is capable of monitoring the value taken by the generator stator current under load conditions and sending a warning when the current value exceeds a predefined limit for a pre-established time interval; this time interval can be derived from a curve of the type shown in Fig. 3.6.5.a. All of that before the over-current causes a generator overheating/failure. The characteristic curve is calculated starting from the determination of a maximum continuative current level (given in percentage compared with the generator rated current value, with values included between 0 and 110%, and minimum increase of 1%), a current reference level (expressed in percentage compared with the generator rated current value, with values included between 0 and 120%, and minimum increase of 1%) and a minimum operation time value (time delay from 0 to 3600s, minimum increase of 1s) associated to the reference level.

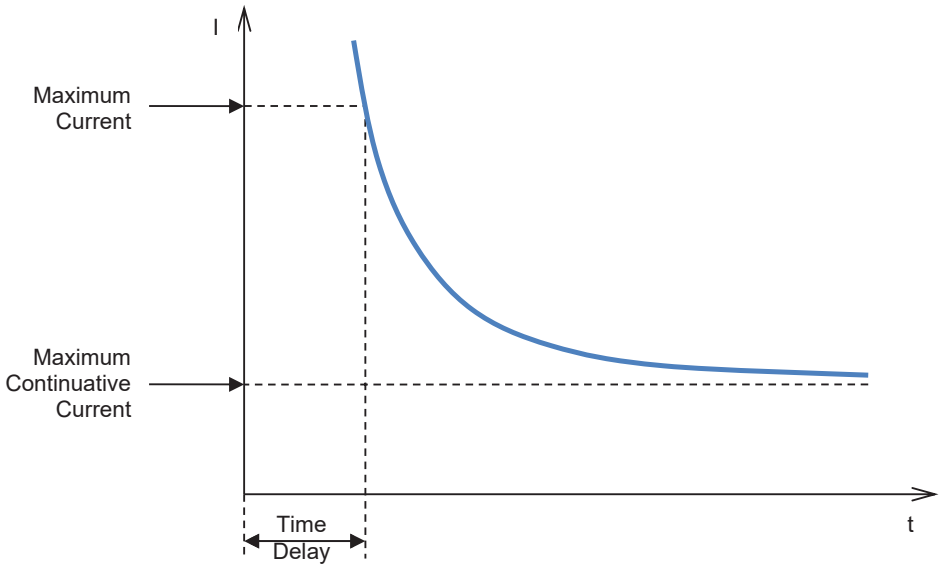


Fig. 3.6.5.a
Generator Over-current Protection Curve

When the stator current value exceeds the maximum continuous current value, the generator over-current protection is activated by a warning signal after a time interval depending on the generator current value which has been reached, according to the curve of Fig. 3.6.5.a.
Higher the over-current, shorter the operation time (time delay). The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Generator Overcurrent Protection* item flashing, see Par. 5.8.3), and optionally can be associated to one of the two programmable output relays. This function can be enabled/disabled.

3.6.6. Loss of Sensing Protection

The MEC-100 is capable of sensing the over-excitation conditions resulting from the loss of voltage sensing and coming into operation by a warning signal in less than 1s. In particular, the protection detects the loss of one or more wires of the sensing, via a hardware solution, that allows to discriminate the cases in which the sensing voltage is zero due to operating conditions of the generator (eg. short circuit).
The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System (*Loss of Sensing Protection* item flashing), and optionally can be associated to one of the two programmable output relays. The *Loss of Sensing* protection can directly operate one of the two following actions (preliminary choice is required, see Par. 5.7.8):

- *Shutdown*: the MEC-100 operates the instantaneous de-excitation (shutdown) of the generator.
- *FCR*: the MEC-100 automatically changes over to FCR mode, supplying the excitation current value set in the *Setpoint* window (see Par. 5.7.3.).

This function can be enabled/disabled.

WARNING: Any activation of the protection when it is enabled will cause an excitation shutdown or a change over to the FCR mode. Before enabling the protection, please make sure that the choosen protection option is not dangerous for the plant or the network to which the generator is connected.

3.6.7. Diode Failure Monitoring (P.N. M71FA320A)

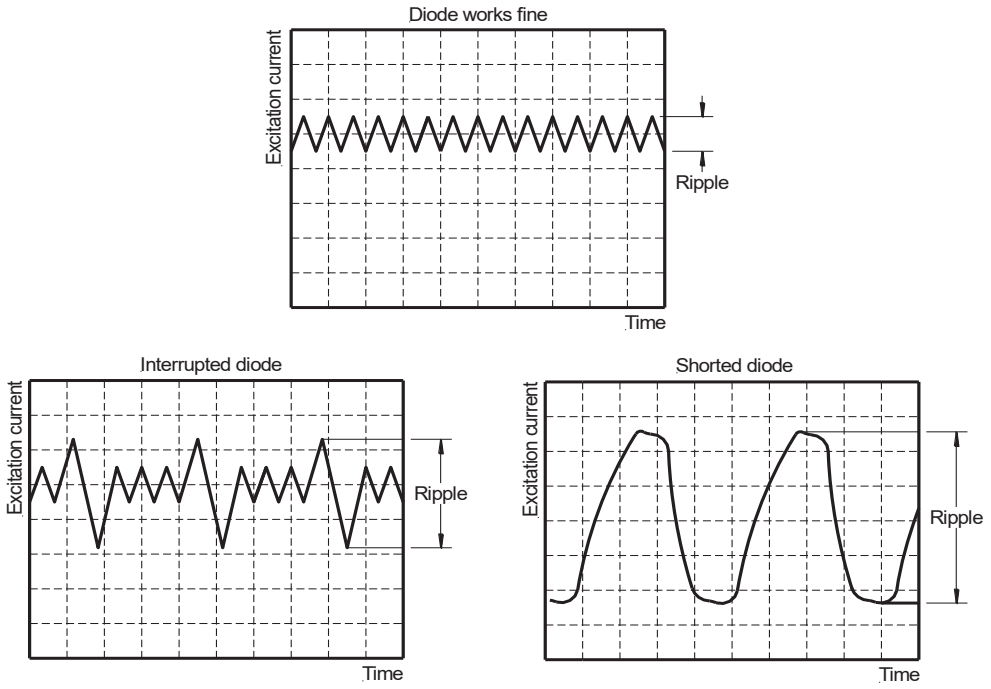


Fig. 3.6.7.a
Excitation current when diode fails.

The MEC-100 is capable of sensing abnormal excitation currents due to the damaging of one or more diodes in the generator rectifier bridge (interrupted or shorted diode). These currents can lead to the exciter and/or regulator damaging. MEC-100 measures the excitation current (average value) and the width of its ripple.
If a diode is damaged, the excitation current ripple is higher than the one present in correct behaviour conditions, as showed in Fig. 3.6.7.a. MEC-100 offers two types of protection threshold or failure level: *Low Level* and *High Level* of failure. The two thresholds can be chosen in such a way to discern from a light failure (i.e. interrupted diode) to a heavy failure (i.e. shorted diode). For example, the two levels can be chosen with the following method:

- If excitation current ripple is lower than the *Low Level* of failure, the rectifier bridge can be considered properly working.
- If excitation current ripple is higher than the *Low Level* of failure (for a period longer than the set delay) but lower than the *High Level* of failure, the *Low Level* allarm occures. This situation could be associated for example to a light failure (i.e. interrupted diode) which can not damage the generator in a short period of time, but has to be anyway solved.
- If excitation current ripple is higher than the *High Level* of failure (for a period longer than the set delay), the *High Level* allarm occures. This situation could be associated for example to a heavy failure (i.e. shorted diode) which can damage the generator in a short period of time, and has to be solved as soon as possible.

The activation of this protection is accompanied by a visual warning in the MEC-100 Interface System: when *Low Level* is reached, *Diode Monitoring - Low Level* item starts flashing (see Par. 5.8.3) and optionally can be associated to one of the two programmable output relays. When *High Level* is reached, *Diode Monitoring - High Level* item starts flashing (see Par. 5.8.3) and optionally can be associated to one of the two programmable output relays or to the *Shutdown* option. This function can be enabled/disabled.

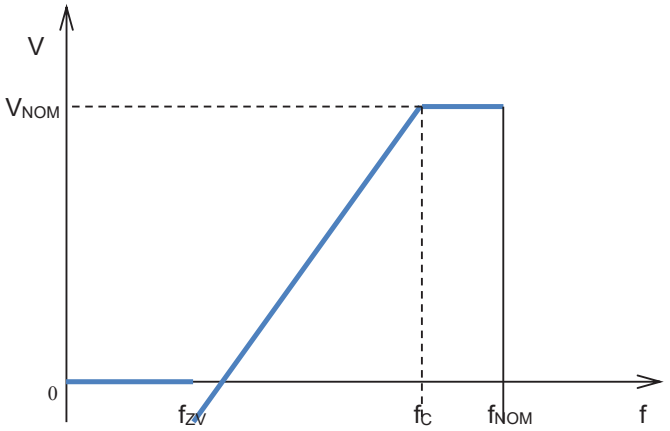
3.7. LIMITATION FUNCTIONS

3.7.1. Under-frequency Limiter

The MEC-100 reduces the excitation current any time the generator is used at low speed to avoid damages to the generator excitation system: in particular the voltage setpoint is automatically modified and reduced as soon as the generator frequency falls below a set value, according to the curve shown in Fig. 3.7.1.a.
The parameters which determine the curve and, in particular, its slope are the following:

- The *Corner Frequency* f_C, which can be set from 40 to 60Hz with increases of 0.1Hz: represents the frequency value below which the MEC-100 decreases the voltage setpoint.
- The *Zero Volt Frequency* f_{ZV}, which can be set from 0 to 40Hz with increases of 0.1Hz: represents the frequency relative to the point where the voltage setpoint is zeroed.

The activation of this limitation function is accompanied by a visual warning in the MEC-100 Interface System (*Underfrequency Limiter* item flashing, Par. 5.8.3). This function is always enabled and operates in AVR Mode.



V_{NOM}	Rated Voltage
f_{ZV}	Zero Volt Frequency
f_C	Corner Frequency
f_{NOM}	Rated Frequency

Fig. 3.7.1.a
Generator Voltage Setpoint in Under-frequency Conditions

3.7.2. Overexcitation limiter

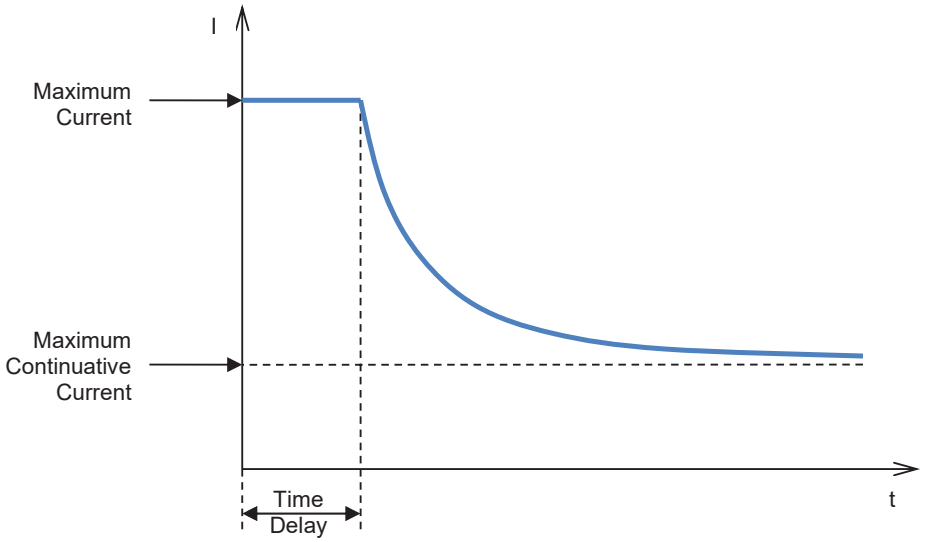


Fig. 3.7.2.a
Overexcitation Limiter Curve

The MEC-100 is capable of reducing the excitation current when this last reaches such a value as to cause the overheating of the exciter field. When this function is active (the activation results from the relevant authorization) and a field over-current takes place, the field current value is decreased to a safety value, within a pre-established time interval, which can be derived from the curve shown in Fig. 3.7.2.a. This characteristic curve is calculated starting from the determination of a maximum current level which can never be exceeded (with value included between 0 and 25A, minimum increase of 0.1A), a minimum operation time value (0 to 10s, minimum increase of 0.1s) and a maximum field current value which the MEC-100 can support continuously without the activation of the relevant protection (0 to 15A, minimum increase of 0,1A). When the field current value exceeds the maximum continuative current value, the field over-current limitation is activated after a time interval depending on the field current value which has been reached, according to the curve of Fig. 3.7.2.a. Higher the over-current, shorter the operation time. The activation of this limitation consists in reducing the field current until the maximum continuative current value is reached. This current value is maintained until both the following conditions are simultaneously satisfied:

- Enough time is passed to eliminate the generator overheating.
- The operating conditions set the excitation current value required to the MEC-100 below the maximum continuous current value.

The activation of this limitation is accompanied by a visual warning in the MEC-100 Interface System (*Overexcitation Limiter* item flashing, see Par. 5.8.3), and optionally can be associated to one of the two programmable output relays. This function can be enabled/disabled:

- If enabled, it can operate in all working Modes.
- Even if disabled, the MEC-100 limits the maximum excitation current which can be supplied to the maximum allowed set value.

3.7.3. Under-excitation limiter

The MEC-100 is capable of activating an under-excitation limitation function to avoid demagnetizing effects and losses of synchronism during the paralleling operations. When this function is active (the activation results from the relevant authorization), the MEC-100 senses the reactive power output (of demagnetizing type) and limits any consequent field current reduction. The area of operation of the under-excitation limitation function is identified by a curve like that shown in Fig. 3.7.3.a.
In the figure, the dotted section is the area within which MEC-100 cannot operate; the limiter will intervene:

- in PF mode by limiting the excitation current, to ensure that the working point remains inside the permitted area
- in AVR mode, with Droop enabled, by just providing an external notification.

In both case, the limiter intervention is notified through a visual indication in the MEC-100 Interface System (blinking of the *Underexcitation Limiter* item - see Para. 5.8.3); it can also be optionally associated with one of the two programmable output relays. The limitation curve is obtained by linear interpolation between two point A and B (see example in Fig. 3.7.3.a, percentage values refer to rated apparent power). The maximum underexcited reactive power values are given with Point A for P=0 %, with point B for P = 100 % rated apparent power, in steps of 1 % from 0 % to 60 % of rated apparent power. For rated apparent power, the calculated value in *System Parameters* tab (see Section 5).
The function can be enabled/disabled.

