NON-INSULATED DC/DC CONVERTER
ASSEMBLED IN A CASING

OPERATING MANUAL

PREMISE

By purchasing this DC/DC converter, the customer undertakes to view this manual and comply and have the personnel comply with the operating instructions contained in it. The manufacturer shall not, under any circumstance, be held liable for direct, indirect or accidental injuries to persons or damage to materials caused by operations or manoeuvres not complying with the instructions.

The features of this DC/DC converter are listed in the GENERAL INFORMATION paragraph of this manual.

The DC/DC converter must be installed and monitored by qualified and skilled personnel, as required by the standards in force, and in compliance with the instructions in the INSTALLATION paragraph of this manual.

Carefully read the OPERATION paragraph in this manual to become familiar with the equipment, learn the available functions and evaluate the operating limits beyond which it no longer operates under safety conditions.

Maintenance of the DC/DC converter must be carried out by qualified personnel informed about the hazards related to operations on electrical equipment; personnel must comply with the instructions provided in the MAINTENANCE paragraph in this manual. Operations or manoeuvres with the casing open and the converter powered up are prohibited. Should it be necessary to operate on the powered converter with the casing open for measurements or verifications, the presence of another qualified person, who can promptly intervene in the presence of the emergency is mandatory.

WARNING

The converter contains high capacity electrolytic capacitors, which, despite the equipment being equipped with appropriate discharging circuits, require several seconds to fully deplete the stored energy; therefore, it is crucial to wait for the energy stored in the converters to be fully discharged before accessing the internal parts of the converter; use a reliable tool to ensure there is no voltage in input and output terminals.

Failure to comply with general safety standards and with the instructions in bold in this manual constitute a serious hazard for people.
INSTALLATION

HANDLING - LOCATION

The converter assembled in a casing weighs approximately 15 kg. The equipment must be handled using appropriate protection devices.

VENTILATION - FILTERS

DC/DC converters have an IP 21 protection class; ventilation is natural in converters having voltage ≤ 110V-125V and/or current ≤ 60A, and forced in converters having voltage ≤ 110V-125V and/or current > 60A and in converters having a 220V voltage.

Converters with natural ventilation must be installed in a vertical position to ensure natural convection.

Converters having forced ventilation can be installed also in horizontal position.

In any event, installation must not prevent inbound and outbound cooling air from flowing through the ventilation grilles; moreover, the equipment must be located in such a way as to prevent the converter from being hit by the hot air generated by other components or other converters.

Filters located in the containment panel must be carefully cleaned in order to ensure proper air replacement.

EARTH CABLE

The earth cable must comply with the provisions of the standards in force. The converter is equipped with a 16 mm² or 35 mm² earth terminal depending on the delivered current.

The earth cable must be connected before powering the converter.

POWER CABLES

Particular attention must be paid to the power cabling when the converters are used in parallel. The cable cross-section and length of every single connection between the converter and the relative parallel node must be the same; otherwise, it will not be possible to keep a constant distribution of the current delivered between the single converters (distribution occurs to compensate the voltage) under every load condition.

DISPOSAL

In the event that the converter must be disposed of, do not proceed alone; contact the BODIES in charge according to the laws in the country of installation.
GENERAL INFORMATION

This operating manual is dedicated to converters used in systems requiring stabilised DC voltage in the presence of a DC voltage source having a wide dynamic range (typical charging and discharging battery voltage).

The DC/DC converters of the M71 and M85 series are divided into two large families: STEP-DOWN and STEP-UP.

STEP-DOWN converters stabilise the output voltage at a value below the input voltage and have a positive voltage across it.

The basic version of STEP-DOWN converters consists of:
- ferrite or iron-silicon inductor with DC-premagnetisation
- High-frequency converter module with relative dissipator
- Voltage regulation unit, with a trimmer that can be accessed from the outside
- Auxiliary relays for converter conduction
- Power terminals
- Pluggable 12-pin terminal block for the control and indicator interface
- Galvanised sheet metal casing having an IP21 protection class
- Cooling fan with relative power supply (if any only where provided in the basic version)

The following options can be installed, upon request, on STEP-DOWN converters:
- \( \text{1V1} \) parallel diode
- \( \text{1B1} \) time delayed undervoltage unit (with dual external signal)
- \( \text{1B2} \) time delayed overvoltage unit (with external signal and delivery block)
- \( \text{1B3} \) time delayed overcurrent unit (with external signal and delivery block)
- Additional pluggable 12-pin terminal block for indicator interface
- Additional redundant forced ventilation
- \( \text{1B4} \) ventilation monitoring unit
- Digital equipment to indicate the delivered voltage and/or current

STEP-UP converters stabilise the output voltage at a value above the input voltage and have a negative voltage across it.

