User Manual

M4 Evolution

10 - 200 kVA

GENERAL INDEX

1 INTRODUCTION

The equipment described hereafter can cause considerable physical damage if incorrectly handled. This is why, the installation, maintenance and/or repair of this equipment must be done by our staff or specifically authorized technicians.
According to our policy of continuous improvement, we reserve the right to modify the specifications, in part or in whole, without prior warning.
All reproduction or third party concession of this manual is prohibited without prior written authorization from our firm.

1.1 Using this manual

The purpose of this manual is to explain the installation and operating procedures. This manual must be read carefully before installing and operating the equipment. Keep this manual for future reference.
This equipment must be **installed by qualified staff** and, with the simple advice in this manual, **can be used by personnel without any specific training**.

1.2 Symbols and conventions

"**Warning**" symbol.
Carefully read the indicated paragraph and take the stated preventive measures.

"**Danger of electrical discharge**" symbol. Pay special attention to it, in terms of both the indication on the equipment and the paragraph referred to in this user manual.

"**Warning**" symbol. The electrolyte corrodes the metals, and can be harmful to people. It is also very contaminant for the environment.
Never touch the spilled electrolyte of the deposited rests in the batteries and its surrounding with bare hands. Under no circumstances, it has not to be ingested or in contact with the eyes.
In case of accidental spillage act accordingly for its collection, in accordance with your company protocol.

"**Explosion**" risk. Batteries emit explosive gases during charging. There is a risk of explosion in case of a short-circuit or fire. Do not leave conductive parts over the battery terminals, as there is a high risk of short-circuit and explosion if some gas accumulate inside the equipment or the battery enclosure.

Attention! Danger of tipping during transport on inclined areas and when removing battery trays without stabilizing the unit first. Do not pull out more than one tray at the same time. There is a high risk of serious injury to the operator because of a possible fall of the equipment and / or entrapment.

Precaution! Fan blades in operation or fans can suddenly start up automatically**.**

Caution! Hot surface, elements or parts. Possible burns due to the temperature.

Never touch or manipulate the components of the electronic PCB with bare hands and without any protection against electrostatic discharges (ESD). They are highly destructive for most of the parts and they can cause expensive breakdowns.

"Main protective earthing terminal" symbol. Connect the earth cable from the installation to this terminal.

"Earth bonding terminal". Connect the earth cable from the load & external battery to this terminal.

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“Information” symbol. Additional information to the basic procedures.

Use insulated gloves to prevent possible electrical discharges, when manipulating the connections and especially those related to the batteries.

Use insulated shoes to prevent possible electrical discharges, when manipulating the connections and especially those related to the batteries.

Use protection glasses, tight and appropriate work clothes, without hanging part.

Turn off the equipment’s power supply or loads connected to the output.

Read the instruction manual carefully

Smoking, fire or any actions that could produce sparks around the batteries are prohibited.

Do not pull off the connection cables. Follow the suitable procedure to free the connections from the terminals.

Do not touch with bare hands. There is a risk of electric shock in case of a contact with low potential parts. Do not open, manipulate inside the equipment and/or terminals and battery connections.

Do not turn randomly the switches or protections. All manoeuvres must be done as it is described in the instruction manual.

In case the acid of the batteries enters in contact with bodyparts, wash with plenty of water and go to the nearest medical service.

Preservation of the environment: The presence of this symbol in the product or in their associated documentation states that, when its useful life is expired, it will not be disposed with the trash. In order to avoid possible damage to the environment, separate this product from other trash and recycle it suitably. Users can contact their provider or with local authorities to obtain information as to how and where they can take the product to be recycled and/or disposed correctly.

Any packaging material must be recycled according to the legal norms applicable to the country where the equipment is installed.

Alternative current (AC)

Direct current (DC)

1.3 For further information and/or help

For further information and/or help of the version of your specific unit, refer to our Service and Technical Support Department.

1.4 Safety and first aid

1.4.1 TO PROVIDE FOR.

• These “Safety Instructions” are associated with the “Operating Manual” regarding the equipment you have purchased. Before proceeding with the installation or start-up, check that you have both sets of information, if not, ask for them. Compliance with the “Safety Instructions” is compulsory and is the user’s legal responsibility. Read them carefully, follow the steps in the given order and keep them for future reference. The local electrical standards and different restrictions of the end user’s city may invalidate some of the recommendations given in the manuals. In case of discrepancies, the user must comply with the pertinent local standards. The situation may arise where the equipment’s distribution of connecting terminals and/or commands do not line up with the manual’s illustrations. However, the simplicity of the operation together with the correct labelling provides for easy understanding in an intuitive way.

• It is strictly forbidden to reproduce or to release this information without written permission from our company.

• Do not install the machine in a corrosive or dusty atmosphere, and never outdoors.

• Do not obstruct the ventilation grates nor introduce objects through these or other orifices. Leave a minimum free space of 25 cm around the machine for ventilation and air circulation.

• The location must be spacious, airy, away from heat sources and easily accessible. In addition to the ventilation space indicated above, there must be an area of 75 cm clearance all-round the device for possible action by the After Sales Service (A.S.S.), so that if this involves moving the machine the connecting cables will have the required space.

• Do not place materials on top of the machine or objects which would obstruct a proper view of readings.

1.4.2 GENERAL SAFETY INSTRUCTIONS.

• All equipment connections including those of the control should be done without the presence of the mains supply and with the switches turned off, position “Off”.

• Special attention should be paid to the labelling on the equipment warning about the “Risk of electric shock” and indicators like ( ). Hazardous live parts inside the equipment, do not remove the cover. Servicing is reserved for qualified service personnel. For maintenance or repair services, contact your nearest After Sales Service (A.S.S.) in our company.

• It is compulsory to connect the earth protection. Make sure that this is done before powering up the input to the equipment.

• The installation of hard wired equipment should be done by personnel qualified in electrical low voltage installations.

• The cross section of the power supply and output cables to the loads should be determined according to the rated current given on the equipment’s specifications plate and comply with the Local Low Voltage Electro technical Regulations.

• The power supply cables to the equipment as well as to the loads, interfaces, etc. should be fastened to non-movable parts to prevent pulling.

• Please keep in mind that as the equipment incorporates a Bypass with mains power available it will supply output voltage even if the equipment is not turned on. Place warning notices and /or emergency switches as requested by the safety Regulations of your specific installation.

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• The voltage stabilizers and line conditioners should be considered as transformers or distribution lines from the point of view of the installation and of the electrical safety. This equipment is “transparent” to the input voltage.

• The Neutral input of the three-phase equipment should be necessarily connected to the terminal intended for this purpose.

1.4.3 SAFETY INTERACTIONS FOR BATTERY EQUIPPED PRODUCTS.

• The UPS are continuous supply equipment. If the mains supply fails while the equipment is operating, the output lines will continue supplying output voltage depending on the autonomy provided by the battery.

• Generally batteries are already fitted in a single cabinet except in specific situations where, for various reasons, they are delivered inside a separate enclosure.

• For proper operation the battery cabinet must be located beside the machine.

• The battery supply can involve the risk of electric shock and can produce high short circuit current. Observe the following preventive measures before handling any terminal block identified in the labelling as “Battery”.

- Disconnect the corresponding protection components.
- When connecting a battery cabinet to the equipment abide by the cable polarity and color (red-positive; black-negative) indicated in the manual and by the corresponding labelling.
- Wear rubber gloves and shoes.
- Use tools with insulted handles.
- Remove watches, rings or other metal objects.
- Do not place metal tools or objects on the batteries.
- Never touch with your hands or through conducting objects, do not short the battery terminal block or the battery enclosure.

• To prevent full battery discharge and as a safety measure after an extended power failure, as well as at the end of the daily work, you should turn off the loads and later the equipment according to the operation given in the “Operating Manual”.

• For extended periods of disconnection connect the equipment every month for at least 12 hours to charge the battery, to prevent any irreversible deterioration. When storing the equipment, place it in a cool and dry location, never outdoors.

• For installation with supplementary machines or an independent Bypass line, only a single differential of 300 - 500 mA will be placed in common for both lines, at the head of the installation.

1.4.4 SAFETY INSTRUCTIONS REGARDING THE BATTERIES.

• Never short the battery terminals as this involves high risk. It will damage the equipment and the battery.

• Avoid mechanical stress and impacts.

• Do not open or mutilate the battery. Released electrolyte is harmful to the skin and eyes.

• Do not dispose of a battery in a fire. The battery may explode.

• In the event parts of the body come into contact with battery acid, wash immediately with plenty of water and call the nearest medical service as soon as possible.

• Batteries involve a serious risk for health and the environment. They should be disposed of according to current laws.

2 QUALITY AND STANDARD GUARANTEE

2.1 Standard

The M4T Evolution UPS series product is designed, manufactured and commercialised in accordance with standard EN ISO 9001 of Quality Management Systems.
The EC marking is proof of conformity with the EEC Directive (in brackets) in application of the following standards

- **2006/95/EC** Low voltage directive.
- **2004/108/EC** Electromagnetic Compatibility directive (EMC)

In accordance with the specifications of harmonised standards:

- **EN-IEC 62040-1-2**. Uninterruptible power supply (UPS).
  Part 1-1: General and safety requirements for UPS devices in use in accessible areas by end users.
- **EN-IEC 60950-1**. IT equipment. Safety.
  Part 1: General requirements.
- **EN-IEC 62040-2**. Uninterruptible power supply (UPS).
  Part 2: Requirements for Electromagnetic compatibility (EMC).

The manufacturer may not be held responsible for any modification of or repair to the product by the customer.

2.2 Environment

UPS devices belong to the electronic and electrical equipment category. At the end of their useful life they must be disposed of separately and in an appropriate manner.

To recycle packaging, please follow legal regulations in force depending on the particular standard of the country where the equipment is installed.

This symbol is also affixed to the batteries supplied with this device, which means they too have to be taken to the appropriate place at the end of their useful life.
Contact your local recycling or hazardous waste centre for information on proper disposal of the used battery.

3.1 Views.

Figures from 1 to 9 show the illustrations of the equipments according to model, nominal operating voltage and input-output setting, which is summarized in chart 1.
Format of protections and size of the terminals shown in the illustrations of this document, always correspond to the highest power rate model manufactured in that cabinet, at the same power supply voltage and input-output setting.
Nevertheless and as the product is in constant evolution, some
discrepancies or small contradictions can arise. So, if any questions, the labels over the own equipment will prevail.

Each equipment corresponds to one power rate, voltage, frequency and input and output currents. All values of these features can be checked on the nameplate, located at the back of the front door (**PF**).

In the description of this manual, there are references to «LV» (Low voltage) and «HV» (High voltage) abbreviations, described in the nomenclature of the model with an «A» for «LV» and omitted for «HV», grouping the following interval of voltages:

- LV.- 3x200 to 3x230 V (115 to 133 V in single phase).
- HV.- 3x380 to 3x415 V (220 to 240 V in single phase).

These abbreviations do not have any other purpose than matching and/or helping in order to give a better comprehension of the detailed information in this document. They are not displayed either in the nomenclature, or in the reference of the nameplate model.

All models can operate as single units or connected in parallel with other devices of the same family, because the needed electronic kit is already included.

Parallel connection can be done at any time when the upgrading is required to increase the supplied power of the equipment or in order to have redundant operating systems for installations with higher safety.

Do not connect UPS devices of different features, versions, settings, back up times or duplicated addresses in parallel (i.e.: two devices, although they are identical, coming from two parallel systems and with the same address).

In any parallel system only one and different address is assigned to each equipment that makes the system.

Chart 1

<table>
<tr><th rowspan="2">Model.</th><th rowspan="2">Voltage (V)</th><th rowspan="2">Power (kVA /kW)</th><th colspan="2">Fig. no.
Front UPS cabinet</th><th colspan="2">Fig. no.*
Front battery cabinet</th></tr>
<tr><th>Door closed</th><th>Door opened</th><th>Door closed</th><th>Door opened</th></tr>
<tr><td>M4T Evolution 7.5</td><td rowspan="10">«LV»
3 x 200V
3 x 208V
3 x 230V
(115/ 120/ 133V
in single phase)</td><td>7.5 / 6.75</td><td rowspan="5">1
(*) 1 for (-B)</td><td rowspan="2">6
(*) 8 for (-B)</td><td rowspan="5">15
(Battery cabinet for extended back up time models only)</td><td rowspan="5">16
(Battery cabinet for extended back up time models only)</td></tr>
<tr><td>M4T Evolution 10</td><td>10 / 9</td></tr>
<tr><td>M4T Evolution 15</td><td>15 / 13,5</td><td>6
(*) 9 for (-B)</td></tr>
<tr><td>M4T Evolution 20</td><td>20 / 18</td><td>6
(*) 10 for (-B)</td></tr>
<tr><td>M4T Evolution 30</td><td>30 / 27</td><td>7</td><td>15</td><td>16</td></tr>
<tr><td>M4T Evolution 40</td><td>40 / 36</td><td rowspan="3">2</td><td>11</td><td rowspan="3">17</td><td rowspan="3">18</td></tr>
<tr><td>M4T Evolution 50</td><td>50 / 45</td><td rowspan="2">12</td></tr>
<tr><td>M4T Evolution 60</td><td>60 / 54</td></tr>
<tr><td>M4T Evolution 80</td><td>80 / 72</td><td rowspan="2">3</td><td rowspan="2">13</td><td rowspan="2">19</td><td rowspan="2">20</td></tr>
<tr><td>M4T Evolution 100</td><td>100 / 90</td></tr>
<tr><td>M4T Evolution 10</td><td rowspan="9">«HV»
3 x 380V
3 x 400V
3 x 415V
(220V 230V 240V
in single phase)</td><td>10 / 9</td><td rowspan="5">1
(*) 1 for (-B)</td><td rowspan="3">6
(*) 8 for (-B)</td><td rowspan="5">15
(Battery cabinet for extended back up time models only)</td><td rowspan="5">16
(Battery cabinet for extended back up time models only)</td></tr>
<tr><td>M4T Evolution 15</td><td>15 / 13.5</td></tr>
<tr><td>M4T Evolution 20</td><td>20 / 18</td></tr>
<tr><td>M4T Evolution 30</td><td>30 / 27</td><td>6
(*) 9 for (-B)</td></tr>
<tr><td>M4T Evolution 40</td><td>40 / 36</td><td>6
(*) 10 for (-B)</td></tr>
<tr><td>M4T Evolution 60</td><td>60 / 54</td><td>1</td><td>7</td><td>15</td><td>16</td></tr>
<tr><td>M4T Evolution 80</td><td>80 / 72</td><td>2</td><td>11</td><td rowspan="2">17</td><td rowspan="2">18</td></tr>
<tr><td>M4T Evolution 100</td><td>100 / 90</td><td>2</td><td>12</td></tr>
</table>

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M4T Evolution 120		120 / 108				
M4T Evolution 160		160 / 144	4	13	19	20
M4T Evolution 200		200 / 180				

***** Battery cabinets can be different according to the county or the productions.

3.1.1 Equipment.

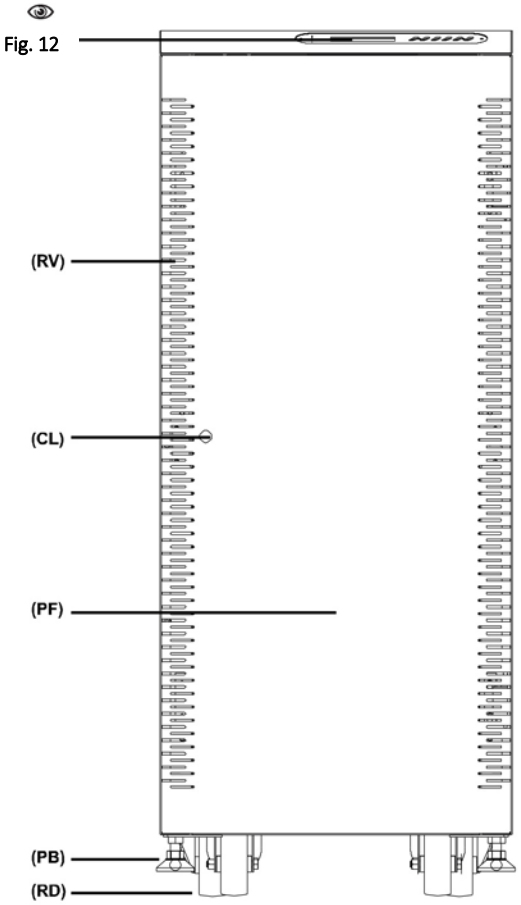

Fig.1.
Cabinet front view for UPS devices from 7,5 to 30 kVA (LV) / 10 to 60 kVA (HV).

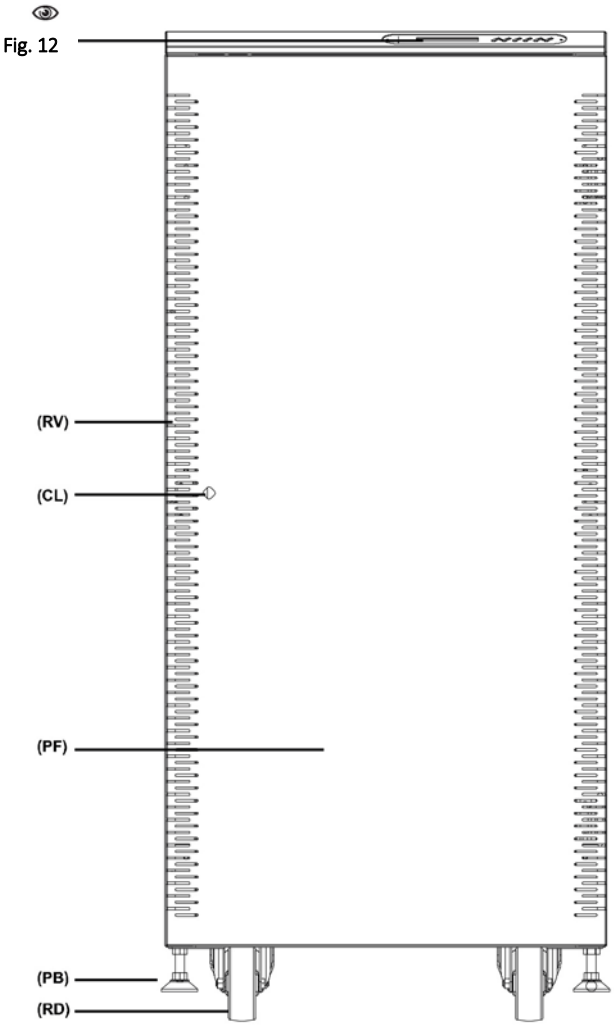

Fig.2.
Cabinet front view for UPS devices from 40 to 60 kVA (LV) / 80 to 120 kVA (HV).

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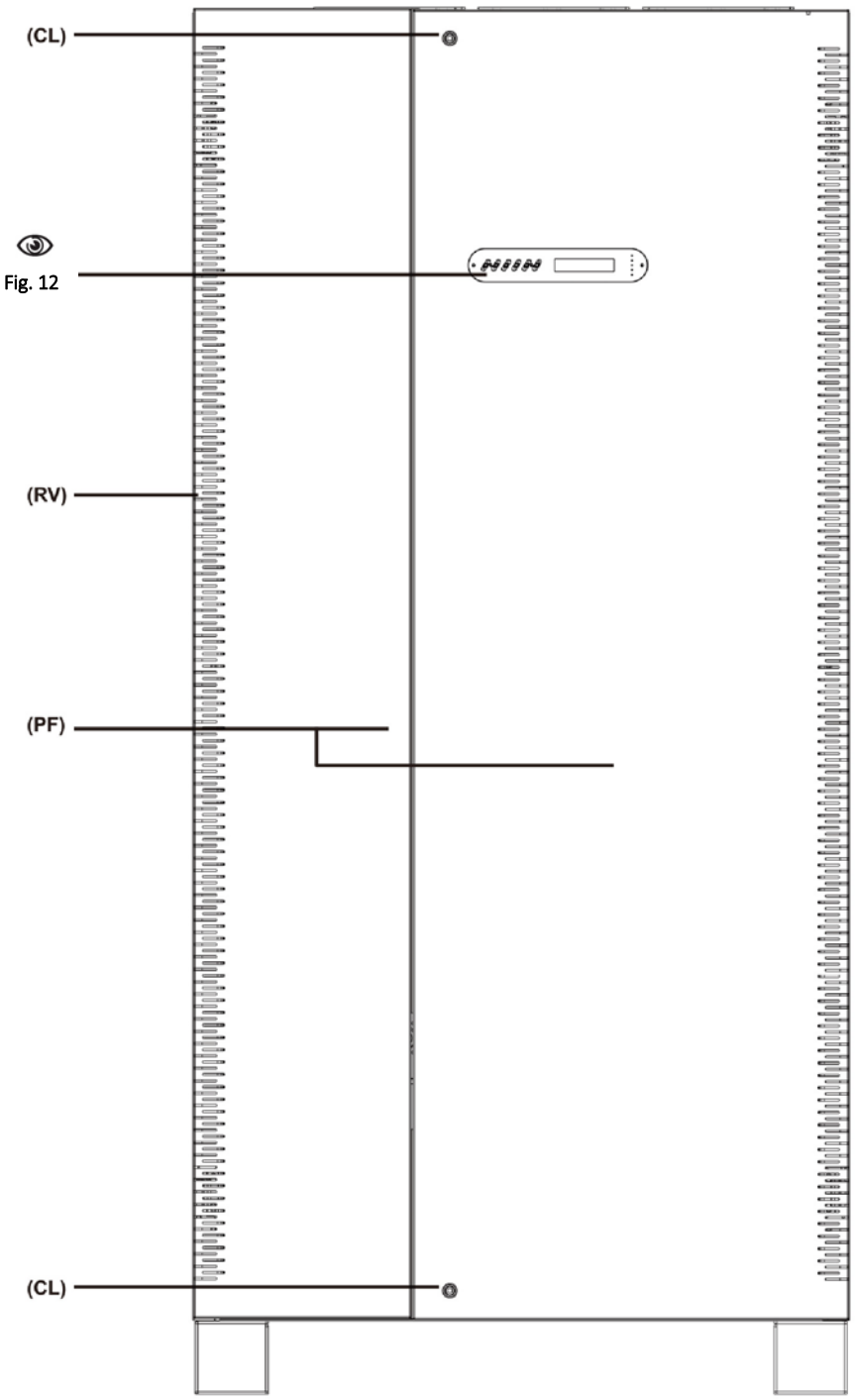

Fig. 3.
Cabinet front view for UPS from 80 to 100 kVA (LV) / 160 to 200 kVA (HV), without separate static bypass line.

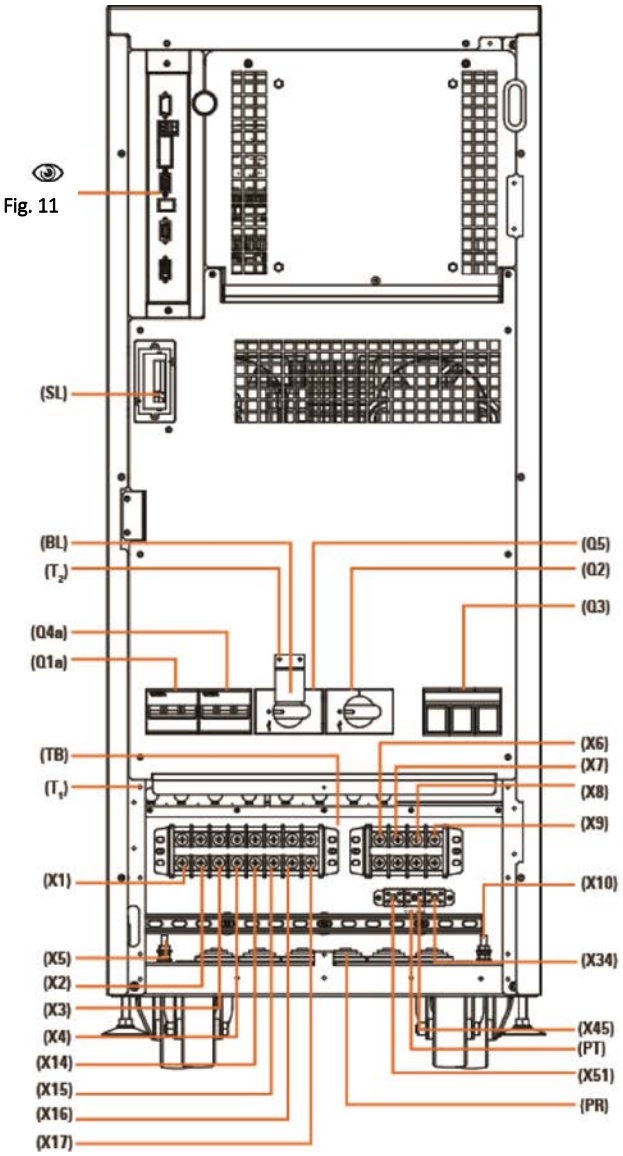

Fig.4.
Cabinet front view with door opened for UPS from 7,5 to 10 kVA (LV) / 10 to 20 kVA (HV).

