

GE



TME Modular Series UPS System

15 - 90 kVA/kW - 208/220 VAC



TME Modular Series UPS

15-90 kVA/kW

Highest Technology with Modular Design

GE's TME Series UPS is one of the most reliable three-phase UL UPS modular systems, designed for N+X redundancy, on-line and hot-swappable. The TME Series provides compact footprint with power modularity, achieving up to 90kW in order to guarantee maximum flexibility of system design for any kind of application.

The TME Series UPS provides high efficiency in all operating conditions keeping high level of protection to critical loads connected, minimizing input current distortion and consequently reducing operational costs. This makes TME Series UPS a perfect choice for environmental-friendly solutions.

Flexible Design for Maximum Suitability

- 15kVA/kW Modular design on-line and hot-swappable
- N+X redundancy up to 270kVA/kW by paralleling 3 cabinets
- Top & Bottom cable entry available as standard
- Movable on wheels for easy handling in narrow environments

Highest System Availability

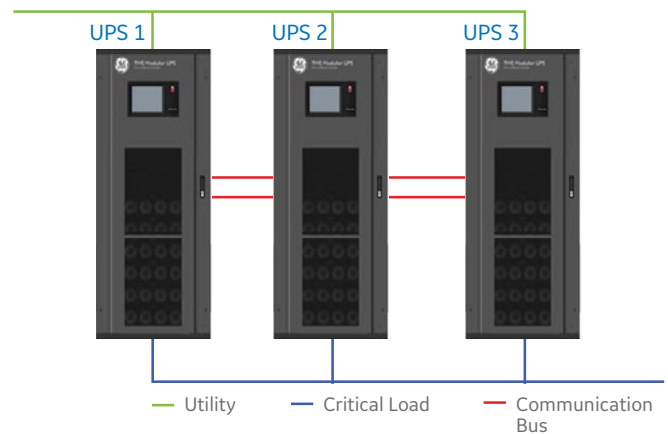
- Excellent output performance with minimized voltage distortion and fast dynamic regulation
- Enhanced handling capability of stressing loads
- Wide accepted input voltage range for maximum compatibility with bad mains
- "Cold Start" available: UPS can be powered on from the battery in absence of input mains

Key Features

- 15-90kVA/kW modular design
- High power capability up to 270kVA/kW
- On-line efficiency up to 93% and 98% in ECO mode
- Clean input performance with >0.99 PF and <4% THDi
- 125-261V (phase - phase) accepted input voltage minimizes battery operations
- Low output voltage distortion <1.5% THDU
- User-friendly 10.4" touch LCD display
- SNMP card included
- Backfeed protection included
- Maintenance bypass included



RPA Configuration
True Redundancy up to 270kVA/kW





Modular Technology

Easy System Scalability

Thanks to its modular design, the TME Series UPS can easily scale power hand in hand with load demand, by plugging-in modules while the system is running: no need to switch on bypass.

Optimized Redundant Architecture (N+X)

The TME Series UPS is based on 15kVA/kW power modules, 3U (5.25 in) high each. Thanks to this, N+X redundancy can be achieved at lower cost than standalone systems, where you need to add full sized UPS, resulting in less space required and minimized installation costs.



Representative Picture

Superior Battery Management (SBM)

Every GE UPS incorporates a standard feature called Superior Battery Management (SBM) that can be configured to periodically test the battery system and calculate true battery runtime using measured values for temperature and load.

Advantages

- Works with all battery types: Flooded and VRLA
- Programmable features allow the user to select the frequency and type of battery tests that are performed:
 - Frequency range can be from once per week to once annually
 - Test type range can be from deep cycle to 3-min discharges
 - Manual tests can be performed at any time
- Temperature compensated battery charger - prevents overcharging
- Programmable end of discharge voltage - protects against deep discharge
- Deep discharge test (manually) - provides battery performance tracking
- Boost charging - enables fast recharging of batteries

Higher Reliability with Hot Swappability

TME Series UPS has a design that simplifies Maintenance when a failure occurs. Modules can be hot-swapped safely, without either interrupting protection to the load or putting the system at risk, preventing human errors and reducing Mean Time To Repair (MTTR).

- Waveform capturing capability
- Fan failure detection
- Component life time counters (fan and capacitors)
- IGBT status diagnostic

Improved reliability and availability

- Dedicated supply for bypass logic
- Dedicated supply for connectivity channels
- Main-board integrated RPA control: RPA board contains only interface hardware

User Friendly LCD Display

Intuitive System Data Access

10.4" Touch LCD Display, with self-explanatory graphics for easy access to system metering and Alarm screen.

Multi-language communication interface supporting: English, French and Spanish.

Modules Monitoring

Detailed system information with dedicated screen for individual power modules: real time monitoring module status, including internal temperature and life counters of consumable parts, improves diagnostic capability of TME Series UPS.

Scope Function

Real time plotting of UPS provided output voltage as well as connected load current, to provide clear information about how the UPS behaves based on load stressing.

Advanced Remote Monitoring Capability

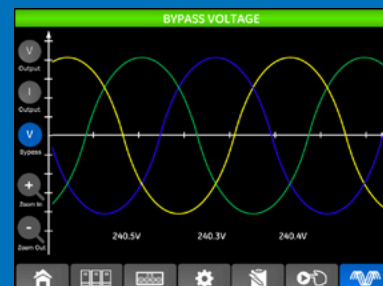
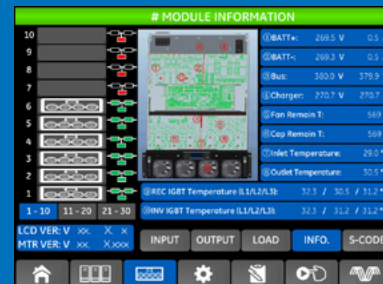
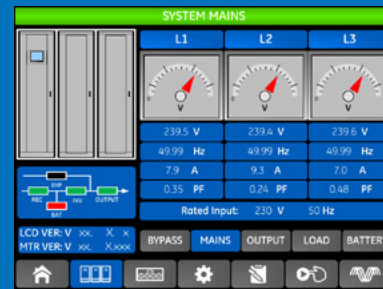
Integrated Relay Card (standard) for easy interface to Building Management Systems (BMS):

- 4 Programmable dry-contacts
- 2 Input dry-contacts for battery breakers interface
- Emergency Power Off (EPO) Contact

Integrated SNMP Card for Web Monitoring

This Plug-In Card allows the UPS to communicate over a LAN or interface through all major building management systems (BMS).

Integrates a modern web server for UPS monitoring Via LAN, drives remote server shutdown in case of critical UPS alarms and works as Modbus TCP Converter "as well as Modbus RTU 485".



Representative Pictures



TME Series Specifications

GENERAL DATA	TME SERIES 15 -90 KVA/KW (1 TO 6 MODULES)
Topology	VFI, double conversion
Nominal output power	15-90 kVA/kW
Overall efficiency in VFI mode	up to 93%
Overall efficiency in ECO mode	up to 98%
Audible noise level	65dB(A) full load (at 1 m)
UPS operating temperature range	32-104°F / 0-40°C
Protection degree	IP20 (IEC 60529)
Standards	UL 1778 5th edition
EMC (Electromagnetic Compatibility)	IEC/EN 62040-2, category C3 (FCC PART 15 Class A option)
Electrostatic discharge immunity	4kV contact / 8kV air discharge
Colour	RAL 9005 (Black)
External cable connections	Rear site: Top and bottom cable entry
Paralleling	Up to 3 units for redundancy or capacity in RPA configuration (option)

RECTIFIER	
Standard input voltage	3x 208/120V + Neutral + Ground
Rectifier accepted ph-ph voltage range	125*-261V (phase - phase, low voltages acceptable with de-rated loads)
Input frequency	40Hz ÷ 70 Hz
Power factor	>0.99
Input current THD	<4% at 100% linear load

*conditions apply

BATTERY	
Battery type	Valve regulated lead-acid (VRLA)-standard, Vented lead-acid and wet battery
Float voltage at 68°F / 20°C	2x 136Vdc
GE Battery Solutions	10 years design life VRLA batteries (EUROBAT)
Battery cold start	Available

INVERTER	
Nominal output voltage	3 x 208/120V
Output frequency	60 Hz
Output voltage THD for 100% linear load	<1.5%
Output voltage THD for 100% non-linear load	<6%
Overload capability (at 77°F / 25°C ambient temperature)	110% for 1 hour / 125% for 10 minutes / 150% for 1 minute / >150% for 200ms

TME Series Specifications (Cont.)

BYPASS		TME SERIES 15 -90 KVA/KW (1 TO 6 MODULES)
Overload on bypass		110% Long term operation / 111%-130% for 10 mins / 131-150% for 1 min. / >150% for 200ms
Primary components		Internal backfeed protection (circuit breaker) and maintenance bypass (circuit breaker)
INTERFACING		
SNMP Card with iUPS Guard 1 year license		Included
PHYSICAL DATA		
Weights		Cabinet - 617lbs./280kg, Power Module 15kW - 75lbs/34kg
Dimensions (WxDxH)		31.5 x 43.31 x 75 inches - 800x 1100x 1905mm



TME UPS - Battery Systems

Battery System Design

2.27VDC/Cell Float, 2.4VDC/Boost, 60 Cells (+ to N) and 60 Cells (- to N), 120 Cells total.

Battery System Design

UPS POWER RATING	BATTERY RUNTIME (BOL)	NO. OF BATTERIES	NO. OF CABINETS	CABINET WIDTH (IN)	LINEUP WIDTH (IN)	CABINET DEPTH (IN)	CABINET HEIGHT (IN)	CABINET WEIGHT (LBS)	LINEUP WIDTH (LBS)
15kva / 15kw	9	20	1	24	24	42	75	1050	1050
	13	20	1	24	24	42	75	1120	1120
	18	20	1	24	24	42	75	1120	1120
	31	20	1	24	24	42	75	1460	1460
	46	20	1	24	24	42	75	1800	1800
	59	20	1	24	24	42	75	2020	2020
	73	20	1	24	24	42	75	2200	2200
30kva / 30kw	5	20	1	24	24	42	75	1120	1120
	11	20	1	24	24	42	75	1460	1460
	17	20	1	24	24	42	75	1800	1800
	23	20	1	24	24	42	75	2020	2020
	29	20	1	24	24	42	75	2200	2200
	42	20	1	24	24	42	75	2720	2720
	46	40	2	24	48	42	75	1800	3600
	59	40	2	24	48	42	75	2020	4040
45kva / 45kw	7	20	1	24	24	42	75	1800	1800
	13	20	1	24	24	42	75	2020	2020
	16	20	1	24	24	42	75	2200	2200
	24	20	1	24	24	42	75	2720	2720
	26	20	2	24	48	42	75	1800	3600
	35	40	2	24	48	42	75	2020	4040
	43	40	2	24	48	42	75	2200	4400
	62	40	2	24	48	42	75	2720	5440
60kva / 60kw	7	20	1	24	24	42	75	2020	2020
	9	20	1	24	24	42	75	2200	2200
	15	20	1	24	24	42	75	2720	2720
	17	40	2	24	48	42	75	1800	3600
	23	40	2	24	48	42	75	2020	4040
	29	40	2	24	48	42	75	2200	4400
	42	40	2	24	48	42	75	2720	5440
	50	60	3	24	72	42	75	2200	6600
	73	60	3	24	72	42	75	2720	8160

TME UPS - Battery Systems (Cont.)

UPS POWER RATING	BATTERY RUNTIME (BOL)	NO. OF BATTERIES	NO. OF CABINETS	CABINET WIDTH (IN)	LINEUP WIDTH (IN)	CABINET DEPTH (IN)	CABINET HEIGHT (IN)	CABINET WEIGHT (LBS)	LINEUP WIDTH (LBS)
75kva / 75kw	5	20	1	24	24	42	75	2200	2200
	9	20	1	24	24	42	75	2720	2720
	12	40	2	24	48	42	75	1800	3600
	17	40	2	24	48	42	75	2020	4040
	21	40	2	24	48	42	75	2200	4400
	30	40	2	24	48	42	75	2720	5440
	38	60	3	24	72	42	75	2200	6600
	54	60	3	24	72	42	75	2720	8160
	78	80	4	24	96	42	75	2720	10880
90kva / 90kw	6	20	1	24	24	42	75	2720	2720
	7	40	2	24	48	42	75	2020	4040
	13	40	2	24	48	42	75	2020	4040
	16	40	2	24	48	42	75	2200	4400
	24	40	2	24	48	42	75	2720	5440
	29	60	3	24	72	42	75	2200	6600
	42	60	3	24	72	42	75	2720	8160
	62	80	4	24	96	42	75	2720	10880

TME UPS - Matching Accessories

Battery Cabinet
- Up to 4 cabinets



24"w

Input Transformer Cabinet (optional)
- 600V or 480V input
- K13, DOE2016 Xfmr
- 3CB MBP included



30"w

TME Modular Series UPS



31.5"w

Output Maint Bypass Cabinet (optional)
- 3CB or 2CB, 208V
- Mech or Elect Interlock



12"w

Output Distribution Cabinet (optional)
- 30 or 42 Ckt GE Panel
- Up to (6) 15-225A 3P GE Subfeed CBs



18"w

All matching accessory assemblies are 75"hi and 42"deep

Power Quality Service

Performance Through People

Whether you are a large corporation with multiple sites or a small business owner with a single location, GE will enable you to have a constant supply of clean and reliable power to keep your business up and running.

GE has local offices in a numb of countries around the globe and also a network of selected business partners, whose salespeople and service engineers combine expertise in our solutions with an in-depth knowledge of local market conditions.

GE's service & authorized service providers business partners, located in more than 100 countries around the world, use all that expertise and knowledge to adapt GE's products and services precisely to their customers' needs.

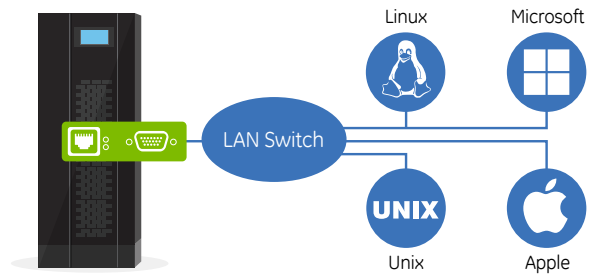
- On site & emergency services
- Service agreements
- Spare parts and repairs
- Support and remote services
- 24/7 online support

Software & Connectivity Solutions

Protection Software

GE Data Protection software can communicate with the UPS over RS-232, USB or SNMP to receive status information and measurement values of the UPS. In case of a critical condition (time on battery, remaining battery autonomy time or low battery) for the load, the software starts a controlled shutdown.

An enhanced alarm management system provides the possibility to start applications, send messages, and send e-mails for every upcoming or disappearing alarm.



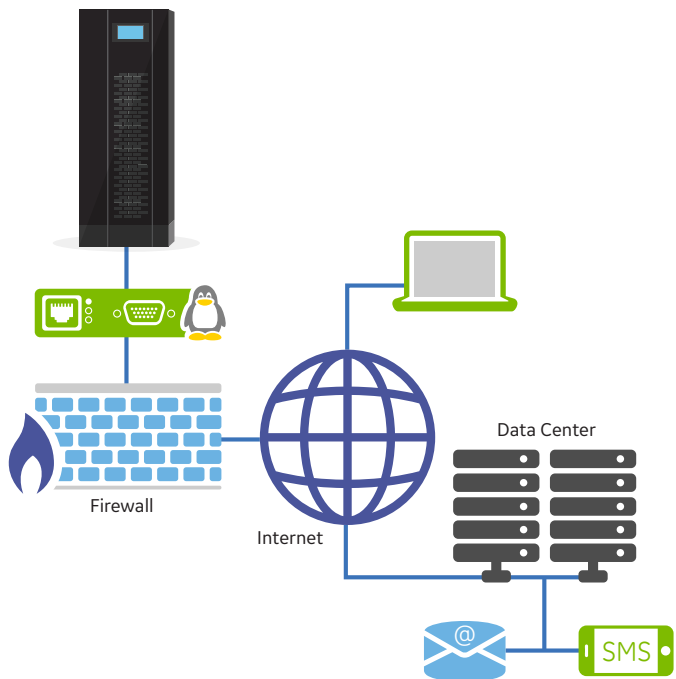
Representative Picture

Remote Monitoring and Diagnostic Solution (iUPSGuard)

GE remote monitoring solution is an anytime, anywhere concept in UPS status monitoring and alarm notification supporting all GE UPS product lines.

Accessing the latest site information via Web and being alerted by Email or SMS, it enables the user to make timely decisions in case of changing critical conditions. With comprehensive data collection and analysis it improves diagnostics capability and enhances response time.

- 24/7 remote access to your UPS data using standard web browser
- Automatic alerting in case of event direct and immediately to you cell phone or by email
- Regularly operational reports with proactive information on critical data
- Preventative information using PMAD (Preventative Maintenance & Advanced Diagnostics) feature
- Possibility to reduce intervention and onsite work





For more information and pricing contact:



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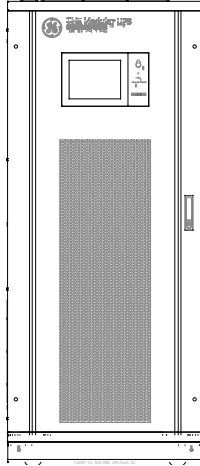
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Imagination at work



User Manual

Uninterruptible Power Supply

TME Modular Series 15 to 90

15 – 30 – 45 – 60 – 75 – 90 kVA/kW

208Vac – 120Vac UL / S1

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imagination at work



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The illustrations and plans describing the equipment are intended as general reference only and are not necessarily complete in every detail.

The content of this publication may be subject to modification without prior notice.

Dear Customer,

We thank you for selecting our products and are pleased to count you amongst our very valued customers at **GE**.

We trust that the use of the **TME Modular Series 15 to 90** Uninterruptible Power Supply System, developed and produced to the highest standards of quality, will give you complete satisfaction.

Please read carefully the *User Manual*, which contains all the necessary information and describes all you need to know about the installation and use of the UPS.

Thank you for choosing **GE** !



START-UP AND COMMISSIONING

A GE GLOBAL SERVICES FIELD ENGINEER must perform start-up and commissioning of the UPS.

Please contact GE GLOBAL SERVICES at least two weeks prior to schedule start-up and commissioning at 1-800-637-1738, or by E-mail at pgservice@ge.com.

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Preface

Congratulations on your choice of a *TME Modular Series 15 to 90* Uninterruptible Power Supply (UPS).

It will keep you away from any trouble due to unexpected power problems.

This manual describes how to prepare the installation site, provides weight and dimensions and procedures for moving, installing and connecting the UPS, and details of maintenance procedures suggested to preserve maximum reliability.

It explains the function of the UPS module, the purpose and location of the switches, the meaning of the system events related to the front panel indication, and provides procedures for starting and stopping the equipment.

While every care has been taken to ensure the completeness and accuracy of this manual, *GE* assumes no responsibility or liability for any losses or damages resulting from the use of the information contained in this document.

WARNING!

TME Modular Series 15 to 90 is a Category C3 UPS Product (according to IEC 62040-2).

This is a product for commercial and industrial application in the second environment – installation restrictions or additional measures may be needed to prevent disturbances.

We recommend that this manual is kept next to the UPS for future references.

If any problems are encountered with the procedures contained in this manual, please contact your *GE SERVICE CENTER* before you proceed.

This document shall not be copied or reproduced without the permission of *GE*.

Due to technical improvements, some of the information contained in this manual may be changed without notice.

SAFETY INSTRUCTIONS

Carefully read the safety instructions contained on the following page before the installation, start-up and maintenance of the UPS, options and battery.

Pay attention to the rectangular boxes included in the text:

They contain important information or warning concerning electrical connections and personnel safety.

Table of content

Page

1	SAFETY RULES	7
1.1	SAFETY SYMBOLS AND WARNINGS	9
2	LAYOUT	10
2.1	LAYOUT TME MODULAR SERIES 15 TO 90	10
3	INTRODUCTION	11
3.1	SYSTEM CONFIGURATION	11
3.2	POWER MODULE	11
3.3	OPERATION MODE	12
3.3.1	Normal mode	12
3.3.2	Battery mode	12
3.3.3	Bypass mode	12
3.3.4	Maintenance mode (manual bypass)	13
3.3.5	ECO mode	13
3.3.6	Auto-restart mode	13
3.3.7	Frequency converter mode	13
3.4	UPS STRUCTURE	13
3.4.1	UPS configuration	13
3.5	SERVICE AND TECHNICAL SUPPORT	14
3.6	WARRANTY	14
3.7	RECYCLING AT THE END OF SERVICE LIFE	15
4	INSTALLATION	16
4.1	TRANSPORT	16
4.1.1	Dimensions and weights TME Modular Series 15 to 90	17
4.2	DELIVERY	18
4.3	STORAGE	18
4.3.1	Storage of the UPS	18
4.3.2	Storage of the battery	18
4.4	PLACE OF INSTALLATION	19
4.4.1	UPS location	19
4.4.2	Battery location	20
4.4.3	Ventilation and cooling	20
4.5	UNLOADING AND UNPACKING	21
4.5.1	Moving and unpacking of the UPS cabinet	21
4.5.2	Unpacking power module	23
4.6	INSTALLATION OF THE TME MODULAR SERIES 15 TO 90	24
4.6.1	Positioning of the TME Modular Series 15 to 90	24
4.6.2	Installation of the power modules	25
4.6.3	Replacement of the power module	26
4.7	BATTERY INSTALLATION	27
4.8	CABLE ENTRY	27
4.9	POWER CABLES	28
4.9.1	Utility input connection	28
4.9.2	Line protections	30
4.9.3	Specifications for power cables terminal	30
4.9.4	Specifications for power cables size	30
4.9.5	Connection of the power cables	32
4.10	CONTROL AND COMMUNICATION CABLES	34
4.10.1	Dry contact interface	35
4.10.1.1	Interface of battery and environmental temperature detection	36
4.10.1.2	Remote EPO (Emergency Power Off) input port	36
4.10.1.3	UPS internal function	36
4.10.1.4	BCB input port	37
4.10.1.5	Battery warning output dry contact interface	37
4.10.1.6	General alarm output dry contact interface	37
4.10.1.7	UPS internal function	37
4.10.2	Communication interface	38
4.10.2.1	SNMP card	38
4.11	INSTALLATION OF THE PARALLEL SYSTEM	39

5	UPS AND POWER MODULE CONTROL PANEL	40
5.1	LCD PANEL OF THE POWER MODULE	40
5.1.1	LED indicator.....	40
5.1.2	Control and operation keys.....	41
5.1.3	LCD Display.....	41
5.2	UPS CONTROL PANEL.....	43
5.2.1	LED indicator.....	44
5.2.2	Control and operation keys.....	44
5.2.3	LCD touch screen.....	45
5.3	MAIN MENU	47
5.3.1	Cabinet	47
5.3.2	Module	49
5.3.3	Setting.....	51
5.3.4	Log.....	52
5.3.5	Operate	53
5.3.6	Scope.....	55
6	OPERATIONS	56
6.1	UPS START-UP	56
6.1.1	Start in Normal mode	56
6.1.2	Start from battery.....	57
6.2	PROCEDURE FOR SWITCHING BETWEEN OPERATION MODES	58
6.2.1	Switching the UPS from Normal mode into Battery mode	58
6.2.2	Switching the UPS from Normal mode into Bypass mode.....	58
6.2.3	Switching the UPS into Normal mode from Bypass mode	58
6.2.4	Switching the UPS from Normal mode into Maintenance Bypass mode.....	59
6.2.5	Switching the UPS into Normal Mode from Maintenance Bypass Mode	59
6.3	BATTERY MANUAL	60
6.4	EPO – EMERGENCY POWER OFF	61
7	MAINTENANCE.....	62
7.1	GENERAL MAINTENANCE.....	62
7.2	SERVICE CHECK	62
7.3	BATTERY MAINTENANCE	63
8	OPTION	64
8.1	OPTIONS GENERAL VIEW	64
8.2	OPTIONS ASSEMBLY AND CONNECTION	65
8.2.1	BC44 Battery cabinet.....	65
9	SECURE DEPLOYMENT GUIDE	67
9.1	INTRODUCTION.....	67
9.2	GENERAL RECOMMENDATIONS	67
9.3	CHECKLIST.....	68
9.4	COMMUNICATION REQUIREMENTS.....	68
9.5	SECURITY CAPABILITIES.....	69
9.5.1	Physical security perimeter protection	69
9.5.2	Electronic security perimeter protection.....	69
9.5.3	Password management.....	69
9.6	CONFIGURATION HARDENING.....	70
9.7	NETWORK BANDWIDTH LIMITING	70
9.8	SOFTWARE UPDATES AND PATCH MANAGEMENT	70
9.9	GOVERNMENT AGENCIES AND STANDARDS ORGANIZATIONS.....	70
10	NOTES	71
10.1	NOTES FORM.....	71

1 SAFETY RULES

Save these instructions!

GENERAL

- Move the UPS in an upright position in its original package to the final destination room.
To lift the cabinets, use a forklift or lifting belts with spreader bars.
- Check for sufficient floor and elevator loading capacity.
- Check the integrity of the UPS equipment carefully.
If you notice visible damage, do not install or start the UPS.
Contact the nearest GE SERVICE CENTER immediately.
- **WARNING! RISK OF ELECTRICAL SHOCK:**
Do not remove covers, there are no user serviceable parts inside.
- After switching OFF takes 5 minutes for the DC capacitors to discharge because a lethally high voltage remains at the terminals of the electrolytic capacitors.
- UPS and battery system require a 12 months' periodic maintenance to operate reliably and safely.
This should be performed by qualified service personnel.
- The field-wiring outlets may be electrically live, even when the UPS is disconnected from the utility.
- Dangerous voltages may be present during battery operation.
- The battery must be disconnected during maintenance or service work.
- This UPS contains potentially hazardous voltages.
- Be aware that the inverter can restart automatically after the utility voltage is restored.
- End user must follow applicable regional occupational safety codes/regulations during installation, operation and equipment maintenance. This may require additional field marking or labelling defining appropriate level of PPE (Personal Protection Equipment) to reduce the risk of Arc-flash related injuries.
Contact our Technical Support for product specific information.

INSTALLATION

- This UPS must be installed and connected only by trained personnel.
- Verify accurately during Commissioning and Maintenance of the UPS, for the following:
Damaged components, squeezed wires and cables, or not correctly inserted plugs.
- After removing the sidewalls of the UPS, make sure that all earth connections when reassembling, are correctly reattached.
- This UPS is intended for use in a controlled indoor environment free of conductive contaminants and protected against animals' intrusion.
- **WARNING! HIGH EARTH LEAKAGE CURRENT:**
Earth connection is essential before connecting to AC input!
- Switching OFF the unit does not isolate the UPS from the utility.
- Do not install the UPS in an excessively humid environment or near water.
- Avoid spilling liquids on or dropping any foreign object into the UPS.
- The unit must be placed in a sufficiently ventilated area; the ambient temperature should not exceed 104°F (40°C).
- Optimal battery life is obtained if the ambient temperature does not exceed 77°F (25°C).
- It is important that air can move freely around and through the unit. Do not block the air vents.
- Avoid locations in direct sunlight or near heat sources.

STORAGE

- Store the UPS in a dry location; storage temperature must be within -13°F (-25°C) to 131°F (+55°C).
- The optimal temperature for Battery storage is 68°F (20°C) to 77°F (25°C) and shall never exceed the range -4°F (-20°C) to 104°F (40°C).
- If the unit is stored for a period exceeding 3 months, the battery must be recharged periodically (time depending on storage temperature).

BATTERY

- The battery-voltage is dangerous for person's safety.
- When replacing the battery, use the same number, voltage (V) and capacity (Ah).
- Proper disposal or recycling of the battery is required.
Refer to your local codes for disposal requirements.
- Never dispose of battery in a fire: they may explode.
- Do not open or mutilate battery: their contents (electrolyte) may be extremely toxic.
If exposed to electrolyte, wash immediately with plenty of water.
- Avoid charging in a sealed container.
- Never short-circuit the batteries.
When working with batteries, remove watches, rings or other metal objects, and only use insulated tools.