The basic version of STEP-UP converters consists of:
- Input buffer electrolytic capacitor (which must not be considered as a smoothing filter)
- ferrite or iron-silicon inductor with DC-premagnetisation
- High-frequency converter module with relative dissipator
- Voltage regulation unit, with a trimmer that can be accessed from the outside
- Dual common cathode diode (one diode for conduction and one for parallel connection)
- \( \text{1B1} \) STEP-UP metric management unit
- Auxiliary relays for converter conduction
- Power terminals
- Pluggable 12-pin terminal block for the control and indicator interface
- Galvanised sheet metal casing having an IP21 protection class
- Cooling fan with relative power supply activated when the converter is on (only where provided in the basic version)

The following options can be installed, upon request, on STEP-UP converters:
- Additional redundant forced ventilation
- Additional pluggable 12-pin terminal block for indicator interface
- \( \text{1B4} \) ventilation monitoring unit
- Digital equipment to indicate the delivered voltage and/or current
OPERATION

Operation of DC/DC converters depends on the quality of mean input DC voltage. The lower the undulation and the higher the performance of the converter.

The presence of high-capacity condensers at the converter inlet implies the necessity to activate them through suitable precharge circuits.

STEP-DOWN basic version

The STEP-DOWN converter maintains the output voltage stable at the value set for input voltage dynamics ranging between 105% and 150% of the output voltage. When the output voltage drops below 105% of the output voltage, the converter, which remains on, becomes transparent and introduces a voltage drop between the input and output ranging between 4% and 5%. The voltage drop can be removed by short-circuiting the negative pole between input and output.

To adapt the output voltage to your requirements (compensating, for example, small voltage drops of the system) you can adjust the multiturn trimmer that can be accessed from outside the casing and located in the proximity the green LED that indicates that the converter is on. Clockwise turns increase the voltage. WARNING: modifications over 4% of the rated voltage are prohibited.

In the basic version of the STEP-DOWN converter, terminals 3 and 4 of terminal block X1 must be permanently connected between them. A contact between terminals 1 and 2 of terminal block X1 allows electronically switching the converter on and off.

The voltage at the upstream output of any parallel diode is always available at terminals 7+ and 8- of the STEP-DOWN converter. This voltage can be used for drawouts below 300mA.

STEP-DOWN options

In order to use two or more converters in parallel to ensure hot redundancy or increase the current capacity of the system, the converters must be decoupled from the "1V1" parallel diode located on the negative pole. Current distribution among the modules occurs to compensate the voltage. Therefore, after following the instructions regarding the POWER CABLES in the INSTALLATION chapter, calibrate the current distribution between the modules by gently adjusting the multiturn trimmer, which allows calibrating the voltage.

An acceptable calibration (difference in delivery between the modules ≤ 10%) requires:

- Applying a significant load 30-50% of the current that can be delivered by each module
- Using a DC amperometric clamp to verify the current delivered by every module from the negative pole and correct its value by adjusting the multiturn trimmer. Clockwise turns increase the current. Adjust it gently and wait for the system to reach equilibrium.

The "1B1" time delayed undervoltage unit is used to verify the presence and value of the voltage delivered by the converter. Since the output voltage can decrease even when the converter enters into limitation mode (a possible but not hazardous condition), the activation of the "1B1" unit is duly delayed and locally indicated by the switch-off of the LED associated to the relay and remotely by means of two potential-free changeover contact.

The "1B2" time delayed overvoltage unit is used to verify the value of the voltage delivered by the converter and prevent excessive values from damaging the utilities. Since the output voltage can decrease even when the converter enters into limitation mode (a possible but not hazardous condition), the activation of the "1B2" unit is duly delayed and locally indicated by the switch-off of the LED associated to the relay and remotely by means of two potential-free changeover contact.
rise temporarily with concomitant step load release (a possible but not hazardous condition), the activation of the \( \text{f} B2 \) unit is duly delayed. If the delivered voltage remains at a high value for a period of time exceeding the set delay, the converter delivery will be blocked. Upon converter switch-off, delivery stops and the \( \text{f} B2 \) unit releases. Remote information acquisition must be made externally. This blocking can be reset by adjusting the switch-on contact located between terminals 1 and 2 of terminal block X1 or by inserting a NC button between terminals 3 and 4 of terminal block X1.