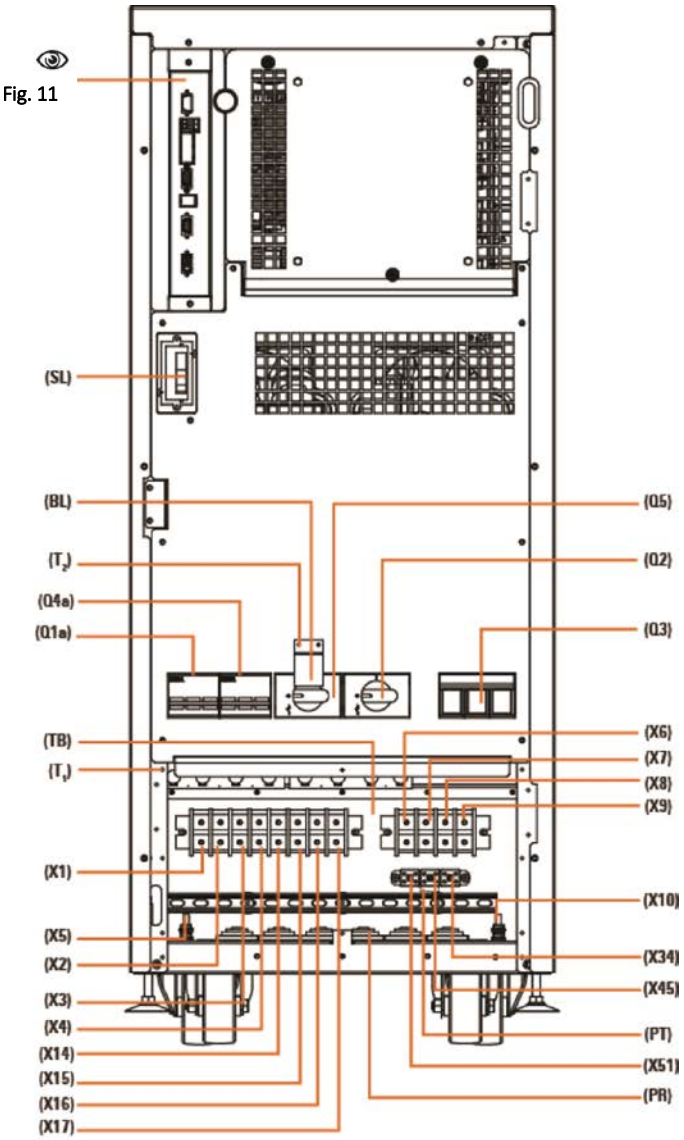

Fig.5.
Cabinet front view with door opened for UPS 15 kVA (LV) / 30 kVA (HV).

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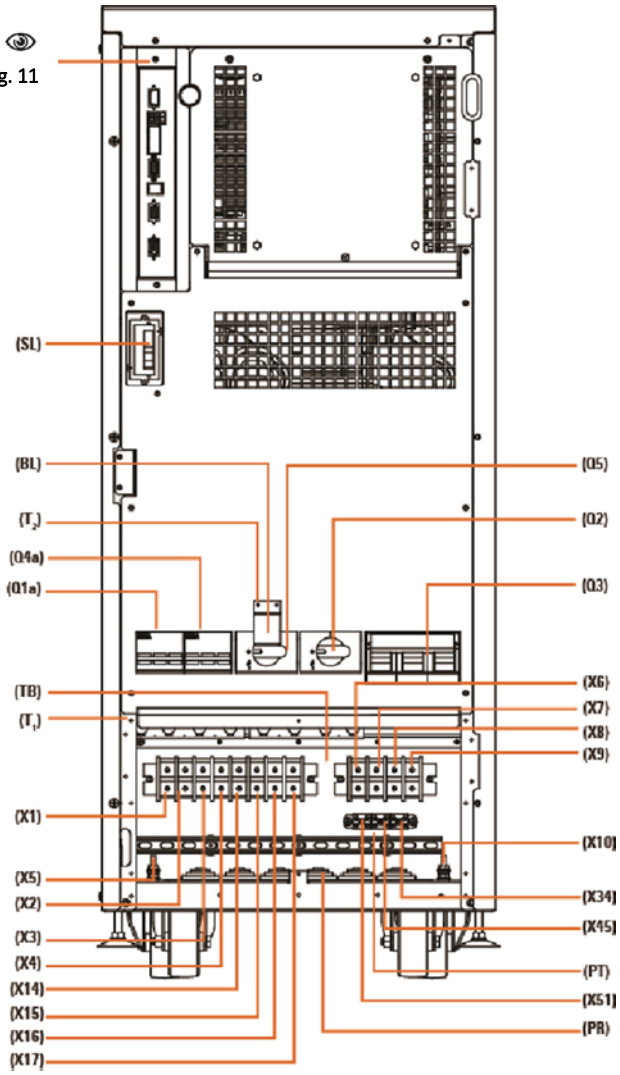

Fig.6.
Cabinet front view with door opened for UPS 20 kVA (LV) / 40 kVA (HV).

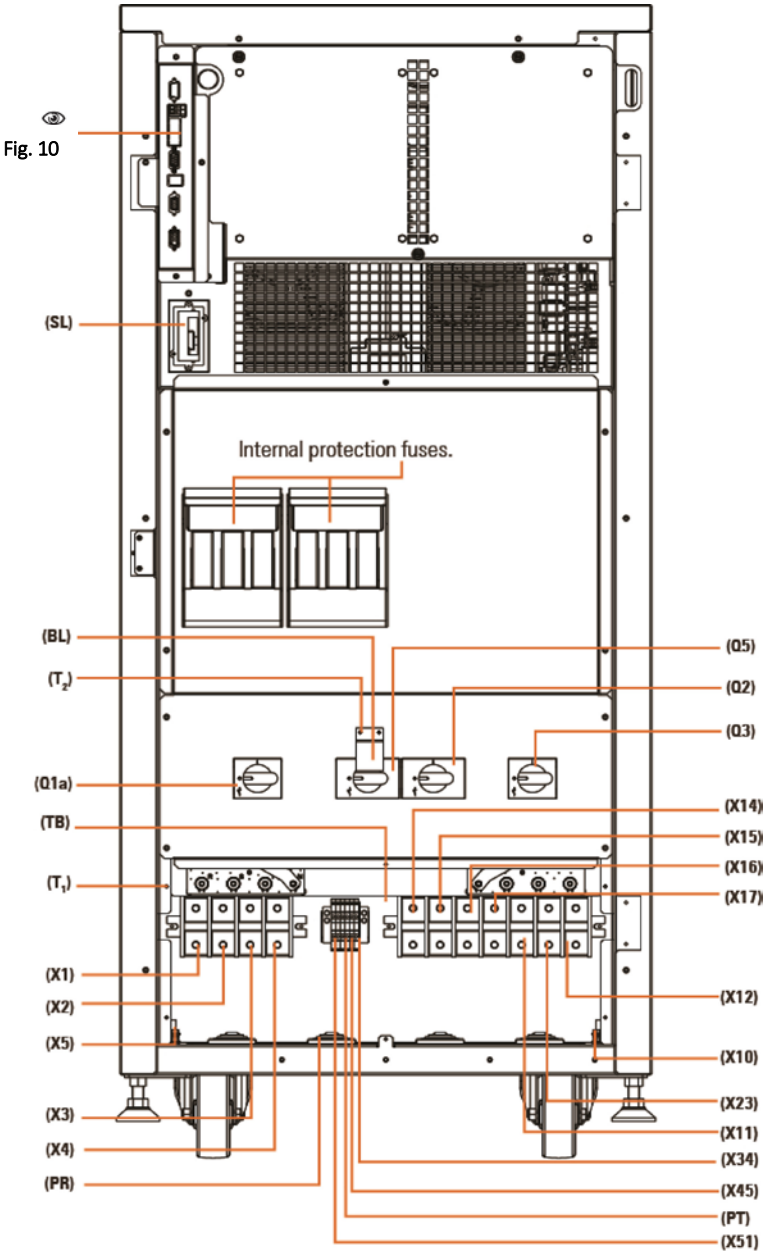

Fig.7.
Cabinet front view with door opened for UPS 40 kVA (LV) / 80 kVA (HV).

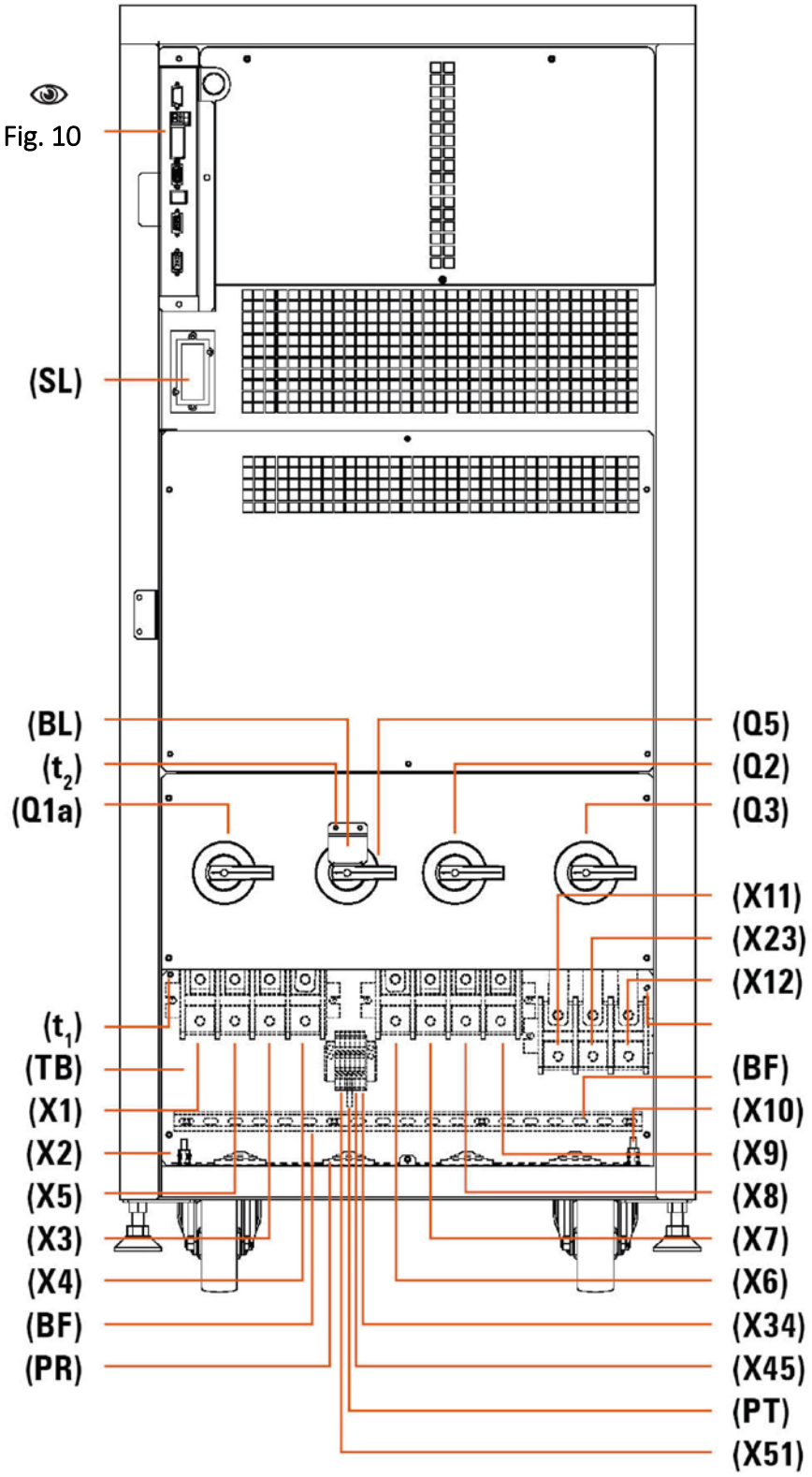

Fig. 8.
Cabinet front view with door opened for UPS from 50 and 60 kVA (LV) / 100 and 120 kVA (HV), without separate static bypass line.

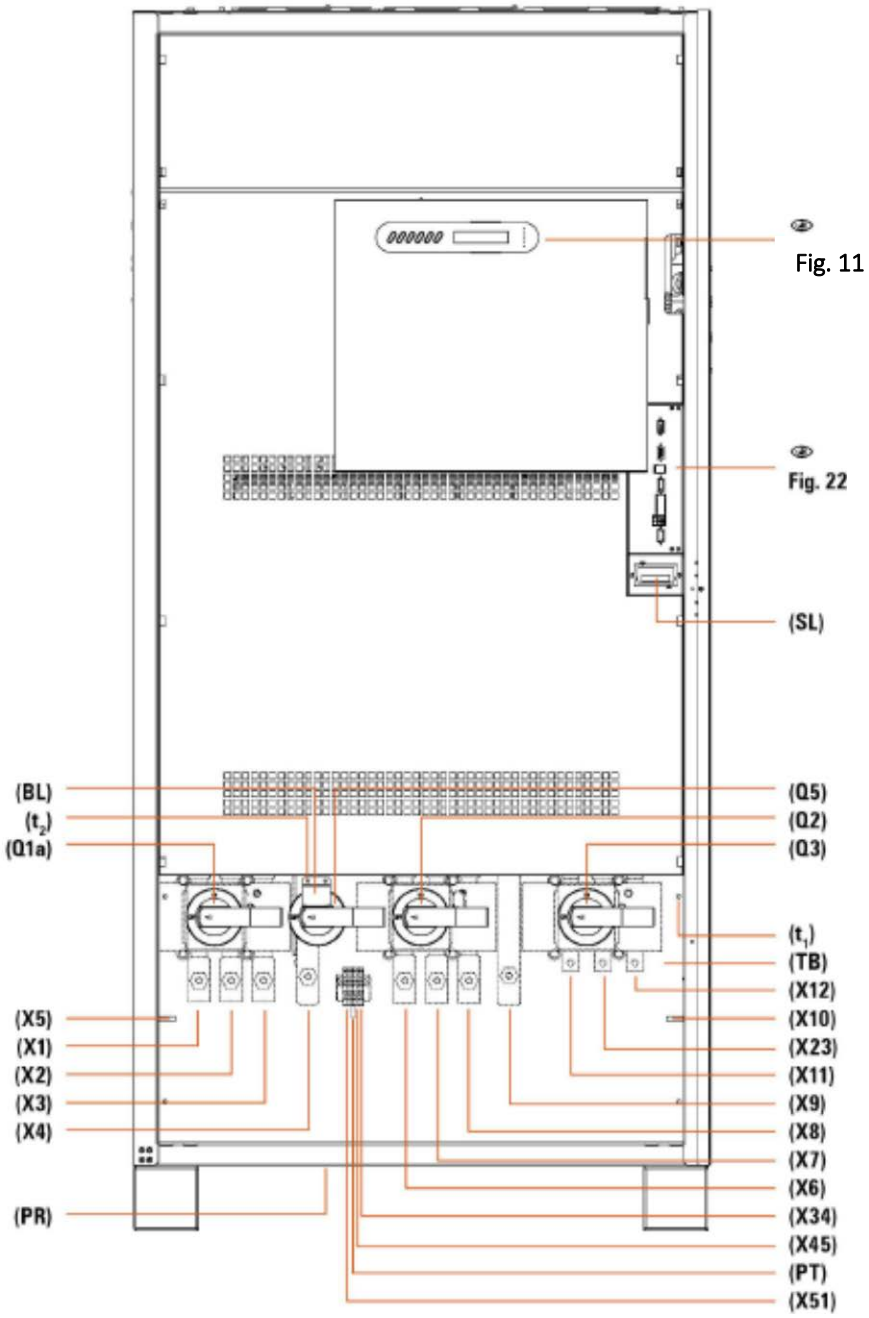

Fig. 9.
Cabinet front view with door opened, models 80 and 100 kVA (LV) / 160 and 200 kVA (HV), without separate static bypass line.

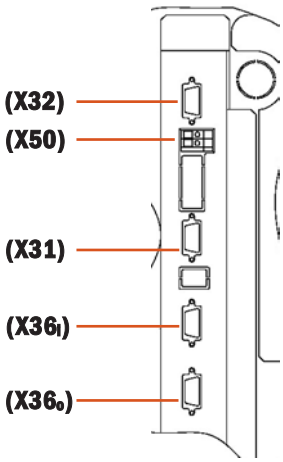

Fig. 10.
Connection of communications from 7.5 to 20 kVA (LV) / 10 to 40 kVA (HV)

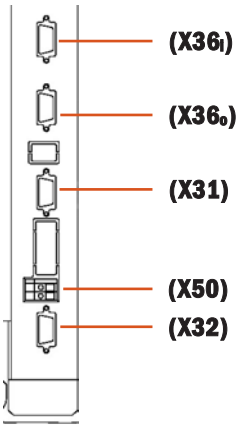

Fig. 11.
Connection of communications for models above 60 kVA (LV) / 120 kVA (HV)

Fig. 12.
Control panel

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3.1.2 Diagram keys.

Protection and handling components (Q*):

(Q1a) Input circuit breaker or switch according to power of the equipment.
(Q2) Output switch.
(Q3) Battery fuse holder switch with 3 fuses (models up to20 kVA (LV) / 40 kVA (HV)) or switch (for higher models).
(Q4a) Static bypass, three poles depending on the mains typology (dual input version only)
(Q5) Maintenance bypass switch.

Connecting elements (X*):

(X1) Phase input terminal R.
(X2) Phase input terminal S.
(X3) Phase input terminal T.
(X4) Neutral input terminal N.
(X5) Main protection earthing terminal (⏚).
(X6) Phase output terminal U.
(X7) Phase output terminal V.
(X8) Phase output terminal W.
(X9) Neutral output terminal N.
(X10) Earth bonding terminal for load(s) and/or battery cabinet (⏚).
(1)(X11) Batteries terminal +.
(1)(X12) Batteries terminal -.
(X14) Phase static bypass terminal R (Dual Input).
(X15) Phase static bypass terminal S (Dual Input).
(X16) Phase static bypass terminal T (Dual Input).
(X17) Neutral static bypass terminal N (Dual Input).
(1)(X23) Batteries terminal N (middle connector).
(X31) DB9 connector COM RS-232 and RS-485 ports.
(X32) DB9 connector relay interface.
(X34) Terminal strip for temperature sensor / floating voltage. Equipments with separate battery cabinet only.
($X36_i$) HDB15 female connector, parallel bus input. Only useful in parallel systems connection.
($X36_o$) HDB15 male connector, parallel bus output. Only useful in parallel systems connection.
(X45) Terminal strip for auxiliary contact output switch.
(X50) Terminals for external EPO.
(X51) Terminal strip, auxiliary contact manual bypass switch. To be connected with external counterpart.

Keyboard and optical indications control panel (PC):

(LCD) LCD screen.
(ENT) “ENTER” key.
(ESC) “ESC” key.
(↗) Move up key.
(↙) Move down key.
(➔) Move to the right key.
(←) Move to the left key.
(a) Rectifier Input Voltage OK LED (green).
(b) Output voltage unit from the Bypass LED (orange).
(c) Inverter is working LED (green).
(d) Unit working from batteries -mains failure- LED (red).
(e) General alarm LED (red).

Other abbreviations:

(BC) Communication BUS bundle between equipments. 5m length with HDB15 connectors in both ends.
(BL) Rod to fix the connection wires of the equipment or battery cabinet by means of wraps.
(BL) Mechanical block for manual bypass switch (Q5).
(CL) Lock for cabinet front door.
(LL) Key to lock and unlock (CL).
(PB) Levelers immobilizing UPS.
(PC) Control panel.
(PF) Cabinet front door.
(PR) Cables passage.
(PT) Cable as a bridge mode to close the circuit between both pins of (X45).
(R103) Two wires bundle with probe to control floating voltage according to temperature.
Equipments with separate battery cabinet only.
(RD) Scroll wheel.
(RV) Ventilation grate.
(SL) Slot for optional SNMP card.
(TB) Terminal cover.
(t_1) Attachment screws for terminals cover (TB).
(t_2) Attachment screws for mechanical block (BL) and switch (Q5).

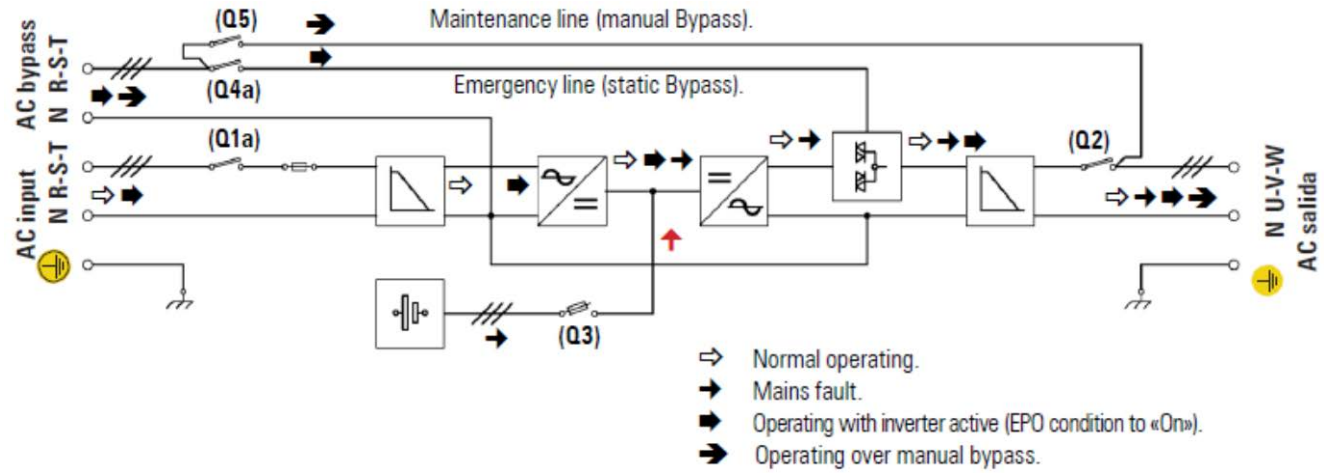
(1): Battery terminals **(X11)**, **(X12)** and **(X23**) available in models > 20 kVA (LV) / > 40 kVA (HV) only, or in equipments B1 type (extended back up time).

By means of the connectors **($X36_i$)** and **($X36_o$)** the communication loop or ring is closed between two or more equipments connected in parallel, by means of the bundle **(BC)**. These connectors are not useful when there is a single equipment.

Together with each UPS, it is supplied only one bundle **(BC)** to connect the communication BUS. Therefore in any parallel system there will be the same quantity of communication bundles **(BC)** as equipment, so it makes possible to close the communication loop.
Each communication bundle **(BC)** has 5 meters length and is provided with HDB15 connectors at both ends (male and female).

3.2 Definition and structure.

3.2.1 Structural diagram.



M4T Evolution block diagram with operating flow 10k to 80k VA.

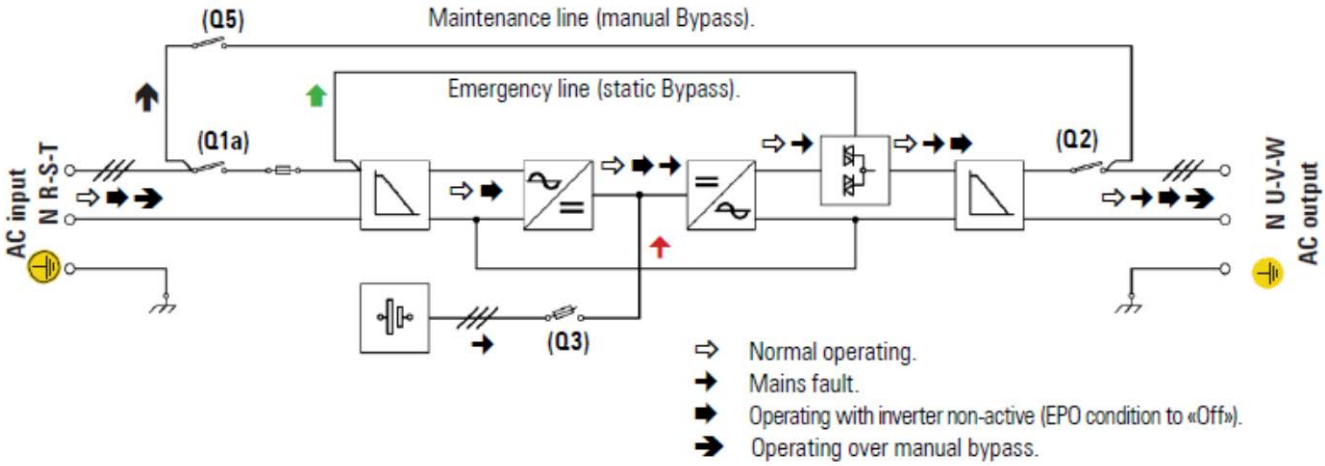
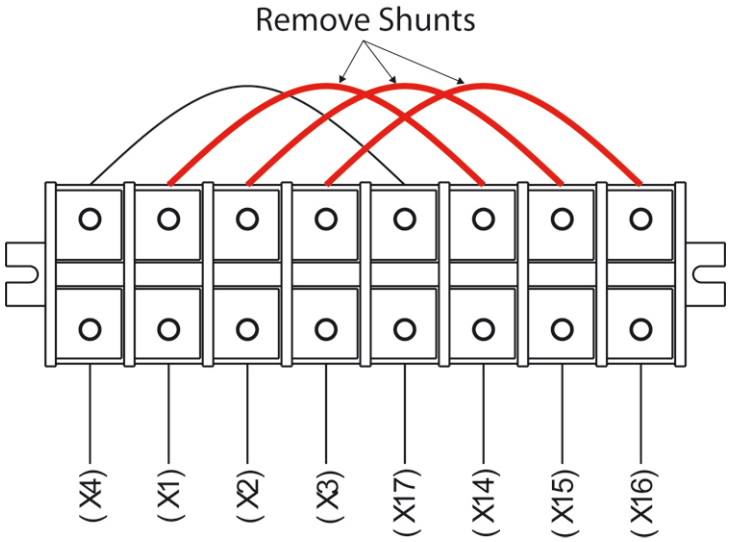


Fig.13. M4T Evolution block diagram with operating flow 100k to 200k VA.