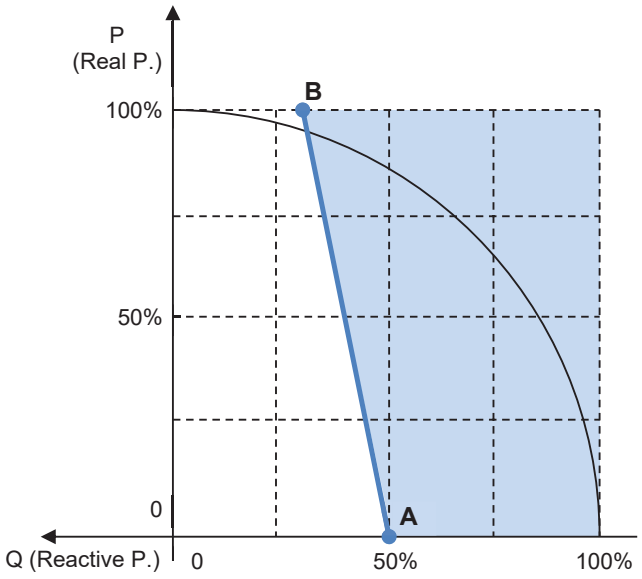


Fig. 3.7.3.a
Under-excitation Limitation Curve

3.7.4. Inrush current limiter

The MEC-100 is equipped with an internal protection against the so-called “Inrush Current” or “Input Surge Current”, that is the maximum, instantaneous input current which appears when the device input stage is instantaneously energized. The limiter acts only on the inrush current, while it has not any further influence on the normal working of the MEC-100.

3.8. PROGRAMMABLE RELAYS

The protection and limitation functions which can be set from MEC-100 Interface System can be individually associated to each one of the two programmable relays provided with the MEC-100.
The provided contacts are normally open.

3.9. REACTIVE DROOP COMPENSATION

The MEC-100 provides a Reactive Droop Compensation function: it is used to obtain the desired distribution of the reactive load between two or more generators which operate in parallel.

When the function is enabled, MEC-100 calculates the reactive part of the generator load, starting from the measurement of the generator voltage between phases U and V and of the W phase current, and accordingly modifies the generator voltage setpoint.
If the power factor is equal to one, the voltage setpoint will not be modified. An inductive (“lagging”) power factor results in a reduction of the generator output voltage (*Droop*). A capacitive (“leading”) power factor results in an increase of the generator output voltage.

Should the generator voltage increase in the presence of an inductive load, you need to check that:
- *the U phase is connected to S1 and the V phase is connected to S2.*
- *current is measured on phase W.*

If both conditions are met, you will need to invert the two leads from the measuring TA on the generator current measurement terminals.

Droop can be set from 0 to 10%, with increase of 0.1%, with phase current equal to the rated generator current and power factor corresponding to 0.80. This function is enabled by closing the PAR contact (C5 contact, see Par. 3.5.5). It can only be activated in AVR Mode. The switching to the PF or VAR Mode disables automatically the Reactive Droop Compensation. During parallel operation between two or more generators (PAR contact closed), the LED corresponding to the *Reactive Droop Compensation* item in the system status window in *System Monitoring* becomes green.

3.10. SOFT-START

The MEC-100 provides the SOFT-START function to bring linearly the generator voltage from the residual value to the reference one, in a time interval whose length can be defined, with minimum overshoot. For this function, it is enough to set only one parameter: that is, the ramp-up time of the voltage setpoint. This parameter, whose value is included between 0 and 3600s with increases of 1s, accounts for the time necessary to the MEC-100 to lead the voltage setpoint from 0Vac to 100% of its predefined value (the rated voltage), starting from the moment when the MEC-100 is enabled from the *START* contact. In Fig. 3.10.a. the ideal time diagram of the voltage setpoint during the SOFT-START function is shown.

The diagram in Figure 3.10.a refers to the ideal curve which the card processor makes the voltage setpoint follow to reach 100% of the pre-established value. Obviously, under real conditions, and especially at full rpm, the generator voltage does not start from 0Vac, but from the residual machine voltage value; moreover, under real conditions, starting from 0rpm up to reach the rated speed, the voltage ramp-up may not be perfectly linear, but on the contrary may present a light overshoot at low frequencies and voltages (in any case included within a range of not significant values).

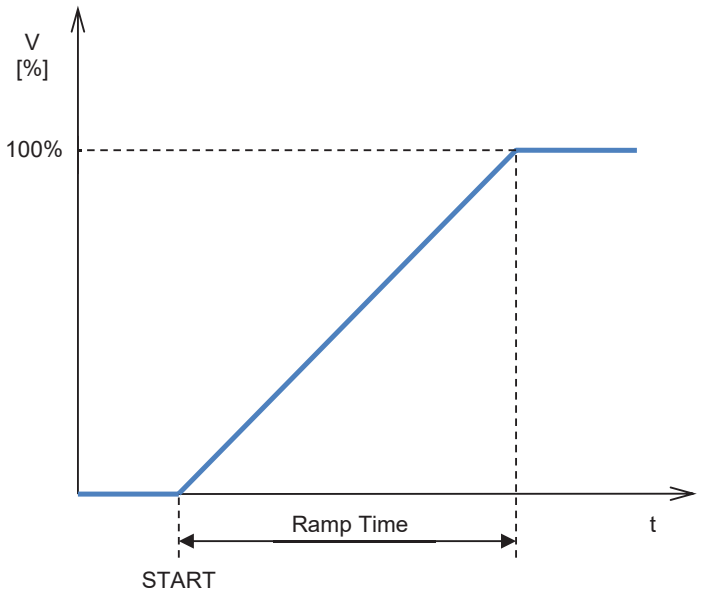


Fig. 3.10.a
Generator Voltage Setpoint when the SOFT-START Function is Active

3.11. SETTING THE P.I.D. PARAMETERS

One of the functions which make the MEC-100 a particularly efficient and flexible device is the configurability of the parameters that define the transient performances and the stability of the control system.
In particular, the MEC-100 system allows to use P.I.D. (Proportional, Integral, Derivative) controllers which can be individually set by the direct insertion of the values corresponding to the relevant constants: K_P, K_I, and K_D.

3.11.1. Proportional, Integral and Derivative Controllers

In the Table below an indicative scheme is provided where the K_P, K_I, and K_D values are determined starting from the hypothesis of submitting the closed chain system to a step input.

Controller	*Ramp-up Time*	*Overshoot*	*Transient Length*	*Steady-State Error*
Increase of K_P	Decreases	Increases	Does not influence	Decreases
Increase of K_I	Decreases	Increases	Increases	Eliminated
Increase of K_D	Does not influence	Decreases	Decreases	Does not influence

It is to be specified that the above-mentioned relationships are not accurate, since controllers depend each other, but they can be considered enough to tune controllers in order to obtain the best possible transient response. Generally speaking, the Proportional controller (K_P) will contribute to reduce the step-response rise time (parameter which characterizes the response readiness) and decrease, but not to eliminate, the steady-state error. The Integral controller (I controller with K_I constant) eliminates the steady-state error but worsens the transient response (reduces the stability). The Derivative controller (K_D) increases the stability of the system, by improving the transient response.

3.11.2. Derivative Adjustments

The MEC-100 Interface System provides two further adjustment parameters (for derivative adjustments) to improve the transient response:

- *1st Derivative Item – Time*: describes the number of sampling intervals, referred to the discrete time, used for the derivate calculation.
- *2nd Derivative item – Filter*: describes the time constant, referred to the discrete time, of the low-pass filter used to eliminate the derivate noise.

3.11.3. P.I.D. in PF/VAR Modes

The MEC-100 Interface System provides 3 P.I.D. controllers and 2 derivative adjustments to set the stability in AVR Mode. Only P.I. controllers must be set in PF and VAR Modes. For the setting of each parameter, see Par. 5.7.5.

3.12. DE-EXCITATION (SHUTDOWN) CONTACT: INSTRUCTIONS

Most of the generator connection diagrams include a de-excitation (shutdown) contact between the generator power source (main terminals, auxiliary winding, PMG, etc.) and the MEC-100 supply terminals P1-P2(-P3 if used), see Par. 4.4.
Switching-off the de-excitation contact leads to stop powering the generator exciter in a short time.
Especially in generator/hydro turbine applications, the load rejection (i.e. when generator is paralleled with the network) must be always simultaneously accompanied by the prompt excitation shutdown of the generator, in order to limit the generator over-voltage due to the load rejection and the turbine over-speed.

In case of hydro turbine applications, the de-excitation contact must be always switched-off simultaneously with the load rejection and/or disconnection from parallel operation.

Generally, Marelli Motori recommends to associate the momentary switch-on of the STOP contact (C2) to the switch-off of the de-excitation contact. This procedure permits to accelerate the excitation shutdown and strongly limit the generator over-voltage.

WARNING: during the parallel operations, STOP contact and/or de-excitation contact can be only used simultaneously with the load rejection and/or disconnection from parallel operation.

WARNING: read carefully all the instructions about START and STOP contacts operating use, see Par. 3.5.

WARNING: Marelli Motori recommends to associate STOP contact to the de-excitation contact only for improving the generator transient performance during the load rejection and/or disconnection from parallel operation, and safe the MEC-100 regulation system.

4. INSTALLATION

4.1. INTRODUCTION

In this section the instructions for the mechanical fastening of the MEC-100 and its electrical connection are provided.

4.2. MOUNTING

The MEC-100 case is suitable for both on-board machine mounting and panel mounting.
See Fig. 4.2.a.

4.3. SERIAL COMMUNICATION AND PRELIMINARY SET-UP

The MEC-100 is equipped with an RS-232 serial port located on the card component side: it consists of a DB-9 female connector. For the connection to Personal Computer (see Section 5 for the MEC-100 Interface System setting instructions) a standard communication cable ending with a DB-9 female connector is required. In Fig. 4.3.a the provided pin-to-pin connection is shown.

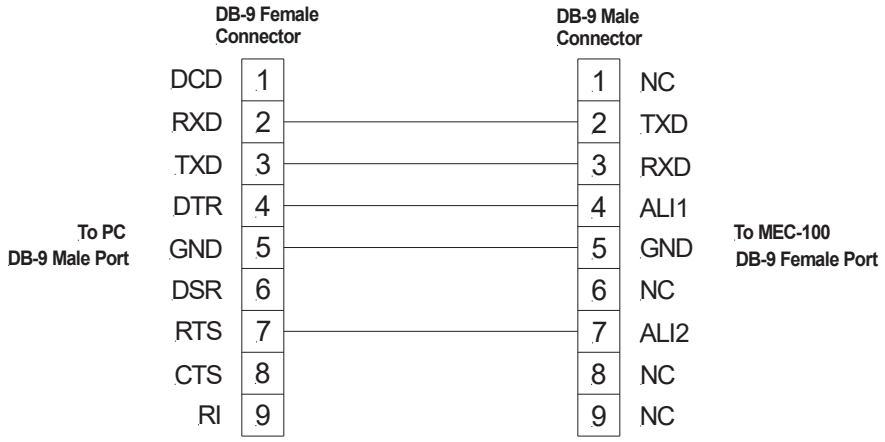


Fig. 4.3.a
MEC-100 Serial Connection to Personal Computer

If the DB-9 serial port is not available on PC, one of the USB ports must be used, paying attention to:

- Interpose an USB/DB-9 adapter between the standard cable and the PC.
- Install the adapter driver files on PC (please follow the provided instructions).

It is possible to set the MEC-100 parameters only if the MEC-100 is properly supplied, as described in Par. 2.1.
The MEC-100 is properly supplied if connected to a working generator (operating at rated voltage and rated frequency), according to the provided connection diagrams, or supplied from an external supplier. It is always advisable to supply the MEC-100 with the minimum voltage values included into the allowed supply voltage range (see Par. 2.1). It is strongly recommended to not supply MEC-100 with voltage values > 240Vac.

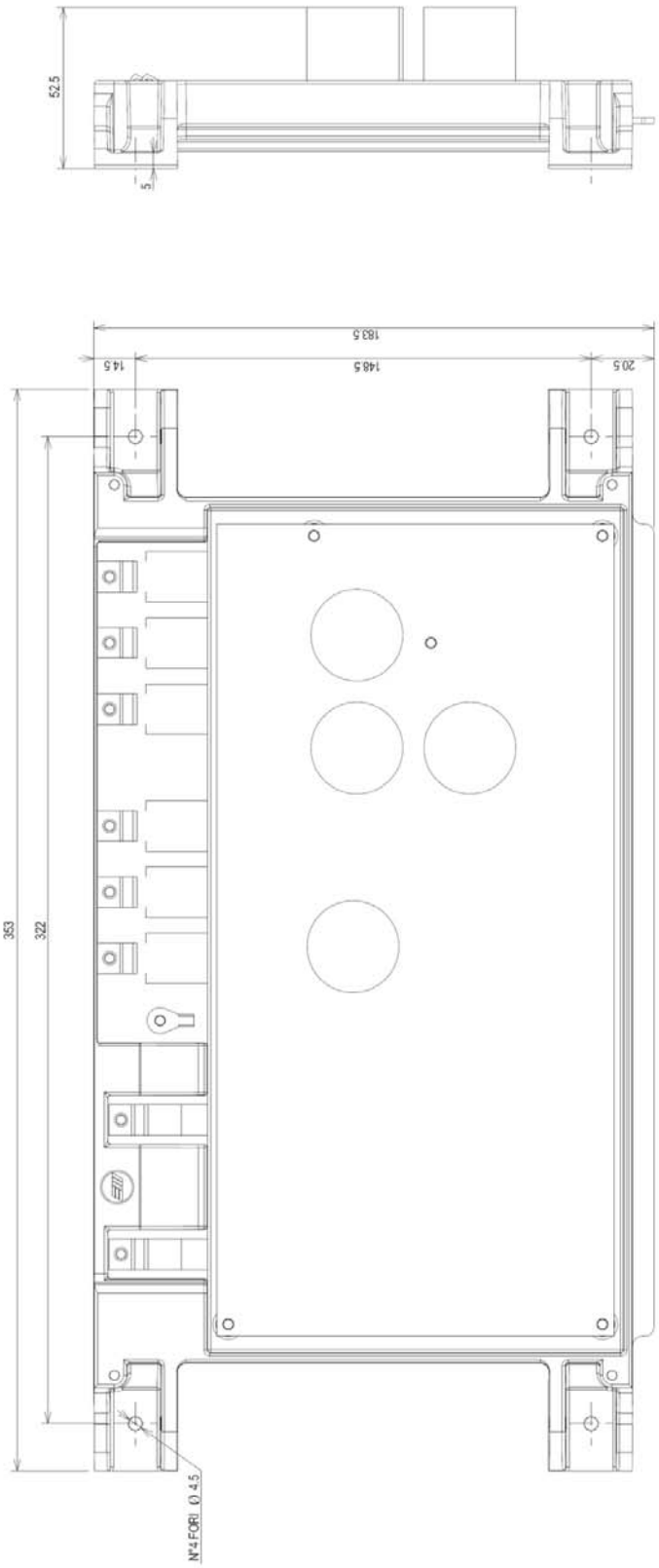


Fig. 4.2.a
MEC-100, Standard Fastening

4.4. BEFORE STARTUP - IMPORTANT NOTES CONCERNING CONNECTIONS – RESTRICTIONS

For the MEC-100 installation, please consider the following important notes/restrictions:

1. For all the applications with MEC-100, the connections must always comply with the Marelli Motori connection diagrams provided with the generator.