The \( \text{f} B3 \) time delayed overcurrent unit is used to verify the value of the current delivered by the converter and prevent excessive load values from blocking the converter in current-limitation mode. Since the load peaks can temporarily cause the activation of the limitation mode (a possible but not hazardous condition), the activation of the \( \text{f} B3 \) unit is duly delayed. If the delivered current remains at a high value for a period of time exceeding the set delay, the converter delivery will be blocked. Upon converter switch-off, delivery stops and the \( \text{f} B3 \) unit releases. Remote information acquisition must be made externally. This blocking can be reset by adjusting the switch-on contact located between terminals 1 and 2 of terminal block X1 or by inserting a NC button between terminals 3 and 4 of terminal block X1. The \( \text{f} B3 \) unit requires the use of a current shunt, whose signal is made available to terminals 9+ and 10- of terminal block X1.

In the presence of redundant ventilation, the \( \text{f} B4 \) monitoring unit monitors the current absorption of the two fans and, in the event that one of the two shows excessive absorption deviation compared to the value indicated by the fan manufacturer, it remotely indicates the anomaly by means of a closing contact in correspondence of terminals 11 and 12 of terminal block X1.

**STEP-UP basic version**

The STEP-UP converter increases and stabilises output voltage to a value above the input voltage. As specified at the beginning of the GENERAL INFORMATION chapter, the operation described in this manual is specific and aimed at the utilities that require stabilised DC supply voltage both in the presence and in the absence of mains voltage. In the presence of mains voltage, utility voltage stabilisation is ensured by the STEP-DOWN converter, which draws energy from the source being charged and keeps the battery charged at a higher voltage than the one required by the utilities. In the event of mains voltage outage, the STEP-DOWN converter will be powered directly by the battery. The battery voltage starts decreasing and, when the voltage value is close to 105% of the output voltage, the STEP-UP converter is switched on and raises the input voltage of the STEP-DOWN converter to a value corresponding to the battery QUICK CHARGE level.

The STEP-UP converter remains on until reaching the battery end-of-discharge voltage. Once the mains voltage is restored, the battery goes back to charging, the voltage at its terminals increases and the STEP-UP converter is turned off when its input voltage reaches approximately 108% of the output voltage of the STEP-DOWN converter.

The \( \text{f} B1 \) instantaneous undervoltage unit is used to activate and deactivate the STEP-UP converter according to the voltage criteria described above. Forced ventilation, where provided, is enabled only when the STEP-UP converter is activated.

In the STEP-UP converter, a contact between terminals 1 and 2 of terminal block X1 allows electronically switching the converter on and off. **WARNING** electronic converter switch-off does not eliminate delivery, but simply inhibits the function to raise the output voltage. During this stage, as during the automatic switch-off, the output current is supported by a \( \text{f} V1 \) continuity diode.
The voltage at the upstream output of any parallel diode is always available at terminals 7+ and 8- of the STEP-UP converter. This voltage can be used for drawouts below 300mA.

**STEP-UP options**

A current shunt can be added upon request, whose signal is made available to terminals 9+ and 10- of terminal block X1.

In the presence of redundant ventilation, the ÌB4òmonitoring unit monitors the current absorption of the two fans and, in the event that one of the two shows excessive absorption deviation compared to the value indicated by the fan manufacturer, it remotely indicates the anomaly by means of a closing contact in correspondence of terminals 11 and 12 of terminal block X1.

**MAINTENANCE**

The DC/DC converters of the M71 and M85 series do not have parts subject to wear requiring preventive replacements; however, converters, as all electrical components, are subject to ageing, which accelerates under unfavourable environmental conditions.

Therefore, routine maintenance must include:

- Periodic verification of electrical connections (especially in the beginning)
- Verification of cooling fan operation (where installed)
- Annual verification of electrical values
- Verification of the containment panel filters

Should it be necessary to disassemble the converter, ensure that the module is not powered and that the energy stored in the condensers is fully depleted before carrying out any operation.

To remove the converter, all you have to do is disconnect the four power cables, earth cable, and the pluggable terminal blocks.