M4T Evolution may be used with main input and separate bypass line.
The most common required connection is the one with common main input and bypass. Both input terminals are then short-circuited by shunt.
If final configuration is set with dual input please remove shunts between main input terminal and bypass line terminal (see figure below).

➔ **Coupling NETWORK1 & NETWORK2 - M4T 10 to 80 kVA**

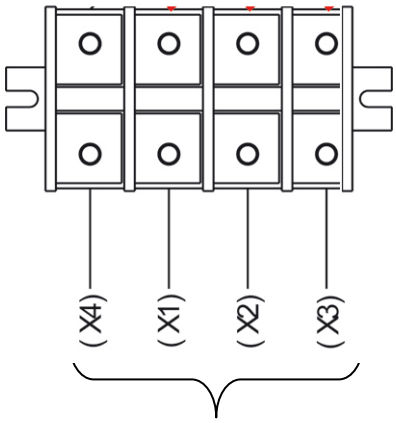


Input terminals M4T 10 to 80 kVA standard version

In equipment with separate bypass line, an isolation transformer must be placed at either or both of the UPS mains power supply inputs (rectifier input or static bypass), in order to avoid the direct connection of the neutral terminal with both mains through the internal wiring of the equipment. This is only applicable if the power supply comes from two different electrical mains, for example:
- Two different electricity companies.
- An electricity company and a generator set, etc.

➔ **Coupling NETWORK1 & NETWORK2 - M4T 100 to 120 kVA**

The UPS M4T Evolution range has the opportunity to have the main power supply (network 1) and a separated bypass supply (network 2) only optional. If it is not required, the main network power supply and BYPASS are common.



Input terminals – M4T Evolution 10 to 80 kVA standard version

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3.3 Functioning stages.

3.3.1 I/O EMI filters

EMI filter is a three-phase low-band filter designed to reduce and cancel all the radio frequency perturbations. The filter performs in a bidirectional way:

- It cancels the perturbations that comes from the line and protect the UPS control circuits.
- It avoids the possible radio electrical perturbations that the UPS could generates flows through the line and affect to other equipment connected to it.

3.3.2 Rectifier-PFC stage (AC/DC)

Constructive parts:

- **Input protection and switch**: it is the particular protection of the PFC rectifier.
- **Current sensor:** it uses alternative current transformers to measure and control the input current, to get a THDi < 3% at full load condition and even < 1% depending on the quality of mains.
- **"T" filter:** it is used to attenuate the current ripple caused by the PFC switching.
- **IGBT's three-phase bridge:** it will be used to make the AC/ DC conversion with the lowest distortion and highest efficiency. The Trench-gate IGBT technology of 4th generation is used.
- **Input chokes:** They are used by the PFC rectifier as energy storage elements (in switching times), for the AC/DC conversion.
- **DC Bus:** it is used to filter the DC needed for the correct operation of PFC converter and inverter

3.3.3 Batteries

This M4T Evolution series has a battery set that stores energy during the normal operating mode (present mains) and they are discharged during the emergency operation (mains fault), keeping the critical loads running during the required time.
Batteries are sized to supply full power to the assigned critical loads during the backup time for any load condition. Standard batteries are sealed Lead Acid, maintenance free and VRLA technology.
Each cell or cell group (battery block) are duly marked in a permanent way, with polarity indication, voltage and safety warning required by the standard.
Cells are duly assembled and electrically connected. Battery set is protected by means of a fuse holder with ultra fast fuses, ready for the described conditions in section «3.3.2. Rectifier-PFC stage».
In normal operation (mains present and charged batteries), the bat- tery set is working on floating voltage.
As an option the battery set of Pb-Ca or Ni-Cd can be assembled in a cabinet or rack separately from the equipment, shared for systems made of two UPSs in parallel

3.3.4 Inverter stage (DC/AC)

Constructive parts:

- **DC Bus:** it is used to filter the DC and it is in charge of interconnecting the PFC and Inverter through the protection fuses.
- **IGBT three-phase Inverter Bridge:** it is equal to the PFC stage but in counter way, it is in charge of making the DC/AC conversion with the lowest distortion and highest efficiency. It is also using the Trench-gate technology of 4th generation.
- **Current sensor:** as it has been described before, in this case conventional AC currents sensors are also used (current transformers) for measurement and control the output current of the inverter to get a total harmonic distortion at the output voltage lower than 1% in full load conditions.
- **Output chokes:** it is used an identical solution as the used at the input. These chokes are used by the inverter as energy storage elements (in switching times), for DC/AC conversion.

3.3.5 Static bypass stage

When the inverter can't keep the voltage to the critical loads due to overloads, short-circuits, current limits or faults, the UPS has a bypass circuit, which supplies isolation for the inverter and supplies the critical loads directly from electrical mains.
The UPS controls the availability inverter-bypass permanently in order to make the shifting between them.
The bypass stage is based on six double thyristors in semipack format, working as AC switches, three of them are for shifting the input over the output and the other three are for shifting the inverter over the output.
The managing system of the SCR switches is based on drivers designed with a shifting system that responds to the following requirements:

- Full static shifting system.
- Shifting with no high transient currents.
- Shifting with no transfer time.

The control algorithm of the triggering signals of the thyristors assures a nil transfer time, and avoids short-circuits between the thyristors of bypass and inverter (shifting with zero cross current).

3.3.6 Maintenance or manual bypass

All M4T Evolution from this series are foreseen with an auxiliary line protected by a circuit breaker switch, which makes an electrical bridge between the input and output terminals.
Managing this switch, properly together with the input and output, allows isolating electrically all the UPS elements from the electrical lines.
The type of maneuvering of the maintenance bypass is a “make before break”, with the purpose of keeping the critical loads fed, even during the maintenance tasks.

3.3.7 Terminals for EPO

The UPS has two terminals to install an external button of emergency output shutdown (EPO).

3.3.8 Control panel

This UPS has a sophisticated control panel based on a DSP (Digital Signal Processor) that performs as interface between the UPS and end-user.
Each UPS is equipped with an alphanumerical LCD panel, which automatically informs about the current status of the equipment and electrical measurements to the end-user. It is based on a tree menu, allowing an easy browsing through its screens.

3.3.9 Control firmware and communication

AFC Control (Adaptive Feedforward Cancellation).
It consists in the use of digital resonators connected in parallel and set to those frequencies where the consigns or perturbations to refuse are expected.
This control technique allows doing the follow of the sinewave signals of reference of the output voltage in the inverter and input current of the active rectifier.
It is important to highlight that the different controls of the UPS do not operate either isolated or locally, but they interact between them in such way that it results a global controller of coupled type. It means operating advantages like to adapt the rectifier to the load conditions immediately.
The digital control software works at two different levels:

3.3.9.1 Control firmware at low level

Input three phase rectifier controller: PFC control and battery charge loops. The structure adopted of independent control per phase of cascade type allows managing both single phase and three phase inputs.
The AFC control technique has been also applied, to assure a sinewave mains currents, with a THDi < 2%, and in phase shifting with the voltages, to balance the active power of all the system, to accelerate its response and make it insensitive against the load transients.

In normal conditions, the rectifier is running and charging the batteries, controlling at any moment the charging current and floating voltage according to the temperature of themselves. The system is also in charge of minimising the charging current ripple that flows through them.
When the input voltage or frequency is out of the correct operating range, it is shut down and batteries are responsible of keeping the inverter in operation, which at the same time supplies the loads connected at the output of the equipment until the battery voltage decreases until the end of back up time.
Another important feature of the rectifier is its bidirectional capacity of operation. This allows consigning a battery discharging current even with mains present. This quality performance will make possible to do a battery test both in full load and no load conditions.

Output three-phase rectifier controller: independent per phase, it is easy adapted to different settings, either single phase or three phase.
It is highlighted the use of the AFC control technique that allows getting an output voltage with a THDv lower than 1,5% with non-linear load at the output and good dynamic response against unexpected step loads.

Switching algorithm of the bypass thyristors.

Parallel control: High-speed communication and inverter parallel connection.

3.3.9.2 Managing firmware of the equipment

- Managing and control of different parts.
- Visualization software for user interface.
- Software of communication and protocol implementation.
- Managing software of parallel system.

3.3.9.3 Communications

COM port to relays: It supplies a digital signal in a dry contact way, which makes possible the dialogue between the equipment and other machines or devices.
By default the equipment is supplied with 4 signal relays with a preset programming (see table 2), which can be modified at factory or by teh S.T.S. under request. Figure 35 shows all the alarms that can be set to any relay.
A fifth relay can be supplied as an option and under request, which can be defined in the purchase order.
A “shutdown” input allows shutdown the inverter.
The most common use of this type of port is to supply the needed information to the closing file software.
COM port RS-232 and RS-485: By means of the same DB9 connector supplies the RS-232 and RS-485 communication ports. They are mutually exclusive between them and they are used to connect the UPS with any machine or device that has this standard bus.
The RS-232 port consists in the serial transmission of data, in such way that it can send a lot of information through a communication cable of 3 wires.
The RS-485, unlike other serial communication channels, it uses 2 wires only to dialogue among the systems connected to this network. The communication is established by sending and receiving signals in differential mode, so it gives to the system high immunity to the noise and long range (approx. 800m).
The used protocol is “MASTER/SLAVE” type. The computer or IT system (“MASTER”) asks for a determined data, and the UPS answers immediately (“SLAVE”).

3.4 Operating principle.

The M4T UPS series is a double conversion system AC/DC, DC/AC with a sine wave output that gives safe protection in extreme power supply conditions (variations in voltage, frequency, electrical noises, blackout and micro cuts, etc...). Regardless of the type of load to be protected, these devices are designed to ensure a quality and continuous power supply.

The operation is as follows:

- An IGBT three phase rectifier converts the AC voltage into DC by absorbing a pure sine wave current (THD <2%) and charging batteries at constant current / voltage.
- The batteries supply the power needed by the inverter in the event of mains failure.
- The basic double conversion structure is completed by two new functional blocks, the static bypass commuter switch and the manual bypass commuter switch.
- The static bypass commuter switch connects the output load directly to the bypass network in special circumstances such as overloading or overheating and reconnects it to the Inverter when normal conditions are restored.
- The standard version has separate lines for the Inverter and bypass blocks, thus increasing the safety of the installation as it allows the use of a second power supply (generator unit, other electricity company, etc.).
- The manual bypass commuter switch isolates the UPS from the mains and from the loads connected to the output, so that maintenance operations may be performed on the UPS without any need to interrupt the supply to the loads.

3.4.1 Normal operation, (⇨).

When there is a mains power supply, the rectifier transforms the AC input voltage into DC raising the DC voltage to a suitable level to supply the inverter and to charge the batteries.
The inverter transforms the voltage of the DC bus into AC, providing a sine wave alternating output, stabilized in voltage and frequency to supply the loads connected to the output (figure 13).

3.4.2 Operation with mains failure, (➔).

In the event of mains failure or should a micro cut occur, the group of batteries supplies the power needed to supply the inverter.
The inverter continues working normally without being affected by the lack of mains and the back-up time of the device depends only on the capacity of the group of batteries (figure 13).
When the battery voltage reaches the end of back-up time, the control blocks the output to protect against deep battery discharge.
When mains is restored and after the first seconds of analysis, the UPS again operates as described in the “Normal operation” section.

3.4.3 Operation with inverter not active, (➡).

The inverter is inactive due to the existence of alarm conditions such as overloads, overheating, end of back-up time, etc. In this case the rectifier continues charging the batteries to maintain the optimal charge.
The inverter is also inactive if the unit has not been started up with the keyboard. In that case, the rectifier will be inactive.

In all these cases the output voltage of the UPS is supplied by the emergency bypass line through the static bypass commuter switch (figure 13), provided that the EPO is inactive

3.4.4 Operation in manual bypass, (➔).

When maintenance checks are to be performed on the device, it may be disconnected from the mains without any need to cut the power supply to the system and affect the critical load. The UPS may only be worked on by technical or maintenance personnel, by means of the maintenance bypass (as per specific instructions for that purpose).

3.4.5 Operation in Smart Eco-mode.

For applications requiring less energy, the smart and efficient function Smart Eco-mode allows to supply the loads directly from mains through the solid state static bypass («Off Line» mode). This function can only be used when the power supply is available.

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In case of a mains input failure, the system will automatically switch back to the normal On Line operating mode and will supply the loads through the inverter using the energy of the batteries. The Smart Eco-mode can improve the efficiency of the UPS by 4 and 4.5 %, thus almost reaching 100%.
Since the Smart Eco-mode depends entirely on the static bypass line and preset activation ranges, a perfect stability of the frequency, the voltage or the shape of the sinewave cannot be guaranteed.
The detection of these parameters can take up to 3 ms. It is therefore recommended to assess the level of protection required by the loads if this operating mode is to be used.
This operating mode is disabled in the factory presets. It can be activated by following the instructions in section 6.3.3., Fig. 27.

3.4.6 Operation in Frequency Converter.

The M4T Evolution is set by default as a frequency converter from 50 to 60 Hz or from 60 to 50 Hz, regardless of the presence of batteries.

3.5 Parallel system operation

The M4T Evolution was designed to allow connecting in parallel up to four units of the same model without adding hardware. Figure 14 displays a diagram of a three-phase input/three-phase output parallel system, with a separate static bypass line.
The diagram shows the input-output power connections and the parallel control BUS.

There are several types of parallel installations for M4T Evolution:

• **Simple parallel system (non-redundant):** a parallel system is non-redundant when all the M4T Evolution supply the required power to the loads.
The total power of the system based on N equipment with a nominal power rate of Pn, is N x Pn.
If the system is operating with a load close or equal to the maximum and one of the M4T Evolution fails to provide the load, the latter will automatically shift to bypass before a technical break, since it will not be able to support the overload that it will cause to the other UPSs.

• **Redundant system:** a parallel system is redundant when several M4T Evolution share the load between them. Should one of the UPSs fail, it will exit the system and the remaining UPSs will continue supplying the load securely. Once the damaged UPS is fixed, it can be connected to the system in order to go back to the redundant system. A redundant system increases the reliability and guarantees a quality AC power supply for the most critical loads. The requirements of the applications will determine the number of devices installed in the redundant system.

The parallel connection of UPS devices provides numerous other advantages:

• **Higher punctual power and back up time:** Supposing that in a parallel system equipped with N+M devices, the nominal maximum load is the one of the N devices and M are the backup ones. Therefore:
  - o N, is the quantity of parallel devices, corresponding to the minimum quantity required by the total needed power.
  - o M, is the additional quantity of devices corresponding to the residual safety power (redundant equipment).

Therefore, a redundant parallel system with 3 UPS of 40 kVA and N+1 configuration, the nominal maximum load contemplates 80 kVA (2x40 kVA), although the system can accept load demands up to 120 kVA (3x40 kVA). Therefore, the fact of having +M reserve equipments, increases the back up time of the set, because the battery set is higher.
• **Modularity:** capacity can be added to a UPS parallel system by adding equipment of the same feature, without needing to replace the devices already installed. Therefore, in an installation with a parallel system of 2 UPSs, adding a third equipment later to the system is possible, without replacing the 2 original installation.

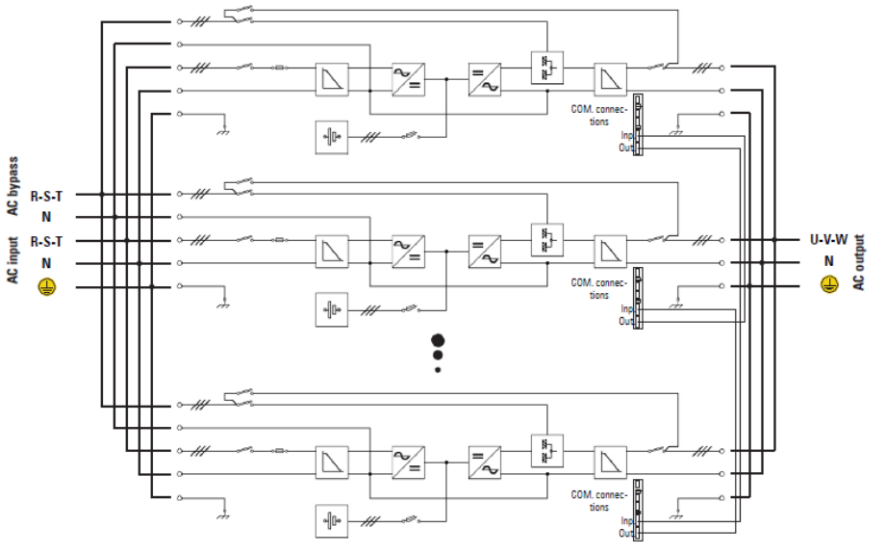

Fig.14. Single line diagram of the connection of a parallel system with up to 4 units.

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4 INSTALLATION

Check the Safety Instructions.
Make sure that the data on the characteristics plate are those required for the installation.
Any incorrect connection or handling may cause damage to the UPS and/or the loads connected to it. Read these instructions carefully and follow the steps in the order indicated.
This UPS must be installed by qualified staff but can be used by personal with without any specific preparation aside from this “User Guide”.

4.1 Important Safety Instructions.

⚠ As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection (⏚)). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

All connections to the device, including those for control (interface, remote control, etc.), will be performed with the switches in the off position and without any mains present (UPS power line cut off “Off”).

It should always be remembered that the UPS is a generator of electrical power, so users must take all necessary precautions against direct or indirect contact.

Warning labels should be placed on all primary power switches installed in places that are not in the vicinity of the device to alert the electrical maintenance personnel of the presence of a UPS in the circuit.
The label will bear the following or an equivalent text:

Before working on this circuit. - Isolate the Uninterruptible Power Supply (UPS). -Then check for Hazardous Voltage between all terminals including the protective earth. ⚠ Risk of Voltage Back feed

When the power supply reaches the UPS input with static bypass included, although the inverter is “Off” (shut-down), it does not mean there is no output voltage at the output terminals.
To do this, (Q1a), (Q4) and (Q2) must be switched to the “Off” position.
The UPS may be supplying output voltage from the manual bypass which must be taken into account for safety purposes. If the output power supply of the UPS has to be interrupted in this situation, deactivate the switch (Q5).

Precautions must be taken for devices with battery terminals, as they are not isolated from the alternative input line, and there could be dangerous voltage between the battery terminals and the ground.

4.1.1 Batteries.

Batteries should be handled and connected or supervised by qualified personnel with battery knowledge.

For units supplied without batteries, the batteries will always acquire, installed and connected by the customer and under his responsibility. The battery details (number, capacity and voltage) are indicated on the battery label pasted beside the nameplate of the equipment. These requirements should be strictly adhered to as well as the battery polarity connection and the circuit diagram provided with this documentation.
The battery supply may involve the risk of electric shock and may produce high short circuit current. Please observe the following preventive measures before manipulating any terminal block identified on the label as “Battery”:

- ❒ Disconnect the corresponding protection components.
- ❒ When connecting a battery cabinet to the equipment, the cable's polarity and color (red-positive; black-negative) indicated in the manual and in the corresponding labeling must be adhered to.
- ❒ Wear rubber gloves and shoes.
- ❒ Use tools with insulated handles.
- ❒ Remove watches, rings or other metal objects.
- ❒ Do not place metal tools or objects on the batteries.
- ❒ Never handle with your bare hands or through conducting objects as this may short-circuit the battery terminal block or the battery enclosure.

- Never short-circuit the battery terminals as it involves high risk and will be detrimental to the equipment and batteries.
- Avoid mechanical stress and impacts.
- Do not open or mutilate the battery. Released electrolyte is harmful to the skin and eyes.
- Do not dispose of batteries in a fire. The batteries may explode.
- In the event parts of the body come into contact with battery acid, wash immediately with plenty of water and call the nearest medical service as soon as possible.
- Batteries involve a serious risk for health and the environment.
- They should be disposed of according to current laws.

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4.2 Equipment Reception.

4.2.1 Unpacking and content checking.

- On receiving the device, make sure that it has not suffered any damage during transportation. Otherwise, make all pertinent claims to your supplier or to our company. Also check that the data on the nameplate, which is affixed inside the front door (PF), corresponds to those specified in the purchase order, to do this, you will need to unpack it. In the event of non-conformity, please give notification as soon as possible quoting the device serial number and references of the delivery remittance.

- When the device has been accepted, it is best to repack the UPS until it is commissioned in order to protect it from any knocks, dust, dirt, etc....

- The packaging of the device consists of a wooden pallet, a cardboard or wooden surround depending on the case, expanded polystyrene corner pieces, polyethylene sleeve and band, all recyclable materials; they should therefore be disposed of according to local regulations. We recommend that the packaging is kept for future use.

- To unpack, cut the bands on the cardboard surround and remove it from above as if it is a cover or remove it with the necessary tools if the surround is made of wood; remove the corner pieces and the plastic sleeve. The UPS will be unpacked on the pallet, to lower it, suitable equipment must be used with the required safety procedures (use the specific ramp to remove UPS from pallet). See section 8.1.

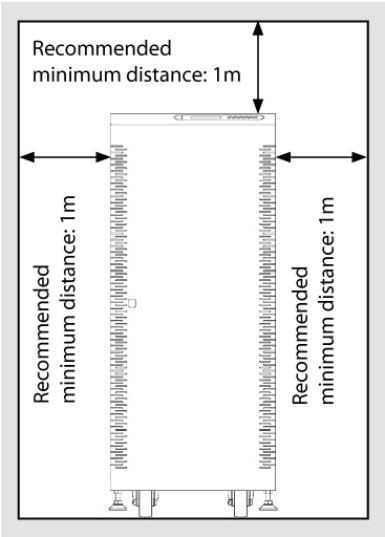

Fig.15. Front view UPS location

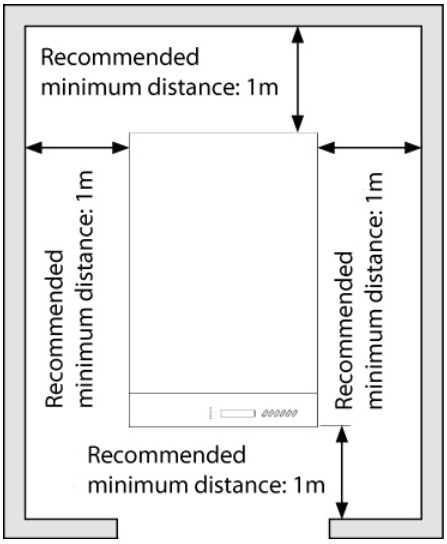

Fig.16. Top view UPS location.

- Content of the packaging:
    - Standard UPS up to 20k VA (LV) or 40k VA (HV):
        - M4T Evolution UPS device
        - InfoPower management software
        - User Manual
        - Battery Fuses
        - Parallel communication cable bundle (if necessary)
    - Standard UPS over 20k VA (LV) or 40k VA (HV):
        - M4T Evolution UPS device
        - InfoPower management software
        - User Manual
        - Battery Bank (fuses and cable connection bundle)
        - Parallel communication cable bundle (if necessary)

4.2.2 Storage.

- The UPS must be stored in a dry, well-ventilated place and protected against rain, water jets or chemical agents. It is advisable to keep the equipment and the battery pack(s) in their original package, which has been designed to guarantee the maximum protection during transport and storage.

⚠

- Except for special cases, the UPS has sealed airtight, lead batteries and should not be stored for more than 12 months (see the date the batteries were last charged on the label affixed to the device packaging or on the battery cabinet).

- After this time, connect the device to the mains along with the battery pack(s), as the case may be. Start it up as per the instructions given in this manual and charge the batteries for 12 hours from float level. Devices with a separate static bypass line do not require this procedure.