2. If included in the Marelli Motori connection diagrams, the de-excitation (shutdown) contact must always be used (see instructions in Par. 3.12), unless prior agreement or authorization of Marelli Motori skilled personnel.

3. All types of switch or other devices not formally included in the Marelli Motori connection diagrams can not be used and/or put on the MEC-100 output and/or exciter field, unless prior agreement or authorization of Marelli Motori skilled personnel.

4. If the MEC-100 application environment is affected by electromagnetic disturbance (EMI) higher than the specific limits described in Par. 2.13, the User must equip the MEC-100 system of the the proper and suitable protections (shielded cables, ferrites, etc.) on his own. EMI out of specifications can lead to unproper working of MEC-100 and/or to hardware damages.

5. MEC-100 can be permanently damaged in case of imprioper voltage applied to the digital contact terminals, e.g. (but not exclusively) due to interferences entering the connections.
   In detail, it is compulsory to avoid voltage peaks higher than 40V on the terminals named Cx, M.

   In case of doubt about interference peak values on these terminals, the user is bound to install dry contacts (relays) near to the regulator (distance ≤ 50cm); suitable cabling (shielded and twisted cables) between dry contacts and MEC-100 must not be longer than 2m.

6. MEC-100 can be permanently damaged if an external device connected to the analogue input of MEC-100 has not an output galvanically insulated. Make sure the device has suitable output before connecting to the MEC-100.

7. The aluminum enclosure of MEC-100 must be electrically connected to GROUND.

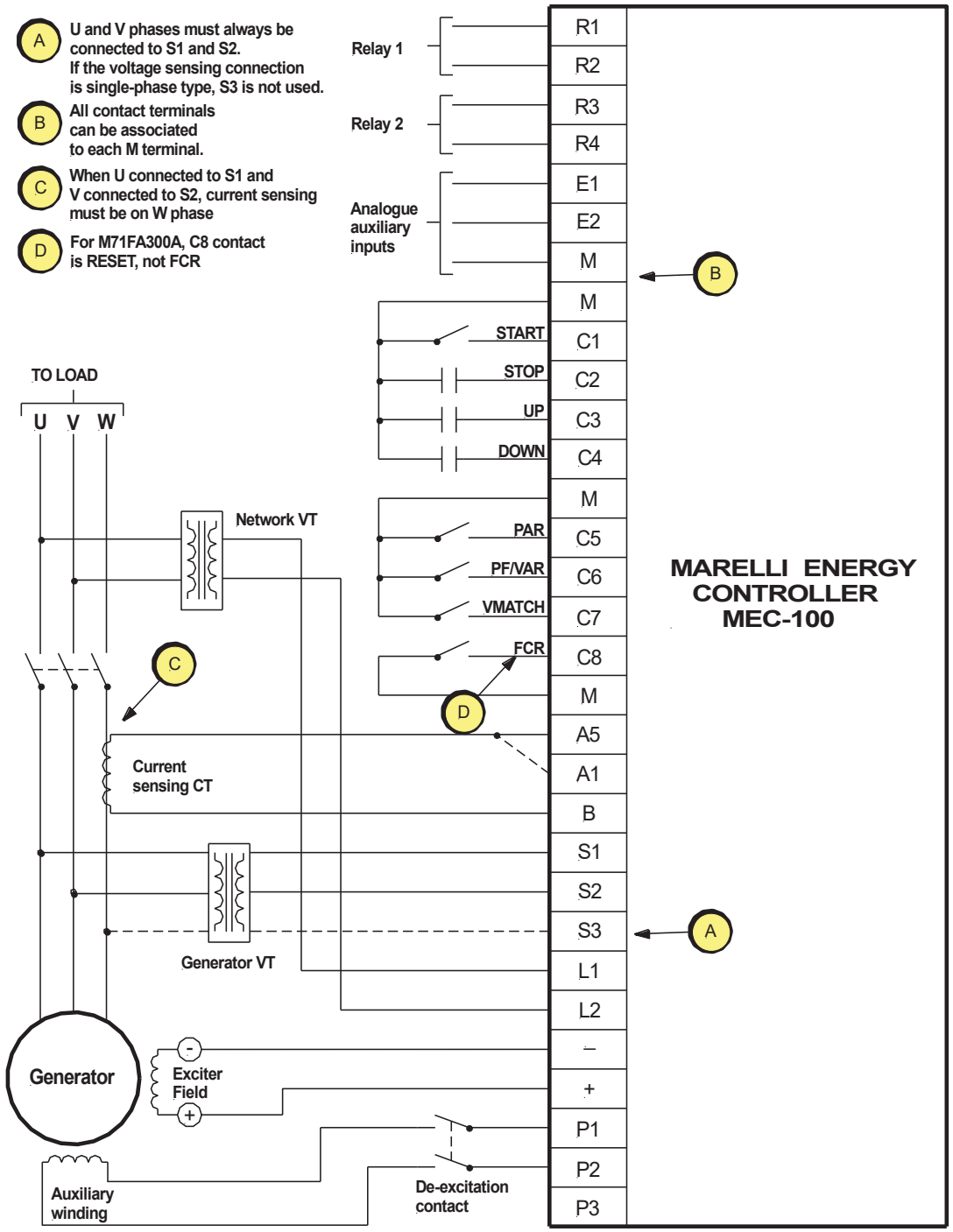
8. Should further information about the connection diagrams and/or the used components be required, Marelli Motori Services (see Par. 6.2) must always be contacted and/or involved before the MEC-100 commissioning.

WARNING: Before doing any operations and/or any set-up on MEC-100, is to be taken into consideration that lethal voltage is present at the top panel when the unit is energized. Top panel connections and/or operations with or without tools should be made only when the unit is de-energized. Is to be understood that this lethal voltage affects all the components included in the card and all the parts electrically connected to the controller.
Marelli Motori is under no liability for any damages which may occur to the AVR, the plant or the persons, or for lost earnings, or financial loss, or system stoppages, due to missing application of these notes.

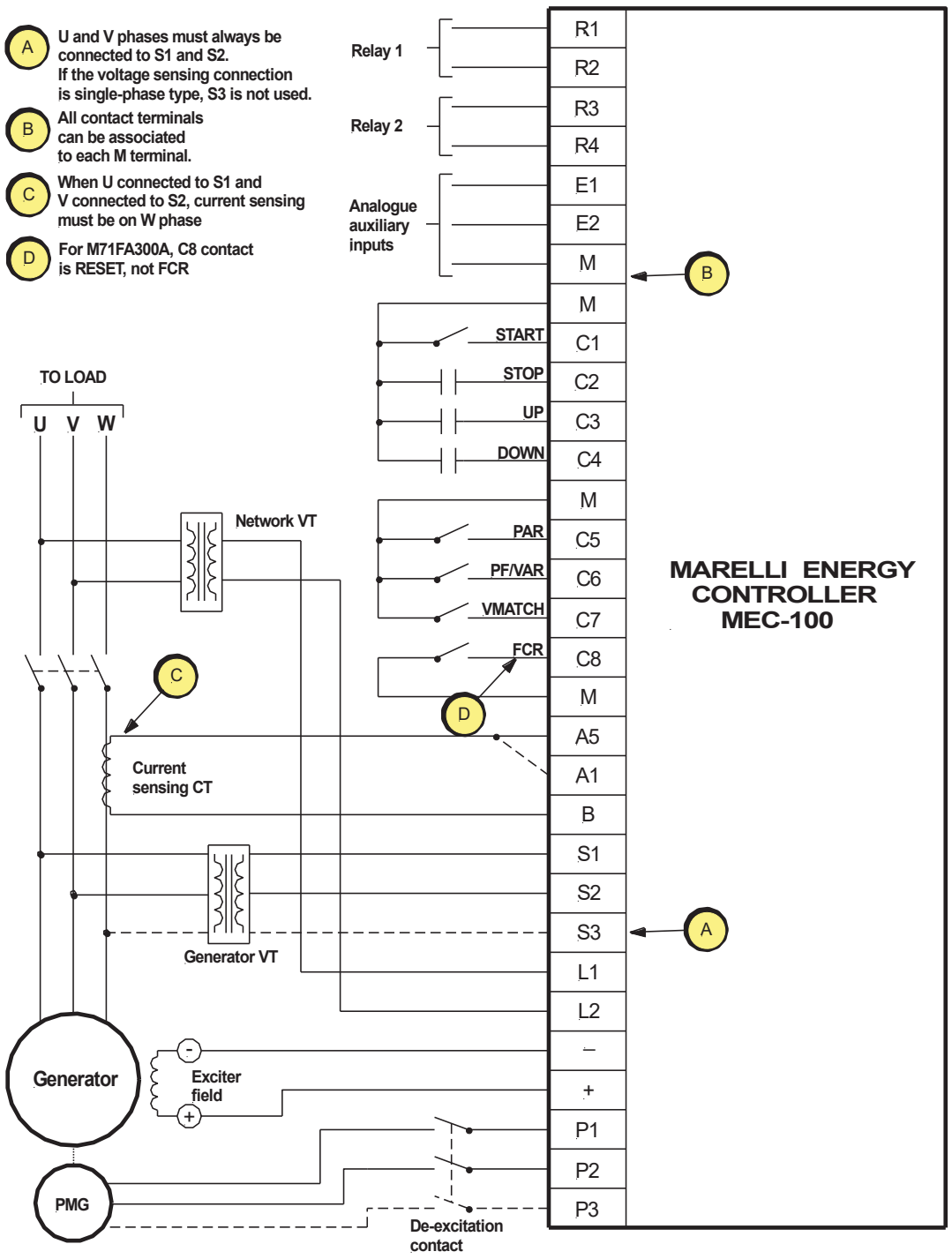
4.5. CONNECTIONS (TYPICAL)

Minimum cable size suggested:
1. On board installation: 1.5mm^2 minimum.
2. External installation (distance ≤50m): 2.5mm^2 minimum (shielded cable suggested).
3. External installation (distance >50m): 4.0mm^2 minimum (shielded cable suggested).

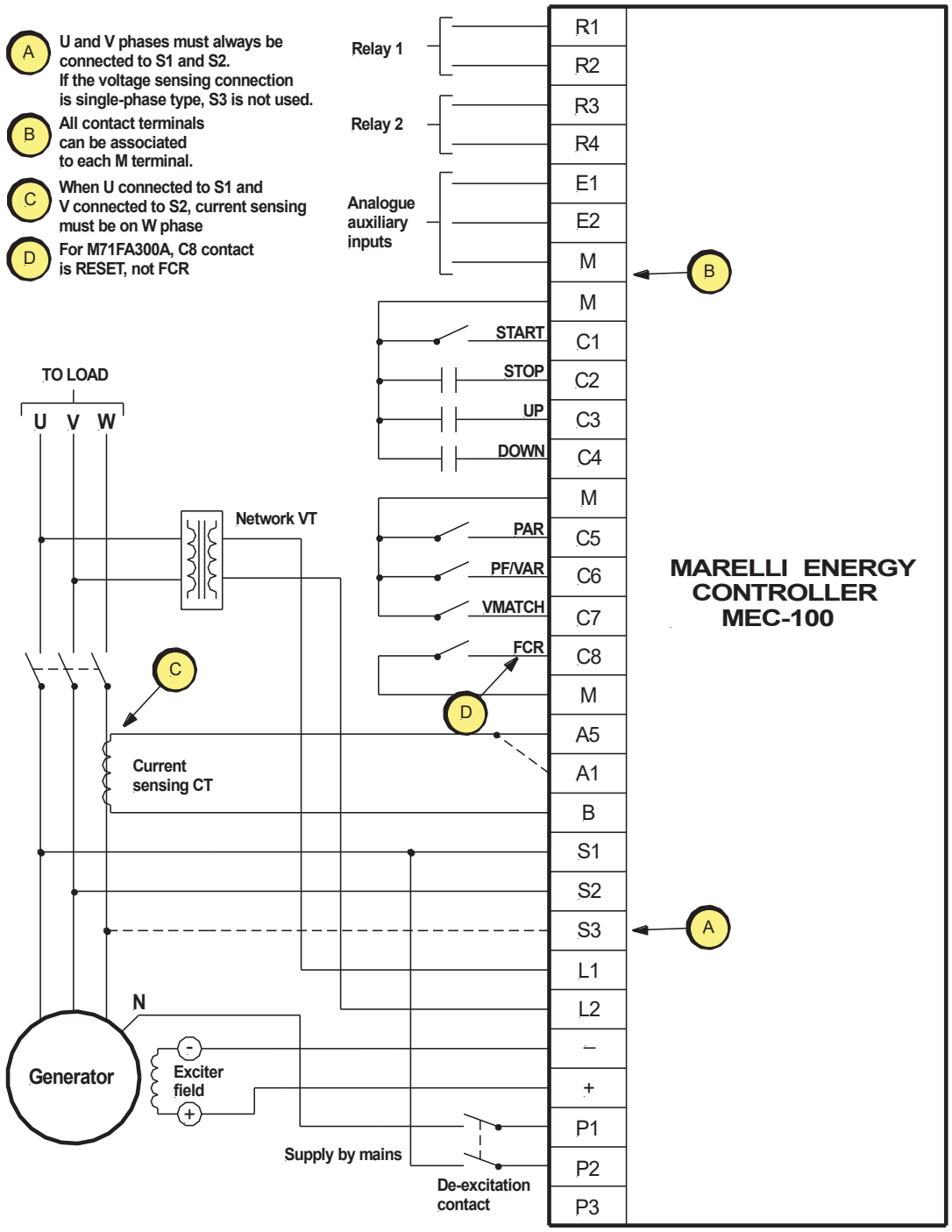
4.5.1. Power Supply from Auxiliary Winding



