Lenovo

6U Rack or Tower UPS RT 8.0 kVA and RT 11.0 kVA and Maintenance Bypass Installation, User, Operation, and Maintenance Guide

Machine Types: 5594-8KX, 5594-8PX, 5594-9KX, 5594-9PX

- Before using this information and the product it supports, be sure to read and understand the safety information and the safety instructions, which are available at: http://thinksystem.lenovofiles.com/help/topic/safety_documentation/pdf_files.html
- This equipment is not suitable for use in locations where children are likely to be present.

Notes:

- In addition, be sure that you are familiar with the terms and conditions of the Lenovo warranty for your server / hardware, which can be found at: https://support.lenovo.com/warrantylookup/warrantypolicy
- Check the warranty and maintenance agreement status for your server / hardware, which can be done at: http://datacentersupport.lenovo.com/warrantylookup
- If you require assistance, please check https://support.lenovo.com/documents/LNVO-CALL prior to calling Lenovo Technical Support
- Lenovo Data Center phone numbers are available at: https://datacentersupport.lenovo.com/supportphonelist
- See also Appendix C. Getting help and technical assistance

Fifth Edition (May 2022)

Contents

General Safety

These are the standard Safety instructions.

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج يجب قراءة الملاحظات الامنيه

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读。
(安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Pčed instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προιόν αυτό, διαβάστε τις πληροφορίες ασφάλειας.

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztongsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пожалуйста! Прочитайте информацию по безопасности перед установкой этого продукта!

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Преди да инсталирате този продукт, моля прочетете информацията за безопастност.

Przed zainstalowaniem tego produktu, należy zapoznać się z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Преди да се инсталира овој продукт, прочитајте информацијата за безбедност.

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед початком експлуатації цього продукту, ознайомтесь з інформацією по безпеці.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

ཐོན་རྫས་འདི་བེད་སྤྱོད་མ་བྱས་གོང་། སྔོན་ཀྱི་ཡིད་གཟབ་བྱ་འདྲ་མིན་ཡོད་པའི་འདོད་སྣེ་རབ་བཤད་དགོས།

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Bu ürünü kurmadan önce güvenlik bilgilerini okuyun.

مصنوعات کو انسٹال کرنے سے پہلے، حفاظت کی معلومات پڑھیں

مەزكۇر مەھسۇلاتنى قاچىلاشتىن بۇرۇن بىخەتەرلىك ئۇچۇرلىرىنى ئوقۇپ چىقىڭ.

Youq mwngz yungh canjbinj neix gaxgonq, itdingh aeu doeg aen canjbinj soengq cungj vahgangj ancien siusik.

Safety statements

These statements provide the caution and danger information that is used in this documentation.

Important:

Each caution and danger statement in this documentation is labelled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the Safety Information document.

For example, if a caution statement is labelled **Statement 1**, translations for that caution statement are in the Safety Information document under **Statement 1**.

Be sure to read all caution and danger statements in this documentation before you perform the procedures. Read any additional safety information that comes with your system or optional device before you install the device.

Attention! In order for the ThinkSystem hardware to operate error free in both a DC or AC electrical environment a TN-S earthing system which complies to 60364-1 IEC 2005 standard has to be present or installed.

Statement 1

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	**To Disconnect:**
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2

CAUTION: When replacing the lithium battery, use only Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100°C (212°F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Statement 3

CAUTION: When laser products (such as CD-ROMs, DVD drives, fibre optic devices, or transmitters) are installed, note the following:

- **Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.**
- **Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**

DANGER

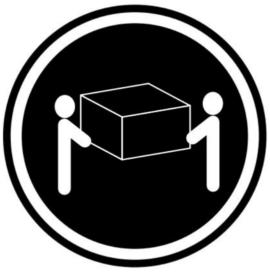
Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

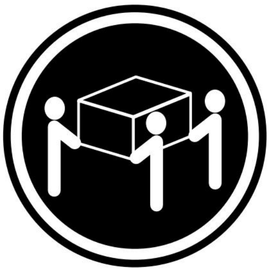
Class 1 Laser Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil A Laser de Classe 1

Statement 4

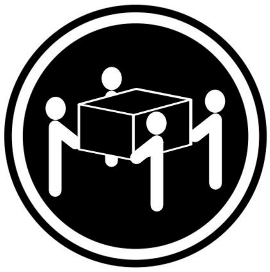
CAUTION: Use safe practices when lifting.



≥ 18 kg (39.7 lb)



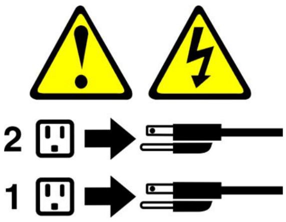
≥ 32 kg (70.5 lb)



≥ 55 kg (121.2 lb)

Statement 5

CAUTION: The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.

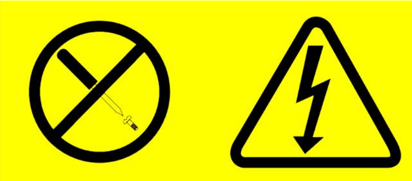


Statement 6

CAUTION: If you install a strain-relief bracket option over the end of the power cord that is connected to the device, you must connect the other end of the power cord to an easily accessible power source.

Statement 8

CAUTION: Never remove the cover on a power supply or any part that has the following label attached.



Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

Statement 12

CAUTION: The following label indicates a hot surface nearby.

Statement 26

CAUTION: Do not place any object on top of rack-mounted devices.

Statement 27

CAUTION: Hazardous moving parts are nearby.

Rack Safety Information, Statement 2

DANGER

- **Always lower the levelling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Always install the heaviest devices in the bottom of the rack cabinet.**

Guidelines for trained service technicians

This section contains information for trained service technicians.

Inspecting for unsafe conditions

Use this information to help you identify potential unsafe conditions in a Lenovo product that you are working on.