- Then shut down the device, disconnect it and keep the UPS and the battery cabinet(s) in their original packaging, noting the new battery charge date on the respective labels.

- Do not store the unit where the ambient temperature exceeds 40ºC or falls below -20ºC, as this may deteriorate the electrical characteristics of the batteries.

4.2.3 Transport to location.

- All UPS devices have castors to facilitate their transport to their final location. It is important to abide by the approximate weight requirements indicated in table 5 with respect to the site itself and the installation means (floor, hoist, lift, stairs, etc.).

4.2.4 Location.

<u>Location requirements for a standard installation</u>

- The Safety Instructions indicate that a minimum clearance should be left around the equipment for ventilation purposes:
  - 25 cm on both sides
  - 50 cm at the rear
  - 100 cm at the top
  - 150 cm at the front

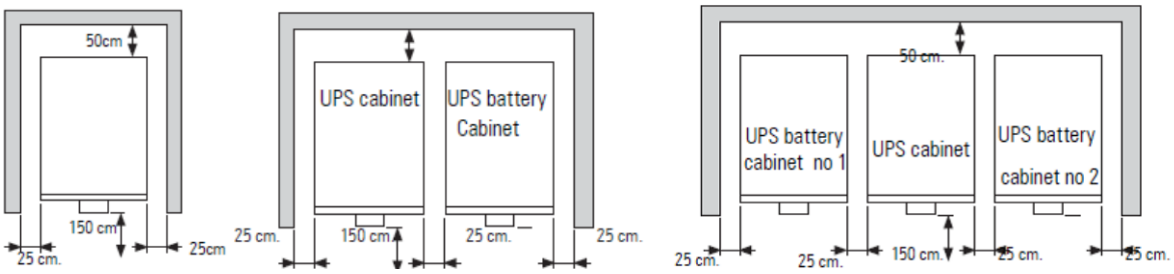

Fig.17. Minimum distances for the installation of M4T Evolution

- It is recommended to add an additional 75 cm free space on both sides to make interventions easier.

<u>Location requirements for a parallel installation</u>

Fig.18 shows the free space requirements for the surrounding of several M4T Evolution and its Battery Banks in a parallel installation.

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- It is more convenient to store and install the UPS devices in order according to their numbers, since the length of the battery wires are limited to 3.5m. If more than one Battery Bank is used per UPS device, the same installation must be respected symmetrically.

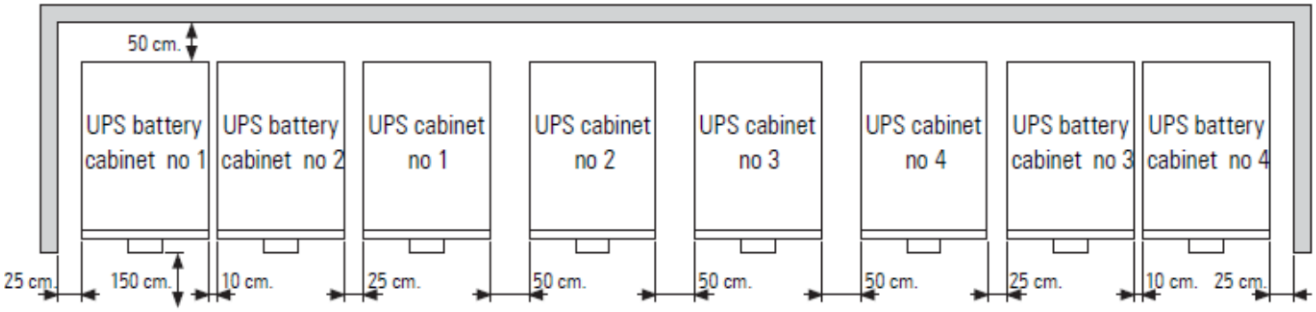


Fig.18. Minimum distances for the installation M4T Evolution in a parallel installation

Immobilization and levelling of M4T Evolution

- The UPS includes four leveling screws (PB) located near the front casters, which immobilize the unit once in place.

Warning!

If the UPS device is not stable enough, a risk of collapsing may exist when extracting the battery shelves. Take the shelves out on by one.

Loosen the PB by hand turning them counterclockwise as far as possible. Then, use a spanner to lift the unit so that the UPS may rely upon the PB.

Fig.19. Equipment stabilisers (PB)

To access the battery shelves, the side covers of the cabinets must be removed. Before handling the battery sliding shelves, read and respect the indications on the labels of each shelf.

Preliminary considerations before connecting M4T Evolution

These instructions refer to M4T Evolution models with or without extended backup time.

It is essential to use flexible casts instead of hard cables for connection of the terminal input/output/static bypass/battery.

For parallel installations, an external manual bypass panel board is essential to isolate the UPS during maintenance operations in order to avoid any damage of the loads.

The information is based on an installation with cables not exceeding a 20 metres length between the distribution panel board, the equipment and the loads.

- For longer lengths, correct the cross sections in order to avoid a voltage loss, according to your local regulation.
- In this user manual you may find the information as to which parameters to select for a given number of UPS connected, as well as the features of the backfeed protection.

In parallel installations, the length and cross section of the wires from the panel board to each M4T Evolution must be the same.

The nominal currents of M4T Evolution stated on the nameplate of the device are the ones communicated in the EN 62040-1 safety standard. The input current has been calculated according to the power factor and efficiency of the device. See also chart XXX

If other peripheral elements are added to the UPS or parallel system input, output or bypass like transformers or autotransformers, take into account the currents stated on the nameplates of those elements in order to use the suitable cross sections, always respecting the Local and/or National Low Voltage Electrotechnical Regulations.

When a UPS or parallel system includes a galvanic isolation transformer, protections against indirect contact (RCD) have to be fitted in at the output of each transformer.

Any isolation transformer installed or supplied by Infosec UPS System, must have the neutral output connected to earth by a bridge connecting the neutral and earth terminals. Should an isolated neutral be required, remove this bridge by taking the precautionary measures stated in the respective local and/or national low voltage regulations.

To enter the cables inside the cabinet, there are either cable glands (PR) assembled in the metallic structure.

Models with power rate higher than 40 kVA (LV) / 80 kVA (HV), have a rod to fix the connection wires of the equipment to it, using a clamp (BF).

Once the cables are connected to their respective terminals, connect them with clamps to the rod (BF).

Preliminary considerations over batteries before connecting M4T Evolution

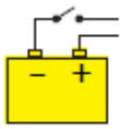
Battery protection must always be done at least with fuses. Their physical layout is therefore determined by the localization of the batteries.

For standard M4T Evolution models up to 20 kVA (LV) / 40 kVA (HV), batteries are already installed in the UPS's cabinet. Higher power models' batteries are supplied in a separate cabinet. The protection of the batteries is arranged as follows:

- In the UPS: Battery fuse holder switch with three fuses in models up to 20k VA (LV) / 40k VA (HV) or switch for higher power models.
- In the battery bank (for standard backup time models): Battery fuse holder switch with three fuses in models up to 60k VA (LV) / 120k VA (HV) or a switch for the battery string n°1 in models higher than 60 kVA (LV) / 120 kVA (HV) containing 3 non-switchable fuses.

Fuses are supplied in a plastic bag together with the user manual or inside the battery bank, except for battery modules of models over 60 kVA (LV) / 120 kVA (HV), where the fuses are attached to the cabinet.

The battery circuits are opened by default.



Put the fuses in the corresponding fuse holder switch and turn it «On» when it is indicated, **never before**. **Proceeding differently may damage the equipment and/or serious injuries.**

Do not manoeuvre the battery fuse holder and/or switch when the equipment is turned on. This mechanisms cannot be turned on/off with a load connected.

When the power supply of M4T Evolution or the parallel system is broken beyond a simple intervention, or when they are about to be out of service for a long time, shut them down completely and remove the 3 fuses from the fuse holder switch or battery module for better safety, and keep them in a safe place. For models higher than 60 kVA (LV) / 120 kVA (HV), open the battery switch in both cabinets (equipment and battery module).

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Access to the cabinet for its connection

M4T Evolution has terminals as connection elements for power, and a terminal strip for the auxiliary connections and HDB9 / DB9 communication connectors.

To get acces, proceed as follows for each unit of the parallel system:

- Open the lock using the supplied key by turning it clockwise 45°.
- Open the front door. The DB9 connectors of the communication ports and the terminals for the EPO remote button should be visible.
- Remove the screws of the cover of the cabinet and remove it; the connection terminals should be visible.
- When the connection of M4T Evolution is done, put the cover back and screw it, close the door using the key and lock it.
- Take the cross cable section into account for the size of the switches terminals, in order to make all their section match properly for an optimal contact between both elements

4.2.5 Connections access.

	Model.	Equipment power (kVA)	Maximum input and bypass current, and nominal output current (A)								
			3x380 V			3x400 V			3x415 V		
			Input	Output	Bypass	Input	Output	Bypass	Input	Output	Bypass
1 common supply	M4T-10	10	15	15	-	14	14	-	13	13	-
	M4T-15	15	22	23	-	21	22	-	20	21	-
	M4T-20	20	30	30	-	28	29	-	28	28	-
	M4T-30	30	44	45	-	43	43	-	40	41	-
	M4T-40	40	59	61	-	57	58	-	53	55	-
	M4T-50	50	74	76	-	71	72	-	67	68	-
	M4T-60	60	89	91	-	85	87	-	80	82	-
	M4T-80	80	118	122	-	113	116	-	107	110	-
	M4T-100	100	146	152	-	139	145	-	133	139	-
	M4T-120	120	176	182	-	168	174	-	163	167	-
	M4T-160	160	237	244	-	225	232	-	216	223	-
	M4T-200	200	295	304	-	281	290	-	270	278	-
Dual input	M4T-10	10	15	15	15	14	14	14	13	13	13
	M4T-15	15	22	23	23	21	22	22	20	21	21
	M4T-20	20	30	30	30	28	29	29	28	28	28
	M4T-30	30	44	45	45	43	43	43	40	41	41
	M4T-40	40	59	61	61	57	58	58	53	55	55
	M4T-50	50	74	76	76	71	72	72	67	68	68
	M4T-60	60	89	91	91	85	87	87	80	82	82
	M4T-80	80	118	122	122	113	116	116	107	110	110
	M4T-100	100	146	152	152	139	145	145	133	139	139
	M4T-120	120	176	182	182	168	174	172	163	167	167
	M4T-160	160	237	244	244	225	232	232	216	223	223
	M4T-200	200	295	304	304	281	290	290	270	278	278

Table 1. Input, output and bypass currents for a standard three phase voltage UPS.

- ❒ Once the UPS is connected, replace the cover (TB) and close the door (PF) with the lock (CL).

- The cable cross section of the bypass, input and output lines shall be determined from the maximum currents for the first two and from nominal ones for the output, by respecting the local and/or country Low Voltage Electro-technical standards.
  To calculate the cross cable sections, take the figures of the current given in tables 1 or depending on the model, single or three phase configuration and nominal voltage value of the UPS.
  The equipment nameplate only gives the nominal currents as stated in safety standard EN-IEC 62040-1.

- The protections in the distribution board will have the following characteristics:
  - ❒ For the input and bypass lines, type B earth leakage breakers and curve C circuit breakers.
  - ❒ For the output (supply loads), curve C circuit breaker.

- If input, output or bypass peripherals such as transformers or autotransformers are added to the UPS, currents stated on the nameplates of those components have to be taken into account, in order to use the suitable cross sections, by complying with the Local and/or National Low Voltage Electro-technical Regulations.

- When a piece of equipment has a galvanic isolation transformer, as standard, as an option or installed by the end user, at the UPS input, bypass, output line or in all locations, they have to be fitted with protections against indirect contacts (earth leakage breaker) at the output of each transformer, because its own isolation feature will impede the tripping of protections installed at the primary winding of the transformer in case there is an electric shock in the secondary winding (isolation transformer output).

- May we remind you that all isolation transformers supplied or installed from factory have the neutral cable connected to the ground through a cable bridge between the neutral and ground terminals. If you require an isolated output neutral, please remove this bridge, taking the stated precautions to comply with local and/or national low voltage standards.

- The supplied cable passages fitted to the metal structure are those recommended to correctly attach the input, output and bypass wires with the sections determined by the National Low Voltage Electro-technical Regulation in accordance with the currents of the device.

If these sections have to be changed for any reason, it should be done from a separate distribution box and the sections indicated should be maintained from the device to the distribution box.

- In standard equipment up to 40 kVA, batteries are supplied inside the UPS enclosure and for higher power rates; they are supplied in a separate cabinet. By default, the UPS has a battery fuse-holder switch (Q3) with 3 fuses for models up to 60 kVA or battery switch (Q3) for models with higher power rate. The battery cabinet has a fuse holder switch with 3 fuses, for both models with a higher power rate of 40 kVA and for extended back up times. fuse holder switch (Q3), install the 3 fuses and **WAIT until it is indicated before CLOSING IT**.

⚠ **IMPORTANT FOR YOUR SAFETY**: Do not turn the battery fuse holder switch (Q3) located in the battery cabinet to “On” (Close), until the equipment is switched on completely because it may cause irreversible damage to the equipment or accidents.

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4.3 Connections.

This equipment can be connected to the mains with a TT, TN-S, TN-C or IT power distribution system within the national electrical regulation of the destination country.

4.3.1 Mains terminals (X1 to X4).

- As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection ()). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

- In accordance with safety standard EN 62040-1, the installation has to be provided with a “Backfeed protection” system. A contactor, for example, will prevent the appearance of voltage or dangerous energy in the input mains during a mains fault (see figure 20).

There can be no bypass in the line that goes from the “Backfeed protection” to the UPS, as this would infringe on standard safety requirements.

Warning labels should be placed on all primary power switches installed in places that are not in the vicinity of the device to alert the electrical maintenance personnel of the presence of a UPS in the circuit.

The label will bear the following or an equivalent text:

Before working on this circuit : - Isolate the Uninterruptible Power Supply (UPS). - Then check for Hazardous Voltage between all terminals including the protective earth. Risk of Voltage Backfeed.

Connect the input cables to the respective terminals according to the available equipment setting.

For parallel systems, it will be necessary to repeat the connections that go from the panel board to each equipment.

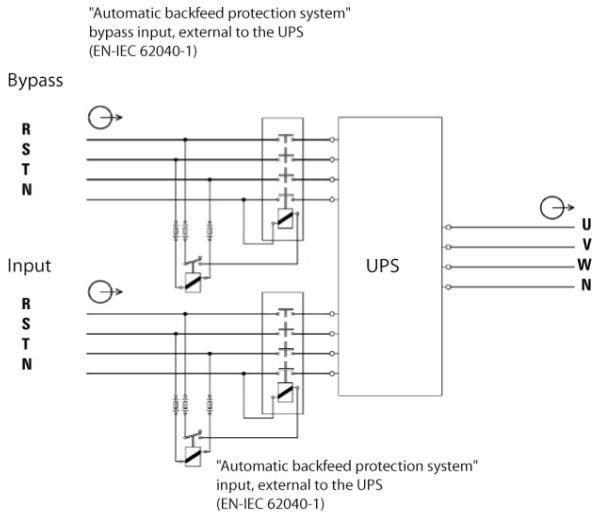

Fig.20. Block diagram for the “Backfeed protection” application, for three phase input / three phase output configuration.

Mains three phase:

Connect the power supply cables N-R-S-T to the input terminals **(X4), (X1), (X2) and (X3), adhering to the order of neutral and phases** indicated on the label of the device and in this manual. If the order of the phases is not adhered to, the device will not operate.
When there are discrepancies between the labelling and the instructions of this manual, the label will always prevail.

4.3.2 Independent static bypass line connection, terminals (X14 to X17). For M4T Evolution from 10k to 80k VA with dual input only.

- ⚠ As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection ( )). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

- In accordance with safety standard EN-IEC 62040-1, the installation has to be provided with a “Backfeed protection” system, such as a contactor, which will prevent the appearance of voltage or dangerous energy in the input mains during a mains fault (see figure 16).

- ⚠ There can be no bypass in the line that goes from the “Backfeed protection” to the UPS, as this would infringe on standard safety requirements.

- Warning labels should be placed on all primary power switches installed in places that are not in the vicinity of the device to alert the electrical maintenance personnel of the presence of a UPS in the circuit.
  The label will bear the following or an equivalent text:

  Before working on this circuit.
  - Isolate the Uninterruptible Power Supply (UPS).
  - Then check for Hazardous Voltage between all terminals including the protective earth.
  ⚠ Risk of Voltage Backfeed.

- Connect the static bypass line cables to the respective terminals according to the configuration of the available equipment.

For parallel systems, it will be necessary to repeat the connections that go from the panel board to each equipment.

Mains three phase:
Connect the power supply cables N-R-S-T to the input terminals **(X4), (X1), (X2) and (X3), adhering to the order of neutral and phases** indicated on the label of the device and in this manual. If the order of the phases is not adhered to, the device will not operate.
When there are discrepancies between the labelling and the instructions of this manual, the label will always prevail.

Separated static bypass line – M4T Evolution 10-80 kVA:

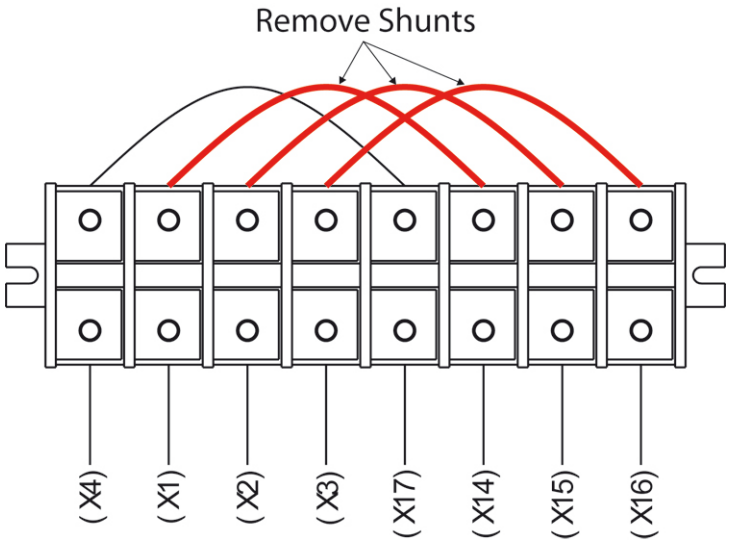

Fig.21.

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Remove shunts between terminals X4 and X17, X1 and X14, X2 and X15, X3 and X16 in case of Dual Input configuration.

Connect the power supply cables N-R-S-T to the static bypass line terminals **(X17), (X14), (X15) and (X16), adhering to the order of neutral** and phases indicated on the label of the device and in this manual. If the order of the phases is not adhered to, the device will not operate.
When there are discrepancies between the labelling and the instructions of this manual, the label will always prevail.

⚠ In equipment with a separate bypass line, an isolation transformer must be placed at either or both of the UPS mains power supply inputs (rectifier input or static bypass), in order to avoid the direct connection of the neutral terminal with both mains through the internal wiring of the equipment.
This is only applicable if the power supply comes from two different electrical mains, for example:
- Two different electricity companies.
- An electricity company and a generator set, etc.

➔ **Separated static bypass line - M4T Evolution 100 and 120 kVA :**

The connection of separate static bypass on M4T UPS 100 and 120 kVA is done by adding the specific module (see page X and X), connection elements references remain the same.

4.3.3 Output, terminals (X6 to X9).

- ⚠ As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection ( )). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

- Connect the output cables to the respective terminals according to configuration of the available equipment.

For parallel systems, it will be necessary to repeat the connections that go from the panel board to each equipment.

Three phase output:

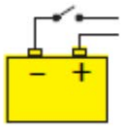
Connect the load cables N-U-V-W to the output terminals (X9), (X6), (X7) and (X8), adhering to the order of neutral and phases indicated on the label of the device and in this manual. When there are discrepancies between the labelling and the instructions of this manual, the label will always prevail.

- With respect to the compulsory protection on the UPS output, we recommend that the output power should be distributed in at least four lines. Each has a magnetic thermal protection switch with a value equivalent to a quarter of the nominal power. This type of power distribution means that only the faulty line will be affected in the event of a breakdown in any of the machines connected to the device resulting in a short circuit. The rest of the connected loads will have their continuity ensured due to the triggering of the protection, only the line affected by the short circuit will remain.

4.3.4 UPS connection to each in-cabinet battery pack, terminals (X11, X12, X23).

- ⚠ As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection ( )). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

- The battery circuits are opened by default.



Put the fuses in the corresponding fuse holder switch and turn it «On» when it is indicated, **never before**. **Proceeding differently may damage the equipment and/or serious injuries.**

- ⚠ IMPORTANT FOR YOUR SAFETY: Do not turn the battery fuse holder switch (Q3) located in the battery cabinet to “On” (Close), until the equipment is switched on completely, it may cause irreversible damage to the equipment or accidents because the fitter is exposed to ELECTRICAL DISCHARGE DANGERS when connecting the UPS with the battery cabinet.

- Do not manoeuvre the battery fuse holder and/or switch when the equipment is turned on. This mechanisms cannot be turned on/off with a load connected.

- The connection of the battery cabinet with an M4T Evolution from 10k to 80k VA, must be done with a cable, by connecting one side to terminals (X11), (X23) and (X12) of the UPS and the other one to terminals (X47), (X49) and (X48) of the battery module. Always respect the stated polarity on the label of each element and this manual, as well as the colour of the cables (red for positive, black for negative, blue for middle tap (N) and green-yellow for earth bonding), see Fig. 23.

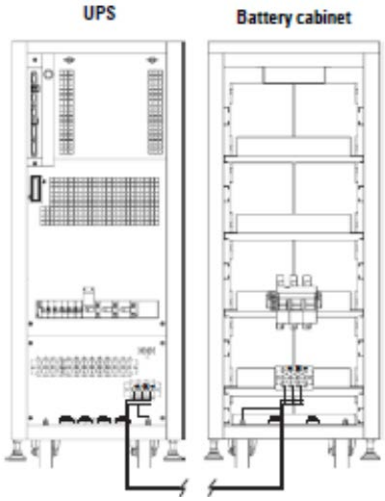


Fig.22. Connection between the UPS and a battery cabinet.

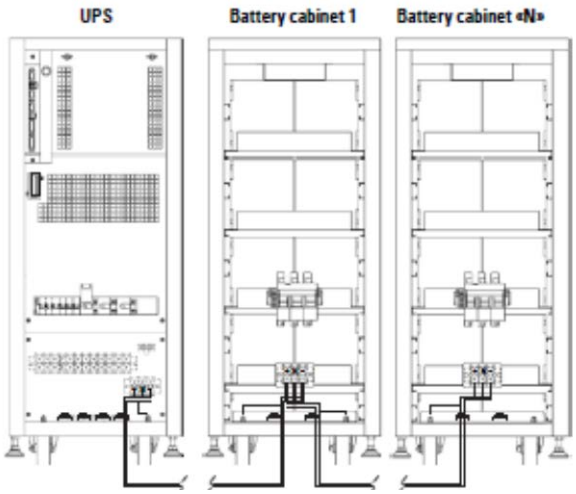


Fig.23. Example of connection between UPS and two battery cabinets.

- For extended back up times with more than one battery module or cabinet, the connection will always be done in parallel between them and the equipment: the black cable will link the UPS negative and to the negative of the first battery cabinet and from this negative to the second battery cabinet and so on. Proceed in the same way to connect the positive red cable, the blue cable of the middle tap (N) and the green-yellow to the earth bonding.
  As an example Fig. 23 shows the connection between one UPS and two battery cabinets. Proceed in the same way when connecting more modules.

- In case of belonging or being connected to parallel system, the connection of the batteries to the UPS will not be different as the one of a single equipment, as each battery set is connected directly with its UPS, regardless of the quantity of battery cabinets.

- As an option, another structure also exists: a common battery set for the parallel system.

- The connection of each M4T Evolution with the battery cabinet must be done with a cable, by connecting one side to terminals (X11), (X23) and (X12) of the UPS and the other one to the terminals of the battery module. Always respect the stated polarity on the label of each element and this manual, as well as the colour of the cables (red for positive, black for negative, blue for middle tap (N) and green-yellow for earth bonding), see Fig. 24.

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Repeat the same procedure with the other UPS.

- ⚠ **Electrical discharge danger**. If after starting up the UPS, the battery cabinet needs to be disconnected, the equipment has to be completely shut down (see section 5.2). Turn off the battery fuse holder switch located in the battery cabinet and/or fuse holder switch or switch (Q3) located in the UPS. Wait at least 5 min. until the filter capacitors have been discharged.

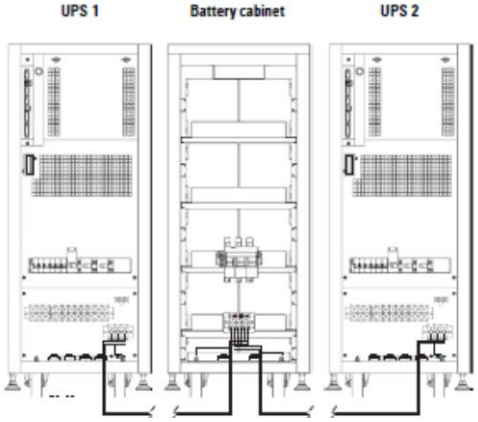

Fig.24. Example of connection of two UPSs in parallel and a common battery set.