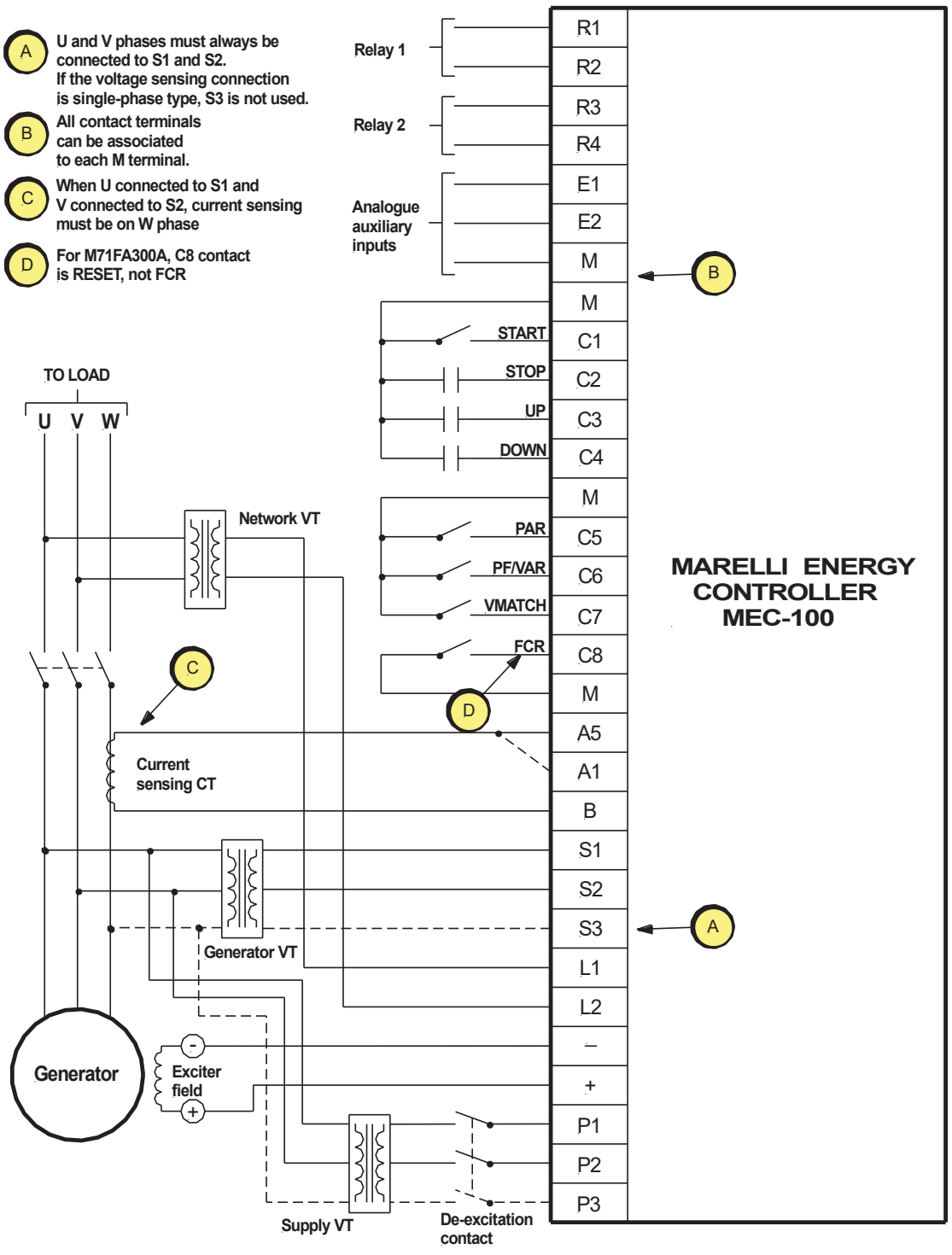
4.5.2. Power Supply from PMG (Permanent Magnet Generator)



4.5.3. Power Supply from Main Terminals (Low Voltage)



4.5.4. Power Supply from Main Terminals (Medium Voltage)



5. MEC-100 INTERFACE SYSTEM

5.1. INTRODUCTION

The MEC-100 Interface System provides an interface tool between the MEC-100 and the user capable of:
- Providing a user-friendly and intuitive working environment for the setting of the regulation system parameters.
- Displaying in real time the electrical data of the system controlled by the MEC-100.
- Allowing the system status control.
- Enabling the storage of the complete set of system parameters in the form of program files or text files.

5.2. MEC-100 PRELIMINARY SETUP AND INSTALLATION OF THE MEC-100 INTERFACE SYSTEM

MEC-100 is equipped with an RS-232 serial port located on the component side of the board, consisting of a female DB-9 connector. To connect it to a Personal Computer you will need a standard serial communication cable, terminated with a female DB-9 connector, to be plugged into the relevant PC port.
Should the PC not be equipped with an RS-232 serial port, use the USB port, taking care of:
- Interposing a male USB/DB-9 adapter between the serial cable and the USB port.
- Installing on the PC the drivers supplied along with the adapter (follow the instructions provided by the manufacturer).

Fig. 5.2.a shows the wiring diagram you will have to follow for the preliminary setup of MEC-100. You will have to perform the following actions (in the specified sequence):
- Connect MEC-100 to the PC through the serial cable.
- Power the board, by supplying voltage to terminals P1 and P2. The supply voltage can be anywhere between 30Vac and 240Vac.
- The aluminium support of MEC-100 must be connected to GROUND.

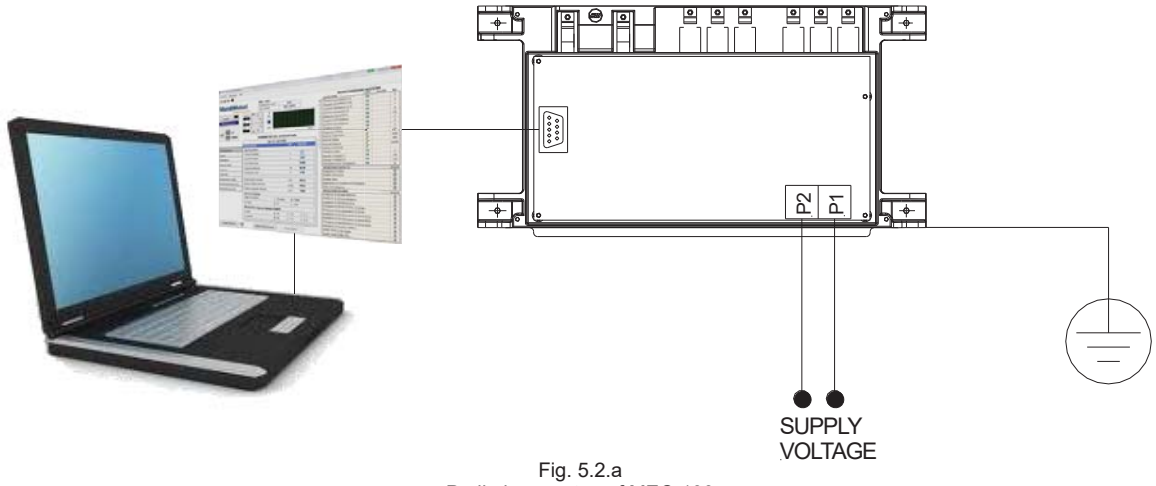


Fig. 5.2.a
Preliminary setup of MEC-100

FOR THE PRELIMINARY SETUP OF MEC-100 DISCONNECT ANY CONNECTED CABLES AND POWER THE BOARD FROM A SOURCE OTHER THAN THE GENERATOR. The only connections must be the ones shown in Fig. 5.2.a.

WARNING: Should you have to physically intervene on the MEC-100 and/or perform any setup operation, never forget that if the regulator unit is powered, the upper section of the MEC-100 regulation panel (on the connection site) is subject to a lethal voltage. Any operation resulting in direct contact with the regulator board must be performed when the unit is not powered.

The CD-ROM provided together with the MEC-100 system includes the utility for the installation of the MEC-100 Interface System software and the user and maintenance manuals (User Manual) of the regulation system.

5.2.1. Minimum System Requirements

Here below the minimum PC system requirements for the proper installation and utilization of the software are listed:
- Microsoft Windows®.
- CD-ROM drive.
- RS-232 Serial port or USB port.

5.2.2. Installing the MEC-100 Interface System

To install the MEC-100 Interface System in the PC you must:
- Insert the CD-ROM disk provided with the MEC-100 into the PC CD-ROM drive.
- When the installation menu appears, click the *Install* button; the set-up utility of the MEC-100 Interface System will install automatically the software.
- Follow the instructions which appear on the PC screen.

5.2.3. Starting the Program

To start the MEC-100 Interface System you must:
- Click the Windows® *Start* button.
- Select *Programs*.
- Point to the *MarelliMotori* directory.
- Select the *MEC-100 Interface System* icon.
- Follow the instructions which appear in the start menu.

5.2.4. Uninstalling the MEC-100 Interface System

To uninstall the MEC-100 Interface System from your PC you must:
- Open the Windows® File Manager.
- Select the MEC-100 Interface System installation folder.
- Double click on *unins000.exe* file.
- Follow the instructions which appear on the PC screen.

5.3. START-UP

5.3.1. Acceptance of the General Contract Conditions

To start the MEC-100 Interface System follow the instructions provided in Par. 5.2.3**Errore. L'origine riferimento non è stata trovata.**. At the start-up a presentation window (see Fig. 5.3.1.a), will be displayed with indication of the software version and the request for acceptance of the general contract conditions.

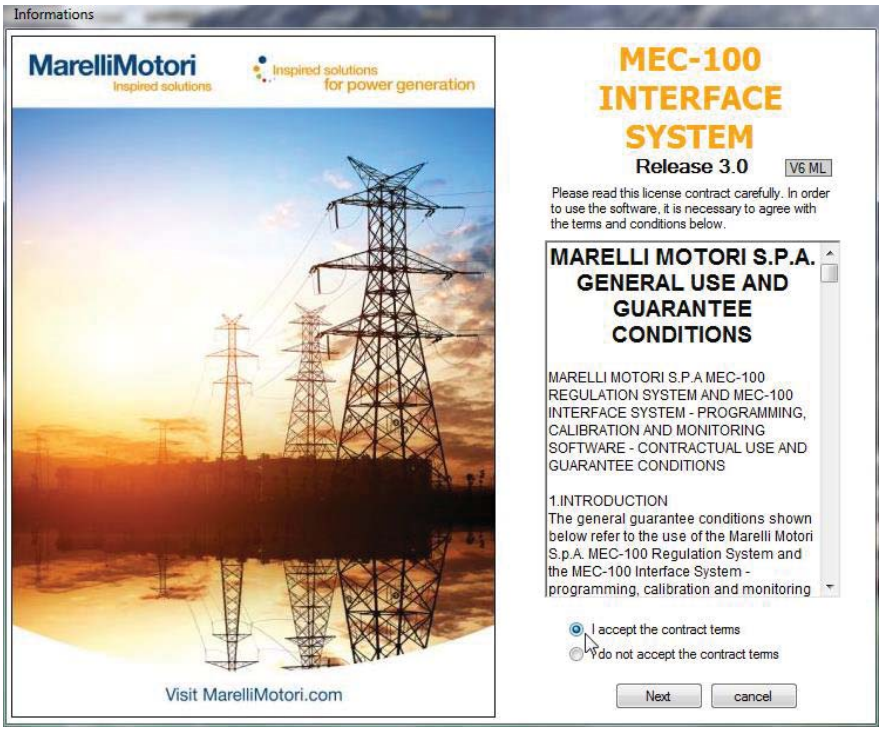


Fig. 5.3.1.a
Start-up Window

To start the MEC-100 Interface System you must select *I accept the contract terms* and then click on the *Next* button.

READ CAREFULLY THE GENERAL CONTRACT CONDITIONS.
Perform the above-mentioned operations to start the program involves the SIGNING and FULL ACCEPTANCE by the user of the there described terms and conditions.

5.3.2. Description of the Work Window

After you have started the MEC-100 Interface System as described in Para. 5.2.3 and 5.3.1, the equipment will display the work window allowing to configure and monitor the regulation system parameters. Fig. 5.3.2.a. shows the displayed screen:

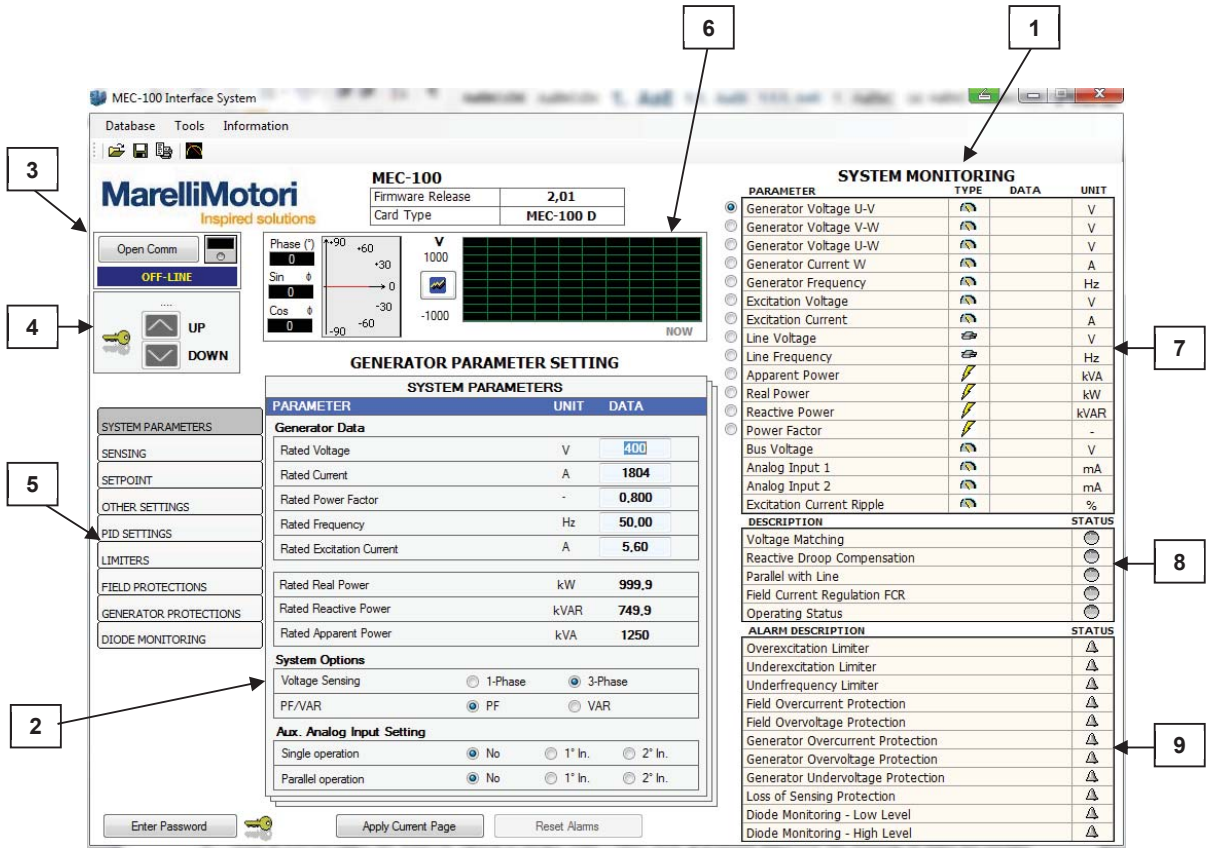


Fig. 5.3.2.a
MEC-100 Interface System Work Window

It includes the following elements:

1. *System monitoring area*: displays in real time the values relative to the electrical system data, the status of contacts and alarms.
2. *Generator parameter area*: set of pages dedicated to the system configuration. It includes the fields where to assign the appropriate values to all parameters involved in the system configuration. The parameters are grouped by type in 9 Categories (system data, sensing, setpoints and other settings, stability, limitation parameters, protections, field and generator, diode monitoring).
3. *MEC-100-PC communication area*: area for the management of the communication between MEC-100 and PC. It shows in real time the communication status.
4. *Setpoint variation buttons*: tools for the modification of the controlled quantity setpoint (voltage, power factor or reactive power depending on the actual operating mode).
5. *Group selection area*: frame to select the desired configuration window.
6. *Oscillographic tracing of a system quantity*.
7. *Electrical system parameter monitoring*.
8. *System status window*.
9. *Alarm window*.

5.3.3. Establishing a Communication Link

Before configuring or monitoring the regulation system parameters you must establish a communication link between MEC-100 and MEC-100 Interface System.

To establish a communication link between MEC-100 and MEC-100 Interface System you must:
- Verify that the connection between MEC-100 and Personal Computer has been established as described in Par.5.2.
- Start the MEC-100 Interface System software as described in Par. 5.3.1.
- Click on the *Open Comm* button as shown in Fig. 5.3.3.a.

Fig. 5.3.3.a
Connection Button

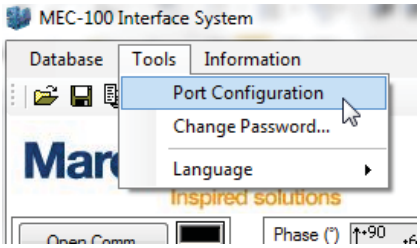


Fig. 5.3.3.b
Port configuration

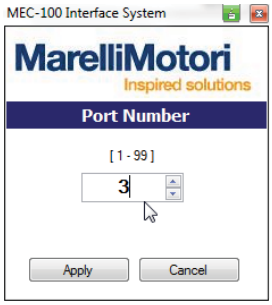


Fig. 5.3.3.c
Communication port selection

To select a PC communication port other than the default, execute the following operations:
- Click on the *Tools* item in the menu bar of the MEC-100 Interface System (see Fig. 5.3.3.b).
- In the displayed pull-down menu, select the *Port Configuration* item.
- A window (see Fig. 5.3.3.c) appears where the desired communication port can be selected (from 1 to 99).

After establishing the connection, the MEC-100 Interface System configuration parameters, initially set to zero by default, are automatically updated to the values saved in the MEC-100; these last can correspond to the default values, if the regulator is set for the first time, or to those stored in the E^2PROM in case of previously performed configuration operations.

The communication initialization and the update of the regulation system parameters may take a few seconds. In view of the correct execution of such operations, it is recommended to wait until they are completed before entering any data.

You can connect to MEC-100 only when current is properly supplied to its power terminals; in order to communicate with the device microprocessor, in fact, the latter must be powered and in operation.

5.4. PASSWORD MANAGEMENT

After starting the MEC-100 Interface System and establishing the connection, the *System Monitoring* section is operative and shows the value of the regulation system electrical quantities on a real-time basis. In the *System Parameters* section the values of the system parameters stored in the MEC-100 are displayed: they can correspond to the default values in case of first configuration or to those saved during a previous configuration operation.
Immediately after establishing the connection to the MEC-100 or after 5 minutes from the last use of the MEC-100 Interface System, the *System Parameters* section appears to be write-protected: it is therefore necessary to remove the write protection by entering a password. Here below the password management modes for the MEC-100 Interface System are described.

5.4.1. Entering Password

To remove the write protection of the MEC-100 Interface System and enter the password:
- Click on the *Enter Password* button, placed at the left bottom of the main screen, see Fig. 5.4.1.a.
- Enter the password in the field of the displayed window (see Fig. 5.4.1.b).
  The default password is "*marelli*".
- Click *Apply*.

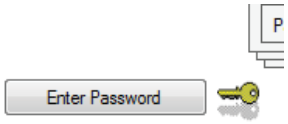


Fig. 5.4.1.a
Password entering button

Fig. 5.4.1.b
Entering the password

5.4.2. Changing Password

To modify the password:

- Click on the *Tools* item in the menu bar of the MEC-100 Interface System (see Fig. 5.4.2.a).
- In the displayed pull-down menu, point to the *Modify Password* item and click.
- In the window which appears enter the current password in the *Previous Password* field and the desired password in the *New Password* field; afterwards enter the desired new password again for confirmation in the *Confirm Password* field (see Fig. 5.4.2.b).
- Click *OK*.

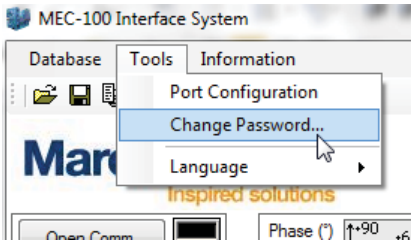


Fig. 5.4.2.a
Selecting *Change Password*

Fig. 5.4.2.b
Entering a *New Password*

5.5. CHANGING THE SYSTEM SETTINGS

As anticipated in Par. 5.3.2., the system parameters are grouped into eight main categories according to their typology:

- *System parameters.*
- *Sensing.*
- *Setpoint.*
- *Stability.*
- *Other settings.*
- *Limiters.*
- *Field protections.*
- *Generator protections.*
- *Diode monitoring.*

Each category can be selected by the relevant button in the frame indicated Fig. 5.5.a. After selecting one of the categories, the corresponding set of parameters is displayed. If connected to the MEC-100, the above-mentioned set of parameters can also be configured.

A parameter can be configured by clicking in the appropriate field and typing the desired value or selecting the desired option between the available options. In any field you can only enter values falling within determined limits, established on the basis of the parameter type, the particular application and the other set parameters. The limits are normally indicated next to the name of the parameter to be configured. If you try to enter a value outside the allowed range a red exclamation mark will appear next to the entered item. After configuring a group of parameters, you need to send the entered data to the MEC-100 before switching to the next group; otherwise, the typed data will be lost.

To configure the MEC-100, that is to enter the desired values for the system parameters, you must:

- Connect to the MEC-100 (see Par. 5.3.3).
- Enter la password if required (see Par. 5.4.1).
- Select the desired group of data (see Fig. 5.5.a).
- Click in the field to modify and enter the desired value. Repeat the operation for each parameter to be configured (see Fig. 5.5.b).
- As soon as all parameters into the group are set, click the *Apply Current Page* button, located under the configuration area (see Fig. 5.5.c).

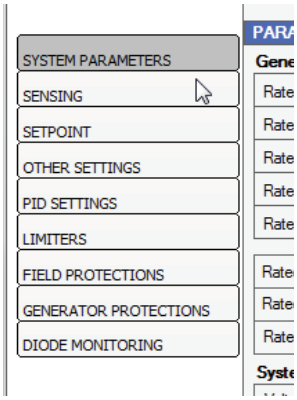


Fig. 5.5.a
Selecting the parameter category

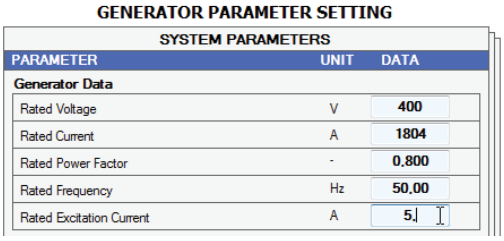


Fig. 5.5.b
Entering the parameter

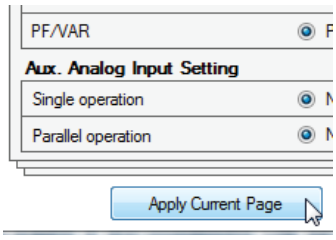


Fig. 5.5.c
Button for data forwarding to MEC-100

5.6. SAVING AND RETRIEVING A SET OF PARAMETERS

The MEC-100 offers the possibility of saving in a file the full set of system parameters to retrieve and load this last later in the same MEC-100 or in another unit.

5.6.1. Saving a Set of Parameters

To save a full set of system parameters:

- Connect to the MEC-100 (see Par. 5.3.3).
- Enter the password if required (see Par. 5.4.1).
- Configure all the parameters to be set.
- Click the *Database* button in the menu bar of the MEC-100 Interface System (see Fig. 5.6.1.a).
- In the displayed pull-down menu, point to the *Save Parameter File On-line* item and click.
- In the File Manager window, select a directory where to save the file, type the file name and click on *OK*.

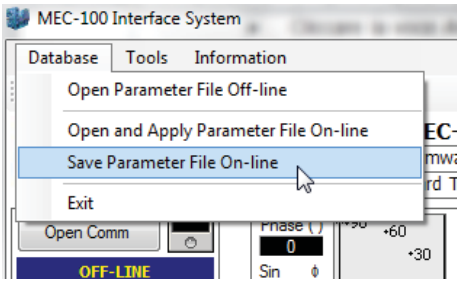


Fig. 5.6.1.a
Saving the MEC-100 parameters, online

5.6.2. Loading a Set of Parameters

To load a full set of system parameters:
- Connect to the MEC-100 (see Par. 5.3.3).
- Enter the password if required (see Par. 5.4.1).
- Click the *Database* button in the menu bar of the MEC-100 Interface System (see Fig. 5.6.2.a).
- In the displayed pull-down menu, point to the *Open and Apply Parameter File On-line* item and click.
- In the File Manager window, select the directory where the file to load is stored, select it and click on *OK*.

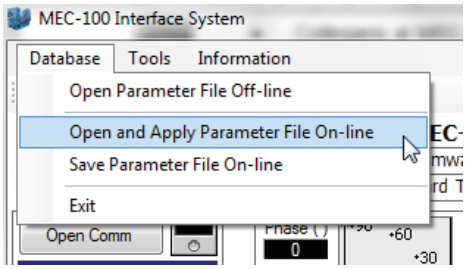


Fig. 5.6.2.a
Loading a set of parameters

This operation is possible only if the MEC-100 and the PC are communicating (On-line operating mode). To check a parameter file without automatic applying to MEC-100, see Par. 5.6.3.

BE CAREFUL TO APPLY A CONFIGURATION SET TO THE MEC-100 WHEN THIS LAST IS COMMUNICATING WITH THE OPERATING GENERATOR. Perform the above-mentioned operations to apply a configuration set to the MEC-100 regulating the generator, involves a regulation setting alteration; it could be dangerous if the system parameters are not properly set for the application. IT IS ALWAYS ADVISABLE TO LOAD A NEW CONFIGURATION FILE WHEN THE MEC-100 IS NOT REGULATING THE GENERATOR.

5.6.3. Checking a Set of Parameters Off-line

To check a whole set of parameters without applying to MEC-100:
- Interrupt the connection to the MEC-100.
- Click the *Database* button in the menu bar of the MEC-100 Interface System (see Fig. 5.6.3.a).
- In the displayed pull-down menu, point to the *Open Parameter File Off-line* item and click.
- In the File Manager window, select the directory where the file to load is stored, select it and click on *OK*.

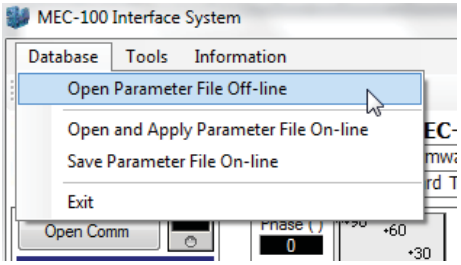


Fig. 5.6.3.a
Viewing a set of parameters offline

This operation only allows to check the configuration file: it is not possible to save a new configuration file in Off-line operating mode.

5.6.4. Printing a Set of Parameters

To print a whole set of parameters:
- Connect to the MEC-100 (see Par. 5.3.3) if required.
- Enter the password if required (see Par. 5.4.1).
- Click the button shown in Fig. 5.6.4.a. A new window will appear (see Fig. 5.6.4.b).
- Type the required data and click the button *Preview*. A preview of the parameter list will appear.
- To print it, click the button shown in Fig. 5.6.4.c.

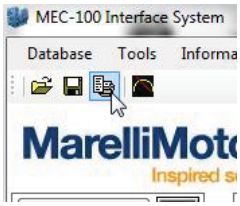


Fig. 5.6.4.a
Selecting the Print operation

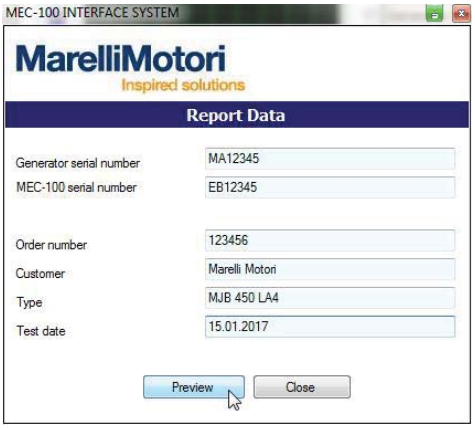


Fig. 5.6.4.b
Selecting the Print operation

Fig. 5.6.4.c
Selecting the Print operation

5.7. DEFINITION OF CONFIGURABLE PARAMETERS

Each one of the 10 parameter categories is characterized by its own window, which includes as many configurable fields as many parameters are here considered and contained. Each field is generally characterized by:
- *Parameter name.*
- *Unit of measurement.*
- *Maximum and minimum entry limits.*
- *Entered parameter.*

At the moment of the first configuration operation, each field includes a default value which prevents the MEC-100 from malfunctions or damages. **ALL PROTECTIONS AND LIMITATIONS ARE DISABLED**.