Each Lenovo product, as it was designed and manufactured, has required safety items to protect users and service technicians from injury. The information in this section addresses only those items. Use good judgement to identify potential unsafe conditions that might be caused by alterations or attachment of non-Lenovo features or optional devices that are not addressed in this section. If you identify an unsafe condition, you must determine how serious the hazard is and whether you must correct the problem before you work on the product.

Consider the following conditions and the safety hazards that they present:

- Electrical hazards, especially primary power. Primary voltage on the frame can cause serious or fatal electrical shock.
- Explosive hazards, such as a damaged CRT face or a bulging capacitor.
- Mechanical hazards, such as loose or missing hardware.

To inspect the product for potential unsafe conditions, complete the following steps:

1. Make sure that the power is off and the power cords are disconnected.
2. Make sure that the exterior cover is not damaged, loose, or broken, and observe any sharp edges.
3. Check the power cords:
   - Make sure that the third-wire ground connector is in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and the frame ground.
   - Make sure that the power cords are the correct type.
   - Make sure that the insulation is not frayed or worn.
   - Remove the cover.
4. Check for any obvious non-Lenovo alterations. Use good judgement as to the safety of any non-Lenovo alterations.
5. Check inside the system for any obvious unsafe conditions, such as metal filings, contamination, water or other liquid, or signs of fire or smoke damage.
6. Check for worn, frayed, or pinched cables.
7. Make sure that the power-supply cover fasteners (screws or rivets) have not been removed or tampered with.

Guidelines for servicing electrical equipment

Observe these guidelines when you service electrical equipment.

- Check the area for electrical hazards such as moist floors, non-grounded power extension cords, and missing safety grounds.
- Use only approved tools and test equipment. Some hand tools have handles that are covered with a soft material that does not provide insulation from live electrical current.
- Regularly inspect and maintain your electrical hand tools for safe operational condition. Do not use worn or broken tools or testers.
- Do not touch the reflective surface of a dental mirror to a live electrical circuit. The surface is conductive and can cause personal injury or equipment damage if it touches a live electrical circuit.
- Some rubber floor mats contain small conductive fibres to decrease electrostatic discharge. Do not use this type of mat to protect yourself from electrical shock.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages.
- Locate the emergency power-off (EPO) switch, disconnecting switch, or electrical outlet so that you can turn off the power quickly in the event of an electrical accident.
- Disconnect all power before you perform a mechanical inspection, work near power supplies, or remove or install main units.
- Before you work on the equipment, disconnect the power cord. If you cannot disconnect the power cord, have the customer power-off the wall box that supplies power to the equipment and lock the wall box in the off position.
- Never assume that power has been disconnected from a circuit. Check it to make sure that it has been disconnected.
- If you have to work on equipment that has exposed electrical circuits, observe the following precautions:
  - Make sure that another person who is familiar with the power-off controls is near you and is available to turn off the power if necessary.
  - When you work with powered-on electrical equipment, use only one hand. Keep the other hand in your pocket or behind your back to avoid creating a complete circuit that could cause an electrical shock.
  - When you use a tester, set the controls correctly and use the approved probe leads and accessories for that tester.
  - Stand on a suitable rubber mat to insulate you from grounds such as metal floor strips and equipment frames.
- Use extreme care when you measure high voltages.
- To ensure proper grounding of components such as power supplies, pumps, blowers, fans, and motor generators, do not service these components outside of their normal operating locations.
- If an electrical accident occurs, use caution, turn off the power, and send another person to get medical aid.

Safety statements

These statements provide the caution and danger information that is used in this documentation.

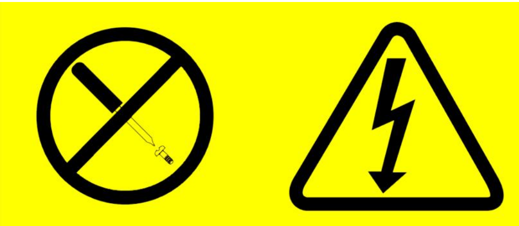
Important:

Each caution and danger statement in this documentation is labelled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the Safety Information document.

For example, if a danger statement is labelled D005, translations for that caution statement are in the Safety Information document under D005.

Be sure to read all caution and danger statements in this documentation before you perform the procedures. Read any additional safety information that comes with your system or optional device before you install the device.

L001



DANGER

Hazardous voltage, current, or energy levels are present inside any component that has this label attached. Do not open any cover or barrier that contains this label. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

DO NOT **open up the chassis or any other parts of any UPS unit. This will void the unit warranty. Only replace parts for which a serviceable part exists, that is servicing any UPS unit is limited to FRU / CRU replacement parts.**

(L001)

D005

DANGER

When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- **If Lenovo supplied a power cord(s), connect power to this unit only with the Lenovo-provided power cord. Do not use the Lenovo-provided power cord for any other product.**
- **Do not open or service any power supply assembly.**
- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.**
- **Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.**
- **Connect any equipment that will be attached to this product to properly wired outlets.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.**

  To disconnect:

  1. Turn everything OFF (unless instructed otherwise).
  2. Remove the power cords from the outlets.
  3. Remove the signal cables from the connectors.
  4. Remove all cables from the devices.

  To connect:

  1. Turn everything OFF (unless instructed otherwise).
  2. Attach all cables to the devices.
  3. Attach the signal cables to the connectors.
  4. Attach the power cords to the outlets.
  5. Turn the devices ON.
- **Sharp edges, corners and joints might be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching.**

(D005)

C004

CAUTION:

Lead-acid batteries can present a risk of electrical burn from high, short-circuit current. Avoid battery contact with metal materials; remove watches, rings, or other metal objects, and use tools with insulated handles. To avoid possible explosion, do not burn.

Exchange only with the Lenovo approved part. Recycle or discard the battery as instructed by local regulations. In the United States, Lenovo has a process for the collection of this battery. For information, call 1-800-426-4333. Have the Lenovo part number for the battery unit available when you call. (C004)

DO NOT **mix old and new batteries in an Uninterruptible Power Supply unit.**

DO NOT **open up any battery pack retrieved from an Uninterruptible Power Supply unit.**

Wear safety goggles and gloves for your own protection when replacing batteries of an Uninterruptible Power Supply unit.