Safety instructions when working with battery



**EXTERNAL BATTERY MUST BE INSTALLED AND CONNECTED TO THE UPS BY QUALIFIED SERVICE PERSONNEL.
INSTALLATION PERSONNEL MUST READ THIS ENTIRE SECTION BEFORE HANDLING THE UPS AND BATTERY.**

DANGER!

Full voltage and current are always present at the battery terminals.

The battery used in this system can provide dangerous voltages, extremely high currents and a risk of electric shock.

If the terminals are shorted together or to ground, they may cause severe injury.

You must be extremely careful to avoid electric shock and burns caused by contacting battery terminals or shorting terminals during battery installation.

Do not touch uninsulated battery terminals.

A qualified service person, who is familiar with battery systems and required precautions, must install and service the battery.

The installation must conform to national and local codes.

Keep unauthorized personnel away from the battery.

The qualified service person must take these precautions:

- 1 Wear protective clothing, such as rubber gloves and boots and protective eye wear.
Batteries contain caustic acids and toxic materials and can rupture or leak if mistreated.
Remove rings and metal wristwatches or other metal objects and jewelry.
Do not carry metal objects in your pockets where the objects can fall into the battery cabinet. High energy through conductive materials could cause severe burns.
- 2 Tools must have insulated handles and must be insulated so that they will not short battery terminals.
Do not allow a tool to short between individual or separate battery terminals or to the cabinet or rack.
Do not lay tools or metal parts on top of the battery, and do not lay them where they could fall onto the battery or into the cabinet.
- 3 Disconnect charging source prior to connecting or disconnecting battery terminals.
Install the battery as shown on the drawing provided with the battery.
When connecting cables, never allow a cable to short across a battery's terminals, the string of battery, or to the cabinet or rack.
- 4 Align the cables on the battery terminals so that the cable lug will not contact any part of the cabinet or rack, even if the battery is moved.
Keep the cable away from any sharp metal edges.
- 5 Install the battery cables in such a way that the UPS or battery cabinet doors cannot pinch them.
- 6 Do not connect the battery terminal to Ground.
If any battery terminal is inadvertently grounded, remove the source of the ground.
Contacting any part of a grounded battery can cause a risk of electric shock.
- 7 Determine if battery is inadvertently grounded. If inadvertently grounded, remove source from ground.
Contact with any part of a grounded battery can result in electrical shock.
The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance.
- 8 To reduce the risk of fire or electric shock, install the battery in a temperature and humidity controlled indoor area, free of contaminants.
- 9 Battery system chassis ground (earth) must be connected to the UPS chassis ground (earth).
If you use conduits, this ground conductor must be routed in the same conduit as the battery conductors.
- 10 Where conductors may be exposed to physical damage, protect the conductors in accordance with all applicable codes.
- 11 If you are replacing the battery or repairing battery connections, shut OFF the UPS and remove the battery fuses.



1.1 SAFETY SYMBOLS AND WARNINGS

Safety warnings

The text of this manual contains some warnings to avoid risk to the persons and to avoid damages to the UPS system and the supplied *critical Loads*.

The non-observance of the warnings reminding hazardous situations could result in human injury and equipment damages.








Please pay attention to the meaning of the following warnings and symbols:

	WARNING ! Referred to procedures or operations which could cause damages to the persons or to the system, when not correctly operated.
	NOTE ! Warns the user about important operations or procedures described in this manual.

Safety symbols

When the text includes one or more of the following symbols, that means exist a potentially hazardous situation.

Please remind the meaning of each symbol.

	CAUTION Related to all the potentially hazardous situations which may result in injury.
	DANGER OF PARTS ELECTRICALLY LIVE Related to all the situation with potentially hazardous voltage.
	DANGER OF EXPLOSION Used to indicate conditions where exploding parts can cause serious injury.
	DANGER OF CRUSHING Used when moving the equipment due to the heavy weight.
	DANGER OF OVERHUNG LOAD Used when the equipment is lifted by a crane.
	DANGER OF HOT SURFACE Used to indicate conditions of elevated temperature on some parts.
	DO NOT TOUCH Risk of parts with hazardous voltages or parts in movement.

2 LAYOUT

2.1 LAYOUT TME MODULAR SERIES 15 TO 90

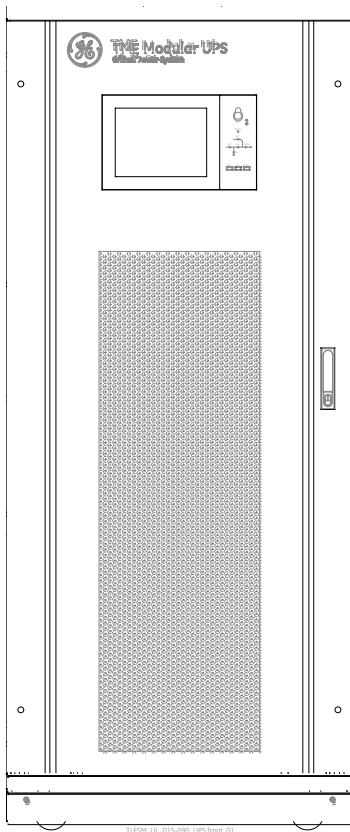


Fig. 2.1-1 TME Modular Series 15 to 90 - Front view

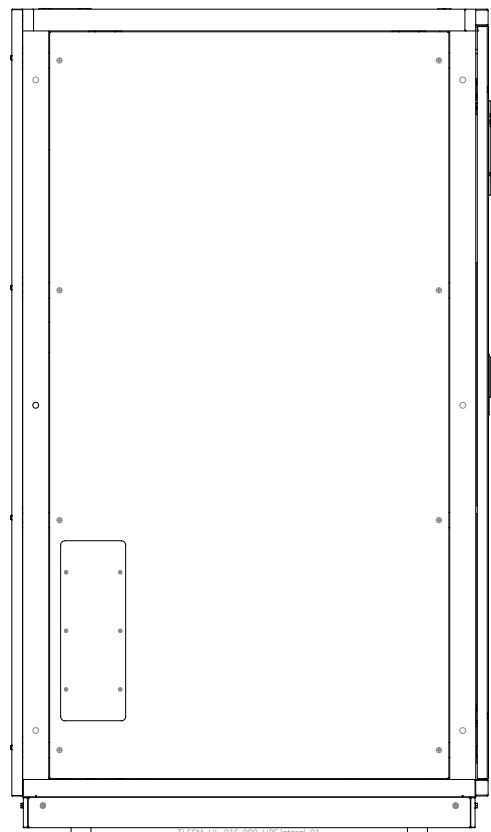


Fig. 2.1-2 TME Modular Series 15 to 90 - Lateral view (left side)

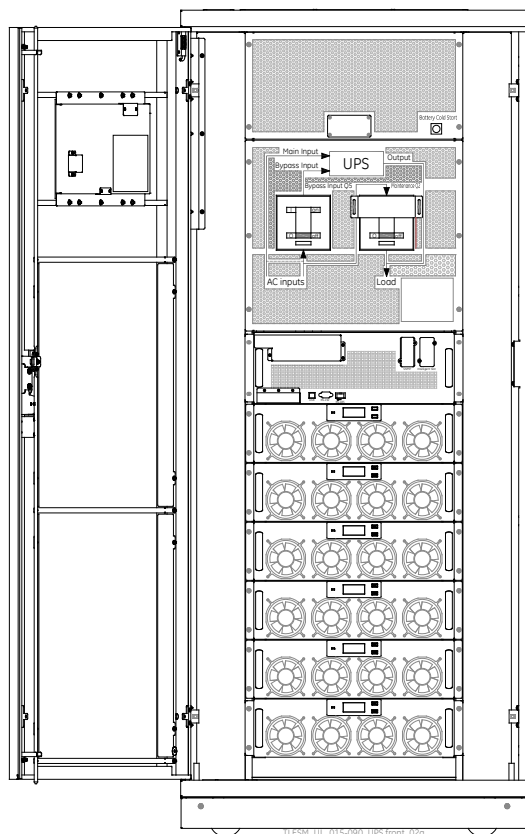


Fig. 2.1-3 TME Modular Series 15 to 90 - Front view with open door

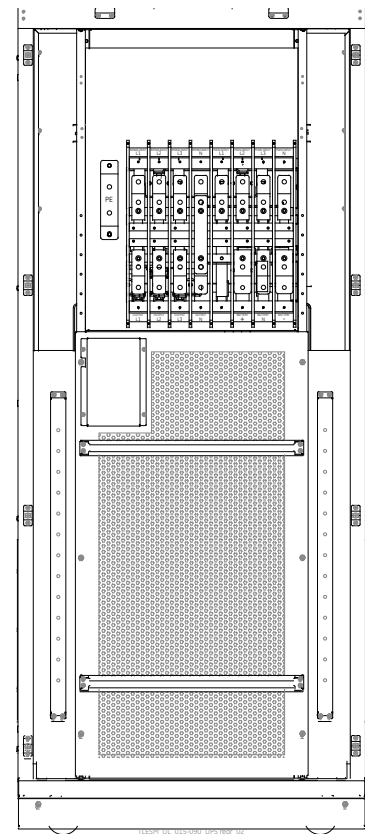


Fig. 2.1-4 TME Modular Series 15 to 90 - Rear view without protection

3 INTRODUCTION

TME Modular Series 15 to 90 Uninterruptible Power Supply (UPS) provides the energy supply for critical loads which need a reliable, continuous free from voltage disturbances and frequency fluctuations supply.

In case the power provided by the *Utility Fails*, or exceeds the permitted tolerances, the power supplying the *Load* is provided by the *Battery* for the specified time at the rated *Load* (or longer at a reduced *Load*).

3.1 SYSTEM CONFIGURATION

The Modular UPS is configured by the following parts: up to 6 Power modules, Bypass & Monitoring module and cabinet with Maintenance Bypass switch.

One or several battery strings should be installed to provide backup energy in case of the utility failure. The UPS structure is shown in Fig. 3.1-1.

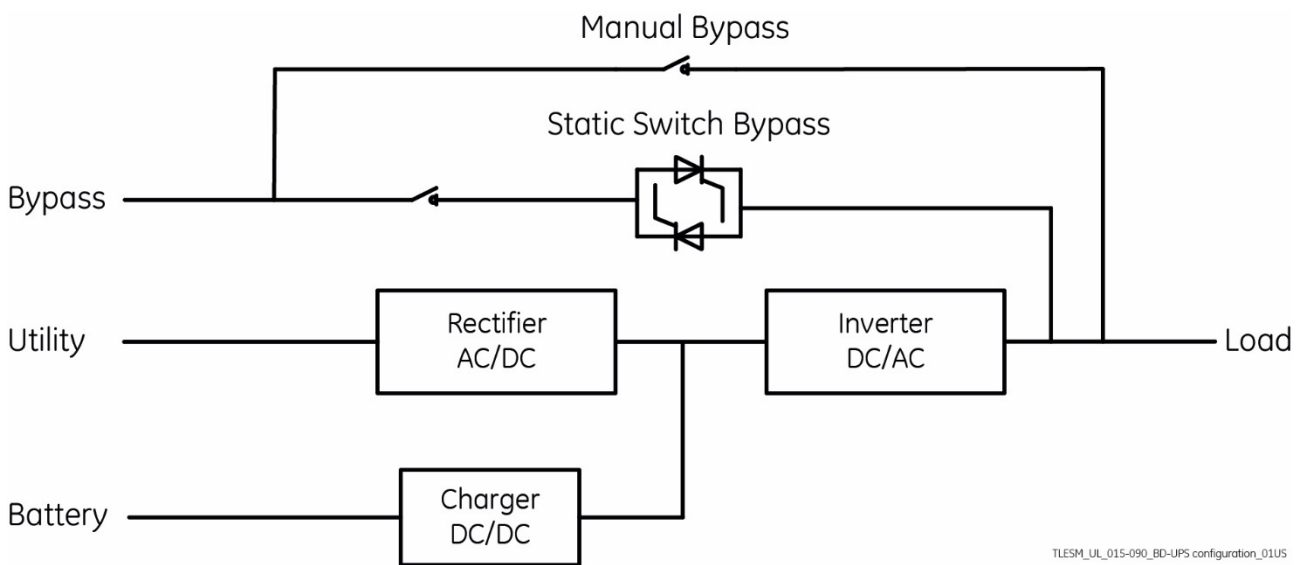


Fig. 3.1-1 UPS Configuration

3.2 POWER MODULE

The power module structure is shown as Fig. 3.2-1.

The power module contains a rectifier, an inverter and a DC/DC converter for charge and discharge of the external batteries.

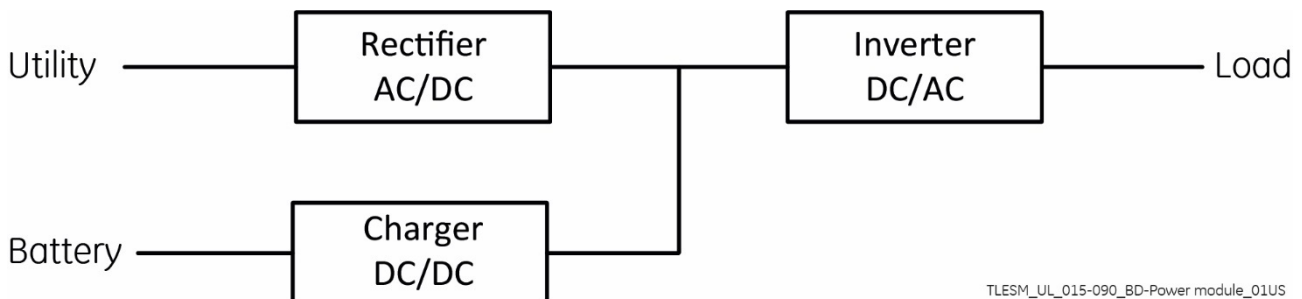


Fig. 3.2-1 Power module structure

3.3 OPERATION MODE

The Modular UPS is an on-line double-conversion UPS that permits operation in the following modes:

- Normal mode
- Battery mode
- Bypass mode
- Maintenance mode (manual bypass)
- ECO mode
- Auto-restart mode
- Frequency converter mode

3.3.1 Normal mode

The inverter of power modules continuously supply the critical AC load.

The rectifier/charger derives power from the AC input utility and supplies DC power to the inverter and the charger.

The charger will FLOAT or BOOST charge the battery.

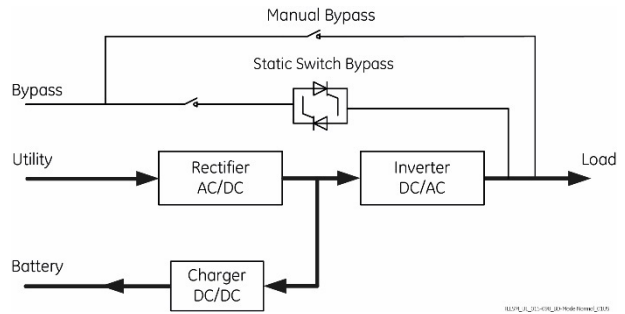


Fig. 3.3.1-1 Normal mode operation diagram

3.3.2 Battery mode

Upon failure of the AC input utility, the inverter will continue to supply the critical AC load. The rectifier will now be powered from the battery and operate as a DC/DC converter.

There is no interruption in power to the critical load upon failure.

After the restore of the AC input utility, the "Normal mode" operation will continue automatically without the necessity of user intervention.

NOTE! With the function of Battery Cold Start, the UPS may start without utility.
See more detail in Section 6.1.2.

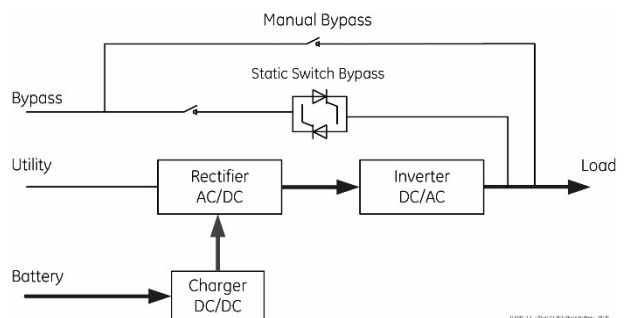


Fig. 3.3.2-1 Battery mode operation diagram

3.3.3 Bypass mode

If the inverter overload capacity is exceeded under Normal mode, or if the inverter becomes unavailable for any reason, the static switch will perform a transfer of the load from the inverter to the bypass line, with no interruption in power to the critical AC load.

Should the inverter be asynchronous with the bypass, the static switch will transfer the load from inverter to bypass in less than half a cycle.

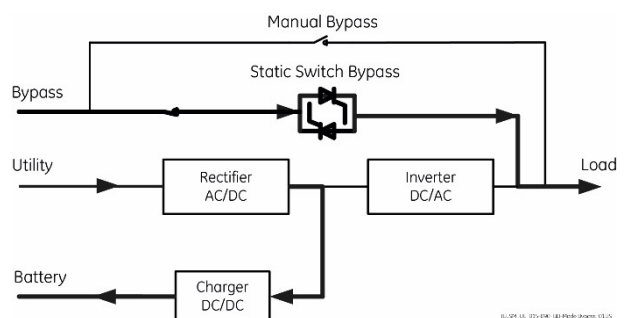


Fig. 3.3.3-1 Bypass mode operation diagram

3.3.4 Maintenance mode (manual bypass)

A maintenance bypass switch is available to ensure continuity for the critical load when the UPS becomes unavailable e.g. during a maintenance procedure.

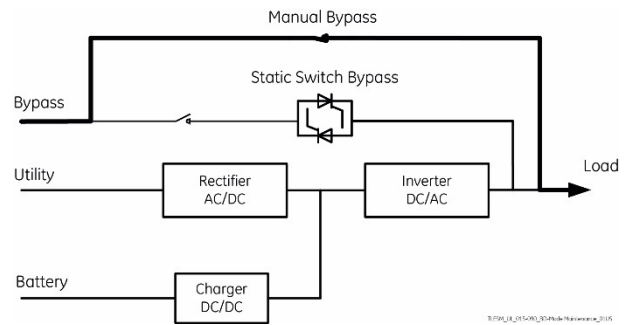


Fig. 3.3.4-1 Maintenance mode operation diagram



DANGER !

During Maintenance mode, dangerous voltages are present on the bus bars of input, output and neutral, even with all the modules and the LCD turned Off.

3.3.5 ECO mode

To improve system efficiency, UPS works in Bypass mode normally and inverter is on standby. When utility fails, UPS transfers to Battery mode and the inverter feeds the load.

NOTE! There is a short interruption time (less than 10ms) when transfers from ECO mode to Battery mode, it must be sure that the interruption has no effect on load.

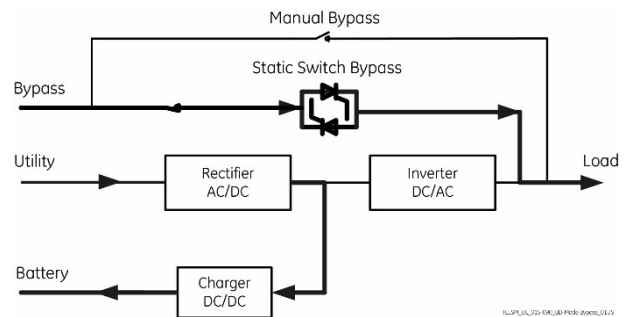


Fig. 3.3.5-1 ECO mode operation diagram

3.3.6 Auto-restart mode

The battery may become exhausted following an extended AC utility failure. The inverter shuts down when the battery reaches the End of Discharge Voltage (EOD). The UPS may be programmed to "System Auto Start Mode after EOD". The system restarts after a delay time when the AC utility returns. The mode and the delay time are programmed by the commissioning engineer.

3.3.7 Frequency converter mode

By setting the UPS in Frequency Converter mode, the UPS can provide a stable output of fixed frequency (50 or 60Hz) and the bypass static switch is not available.

3.4 UPS STRUCTURE

3.4.1 UPS configuration

The UPS configuration is provided in *Table 3.4.1-1*.

Item	Components	Quantity	Remark
TME Modular Series	Maintenance Bypass	1	Required, factory installed.
	Bypass & Monitoring module	1	Required, factory installed.
Power module 15 kVA/kW	Power module	1-6	Required, installed on site.

Table 3.4.1-1 UPS Configuration

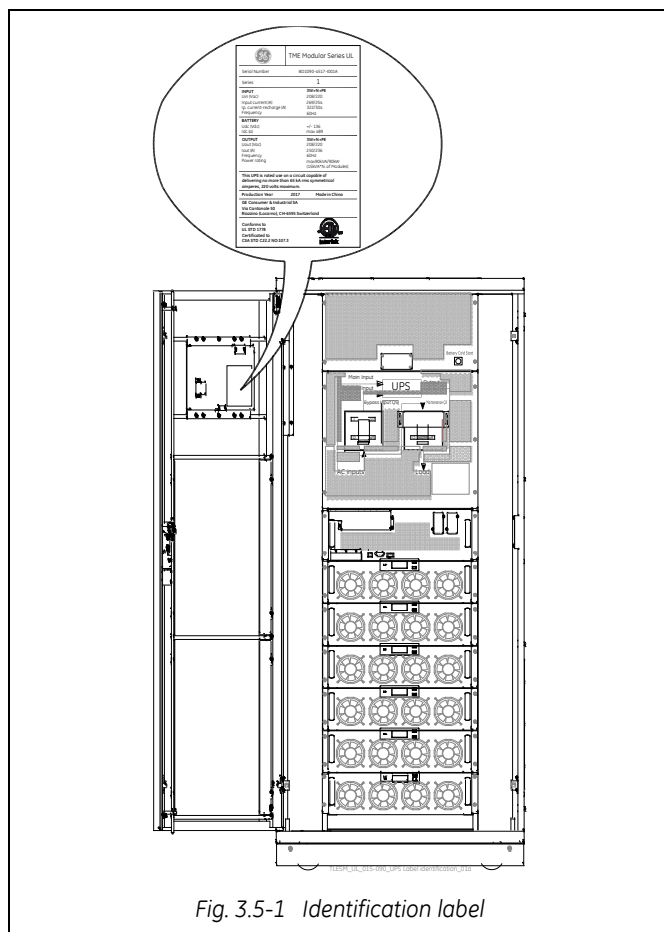
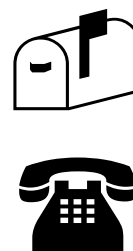
Stamp of your local *GE SERVICE CENTER* (see page 3)

Fig. 3.5-1 Identification label

The requested data permitting to identify your UPS are marked on the **identification label** fixed on the front of the cabinet, behind the front door.

For fast and efficient technical support please mention the data marked on the identification label

3.6 WARRANTY

GE, operating through its authorised agents, warrants that the standard products will be free of defects in materials and workmanship for a period as per contract specifications.



NOTE !

This warranty does not cover failures of the product which result from incorrect installation, misuse, alterations by persons other than authorized agents, or abnormal working conditions.

3.7 RECYCLING AT THE END OF SERVICE LIFE

**NOTE !**

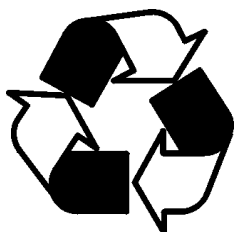
This product has been designed to respect the environment, using materials and components respecting eco-design rules.

It does not contain CFCs (Carbon Fluor Clorid) or HCFCs (Halogen Carbon Fluor Clorid).

**PACKING MATERIAL RECYCLING**

GE, in compliance with environment protection, uses only environmentally friendly material.

UPS packing materials must be recycled in compliance with all applicable regulations.

**RECYCLING AT THE END OF SERVICE LIFE !**

GE, in compliance with environment protection recommends to the *User* that the UPS equipment, at the end of its service life, must be recovered conforming to the local applicable regulations.

**WARNING !**

Leads contained in the batteries is a dangerous substance for the environment, therefore it must be correctly recycled by specialized companies!

4 INSTALLATION

4.1 TRANSPORT

The UPS is packaged on a pallet suitable for handling with a forklift.

The UPS must be moved in **upright position**.

Do not tilt cabinets **more than $\pm 10^\circ$** during handling.

Move the UPS in its original package to the final destination site.

Do not stack other packages on top: this could damage the UPS.

Forklift

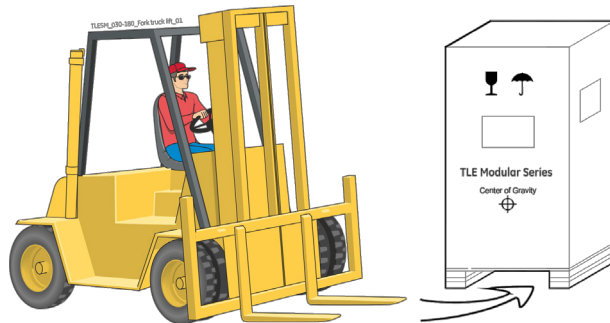


Fig. 4.1-1 Position of the forklift when moving the unpacked UPS

Crane

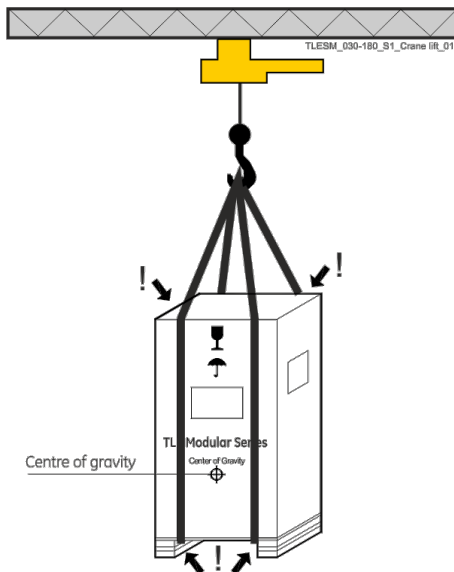


Fig. 4.1-2 Position of the carrying belts when moving the unpacked UPS

Forklift

The UPS may be lifted with a forklift in upright position.

Take note of the **center of gravity** marked on the package.



WARNING !

Check for sufficient floor and elevator loading capacity.

Transport UPS only in upright position.

Do not stack other package on top of the UPS.

Crane

If the UPS has to be lifted by crane, use suitable carrying belts taking note of the **center of gravity** marked on the package.

Take all necessary precautions to avoid damage to the cabinet while hoisting the UPS.



WARNING !