4.3.5 Main protective earthing terminal (X5 ⏚) & protective earth bonding terminal (X10 ⏚).

- ⚠ As this is a device with class I protection against electric shocks, it is essential to install a protective earth conductor (earth connection (⏚)). Connect the conductor to the terminal (X5), before connecting the power supply to the UPS input.

- Make sure that all the loads connected to the UPS are only connected to the protective earth bonding terminal (⏚). The fact that the earthing of the load(s) and/or the battery case(s) or cabinet(s) is not restricted to this single point will create return loops to earth which will affect the quality of the power supplied.

- All of the terminals identified as protective earth bonding (⏚), are joined together and to the main protective earthing terminal (⏚) and to the frame of the device.

4.3.6 COM port to relay. Connector (X32).

- ⚠ The communications line (COM) represents a very low safety voltage circuit. To maintain the quality, it must be installed away from other lines that have dangerous voltages (power distribution line).

- The communication port to relays provides digital signals in the form of potential free contacts with a maximum applicable voltage and current of 6 A 30 V DC or 6 A 100 V AC. Both channels are used to connect the UPS to any machine or device that has this standard bus (connector DB9 (X32)).

Pin-out No.	Relay	Description	N.C.-N.O. Position
1		Shutdown signal +	-
2		Shutdown signal –	-
3	RL5	Configurable (optional)	N.C. or N.O.
4	RL2	Discharge - Mains fault	N.C.
5	RL1 to RL5	Common	-
6	RL1	Equipment in Bypass	N.O.
7	RL3	Low battery	N.O.
8	RL4	General alarm	N.O.
9	RL2	Discharge - Mains fault	N.O.

❒ N.C.: Normally closed contact.
❒ N.O.: Normally open contact.

Table 2. Alarm interface to relay connector DB9 **(X32).**

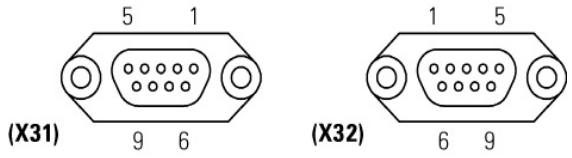

Fig.25. DB9 Connector (X31) & (X32).

- By default the equipment is supplied with 4 signal relays with a preset programming (see chart 2), which can be modified at factory or by teh S.T.S. under request. Chart 6 shows all the alarms that can be set to any relay. A fifth relay can be supplied as an option and under request, which can be defined in the purchase order.
  There is also a «Shutdown» input that allows to turn off the inverter when there is a voltage between (5÷12 V) at this input.

- The most common use for these ports is the supplying of the necessary information to the file closing software.

4.3.7 Port COM RS-232 & RS-485. Connector (X31).

- ⚠The communications line (COM) represents a very low safety voltage circuit. To maintain the quality, it must be installed away from other lines that have dangerous voltages (power distribution line).

- Both of the equipment's communication ports, RS-232 and RS-485, are in the same connector DB9. It is not possible to use them simultaneously.

- Both channels are used to connect the UPS with any machine or device that has this standard bus. The RS-232 transmits serial data, so it is possible to send a large amount of information through a communication cable with just 3 wires.

- **Physical structure of the RS-232.**
  - Pin 2. RXD. Serial data reception.
  - Pin 3. TXD. Serial data transmission.
  - Pin 5. GND. Signal mass.

- **Physical structure of the RS-485.**

Unlike other serial communication links, this uses only 2 wires (pins 4 and 9 of the female DB9 connector) to perform the dialogue between the systems connected to the network. The communication will be established by sending and receiving signals in differential mode, which gives the system great immunity to noise and a long reach (approx. 800 m).

- Pin 4. RS-485 output signal A (+).
- Pin 9. RS-485 output signal B (–).

- **Communication protocol**

The communication protocol used is a "MASTER/SLAVE" type. The computer or computer system ("MASTER") asks for certain data, and the UPS ("SLAVE") answers immediately with the required data.
If this communication way, is going to be used, ask for the protocol IN467*00.
First, the computer communication channel will be programmed with the same parameters as the UPS communication channel.
Then the communication can begin and the UPS is sent the first question.
If a problem occurs during the communication, it is advisable to repeat the channel initialization sequence.

- **The RS-232 and RS-485 communication parameters are as follows:**

- Communication speed: 1200, 2400, 4800, 9600 or 19200 Bauds.
- No. information bits: 8 Bits.

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- No. stop bits: 1 or 2 stop bits.
- Parity: Even, Odd or None.
- The base of the front door (PF) has a slot to facilitate the entering and way out of the communication cables inside the UPS.

4.3.8 EPO terminals (X50).

- The equipment has two terminals ready for external (remote) Emergency Power Off (EPO).

- If a switch or button (EPO) has to be installed, the cable bridge that closes the circuit has to be removed from terminal strip (X50).

- For a parallel system, two different solutions can be applied:
  - o Connect the button (EPO) to only one equipment of the parallel system. Remove the cable bridge from the terminals (X50) in the equipment that it is only connected.
    In case of a fault, when removing the equipment that is physically connected the EPO button, there is a risk of leaving the system without the emergency stopping function, unless it is reconnected to the other operative UPSs.
  - o Connect the EPO button to each equipment of the parallel system. In order to do this, remove all the cable bridges from the terminals (X50) in each equipment.
    Therefore, the EPO function will be maintained in each UPS, regardless of what happens to the other devices of the parallel system.

  By means of the own communication BUS among the equipments that make the parallel system, any action over any button will affect to the whole.

In any case, the EPO switch or button has to be normally closed (NC), so the emergency shutdown order will be triggered when opening the circuit between these terminals (X50).
To restore the UPS to normal mode, revert the position of the EPO switch or button and close the circuit between the terminals (X50), then unlock the button.

- For information on EPO operation, see section 5.3 of this manual.

- The base of the front door (PF) has a slot to facilitate the entering and way out of the communication cables inside the UPS.

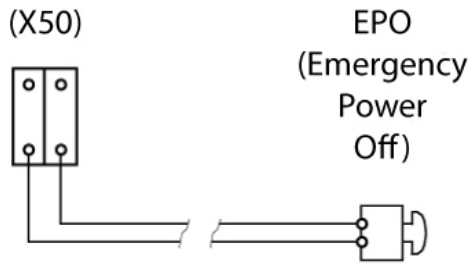

Fig.25. Terminals for connecting an external push-button (EPO), property of the user.

4.3.9 Auxiliary contact and battery temperature probe terminal strip.

- All the equipments are provided with a terminal strip that corresponds to the auxiliary contacts of manual bypass (X51) and output (X45) switches.

- The additional X34 terminal strip is provided with the separate battery cabinet for models >20 kVA (LV) / >40 kVA (HV). Use it to connect the battery temperature probe that allows compensating the floating voltage according to the ambient temperature.

- Any wire connected to the terminals (X34), (X45) and (X51), will be entered into the equipment through the cable bushing (PR).

4.3.9.1 Terminal strip, auxiliary contact of manual bypass switch (X51).

- Terminal strip (X51) of two pins of the UPS, is connected in parallel with the normally opened auxiliary contact of the switch or manual bypass switch of the equipment.

- The switchgear panel board with the manual bypass holds a terminal strip of two terminals connected in parallel with the normally opened auxiliary contact of the switch or manual bypass switch. Any auxiliary contact of the manual bypass is moved on in advance when closing.

⚠ Do not use a switchgear panel board provided by another manufacturer.

⚠ It is ESSENTIAL as safety measure of the system, loads included, to connect the terminal strips (X51) of the UPSs with the terminal strip with the same functionality of the switchgear panel board. Any wrong action over any switch or manual bypass switch of the turned on UPSs will thus avoid causing a total or partial fault of the installation, loads included.

4.3.9.2 Terminal strip, auxiliary contact of output switch (X45).

- This terminal strip of two pins is for parallel systems only.

- The normally opened auxiliary contact of the output switch is extended to the terminal strip of two pins (X45). The circuit is closed through the isolated cable as a bridge mode that is supplied connected between both pins. Do not remove it in single devices, because although the equipment would be in operation, there would be an alarm of output switch deactivated.

- In case of acquiring a switchgear panel board by a third party, check if the output auxiliary contact is available and connect it to the terminal strip (X45) of each equipment. As a must, the auxiliary contact has to be moved on in advance when opening.

4.3.9.3 Terminal strip, battery temperature probe (X34). For external battery banks.

- The battery manufacturer recommends a variable floating voltage depending on the ambient temperature. The control of this feature will be done through the measurement of the temperature by means of a probe, located inside the cabinet itself when batteries and equipment are fitted in the same enclosure.
  In the case of batteries supplied in a separate cabinet out from the UPS (models >20 kVA (LV) / >40 kVA (HV)), there will be a terminal strip of two pins (X34), that allows bringing the probe located at the end of a two wires bundle with 4.5 m., up to the inside of the battery cabinet.
  The connection of the two wires from the cable bundle to the terminal strip (X34) does not have polarity.

- Through this probe the ambient temperature inside the battery cabinet can be visualized on the LCD control panel.

- The bundle with the probe will always be supplied already connected to the terminal strip (X34), so it is only necessary to cut the clamp that keep it rolled, to take it out from the UPS cabinet and enter it into the battery cabinet, in both cases, through the foreseen cable bushing (PR).

4.3.10 Connection of parallel BUS (X36i) and (X36o).

- This section is only useful for parallel systems.

- For the correct operation of the parallel functions and operating, any unit connected in parallel are continuously communicated between each other. It is achieved through the communication line or BUS.

- Any operation of this section, regarding parallel systems, has to be done by authorized staff of our firm.

- Once the power connections of the UPSs of the parallel systems are done, it is required to link the ones related to the control or communication BUS. In order to do this, connect them in a sequential way, two lines of the communication BUS between a unit and its adjacent.

- Together with each UPS of a parallel system, a 15 wires bundle with HDB15 connectors at both ends is supplied, one male and the other one female, with a 5 m length. Therefore, there will be as many communication BUS bundles (BC) as devices used to parallel the system.

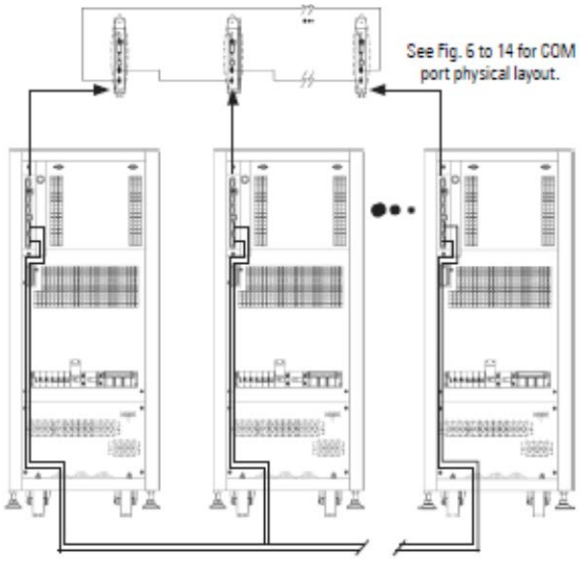

Fig.26. Connection of the communication BUS.

4.3.10.1 Connection of the communication or Bus Bundle (BC).

- Respect the sequence and connection order of the communication BUS to the equipment.
  Although the order of the connections of communication BUS among equipments are made, is not important, on condition that the communication loop is completed or closed properly, it is advisable to carry out the connections with the immediately next equipments in order simplify the connection.

- The connection limit of the installation will be determined by the quantity of available devices to put in parallel with a maximum of four units.

- Each equipment has two HDB15 connectors for the communications among them, one male labelled as “Output” (X36°) and another one female as “Input” (X36°).

- In the same way, all the bundles supplied with the equipment, are equal in connections and length.

⚠ DO NOT MODIFY THE COMMUNICATION BUS BUNDLE, OR THE CONNECTORS UNDER ANY CIRCUMSTANCE.

- Take one of the bundles and insert the HDB15 female connector (located in one of its end) into the male connector named “Output” (X36°) of any one of the devices of the system and insert the HDB15 male connector located at the opposite end of the bundle into the female connector labelled as “Input” (X36) of the adjoining equipment.

- Repeat the procedure with each equipment of the system, until the communication BUS loop is closed.

- Fig. 26 shows, how the communication BUS connections have to be done.

- The base of the front door (PF) has a slot to facilitate the entering and way out of the communication cables inside the UPS.

5 OPERATION

This section describes the procedure to follow in order to benefit from the different functionalities of a system of «n» devices connected in parallel.
If you use only one UPS, proceed the same way, but simplifying the operating for a single unit.

As it has been stated before, it is advisable to have an external manual bypass panel board equipped with input, output, static bypass (10k to 80k only) and manual bypass protections, in single installations.

- For parallel systems up to two units it is strongly recommended to have a switchgear panel board and for systems with 3 or 4 devices, it is essential. Switches of the panel board have to allow the isolation of a UPS from the system against any wrong operation and feeding the loads with the other ones, either during the preventive maintenance period or during the fixing itself.
- Therefore it has been considered appropriate and natural, to read the instructions of the equipment and of the installation of a system with «n» devices connected in parallel with their respective external manual bypass panel board as it is shown in the «Recommended installation» documentation included in the CD.

This panel board allows to isolate each equipment individually in case of a fault and to remove it without any difficulty for its fixing or replacement. The manual bypass switch also makes easier the preventive maintenance tasks or interventions on the complete system, supplying the voltage to the loads directly from the mains, on the «bypass» mode operating, while the input voltage is available. In those installations without external manual bypass panel board, skip the steps involving the maneuvering of the switches.

5.1 First considerations before starting the operation

It is very important to always operate in the order described in the instructions of the next sections, by respecting the sequence of the switches according to their function.
Therefore, in a parallel system based on four devices, when it is indicated to turn on the «Input» mechanisms, the order they are switched on will not matter, but any other switch with a different function (such as «Output») switch will not be turned on, until it is indicated to do so.
Unlike other UPS devices, where the «Master» and «Slave» equipment are preset from factory, conditioning the order of the starting up and shutdown. The M4T Evolution series is managed by a more flexible hierarchy according to the operating mode that it is.

5.2 Start up

5.2.1 Control before start-up.

- Carefully check that all the connections have been made correctly and are sufficiently tight, complying with the labelling on the device and the instructions of chapter “4. Installation and wiring of the unit”.
- Check that the UPS switches and the batteries cabinet(s) are turned off (position “Off”).
- Be sure that all the loads are turned “Off”.

5.2.2 Start-up procedure.

5.2.2.1 First starting procedure.

- When the equipment is started up for the first time, the installation menu of the control panel is activated automatically, in English by default. The basic parameters of the unit like language, date, nominal voltage and frequency are already defined.

- The preset language is «English» by default.

⚠ For parallel systems, repeat the steps for each one of them all at the same time or chronologically one by one:

- o Supply input voltage to the switchgear panel board.
- o Turn «On» the input switch or switches of the panel board.

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o Turn «On» the UPS input switch (Q1a) or from each equipment that the systems is make up. The following message will be displayed for a few seconds:

INSTALLATION MENU

The sound alarm will beep every 5 sec. The following message will then be displayed on the LCD panel:

LANGUAGE AAAAAA

AAAAAA corresponds to the language of the menus displayed on the LCD panel. The available languages are English, French, Spanish, German, Turkish and Russian.
Use the keys (▲) and (▼) and press (**ENT**) to select the language.
The next screens will allow to set the time (hour, minutes, seconds) and date (day of the week, day of the month, month and year).

Clock HH: MM: SS
Date: WKD DD/MM/YYYY

To begin the time and date setting press (**ENT**). Modify each character one by one. In order to change the first character of the field use the keys (▲) and (▼) and validate with (**ENT**). To jump to the next character use the keys (<) and (>). To finish press (**ESC**), the values will be validated and the following screen displayed.

UNIT NOMINAL VOLTAGE
3 X AAA V

AAA corresponds to the nominal phase to phase value of the operating voltage of the equipment.

Use the keys (▲) and (▼), move it to the nominal value of the power supply voltage and validate it with (ENT). When the required value is not in chart 3, select the closest one and validate with (ENT).

Type of voltage interval	Value of phase to phase voltage
LV (Low voltage), Referred to the model	3x200 V / 3x208 V / 3x220 V /3x230V
HV (High voltage)	3x380 V / 3x400 V / 3x415 V

Chart 3. Nominal values, operating voltages of the equipment.

Once the operating voltage is selected, it is compulsory to select the nominal frequency. The following message is displayed:

NOMINAL FREQUENCY
AAAA

By means of the keys (▲) and (▼), move till one of the following frequency values and validate with (**ENT**):

- 50 Hz: Frequency of the equipment (rectifier and inverter), will be set to 50 Hz.
- 60 Hz: Frequency of the unit (rectifier and inverter), will be set to 60 Hz.
- AUTO: In each UPS start up, the input frequency will be sensed and set to 50 or 60 Hz accordingly.

⚠This setting is not recommended if the unit is supplied by a generator set.

Once the operating frequency is selected, the following message will be displayed:

EXIT INSTALL MENU ?
<ENT> YES <ESC> NO

Press the (**ENT**) key to validate the values, the sound alarm will be stopped.
Press (**ESC**) to go back to the beginning of the installation menu to set them again.

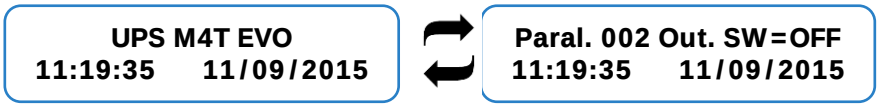
⚠Once they are validated, it will not be possible to change them without an S.T.S. (Service and Technical Support) intervention.

A rotation alarm may trigger during the procedure on an equipment. Refer to section 5.2.2.2.

Note: Infosec sets these parameters before delivering M4T Evolution.

5.2.2.2 Regular starting procedure.

- Supply input voltage to the switchgear panel board.
- Turn «On» the input switch or switches of the panel board, depending if it is a single equipment or parallel system.
- Turn the UPS or each UPS input switch (Q1a) to «On» position. The LCD of the Control Panel (PC) of each equipment will be switched on automatically.
- For a single equipment, the LCD panel will display the left message of the screen 0.0. For a parallel system, both messages will be displayed 0.0.



Screen 0.0*

In parallel systems, the right screen 0.0 corresponds to:

- Paral. ---: address of each UPS with three characters (in the example 002).
- Out.SW ---: the position of the output switch of the UPS and/or the switchgear panel board, with two status: ON and OFF (the auxiliary contact of the output switch in the output panel board has to be connected according to the instructions of section 4).

- If the following alarm message appears on the Control Panel Display ...

Screen 4.*

... also an audible alarm will beep in each equipment with the message on the screen and the affected UPS/s will not be able to be started, due to a wrong input phase rotation.

- If it happens to only one UPS of the parallel system, turn «Off» the input switch (Q1a) of the corresponding equipment and the one in the switchgear panel board. Swap the two phases of the input terminals of the UPS leaving the connections in the same order as the rest of the equipment and repeat the starting procedure.
- If it happens to all the UPS devices of the parallel system, turn «Off» the input switch (Q1a) of each UPS and input switches of the switchgear panel board, swap the two phases in the input terminals of the switchgear panel and repeat the starting procedure.

In devices or systems with separate static bypass line (from 10k to 80k VA):

- Turn the bypass switches from panel board «On».
- Turn the bypass switches (Q4a) of each UPS «On».

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- If the following alarm message appears on the Control Panel Display ...

BYPASS PHASE ROT. UPS START INH.

Screen 4.*

... also an audible alarm will beep from each equipment with the message on the screen and the affected UPS/s will not be able to be started, due to a wrong bypass phase rotation.

- If it happens to only one UPS of the parallel system, turn «Off» the bypass switch (Q4a) of the corresponding equipment and the one in the switchgear panel board. Swap the two phases of the bypass terminals of the UPS leaving the connections in the same order as the rest of the devices and repeat the starting procedure described in the three previous steps.
- If it happens to all the UPS of the parallel system, turn «Off» the bypass switch (Q4a) of each UPS and bypass switches of the switchgear panel board, swap two phases in the bypass terminals of the switchgear panel and repeat the starting procedure.

At this point, with no alarm active, with green LED indications of Input Voltage OK, and with the Unit on Bypass, (a) & (b) LED indicator lights up (see Fig. 27).

Fig.27. Indications of LED from control panel (PC).

Start up the inverter, by means of the keypad (3) (see Fig. 27). In parallel systems, make the procedure equipment by equipment the first time or after complete shutdown, in order to establish the communications among each unit of the system.

From the main screen press (▲) key to access to « CONTROL AND STATUS OF THE UNIT » submenu (screen 1.0), and then press (◢) key. The screen 1.1 will be displayed, asking you to start the equipment up by pressing (ENT). Do so, and then validate the operation by pressing (ENT) again. See the diagram of Fig. 28.

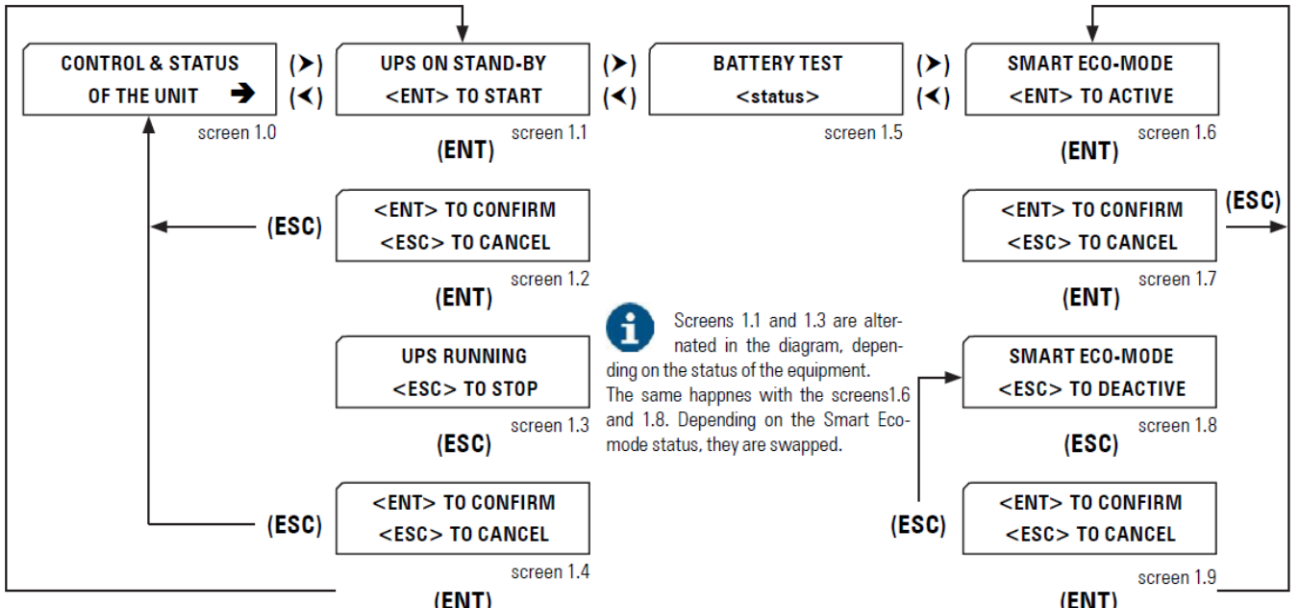

Fig.28. Diagram, start up/shutdown procedure.

After about 30 seconds, the inverter and rectifier of the UPS or each UPS will be running, but not supplying output voltage because the respective switches (Q2) of the equipment and panel board are still off. In parallel systems, the first UPS starting the inverter will be the one set as «Paral. Mst. Byp», the one with the highest address as «Paral. Slv. By.Rsv» and the other ones, if any, as «Paral. Slv. By».

For parallel equipment only.