C009

CAUTION:

18 kg (39.7 lb) – 32 kg (70.5 lb)

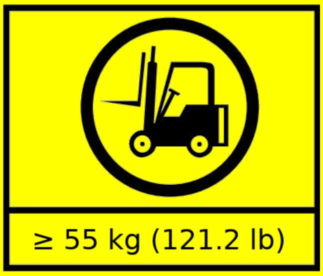
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

CAUTION:

32 kg (70.5 lb) – 55 kg (121.2 lb)

The weight of this part or unit is between 32 and 55 kg (70.5 lb and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)

CAUTION:



≥ 55 kg (121.2 lb)

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

C022

CAUTION:

This product might be equipped with a hard-wired power cable. Ensure that a licensed electrician performs the installation per the national electrical code. (C022)

R001

Important:

The following general safety information should be used for all rack-mounted devices:

DANGER

Observe the following precautions when working on or around your IT rack system:

- **Heavy equipment - personal injury or equipment damage might result if mishandled.**
- **Always lower the levelling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Rack-mounted devices are not to be used as shelves or work spaces.**
  Do not place objects on top of rack-mounted devices.

- **Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.**
- **Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.**
- **An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.**

(R001 part 1 of 2)

CAUTION:

- **Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.**
- **Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.**
- **Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or over-current protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.**
- *(For sliding drawers)* **Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.**
- *(For fixed drawers)* **This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack.**

(R001 part 2 of 2)

Rack Safety Information, Statement 3

DANGER

- **Always lower the levelling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Always install the heaviest devices in the bottom of the rack cabinet.**

Output power and ampere ratings

Important: Make sure that the power receptacle is near the equipment and is easily accessible so that the uninterruptible power supply (UPS) can be disconnected quickly.

To reduce the risk of fire, connect only to a circuit provided with branch circuit over-current protection with an ampere rating in accordance with the National Electrical Code (NEC), ANSI/NFPA 70 or your local electrical code.

Product Safety

- The UPS connection instructions and operations described in the manual must be followed in the indicated order.
- **Important:** To reduce the risk of fire, the unit connects only to a circuit provided with branch circuit over-current protection as described in this manual, in accordance with the National Electric Code, ANSI/NFPA 70.
- The upstream circuit breaker for Normal AC and Bypass AC must be easily accessible. The unit can be disconnected from AC power source by opening this circuit breaker. This circuit breaker is used for back-feed protection and must comply with IEC/EN 62040-1 (the creepage and clearance distances shall meet the basic insulation requirements for pollution degree 2).
- Disconnection and over-current protection devices shall be provided by others for permanently connected AC input (Normal AC and Bypass AC) and AC output circuits.
- Check that the indications on the rating plate correspond to your AC powered system and to the actual electrical consumption of all the equipment to be connected to the system.
- For *PLUGGABLE EQUIPMENT*, the socket-outlet shall be installed near the equipment and shall be easily accessible.
- Never install the system near liquids or in an excessively damp environment.
- Never let a foreign body penetrate inside the system.
- Never block the ventilation grates of the system.
- Never expose the system to direct sunlight or source of heat.
- If the system must be stored prior to installation, storage must be in a dry place.
- The admissible storage temperature range is -15° C (5° F) to +50° C (122° F).
- This unit is not designed to conform to ANSI/NFPA 75 and therefore is not for use in ANSI/NFPA 75-certified data centres.
- Although the UPS does not contain back-feed (ABF) relays, some back-feed protection is provided. For example, if some components are damaged in battery mode, the output voltage may feed back to the input. In this case, a current transformer (CT) is used to detect the bypass current feedback voltage. If a current back-feed fault condition is detected, the UPS will terminate the inverter output to avoid personal injury.

Preface

Authors

The original document was provided by Eaton Corporation.

Christian Flatscher	Lenovo Product Engineer for UPS units

Contributors

This guide would have not been possible with the following Eaton employees:

Paul E Sagun	Retired Eaton UPS engineer
Lee Niño	Eaton UPS engineer
Reginal Greene	Eaton networking engineer
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Matthias Habsburg-Lothringen	Retired power specialist, IBM Austria
Szabolcs Stanca-Vass	Schneider Electric, APC
Shinsuke Uesugi	Lenovo PFE, Lenovo Japan
Andrey Pivnev	IBM System Service Representative, Russia
Charles Coleman	IT Supervisor, School District 6 Rocky Mountain, Canada
Brent Raven	Electrician, School District 6 Rocky Mountain, Canada

Thank you

I take this opportunity to thank all contributors to this document for providing me with additional information, technical explanations, and their patience in advising me on the UPS units discussed in this guide.

Another big thank you goes to all the Lenovo employees who helped me with their language skills. I especially thank Yiting Lee (Product Engineering, Lenovo Taiwan), Amy Hsiao (Technical Writer, Lenovo China), Ilya Solovyev (Lenovo Professional Services, Lenovo Russia), Shinsuke Uesugi (Lenovo PFE, Lenovo Japan), and all my other Lenovo colleagues who helped me with their local language skills over the past few years.

Document formatting

This guide has been written with a larger and wider than usual font. All images have been provided as big as possible.

All cross references in this document have been made without providing any page numbers. This helped significantly in simplifying this guide and makes any potential changes a lot easier.

Chapter 1 Introduction

Thank you for selecting a Lenovo Uninterruptible Power Supply, in short **UPS**, product to protect your electrical equipment.

Read this manual to take full advantage of the features of your equipment.

Before installing your equipment, read the safety instructions. Then, follow the instructions in this manual for setting up and using the product.

To discover the entire range of Lenovo products and the options available for the Lenovo UPS device, we invite you to visit our website or contact your Lenovo representative.

Notices and statements

The caution and danger statements in this document are also in the multilingual *Safety Information* document, which is on the Lenovo Web site at https://support.lenovo.com/documents/LNVO-DOCS. Each statement is numbered for reference to the corresponding statement in the Safety Information document.