To configure all the MEC-100 parameters through the MEC-100 Interface System, carefully read the following instructions.
Remember that the parameters are divided into 9 categories according to their type; each category is associated with a single setting window.
As parameters are entered on an individual window basis, other parameters in other windows might not be consistent with the ones you have just entered.
Check all the parameters you entered before you start using MEC-100.

The below a description of the configurable fields is provided: they are divided based on the group they belong to.

Key:

❑ *Numeric value entry.*

💻 *Value calculated, measured and/or displayed by MEC-100 Interface System.*

⊙ *Choosing one option leads to the exclusion of the other options.*

☑ *Enabling flag.*

Pull-down menu option.

5.7.1. System Parameters

In Fig. 5.7.1.a the system parameters configuration area is shown.

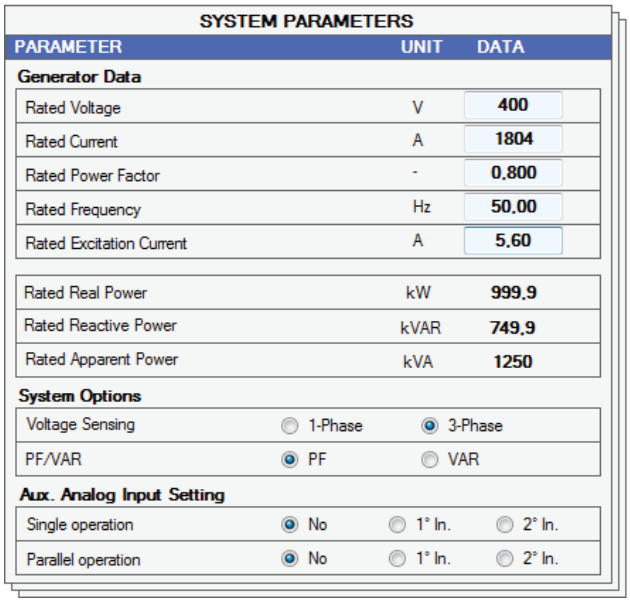


Fig. 5.7.1.a
System Parameter Area

Generator Electrical Data

- ❑ *Rated Voltage (V)*: enter in this field the generator rated voltage value (phase-phase).
- ❑ *Rated Current (A)*: enter in this field the generator rated current value.
- ❑ *Rated Power Factor*: enter in this field the generator rated power factor value.
- ❑ *Rated Frequency (Hz)*: enter in this field the generator rated frequency value.
- ❑ *Rated Excitation Cirrent (A)*: enter in this field the generator rated excitation current value.
- 💻 *Rated Real Power (kW)*: based on the data entered in the previous fields, the MEC-100 Interface System calculates the generator rated real power value.
- 💻 *Rated Reactive Power (kvar)*: based on the data entered in the previous fields, the MEC-100 Interface System calculates the generator rated reactive power value.
- 💻 *Rated Apparent Power (kVA)*: based on the data entered in the previous fields, the MEC-100 Interface System calculates the generator rated apparent power value.

System Options

- ⊙ *Voltage Sensing*: in this field the user can define the type of sensing required by a given application: single-phase or three-phase sensing.
- ⊙ *PF/VAR*: network parallel mode selection field; in this field you can select which regulation mode should be used in the network parallel operations. When the *PF/VAR* contact (see Par. 3.5.6) is closed, the MEC-100 will perform the adjustment of the power factor if PF has been selected or the reactive power if VAR has been selected.

Aux. Analog Input Setting – Single Operation (see Par. 3.4.4):

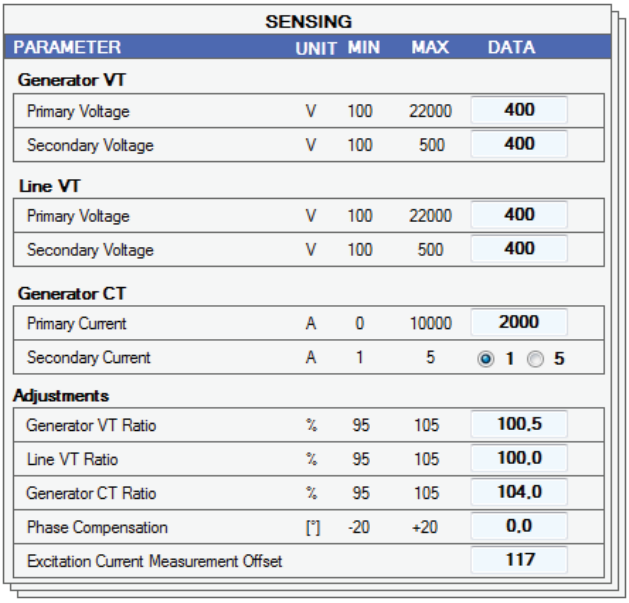
- ⊙ *No*: if this option is selected, no analogue auxiliary input will be associated to the generator voltage setpoint.
- ⊙ *1° In.*: if this option is selected, analogue auxiliary input 1° will be associated to the generator voltage setpoint.
- ⊙ *2° In.*: if this option is selected, analogue auxiliary input 2° will be associated to the generator voltage setpoint.

Aux. Analog Input Setting – Parallel Operation (see Par. 3.4.4):

- ⊙ *No*: if this option is selected, no analogue auxiliary input will be associated to the power factor or reactive power setpoint (it depends on the Operating Mode selected in *System Parameter* area, see Par. 5.7.1).
- ⊙ *1° In.*: if this option is selected, the analogue auxiliary input 1° will be associated to the power factor or reactive power setpoint (it depends on the Operating Mode selected in *System Parameter* area, see Par. 5.7.1).
- ⊙ *2° In.*: if this option is selected, the analogue auxiliary input 2° will be associated to the power factor or reactive power setpoint (it depends on the Operating Mode selected in *System Parameter* area, see Par. 5.7.1).

5.7.2. Sensing

In Fig. 5.7.2.a the sensing parameters configuration area is shown.



SENSING				
PARAMETER	UNIT	MIN	MAX	DATA
Generator VT				
Primary Voltage	V	100	22000	400
Secondary Voltage	V	100	500	400
Line VT				
Primary Voltage	V	100	22000	400
Secondary Voltage	V	100	500	400
Generator CT				
Primary Current	A	0	10000	2000
Secondary Current	A	1	5	◉ 1 ○ 5
Adjustments				
Generator VT Ratio	%	95	105	100,5
Line VT Ratio	%	95	105	100,0
Generator CT Ratio	%	95	105	104,0
Phase Compensation	[°]	-20	+20	0,0
Excitation Current Measurement Offset				117

Fig. 5.7.2.a
Sensing Parameter Area

<u>*Generator VT*</u>: present in the applications with generator voltages higher than 500V, which need a step-down transformer between generator and MEC-100 sensing terminals.

- ❑ *Primary Voltage (V)*: enter in this field the primary voltage value of the TV used (100 to 22000V, with minimum increase of 1V).
- ❑ *Secondary Voltage (V)*: enter in this field the secondary voltage value of the TV used (100 to 500V, with minimum increase of 1V).

If the generator voltage value is lower than 500V, the use of a step-down transformer may not be necessary: therefore, the MEC-100 is directly connected to the mains terminals. In this case, in both the Primary *and* Secondary Voltage *fields the same value, equal to the predefined rated value, should be entered.*

<u>*Line VT*</u>: present in the applications with network (*Line*) voltages higher than 500V, which need a step-down transformer between the network and MEC-100 sensing terminals.

- ❑ *Primary Voltage (V)*: enter in this field the primary voltage value of the TV used (100 to 22000V, with minimum increase of 1V).
- ❑ *Secondary Voltage (V)*: enter in this field the secondary voltage value of the TV used (100 to 500V, with minimum increase of 1V).

If the network voltage value is lower than 500V, the use of a step-down transformer may not be necessary: therefore, the MEC-100 is directly connected to the network terminals. In this case, in both the Primary *and* Secondary Voltage *fields the same value, equal to the predefined rated value, should be entered.*

<u>*Generator CT*</u>: makes the generator current sensing.

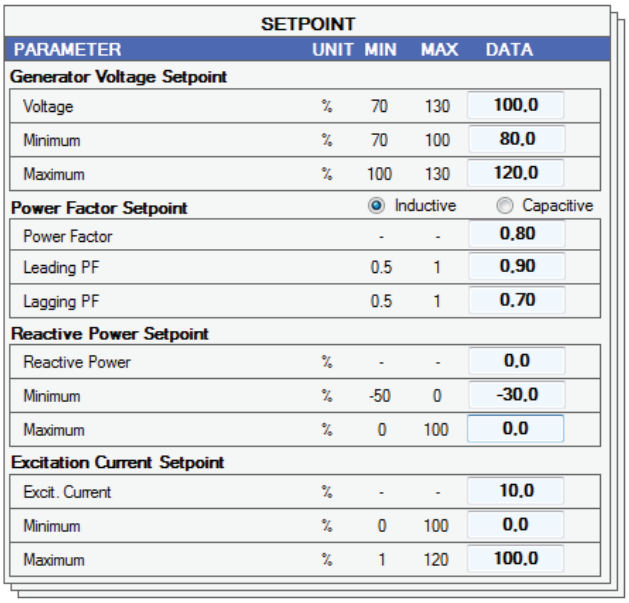
- ❑ *Primary Current (A)*: enter in this field the primary current value of the CT used (1 to 10000A, with minimum increase of 1A).
- ⊙ *Secondary Current (A)*: select in this field the secondary current value of the TA used by choosing between the two standard values: 1A and 5A.

<u>*Calibrations*</u>: this set of parameters allows to calibrate the MEC-100 sensing function in case of non-ideal transformation ratios; in this way the correct voltage, current and phase values are guaranteed to both the regulation and monitoring areas.

- ❑ *Generator VT Ratio (%)*: if the MEC-100 Interface System senses and displays a generator voltage value higher, of a given percentage, than the actual value, you need to add this percentage to the percentage already entered in the field (100% of default), to obtain a correct and accurate sensing calibration (95 to 105%, with minimum increase of 0.1%).
- ❑ *Line VT Ratio (%)*: if the MEC-100 Interface System senses and displays a network voltage value higher, of a given percentage, than the actual value, you need to add this percentage to the percentage already entered in the field (100% of default), to obtain a correct and accurate sensing calibration (95 to 105%, with minimum increase of 0.1%).
- ❑ *Generator CT Ratio (%)*: if the MEC-100 Interface System senses and displays a generator current value higher, of a given percentage, than the actual value, you need to add this percentage to the percentage already entered in the field (100% of default), to obtain a correct and accurate sensing calibration (95 to 105%, with minimum increase of 0.1%).
- ❑ *Phase Compensation (degrees)*: if the MEC-100 Interface System senses and displays a power factor value higher or lower than the actual value, you need to introduce a compensation angle (0° default value), to obtain a correct and accurate power factor measurement (-10° to +10°, with minimum increase of 0.1°).
- ❑ *Excitation current measurement offset*: should the excitation current reading by MEC-100 be incorrect, increase or decrease the *Offset* value until the displayed measurement is correct.

5.7.3. Setpoint

In Fig. 5.7.3.a the setpoint configuration area is shown.



SETPOINT

PARAMETER	UNIT	MIN	MAX	DATA
Generator Voltage Setpoint				
Voltage	%	70	130	100,0
Minimum	%	70	100	80,0
Maximum	%	100	130	120,0
Power Factor Setpoint		(•) Inductive	( ) Capacitive	
Power Factor		-	-	0,80
Leading PF		0.5	1	0,90
Lagging PF		0.5	1	0,70
Reactive Power Setpoint				
Reactive Power	%	-	-	0,0
Minimum	%	-50	0	-30,0
Maximum	%	0	100	0,0
Excitation Current Setpoint				
Excit. Current	%	-	-	10,0
Minimum	%	0	100	0,0
Maximum	%	1	120	100,0

Fig. 5.7.3.a
Setpoint Area

Generator Voltage Setpoint:

- ❑ *Voltage (%)*: enter in this field the voltage setpoint which is required at the generator output terminals, expressed in percentage with respect to the machine rated value, see Par. 5.7.1 (the maximum and minimum limits are defined in the two following fields, with minimum increase of 0.1%).
- ❑ *Minimum Limit (%)*: enter in this field the minimum value which the voltage setpoint can reach, expressed in percentage with respect to the machine rated voltage, see Par. 5.7.1 (70 to 100%, with min. increase of 1%).
- ❑ *Maximum Limit (%)*: enter in this field the maximum value which the voltage setpoint can reach, expressed in percentage with respect to the machine rated voltage, see Par. 5.7.1 (100 to 130%, with min. increase of 1%).

If one of the two limits is modified and the actual voltage setpoint is outside the new defined range, the setpoint is automatically brought to the just modified limit value.

Power Factor Setpoint:

- ⊙ *Power Factor Setpoint*: defines if the power factor setpoint should be inductive or capacitive.
- ❑ *Power Factor*: enter in this field the power factor setpoint you like to keep (the minimum leading and minimum lagging limits are set in the following two fields; minimum increase of 0.001).
- ❑ *Leading PF*: enter in this field the minimum leading value which the power factor setpoint can reach (0.5 to 1, with minimum increase of 0.01).
- ❑ *Lagging PF*: enter in this field the minimum lagging value which the power factor setpoint can reach (0.5 to 1, with minimum increase of 0.01).

If one of the two limits is modified and the current power factor setpoint is outside the new defined range, the setpoint is automatically brought to the just modified limit value.

Reactive Power Setpoint:

- ❑ *Reactive Power (%)*: enter in this field the reactive power setpoint you like to keep, expressed in percentage with respect to the maximum reactive power (the maximum and minimum limits are established in the following two fields, with minimum increase of 0.1%).
- ❑ *Minimum Limit (%)*: enter in this field the (capacitive) minimum value which the reactive power setpoint can reach, expressed in percentage with respect to the maximum reactive power (–50% to 0%, with minimum increase of 1%).
- ❑ *Maximum Limit (%)*: enter in this field the (inductive) maximum value which the reactive power setpoint can reach, expressed in percentage with respect to the maximum reactive power (0% to 100%, with minimum increase of 1%).