To check the hierarchy of the UPSs (parallel status), i go back to the main screen in each equipment (press 3 times (ESC)) and access to screen 0.1 in all of them (press once (**>**) key), see Fig. 29:

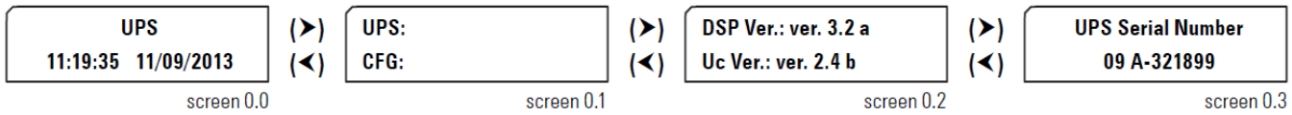

Fig.29. Screen 0.0 «Start» and its submenus

UPS: Normal, Invert
CFG; Paral. -------

Screen 0.1

- The first row corresponds the UPS status.
- The second row corresponds to the UPS hierarchy regarding the rest of the system, which is dynamic depending on the status of the rest of the devices:
  - o «Paral. Mst. Byp» bypass Master of the parallel system. By default, the first UPS starting up the inverter according to the established procedure.
  - o «Paral. Slv. By.Rsv» reserved bypass Slave. Initially corresponds to the equipment with the highest address excepting the one from «bypass Master». In case of a failure of the Master, it will take its functions.
  - o «Paral. Slv. Byp» bypass Slave of the parallel system (systems with more than two devices only). It will become the «reserved bypass Slave», when it is used as «bypass Master». In systems with more than three devices in parallel, the one with the highest address among the «bypass Slave» will take the hierarchy of «reserved bypass Slave».
  - o «Paral. Mst. Volt» voltage Master of the parallel system. By default, the first UPS on normal operating (inverter in operation), that the output switch (Q2) is turned «On».
  - o «Paral. Slv. Vt.Rsv» reserved voltage Slave of the parallel system. Equipment operating normally (inverter in operation) with the output switch (Q2) turned «On» in 2nd place or subsequently (after the «Paral. Mst. Volt» or «Paral. Mst. Vt.Rsv»). It corresponds to the equipment with the highest address, excepting the one from «Voltage Master». In case of failure of the Master, it will take its functions.
  - o «Paral. Slv. Volt» voltage Slave of the parallel system (systems with more than two equipments only). Equipment operating normally (inverter in operation) with the output switch (Q2) turned «On» in 2nd place or subsequently (after the «Paral. Mst. Volt» or «Paral. Mst. Vt.Rsv»). It will become the «reserved voltage Slave», when working as «voltage Master». In systems with more than three devices in parallel, the one with the highest address among the «voltage Slave» will take the hierarchy of «reserved voltage Slave».
- Turn «On» the output switch or switches of the panel board, depending if it is a single equipment or a parallel system.
- Turn the output switch (Q2) of the UPS or each UPS «On». The equipment or parallel system supplies voltage to the output terminals of the switchgear panel board.
- Make sure that the inverter on the LED indication (c) lights (green), and bypass LED (b) is turned OFF in all UPSs (see Fig. 27). If the status of the LEDs is wrong, please contact the S.T.S. (Service and Technical Support).
- For equipment with external battery cabinet, turn the switch fuse holder of the battery cabinet (Q8) of each UPS to position «On».

BATT. SWITCH OPEN
SWITCH IT ON

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⚠DO NOT TRY to perform this maneuver at any other moment, since this operation could damage the equipment and/or cause possible accidents.

- Once the rectifier is fully functioning, a process of equalization (DC bus voltage starts to be equalized with battery voltage) will be started. After a few seconds (depending on the battery level), an alarm message will be displayed meaning that the equalizing process is over. The battery switch-fuse holder or switch of each UPS (Q3) can then be turned «On».

⚠DO NOT TRY to perform this maneuver at any other moment, since this operation could damage the equipment and/or cause possible accidents.

If the equipment or parallel system has an outgoing distribution, turn its switches «On».
Start up the loads to be supplied progressively. The joint is started up completely, and the loads are protected through the UPS or UPS parallel system.
After the first start up, the usual start up/shutdown operation of an equipment or parallel joint will be done through the keypad of the control panel (PC). In parallel systems, it will be required to act over one of them only.
Consider that the UPS or system will still be supplying output voltage, it does not matter the status of the own inverter or inverters:

- Shutdown, from static bypass.
- Started up, from inverter (On-line mode).
- Started up, from static bypass (on Smart Eco-mode).

5.2.2.3 Considerations regarding Master and Slave (parallel systems only)

- Bypass Master and Slave («Mst. Byp.», «Slv. Byp.», «Slv. By.Rsv»).
  - Master manages the status of the own solid-state static bypass switch and the one of the Slave equipments.
  - The equipments are not sharing the load in the inverters. The cause can be any of the following:
    - Output switches (Q2) to position «Off».
    - Equipment output on bypass.
    - Inverters are shutdown or in start up process.
  - Voltage Master and Slave («Mst. Volt», «Slv. Volt», «Slv. Vt.Rsv»).
    - Master manages the status of the own solid state static bypass switch and controls the inverter voltage, as well as the one of the Slave devices.
  - Devices are sharing the load in inverter. Therefore:
    - Output switches (Q2) are «On».
    - Inverter are operative and solid state switches are on inverter.

5.3 Shutdown of an equipment from the parallel system.

Turn the output switch (Q2) of the UPS to shutdown, to position «Off». The screen 0.1 of the LCD panel will display:

UPS: Normal, Invert.
CFG: Paral. Not connected

Screen 0.1

5.4 Start back the UPS of a parallel system.

- Start up the inverter with the keypad of the control panel (3) (see Fig. 27).
  From main screen press (▼) key to access to «CONTROL AND STATUS OF THE UNIT» submenu (screen 1.0), and then press (**>**) key. The screen 1.1 will be displayed, asking you to start the equipment up by pressing (**ENT**). Do so, and then validate the operation by pressing (ENT) again. See the diagram of Fig. 39.
  The UPS will take about 30 seconds to be operative again.
- Turn the output switch (Q2) of the UPS, to position «On».

5.5 Complete UPS shutdown.

- Shut down the loads.
- If the system has outgoing distribution protections, switch them “Off”.
- Shut down the inverter. Go down to the “CONTROL & STATUS OF THE UNIT” submenu (screen 1.0) using the control panel keypad ((3) from figure 27), and then right once only. Screen 1.3 will appear asking you to shut down the unit by pressing (ESC). Do so, and then confirm the operation by pressing (ENT). In parallel systems, this needs to be done only on one device. At this stage, the UPS or system is still supplying output voltage through the static bypass.
- Turn the switch-fuse holder or battery switch (Q3) of the UPS or each equipment of the system, to «Off» position.
- For equipment with external battery cabinet, turn the switch fuse holder of the battery cabinet (Q8) corresponding to each UPS, to «Off» position.
- For models from 10k to 80k VA: Set the input switch (Q1a) and static bypass switch (Q4) to the “Off” position for the UPS or each equipment of the system.
- Turn the input switch or switches of the panel board to «Off».
- For standard input UPS, turn the input switch (Q1a) of the UPS or each equipment of the system, to «Off».
- Break the input power supply of the switchgear panel. The system will be completely deactivated.
- ⚠ **Electrical discharge hazard**. If after equipment shutdown, the separate battery pack(s) have to be disconnected, wait several minutes (5 min. approx.), until the electrolytic capacitors have discharged.

5.6 Emergency power off (EPO) operation.

Emergency Power Off (EPO) is equivalent to a complete unit system shutdown:
- All UPS converters are turned off (rectifier and inverter).
- No output voltage is supplied to the loads.

See table below for the operation:

E.P.O. function	**Activation (perform System Halt)**	**Return to normal mode.**
Terminals **(X50)**. Normally closed circuit by means of the cable bridge provided (it allows an external switch (EPO)).	Contact normally closed. Remote button or switch has to be opened **(X50)**.	The equipment has to be shut down and fully de-energized (turn off all switches), wait until the DC bus is discharged (all LEDs and LCD have to be turned off). The equipment has to be started up according to section “5.1.2. Start-up procedure”.

Chart 4. Emergency power off (EPO) operating.

The emergency power off (EPO) function can only be activated through the two pins terminal strip (X50). In a parallel system, it is not required to make more connections than the ones done in a single equipment, because through the communication BUS, any action over the button will affect to the complete parallel system.

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5.7 Smart Eco Mode Operating

For less critical applications, the smart and efficient function «Smart Eco-mode» allows, when the power supply is available, to supply the loads from the mains directly through the solid-state static bypass («Off Line» mode). In the event of a power supply failure, the system will automatically shift to its normal operating mode («On Line») and loads will be fed from the inverter with the energy of the batteries. The «Smart Eco-mode» operating mode is 4 to 4.5 % more efficient than the normal «On Line» mode.
The «Smart Eco-mode» operating does not assure a perfect stabilization of the frequency, the voltage or the sinewave shape (distortion) as in «On Line» mode, as these parameters depend on the static bypass line.
The detection of any of these parameters can take up to 3 ms, so it is recommended to assess the use of this operating mode, depending on the required protection level by the loads.
This operating mode is disabled by factory preset and can be activated.

- The «Smart Eco-mode» operating mode is not available in parallel systems.

5.8 Bypass manual switch (MAINTENANCE).

5.8.1 Operating principle.

The UPS integrated manual bypass is a very useful feature, but undue use can have irreversible consequences both for the UPS and for the loads connected to its output. It is therefore important to handle it as described in the following paragraphs.

5.8.2 Transfer to manual maintenance bypass.

Procedure for passing from normal operation to maintenance bypass:

- Shut the inverter down.
- Go down to the "CONTROL & STATUS OF THE UNIT" submenu (screen 1.0) using the control panel keypad ((3) from figure 27), and then right once only. Screen 1.3 will appear asking you to shut down the unit by pressing (ESC). Do so, and then confirm the operation by pressing (**ESC**). Do so, and then confirm operation by pressing (**ENT**).
- In parallel systems, this needs to be done only on one device. At this stage, the UPS or system is still supplying output voltage through the static bypass.
- In parallel systems, while the inverters are on, if any manual bypass switch of the UPS or switchgear panel board is turned «On» by mistake, the power supply to the loads will be shifted to the input or bypass mains, ON CONDITION that the electrical connections of the auxiliary contacts of the manual bypass have been already made.
- Remove the screws (t2) that fix the mechanical block (BL) of the manual bypass switch (Q5) of the UPS or each UPS and take it/them out.
- Remove the mechanical block (BL) of the manual bypass switch (Q5) and set it to the "On" position.
- Turn the manual bypass switch of the switchgear panel board to the "On" position.
- Set the output switch (**Q2**) to the "Off" position.
- Set the Battery Fuse Holder or battery switch (**Q3**) to "Off". In addition, in models with independent battery pack(s) also turns Battery Fuse Holder (**Q8**) of each pack to "Off".
- Turn the input switch (Q1a) of the UPS or each equipment, to the "Off" position.
- In UPSs or systems with separate static bypass (from 10k to 80k VA): Turn the bypass switch (Q4a) of the UPS or each equipment, to the "Off" position.

The UPS or system is completely shutdown and isolated, with the loads supplied directly from the mains, through the manual bypass of the switchgear panel board. In the case of a UPS or system with no panel board, the loads are supplied directly from the mains through the manual bypass of the equipment. The power supply comes from the input line in the UPS or static bypass line in versions from 10k to 80k.

5.8.3 Transfer to normal operation

Procedure for passing from maintenance bypass to normal operation:

- Set the input switch (**Q1a**) and static bypass switch (**Q4**) (for models from 10k to 80k VA) to the "On" position.
- Set the output switch (**Q2**) to the "On" position.
- Equipment in parallel are set to Master or Slave of bypass or voltage, as they were in the last setting.
- Wait until the static bypass of the equipment acts (bypass LED (b) lights -see Fig. 27).
- Set the manual bypass switch (**Q5**) to the "Off" position and refit the mechanical block (BL) and the screws (**t2**).

⚠ It is an essential safety requirement, for the life of the UPS and the loads connected to it, to refit the mechanical block (**BL**) as this avoids dangerous handling.

- Start up the inverter. Go down to the "CONTROL & STATUS OF THE UNIT" submenu (screen 1.0) using the control panel keypad ((3) from figure 27), and then right once only. Screen 1.1, asking you to start the unit up by pressing (**ENT**). Do so, and then confirm operation by pressing (**ENT**) again. See following screen diagram (figure 21).
- After the first start up, the usual start up/shutdown operation of an equipment or parallel joint will be done with the keypad of the control panel (PC). In parallel systems, this needs to be done only on one device. At this stage, the UPS or system is still supplying output voltage through the static bypass, regardless of the status of the inverter(s):
  - Shutdown, from static bypass.
  - Started up, from inverter (On-line mode).
  - Started up, from static bypass (on Smart Eco-mode).
- After about 30 seconds, the inverter and rectifier of the UPS or each UPS will be running and the output will supply voltage through the inverter(s).
- Make sure that the "ON" LED indicator (c) light is green, and bypass LED (b) is turned OFF (see Fig. 27). If the status of the LEDs is wrong, please contact with the S.T.S. (Service and Technical Support).
- For equipment with external battery cabinet, turn the switch fuse holder of the battery cabinet of each UPS to the "On" position.
- ⚠ DO NOT TRY to make this maneuver in any other moment, since this operation could damage the equipment and/or cause possible accidents.

The UPS supplies output voltage entirely protected against voltage variations, electric noise, etc.

- Wait for the following alarm message to appear:

BATT. SWITCH OPEN
SWITCH IT ON

Screen 4.*

- The fuse holder switch from battery cabinet and/or battery fuse holder switch or switch from UPS (**Q3**) will be turned "On" only if the alarm message above displays.

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DO NOT TRY to close any battery fuse holder switch at any other moment, because this operation could damage the equipment and/or potentially cause an accident. They can only be turned on by following the aforementioned steps.

- The UPS supplies output voltage entirely protected against cuts, micro cuts, voltage variations, electric noise, etc.

6 CONTROL PANEL AND DISPLAY DESCRIPTION

6.1 Control panel parts.

(LEDs) LED indications:
- **(a)** Rectifier Input Voltage OK (green).
- **(b)** Unit on Bypass (orange).
- **(c)** Inverter is working (green).
- **(d)** Unit working from batteries -mains failure- (red).
- **(e)** In the event of a unit alarm (red).

(2) Character Display

(3) Keyboard

ENT "Enter" key. Confirmation of orders, program values (or other specified functions)

🡐 "Left" key for submenu navigation, or cursor displacement.

🡒 "Right" key for submenu navigation, or cursor displacement.

🡑 "Up" key for menu navigation, or digit modification.

🡓 "Down" key menu navigation, or digit modification.

ESC "Escape" key. Return to the main screen, cancel/finish programming (or other specified functions).

Fig.27. Control panel parts.

6.2 Basic functions of keyboard from overview.

- Advance (🡑) and return (🡓) keys give access to all the LCD panel menus and allow movement from one to another.

- Right (🡒) or left (🡐) keys give access to the screens of all the LCD panel submenus, and allow movement from one to another.

- Key (ENT), has different purposes depending on the menu:

  - Setting values. Press (ENT) key to activate the function setting, the figures in the screen flash. With keys (🡒)-(🡐) the character to set is selected and with keys (🡓)-(🡑) the value is selected. To confirm press (ENT). The next field will flash. To continue with the settings proceed in the same way or press (ESC) to return to no-setting situation.
  - Validation of orders or commands.

- Press (**ESC**) key on any screen of any submenu, to return to main screen (**Screen 0.0**), unless on a screen of a "**Parameters**" menu and setting any of them. If so, the first pulsation of (**ESC**) key will stop the flashing value, and a second time to return to main screen.

- Notes related to the screen map (see figure 23):

  - Some screens have a certain number of "–" characters. Each one represents a character so their number will determine the maximum length of the field.
  - Each screen is numbered with a number located to the right bottom corner. It is only included as a simple reference for the next description and explanation.

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❒ Note (*1): means the hidden programming screens through the password (*****) in “**screen 1**...” This safety level prevents unauthorized staff from altering or modifying setting.

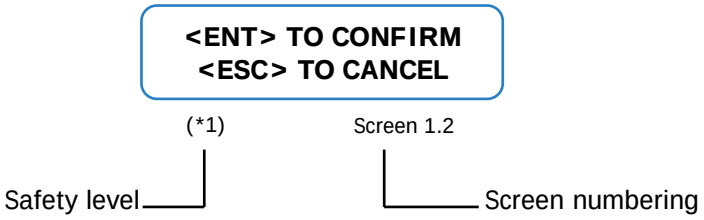

Fig.30. Notes related to the screens.

6.2.1 Message menus and classification in submenus.

- Use (🡻) and (🡹) keys to choose between different menus (0.0, 1.0,...7.0).
- Use (🡺) and (🡸) keys to move inside submenu screens.

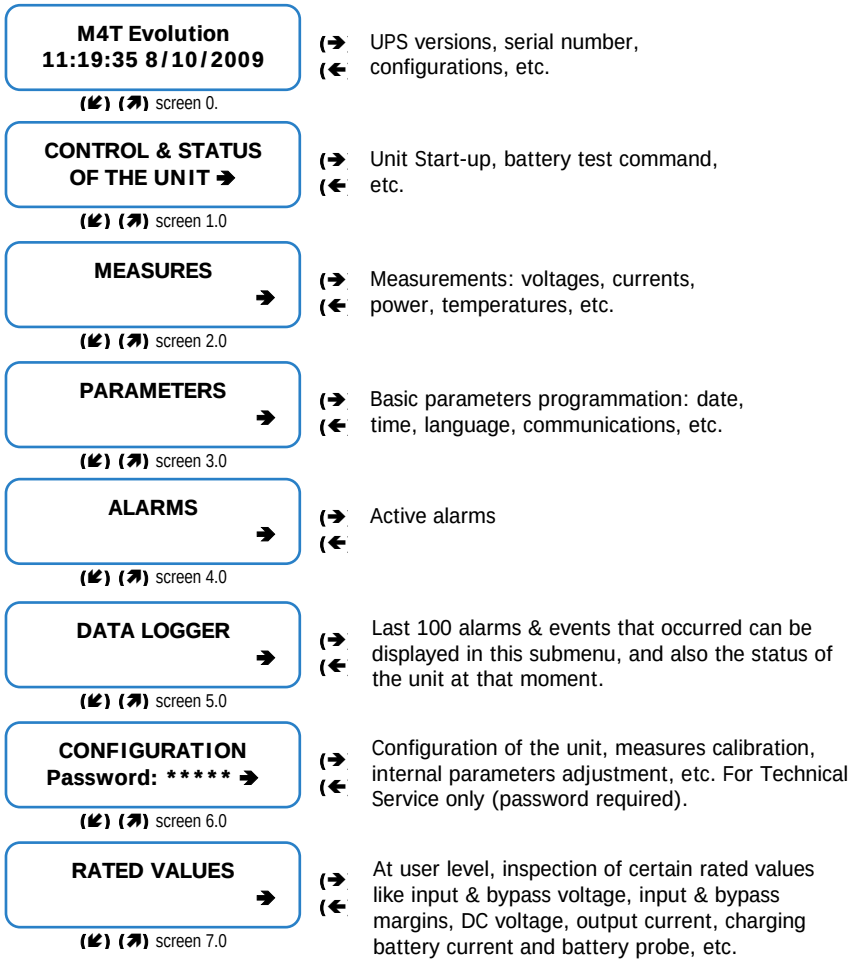

Fig.31. Display message menus and classification in submenus.

6.3 Screen description.

6.3.1 Main level (screen menu 0.0).

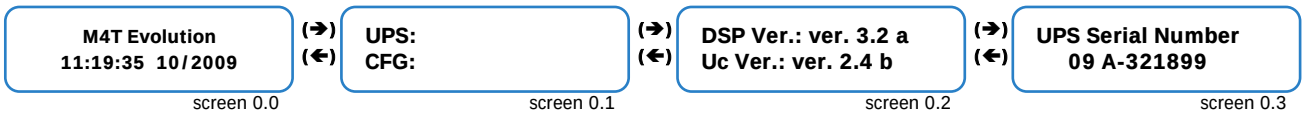

Fig.32. Screen 0.0 "Initial" and its submenus.

- **Screen 0.0**: Main presentation screen, with time and date indication.
  In paralleled devices, the first row of the screen changes between "UPS" and "Paral.-- Out.SW=---", and where:
  - Paral. ---, corresponds to the address of each UPS with three characters.
  - Out.SW ---, corresponds to the position of the output switch of the UPS and/or switchgear panel board, with two status ON and OFF (the auxiliary contact of the output switch in the output panel board has to be connected according to the instructions of this manual).

  Press (**ESC**) key on any screen of any submenu, to return to main screen (Screen 0.0),

- **Screen 0.1:** UPS Status ("UPS:" 1st row) and configuration ("CFG:" 2nd row). In the first row, there are two fields, first to show the general status of the converters, and second to show the origin of the output voltage. These two fields are separated by a " , ":
  - ❒ Possible state of the converters:
  - "Shutdown" Rectifier and Inverter stopped or blocked.
  - "Start" UPS converters (rectifier and inverter) are starting, but still not ready.
  - "Normal" UPS is running in normal mode: mains present, rectifier running, and output on inverter. Loads are protected.
  - "Discharge" Mains failure. UPS running in back-up mode (rectifier stopped, inverter running).
  - ❒ Origin of the output:
  - "OFF" No voltage supplied at the output (either EPO pressed, or severe problem on the unit).
  - "Invert" Inverter voltage is supplied at the output. Loads are protected.
  - "Bypass" Bypass voltage is supplied at the output. Either the unit is manually stopped, or overloaded, or other possible problems on the inverter.

In the second row is the hierarchy of the UPS regarding the rest of the system, which is dynamic depending on the status of the rest of the devices in the system. For a single equipment, the LCD screen will display the message «CFG: Single»

- ❒ Equipment hierarchy (parallel systems):
- "Paral. Mst. Byp" bypass Master of the parallel system. By default, the first UPS starting up the inverter according to the established procedure.
- "Paral. Slv. By.Rsv" reserved bypass Slave. Corresponds to the equipment with the highest address excepting the one from «bypass Master». In case of failure of the Master, it will take its functions.
- «Paral. Slv. Byp» bypass Slave of the parallel system (systems with more than two devices only). It will become the «reserved bypass Slave», when it is acting as «bypass Master». In systems with more than three equipments in parallel, the one with the highest address among the «bypass Slave» will take the hierarchy of «reserved bypass Slave».
- «Paral. Mst. Volt» voltage Master of the parallel system. By default, the first UPS on normal operating (inverter in operation), that the output switch (Q2) is turned «On».
- «Paral. Slv. Vt.Rsv» reserved voltage Slave of the parallel system. Equipment on normal operating (inverter in operation), that the output switch (Q2) is turned «On» in 2nd place or subsequently (after the «Paral. Mst. Volt» or «Paral. Mst. Vt.Rsv»). Initially, it corresponds to the equipment with the highest address, excepting the one from «Voltage Master». In case of failure of the Master, it will take its functions.
- «Paral. Slv. Volt» voltage Slave of the parallel system (systems with more than two equipments only). Equipment on operating normally (inverter in operation) with the output switch (Q2) turned «On» in 2nd place or subsequently (after the «Paral. Mst. Volt» or «Paral. Mst. Vt.Rsv»). It will become the «reserved voltage Slave», when working as «voltage Master». In systems with more than three devices in parallel,

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the one with the highest address among the «voltage Slave» will take the hierarchy of «reserved voltage Slave».

Examples:

a)

UPS: Normal, Invert.
CFG: Single

b)

UPS: Shutdown, Bypass
CFG: Parallel-Master

- **Screen 0.2:** Internal firmware versions of both Digital Signal Processor ("DSP Ver:") and microcontroller ("uC Ver:"). On the sample screen, "ver. 3.2 a" and "ver. 2.4 b" respectively.

- **Screen 0.3:** UPS Serial Number, expressed with 10 characters. Possible characters ranges are "0"-"9", "A"-"Z" and also " " (blank space), "-". See sample screen.

6.3.2 "UNIT CONTROL & STATUS" Level (screen menu 1.0).

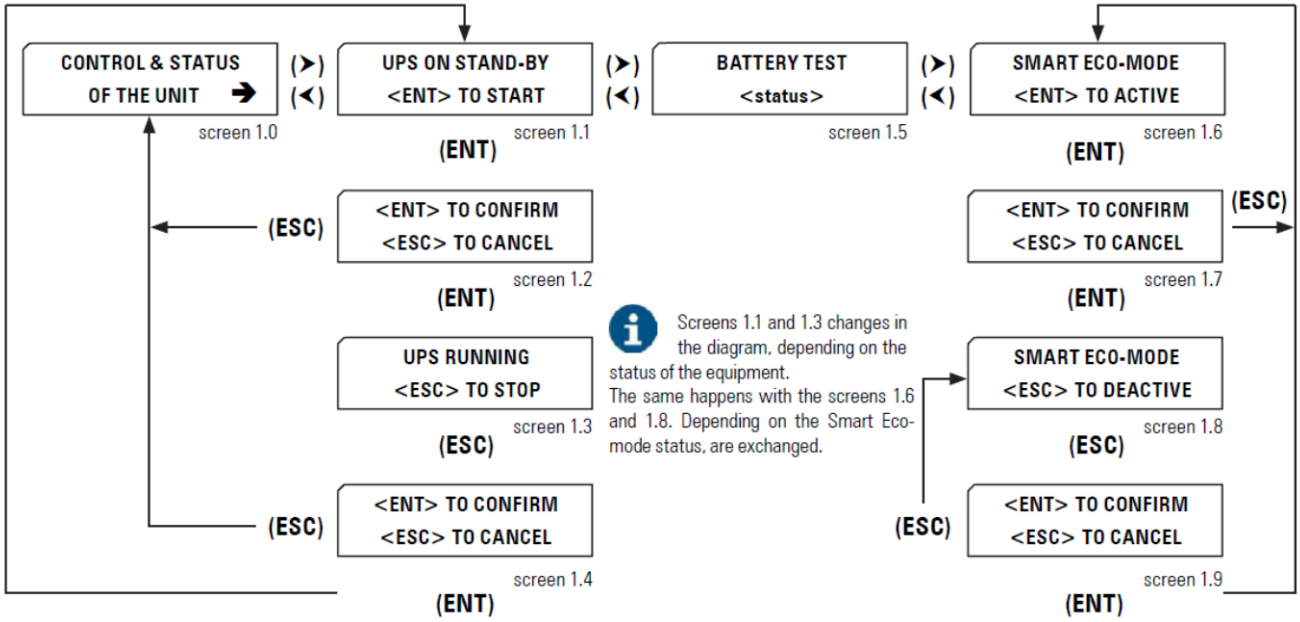

Fig.33. Procedure start-up / shutdown.