Notices and statements in this document

The following notices and statements are used in this document:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Danger:** These statements indicate situations that can be potentially lethal or hazardous to you. A danger statement is placed just before the description of a potentially lethal or hazardous procedure step or situation.

Environmental protection

Lenovo has implemented an environmental-protection policy. Products are developed according to an environmentally friendly design approach.

Substances

This product does not contain CFCs, HCFCs or asbestos.

Packing

To improve waste treatment and facilitate recycling, separate the various packing components.

- The cardboard we use comprises over 50% of recycled cardboard.
- Sacks and bags are made of polyethylene.
- Packing materials are recyclable and bear the appropriate identification symbol, see the below example:

Materials	Abbreviations	Number in the symbols 
Polyethylene terephthalat	PET	01
High-density polyethylene	HDPE	02
Polyvinyl chloride	PVC	03
Low-density polyethylene	LDPE	04
Polypropylene	PP	05
Polystyrene	PS	06

Follow all local regulations for the disposal of packing materials.

Refer to the Lenovo Environmental Notices and User's Guide, provided on the Lenovo Web site at https://support.lenovo.com/documents/LNVO-DOCS.

End of life

Lenovo will process products at the end of their service life in compliance with local regulations. Lenovo works with companies in charge of collecting and eliminating our products at the end of their service life.

Product

The product is made up of recyclable materials. Dismantling and destruction must take place in compliance with all local regulations concerning waste. At the end of its service life, the product must be transported to a processing centre for electrical and electronic waste.

Battery

The product contains lead-acid batteries that must be processed according to applicable local regulations concerning batteries.

The battery pack can be removed to comply with regulations and in view of correct disposal.

With the Lenovo UPS device, you can eliminate the effects of power disturbances and guard the integrity of your equipment. Providing outstanding performance and reliability, the Lenovo UPS device's unique benefits include:

Main UPS features

- True online double-conversion technology with high power density, utility frequency independence, and power generator compatibility.
- Advanced Battery Management (**ABM**®) technology that uses advanced battery management to increase battery service life, optimize recharge time, and provide a warning before the end of useful battery life.
- Selectable High Efficiency mode of operation.
- Standard communication options: one RS-232 communication port, one USB communication port, and relay output contacts.
- UPS Network Management Card with enhanced communication capabilities.
- Extended runtime with up to four Extended Battery Modules (**EBMs**) per UPS.
- Firmware that is easily upgradable without a service call.
- Remote On/Off control through Remote On/Off (**ROO**) and Remote Power Off (**RPO**) ports.

Images

This guide contains a lot of images and photographs to help with the UPS installation and usage.

There are some images that may not reflect the actual hardware you have. These images are still correct and are provided for additional information and guidance.

Chapter 2 UPS Safety Instructions

SAVE THESE INSTRUCTIONS. This manual contains important instructions that should be followed during installation and maintenance of the Maintenance Bypass Panel (MBP), the Uninterruptible Power Supply (UPS) and batteries.

The UPS models that are covered in this manual are intended for installation in an environment within 0 °C / 32 °F to 40 °C / 104 °F, free of conductive contaminant.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Certification standards

- Safety: IEC/EN 62040-1 / Ed.1: 2008. UL 1778 4th edition
- EMC: IEC/EN 62040-2 / Ed.2: 2006. FCC part 15 Class A.
- Performance: IEC/EN 62040-3 / Ed.2.0: 2011.
- IEC 61000-4-2 (ESD): level 3.
- IEC 61000-4-3 (Radiated field): level 3.
- IEC 61000-4-4 (EFT): level 4.
- IEC 61000-4-5 (Fast transients): level 4.
- IEC 61000-4-6 (Electromagnetic field): level 3.
- IEC 61000-4-8 (Conducted magnetic field): level 4.

Special symbols

The following are examples of symbols used on the UPS or accessories to alert you to important information:

RISK OF ELECTRIC SHOCK - Observe the warning associated with the risk of electric shock symbol.

Important instructions that must always be followed.

Information, advice, help.

DO NOT discard the UPS or the UPS batteries in the regular waste.

Pb

This product contains sealed lead acid batteries and must be disposed as it's explain in this manual. For more information, contact your local recycling / reuse or hazardous waste centre.

This symbol indicates that you should not discard waste electrical or electronic equipment (WEEE) in the regular waste. For proper disposal, contact your local recycling / reuse or hazardous waste centre.

Safety of persons

- **RISK OF VOLTAGE BACKFEED.** The system has its own power source (the battery). Consequently, the power outlets may be energized even if the system is disconnected from the AC power source. Isolate the UPS and check for hazardous voltage upstream and downstream during lockout-tagout operation. Terminal blocks may be energized even if the system is disconnected from the AC power source.
- Dangerous voltage levels are present within the system. It should be opened exclusively by qualified service personnel.
- The system must be properly grounded.
- The battery supplied with the system contains small amounts of toxic materials. To avoid accidents, the directives listed below must be observed:
  - Servicing of batteries should be performed or supervised by personnel knowledgeable about bat-teries and the required precautions.
  - When replacing batteries, replace with the same type and number of batteries or battery packs.
  - **DO NOT** dispose of batteries in a fire. The batteries may explode.
  - Batteries constitute a danger (electrical shock, burns). The short-circuit current may be very high.
- Precautions must be taken for all handling:
  - Wear rubber gloves and boots.
  - Do not lay tools or metal parts on top of batteries.
  - Disconnect charging source prior to connecting or disconnecting battery terminals.
  - 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 (applicable to equipment and remote battery supplies not having a grounded supply circuit).

Product safety

- The UPS connection instructions and operation described in the manual must be followed in the indicated order.