When loading / unloading and when moving the UPS, it is forbidden:

When loading / unloading and when moving the UPS, pay attention to:



4.1.1 Dimensions and weights TME Modular Series 15 to 90

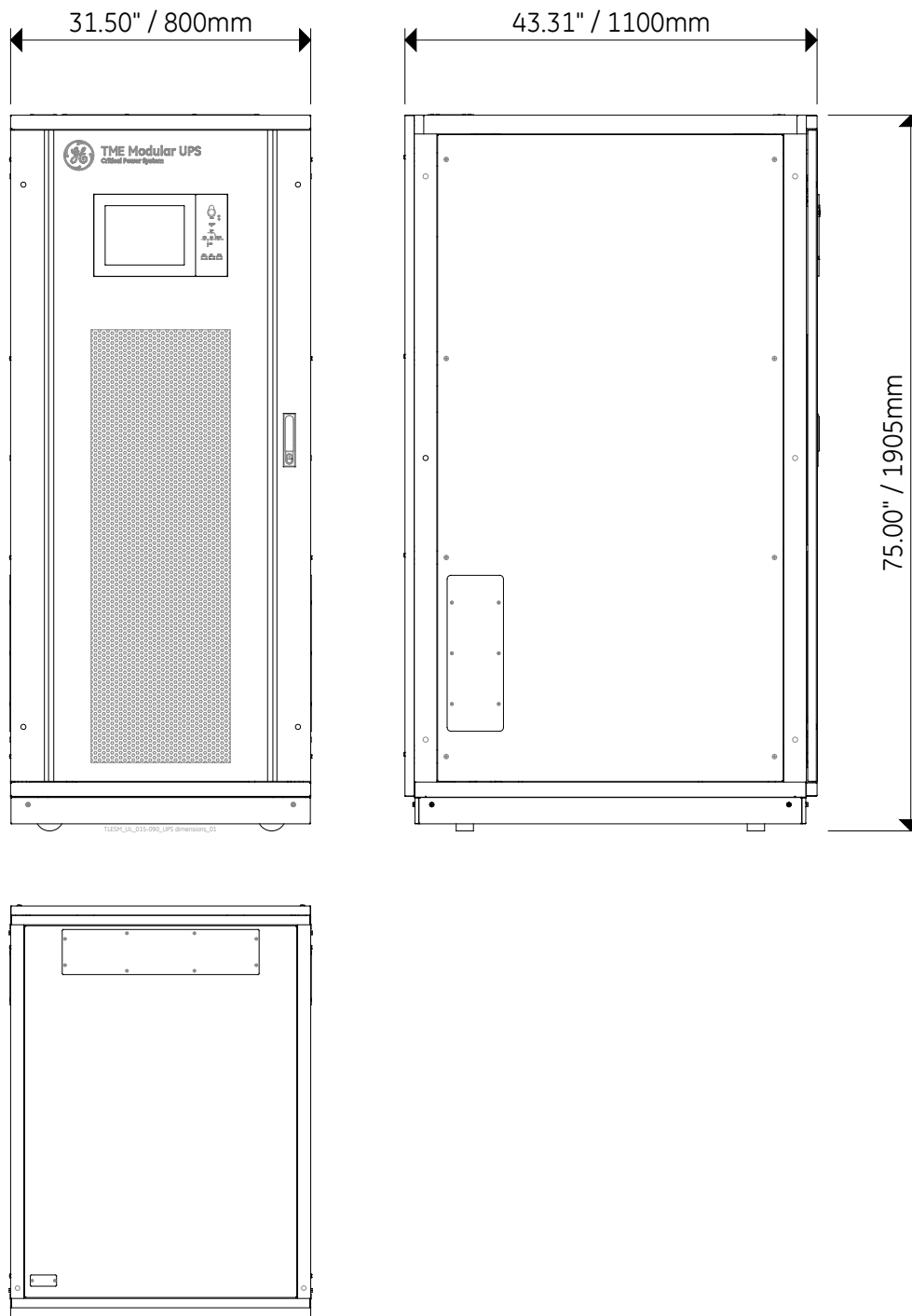


Fig. 4.1.1-1 UPS dimensions

Dimensions and weights TME Modular Series 15 to 90		
TME Modular Series (only cabinet)	Dimensions (W x D x H)	31.50x43.31x75" / 800x1100x1905mm
	Weight	617 lbs/ 280 kg
Power module 15 kVA/kW	Dimensions (W x D x H)	18.11x31.10x5.28" / 460x790x134mm
	Weight	75 lbs / 34 kg
TME Modular Series 90 kVA/kW (cabinet + 6 power modules)	Dimensions (W x D x H)	31.50x43.31x75" / 800x1100x1905mm
	Weight	1067 lbs / 484 kg
	Floor loading	113 lbs-sq.ft / 550 kg/m ²

4.2 DELIVERY

When delivered, inspect the **package integrity** and **the physical condition of the cabinet** carefully.

In case of any damage sustained during transport, immediately inform the carrier and contact your local **GE SERVICE CENTER**.

A **detailed report** of the damage is necessary for any insurance claim.

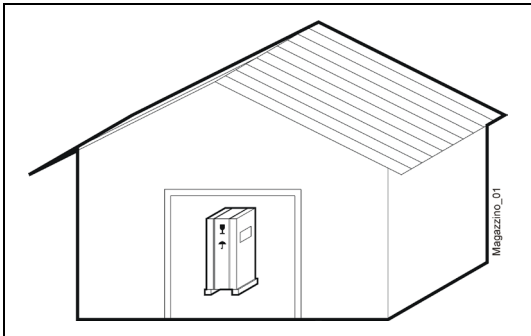


NOTE !

A damaged UPS MUST NEVER be installed or connected to *Utility* or *Battery*!

4.3 STORAGE

4.3.1 Storage of the UPS



The equipment is carefully packed for transport and storage so that it is in a perfect condition when eventually installed.

Never leave an UPS outside the building and do not store the UPS one on top of the other.

We recommend to store the UPS in its original package in a dry, dust-free room, away from chemical substances, and with a temperature range not exceeding **-13°F** (-25°C) to **131°F** (55°C).

4.3.2 Storage of the battery

When the delivery includes a maintenance free *Battery*, keep in mind that they are subject to self-discharge and therefore you must recharge the *Battery*.

The storage time without *Battery* recharge depends on the temperature of the storage site.

The optimal temperature for *Battery* storage is **68°F** (20°C) to **77°F** (25°C) and shall never exceed the range **-4°F** (-20°C) to **104°F** (40°C).

Recharge stored maintenance free *Battery* every:

6 months when the storage temperature is 68°F (20°C)

3 months when the storage temperature is 86°F (30°C)

2 months when the storage temperature is 95°F (35°C)

4.4 PLACE OF INSTALLATION

4.4.1 UPS location



NOTE !

UPS installation and connection must be performed by GE SERVICE TECHNICIAN only.

If optional cabinets and accessories are included with the UPS, please refer to those accompanying manuals for installation and operating instructions.

Refer to the "SAFETY RULES" described on *Chapter 1*.

It is important to have a clean, dust-free environment provided with proper ventilation and air-conditioning to keep the ambient temperature within the specified operating range.

The recommended air inlet temperature is from **68°F** (20°C) to **77°F** (25°C) (max. 104°F / 40°C).

Check for sufficient **floor load capacity** before installing the UPS and the *Battery*.

Refer to *Section 4.1.1*.

For *Battery* installation follow the local codes and the recommendation of the battery supplier.



NOTE !

Operation at temperatures higher than 77°F (25°C) will reduce battery life.

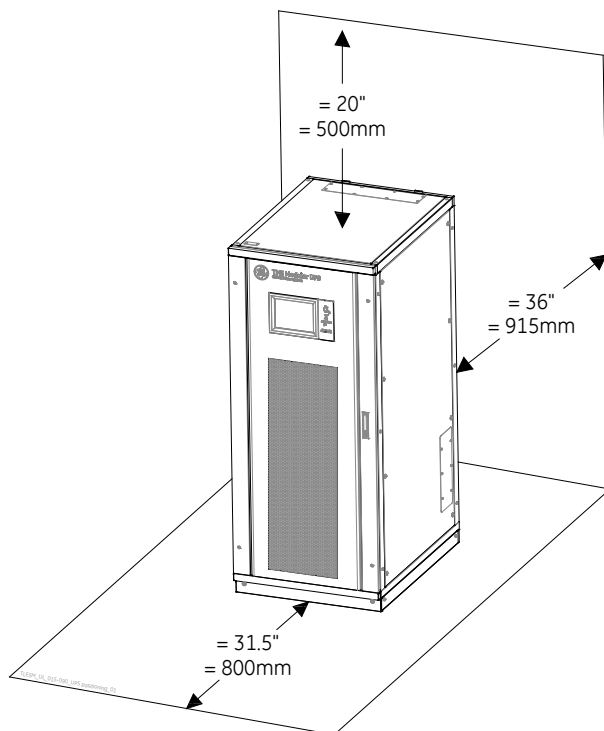
Potential consequences are explained in *Section 7.3*: read and understand them.

The *TME Modular Series 15 to 90* UPS can radiate radio frequency energy.

Although some *RFI* (Radio Frequency Interference) filtering is inherent to the UPS there is no guarantee that the UPS will not influence sensitive devices such as cameras and monitors that are positioned close by.

If interference is expected, the UPS should be moved away from the sensitive equipment.

Positioning of the UPS TME Modular Series 15 to 90



ATTENTION

Ensure the following space margin:
at least **31.5"** (800mm) in front of the cabinet, will facilitate the maintenance of the power module with the front door fully open; at least **36"** (915mm) behind the cabinet for ventilation and cooling.

The space reserved for the cabinet is shown in *Fig. 4.4.1-1*.

A single-phase power outlet (120Vac) should be provided near the UPS for connection of power tools, test equipment or connectivity devices.

This outlet must be grounded.

Fig. 4.4.1-1 Positioning of the UPS TME Modular Series

4.4.2 Battery location

Batteries require a well-ventilated room with controlled temperature to obtain reliable operation.

The *Battery System* associated with larger UPS is usually either rack mounted or installed in multiple *Battery Cabinets*.

The *Battery* can be installed immediately adjacent to the UPS (left or right side) or remotely from the UPS. If the *Battery* is installed remotely from the UPS, a wall mounted DC disconnect device must be installed within line-of-site to both the UPS and the *Battery*.

The optimal room temperature for the *Battery* is **68°F** (20°C) to **77°F** (25°C) and shall never exceed the range **-4°F** (-20°C) to **104°F** (40°C).

The life of valve-regulated batteries will be reduced by 50% for each additional **18°F** (10°C) in case the *Battery* ambient temperature is above **77°F** (25°C).

Installation and assembly must be made according to the local standards and *Battery System* manufacturer's recommendations.

The additional *Battery Circuit Breaker* or *Battery Fuse Box* must be mounted as near as possible to the *Battery*.



WARNING !

Battery installation and connection must be performed by QUALIFIED PERSONNEL only. Read all safety instructions before proceeding with the installation (see Section 1). Battery discharging and/or charging activities may cause the emission of hydrogen gas; therefore, the room requires proper ventilation and fresh air. Comply with the EN50272-2 standard.

4.4.3 Ventilation and cooling

The heat produced by the UPS is transferred to the environment by its ventilation.

A suitable ventilation or cooling system must be installed to extract the heat from the UPS room.

Air filtering systems could be required when the UPS operates in a dirty environment.

In order to prevent overheating of the UPS, the available air intake flow rate must exceed the total air exhaust flow rate requirement of the UPS system.

Contact your **Dealer** or the nearest **GE SERVICE CENTER** for appropriate solutions.

The below table indicates the heat dissipation at full *Load* at **PF = 1.0** and charged *Battery*, up to **1000 m** (3280 ft) altitude, for cooling air **77°F** (25°C) to **86°F** (30°C).

UPS model	Losses		Cooling air flow	
	<i>Normal Mode</i>	<i>ECO Mode</i>	<i>Normal Mode</i>	<i>ECO Mode</i>
<i>TME Modular Series 15</i>	3853 BTU/hr – 1.129 kW	0.306 kW	194 CFM - 329 m³/h	53 CFM - 89 m³/h
<i>TME Modular Series 30</i>	7707 BTU/hr – 2.258 kW	0.612 kW	389 CFM - 659 m³/h	105 CFM - 179m³/h
<i>TME Modular Series 45</i>	11560 BTU/hr – 3.387 kW	0.918 kW	583 CFM - 988 m³/h	158 CFM - 268m³/h
<i>TME Modular Series 60</i>	15413 BTU/hr – 4.516 kW	1.224 kW	777 CFM - 1317 m³/h	211 CFM - 357 m³/h
<i>TME Modular Series 75</i>	19267 BTU/hr – 5.645 kW	1.531 kW	972 CFM - 1647 m³/h	264 CFM - 446 m³/h
<i>TME Modular Series 90</i>	23120 BTU/hr – 6.774 kW	1.837 kW	1166 CFM - 1976 m³/h	316 CFM - 536 m³/h



NOTE !

The ventilation and cooling system must be rated as for operation in *Normal Mode*.

4.5 UNLOADING AND UNPACKING



NOTE !

Be aware of the heavy weight of the UPS, pay attention when moving the UPS cabinet.

Take care not to damage the UPS when moving by forklift.



PACKING MATERIAL RECYCLING

GE, in compliance with environment protection, uses only environmentally friendly material.

UPS packing materials must be recycled in compliance with all applicable regulations.

4.5.1 Moving and unpacking of the UPS cabinet

Move the equipment in it's original packing, wooden case, until the place of installation and remove the packing only just before installing the UPS.

The steps to move and unpack the UPS cabinet are as follows:

1. Check if any damages to the packing (if any, contact the local *GE Service Center*).
2. Transport the equipment to the designated site by forklift, as shown in *Fig. 4.5.1-1*.
3. Make sure to have sufficient space around the UPS before you start unpacking.

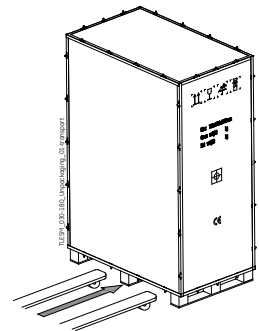


Fig. 4.5.1-1 Transport to the designated site

4. Open the top plate of the steel-edged wooden case with slotted awl and plier, followed by side boards "A" (see *Fig. 4.5.1-2*).

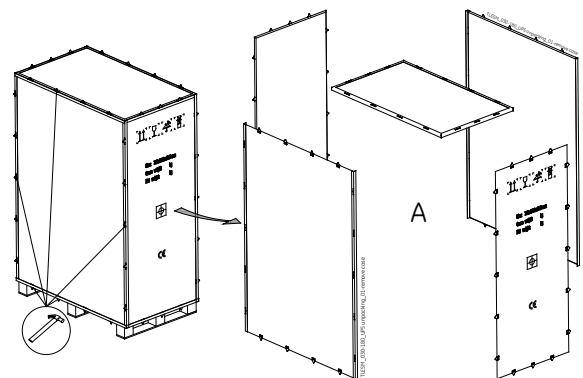


Fig. 4.5.1-2 Remove the wooden case

5. Remove the 2 wooden ramps "B", which will be used as a ramp and position them as shown in *Fig 4.5.1-4*.
6. Remove the protections "C" outside the cabinet.
7. Check the UPS.
Visually examine if there are any damages to the UPS during transportation.
If any, contact the local *GE Service Center*.

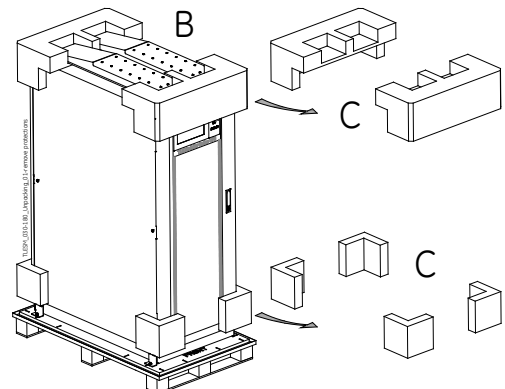


Fig. 4.5.1-3 Remove the cabinet protections

8. Remove the 4 angle irons "**D**", which are fixing the UPS to the wooden base by unscrewing bolts.
9. Remove the 4 air inlet grids "**E**".
10. To put wheels on the UPS cabinet, the 4 feet "**F**" must be rotated counter-clockwise until they are off the floor so that the cabinet rests solely on the wheels.

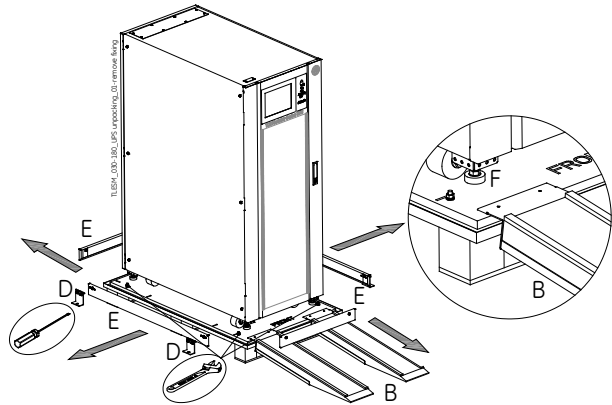


Fig. 4.5.1-4 Remove the 4 angle irons

11. Push the UPS towards the ramp "**B**" and let it slide down the ramp (see Fig. 4.5.1-5).

This has to be done with the utmost care!

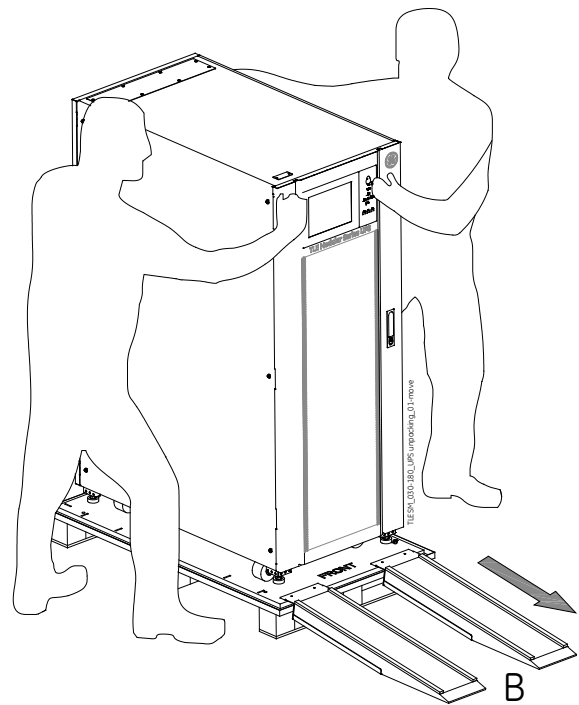


Fig. 4.5.1-5 Remove the UPS from the wooden base

12. After positioning the UPS in its final location, fasten the cabinet to the ground by turning the 4 feet "**F**" in a clockwise direction so that they put pressure on the ground but leaving the wheels in contact with the flooring.



NOTE !

The wheels are designed only for limited movements on the installation site.
To avoid risk of injury do not leave the UPS free to move on wheels!

4.5.2 Unpacking power module

The steps to move and unpack the power module are as follows:

1. The packing case must be placed on the platform smoothly, as shown in *Fig. 4.5.2-1*.

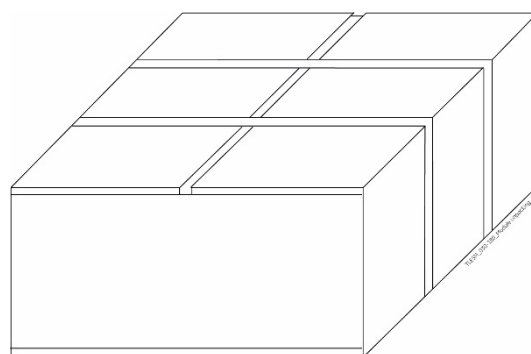


Fig. 4.5.2-1 Place on platform smoothly

2. Cut the plastic packing belt and scotch tape to open the carton (see *Fig. 4.5.2-2*).

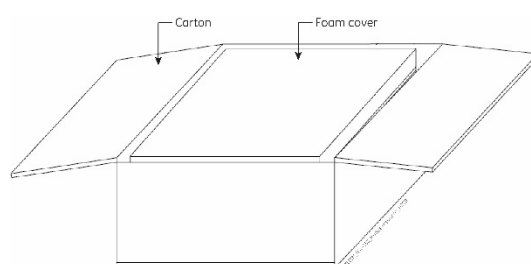


Fig. 4.5.2-2 Disassemble the case

3. Remove the foam cover (see *Fig. 4.5.2-3*).

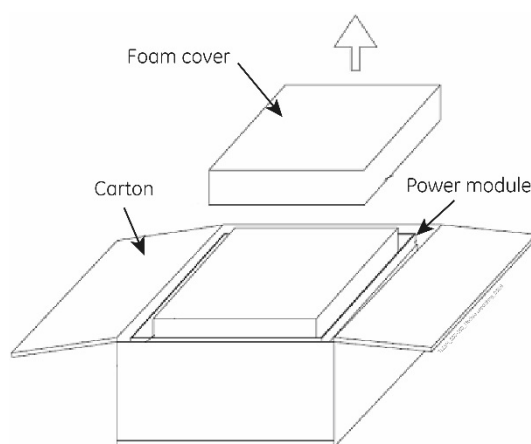


Fig. 4.5.2-3 Remove the foam cover

4. Take out the power module and dismantle the packaging materials.

4.6.2 Installation of the power modules



WARNING !

Do not place the power module on the floor by rear side with connectors.

For its heavy weight, all installation works for power module should be done by 2 persons, will facilitate the job and reduce the risk of injury from falling.

RISK OF ELECTRIC SHOCK! UPS slots must be always fitted with power modules or metallic covers "A". Do not leave slots open. It's recommended to store the metallic covers "A" after modules' installation in case of future needs.

The installation position of power modules is shown in Fig. 4.6.2-1.

Please install the power modules following the principle of from bottom to top to prevent inclination of the cabinet due to high center of gravity.

The steps of installing power module are as follows:

1. Ensure the UPS cabinet is fixed and no damage to the body and inserting port of the power module.
2. Remove the metallic covers "A".
3. Hold the handler and the body of the power module by two persons.
4. Insert the power module in the installation position and push it into the cabinet smoothly.
5. Fix the power module to the cabinet through the mounting holes on both sides at the front plate of the power module (see Fig. 4.6.2-1 at right).
6. Installing of the power module done.

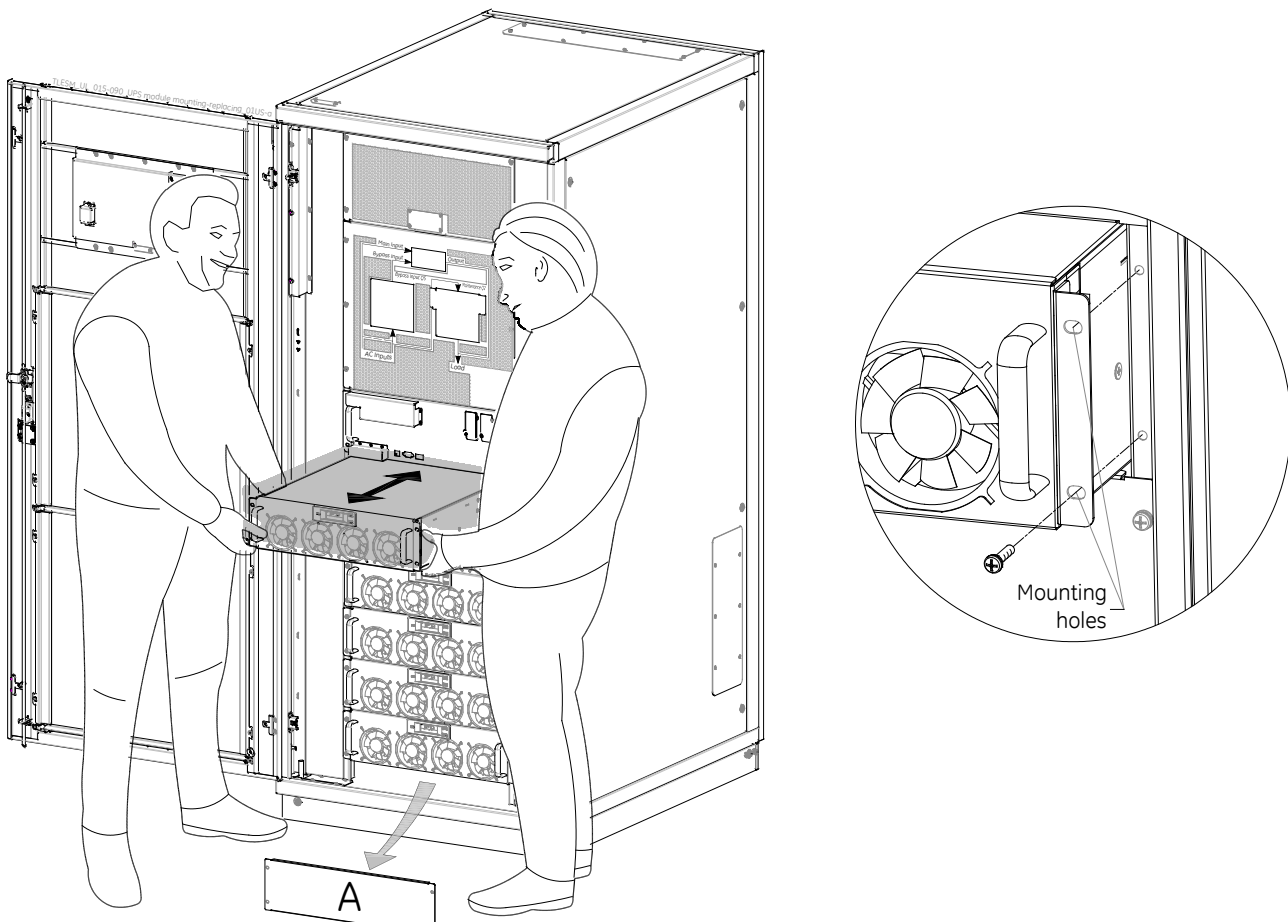


Fig. 4.6.2-1 Installation of the power modules

4.6.3 Replacement of the power module



WARNING !

For its heavy weight, all installation works for power module should be done by 2 persons, will facilitate the job and reduce the risk of injury from falling.
Each time one unit is removed, it **MUST** be replaced by another power module unit or by the metallic cover "A", to fit the opening and avoid risk of electric shock.
Do not place the power module on the floor by rear side with connectors.
There are no field maintenance operations requiring access to internal circuits of a power module.

The replacement of the power module can be performed while UPS is online.
Confirm the UPS is operating in Normal Mode and the bypass is working normally before pulling out the power module needed to be replaced.

The procedure of replacement of the power module are as follows:

1. Ensure the remaining power modules will not be overloaded.
2. Power OFF the power module.

A) Enable LCD panel: -> Menu Operate  -> Enable Module "OFF" Key

B) Press the "OFF" key for 3 seconds, the power module quits from the system.

Enable Module
"OFF" Button

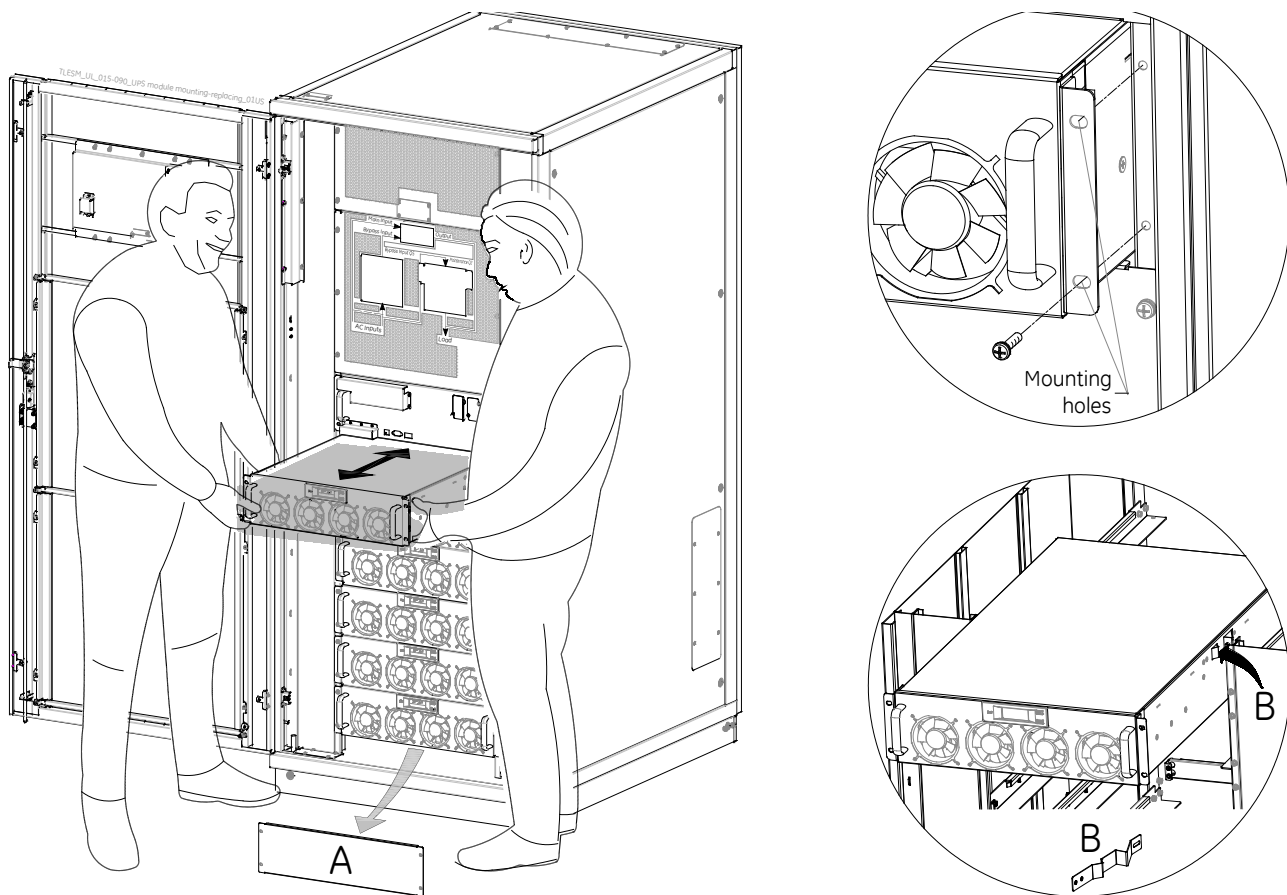


Fig. 4.6.2-1 Replacement of the power module

3. Remove the mounting screws on both front sides of the power module as minimum to unplug the rear connector.
4. Wait 10 minutes for complete discharging of the power module.
5. Pull out the power module by two persons. To remove the power module, unlock the device "B".
6. Insert, by two persons, the new power module into the UPS cabinet and the power module will automatically join the system.