By the term maximum reactive power it is meant the reactive power which can be obtained with rated voltage, rated current and power factor PF=0, that is at zero active power.

If one of the two limits is modified and the current reactive power setpoint is outside the new defined range, the setpoint is automatically brought to the just modified limit value.

Excitation Current Setpoint:

- *Reactive Power (%)*: enter in this field the excitation current setpoint you like to keep, expressed in percentage with respect to the rated excitation current (the maximum and minimum limits are established in the following two fields, with minimum increase of 1%).
- *Minimum Limit (%)*: enter in this field the minimum value which the excitation current setpoint can reach, expressed in percentage with respect to the rated excitation current (0% to 100% with min. increase of 1%).
- *Maximum Limit (%)*: enter in this field the maximum value which the excitation current setpoint can reach, expressed in percentage with respect to the rated excitation current (1% to 120% with min. increase of 1%).

PAY PARTICULAR ATTENTION TO THE SELECTION AND/OR MODIFICATION OF THE SETPOINT VALUES. The limit thresholds set by the MEC-100 Interface System to the setpoint values do not protect against the selection of setpoints which may be potentially dangerous for the generator and for devices and/or installations connected to the generator. In all configuration operations of the MEC-100 Interface System, always check that the new setpoints to be entered are appropriate to the generator and the devices and/or installations connected to the generator.

5.7.4. Other Settings

In Fig. 5.7.4.a the configuration area relative to other functions is shown.

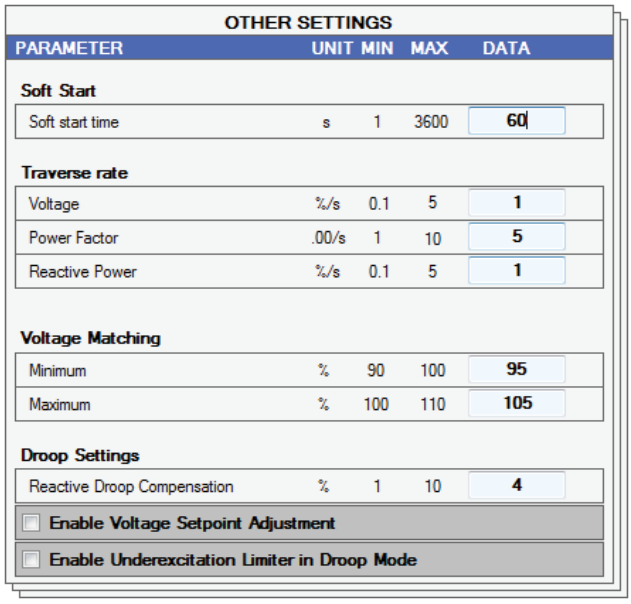


Fig. 5.7.4.a
Other Settings Area

Soft Start (see Par. 3.10):

- *Soft Start Time (s)*: enter in this field the time required by the voltage ramp, at the excitation Start-up, to reach the setpoint value defined in the setpoints window, see Par. 5.7.3 (0 to 3600s, with minimum increase of 1s).

Traverse rate:

- *Voltage (%/s)*: enter in this field the variation speed of the generator voltage setpoint when this last is modified by means of the UP/DOWN contacts or the corresponding buttons of the MEC-100 Interface System see Par. 5.3.2 (0.1%/s to 5%/s, with minimum increase of 0.1%/s).
- *Power Factor (hundredthsPF/s)*: enter in this field the variation speed of the power factor setpoint when this last is modified by means of the UP/DOWN contacts or the corresponding buttons of the MEC-100 Interface System, see Par. 5.3.2 (1*hundredthsPF/s* to 10*hundredthsPF/s*, with minimum increase of 0.1*hundredthsPF/s*).
- *Reactive Power (%/s)*: enter the variation speed of the reactive power setpoint when this last is modified by means of the UP/DOWN contacts or the corresponding buttons of the MEC-100 Interface System, see Par. 5.3.2 (0,1%/s to 5%/s, with minimum increase of 0.1%/s).

The traverse rate of the excitation current is fixed and kept slow by default.

PAY PARTICULAR ATTENTION TO THE MODIFICATION OF THE SETPOINT VALUES. The limit thresholds set by the MEC-100 Interface System to the setpoint values do not protect against the selection of setpoints which may be potentially dangerous for the generator and for the devices and/or installations connected to the generator. In all configuration operations of the MEC-100 Interface System, always check that the new setpoints to be entered are appropriate to the generator and the devices and/or installations connected to the generator.

Voltage Matching:
- ☑ *Minimum Limit (%)*: enter the minimum value of the network voltage range within which the voltage matching is enabled; this limit is expressed in percentage respect to the rated generator voltage (90% to 100%, with minimum increase of 1%).
- ☑ *Maximum Limit (%)*: enter the minimum value of the network voltage range within which the voltage matching is enabled; this limit is expressed in percentage respect to the rated generator voltage (100% to 110%, with minimum increase of 1%).

Droop Settings:
- ☑ *Reactive Droop (%)*: enter in this field the Droop Compensation value (%) for parallel operations (0 to 10%, with minimum increase of 0.1%).
- ☑ *Enable voltage setpoint adjustment*: click this button to enable the adjustment of the voltage setpoint through *UP/DOWN* digital inputs or through 4/20mA analogue inputs with *Droop* function enabled.
- ☑ *Enable underexcitation limiter in Droop mode*: click this button to enable the underexcitation limiter in Droop mode. Remember that in this mode the limiter just issues an underexcitation warning through a green LED on the display or the associated output relay, without actually limiting the excitation current.

5.7.5. Stability (P.I.D. Settings)

In Fig. 5.7.5.a the stability parameters configuration area is shown.

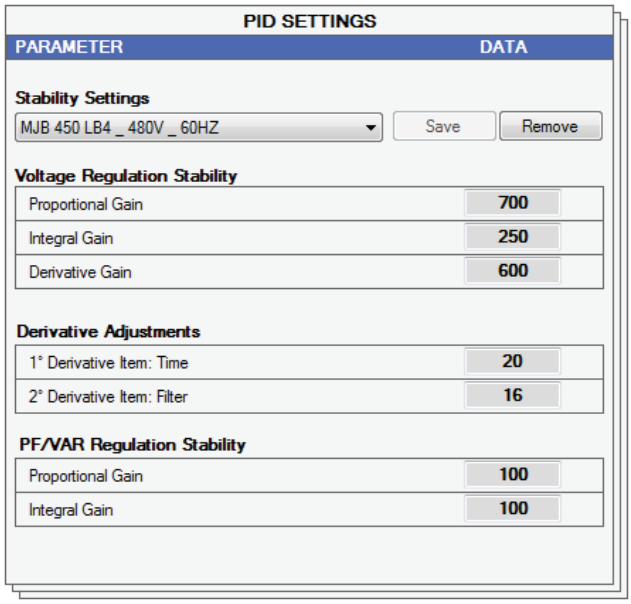


Fig. 5.7.5.a
Stability Parameter Area

Stability settings:

Custom setting: select this item in order to set individually each one of the following fields. After performing the setting, click the *Save* button to store the customised parameter set.

Standard setting: each configuration set contains an entire parameter set, stored by factory or by user.

Voltage Regulation Stability (see Par. 3.11.1):
- ❑ *Proportional Gain*: enter in this field the proportional constant value of the regulation loop.
- ❑ *Integral Gain*: enter in this field the integrative constant value of the regulation loop.
- ❑ *Derivative Gain*: enter in this field the derivative constant value of the regulation loop.

Derivative Adjustments (see Par. 3.11.2):
- ❑ *1st Derivative Term - Time*: enter in this field the parameter *Time* for derivative adjustment.
- ❑ *2nd Derivative Term - Filter*: enter in this field the parameter *Filter* for derivative adjustment.

Power Factor Regulation Stability (see Par. 3.11.3):
- ❑ *Proportional Gain*: enter in this field the proportional constant value of the regulation loop.
- ❑ *Integral Gain*: enter in this field the integrative constant value of the regulation loop.

5.7.6. Limiters

In Fig. 5.7.6.a the limitation parameters configuration area is shown.

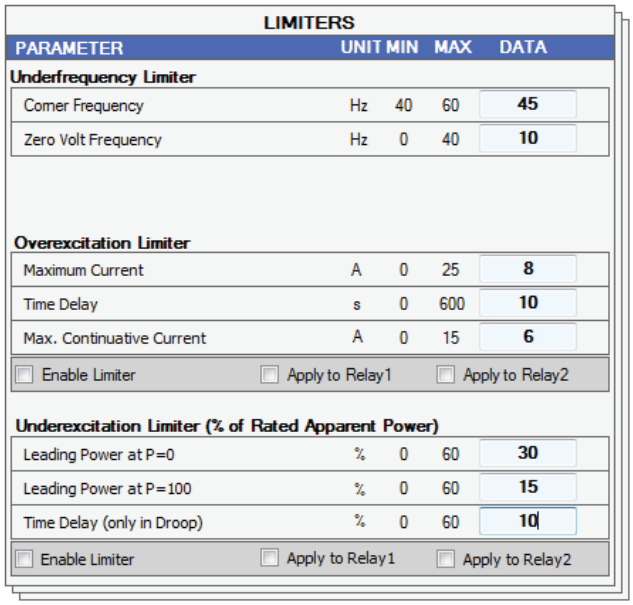


Fig. 5.7.6.a
Limitation Parameter Area

Underfrequency Limiter (see Par. 3.7.1):
- ❑ *Corner frequency (Hz)*: enter in this field the corner frequency value in the under-frequency voltage limitation curve (40 to 60Hz, with minimum increase of 0.1Hz).
- ❑ *Zero Volt Frequency (Hz)*: enter in this field the zero Volt frequency value in the under-frequency voltage limitation curve (0 to 40Hz, with minimum increase of 0.1Hz).

Overexcitation Limiter (see Par. 3.7.2):
- ❑ *Maximum Current (A)*: enter in this field the maximum allowed current level value (0 to 25A, min. increase of 0.1A).
- ❑ *Time Delay (s)*: enter in this field the minimum operation time value during which the MEC-100 is authorized to supply the *Maximum* excitation *Current* (0 to 600s, with minimum increase of 1s).
- ❑ *Max. Continuative Current (A)*: enter in this field the maximum continuative current level value (0 to 15A, with minimum increase of 0.1A).
- ☑ *Enable Limiter*: limiter activation flag; click on this button to activate the over-excitation limitation function.
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the limitation intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the limitation intervention signal to relay 2.

Underexcitation Limiter (see Par. 3.7.3):
- ❑ *Leading Power at P=0 (%)*: in this field you will have to enter the maximum leading power value allowed, expressed as a percentage of the maximum apparent power (0 to 60%, minimum increase 1%) when the active power is null.
- ❑ *Leading Power at P=100 (%)*: in this field you will have to enter the maximum leading power value allowed, expressed as a percentage of the maximum apparent power (0 to 60%, minimum increase 1%) when the active power is equal to 100% of the rated one.
- ❑ *Time Delay (only in Droop)*: in this field you will have to enter the underexcitation limiter notification time, for the Droop operating mode only.
- ☑ *Enable Limiter*: limiter activation flag; click on this button to activate the under-excitation limitation function.
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the limitation intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the limitation intervention signal to relay 2.

5.7.7. Field Protections

In Fig. 5.7.7.a the field protection parameters configuration area is shown.

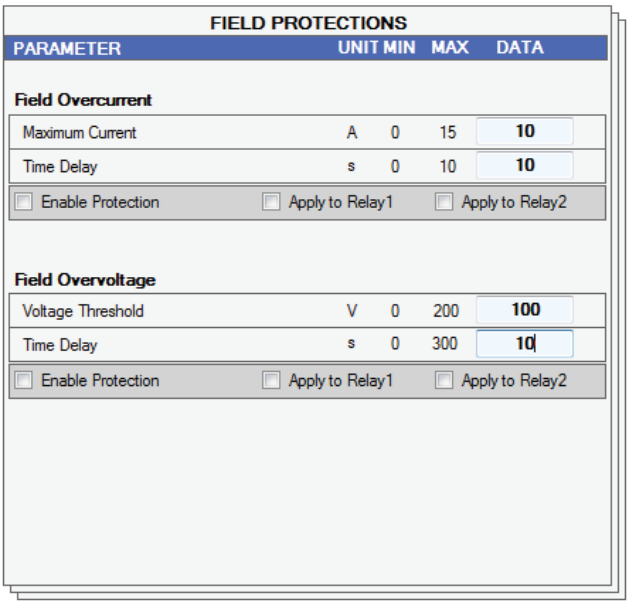


Fig. 5.7.7.a
Field Protection Parameter Area

Field Overcurrent (see Par. 3.6.2):
- ❑ *Maximum Current (A)*: enter in this field the max. allowed field current level value (0 to 15A, with min. increase of 0.1A).
- ❑ *Time Delay (s)*: enter in this field the time interval value, during which the MEC-100 is authorized to supply the *Maximum Current* before the activation of the relevant protection (0 to 10s, with minimum increase of 0.1s).
- ☑ *Enable Protection*: protection activation flag; click on this button to activate the field over-current protection function.
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

Field Overvoltage (see Par. 3.6.1):
- ❑ *Voltage Threshold (V)*: enter in this field the maximum allowed field voltage level value (0 to 200V, with minimum increase of 1V).
- ❑ *Time Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to supply the *Voltage Threshold* value, before the activation of the relevant protection (0 to 10s, with minimum increase of 0.1s).
- ☑ *Enable Protection*: protection activation flag; click on this button to activate the field over-voltage protection function.
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

⚠ **BY DEFAULT, PROTECTIONS ARE INITIALLY DISABLED**. Pay particular attention, when configuring the MEC-100, to the activation of all concerned protections.

5.7.8. Generator Protections

In Fig. 5.7.8.a the generator protection parameters configuration area is shown.
Generator Overcurrent (see Par. 3.6.5):
- ❑ *Maximum Current (%)*: enter in this field the maximum allowed generator current level value related to the following *Time Delay*, and expressed in percentage with respect to the generator rated current value (0 to 120%, with minimum increase of 1%).
- ❑ *Time Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to supply the *Maximum Current*, before the activation of the relevant protection (0 to 3600s, with minimum increase of 1s).
- ❑ *Maximum Continuative Current (%)*: enter in this field the maximum continuous generator current value, expressed in percentage with respect to the generator rated current value (0 to 110%, with minimum increase of 1%).