- **Screens 1.1, 1.3 and confirmation screen (1.2 / 1.4):** to start and stop the unit through the control panel.
  See chapters 5.1.2 and 5.2 for the starting and stopping procedure.

- **Screen 1.5 and confirmation screen (1.2 / 1.4):** to order a battery test. Information about the battery test is given on the second row. Possible messages:
  "NOT AVAILABLE": The battery test is not available.
  "PRESS <ENTER>": Press <ENTER> to run the battery test.
  "EXECUTING": The battery test is running.
  "SUCCESSFUL": The battery test was successful.
  "NOT SUCCESSFUL": The battery test was not successful.

- **Screens 1.6, 1.8 and validation screen (1.7 / 1.9):** to activate and deactivate the Smart Eco-mode operating.

- **‘‘MEASURES’’ level (screen menu 2.0).**

Fig.34. Screen 2.0 “Measures” and its submenus.

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Press key (**ESC**) on any screen of any submenu, to return to main screen (**Screen 0.0**).

- **Screen 2.1:** input voltages phase to phase (units 0.1 V).
- **Screen 2.2:** three phase input voltages phases to neutral (units 0.1 V).
- **Screen 2.3:** input current per phase (units 0.1 A).
- **Screen 2.4:** three phase output voltages phases to neutral (units 0.1 V).
- **Screen 2.5:** output current per each phase (units 0.1 A).
- **Screen 2.6:** three phase inverter output voltages phases to neutral (units 0.1 V).
- **Screen 2.7:** three phase bypass voltages phase to (units 0.1 V).
- **Screen 2.8:** bypass current per each phase (units 0.1 A).
- **Screen 2.9:** positive and negative DC bus voltages (units 0.1 V).
- **Screen 2.10:** positive and negative battery voltages (units 0.1 V).
- **Screen 2.11:** positive and negative battery charging currents
- (units 0.1 A).
- **Screen 2.12:** positive and negative battery discharging currents (units 0.1 A).
- **Screen 2.13:** input apparent power of L1 (units 0.1 kVA).
- **Screen 2.14:** input apparent power of L2 (units 0.1 kVA).
- **Screen 2.15:** input apparent power of L3 (units 0.1 kVA).
- **Screen 2.16:** input active power of L1 (units 0.1 kW).
- **Screen 2.17:** input active power of L2 (units 0.1 kW).
- **Screen 2.18:** input active power of L3 (units 0.1 kW).
- **Screen 2.19:** total input apparent power and active power (units 0.1 kVA and 0.1 kW).
- **Screen 2.20:** input power factor of each phase (units 0.01).
- **Screen 2.21:** apparent output power of L1 (units 0.1 kVA).
- **Screen 2.22:** apparent output power of L2 (units 0.1 kVA).
- **Screen 2.23:** apparent output power of L3 (units 0.1 kVA).
- **Screen 2.24:** active output power of L1 (units 0.1 kW).
- **Screen 2.25:** active output power of L2 (units 0.1 kW).
- **Screen 2.26:** active output power of L3 (units 0.1 kW).
- **Screen 2.27:** total apparent and active powers (units 0.1 Kva and 0.1 kW).
- **Screen 2.28:** output power factor of each phase (units 0.01).
- **Screen 2.29:** total load of three phases (units 0.1%).
- **Screen 2.30:** total input and output load (units 0.1%).
- **Screen 2.31:** input, bypass and output frequencies (units 0.1 Hz).
- **Screen 2.32:** rectifier, inverter and battery temperatures (units 1 ºC).
- **Screen 2.33:** estimated backup time (units 1 minute).

6.3.3 "PARAMETERS" level (screen menu 3.0). See Fig. 33.

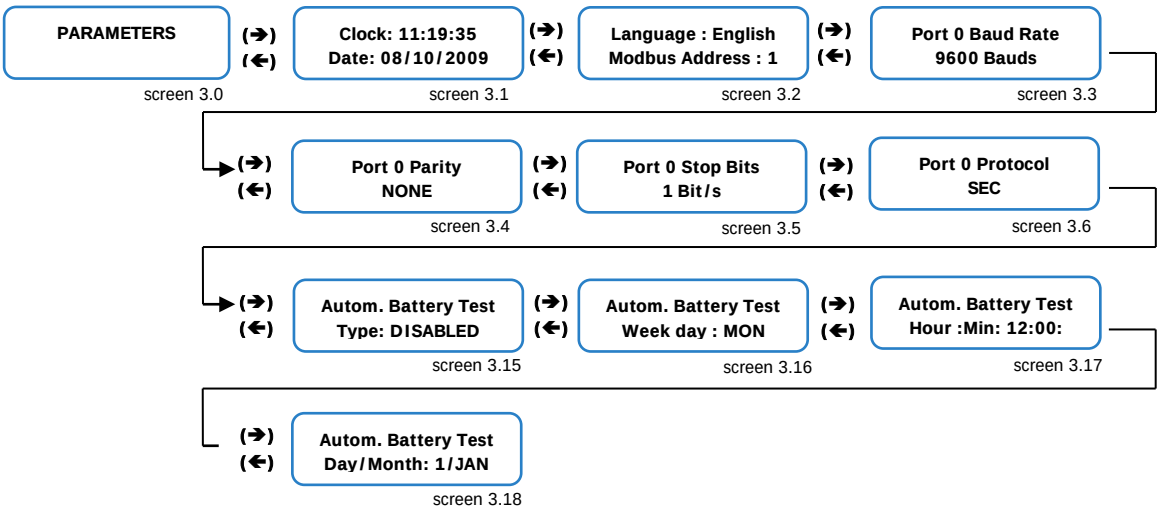

Fig.34. Screen 3.0 "Parameters" and its submenus.

Screen 3.1: You can program the time "hh:mm:ss" (hours/minutes/seconds) in the first row and the date "dd/mm/yy" (day/month/year) in the second row.

Screen 3.2: You can select the display language from the following options in the first row:

- "English"
- "French"
- "Spanish"
- "German"
- "Turkish"
- "Russian"

You can program the Modbus Address in the second row. The address range is from 1 to 247 characters.

Screen 3.3: You can program the BAUD RATE of communication port #0 on this screen. The options are as follows:

- "1200"
- "2400"
- "4800"
- "9600"
- "19200"

Screen 3.4: You can program the PARITY type of communication port #0 on this screen. The options are as follows:

- "NONE"
- "ODD"
- "EVEN"

Screen 3.5: You can program the number of STOP BITS of communication port #0 on this screen. The options are as follows:

- "1"
- "12"

Screen 3.6: You can program the protocol type of communication port #0 on this screen. The options are as follows:

- "SEC"
- "MODBUS"

Screen 3.15: This is the screen for programming the frequency of the automatic battery test. The options to be programmed are as follows:

- "DISABLED'': The automatic battery test is disabled.
- "WEEKLY'': The automatic battery test runs once a week.
- "MONTHLY'': The automatic battery test runs once a month.
- "YEARLY'': The automatic battery test runs once a year.

Screen 3.16: This screen appears independently on the last screen, but it only makes sense to be programmed if the automatic battery test runs once per week. The options to be programmed are as follows:

- "MON": the day selected to run the weekly battery test is Monday.
- "TUE": the day selected to run the weekly battery test is Tuesday.
- "WED": the day selected to run the weekly battery test is Wednesday.
- "THU": the day selected to run the weekly battery test is Thursday.
- "FRI": the day selected to run the weekly battery test is Friday.
- "SAT": the day selected to run the weekly battery test is Saturday.
- "SUN": the day selected to run the weekly battery test is Sunday.

Screen 3.17: This screen appears independently on the last screen, but it only makes sense to be programmed if the automatic battery test is enabled. You can program the time "hh:mm" (hours/minutes) in 24h format on this screen.

Screen 3.18: This screen appears independently on the last screen, but it only makes sense to be programmed if the automatic battery test runs monthly or yearly. You can program the day from 1 to 31 on this screen and the month selecting one of the following options:

- "JAN": the month selected to run the yearly battery test is January.
- "FEB": the month selected to run the yearly battery test is February.

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- “MAR”: the month selected to run the yearly battery test is March.
- “APR”: the month selected to run the yearly battery test is April.
- “MAY”: the month selected to run the yearly battery test is May.
- “JUN”: the month selected to run the yearly battery test is June.
- “JUL”: the month selected to run the yearly battery test is July.
- “AUG”: the month selected to run the yearly battery test is August.
- “SEP”: the month selected to run the yearly battery test is September.
- “OCT”: the month selected to run the yearly battery test is October.
- “NOV”: the month selected to run the yearly battery test is November.
- “DEC”: the month selected to run the yearly battery test is December.

6.3.4 "ALARMS" level (screen menu 4.0).

Active alarms are displayed using key (➔). You can move from one to another within the alarm list using keys (➔) or (🡐).
If there is no alarm, it will not be possible to go forward with key (➔).
Figure 35 shows only one alarm as an example, but there could be other active alarms.
Table 6 shows all the possible alarms displayed on the LCD screen.
In addition, alarm message screens may appear flashing and replacing any other screen (even in different menus or submenus) currently displayed.
The flashing alarm message is acknowledged by pressing (ENT), and the previous screen is displayed again.

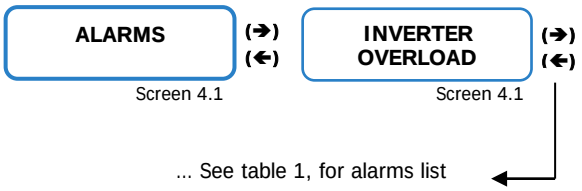

Fig.35. Screen 4.0 "Alarms" and its submenus.

LCD screen display	Alarms	Ref.
RECTIFIER OVERLOAD	RECTIFIER	4.1
INVERTER OVERLOAD	INVERTER	4.2
MAINS FAILURE LOW BATTERY LEVEL		4.3
INVERTER VOLTAGE OUTSIDE MARGINS		4.4
DC VOLT. DETECTED AT THE OUTPUT		4.5
MAINTENANCE BYP.INVERTER NOT AVAIL.		4.6
BATTERY DISCHARGING	UPS	4.7
HIGH TEMPERATURE REDUCE OUTPUT LOAD		4.8
BATT. SWITCH OPEN SWITCH IT ON		4.9
BYPASS FAILURE NOT SYNCHRONISED INV		4.10
UPS ON BYPASS INITIALISE THE UPS		4.11
SOME UNIT BLOCKED DUE TO MAINT. BYPASS		4.12
CAN BUS 1 COMMUNICATION FAIL.		4.13
CAN BUS 2 COMMUNICATION FAIL.		4.14

LCD screen display	Alarms	Ref.
END OF BATTERY LIFE ALARM	UPS	4.15
BATT. TEMPERATURE TOO HIGH		4.16
BATTERY TEST NOT SUCCEEDED		4.17
BAT.DISCONNECTION SHUTDOWN & RESTART		4.18
MAINS PHASE ROT. UPS START INH.		4.19
BYPASS PHASE ROT. UPS START INH.		4.20
EEPROM MEMORY FAILURE		4.20A
ERROR COMS.PARAL. MASTER FIXED	PARALLEL	4.21
ALARM PARAL.SIST. REDUNDANCY LOST		4.22
INP. VOLTA. WRONG RECTIFIER STOP	RECTIFIER STOPS	4.23
RECTIFIER DESATS. RECTIFIER STOP		4.24
DSP INTERN. ERROR RECTIFIER STOP		4.25
INPUT PHASE ROT. RECTIFIER STOP		4.26
DC BUS VOLT WRONG RECTIFIER STOP		4.27

Table .4 Alarm list displayed in the LCD panel.

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PARALLEL SIST. RECTIFIER STOP	RECTIFIER STOPS	4.28
CONT. TEST FAIL RECTIFIER STOP		4.29
INVERTER DESATS. INVERTER STOP	INVERTER STOPS	4.30
INVERTER OVERLOAD INVERTER STOP		4.31
SHUTDOWN COMMAND INVERTER STOP		4.32
MAINTENANCE BYP. INVERTER STOP		4.33
PARAL. SYS. DISC. INVERTER STOP		4.34
HIGH OVERLOAD INVERTER STOP		4.35
OVERTEMPERATURE INVERTER STOP		4.36
RECTIFIER OVERLO. INVERTER STOP		4.37
DSP INTERN. ERROR INVERTER STOP		4.38
OUT SHORT-CIRCUIT INVERTER STOP		4.39
BYPASS PHASE ROT. INVERTER STOP		4.40
INV. FAILURE/OVL INVERTER STOP		4.41
VOLTAGE RAMP ERR. INVERTER STOP		4.42
PARALLEL SYSTEM INVERTER STOP		4.43
LOW BAT TERY INVERTER STOP		4.44
DSP INTERN. ERROR UPS STOP	UPS STOPS	4.45
OVERTEMPERATURE UPS STOP		4.45A
PFC & INV STOP UPS STOP		4.46
PARALLEL SIST. UPS STOP		4.47
EMERGE. POWER OFF NO OUTPUT VOLTAGE	BYP STOPS	4.48
OUT SHORT-CIRCUIT NO OUTPUT VOLTAGE		4.49
DSP INTERN. ERROR UPS BLOCK ALL		4.50
DC BUS VOLT WRONG RECTIFIER BLOCK	RECTIFIER BLOCKS	4.51
RECTIFIER BLOCKED BLK.UPS -> BLK.REC	RECTIFIER BLOCKS	4.52
RECTIFIER DESATS. RECTIFIER BLOCK		4.53
VOLTAGE RAMP ERR. RECTIFIER BLOCK		4.54
INTERN.EXE. ERROR RECTIFIER BLOCK		4.55
DSP INTERN. ERROR RECTIFIER BLOCK		4.56
CONTACTOR T. FAIL RECTIFIER BLOCK		4.57
VOLTAGE RAMP ERR. INVERTER BLOCK	INVERTER BLOCKS	4.58
OUTPUT DC VOLTAGE INVERTER BLOCK		4.59
INVERTER BLOCKED BLK.UPS -> BLK.INV		4.60
INVERTER DESATS. INVERTER BLOCK		4.61
INTERN.EXE. ERROR INVERTER BLOCK		4.62
DSP INTERN. ERROR INVERTER BLOCK		4.63
INVERTER FAILURE INVERTER BLOCK		4.64
UPS BLOCKED BLK.REC -> BLK.UPS	UPS BLOCKS	4.65
INTERN.INI. ERROR UPS BLOCK (DSP)		4.66
INTERN.EXE. ERROR UPS BLOCK (DSP)		4.67
UPS BLOCKED BLK.INV -> BLK.UPS		4.68
INTERN.COM. ERROR UPS BLOCK (DSP)		4.69
DC BUS WRONG DISC. UPS BLOCK		4.70
UPS OVERTEMPERAT. UPS BLOCK		4.71
RECTIFIER OVERLO. UPS BLOCK		4.72
INVERTER DESATS. UPS BLOCK		4.73
DSP INTERN. ERROR UPS BLOCK		4.74
PFC & INV BLOCK. UPS BLOCK		4.75
PARAL. COMS ERROR UPS BLOCK		4.76
FREQ. DET. FAIL UPS BLOCK		4.77

Table .4 Alarm list displayed in the LCD panel.

Screen 4.1: This alarm indicates that the rectifier is overloaded. The rectifier overload appears when the input current of any phase is greater than the following ratio:

$$Iin\text{-}ovl = 0{,}326 \times Pout / Vout\_p\text{-}n$$

Where:

- Iin-ovl is Overload Input Current (A)
- Pout is Rated Output Apparent Power (VA)
- Vout_p-n is Rated Output Voltage phase-to-neutral (V)

Screen 4.2: This alarm indicates that the inverter is overloaded. The inverter overload appears when the output current of any phase is greater than the rated output current.

$$Iout\text{-}ovl = Pout / (Vout\_p\text{-}n * 3)$$

Where:

- Iout is rated Output Current (A)
- Pout is Rated Output Apparent Power (VA)
- Vout_p-n is Rated Output Voltage phase-to-neutral (V) or when the total output active power is greater than the following formula:

$$Pact\_out\text{-}ovl = Pout \times 0{,}8$$

Where:

- Pact_out-ovl is the Overload Output Active Power (W)
- Pout is Rated Output Apparent Power (VA)

Screen 4.3: This alarm appears when the unit input is in mains failure condition and the battery level is lower than 11,5V/bat.

Screen 4.4: This alarm appears when the inverter output voltage phase to neutral in any phase is outside range of +/-6%.

Screen 4.5: This alarm appears when there is an offset voltage higher than 5V, in any phase of the inverter output voltage phase to neutral.

Screen 4.6: When the maintenance bypass switch is ON the UPS inverter will not be available.

Screen 4.7: This alarm can trigger for two reasons:

a) Mains failure: when phase to neutral voltage in any input phase is out of range (+15%/–20% by default) or when input frequency is out of range (±5 Hz by default).

b) PFC-rectifier is on limiting power mode, so, the additional energy that the Inverter needs (it means the load at the output of the equipment), is supplied by the batteries (battery discharging current is displayed).

Screen 4.8: When the inverter or PFC temperature sensors measure temperatures over the programmed values (70ºC by default).

Screen 4.9: This message appears when the battery switch is OFF and the DC bus is charged to the battery voltage level, to inform the user to switch ON the battery switch.

Screen 4.10: This screen indicates that the bypass input voltage or the bypass input frequency are outside the margins. These margins are programmable but the default bypass voltage range is +12%/–15% and the bypass frequency range is ±0.5Hz.

Screen 4.11: The UPS is on bypass for whatever reason. It must be restarted via the display keypad.

Screen 4.12: This is an alarm for parallel systems. It appears when UPS devices in the parallel system are blocked because the maintenance bypass switch of a unit is switched ON.

Screen 4.13: This alarm indicates that the CAN BUS #1 fails. This communication channel is used for remote control.

Screen 4.14: This alarm indicates that the CAN BUS #2 fails. This channel is used for data communication between UPS devices, in a parallel system.

Screen 4.15: This alarm appears at the estimated end of life of the battery bank. The revision and replacement of some batteries will be required by calling the S.T.S. (Service and Technical Support) department.

Screen 4.16: The temperature of the battery cabinet (in the case of a separate battery cabinet) or battery lace (if batteries located inside the UPS) is higher than 40ºC.

Screen 4.17: If the battery test (automatic or manual) is completed unsuccessfully, this alarm will appear.

Screen 4.18: Two possible reasons:

- During the unit start up, a message appears indicating that the battery switch can be switched ON. After a period of time without switching ON, this alarm appears.
- When the unit is running under normal conditions and the battery switch is switched OFF.

Screen 4.19: When mains is connected during the startup, a phase rotation error is detected and the startup procedure is inhibited.

Screen 4.20: When the bypass is connected during the startup, a bypass phase rotation error is detected and the startup procedure is inhibited.

Screen 4.20A: Error in the memory of the equipment setting.

Screen 4.21: In a system with parallel configuration, this alarm is displayed in one of the equipments (or some) that detect commu- nication errors, due to several reasons (parallel communication cables are disconnected, or wrong connected, or in bad status; wrong configuration of any of the equipments; etc.). Therefore, one of the equipments is set as a fix Master of the system, and the rest of the equipments can only be slaves permanently (or till the equipments are shutdown and try to started them up again).

Screen 4.22: In a parallel system, with N+M configuration, where:
N: nr equipment to size the system according to the maximum permissible load.
M: nr redundant equipment in the system. It is equivalent to over sizing the equipment in the system, in order to continue supplying the maximum permissible load without overloading it. Usually, this value is fixed to "1".
The alarm is displayed when the load exceeds the maximum permissible load by N equipment. In this condition, the equipment will not be overloaded individually, meanwhile the load doesn't exceed the maximum load of N+M equipment. Example: Assuming that a parallel system of 2+1 equipment of 20kVA (N=2, M=1).

- If the load of the system is lower than 40kVA. Any overload

alarm is displayed in the system (if it is not exceeded the individual overload per phase of each equipment).

- If the load of the system is higher than 40kVA. The described alarm 4.22 of Lost of Redundancy is displayed.
- If the load of the system is higher than 60kVA. Besides of the alarm 4.22 of Lost of Redundancy, there will also be, as minimum, (among others), the alarm 4.2 of Inverter overload in all the equipments of the system.

• **Screen 4.23**: This alarm is displayed when in any phase, the rectifier input voltage phase to neutral is out of the set range (+15 % / –20 % by default) or the rectifier input frequency is out of the set range (± 5 Hz by default). Next, the rectifier is shutdown.
• **Screen 4.24**: This alarm is displayed when the quantity of
IGBT desaturations in the rectifier stage, reaches its limit.
• **Screen 4.25**: This alarm is displayed when there is a (*) DSP Internal Error in the rectifier module, shutting down the rectifier immediately. There will be 3 more retries before blocking rectifier.
• **Screen 4.26**: When a wrong phase rotation is detected in the mains and under these conditions the rectifier is tried to be turned ON, an input phase rotation alarm is displayed shutting down the rectifier immediately.
• **Screen 4.27**: When a high or low DC bus voltage of the equipment is detected, the rectifier is shutdown for a while, in order to retry to start up later on (see description of screen 4.51 too).
• **Screen 4.28**: In a parallel system, rectifiers from the equipments of the system connected in parallel can be shutdown, due to the management of system as a whole, therefore this alarm is displayed.
• **Screen 4.29**: This alarm can be displayed for two reasons:
Input contactor from the equipment faults (it doesn't close properly). It is shown when the DC bus voltage, it is not kept at certain level when turning on such input contactor.

If for any reason, during the initial start up of the inverter, with the input contactor closed and rectifier still shutdown, it is detected a wrong inverter voltage or it is not able to start up.
The system can retry the contactor test several times (see description of the screen 4.57 too).
• **Screen 4.30**: This alarm is displayed when the quantity of
IGBT desaturations in the inverter, reaches its set limit.
• **Screen 4.31**: When the inverter output is overloaded, it is displayed this alarm. Depending on the level of this overload, the inverter will be shut down after some time according to the UPS overload curve.
• **Screen 4.32**: When a shutdown is enabled by an external signal, the inverter is shut down and it is displayed this message.
• **Screen 4.33**: When the inverter is running and the maintenance bypass switch is turned ON the inverter is shutdown immediately.
• **Screen 4.34**: This alarm appears when, in a parallel system, one UPS goes to battery mode. The inverter will shut down.
• **Screen 4.35**: This message indicates that one UPS of the parallel system is running over 160% of load.
• **Screen 4.36**: When an overtemperature is detected by the PFC or inverter temperature probes, after 1 minute the inverter is turned off automatically. If overtemperature condition remains after another 1 minute with the rectifier running, rectifier is also shutdown (alarm 4.71).
• **Screen 4.37**: This alarm is displayed when the rectifier is over- loaded and depending on the level of this overload, the inverter is shut down after some time according to the rectifier overload curve. If this overload is still present with the inverter turned off, the rectifier will be blocked after 30'' and the blocking alarm
4.72 will be displayed.
• **Screen 4.38**: This alarm is displayed when there is a (*) DSP Internal Error in the inverter module, shutting down the inverter immediately. There will be several retries before blocking the inverter.
• **Screen 4.39**: This alarm is displayed when an output short- circuit is detected, limiting the output RMS current up to the set value (150% of nominal current by default). The short-circuit is detected when the output voltage phase to neutral is lower than 16 % of nominal voltage. The system will retry twice to restart up.
• **Screen 4.40**: With the inverter running, if there's a wrong bypass phase rotation, the inverter will be shutdown.
• **Screen 4.41**: This alarm can be activated due to a connection of a load with high inrush current, or also, if it is detected a wrong transient voltage in the inverter (i.e., if there is a fault in an inverter transistor). In such case, the inverter will be shut- down for while and load will be transferred to bypass immedi- ately. The equipment will retry to start up the inverter several times (see description of the screen 4.64 too).
• **Screen 4.42**: The way to start up the inverter is on voltage ramp mode (rms value from sinewave voltage starts at 0 Vrms till reaching its preset nominal value, i.e., 230 Vrms). If when doing the voltage ramp is detected any fault, the inverter will be shutdown for while, and it will retry to start it up several times (see description of the screen 4.58 too).
• **Screen 4.43**: In a parallel system, the inverters of the equipments of the system connected at the output can be shutdown, due to the management of system as a whole, therefore this alarm is displayed.
• **Screen 4.44**: This alarm means that the battery set has reached the level 10.5 V/bat when the equipment is on battery mode. This is the end of back up time, so the inverter of the UPS must be shutdown.
• **Screen 4.45**: This alarm is displayed when there is a (*) DSP Internal Error in the UPS module, shutting down the UPS immediately. There will be several retries before blocking the UPS.
• **Screen 4.45A**: Unlike the 4.36, in case that the inverter of the UPS is not started and the PFC-rectifier is charging the batteries, in case of internal over temperature detection, the operating of itself has to be shutdown. It will mean a total shutdown of the UPS (Rectifier and Inverter shutdown).
• **Screen 4.46**: This alarm is displayed when a combined shut- down of the PFC-rectifier and inverter has been done at the same time (due to different reasons).
Screen 4.47: In parallel system, the equipments of the system connected at the output can be shutdown (complete shutdown of the rectifier and inverter), due to the management of system as a whole, therefore this alarm is displayed.
• **Screen 4.48**: The EPO (Emergency Power Off) button is pressed. The UPS and the static bypass are turned off and no AC voltage is present at the output.
• **Screen 4.49**: This alarm is displayed after 3 start up retries after detecting an output short-circuit. Then the UPS and the static bypass are turned off and no AC voltage present at the output.
• **Screen 4.50**: This alarm is displayed when there is a (*) DSP Internal Error in the UPS module, after stopping several times the UPS. The UPS blocks including the bypass, so no AC voltage present at the output.
• **Screen 4.51**: After several consecutive attempts, it is detected a wrong DC bus voltage (see screen 4.27), rectifier will be blocked permanently by displaying this alarm.
• **Screen 4.52**: This alarm is displayed when the UPS is blocked for any reason. Also this condition blocks the rectifier.