4.7 BATTERY INSTALLATION

Three terminals (positive, neutral and negative) are drawn from the battery unit and connected to UPS system.

The neutral line is drawn from the middle of the batteries in series (see Fig. 4.7-1).

For the installation and cabling of the "BC44 Battery cabinet" option please refer to Section 8.2.1.

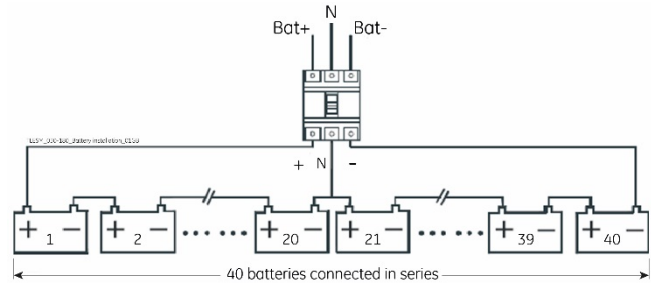


Fig. 4.7-1 Battery string wiring diagram



DANGER !

The battery terminal voltage is of more than 220Vdc, please follow the safety instructions to avoid electric shock hazard.

Ensure the positive, negative, neutral electrode is correctly connected from the battery unit terminals to the breaker and from the breaker to the UPS system.

4.8 CABLE ENTRY

Both top and bottom cable entry are available.

The top and bottom cable entry are shown in Fig. 4.8-1 and Fig. 4.8-2.

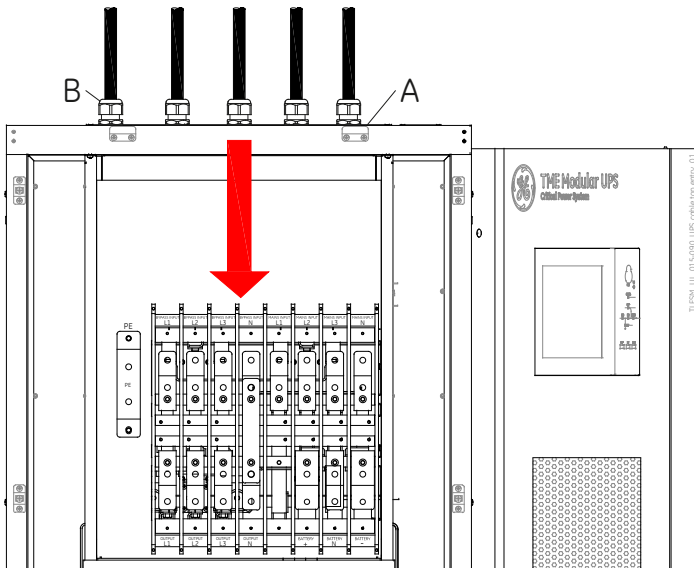


Fig. 4.8-1 Top cable entry

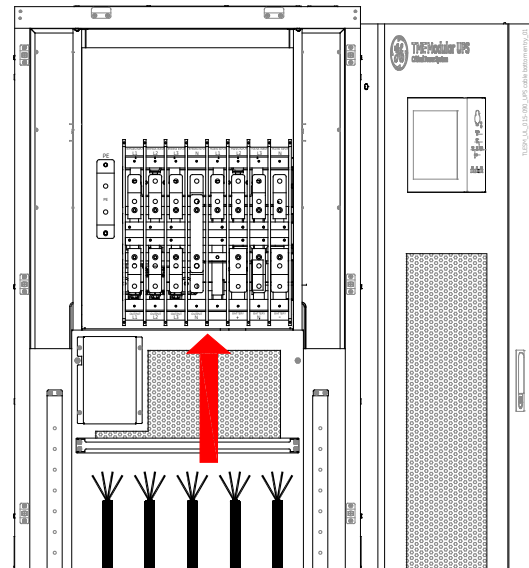


Fig. 4.8-2 Bottom cable entry

The correct procedure for top cable entry is as follows:

1. Remove from the "UPS Cabinet" the top metal cover "A" loosening the 6 screws.
2. Drill the metal cover with appropriate holes for cables entry.

Warning: Do not perform drilling over the top of the UPS to avoid metal filing falling inside the cabinet.

3. The metal cover can accept up to 16 M40 cable glands (see Fig 4.8-1 / "B") suitable for the rated wiring size: each cable requires a drill and a cable gland.
4. Reinstall on the "UPS Cabinet" the top metal cover "A".



NOTE !

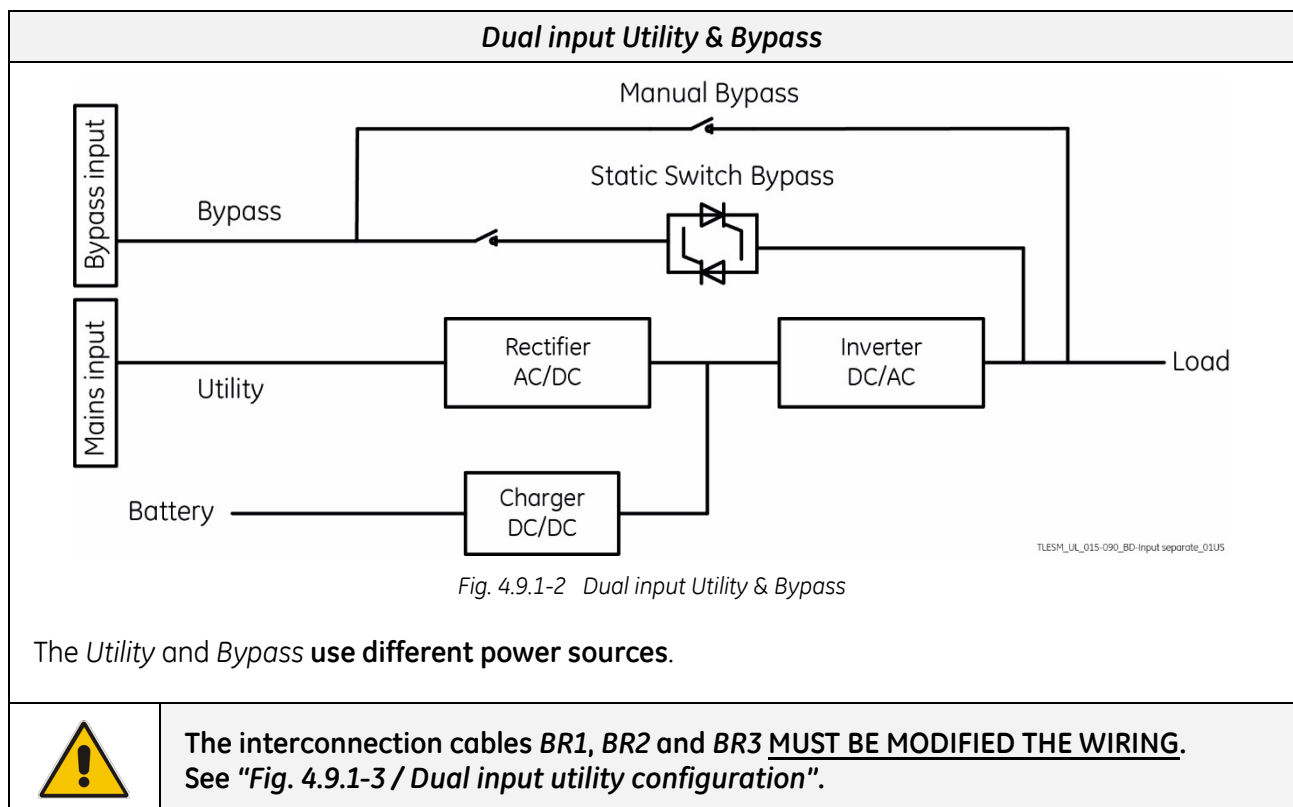
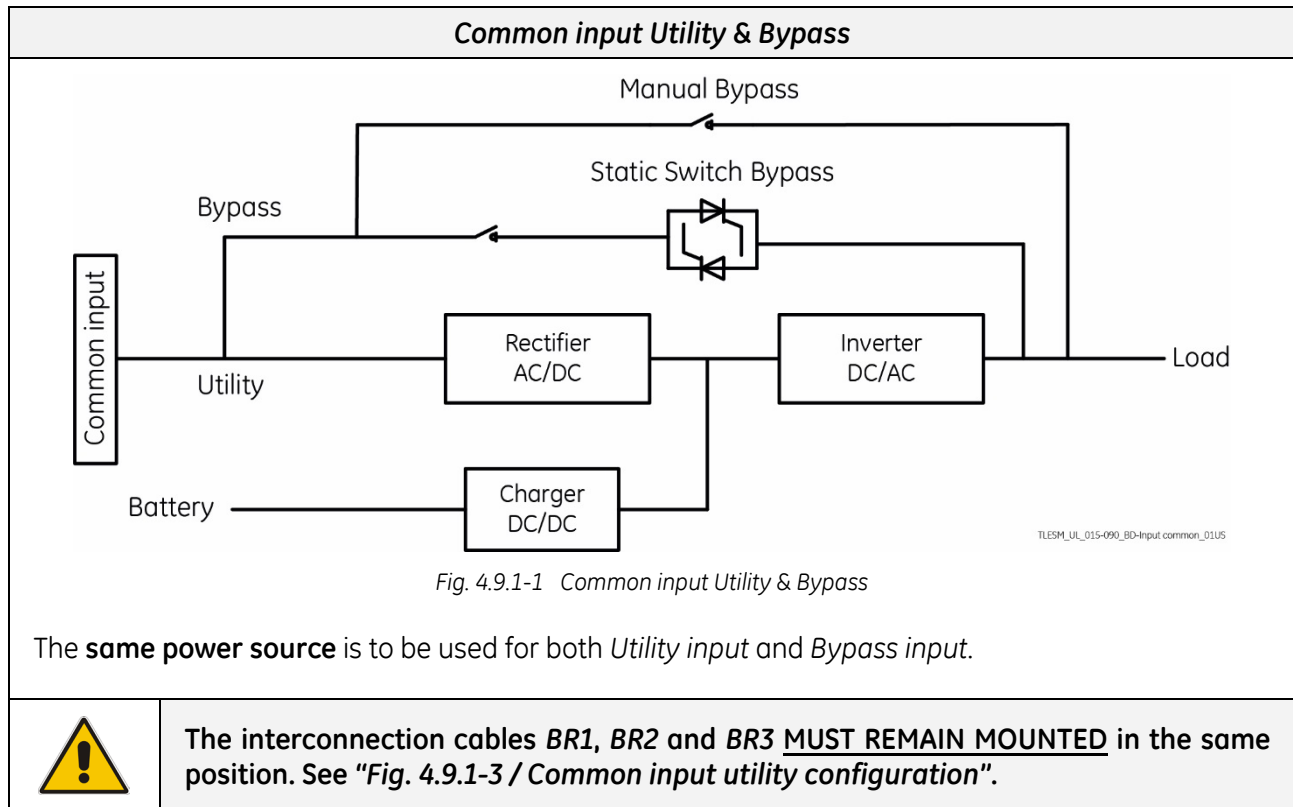
Fix the cables to avoid damage to insulation. See Section 4.9.5 / Fig. 4.9.5-1.

4.9 POWER CABLES

4.9.1 Utility input connection

The *Utility input* power connection can be common or dual for *Utility input* and *Bypass input*, depending on the electrical system provided by the customer.

Standard, the UPS is supplied in configuration “**Common input Utility & Bypass**”.



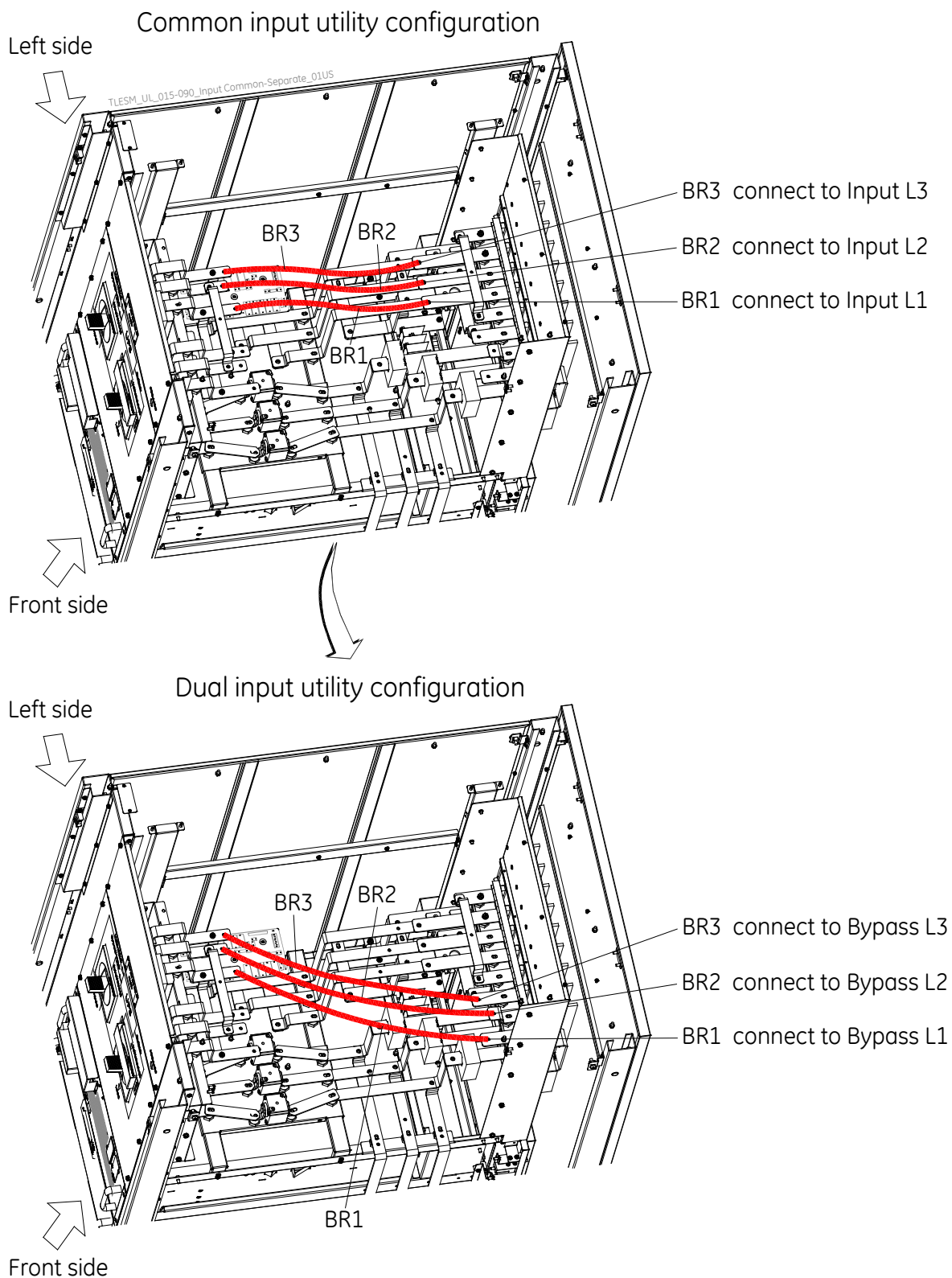
Wiring modification for *Dual Input Utility*

Fig. 4.9.1-3 Wiring modification for Dual Input Utility

Access to interconnection cables *BR1*, *BR2* and *BR3* by removing the left side protection.

- Disconnect interconnection cable *BR1* from "Input L1" bar and connect it to "**Bypass L1**" bar.
- Disconnect interconnection cable *BR2* from "Input L2" bar and connect it to "**Bypass L2**" bar.
- Disconnect interconnection cable *BR3* from "Input L3" bar and connect it to "**Bypass L3**" bar.

4.9.2 Line protections


NOTE !

Power upgrade has to be performed considering external protections and connections.

Protections for utility voltages (3 x 208Vac / 120Vac)

UPS model	Utility Input	Bypass Input	Common Input Utility	External Battery
TME Modular Series 15	3 x 70A	3 x 60A	3 x 70A	3 x 90A
TME Modular Series 30	3 x 150A	3 x 110A	3 x 150A	3 x 175A
TME Modular Series 45	3 x 200A	3 x 175A	3 x 200A	3 x 250A
TME Modular Series 60	3 x 300A	3 x 225A	3 x 300A	3 x 350A
TME Modular Series 75	3 x 350A	3 x 300A	3 x 350A	3 x 450A
TME Modular Series 90	3 x 400A	3 x 350A	3 x 400A	3 x 500A


ATTENTION !

The circuit breakers with RCD (Residual Current Device) is not suggested for the system.

4.9.3 Specifications for power cables terminal

UPS Model	Terminal	Connection	Bolt	Torque
TME Modular Series 15 to 90	Utility Input	Cables crimped (OT terminal)	M10	355Lb-in / 40Nm
	Bypass Input	Cables crimped (OT terminal)	M10	355Lb-in / 40Nm
	Battery	Cables crimped (OT terminal)	M10	355Lb-in / 40Nm
	Output	Cables crimped (OT terminal)	M10	355Lb-in / 40Nm
	PE	Cables crimped (OT terminal)	M10	355Lb-in / 40Nm

4.9.4 Specifications for power cables size


NOTE !

Power upgrade has to be performed considering external protections and connections.


WIRING

Wire sizing according to local regulations.

Use 167°F (75°C) copper or aluminum wire.

Wiring requirements:

AC UTILITY INPUT: 3-Phase, 4 wire plus Ground

AC BYPASS INPUT: 3-Phase, 4 wire plus Ground

AC UTILITY OUTPUT: 3-Phase, 4 wire plus Ground

EXTERNAL BATTERY: 3 wire (positive, negative and neutral) plus Ground

Cables section / Local Standard and cables installation disposal shall be applied

UPS model	Utility Input	Bypass Input	Common Input Utility	Utility Output	External Battery
TME Modular Series 15	4 x AWG 3 + AWG 8	3 x AWG 4	4 x AWG 3 + AWG 8	4 x AWG 4 + AWG 8	3 x AWG 3 + AWG 8
TME Modular Series 30	4 x AWG 3/0 + AWG 6	3 x AWG 1/0	4 x AWG 3/0 + AWG 6	4 x AWG 1/0 + AWG 6	3 x AWG 3/0 + AWG 6
TME Modular Series 45	4 x 250 kcmil + AWG 6	3 x AWG 4/0	4 x 250 kcmil + AWG 6	4 x AWG 4/0 + AWG 6	3 x 250 kcmil + AWG 4
TME Modular Series 60	8 x AWG 3/0 + AWG 4	6 x AWG 1/0	8 x AWG 3/0 + AWG 4	8 x AWG 1/0 + AWG 4	6 x AWG 3/0 + AWG 3
TME Modular Series 75	8 x AWG 4/0 + AWG 3	6 x AWG 3/0	8 x AWG 4/0 + AWG 3	8 x AWG 3/0 + AWG 3	6 x AWG 4/0 + AWG 2
TME Modular Series 90	8 x 250 kcmil + AWG 3	6 x AWG 4/0	8 x 250 kcmil + AWG 3	8 x AWG 4/0 + AWG 3	6 x 300 kcmil + AWG 2

The recommended cable section for power cables are only for situations described below:

- Ambient temperature: 86°F (+30°C).
- AC loss less than 3%, DC loss less than 1%, the length of the AC power cables should be no longer than 1968"/50m and the length of the DC power cables should be no longer than 1181"/30m.

NEC SECTION 210-20 (A)

Table 310-16. Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts, 140°F Trough 194°F (60°C Trough 90°C) Not More than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 86°F (30°C).

Temperature Rating of Conductor						
Size	140°F (60°C)	167°F (75°C)	194°F (90°C)	140°F (60°C)	167°F (75°C)	194°F (90°C)
AWG or kcmil	Types TW, UF	Types FEPW, RH, RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RH, RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
	COPPER			ALUMINUM or COPPER-CLAD ALUMINUM		
18	---	---	14	---	---	---
16	---	---	18	---	---	---
14	20	20	25	---	---	---
12	25	25	30	20	20	25
10	30	35	40	25	30	35
8	40	50	55	30	40	45
6	55	65	75	40	50	60
4	70	85	95	55	65	75
3	85	100	110	65	75	85
2	95	115	130	75	90	100
1	110	130	150	85	100	115
1/0	125	150	170	100	120	135
2/0	145	175	195	115	135	150
3/0	165	200	225	130	155	175
4/0	195	230	260	150	180	205
250	215	255	290	170	205	230
300	240	285	320	190	230	255
350	260	310	350	210	250	280
400	280	335	380	225	270	305
500	320	380	430	260	310	350
600	355	420	475	285	340	385
700	385	460	520	310	375	420
750	400	475	535	320	385	435
800	410	490	555	330	395	450
900	435	520	585	355	425	480
1000	455	545	615	375	445	500
1250	495	590	665	405	485	545
1500	520	625	705	435	520	585
1750	545	650	735	455	545	615
2000	560	665	750	470	560	630
CORRECTION FACTORS						
Ambient Temperature	For ambient temperatures other than 86°F (30°C), multiply the allowable ampacities shown above by the appropriate factor below					
70 – 77°F (21 – 25°C)	1.08	1.05	1.04	1.08	1.05	1.04
79 – 86°F (26 – 30°C)	1.00	1.00	1.00	1.00	1.00	1.00
88 – 95°F (31 – 35°C)	0.91	0.94	0.96	0.91	0.94	0.96
97 – 104°F (36 – 40°C)	0.82	0.88	0.91	0.82	0.88	0.91
106 – 113°F (41 – 45°C)	0.71	0.82	0.87	0.71	0.82	0.87
115 – 122°F (46 – 50°C)	0.58	0.75	0.82	0.58	0.75	0.82
124 – 131°F (51 – 55°C)	0.41	0.67	0.76	0.41	0.67	0.76

**NOTE !**

Values above are for reference only: NEC documentation is subject to review and values may change without notice.
Please ensure you are always referring to the latest revision of the Code.

4.9.5 Connection of the power cables



ATTENTION !

UPS installation and connection must be performed by GE SERVICE TECHNICIAN only.

Refer to the "SAFETY RULES" described on *Chapter 1*.



WARNING !

Tighten the connections terminals to enough torque moment, refer to *Table 4.9.3*, and please ensure correct phase rotation.

Before connection, ensure the input switch and the power supply are OFF, attach warnings label to warn not to operate by others.

The grounding cable and neutral cable must be connected in accordance with local and national codes.

Load must be connected to the same ground as that of UPS system.

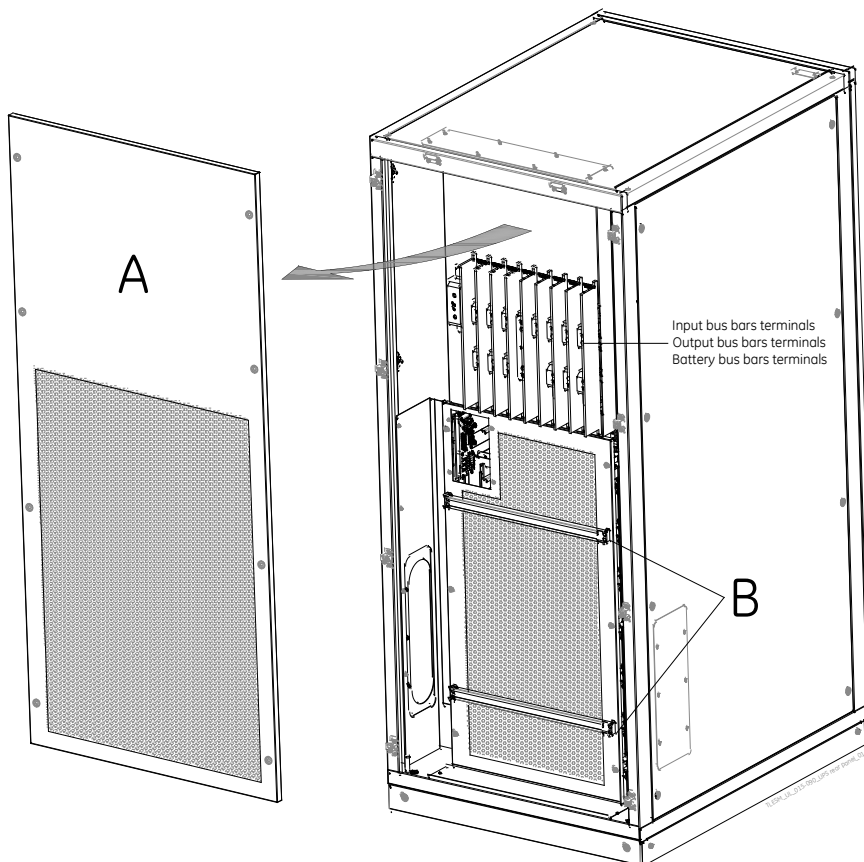


NOTE !

The UPS is designed for TN system.

The input neutral shall be grounded at source and shall never be disconnected.

4 pole breaker shall not be used at the UPS input (see also IEC 60364, IEC 61140, IEC 61557).



Access to bus bars for the cable connections

Remove the rear panel "A" by removing the respective screws.

Fix the cables on accessory "B" with the cable ties.