- The MBP connection instructions and operation described in the manual must be followed in the indicated order.
- **CAUTION** - To reduce the risk of fire, the unit connects only to a circuit provided with branch circuit overcurrent protection for :
  - 50A rating, for 8kVA models,
  - 70A rating, for 11kVA models,

  in accordance with the National Electric Code.
- The upstream circuit breaker for Normal AC/Bypass AC must be easily accessible. The unit can be disconnected from AC power source by opening this circuit breaker. This circuit breaker is used for backfeed protection and must comply with IEC/EN 62040-1 (the creepage and clearance distances shall meet the basic insulation requirements for pollution degree 2).
- The unit can be disconnected from AC power source by opening this circuit breaker, and if still connected to UPS, by previously shutting down the UPS
- Disconnection and overcurrent protection devices shall be provided by others for permanently connected AC input (Normal AC/Bypass AC) and AC output circuits.
- Check that the indications on the rating plate correspond to your AC powered system and to the actual electrical consumption of all the equipment to be connected to the system.
- For **PLUGGABLE EQUIPMENT**, the socket-outlet shall be installed near the equipment and shall be easily accessible
- Never install the system near liquids or in an excessively damp environment.
- Never let a foreign body penetrate inside the system.
- Never block the ventilation grates of the system.
- Never expose the system to direct sunlight or source of heat.
- If the system must be stored prior to installation, storage must be in a dry place.
- The admissible storage temperature range is -15 °C / 5 °F to +50 °C / 122 °F.
- The system is not for use in a computer room AS DEFINED IN the standard for the Protection of Information Technology Equipment.

Special precautions

- The unit is heavy: wear safety shoes and use vacuum lifter preferentially for handling operations.
- All handling operations will require at least two people (unpacking, lifting, installation in rack system).
- Straps are provided only for unpacking manually the unit from the carton; don’t use the straps to carry the unit around. The unit can slip from the straps during handling (risk of injury and product damage):
  - keep 12 in / 30 cm minimum distance between the straps
  - lift the unit carefully and keep it at low height
  - keep the unit horizontal during unpacking.

- Before and after the installation, if the UPS remains de-energized for a long period, the UPS must be energized for a period of 24 hours, at least once every 6 months (for a normal storage tempera-ture less than 25 °C / 77 °F). This charges the battery, thus avoiding possible irreversible damage.
- During the replacement of the Battery Module, it is imperative to use the same type and number of element as the original Battery Module provided with the UPS to maintain an identical level of performance and safety. In case of doubt, don't hesitate to contact your Lenovo representative.
- All repairs and service should be performed by **AUTHORIZED SERVICE PERSONNEL ONLY**. There are **NO USER SERVICEABLE PARTS** inside the UPS.

Opening up any part of the UPS unit, with the exception of the UPS battery compartments, will void the warranty of the UPS unit!

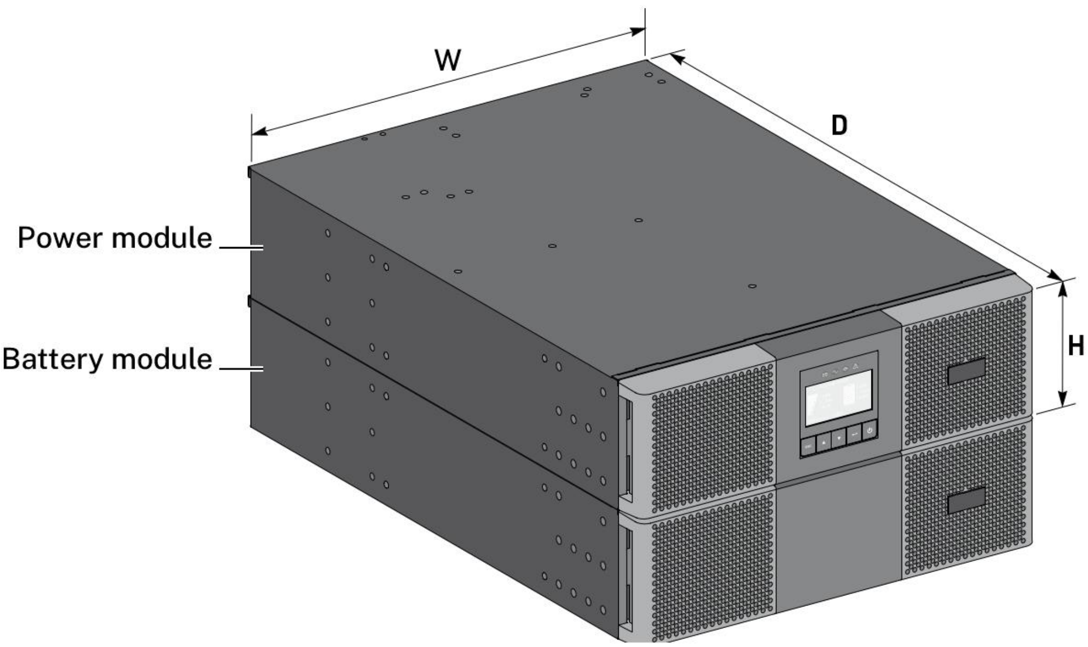
Any subsequent repair or parts replacement is to be paid for!