• **Screen 4.53**: After several times of shutting down the rectifier due to desaturations, this alarm will be displayed indicating rectifier blocked.
• **Screen 4.54**: If an error in the initial rectifier ramp is detected during the PFC start up, this alarm will be displayed blocking the rectifier.
• **Screen 4.55**: There is a command from the microprocessor to the rectifier DSP, with no response. The rectifier is blocked.
• **Screen 4.56**: After several times shutting down the rectifier because of (*) DSP Internal Error in the rectifier module, this alarm will be displayed indicating rectifier blocked.
• **Screen 4.57**: During the start up there is an input contactor test. If this test ends unsuccessfully the rectifier will be blocked.
• **Screen 4.58**: If Inverter voltage ramp is not done properly after several attempts, it will be blocked (see screen 4.42).
• **Screen 4.59**: This alarm appears when there is an offset voltage higher than 8V, in any phase of the inverter output (phase to neutral voltage). Next the inverter is blocked.
Screen 4.62: There is a command from the microprocessor to the inverter DSP, with no response. The inverter is blocked.
• **Screen 4.63**: After several times shutting down the inverter because of (*) DSP Internal Error in the inverter module, this alarm will be displayed and the inverter is blocked.
• **Screen 4.64**: After several attempts detecting "Inverter Fault/ Overload" (see screen 4.41), the inverter is blocked permanently, and output is transferred to bypass.
• **Screen 4.65**: This alarm is displayed when the rectifier is blocked for any reason that also blocks the UPS.
• **Screen 4.66**: The alarm is displayed when the DSP doesn't response to the microprocessor during the initial procedure before starting up.
• **Screen 4.67**: There is a command from the microprocessor to the UPS module DSP, with no response. The UPS is blocked.
• **Screen 4.68**: This alarm is displayed when the inverter is blocked for any reason that also blocks the UPS.
• **Screen 4.69**: There is an internal error in the communication channel between microprocessor and DSP. This condition blocks the UPS.
• **Screen 4.70**: Unlike the cases 4.27, 4.51, if the DC Bus voltage is detected meanwhile the PFC-rectifier is not in operation (equipment discharging the batteries), the UPS has to be shut down completely (inverter has to be shutdown too), so as a result the UPS will be blocked. This phenomena can be due to a failure of the UPS, or due to an "asymmetrical" consumption of a load connected at the output of the UPS (with average value different from 0V, so, with DC level). This type of loads are incompatible with the UPS.
• **Screen 4.71**: When an overtemperature is detected by the PFC or inverter temperature probes, first the inverter will be turned off after 1 minute time automatically (alarm 4.36). If 1 minute later the overtemperature is still present, the UPS will be completely blocked (rectifier also shut-down) and this alarm is displayed.
• **Screen 4.72**: When the rectifier is overloaded, depending on the level of this overload, the inverter will be shut down according to the rectifier overload curve (alarm 4.37). If this over load is still present with the inverter turned off, the UPS will be completely blocked (rectifier also shutdown) after 30'', and this alarm will be displayed.
• **Screen 4.73**: When the quantity of desaturations of an inverter IGBT reaches its limit, the inverter is blocked. After two more retries this alarm UPS blocked is displayed.
• **Screen 4.74**: After several shutting down retries of the UPS because of (*) DSP Internal Error in the UPS module, this alarm will be displayed indicating UPS blocked.
(*) A DSP Internal Error can happen because of the following reasons:
– Watch Dog failure.
– Wrong ADC measurements.
– Communication errors between DSP and micropro- cessor.
• **Screen 4.75**: If there is a blocking condition for the inverter and another blocking condition for the PFC, this alarm will be displayed and the UPS will also be blocked.
• **Screen 4.76**: After the first error in the parallel system communication, when one of the equipments has already been chosen as a Fix Master in the system, a second error or break in the communications has been detected by the Slaves equipments, it will cause to block them permanently (Rectifier and Inverter are shutdown, no output voltage is supplied to the output of the system), by displaying this alarm.
• **Screen 4.77**: Input frequency auto-sensing failure. Equipment blocked.
This alarm will be displayed, when the input frequency selection in the installation menu is set to AUTOMATIC mode only and the input frequency is out of the acceptable range of ±5% respect to 50 or 60 Hz.

6.3.5 "DATA LOGGER" level (screen menu 5.0).

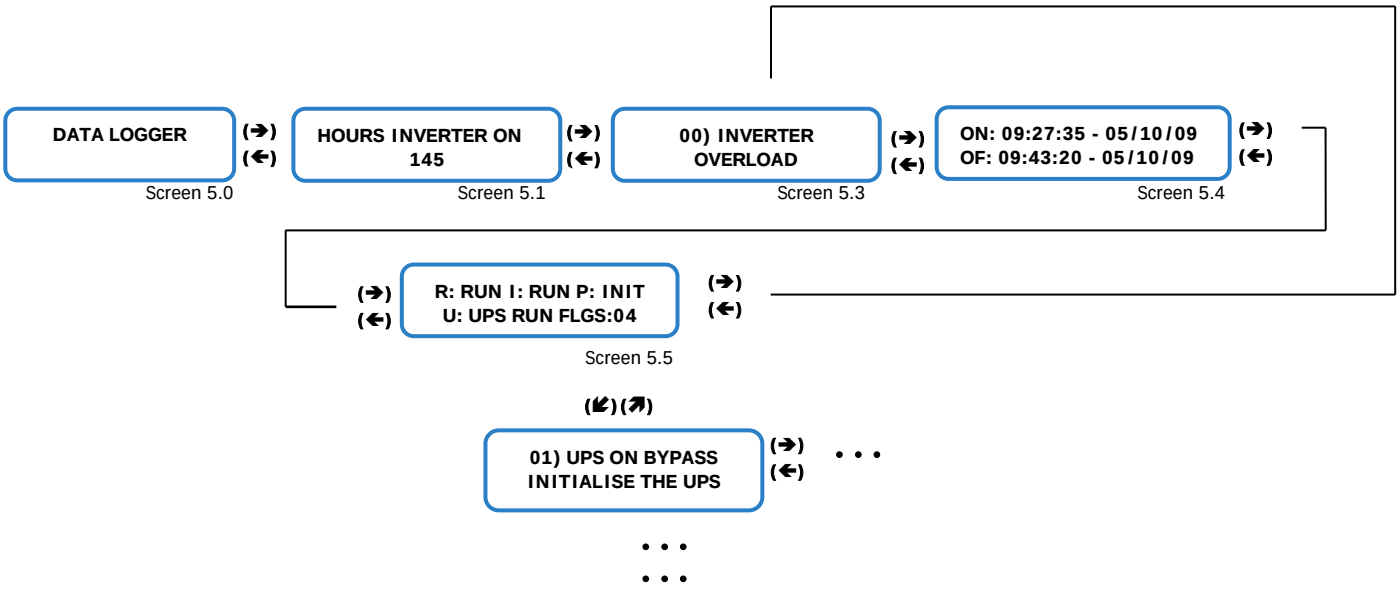

Fig.36. Screen 5.0 "Data logger" and its submenus.

Press key (**ESC**) on any screen of any submenu to return to main screen (**Screen 0.0**).

Screen 5.1: Indicates the inverter runtime from the first unit start-up. This counter accumulates the total inverter running time from the beginning and it is not possible to reset it.

Screen 5.2: This screen indicates that the data logger is empty. This only happens if authorized personnel reset this file. If the buffer is not empty, the following screen will inform of the data logger registers.

You can move through the different registers of this log file using the (↙) (↗) keys. The data logger file can save up to 100 log registers.
You can see the three different screens per register, using the (➔) (➔) keys, with the information described below.

Screen 5.3: The same information appears in this screen as described above in the alarm screens except the first three characters where there is a register counter from 00) to 99).

Screen 5.4: This screen is divided into two rows.

In the first row there is information about alarm activation time and date:

- hh: hour of alarm activation
- mm: minutes of alarm activation
- ss: seconds of alarm activation
- dd: day of deleted alarm
- mm: month of alarm activation dd: day of alarm activation
- yy: year of alarm activation

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In the second row there is information about deleted alarm time and date.

- hh: hour of deleted alarm
- mm: minutes of deleted alarm
- ss: seconds of deleted alarm
- dd: day of deleted alarm
- mm: month of deleted alarm
- yy: year of deleted alarm

Screen 5.5: This is a screen for technical service, to know the state of the different parts of the UPS at the moment the registered alarm was activated.

6.3.6 "CONFIGURATION" level (screen menu 6.0).

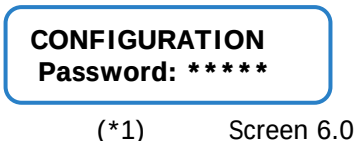

Fig.31. Screen 6.0 "Configuration".

At this level an authorized password will be required to modify some advanced parameters.

6.3.7 Rated values screens (screen menu 7.0).

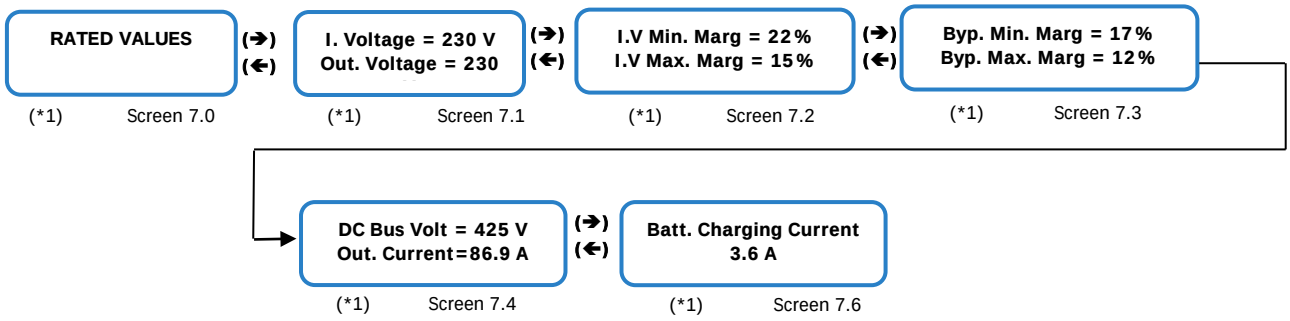

Fig.32. Screen 7.0 "Rated values" and its submenus.

To modify the rated values on the screens of this submenu, the "Password" has to be entered on the previous screen 6.0, otherwise they will be "view only".

Screen 7.1: This screen shows the Rated Input and Output Rectifier Voltage.

Screen 7.2: This screen shows the Input Rectifier Voltage Upper and Lower Margins.

Screen 7.3: This screen shows the Input Bypass Voltage Upper and Lower Margin.

Screen 7.4: This screen shows the Rated DC Bus Voltage and the Rated Output Current.

Screen 7.5: This screen shows the Rated Inverter Voltage and Rated Output Voltage.

Screen 7.6: This screen shows the Rated Battery Charging Current.

7.1 Basic maintenance guide.

Batteries, fans and capacitors must be replaced at the end of their useful lifetime.

- ⚠ Inside the UPS there are dangerous voltages and metallic parts at very high temperatures, even after the UPS is shut down. Direct contact can cause electrocutions and burns. All operations, except battery fuse replacement, must be done by authorized technical staff.
- ⚠ Some internal parts of the UPS (terminals, EMC filters and measurement circuits) are still under voltage during the maintenance bypass operation. To cancel all voltages, the mains and bypass circuit breakers on the panel supplying the UPS and the external battery cabinet fuse holders have to be turned ”OFF“ / ”0“. The internal batteries must also be isolated from the system.

7.1.1 Battery fuses.

Turning on the battery switch or fuse holder according to power of the equipment (“ON” or “I” position) before alarm message “BATT. SWITCH OPEN, SWITCH IT ON” is displayed on the LCD panel can blow the battery fuses or switch.

- ⚠ The battery fuses can only be replaced by ultrafast models type Gould aR 660V (14x51 or 22x58 mm, depending on the unit model) of the same dimensions and rating.

7.1.2 Batteries.

The useful lifetime of the batteries depends on the ambient temperature and other factors such as the quantity of charging and discharging cycles and full discharges.

The average lifetime is between 3 and 5 years if the ambient temperature is between 10 and 20°C. For more information of its status, activate the battery test.

- ⚠ There is a risk of fire and/or explosion if the wrong quantity or type of batteries is used. Do not dispose of the batteries in a fire: they can explode. Do not open or mutilate the batteries: the dumped electrolyte is dangerous for the skin and eyes. It can be toxic.

7.1.3 Fans.

The useful lifetime of the fans used to cool the power circuits depends on the use and surrounding conditions. Their preventive replacement by authorized technical staff is recommended at the same time as batteries replacement.

7.1.4 Capacitors.

The useful lifetime of the DC bus capacitors and those used in input and output filtering depends on the use and the surrounding conditions. Their preventive replacement by authorized technical staff is recommended.

7.2 Warranty conditions.

The limited warranty only applies to those products that you acquire for commercial or industrial use in the normal development of your business.

7.2.1 Product covered.

M4T Evolution series.

7.2.2 Not included in the scope of supply.

Our company is not bound by the warranty if it considers that there is no defect in the product or it was caused by improper use, negligence, installation and/or inadequate testing, attempt to repair or unauthorized

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modification, or any other cause beyond the foreseen use, or by accident, fire, lightning or other dangers. It will not be bound, in all of these cases, to compensation for damages or injuries.

8 APPENDICES

8.1 GENERAL TECHNICAL SPECIFICATIONS.

	M4T Evolution 10	M4T Evolution 15	M4T Evolution 20	M4T Evolution 30	M4T Evolution 40	M4T Evolution 60	M4T Evolution 80	M4T Evolution 100	M4T Evolution 120	M4T Evolution 160	M4T Evolution 160
GENERAL CHARACTERISTICS											
Technology	High Frequency On Line Double Conversion - DSP control										
	Three-phase IGBT inverter & PFC rectifier										
Power	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA	100 kVA	120 kVA	160 kVA	200 kVA
	9 kW	13,5 kW	18 kW	27 kW	36 kW	54 kW	72 kW	90 kW	108 kW	144 kW	160 kW
Output power factor (cos φ)	0,9										0,8
PROTECTION											
Output form	Pure Sinewave										
Protection	Discharge / Overcharge / Overload / Short circuit / Overheating										
Input current limitation	High overload : PFC Limit (charging batteries)										
Surge protection	Protection against transitory over-voltages										
Heat Dissipation max - Watt	1259,67	1259,67	1582,42	2086,96	2594,59	3612,9	4085,11	6021,5	6893,89	7578,95	
Heat Dissipation max - Btu/Min	71,64	71,64	89,99	118,99	147,55	205,47	232,32	342,44	392,05	431,01	
UPS PHYSICAL CHARACTERISTICS											
Dimensions - HxWxD (mm)	1100 x 450 x 770						1320 x 590 x 805			1900 x 900 x 850	
Net weight kg (standard model without batteries)	78	86	94	110	122	162	231	255		550	
Net weight kg (with built-in batteries)	228	236	274	345	357	-	-	-	-	-	-
INPUT TECHNICAL CHARACTERISTICS											
Nominal voltage	3 Ph + N 380/400/415										
Acceptable voltage range	+15% / -20% adjustable										
Frequency	50/60 Hz (± 5%)										
Total Harmonic Distortion (THDi) (100%/50%10% load)	< 1,5 % / < 2,5 % / < 6,0 %			< 1,0 % / < 2,0 % / < 5,0 %				< 1,5 % / < 2,0 % / < 6,0 %			
Power factor	1,00										
OUPUT TECHNICAL CHARACTERISTICS											
Nominal voltage	3 Ph + N 380/400/415										
Precision	Static variation : ± 1% / Dynamic variation : ± 2% (load variations 100%-0%-100%)										
Frequency	Synchronised : 50/60 Hz ± 4% / Free running : 50/60 Hz ± 0,05%										
Slew rate with the mains power on	± 10 Hz per second										
Total Harmonic Distortion (THDi)	Linear load : < 0,5 % / Non-linear load : < 1,5 %										
Phase Displacement	120° ± 1% (balanced load) / 120° ± 1% (imbalances 50% of the load)										
Allowable Overload	125% for 10 min / 150% for 60 s										
Allowable Crest Factor	3,4:1			3,2:1			2,8:1	3,2:1		3,0:1	3,0:1
Output Power Factor (cos phi)	0,9										
Imbalance Output Voltage	< 1% (@ 100% Unbalanced Load)										
Efficiency (Normal Mode at 100% load)	90%	90,5%	91,0%	92,0%	92,5%	93,00%	94,0%	93,3%	93,3%	93,3%	93,3%
STATIC BYPASS											
Type	Static system microprocessor controlled										
Nominal voltage	3 Ph + N 380/400/415										
Frequency	50/60 Hz										
Transfer Time	Zero										
Transfer to Bypass	Immediate for overloads above 150%										
Transfer to normal mode	Automatic										
MANUAL BYPASS (MAINTENANCE)											
Type	Without interruption										
Nominal voltage	3 Ph + N 380/400/415										
Frequency	50/60 Hz										
BUILT-IN BATTERIES											
Batteries (2x31)	12V/7Ah	12V/7Ah	12V/9Ah	12V/12 Ah	12V/12 Ah	-	-	-	-	-	-
Recharging time	5 hours to 90% of capacity					-	-	-	-	-	-
Backup time	15 min.	9 min.	8 min.	7 min.	4 min.	-	-	-	-	-	-
CONTROL PANEL AND DISPLAY											
LCD display	LCD screen with backlight and saving mode + 2 rows of 20 characters										
Controls on front panel	5 LED indications + 6 function buttons										
AUDIBLE ALARMS											
Battery mode	Sounds every second										
Low battery	Sounds every second										
Overload	Sounds every second										
Battery replacement	Sounds every second										
Fault	Continously sounding										
COMMUNICATION											
Main connectors	DB9 connector (RS232 & RS485 ports) - Interface to Relay(AS400) - External EPO										
Communication software	InfoPower (Supports Windows® 98/2000/2003/XP/Vista/2008, Windows® 7, Linux, and MAC)										
SNMP (optional)	Power management from SNMP manager (Vmware compatible) and web browser										
ENVIRONMENT											
Ideal environment	0-40°C, 0-95% of relative humidity (without condensation)										
Operating altitude	Up to 1000 m above sea level (>1000 m 1% deterioration for every 100 m)										
Noise level at 1 meter	< 52dB						< 65dB				
NORMS											
Standard	CE										
EMC (Electromagnetic compatibility)	EN 62040-2										
Low voltage (Safety)	EN 62040-1-2 / IEC 60950-1										
SALES INFO											
Warranty	1 year										
Gencods (230V IEC Model)	3700085 67220 4	3700085 67221 1	3700085 67222 8	3700085 67223 5	3700085 67224 2	3700085 67225 9	3700085 67226 6	3700085 67227 3	3700085 67228 0	3700085 67286 0	3700085 67292 1
	BB M4T Evolution Kit 62B12		**BB M4T Evolution Kit 62B17/26/40**								
BATTERY BANKS											
Battery bank type	Sold in kit form.		Sold in kit form.								
Battery type & number	2x31 batt. 12V/12Ah		2x31 batt. 12V/17Ah 2x31 batt. 12V/26Ah 2x31 batt. 12V/40Ah								
Dimensions - DxWxH (mm)	1190 x 470 x 780		1190 x 880 x 780								
Net weight - kg (empty battery bank)	45		95								
Gencod	3700085 65795 9		3700085 65796 6								

Table 5. Technical specifications

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8.2 Glossary.

AC - It is nominated as alternating current to the electrical current in which the magnitude and direction varies in a cyclic way. The most common wave shape of the alternating current is sine wave, because the energy transmission is better. Nevertheless, some applications could need other period wave shapes, like triangular or square.

Bypass - Manual or automatic, it is the physical junction between the input and the output electric device.

DC and AC - The direct current is the continuous electron flow through a cable between two points with different potential. Unlike the alternating current, in direct current the electrical loads always flow in the same direction from the highest potential point to the lowest one. Although, usually the direct current is identified with the constant current (for example that supplied by the battery), any current that always maintains the polarity is said to be continuous.

DSP - It is the acronym for Digital Signal Processor. A DSP is a system based on a processor or microprocessor that has instructions in it, hardware and optimized software to develop applications where very fast numerical operations are needed. It is very useful to process analogical signals in real time: in a system that runs in this way (real time) samples are received, usually from an analogical/digital converter (ADC).

Power factor - The power factor, p.f., of an alternating current circuit, is defined as the ratio between the active power, P, and the apparent power, S, or as the cosine of the angles that make the current and voltage vectors, designating as Cos φ, being the value of that angle.

GND - The term ground, as its name states, refers to the potential of the earth's surface.

IGBT - The Insulated Gate Bipolar Transistor is a semiconductor used as a controlled switch in powered electronic circuits. This device has the feature of the gate signal of the effect field transistors with the capacity of high current and low voltage saturation of the bipolar transistor, combining an isolated FET gate for the input and a bipolar transistor as the switch in a single device. The triggering circuit of the IGBT is the same as MOSFET one, while the driving features are like the BJT.

Interface - In electronics, telecommunications and hardware, an interface (electronic) is the port (physical circuit) through which signals are sent or received from a system or subsystems toward others.

kVA - The volt-ampere is the unit of the apparent power in electrical current. In direct current it is almost equal to the real power but in alternating current it can differ depending on the power factor.

LCD - Acronym of Liquid Crystal Display. It is an electric system of data presentation based on 2 transparent conductor layers and in the middle a special crystal liquid that have the capacity to direct light passing through.

LED - Acronym of Light Emitting Diode, the LED is a semiconductor (diode) that emits almost monochrome light with a very narrow spectrum, i.e. when it is direct polarized and it is crossed by an electric current. The color, (wave longitude), depends on the semiconductor material used in its construction, being able to vary from ultraviolet going through the visible spectrum of light to infrared. The latter type is called IRED (Infra-Red Emitting Diode).

Circuit breaker - A circuit breaker or switch, is a device ready to break the electrical current of a circuit when it exceeds the maximum set values.

On-Line mode - A piece of equipment is on line when it is connected to the system, and it is in operation, and usually has its power supply turned on.

Inverter - An inverter is a circuit used to convert direct current into alternating current. The function of an inverter is to change an input voltage of direct current into a symmetrical output voltage of alternating current, with the magnitude and frequency required by the user or the designer.

Rectifier - In electronics, a rectifier is the component or circuit that allows the alternating current to be converted into direct current. This is done by rectifier diodes, which can be solid state semiconductors, vacuum or gassy valves such as the mercury vapour. Depending on the features of the alternating current power supply

used, it is classified as single phase when supplied by a single phase electrical mains, or three phase when supplied by the three phase power. Depending on the rectification type, a rectifier can be half wave, when only one of the current semi-cycles is used, or full wave, where both semi-cycles are used.

Relay - The relay (in French “relais”) is an electromechanical device that works like a switch controlled by an electric circuit where, through an electromagnet, a set of contacts is moved.

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