Fig. 4.9.5-1 Access to I/O bus bars

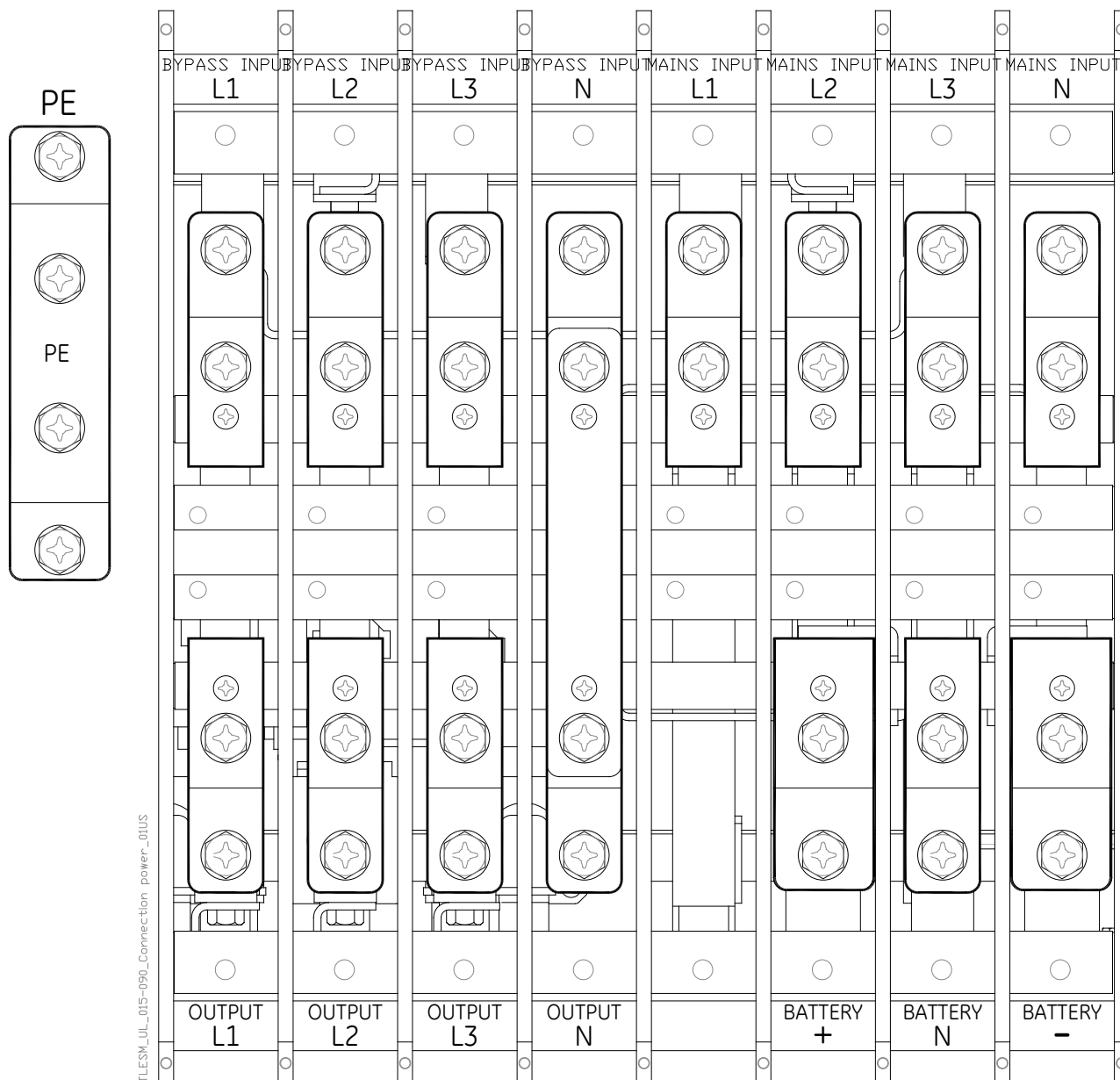


Fig. 4.9.5-2 Connection terminals

The steps of connecting power cables are as follows:

1. Verify that all the external input distribution switches of the UPS are completely open and the UPS internal static and maintenance bypass switches are OFF. Attach necessary warning signs to these switches to prevent unauthorized operation.
2. Connect the protective earth wire to protective earth terminal (PE).
3. Connect the AC input supply cables to the Utility Input terminal and AC output supply cables to the Output terminal.
4. Connect the Battery cables to the Battery terminal.
5. Check to make sure there is no mistake and re-install the rear panel "A" (see Fig. 4.9.5-1).

4.10 CONTROL AND COMMUNICATION CABLES



NOTE !

The cables connected to DRY terminal must be separated from power cables.

Moreover, these cables should be double insulated and be SELV type with a typical AWG 20 to AWG 15 (0.5 mm² to 1.5 mm²) cross-section area for a maximum connection length between 984 inches (25 meters) and 1968 inches (50 meters).

Keep this cable separated from SELV cables.



ATTENTION !

The installation of any optional board or firmware/software upgrade to any device must be performed by a GE SERVICE TECHNICIAN only.

Prior to the installation or firmware/software upgrade, connection and cabling of any optional board the UPS must be **COMPLETELY POWERED DOWN** and all the power sources that will be connected to the optional board must be **DE-ENERGIZED**.

The front panel of the bypass module provides dry contact interface (J2-J10, 4 programmable) and communication interface (USB/RS232/RS485 ports and SNMP card), as shown in Fig. 4.10-1.

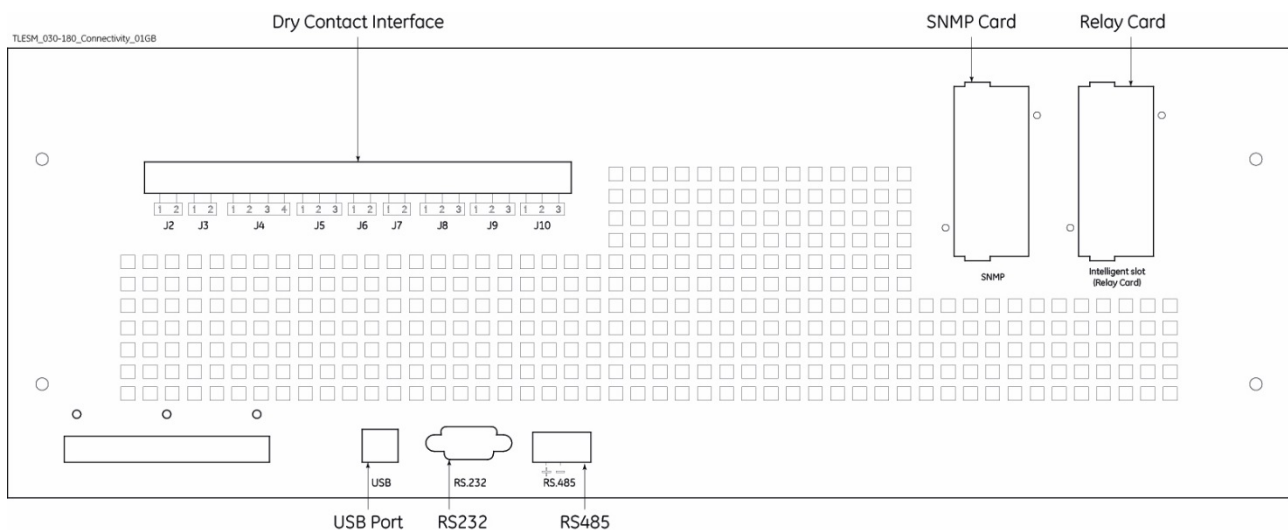


Fig. 4.10-1 Dry contact and communication interface

The UPS accepts external signal through phoenix terminals (dry contacts).



ATTENTION !

The settable functions for each port can be set only by GE SERVICE TECHNICIAN.

USB/RS232/RS485 ports and their configuration are reserved to GE SERVICE TECHNICIAN only, for maintenance activities.

4.10.1 Dry contact interface

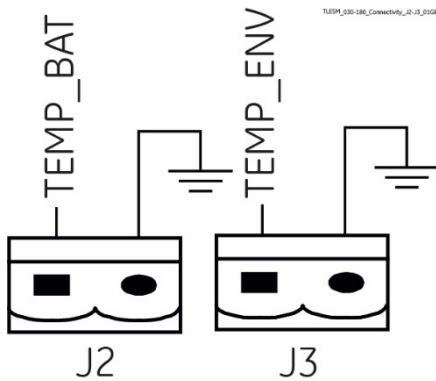
Dry contact interface includes port J2-J10 and the functions of the dry contacts are shown in *Table 4.10.1-1*.

Port	Name	Function
J2-1	TEMP_BAT	Detection of battery temperature.
J2-2	TEMP_COM	Common terminal for temperature detection.
J3-1	ENV_TEMP	Detection of environmental temperature.
J3-2	TEMP_COM	Common terminal for temperature detection.
J4-1	REMOTE_EPO_NC	Trigger EPO when disconnect from J4-2.
J4-2	+24V_DRY	+24V.
J4-3	+24V_DRY	+24V.
J4-4	REMOTE_EPO_NO	Trigger EPO when shorted with J4-3.
J5	INPUT	UPS internal signal (reserved).
J6-1	BCB_DRIV	Output dry contact, function is settable. Default: battery trip signal.
J6-2	BCB_Status	Input dry contact, function is settable. Default: BCB Status and BCB Online (alert no battery when BCB Status is invalid).
J7-1	GND_DRY	Ground for +24V.
J7-2	BCB_Online	Input dry contact, function is settable. Default: BCB Status and BCB Online (alert no battery when BCB Status is invalid).
J8-1	BAT_LOW_ALARM_NC	Output dry contact (normally closed), function is settable. Default: low battery alarming.
J8-2	BAT_LOW_ALARM_NO	Output dry contact (normally open), function is settable Default: low battery alarming.
J8-3	BAT_LOW_ALARM_GND	Common terminal for J8-1 and J8-2.
J9-1	GENERAL_ALARM_NC	Output dry contact, (normally closed) function is settable. Default: fault alarming.
J9-2	GENERAL_ALARM_NO	Output dry contact, (normally open) function is settable. Default: fault alarming.
J9-3	GENERAL_ALARM_GND	Common terminal for J9-1 and J9-2.
J10	INPUT	UPS internal signal (reserved).

Table 4.10.1-1 Functions of the port

4.10.1.1 Interface of battery and environmental temperature detection

The input dry contact J2 and J3 can detect the temperature of batteries and environment respectively, which can be used in environment monitoring and battery temperature compensation.



Port	Name	Function
J2-1	TEMP_BAT	Detection of battery temperature.
J2-2	TEMP_COM	Common terminal.
J3-1	ENV_TEMP	Detection of environmental temperature.
J3-2	TEMP_COM	Common terminal.

Table 4.10.1.1-1 Description of J2 and J3

Fig. 4.10.1.1-1 J2 and J3 for temperature detecting



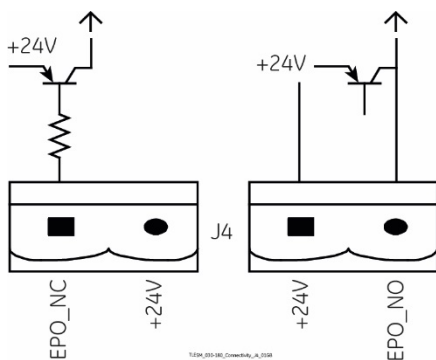
NOTE !

It is recommended to connect both battery and temperature sensors for a better monitoring functionality.

4.10.1.2 Remote EPO (Emergency Power Off) input port

J4 is the input port for remote EPO (Emergency Power Off).

It requires shorting NC (J4-1) and +24V (J4-2) and disconnecting NO (J4-4) and +24V (J4-3) during normal operation, and the EPO is triggered when opening NC and +24V or shorting the NO and +24V.



Port	Name	Function
J4-1	REMOTE_EPO_NC	Trigger EPO when disconnect from J4-2.
J4-2	+24V_DRY	+24V.
J4-3	+24V_DRY	+24V.
J4-4	REMOTE_EPO_NO	Trigger EPO when connect to J4-3.

Table 4.10.1.2-1 Description of input port for remote EPO

Fig. 4.10.1.2-1 Diagram of input port for remote EPO



NOTE !

J4-1 and J4-2 must be shorted in normal operation.

4.10.1.3 UPS internal function

J5-1, 2 are in use for UPS internal functionality.

4.10.1.4 BCB input port

The default function of J6 and J7 are the ports of BCB (Battery Circuit Breaker).

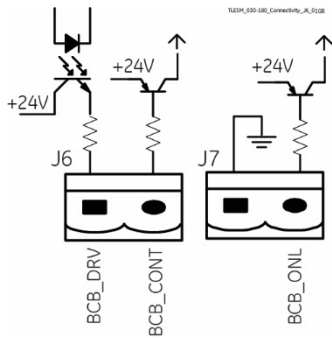


Fig. 4.10.1.4-1 BCB Port

Port	Name	Function
J6-1	BCB_DRIV	BCB contact drive, provides +24V voltage, 20mA drive signal.
J6-2	BCB_Status	BCB contact status, connect with the normally open signal of BCB.
J7-1	GND_DRY	Power ground for +24V.
J7-2	BCB_Online	BCB on-line input (normally open), BCB is on-line when the signal is connecting with J7-1.

Table 4.10.1.4-1 Description of BCB port



NOTE !

In default setting, when a circuit breaker with aux contacts is used, connected J6-2 and J7-1 to auxiliary contacts terminals to get the status of the BCB, this function must be enabled by shorting J7-1 and J7-2.

4.10.1.5 Battery warning output dry contact interface

The default function of J8 is the output dry contact interface, which presents the battery warnings of low voltage, when the battery voltage is lower or higher than set value, an auxiliary dry contact signal will be activated via relay.

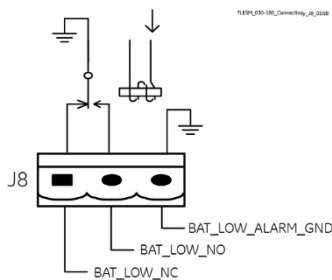


Fig. 4.10.1.5-1 Battery warning dry contact interface diagram

Port	Name	Function
J8-1	BAT_LOW_ALARM_NC	Battery warning relay (normally closed) will be open during warning.
J8-2	BAT_LOW_ALARM_NO	Battery warning relay (normally open) will be closed during warning.
J8-3	BAT_LOW_ALARM_GND	Common terminal.

Table 4.10.1.5-1 Battery warning dry contact interface description

4.10.1.6 General alarm output dry contact interface

The default function of J9 is the general alarm output dry contact interface.

When one or more warnings are triggered, an auxiliary dry contact signal will be active via the isolation of a relay.

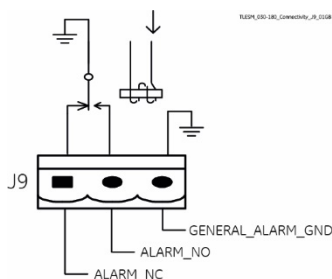


Fig. 4.10.1.6-1 Integrated warning dry contact interface diagram

Port	Name	Function
J9-1	GENERAL_ALARM_NC	Integrated warning relay (normally closed) will be open during warning.
J9-2	GENERAL_ALARM_NO	Integrated warning relay (normally open) will be closed during warning.
J9-3	GENERAL_ALARM_GND	Common terminal.

Table 4.10.1.6-1 General alarm dry contact interface description

4.10.1.7 UPS internal function

J10-2, 3 are in use for UPS internal functionality.

4.10.2 Communication interface

4.10.2.1 SNMP card

The SNMP card can be used on site for local and remote monitoring. In order to activate the communication between UPS and SNMP card, connection parameters must be configured following the display page reported in the picture.

For additional information about SNMP card configuration and functionalities, please refer to SNMP card manual.

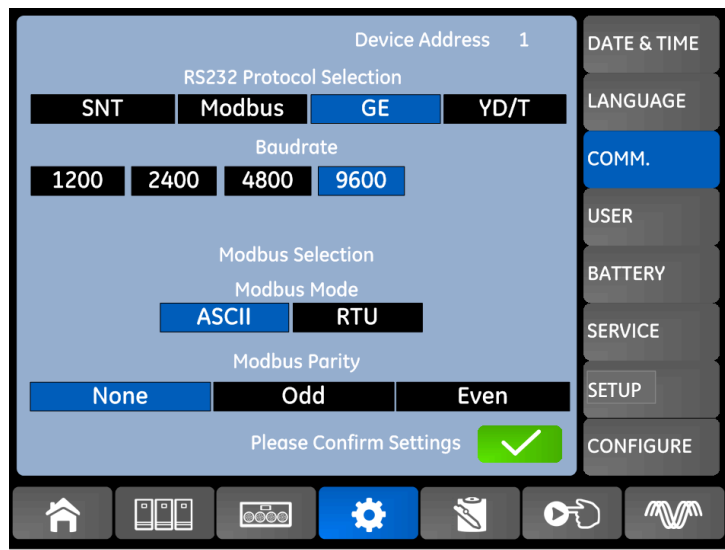


Fig. 4.10.2.1-1 Screen "COMM." selection

4.11 INSTALLATION OF THE PARALLEL SYSTEM



WARNING !

The parallel system connection and the setup of the configuration parameters must be performed by GE SERVICE TECHNICIAN before the start-up (ensure that the UPS is completely powered down).

A wrong setup can compromise the integrity and reliability of the UPS.

Two UPS cabinets are connected as shown in Fig. 4.11-1.

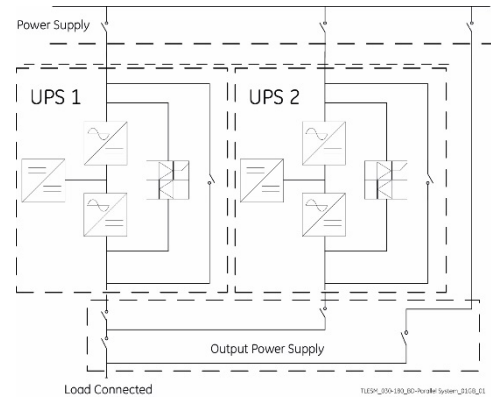


Fig. 4.11-1 Parallel System diagram

The parallel board is located at the back of the UPS cabinet, whose name is PS1203-TF4 as shown in Fig. 4.11-2.

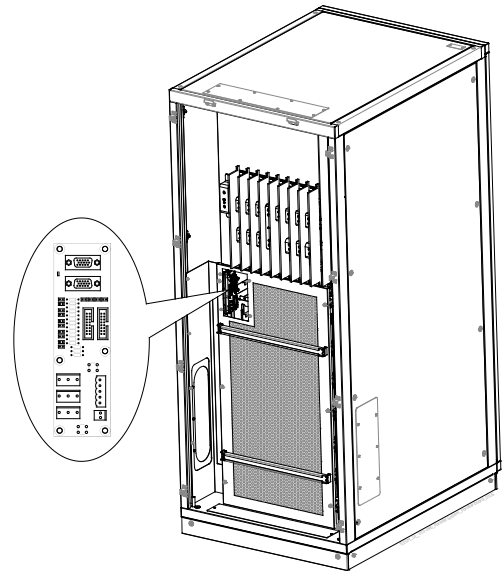


Fig. 4.11-2 Location of the Parallel System board

The control cables for the parallel system must be connected with all single devices to form a closed loop, as shown in Fig. 4.11-3.

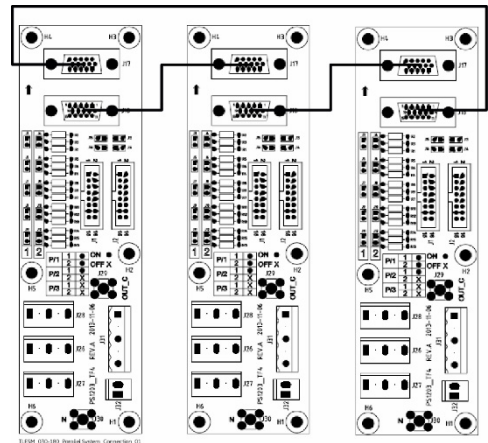


Fig. 4.11-3 Parallel System connection

5 UPS AND POWER MODULE CONTROL PANEL

This chapter introduces the functions and instructions of the operator control and display panel in detail, and provides LCD display information, including LCD display types, detailed menu information, prompt window information and UPS alarm information.

5.1 LCD PANEL OF THE POWER MODULE

The structure of LCD panel for power module is shown in Fig. 5.1-1.

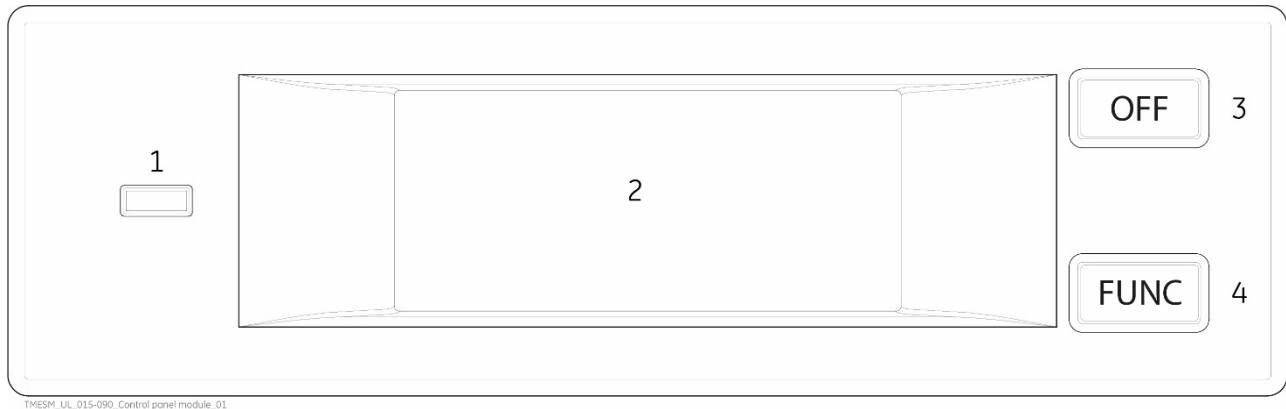


Fig. 5.1-1 Control and display panel of the power module

1 - LED indicator

2 - LCD Display

3 - OFF Key

4 - FUNC Key

The operator control panel is divided into three functional areas: LED indicator, control and operation keys and LCD display.

5.1.1 LED indicator

The LED indicator has green and red colors to indicate the statuses and faults by combinations of different colors and the time it lasts. The combinations are listed in Table 5.1.1-1.


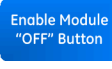
No.	LED combinations	Description
1	Green short-time flashing 1 (green for 1S, Off for 2S)	Rectifier soft starting.
2	Green short-time flashing 2 (green for 2S, Off for 1S)	Inverter soft starting.
3	Green medium-time flashing (green for 1S, Off for 5S)	Power module inverter standby.
4	Green long-time flashing (green for 2S, Off for 10S)	Power module in deep sleep (shutdown).
5	Steady green	UPS is working normally.
6	Red and Green Alternating (red for 1S, Green for 5S)	The load powered by inverter with warnings (no battery, battery discharging, overload, etc.).
7	Steady red	Power module shutdown by fault.
8	Red medium-time flashing (red for 1S, Off for 5S)	Shutdown manually or by monitoring software.
9	Red short-time flashing (red for 1S, Off for 1S)	Situation except all the above.

Table 5.1.1-1 LED combinations

5.1.2 Control and operation keys

The control and operation keys include "FUNC" key and "OFF" key that have different functions:

- "FUNC" key: cycle through the measurements on the display.
- "OFF" key: shut down the module, as the following procedures:
 - The "OFF" key is disabled by default and must be enabled via the display:

-> Menu Operate  -> Press .
 - Press the "OFF" key for 3 seconds, the power module will be excluded from the system.

5.1.3 LCD Display

LCD is for displaying the information for the power module and its structure is shown in Fig. 5.1.3-1.

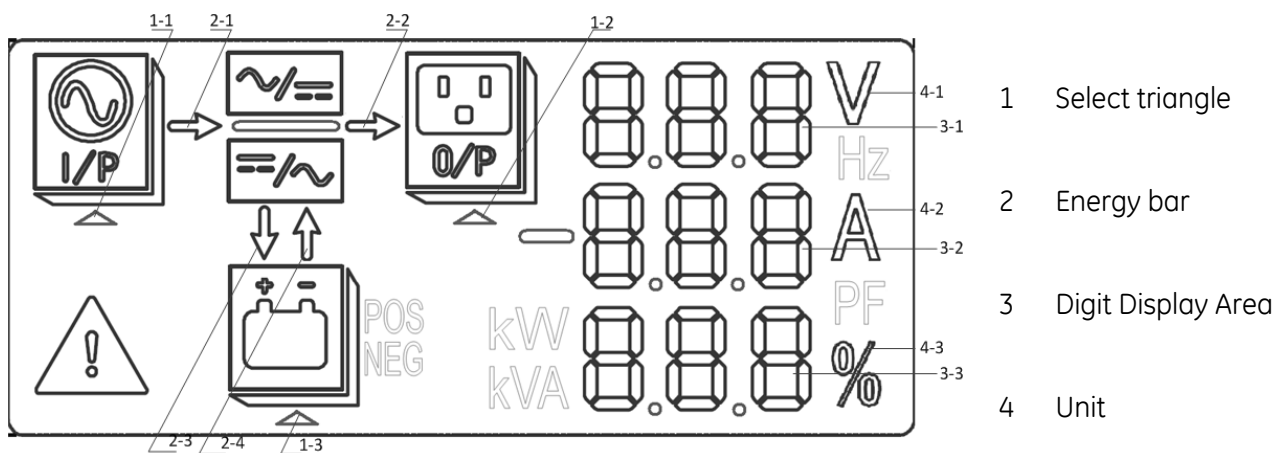


Fig. 5.1.3-1 LCD display for power module

Users can browse the information of each power module by pressing the "FUNC" key to turn the pages.

Select triangle of  highlighted

Input information is presented in the Digit Displays Area: 3-phase voltage and 3-phase current.

Select triangle of  highlighted

Output information is presented in the Digit Displays Area: 3-phase voltage, 3-phase current and the 3-phase load percentage.

Select triangle of  POS highlighted

Battery information is presented in the Digit Displays Area: battery positive voltage, battery positive charge/discharge current and bus positive voltage.

Select triangle of  NEG highlighted

Battery information is presented in the Digit Displays Area: battery negative voltage, battery negative charge/discharge current and bus negative voltage.

 highlighted

Fault and warning codes are shown in Digit Displays Area. The meanings of the codes are listed in Table 5.1.3-1.

 flashing

Indicating a fault occurs.

Energy bar of  

Flashing: rectifier soft start.
Highlighted: the rectifier is working normally.
Off: other situation.



Energy bar of

Flashing: inverter soft start.
 Highlighted: load on inverter.
 Off: other situation.



Energy bar of

Flashing: low battery voltage.
 Highlighted: charging normally.
 Off: battery not connected.



Energy bar of

Lightened: discharging mode.
 Off: battery not connected or charging.

Unit: Voltage (V), Current (A), Percentage (%).

The reading selected on one power module will be shown on all other power modules within 2 seconds.

Codes	Description
16	Utility voltage abnormal
18	Bypass phase sequence fault
20	Bypass voltage abnormal
28	Bypass Over-track frequency
30	Transfer times (from inverter to bypass) in 1 hour exceed the limit.
32	Output shorted
34	EOD (End Discharge Voltage) of battery
38	Battery test fail
41	Battery maintenance fail
47	Rectifier fail
49	Inverter fail
51	Rectifier over temperature
53	Fan fail
55	Output overload
57	Output overload time out
59	Inverter over temperature
61	UPS inverter Inhibited
65	Low battery

Codes	Description
67	Battery polarity reversed
69	Inverter protected
71	Neutral disconnected
74	Module shut down manually
81	Battery or charger fail
83	Lost N+X redundancy
85	EOD (End Discharge Voltage) system inhibited
93	Inverter IO CAN fail
95	Data CAN fail
97	Power share fail
109	Inverter bridge open
111	Temperature difference over limit
113	Input current unbalanced
115	DC bus over voltage
117	Rectifier soft start fail
119	Relay open
121	Relay shorted
127	Transfer to inverter manually

Table 5.1.3-1 Faults and warnings codes

5.2 UPS CONTROL PANEL

The structure of operator control and display panel for cabinet is shown in *Fig. 5.2-1*.