Chapter 3 Overview

Dimensions and weights

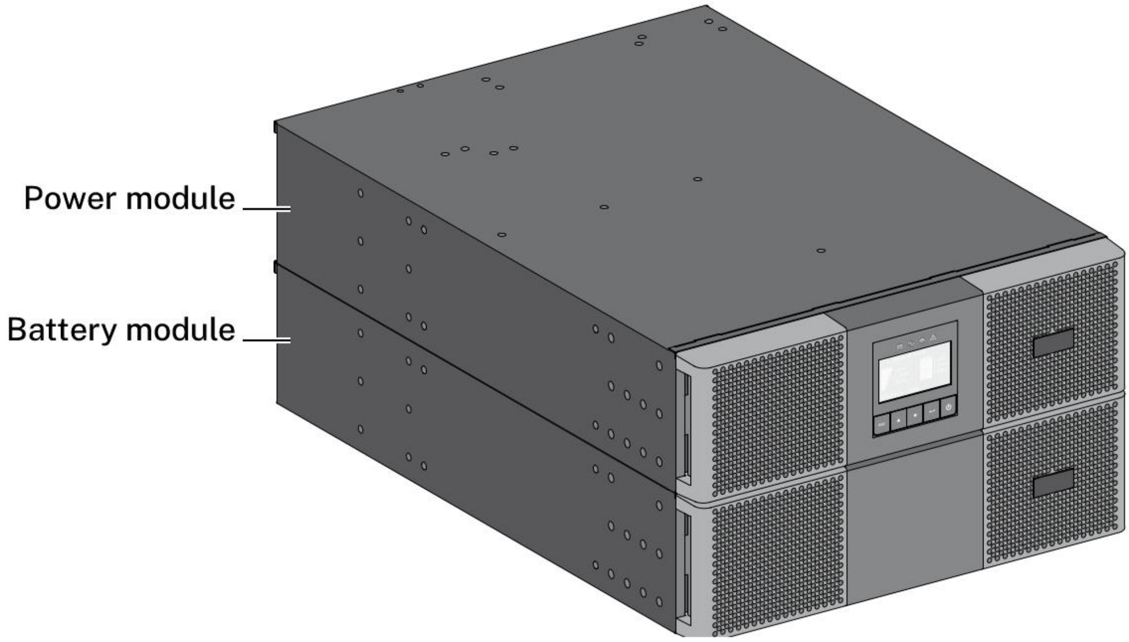
Part description	Dimensions D x W x H (mm / inch)	Weight (kg / lb)
8 kVA 3:1 Power Module	700 x 440 x 130 / 27.6 x 17.3 x 5.1	23 / 51
8 kVA Power Module (1:1) [1)]	700 x 440 x 130 / 27.6 x 17.3 x 5.1	19 / 42
11 kVA 3:1 Power Module	700 x 440 x 130 / 27.6 x 17.3 x 5.1	23 / 51
11 kVA Power Module (1:1) [1)]	700 x 440 x 130 / 27.6 x 17.3 x 5.1	21 / 46
8kVA/11kVA Battery Module	680 x 440 x 130 / 26.8 x 17.3 x 5.1	65 / 143

[1)] Single Phase



Standard installations

Rack Installation



Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

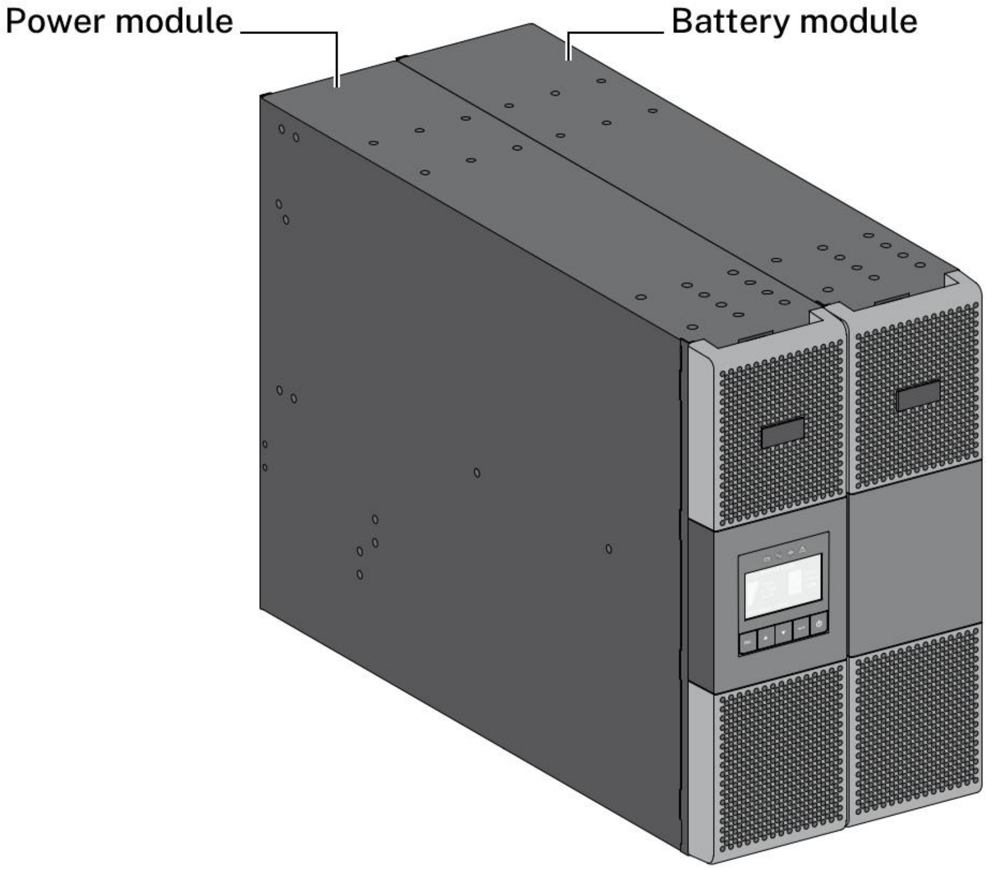
When installing a UPS unit and any additional EBMs into a rack do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

Tower Installation



Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

When installing a UPS unit and any additional EBMs as a tower do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

Shipping bracket kit

If you are shipping the UPS and its associated Extended Battery Modules or EBMs pre-installed in a rack, you must use the shipping bracket kit to prevent damage during shipment. The kit is available from Lenovo. Refer to the instructions in the kit to install the brackets properly. The brackets are not required when the UPS and EBMs are installed in a pre-positioned rack.