- ☑ *Enable Protection*: protection activation flag; click on this button to activate the generator over-current protection function.
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

Generator Overvoltage (see Par. 3.6.3):
- ❑ *Voltage Threshold (%)*: enter in this field the maximum generator voltage level value which corresponds to the activation of the relevant protection. It is expressed in percentage with respect to the generator rated voltage value (100 to 150%, with minimum increase of 1%).
- ❑ *Time Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to supply a voltage higher than or equal to the *Voltage Threshold* value, before the activation of the relevant protection (0 to 300s, with minimum increase of 1s).

☑ *Enable Protection*: protection activation flag; click on this button to activate the generator over-voltage protection function.
☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

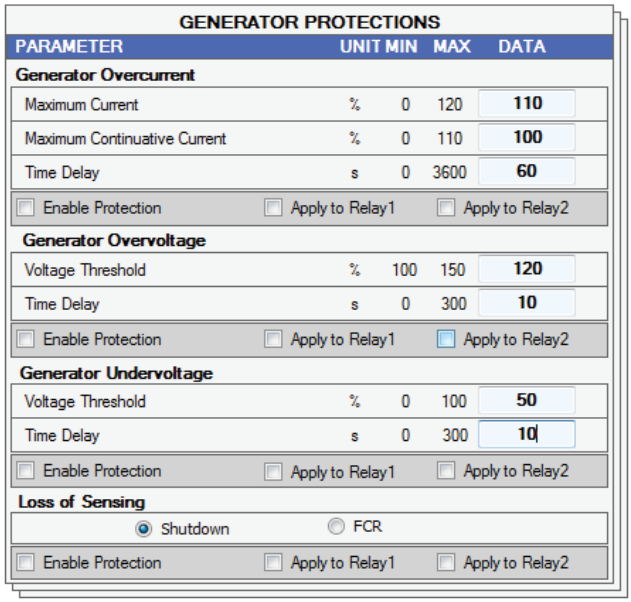


Fig. 5.7.8.a
Generator Protection Parameter Area

Generator Undervoltage (see Par. 3.6.4):
❑ *Voltage Threshold (%)*: enter in this field the minimum generator voltage level value which corresponds to the activation of the relevant protection. It is expressed in percentage with respect to the generator rated voltage value (0 to 100%, with minimum increase of 1%).
❑ *Time Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to supply a voltage lower than or equal to the *Voltage Threshold* value, before the activation of the relevant protection (0 to 300s, with minimum increase of 1s).
☑ *Enable Protection*: protection activation flag; click on this button to activate the generator under-voltage protection function.
☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

Loss of Sensing (see Par. 3.6.6):
⊙ *Shutdown/FCR*: protection type selection. If *Shutdown* is selected, an instantaneous de-excitation of the generator will be operated when the loss of sensing occurs, if *FCR* is selected, an instantaneous switch to FCR Mode will be operated when the loss of sensing occurs.

☑ *Enable Protection*: protection activation flag; click on this button to activate the loss of sensing protection function.
☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

⚠ **BY DEFAULT, PROTECTIONS ARE INITIALLY DISABLED**. Pay particular attention, when configuring the MEC-100, to the activation of all concerned protections.

5.7.9. Diode Monitoring

In Fig. 5.7.9.a the diode monitoring parameters configuration area is shown.

Low Level (see Par. 3.6.7):
- ❑ *Maximum Ripple (%)*: enter in this field the maximum allowed excitation current ripple related to the following *Time Delay*, and expressed in percentage with respect to the generator rated excitation current value (0 to 100%, with minimum increase of 1%).
- ❑ *Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to work at/over *Maximum Ripple*, before the activation of the relevant protection (0 to 100s, with minimum increase of 1s).

High Level (see Par. 3.6.7):
- ❑ *Maximum Ripple (%)*: enter in this field the maximum allowed excitation current ripple related to the following *Time Delay*, and expressed in percentage with respect to the generator rated excitation current value (0 to 100%, with minimum increase of 1%).
- ❑ *Delay (s)*: enter in this field the time interval value during which the MEC-100 is authorized to work at/over *Maximum Ripple*, before the activation of the relevant protection (0 to 10s, with minimum increase of 1s).

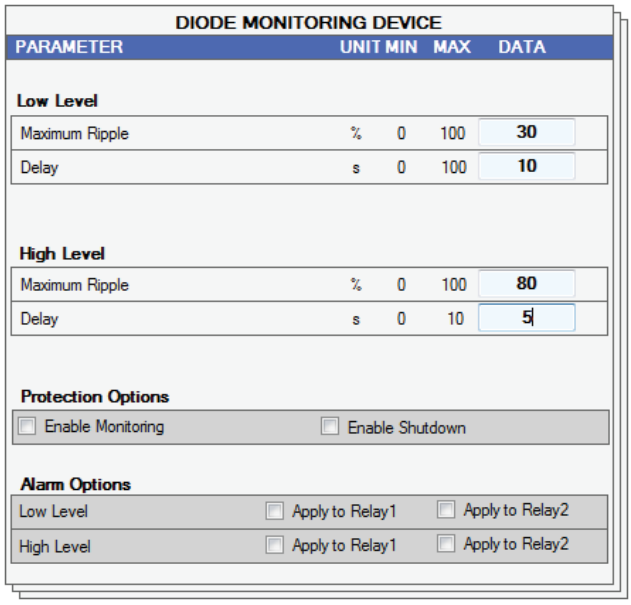


Fig. 5.7.9.a
Diode Monitoring Parameter Area

Protection Options (see Par. 3.6.7):
- ☑ *Enable Monitoring*: protection activation flag; click on this button to activate the diode monitoring function.
- ☑ *Enable Shutdown*: shutdown activation flag; click on this button to activate the shutdown option for *High Level* monitoring.

SHUTDOWN OPTION CAN BE USED ONLY ASSOCIATED TO HIGH LEVEL OF FAILURE.
Low Level can be only associated to external annunciation.

Alarm Options (see Par. 3.6.7):
High Level:
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

Low Level:
- ☑ *Apply to Relay 1*: relay 1 assignment flag; click on this button to assign the protection intervention signal to relay 1.
- ☑ *Apply to Relay 2*: relay 2 assignment flag; click on this button to assign the protection intervention signal to relay 2.

BY DEFAULT, PROTECTIONS ARE INITIALLY DISABLED. Pay particular attention, when configuring the MEC-100, to the activation of all concerned protections

5.8. SYSTEM MONITORING

The MEC-100 allows to display on a real-time basis the value taken by the main electrical system parameters and the status of inputs and outputs. The section of the MEC-100 Interface System dedicated to the system monitoring is that identified by the label 1, as shown in Figure 5.3.2.a. It consists of six monitoring areas, which are described here below.

5.8.1. Electrical System Parameters

In Fig. 5.8.1.a the system parameters monitoring area is shown.
It allows to measure in real time:

- *The three phase-to-phase voltages.*
- *The current in the sensed phase.*
- *The generator electrical frequency.*
- *Excitation current and voltage.*
- *Network frequency and voltage.*
- *Real, reactive and apparent powers.*
- *The power factor.*
- *The internal MEC-100 bus voltage.*
- *Analogue Auxiliary Input 1 current value (mA).*
- *Analogue Auxiliary Input 2 current value (mA).*
- *Excitation Current Ripple (%).*

In the last column the units of measurement of the measured electrical parameters are defined.

PARAMETER	TYPE	DATA	UNIT
Generator Voltage U-V			V
Generator Voltage V-W			V
Generator Voltage U-W			V
Generator Current W			A
Generator Frequency			Hz
Excitation Voltage			V
Excitation Current			A
Line Voltage			V
Line Frequency			Hz
Apparent Power			kVA
Real Power			kW
Reactive Power			kVAR
Power Factor			-
Bus Voltage			V
Analog Input 1			mA
Analog Input 2			mA
Excitation Current Ripple			%

Fig. 5.8.1.a
System parameter monitoring

5.8.2. System Status

In Fig. 5.8.2.a the system status monitoring area is shown.
It allows to display in real time:

- *Voltage Matching.*
- *Reactive Droop Compensation.*
- *Parallel with Line.*
- *Field Current Regulation FCR.*
- *Operating Status.*

In the last column, each one of the illuminated LEDs identifies the relevant active function (see the description of contacts in Par. 3.5).

DESCRIPTION	STATUS
Voltage Matching	
Reactive Droop Compensation	
Parallel with Line	
Field Current Regulation FCR	
Operating Status	

Fig. 5.8.2.a
System status monitoring

5.8.3. Alarm Status

In Fig. 5.8.3.a the alarm status monitoring area is shown.
It allows to display in real time:

- *Limiter status.*
- *Protection status.*

In the last column, each one of the illuminated LEDs identifies the relevant active alarm. Together with the LED, also the relative description of the alarm is flashing red.

ALARM DESCRIPTION	STATUS
Overexcitation Limiter	
Underexcitation Limiter	
Underfrequency Limiter	
Field Overcurrent Protection	
Field Overvoltage Protection	
Generator Overcurrent Protection	
Generator Overvoltage Protection	
Generator Undervoltage Protection	
Loss of Sensing Protection	
Diode Monitoring - Low Level	
Diode Monitoring - High Level	

Fig. 5.8.3.a
Alarm status monitoring

5.8.4. Phase Graphical Display

In Fig. 5.8.4.a an image of the graphical display relative to the angle deviation between generator voltage and current is shown.
Moreover it allows to display the numerical values of:

- *Phase (Degrees).*
- *Sin φ.*
- *Cos φ.*

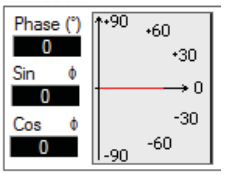


Fig. 5.8.4.a
Phase Graphical Display

5.8.5. Oscillographic indicator

Fig. 5.8.5.and Fig. 5.8.5.b show pictures of the system electrical quantity oscillographic indicator.

- ⊙ *Selecting the electrical quantity to be displayed* (indicator **A** in Fig. 5.8.5.a). Next to each of the items indicating the measured quantities there is a radio button ("⊙") allowing to select the quantity to be displayed.
  To select the parameter you wish to display, click the radio button associated with the relevant voice.
- 💻 *Displaying the selected quantity as a function of time* (indicator **B** in Fig. 5.8.5.b).
- ❑ *The* **C** button in Fig. 5.8.5.b opens a window allowing to configure the chart ordinate axis limit.

The example shown in the figure shows the trend of the voltage between phases U and V measured during the SOFT-START stage.

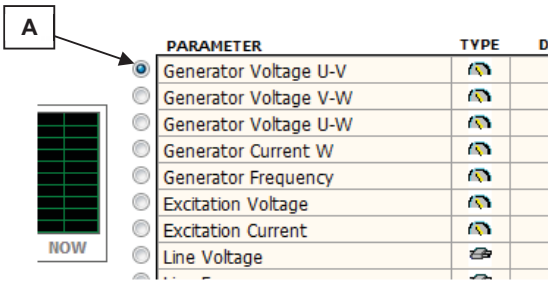


Fig. 5.8.5.a
Selecting the quantity to be traced

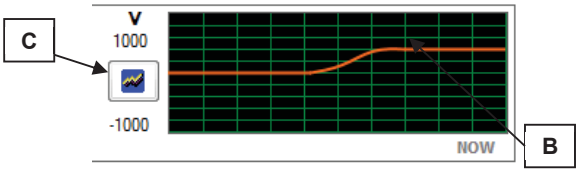


Fig. 5.8.5.b
Oscillographic indicator

5.8.6. Power diagram

Fig. 5.8.6.a shows the button allowing to select the *Power Diagram* graphic mode; if you click on it the diagram will replace the *System Parameters* setting window. Clicking the same button again will restore the *System Parameters* window.
Fig. 5.8.6.b shows a picture of the power diagram. It displays the generator working point in real time, with:

- 💻 *Instant indication of active and reactive power* (indicator **A** in Fig. 5.8.6.b).
- 💻 *Display of the curve defined by the setting of the underexcitation limiter* (indicators **B** and **C** in Fig. 5.8.6.b).

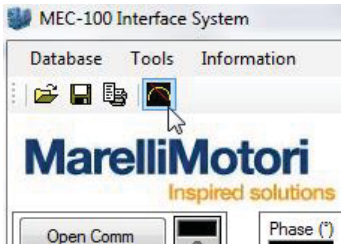


Fig. 5.8.6.a
Opening the power diagram

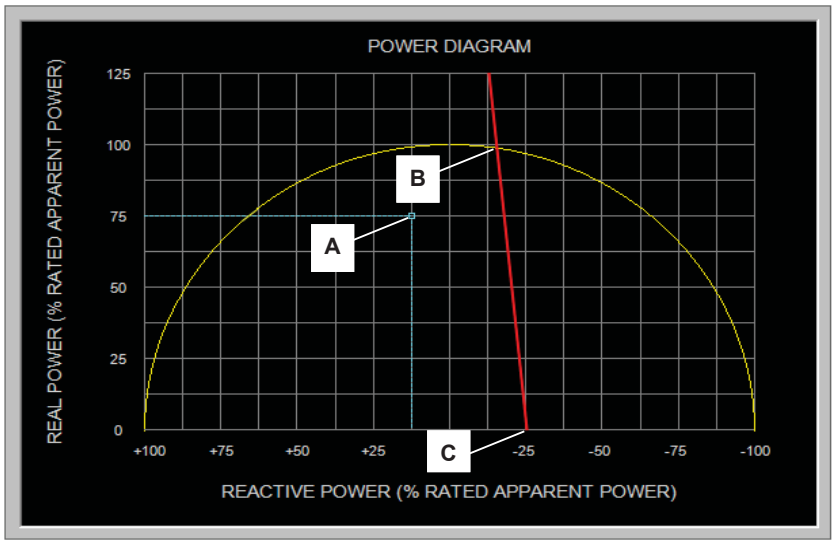


Fig. 5.8.6.b
Power diagram

6. AFTER SALES SERVICE AND MAINTENANCE

6.1. PREVENTIVE MAINTENANCE

The only preventive maintenance required on the MEC-100 is a periodical check-up of the connections between the MEC-100 and the system: pay attention that all the connections are clean and tight and no damages or faults are affecting the wiring.
The MEC-100 is completely resin-bonded and isolated to keep a high operating reliability even in difficult working conditions (high levels of humidity, dust, salty atmosphere) and in presence of vibrations: if it is not working or not correct behaviours are present, MEC-100 must not be repaired or modified without Marelli Motori approval.

6.2. AFTER SALES SERVICE

For any malfunctions, damages or any other queries, please contact Marelli Motori Services.

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