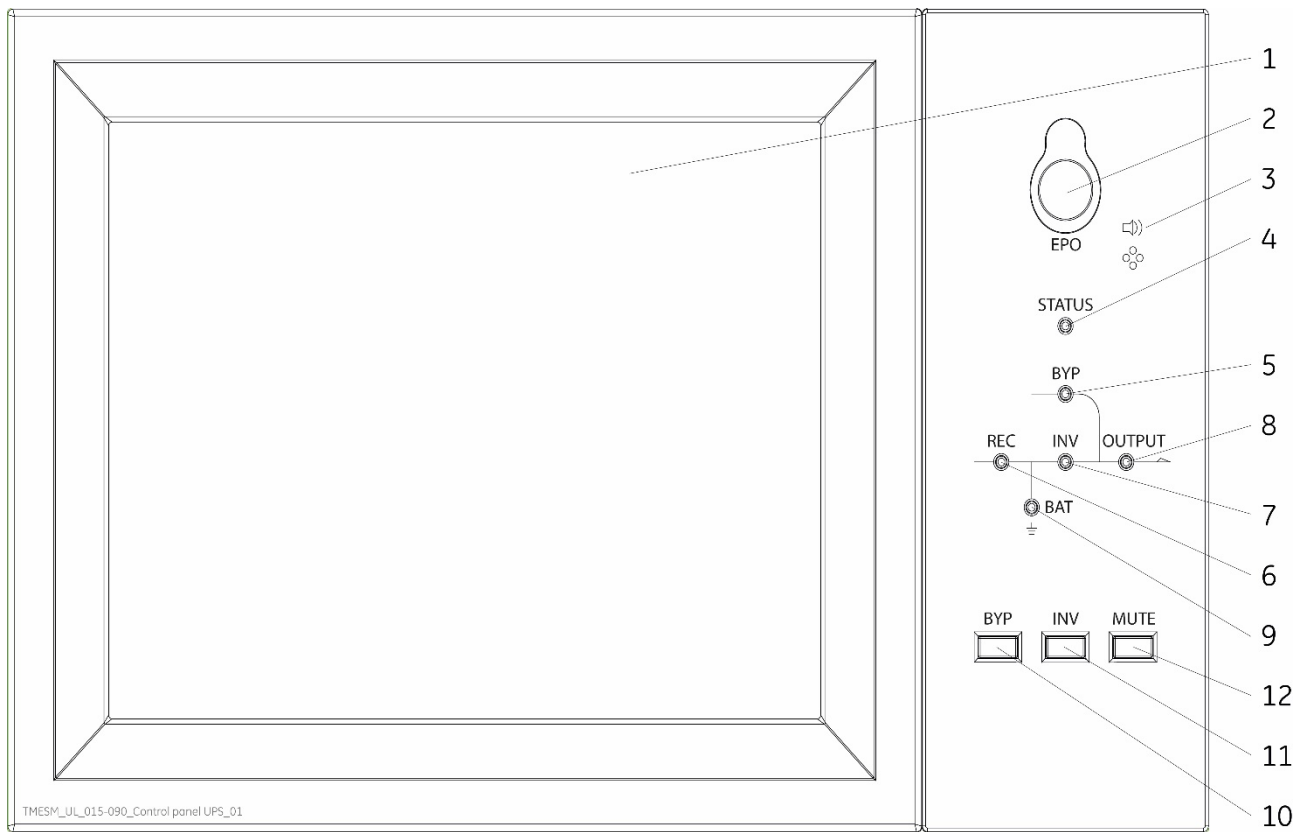


Fig. 5.2-1 Control and display panel for cabinet

1	LCD touch screen	7	Inverter indicator
2	EPO button	8	Output indicator
3	Audible Alarm (Buzzer)	9	Battery indicator
4	Status indicator	10	Bypass transfer
5	Bypass indicator	11	Inverter transfer
6	Rectifier indicator	12	Mute

The LCD panel for cabinet is divided into three functional areas:

- LED indicator.
- Control and operation keys.
- LCD touch screen.

5.2.1 LED indicator

There are 6 LEDs on the panel to indicate the operating status and fault (see Fig. 5.2-1). The description of indicators is shown in Table 5.2.1-1.

Indicator	State	Description
Rectifier indicator	Steady green	Rectifier normal for all modules.
	Flashing green	Rectifier normal for at least one module, utility normal.
	Steady red	Rectifier fault.
	Flashing red	Utility abnormal for at least one module.
	Off	Rectifier not operating.
Battery indicator	Steady green	Battery charging.
	Flashing green	Battery discharging.
	Steady red	Battery abnormal (battery failure, no battery or battery reversed) or battery converter abnormal (failure, over current or over temperature), EOD (End Discharge Voltage).
	Flashing red	Battery low voltage.
	Off	Battery and battery converter normal, battery not charging.
Bypass indicator	Steady green	Load supplied by bypass.
	Steady red	Bypass abnormal or out of normal range, or static bypass switch fault.
	Flashing red	Bypass voltage abnormal.
	Off	Bypass normal.
Inverter indicator	Steady green	Load supplied by inverter.
	Flashing green	Inverter ON, start, synchronized or standby (ECO mode) for at least one module.
	Steady red	System output not supplied by inverter, inverter fault for at least one module.
	Flashing red	System output supplied by inverter, inverter fault for at least one module.
	Off	Inverter not operating for all modules.
Output indicator	Steady green	UPS output ON and normal.
	Steady red	UPS overload time is out, or output short, or output no power supply.
	Flashing red	Overload output of UPS.
	Off	No output of UPS.
Status indicator	Steady green	Normal operation.
	Steady red	Failure.

Table 5.2.1-1 Status description of indicators

There are two different types of audible alarm during UPS operation, as shown in Table 5.2.1-2.

Alarm	Description
Two short alarm with a long one	When system has general alarm (for example: AC fault).
Continuous alarm	When system has serious faults (for example: fuse blown or hardware failure).

Table 5.2.1-2 Description of audible alarms

5.2.2 Control and operation keys

Control and operation keys include four keys of 2, 10, 11 and 12 (see Fig. 5.2-1), which are used together with LCD touch screen. The functions description is shown in Table 5.2.2-1.

Function Key	Description
EPO	Long press, cut OFF the load power (shut down the rectifier, inverter, static bypass and battery).
BYP	Long press, transfer to the bypass.
INV	Long press, transfer to the inverter.
MUTE	Long press to switch between turning OFF and on the buzzing.

Table 5.2.2-1 Functions of control and operation keys



ATTENTION !

When bypass frequency is over track, an asynchronous break before making transfer from bypass to inverter will occur with an interruption up to 10ms.

5.2.3 LCD touch screen

Users can easily browse the information, operate the UPS, and set the parameters through the LCD touch screen, which is friendly for users.

After the monitoring system starts self-test, the system enters the home page, following the welcome window. The home page is shown in Fig. 5.2.3-1.

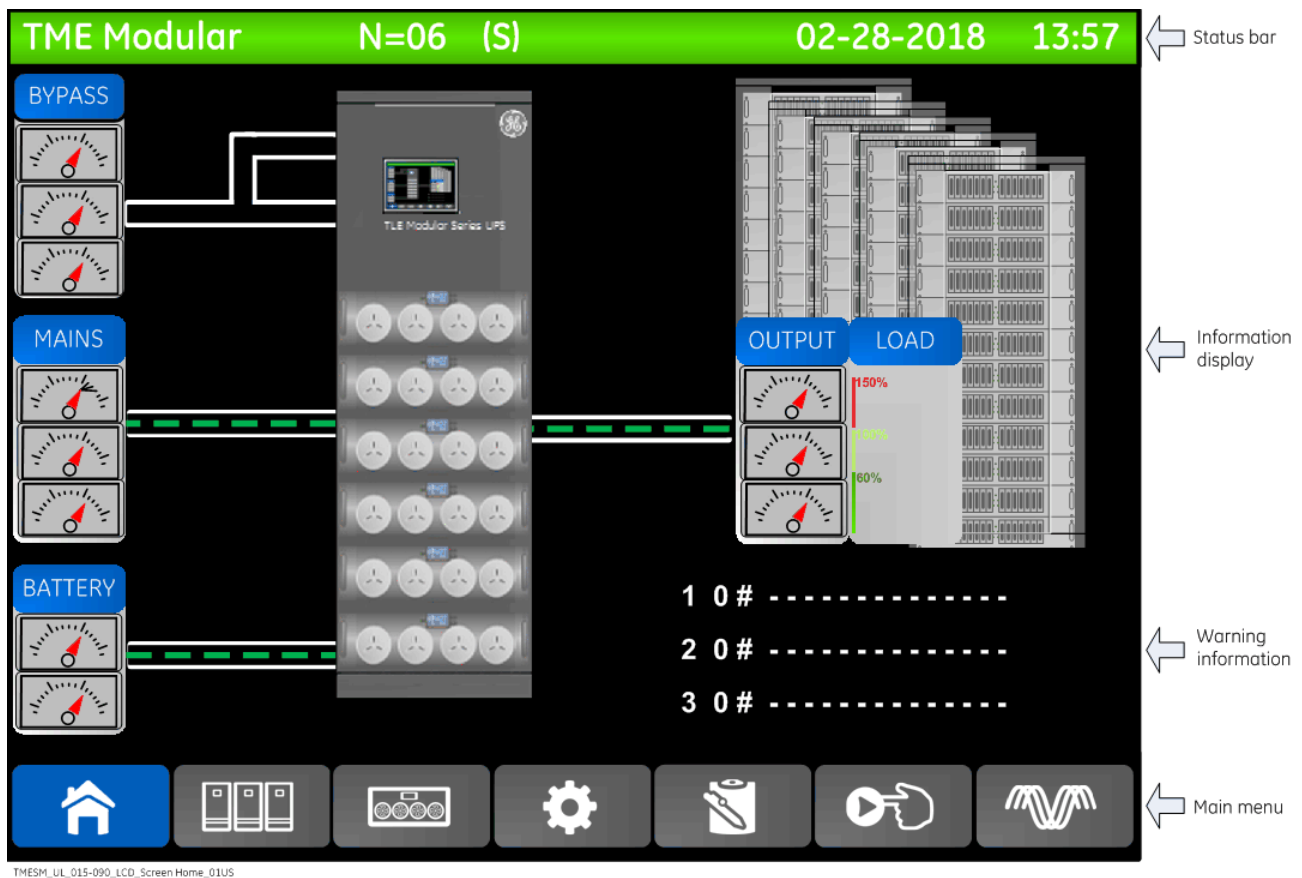


Fig. 5.2.3-1 LCD Home screen

LCD Home page consists of "Status bar", "Information display", "Warning information" and "Main menu".

Status bar

The Status bar contains the model of the product, operating mode, the number of the power module and the time of the system.

Information Display

Users can check the information of the cabinet in this area.

The bypass voltage, utility input voltage, battery voltage, and output voltages are presented in the form of gauge.

The loads are displayed in the form of bar chart in percentage.

The green area stands for a load of less than 60%, yellow area for a load of 60%-100% and red area for a load of more than 100%.

The energy flow mimics the flow of the power.

Warning Information

Display the warning information of the cabinet.

Main Menu

The main menu includes Cabinet, Module, Setting, Log, Operate and Scope. See Fig. 5.2.3-2.

Users can operate and control the UPS, and browse all measured parameters through main menu.

The structure of the main menu tree is shown in *Fig. 5.2.3-2*.

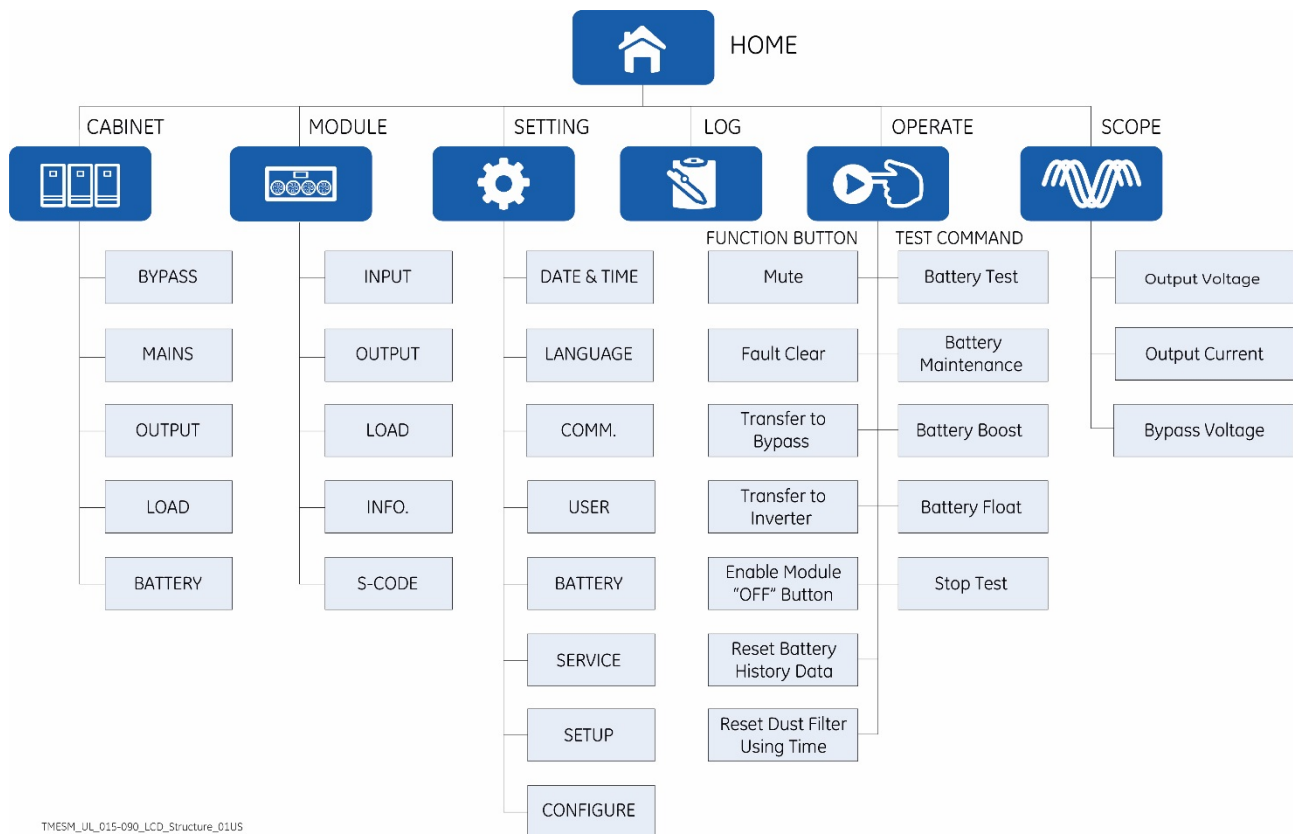



Fig. 5.2.3-2 Structure of the main menu tree

5.3 MAIN MENU

The main menu includes Cabinet, Module, Setting, Log, Operate and Scope and it is described in details below.

5.3.1 Cabinet

Touch the icon  (Cabinet) and the system enters the page of the "Cabinet" as shown in Fig. 5.3.1-1.

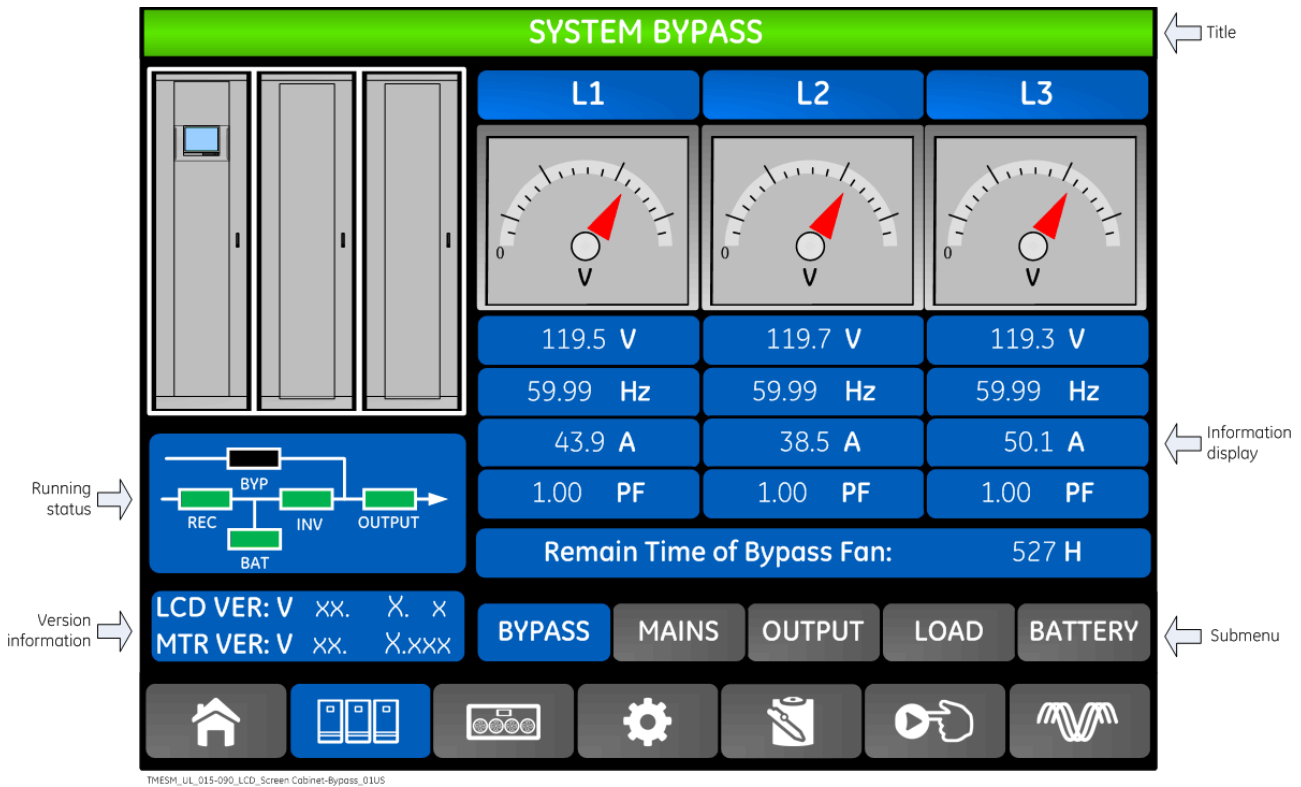


Fig. 5.3.1-1 Cabinet screen

The Cabinet comprises sectors of Title, Information display, Running status, Information display, Version information and Submenu.

The sectors are described as follows.

Title

Display the information of the selected submenu.

Information display

Display information of each submenu.

Running status

The squares shown on the mini current path represent the various UPS power paths and show the current UPS operating status (the green square indicating the block working normally, the black indicating the absence of the block and red indicating the absence of the block or in fault).

Version information

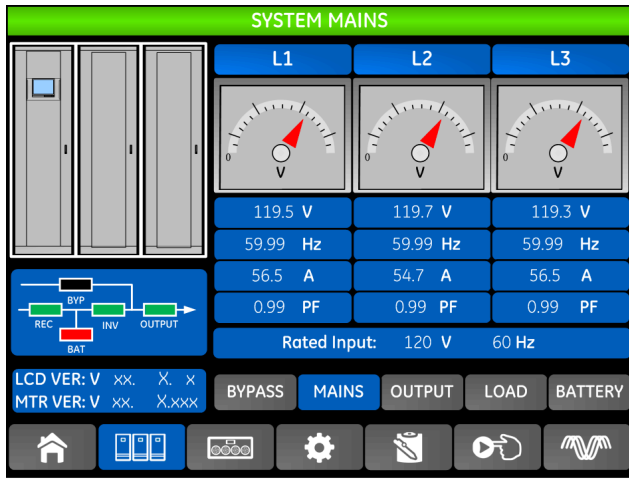
The version information for LCD of the cabinet and monitor.

Submenu

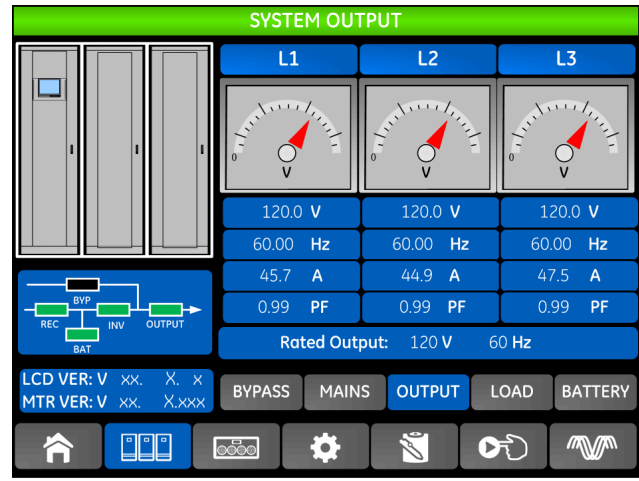
The submenu includes "BYPASS", "MAINS" (Utility), "OUTPUT", "LOAD" and "BATTERY".

Users can enter the interface of each submenu by directly touching the icon.

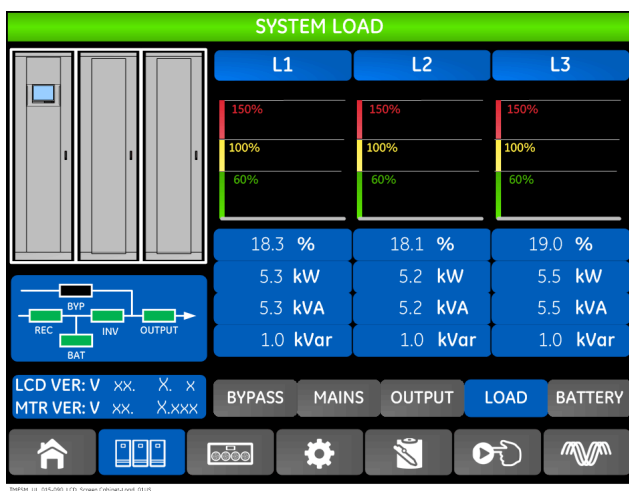
The interface of each submenu is shown in Fig. 5.3.1-2.



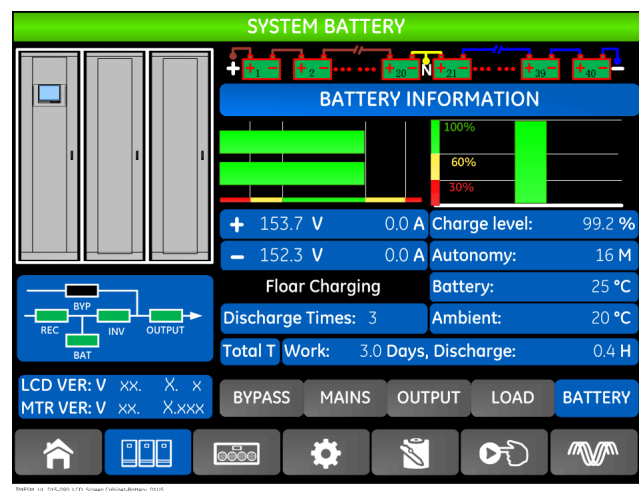
Interface of Cabinet Mains (Utility)



Interface of Cabinet Output



Interface of Cabinet Load



Interface of Cabinet Battery


Fig. 5.3.1-2 Submenu interface of Cabinet

The submenu of Cabinet is described in details below in Table 5.3.1-1.

Submenu	Contents	Meaning
MAINS (UTILITY)	V	Phase voltage
	A	Phase current
	Hz	Input frequency
	PF	Power factor
BYPASS	V	Phase voltage
	A	Phase current
	Hz	Bypass frequency
	PF	Power factor
OUTPUT	V	Phase voltage
	A	Phase current
	Hz	Output frequency
	PF	Power factor
LOAD	kVA	Sout: Apparent power
	kW	Pout: Active power
	kVar	Qout: Reactive power
	%	Load (the percentage of the UPS load)
	V	Battery positive/negative Voltage
	A	Battery positive/negative Current
	Charge level (%)	Battery charge level
BATTERY	Autonomy (Min)	Autonomy battery backup time
	Battery (°C)	Battery temperature
	Ambient (°C)	Environmental temperature
	Total Work T	Total work time
	Total Discharge T	Total discharging time

Table 5.3.1-1 Description of each submenu of Cabinet

5.3.2 Module

Touch the icon  (Module) and the system enters the page of the "Module" as shown in Fig. 5.3.2-1.

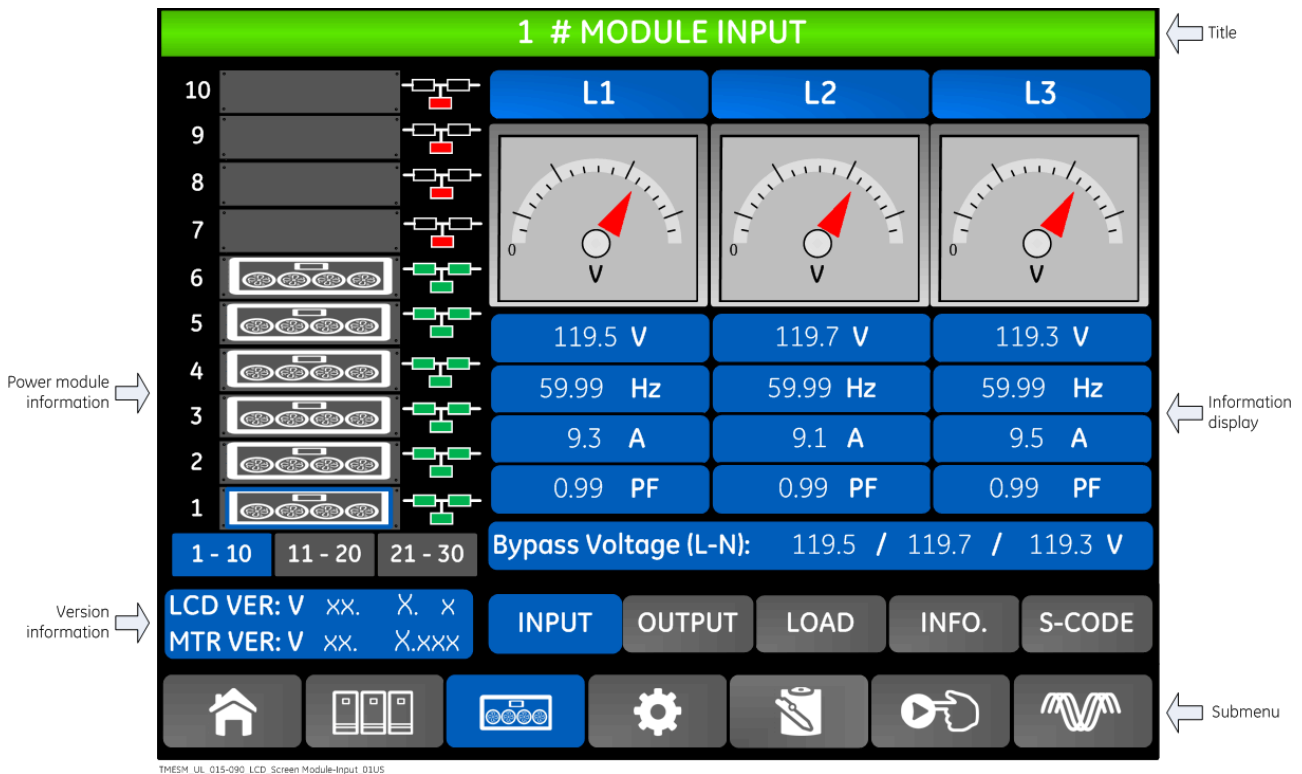


Fig. 5.3.2-1 Module screen

The module comprises sectors of Title, Information display, Power module information, Version information and Submenu.

The sectors are described as follows.

Title

Present the title of submenu of the selected power module.


Information display

Display information of each submenu.

Power module information

The users can choose the power module to browse the information in the "Information display" sector. Colors of the square on the mimic current path represent the various power module paths and show the current operating status.

- The green square indicating the module working normally.
- The black indicating module is invalid.
- The red indicating the absence of the module or in fault.

Take the 1#module  for example. It indicates that UPS is in Normal mode and the rectifier and inverter are working normally. The battery is not connected.

Version information

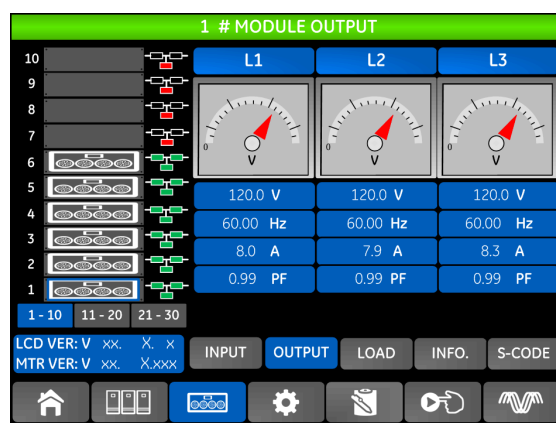
The version information for rectifier and inverter of the selected module.

Submenu

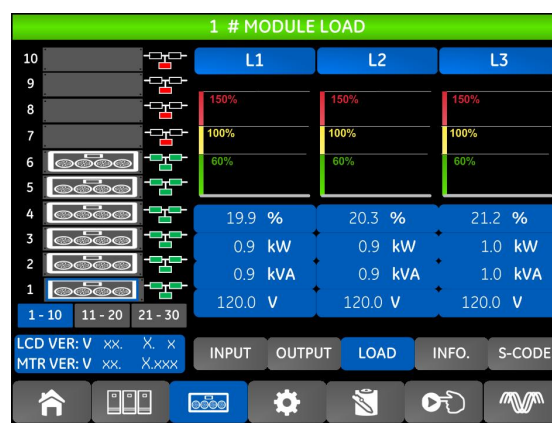
The submenu includes “INPUT”, “OUTPUT”, “LOAD”, “INFO.” and “S-CODE”.