Rear panels

Figure 1. 5594-8KX (8 kVA 1:1), 5594-9KX (11 kVA, 1:1)

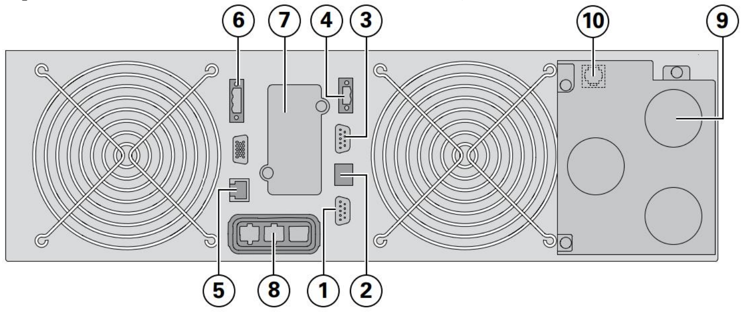
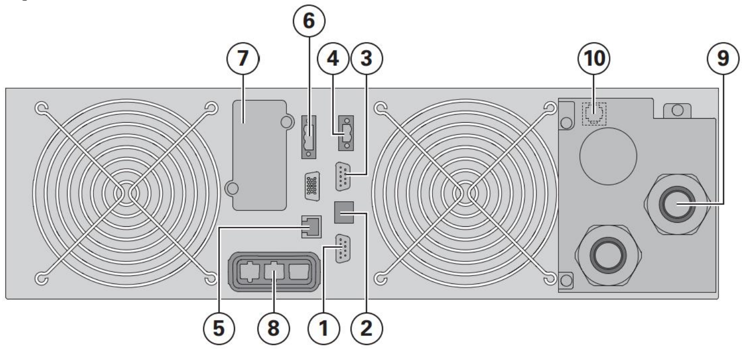
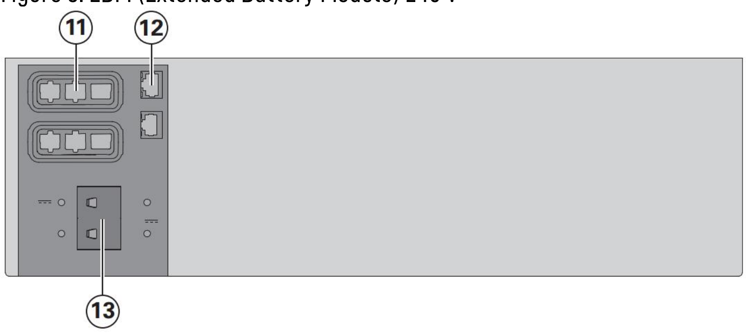


Figure 2. 5594-8PX (8 kVA 3:1), 5594-9PX (11 kVA, 3:1)



① RS232 communication port
② USB communication port
③ Dry (relay) contacts communication port
④ Connector for Remote On/Off (ROO) control
⑤ Connectors for automatic recognition of battery module
⑥ Connector for Remote Power Off (RPO) control
⑦ Slot where UPS Network Management Card is installed
⑧ Connector for battery module power
⑨ Terminal blocks for AC power input and output
⑩ Connector for HotSwap MBP detection

Figure 3. EBM (Extended Battery Module) 240 V



⑪ Connectors for battery modules (to the UPS or to the other battery modules)
⑫ Connectors for automatic recognition of battery modules (UPS-to-EBM or EBM-to-EBM)
⑬ Battery circuit breaker

Control panel

The UPS has a five-button graphical LCD front panel. It provides useful information about the UPS itself, load status, events, measurements, and settings. It also provides a method to change settings.

① Online mode indicator (green)
② Battery mode indicator (amber)
③ Bypass mode indicator (amber) *
④ Fault indicator (red)
⑤ Escape
⑥ Up
⑦ Down
⑧ Enter
⑨ On / Off button

* Bypass mode: For 8/11kVA UPSs, in the event of a UPS overload or internal failure, the UPS powers your equipment directly from utility power.

Battery mode is not available and your equipment is not protected; however, the utility power continues to be passively filtered by the UPS.

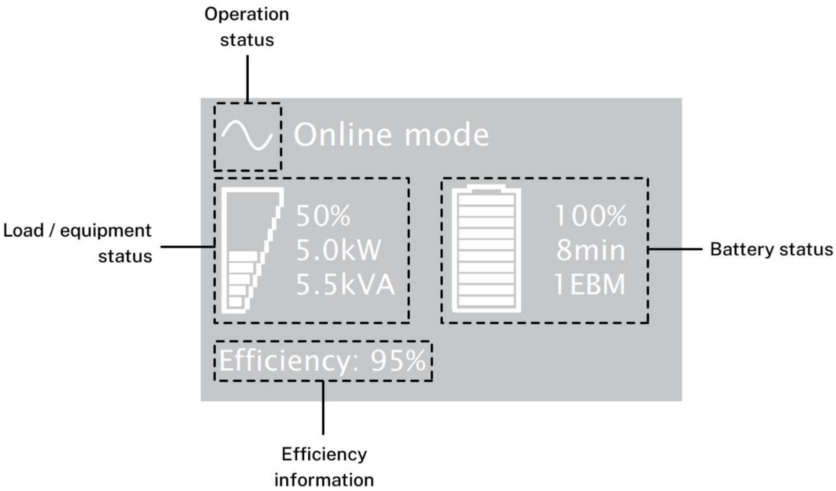
The following table shows the indicator status and description:

Indicator	Status	Description
Green	On	The UPS is operating normally in Online or in High Efficiency mode.
Amber	On	The UPS is in Battery mode.
Amber	On	The UPS is in Bypass mode.
Red	On	The UPS has an active alarm or fault. See Alarms and faults in Chapter 11 for additional information.

LCD description

After 5 minutes of inactivity, the LCD displays the screen saver.

The LCD backlight automatically dims after 10 minutes of inactivity. Press any button to restore the screen.

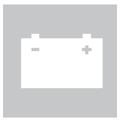
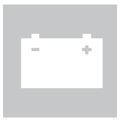


The following table describes the status information provided by the UPS.

Note: If any other indicator displays, see Chapter 11 Troubleshooting for additional information.