Users can enter the interface of each submenu by directly touching the icon.

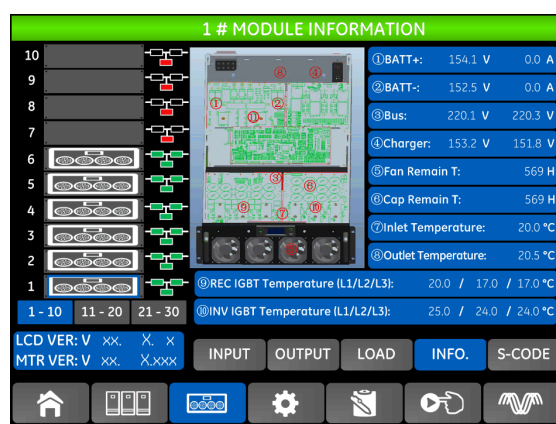
The interface of each submenu is shown in Fig. 5.3.2-2.



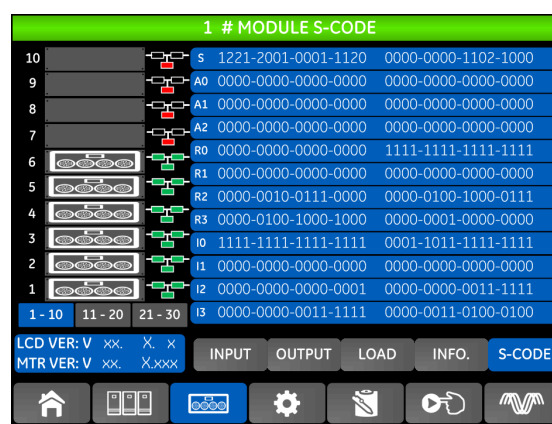
Interface of Module Output



Interface of Module Load



Interface of Module Information



Interface of Module S-Code

Fig. 5.3.2-2 Submenu interface of Module

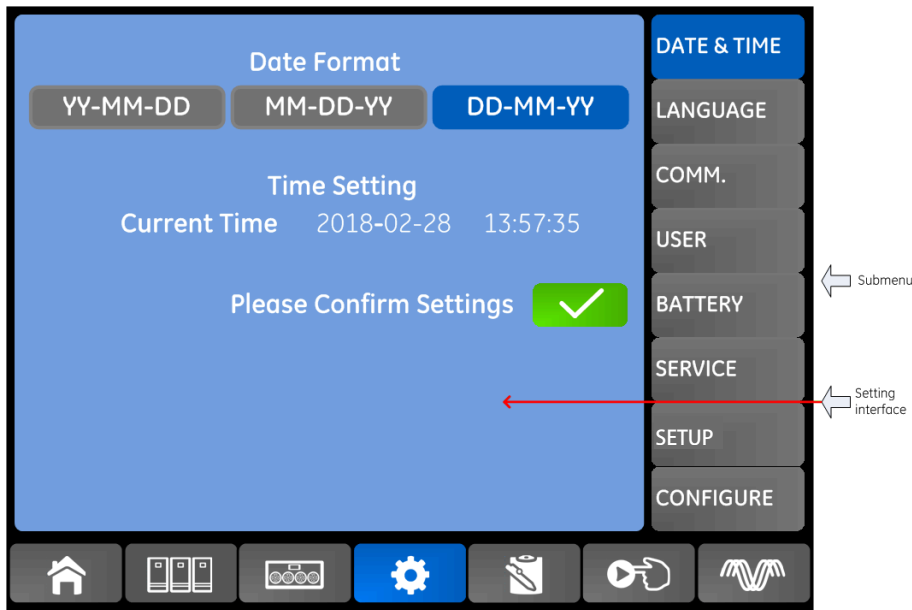
The submenus of Module are described below in details in Table 5.3.2-1.

Submenu	Contents	Meaning
INPUT	V	Input phase voltage of selected module.
	A	Input phase current of selected module.
	Hz	Input frequency of selected module.
	PF	Input power factor of selected module.
OUTPUT	V	Output phase voltage of selected module.
	A	Output phase current of selected module.
	Hz	Output frequency of selected module.
	PF	Output power factor of selected module.
LOAD	V	Load voltage of selected module.
	%	Load (the percentage of the power module selected).
	kW	Pout: active power.
	kVA	Sout: apparent power.
INFO. (Information)	BATT+ (V)	Battery voltage (positive).
	BATT- (V)	Battery voltage (negative).
	BUS (V)	Bus voltage (positive & negative).
	Charger (V)	Charger voltage (positive & negative).
	Fan Remain T	Fan's remaining time of the selected power module before maintenance.
	Cap Remain T	Capacitor's remaining time of the selected power module before maintenance.
	REC IGBT Temperature	Temperature of Rectifier IGBT phase L1, L2 and L3.
	INV IGBT Temperature	Temperature of Inverter IGBT phase L1, L2 and L3.
	Inlet Temperature (°C)	Inlet temperature of the selected power module.
	Outlet Temperature (°C)	Outlet temperature of the selected power module.
S-CODE	Fault Code	For the maintenance personnel.

Table 5.3.2-1 Description of each submenu of Module

5.3.3 Setting

Touch the icon  (Setting) and the system enters the page of the "Setting" as shown in Fig. 5.3.3-1.



The submenus are listed on the right side of the Setting interface.



Users can enter each of the setting interfaces by touching the relevant icon.

The submenus are described in detail below in Table 5.3.3-1.

Fig. 5.3.3-1 Setting screen

Submenu	Contents	Meaning
DATE & TIME	Date format setting	Three formats: "year-month-day" / "month-day-year" / "day-month-year".
	Time setting	Setting time.
LANGUAGE	Current language	Language in use.
	Language selection	English, French and Spanish are selectable (the setting takes action immediately after touching the language icon).
COMM	Device address	Setting the communication address.
	RS232 protocol selection	For GE Service purposes only.
	Baudrate	Setting the baudrate.
	Modbus mode	Setting mode for Modbus: ASCII and RTU selectable.
	Modbus parity	Setting the parity for Modbus.
USER	AC voltage settings	GE Service.
BATTERY	Battery configuration	GE Service.
SERVICE	Parallel and ECO	GE Service.
SETUP	Factory settings	For the factory use.
CONFIGURE	Factory settings	For the factory use.

Table 5.3.3-1 Description of each submenu of Setting

	<p>NOTE !</p> <p>Changes in the service settings pages may damage the UPS, the battery and the connected load. Contact your GE SERVICE CENTER if changes are required after start-up.</p>
	<p>ATTENTION !</p> <p>Ensure the number of the battery, set via the menu or the monitoring software, is completely equal to the real installed number. Otherwise it will cause serious damage to the batteries or the equipment.</p>

5.3.4 Log



Touch the icon (Log) and the system enters the interface of the "Log" as shown in Fig. 5.3.4-1. The log is listed in reverse chronological order (i.e. the first on the screen with #1 is the latest), which displays the events, warnings and faults information and the data and time they occur and disappear.

NO.	M# EVENTS	TIME
1	0 # Load On UPS-Set	28 - 02 - 2018 13:25:37
2	0 # Load On Bypass-Set	25 - 02 - 2018 13:23:55
3	0 # Battery Float-Set	23 - 02 - 2018 13:21:22
4	0 # Battery Connected-Set	20 - 02 - 2018 13:19:45
5	5 # Module Inserted-Set	15 - 02 - 2018 13:19:45
6	0 # Battery Not Connected-Set	10 - 02 - 2018 9:34:57
7	5 # Load On Bypass-Set	09 - 02 - 2018 12:03:26
8	0 # Load On UPS-Set	07 - 02 - 2018 8:28:12
9	0 # Manual Transfer Bypass-Set	05 - 02 - 2018 20:31:45
10	0 # On UPS Inhibited-Clear	01 - 09 - 2016 7:15:33

Events, warnings and faults information with data and time

Total Log Items 135

Navigation icons: Home, System, Settings, Log, Up/Down, Waveform.

Fig. 5.3.4-1 Log screen

Every event recorded in the table includes the sequence number, the content of the event and the time stamp when it occurs.

Sequence number

The serial number of the event.

Content of the event

Display the information of the events, warnings and faults (0# means the event happens to the cabinet, n# means the information is sent by the n-th power module).

Log items in red font stand for events in faults, Log items in yellow font stand for warning events, Log items in green font stands for normal event, Log items in grey font stands for faults or warnings disappear.

	NOTE ! Different colors of the words represent different level of events: <ul style="list-style-type: none"> Green, an event occurs. Yellow, warning occurs. Grey, the event occurs then clears. Red, faults happen.
--	--

Time of the Event

The time of the event occurs.

Total Log Items


Display the total number of events.

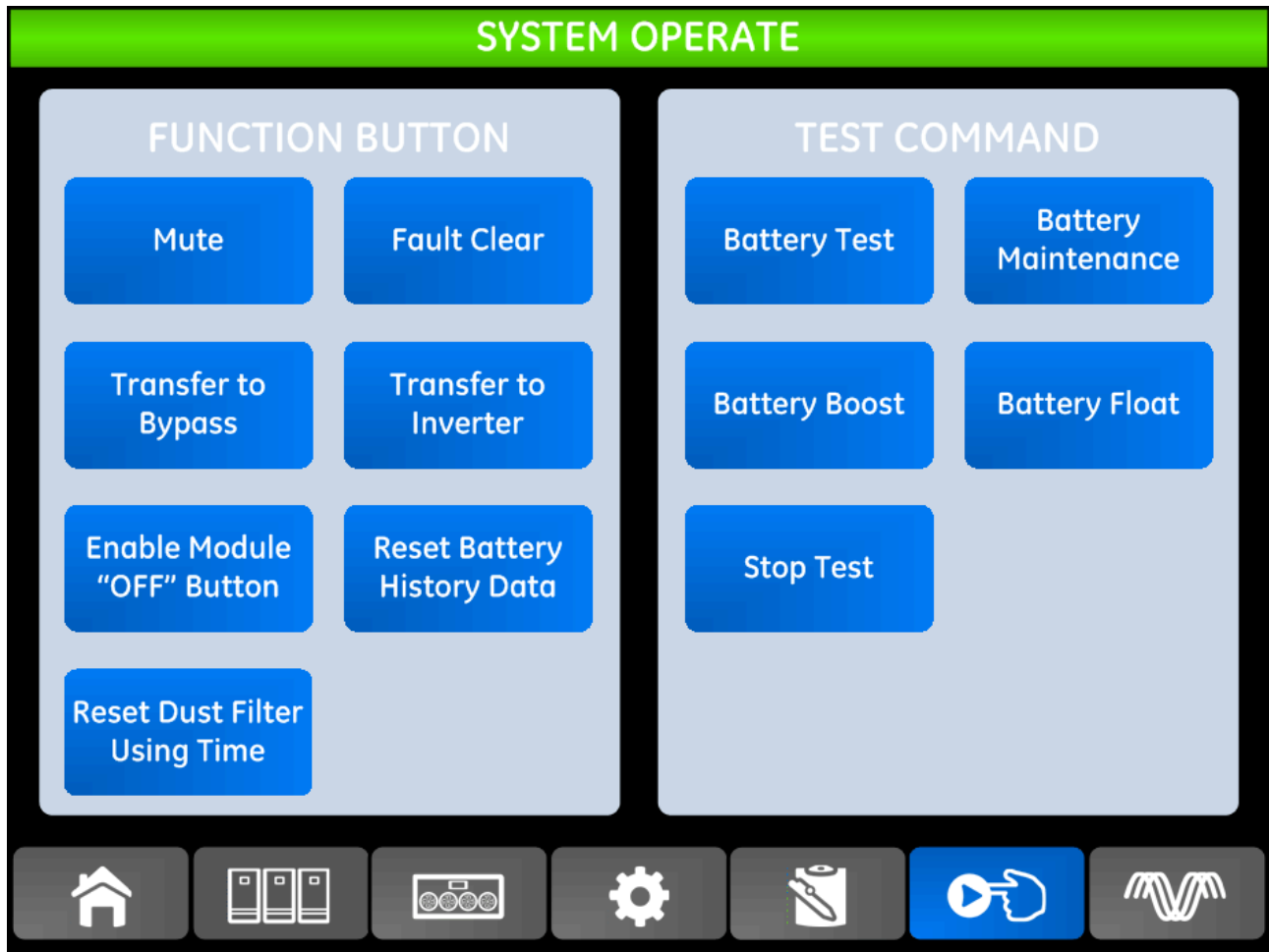
The system can record 895 events. If the number exceeds 895, the system will delete the earliest events.



Turn the list page up/down to check the information of the events.

5.3.5 Operate

Touch the icon  (Operate) and the system enters the page of the “Operate” as shown in Fig. 5.3.5-1.





TME SM_UL_015-090_LCD_Screen Operate_01US

Fig. 5.3.5-1 Operate screen

The “Operate” menu includes FUNCTION BUTTON and TEST COMMAND. The contents are described in details below.

FUNCTION BUTTON



Esc Mute (Clear/Restore Buzzing)

Mute or Restore buzzing of the system by touching the icon  or .

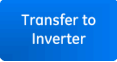
Fault Clear

Clear the faults by touching the icon . For GE Service purposes only.

Transfer to and ESC Bypass

Transfer to Bypass mode or cancel this command by touching the icon  or . For GE Service purposes only.

Transfer to Inverter

Transfer the Bypass mode to Inverter mode by touching the icon . For GE Service purposes only.



WARNING !

Pressing the "Transfer to Inverter" icon, the system will transfer regardless the synchronization.

This is a very dangerous operation, it is recommended **NEVER TO USE IT!**


Enable Module "OFF" Button

Enable the switch for powering OFF the Power module by touching the icon .


Reset Battery History Data

Reset the battery history data by touching the icon , the history data includes the times of discharge, days for running and hours of discharging. For GE Service purposes only.

Reset Dust Filter Using Time


Reset the time of dust filter using by touching the icon , it includes the days of using and maintenance period. For GE Service purposes only.

Front Page


Return to HOME screen by touching the icon .

TEST COMMAND


Battery Test

By touching the icon , the system transfers to the Battery mode to test the condition of the battery. Test can be performed with UPS working on inverter only if the battery charge level is not less than 25%, otherwise, the system will transfer to bypass. Before performing battery test ensure that the bypass is working normally. This operation requires a GE Service Technician.

Battery Maintenance

By touching the icon , the system transfers to the Battery mode. This function is used for maintaining the battery, which requires the normality of the bypass and minimum capacity of 25% for the battery. This operation requires a GE Service Technician.

Battery Boost

By touching the icon , the system starts boost charging.

Battery Float

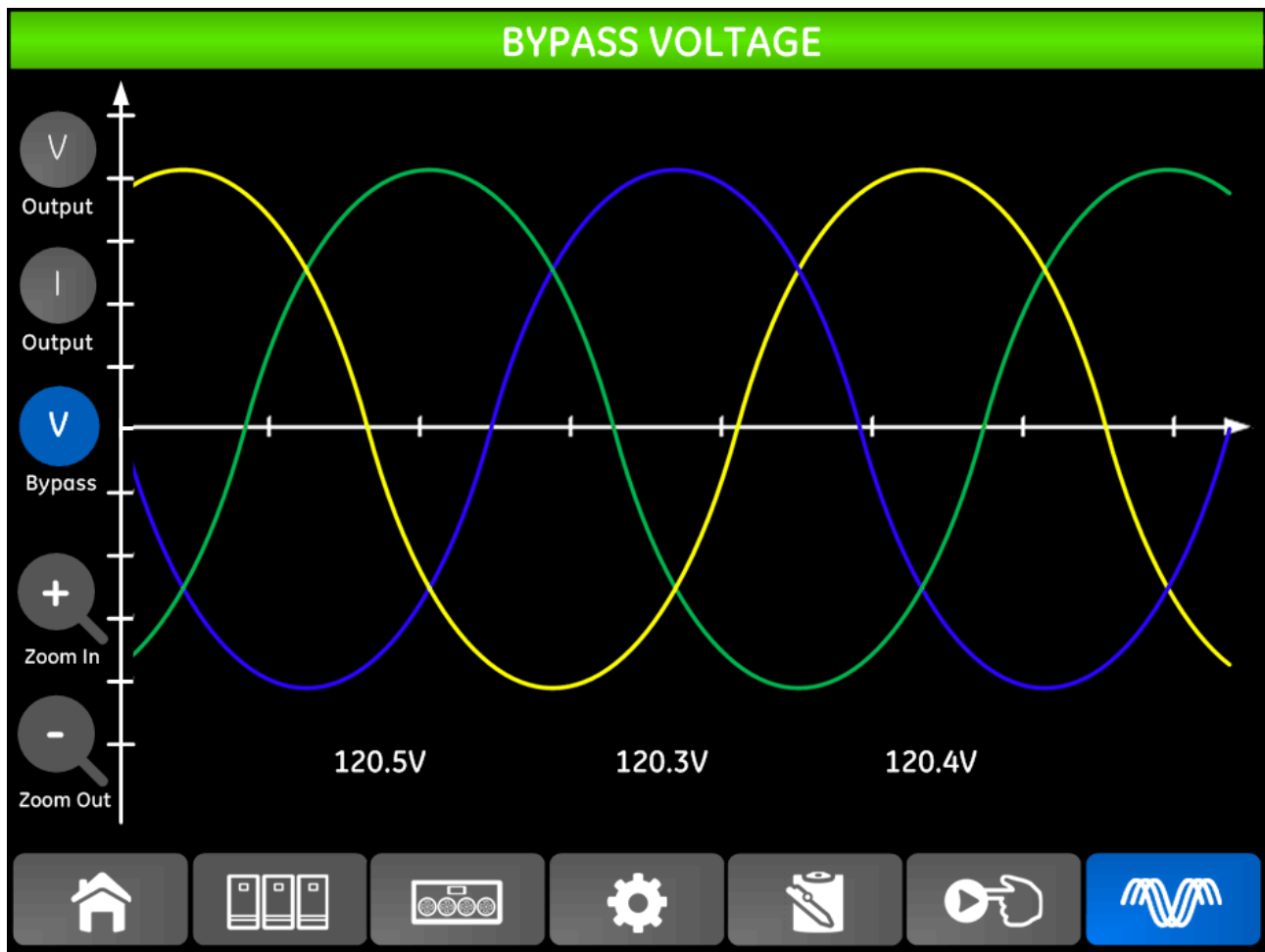
By touching the icon , the system starts float charging.

Stop Test

By touching the icon , the system stops battery test or battery maintenance.

5.3.6 Scope

Touch the icon  (Scope) and the system enters the page of the "Scope" as shown in Fig. 5.3.6-1.



TMESH_UL_015-090_LCD_Screen Scope bypass voltage_01U5

Fig. 5.3.6-1 Scope screen

Users can view the waveforms of Output voltage, Output current and Bypass voltage by touching the corresponding icon on the left side of the interface. The waveforms can be zoomed in or zoomed out.



Touch the icon to display the 3-phase output voltage.



Touch the icon to display the 3-phase output current.



Touch the icon to display the 3-phase bypass voltage.



Touch the icon to zoom in the waveforms.



Touch the icon to zoom out the waveforms.

6 OPERATIONS

6.1 UPS START-UP

6.1.1 Start in Normal mode

The UPS must be started up by commissioning engineer after the completeness of installation. The steps below must be followed:

1. Ensure all the external circuit breakers are open.
2. Close the “input external circuit breaker” and the “static bypass breaker Q5”, the system starts initializing. If the system has dual inputs close both of the external breakers.
3. The LCD in front of the cabinet is lit up. The system enters the home page, as shown in *Fig. 5.2.3-1*.
4. Notice the energy bar in the home page, and pay attention to the LED indicators. The rectifier flashes indicating the rectifier is starting up. The LED indicators are listed below in *Table 6.1.1-1*.

Indicator	Status
Rectifier	Green flashing
Battery	Red
Bypass	OFF

Indicator	Status
Inverter	OFF
Load	OFF
Status	Red

Table 6.1.1-1 Rectifier starting up

5. After 30s, the rectifier indicator goes steady green, presenting the finishing of rectification and bypass static switch closes then the inverter is starting up. The LED indicators are listed below in *Table 6.1.1-2*.

Indicator	Status
Rectifier	Green
Battery	Red
Bypass	Green

Indicator	Status
Inverter	Green flashing
Load	Green
Status	Red

Table 6.1.1-2 Inverter starting up

6. The UPS transfers from the bypass to inverter after the inverter goes normal. The LED indicators are listed below in *Table 6.1.1-3*.

Indicator	Status
Rectifier	Green
Battery	Red
Bypass	OFF

Indicator	Status
Inverter	Green
Load	Green
Status	Red

Table 6.1.1-3 Supplying the load

7. The UPS is in Normal Mode. Close the battery circuit breaker and the UPS starts charging the battery. The LED indicators are listed below in *Table 6.1.1-4*.

Indicator	Status
Rectifier	Green
Battery	Green
Bypass	OFF

Indicator	Status
Inverter	Green
Load	Green
Status	Green

Table 6.1.1-4 Normal mode

8. Close the output circuit breaker for the load and it finishes the start-up of the UPS.

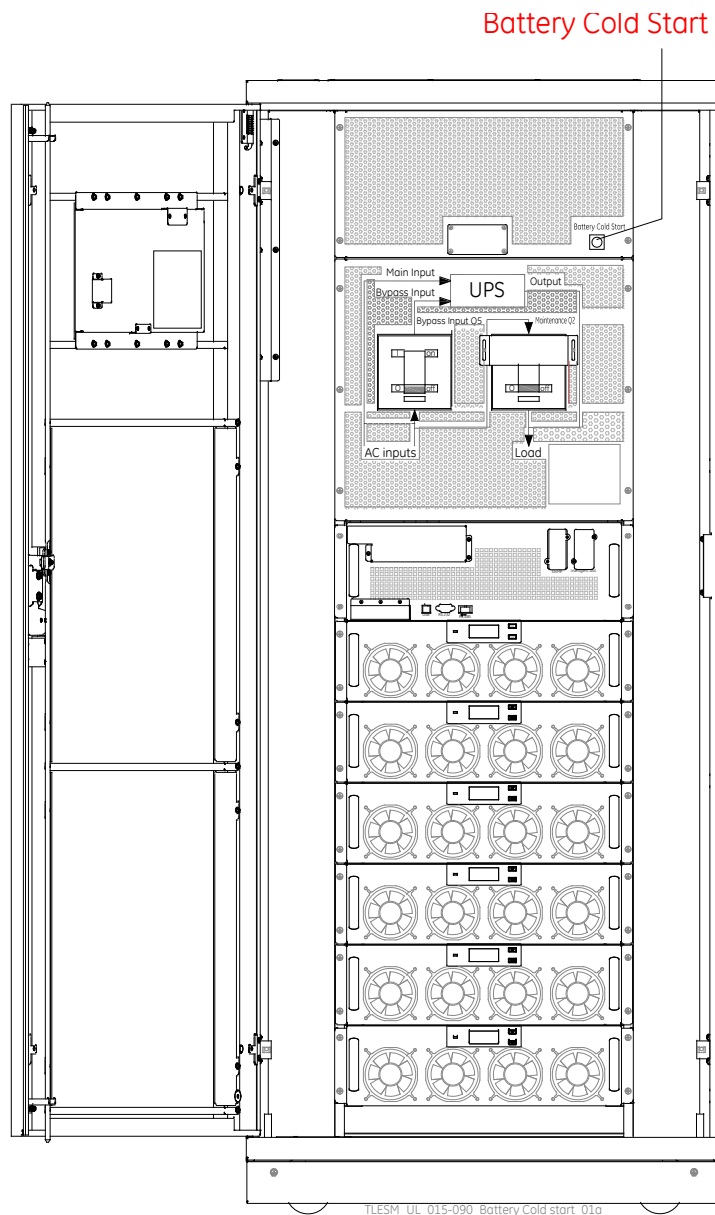


NOTE !

- When the system starts, the stored setting will be loaded.
- Users can browse all events during the process of the start-up by checking the menu Log.
- Users can check the information of the power module by the keys on front panel.

6.1.2 Start from battery

The start from battery is referring to Battery Cold Start.



The steps for the start-up are as follows:

1. Verify that the battery is correctly connected; close the external battery circuit breaker.
2. Press the red button for the battery cold start (see Fig. 6.1.2-1). The system is then powered by the battery.
3. After that, the system is starting up following steps 3 in Section 6.1.1 and the system transfers to Battery mode in 30 seconds.
4. Close the external output power supply isolation to supply the load, and the system is working on Battery mode.

Fig. 6.1.2-1 The position of the Battery Cold Start button

6.2 PROCEDURE FOR SWITCHING BETWEEN OPERATION MODES



NOTE !


The following procedures must be performed by GE SERVICE TECHNICIAN only.

6.2.1 Switching the UPS from Normal mode into Battery mode

The UPS transfers to Battery model immediately after the utility failure or utility out of tolerance.

6.2.2 Switching the UPS from Normal mode into Bypass mode

Two ways to transfer the UPS into Bypass mode from Normal mode:

1. Enter the menu Operate, touch the icon "Transfer to Bypass"  and the system transfers to Bypass mode.
2. Press and hold the "BYP" key on the operator control panel for more than two seconds and the system transfers to Bypass mode.




WARNING !

Ensure the bypass is working normally before transferring to Bypass mode.
Or it may cause failure.

When the UPS is working on Bypass mode, the inverter is inhibited and "Esc Bypass" is the normal way to release the system for automatic transfer to inverter when possible.

6.2.3 Switching the UPS into Normal mode from Bypass mode

Two ways to transfer the UPS into Normal mode from Bypass Mode:

1. Enter the menu Operate, touch the icon "Esc Bypass"  and the system transfers to Normal mode.
2. Press and hold the "INV" key on the operator control panel for more than two seconds and the system transfers to Normal mode.



WARNING !

Normally, the system will transfer to Normal mode automatically after pressing the icon "Esc Bypass".

It is recommended NEVER to use "Transfer to Inverter", this function is used when the frequency of the bypass is over track and when the system needs to transfer to Normal mode by manual.

This is very dangerous since the system will transfer regardless the synchronization!

6.2.4 Switching the UPS from Normal mode into Maintenance Bypass mode

**WARNING !**

Before making this operation, be sure that bypass supply is regular and the inverter is synchronous with it.

These following procedures can transfer the load from the UPS inverter output to the maintenance bypass supply, which is used for maintaining the bypass module.

1. Transfer the UPS into Bypass mode following *Section 6.2.2*.
2. Open the battery breaker and close the “maintenance bypass breaker Q2”.
3. Open the “static bypass breaker Q5” and the load is powered through maintenance bypass.
4. Pull out the bypass module to completely shut down the UPS electronics.

6.2.5 Switching the UPS into Normal Mode from Maintenance Bypass Mode

These following procedures can transfer the load from the Maintenance Bypass mode to inverter output.

1. Insert the bypass module, the static bypass will automatically turn on 30s after the touch screen. The bypass indicator LED will turn ON, the load is powered through maintenance bypass and static bypass.
2. Close the “static bypass breaker Q5”.
3. Switch OFF the “maintenance bypass breaker Q2”.
The load is now supplied by the static bypass, the rectifier(s) and inverter(s) will start automatically.
4. After approximately 60s the system transfers to Normal mode.

6.3 BATTERY MANUAL

If the battery is not in use for a long time, it is necessary to test the condition of the battery. Two methods are provided:

1. Manual Discharging test

Enter the menu Operate as shown in Fig.6.3-1 and touch the icon "Battery Maintenance", the system transfers into the Battery mode for discharging.

The discharging can be stopped by touching the "Stop Test" icon.

This operation requires a GE Service Technician.

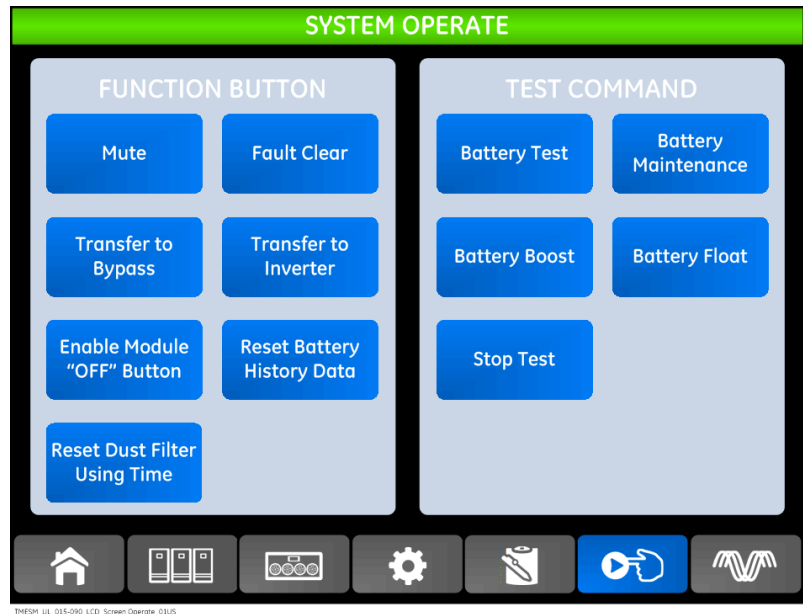


Fig. 6.3-1 Battery maintenance

2. Auto discharging

The system can maintenance the battery automatically when the setting is done.

The setting procedures require a GE Service Technician.

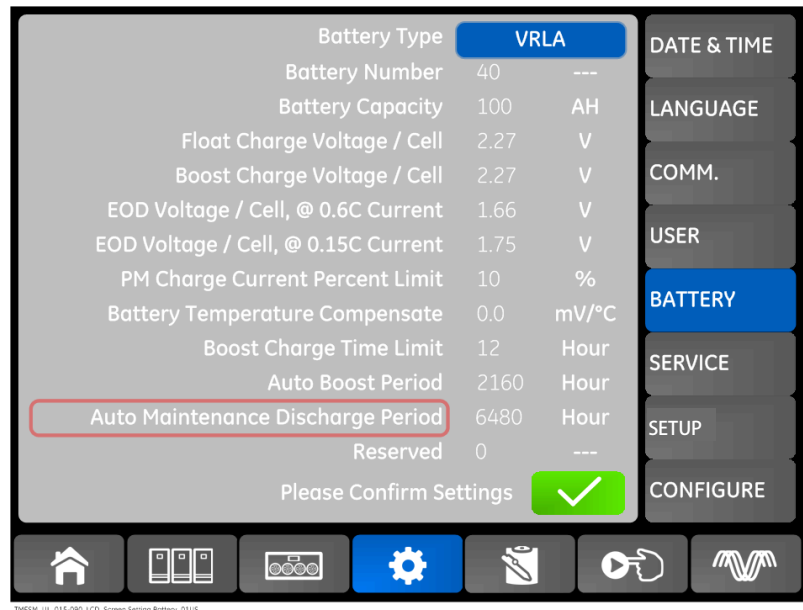


Fig. 6.3-2 Setting period for battery auto discharge



WARNING !

The load for the auto maintenance discharge should be 20% to 100%. If not, the system will not start the process automatically.

6.4 EPO – EMERGENCY POWER OFF

TMESM_UL_015-090_Control panel UPS_EPO_01US

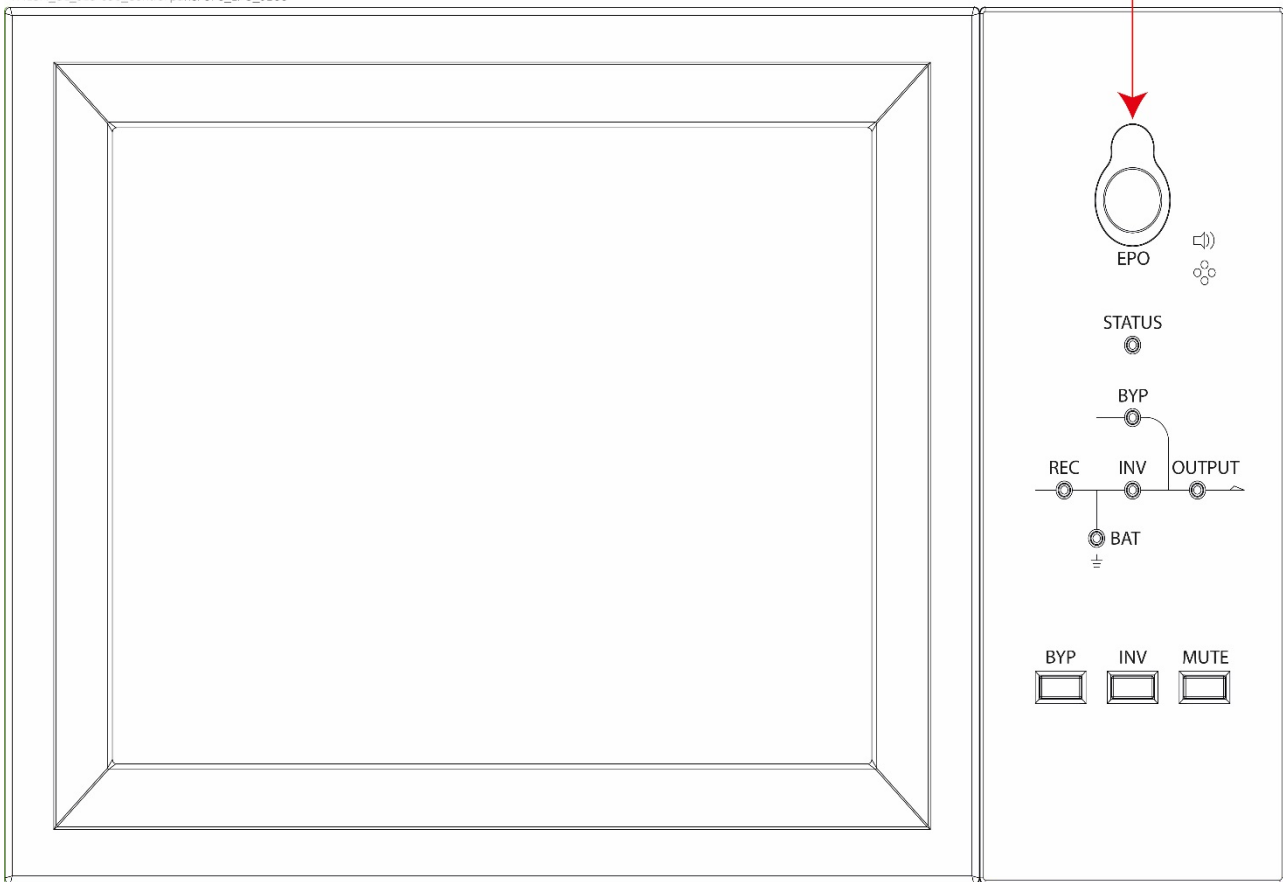


Fig. 6.4-1 EPO Button

The EPO button located in the operator control and display panel (see Fig. 6.4-1) is designed to switch OFF the UPS in emergency situations (e.g., fire, flood, etc.).

Once pressed the EPO button, the system will turn OFF the rectifier, inverter, stop powering the load and charging the battery immediately.

If the input Utility is present, the UPS control circuit will remain active, the EPO can be reset from the

menu Operate, touch the icon .

Attention: this operation requires a GE SERVICE TECHNICIAN.

To completely isolate the UPS, users need to open the external utility input supply to the UPS. Users can restart the UPS by powering the UPS again.



WARNING !

**When the EPO is triggered, the load is not powered by the UPS.
Be careful to use the EPO - EMERGENCY POWER OFF function.**

7 MAINTENANCE

**WARNING !**

All maintenance and service works must be performed by **GE SERVICE TECHNICIAN**. Refer to the “**SAFETY RULES**” described on *Chapter 1*.

7.1 GENERAL MAINTENANCE

A UPS system, like other electrical equipment, needs periodic preventive maintenance.

A regular maintenance check of your installation guarantees higher reliability of your safe power supply.

GE recommends to perform the first service within **12 months** from the commissioning date or within **18 months** from delivery date.

Subsequent services to perform every **12 months**.

Preventive maintenance work on the UPS can be done only by trained *SERVICE TECHNICIANS*.

We therefore recommend you sign a Maintenance and Service contract with the local **GE SERVICE CENTER** organisation.

7.2 SERVICE CHECK


Some components of the UPS which need periodic maintenance, if not replaced, could cause a reliability reduction of the supply system.

We highly recommend that you contact your **GE SERVICE CENTER** for preventive maintenance work.

**NOTE !**

Failure to perform mandatory preventative maintenance on components documented in the UPS product manual may result in thermal damage to the equipment, its surroundings, and an increased risk of personnel injury.

7.3 BATTERY MAINTENANCE

	<p>NOTE !</p> <p>Perform mandatory battery maintenance per battery's manufacturer product manual. This includes electrical and thermal measurements, inspection, cleaning, replacement and re-torque of connections.</p> <p>Failure to perform proper maintenance on the battery, per the battery manufacturer's recommendation, including scheduled battery replacement, may result in thermal damage to the equipment and an increased risk of personnel injury.</p> <p>GE declines any responsibility for any damage to the system and the surrounding caused by battery when the battery maintenance program is provided by other than GE itself and GE authorized partners.</p>
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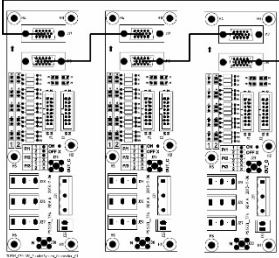
For the Lead-Acid maintenance free battery, when maintenance the battery according to requirements, battery life can be prolonged.

The battery life is mainly determined by the following factors:

1. Installation
The battery should be placed in dry and cool place with good ventilation.
Avoid direct sunlight and keep away from heat source.
When installing, ensure the correct connection to the batteries with same specification.
2. Temperature
The most suitable storage temperature is 68°F (20°C) to 77°F (25°C).
3. Charging/discharging current
The best charging current for the lead-acid battery is 0.1C.
The maximum charging current for the battery can be 0.2C.
The discharging current should be 0.05C-3C.
4. Charging voltage
In most of the time, the battery is in standby state.
When the Utility is normal, the system will charge the battery in Boost mode (constant voltage with maximum limited) to full and then transfers to the state of float charge.
5. Discharge depth
Avoid deep discharging; which will greatly reduce the life time of the battery.
When the UPS runs in Battery mode with light load or no load for a long time, it will cause the battery to deep discharge.
6. Check periodically
Observe if any abnormality of the battery, measure if the voltage of each battery are in balance.
Discharge the battery periodically.

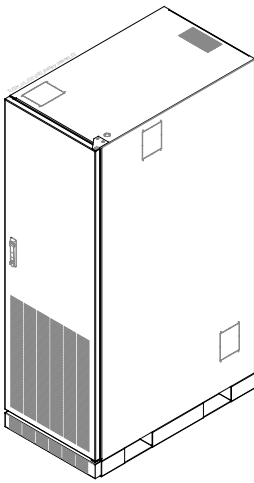
8 OPTION

8.1 OPTIONS GENERAL VIEW



Parallel System Kit

Allows extending the unit to a Parallel System with 2 or up to 3 units connected on the same bus, which ensure the highest reliability rate and increase the power availability without prior investments.



BC44 Battery cabinet

Cabinet with a battery that has similar characteristics and is the same size as a UPS, which allows an increase in autonomy in the event of a power cut.

Dimensions (W x D x H): 24.00" x 42.00" x 75.00" (610 x 1067 x 1905 mm)

8.2 OPTIONS ASSEMBLY AND CONNECTION

8.2.1 BC44 Battery cabinet



ATTENTION !

The installation and cabling of the "BC44 Battery cabinet" must be performed by GE SERVICE TECHNICIAN.

Before proceeding to "BC44 Battery cabinet" connection, follow the *Safety Rules* concerning the battery.

Make sure that the UPS is not powered and the "Battery breaker" is open (Pos. O).

Before closing the "Battery breaker" verify the correct polarity of the battery connection.

BC44 Battery cabinet

Battery	Runtime from 5 to 78 minutes (with 1 to 4 "BC44 Battery cabinet")
Dimensions (W x D x H)	24.00 x 42.00 x 75.00 inches / 610 x 1067 x 1905 mm
Weight	1050 lbs / 476 kg to 2720 Lbs / 1234 kg
Type of cables connection	75°C rating; size per NEC Table 310.16 and/or all applicable national and local codes (see also Section 4.9.3).

"BC44 Battery cabinet" can be located **on either side of the UPS**.

"BC44 Battery cabinet" connection cables are connected to UPS bars **+/-N/-** and **PE** (GND).

The connecting cables (+/-N/-PE) are supplied with the "BC44 Battery cabinet".

Connect the cables to UPS bars using **M10 bolts** with a torque wrench at **355Lb-in / 40Nm**.



NOTE !

Check for sufficient floor loading capacity.

For further information please consult the "*Installation, Operation & Maintenance Manual*" of the "BC44 Battery cabinet".

UPS model	Protections for utility voltages (3 x 208Vac / 120 Vac)	Cables section Local Standard and cables installation disposal shall be applied
TME Modular Series 15	3 x 90A	3 x AWG 3 + AWG 8
TME Modular Series 30	3 x 175A	3 x AWG 3/0 + AWG 6
TME Modular Series 45	3 x 250A	3 x 250 kcmil + AWG 4
TME Modular Series 60	3 x 350A	6 x AWG 3/0 + AWG 3
TME Modular Series 75	3 x 450A	6 x AWG 4/0 + AWG 2
TME Modular Series 90	3 x 500A	6 x 300 kcmil + AWG 2

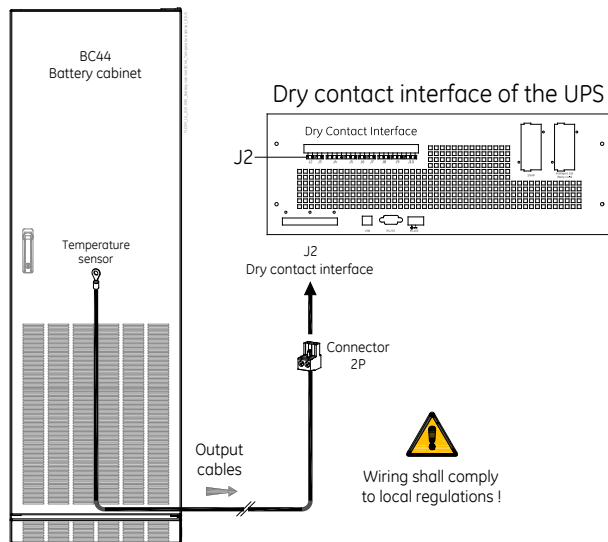
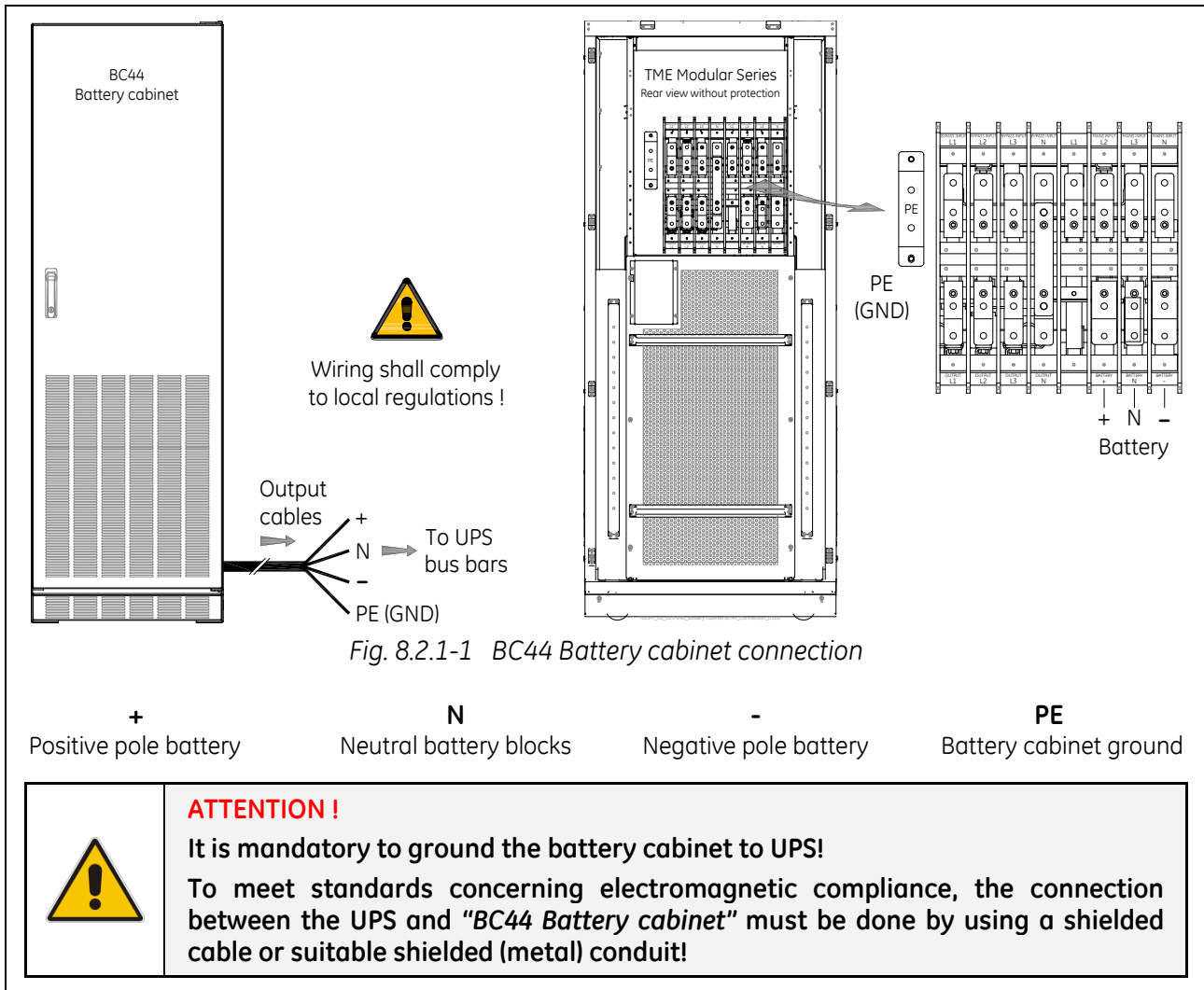


Fig. 8.2.1-2 Battery temperature sensor connection

Battery temperature sensor

The "BC44 Battery cabinet" is supplied with a battery temperature sensor cable (standard length: 5m).

This is to compensate the battery charge voltage (only for type VRLA without maintenance) based on the working temperature.

The battery temperature sensor must be mounted and fixed in the battery cabinet while the "Connector 2P" must be connected to "J2 - Dry contact interface" of the UPS.

DANGER !

RISK OF ELECTRIC SHOCK: The battery sensor is connected to the primary circuit. The cable must be routed under the floor or through conduit, so that it's not accessible and pulling is unlikely to happen.

Keep this cable separated from SELV cables.

9 SECURE DEPLOYMENT GUIDE

9.1 INTRODUCTION

This document provides information that can be used to help improve the cyber security of systems that include UPS, SNMP/Web adapter and other connectivity products.

It is intended for use by service engineers, integrators, IT professionals, and developers responsible for deploying and configuring UPS systems and connectivity products.

Security is the process of maintaining the confidentiality, integrity, and availability of a system:

- Confidentiality: Ensure only the people you want to see information can see it;
- Integrity: Ensure the data is what it is supposed to be;
- Availability: Ensure the system or data is available for use.

GE recognizes the importance of building and deploying products with these concepts in mind and encourages customers to take appropriate care in securing their GE products and solutions.

Firewalls and other network security products, including Data Diodes and Intrusion Prevention Devices, can be an important component of any security strategy.

However, a strategy based solely on any single security mechanism will not be as resilient as one that includes multiple, independent layers of security.

Therefore, GE recommends taking a “Defence in Depth” (DiD) approach to security.

Defence in Depth is the concept of using multiple, independent layers of security to raise the cost and complexity of a successful attack.

To carry out a successful attack on a system, an attacker would need to find not just a single exploitable vulnerability, but would need to exploit vulnerabilities in each layer of defence that protects an asset.

9.2 GENERAL RECOMMENDATIONS

The following security practices should be followed when using GE products and solutions.

- The UPS devices and connectivity products covered in this document were not designed for or intended to be connected directly to any wide area network, including but not limited to a corporate network or the Internet at large.
Additional routers and firewalls that have been configured with access rules customized to the site's specific needs must be used to access devices described in this document from outside the local control networks.
If a system requires external connectivity, care must be taken to control, limit, and monitor all access, using, for example, virtual private networks (VPN) or Demilitarized Zone (DMZ) architectures.
- Harden system configurations by enabling/using the available security features, and by disabling unnecessary ports, services, functionality, and network file shares.
- Apply all of the latest software/firmware patches (ECN process).
- Use whitelisting software on UPS monitoring systems and keep the whitelist up-to-date.

9.3 CHECKLIST

This section provides a sample checklist to help guide the process of securely deploying UPS system and connectivity products.

1. Create or locate a network diagram.
2. Identify and record the required communication paths between nodes.
3. Identify and record the protocols required along each path, including the role of each node.
4. Revise the network as needed to ensure appropriate partitioning, adding firewalls or other network security devices as appropriate. Update the network diagram.
5. Configure firewalls and other network security devices.
6. Enable and/or configure the appropriate security features on each device.
7. On each device, change every supported password to something other than its default value. Encourage users to schedule password changes and use passwords of certain complexity.
8. Harden the configuration of each device, disabling unneeded features, protocols and ports.
9. Implement controlled physical access to the UPS device and/or UPS room.
10. Discourage user from bridging RS232/RS485 Modbus to Ethernet.
For cases that product application absolutely requires such setup, recommend deploying a Modbus firewall device in front of the bridge and set particular configuration that would filter out all Modbus registers contributing to possible vulnerabilities.
Provide user with ideas how to reduce surface of attack by limiting Modbus communications to specific IP source addresses and specific operations (read-only vs. read-write), etc.
11. Test/qualify the system.
12. Create an update/maintenance plan.

9.4 COMMUNICATION REQUIREMENTS

Communication between different parts of a system is, and must be, supported.

However, the security of a system can be enhanced by limiting the protocols allowed, and the paths across which they are allowed, to only what is needed.

This can be accomplished by disabling every communication protocol that isn't needed on a particular device, and by using appropriately configured and deployed network security devices (for example, firewalls and routers) to block every protocol (whether disabled or not) that doesn't need to pass from one network/segment to another.

GE recommends limiting the protocols allowed by the network infrastructure to the minimum set required for the intended application.

Successfully doing this requires knowing which protocol is needed for each system-level interaction.

9.5 SECURITY CAPABILITIES

Security features available in each device can be used as part of a defence-in-depth strategy to secure a system.

9.5.1 Physical security perimeter protection

1. All hardware should be placed in locked cabinets/rooms, with policies and procedures to restrict access to the key.
2. Network equipment such as switches, routers, firewalls, and Ethernet cabling should be physically protected in locked enclosures such as cabinets or closets with policies and procedures to restrict access to these enclosures.
3. Whenever possible, there should be no physical network path from an UPS or connectivity device to the Internet. It should not be possible for an attacker to reach UPS system network from any Internet-facing computer.
4. Networks should always be physically segmented to avoid exposure of UPS and connectivity device networks.
5. Each UPS system asset should be visibly labelled by a unique identifier, with all expected asset identification compiled into an access controlled list.

9.5.2 Electronic security perimeter protection

1. All external access to a UPS network should be managed through a Virtual Private Network (VPN) or similar technology leveraging two-factors authentication (2FA).
2. Next-Generation Firewalls should be properly configured and deployed at each conduit between physical networks that deny all but the specifically allowed protocol families, source addresses, and destination addresses, and specific application-level commands between the two adjacent networks. For example, a Next-Generation Firewall could prohibit write operations across networks while allowing read operations.
3. If one network node such as a PLC or HMI uses unauthenticated protocols to exchange information or commands with another network node on the same physical network, a Next-Generation Firewall could be deployed between the two network nodes. This Next-Generation Firewall should be configured to explicitly whitelist all expected messages between the two network nodes, and deny all other unexpected messages.
4. To detect and alert for unexpected, unauthenticated messages on a given network, an Intrusion Detection System (IDS) could be configured and deployed. Consider configuring the IDS to log all events to a Security Information and Event Management (SIEM) system that aggregates all security information on the ICS network.
5. To detect and actively prevent unexpected, unauthenticated messages on a given network from reaching a given network node, an Intrusion Prevention System (IPS) could be configured and deployed. Consider configuring the IPS to log all events to a Security Information and Event Management (SIEM) system that aggregates all security information on the ICS network.
6. To limit the impact of the compromise of any single user account, it is recommended to divide administrator's privileges into several user accounts, each for its own operational function.
7. To limit the impact of the compromise of any single set of credentials (user name, password) for any equipment in the UPS network, it is recommended to never re-use credentials for different tools or purposes.
8. Carefully protect sources of and access to credentials (user names, passwords) for all UPS and connectivity devices, including switches, routers, firewalls, IDS, IPS, etc.
9. Enforce a policy of rotating credentials for equipment periodically and after personnel changes. Note that products with no support for enforcement of unique passwords over time should be compensated for with policies and procedures that require a history of unique passwords.

9.5.3 Password management

GE strongly recommends the use of long (12 characters or more), complex passwords wherever passwords are used for authentication. Whenever using a password scheme with a fixed maximum character length for passwords, GE recommends setting passwords to utilize the full character length available whenever possible in order to make it more difficult for attackers to crack passwords.

9.6 CONFIGURATION HARDENING

This section is intended to reduce the potential attack surface by providing information that can be used to harden the configuration of the UPS system and connectivity products that are present in a particular installation.

Configuration Hardening should be considered in addition to enabling and using security features such as Authentication, Access Control and Authorization.

GE recommends disabling, on each product, all ports, services and protocols that aren't required for the intended application.

The Ethernet Interface can be configured to disable a number of services, such as ftp, http, telnet.

Note that some of these settings will not entirely close the TCP/UDP port, but they will still reduce the attack surface.

9.7 NETWORK BANDWIDTH LIMITING

In order to reduce the likelihood of intentional or accidental network flooding that could cause a loss of availability of an Ethernet interface, GE strongly encourages following the relevant recommendations in the section "9.5 - SECURITY CAPABILITIES".

To further mitigate the loss of availability for a particularly critical asset, a switch or firewall configured for ingress and egress rate-limiting can be placed directly between the UPS or connectivity devices and the rest of the network.

In the event of a network storm, the switch or firewall will selectively drop traffic to limit the rate of traffic that reaches a given device.

9.8 SOFTWARE UPDATES AND PATCH MANAGEMENT

A strategy for applying security fixes, including firmware updates, and configuration changes, should be included in a facility's security plan.

Applying these updates will often require that an affected product be temporarily taken out of service.

Only GE representative are allowed to perform maintenance on UPS or connectivity devices.

They are allowed to:

- Collect/fetch the GE recommended firmware/software from GE secured storage/sources;
- Perform firmware/software upgrade or modify parameters or configuration on GE devices.

Finally, some installations require extensive qualification be performed before changes are deployed to the production environment.

While this requirement is independent of security, ensuring the ability to promptly apply security fixes while minimizing downtime may drive the need for additional infrastructure to help with this qualification.

9.9 GOVERNMENT AGENCIES AND STANDARDS ORGANIZATIONS

Government agencies and international standards organizations may provide guidance on creating and maintaining a robust security program, including how to securely deploy and use Industrial Control Systems.

For example, the U.S. Department of Homeland Security has published guidance on Secure Architecture Design and on Recommended Practices for cybersecurity with Industrial Control Systems.

Similarly, the International Society of Automation publishes the ISA-99 specifications to provide guidance on establishing & operating a cyber-security program, including recommended technologies for industrial automation and control systems.

Such documentation, when appropriate, should be considered in addition to this document.

It is recommended to note in this section **Notes**, with date and short description all the operations performed on the UPS, as: maintenance, components replacement, abnormal situations, etc.

Modifications reserved

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