Operation status	**Cause**	**Description**	**Is Battery Being Charged**
Standby mode 	The UPS output is Off.	Equipment is not powered until **X** button is pressed.	Yes
Online mode 	The UPS is operating normally.	The UPS is powering and protecting the equipment.	Yes

LCD Status information (continued)

Operation status	Cause	Description	Is Battery Being Charged
Battery mode 1 beep every 10 seconds 	A utility power failure has occurred and the UPS is in Battery mode.	The UPS is powering the equipment with battery power. Prepare your equipment for shutdown.	No
End of backup time 1 beep every 3 seconds 	The UPS is in Battery mode and the battery packs are running low.	This warning is approximate, and the actual time to shut down might vary significantly. Depending on the UPS load and number of Extended Battery Modules (EBMs), the "Battery Low" warning might occur before the battery packs reach 20% capacity.	No
High Efficiency mode 	The UPS is operating in High Efficiency mode.	The UPS is powering and protecting the equipment.	Yes
Bypass mode 	An overload or a fault has occurred or a command has been received and the UPS is in Bypass mode.	Equipment is powered directly from AC input and is not protected by the UPS.	Yes

General LCD Menu structure

The general LCD Menu structure is as shown below:

```
Measurements
   Load
   Input/Output
   Battery
   Efficiency
   Power usage

Control
   Load segments ON/OFF
   Start battery test
   Reset fault state
   Restore factory settings

Settings
   Local Settings
      Language
      LCD settings
      Audible Alarm
   In/Out
      Output voltage
      Input threshold
      Sensitivity
      Load segments
      Overload prealarm
   On/Off
      Cold start
      Forced reboot
      Auto restart
      Energy saving
      Sleep mode
      Remote command
      Power Off Warning
   Battery
      Auto battery test
      Low battery warning
      Restart batt. level
      Battery charge mode
      EBM Number string
      Deep disch. protect.
```

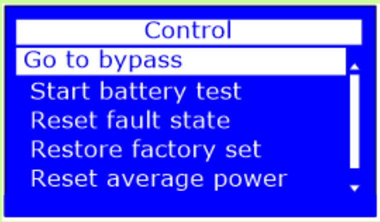
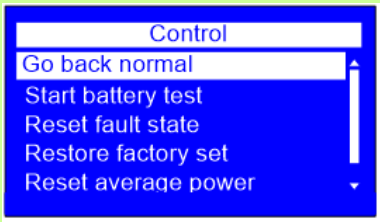
```
Fault Log
   Fault list
   Reset fault list

Identification
   Product Type/Model
   Part/Serial Number
   UPS/NMC Firmware
   COM card IPv4
   COM card IPv6
   COM card MAC
```

This menu structure may vary from UPS model to another UPS model. This structure overview has been provided as a general guide line.

Display functions

Press the Enter (↩) button to activate the menu options. Use the two middle buttons (▲ and ▼) to scroll through the menu structure. Press the Enter (↩) button to select an option. Press the return to the previous menu.

Main menu	Submenu	Function
Measurements		[Load] W VA A pf / [Input/Bypass] V Hz / [Output/Efficiency] V Hz % / [Battery] % min V n° / [DCbus] V / [Average power usage] Wh / [Cumulative power usage] Wh since date
Control	Go to bypass	Transfers the UPS to internal Bypass mode, only available if the UPS is in on-line mode 
	Go back normal	Transfers the UPS back to on-line mode if the UPS has been set to internal Bypass mode 
	Start battery test	Starts a manual battery test
	Reset fault state	Clears active fault

Display functions (continued)

Main menu	Submenu	Function
Control (continued)	Restore factory settings	Returns all settings to factory values
	Reset average power	Clears average power usage measurement
	Reset cumul. power	Clears accumulated power usage measurement
	Dry contacts test	Tests dry contact relay outputs
Settings	Local settings	Sets product general parameters
	In/Out settings	Sets Output parameters
	On/Off settings	Sets On/Off conditions
	Battery settings	Sets battery configuration
Event log	Event filter	Selects faults, alarms and/or events to display
	Event list	Displays the stored events
	Reset event list	Clears all stored events
Fault log	Fault list	Displays the stored faults
	Reset fault list	Clears all stored faults

User settings

The following table displays the options that can be changed by the user.

Attention! When a Network Management Card (NMC) is installed then the IP address *can not* be changed via the LCD panel. The IP address can only be changed via serial port connection to the NMC or via the NMC web interface.

User settings

Submenu		Available settings	Default settings
Local settings	Language	[language_name] Select the desired language from the list. Menus, status, notices and alarms, UPS fault, Event Log data and settings are in all supported languages.	[English]
	Date/time	Format: [International] [US]	[International]

User settings (continued)

	Submenu	Available settings	Default settings
Local settings (continued)	LCD	Modify LCD screen brightness and contrast to be adapted to room light conditions.	
	Audible alarm	[Enabled] [Disabled on battery] [Always disabled] Enable or disable the buzzer if an alarm occurs	[Enabled]
In/Out settings *[The UPS unit must be in Standby Mode in order to change the In/Out settings]*	Output voltage	[200V] [208V] [220V] [230V] [240V] [250V] Can be changed only in Standby mode	[230V]
	Output frequency	Frequency converter: [Enabled] [Disabled] Frequency settable in frequency converter mode	[Disabled]
	Output mode	[Industrial] [Network] Set UPS behaviour regarding transfer on Bypass	[Network]
	Input volt hysteresis	Sets input voltage hysteresis from 1 to 10V	[10 V]
	Bypass transfer	[Transfer if BP AC NOK] [Enabled] [Disabled] Allow transfer on Bypass out of tolerance	[Enabled] for 3:1 (8PX and 9PX) models [Disabled] for 1:1 (8KX and 9KX) models
	Overload pre-alarm	[10%] ... [102%] Load % when overload alarm occurs	[102%]

User settings (continued)

	Submenu	Available settings	Default settings
In/Out settings (continued) *[The UPS unit must be in Standby Mode in order to change the In/Out settings]*	Redundancy mode	[Unitary UPS] [Hot Standby] Force slew rate value to 0.5Hz/s	[Unitary UPS]
On/Off settings	Cold start	[Enabled] [Disabled] Authorize the product to start on battery power.	[Enabled]
	Forced reboot	[Enabled] [Disabled] If utility power recovers during a shutdown sequence: If Enabled, the shutdown sequence will complete and wait 10 seconds prior to restart. If Disabled, the shutdown sequence will not complete and restart will occur immediately.	[Enabled]
	Auto restart	[Enabled] [Disabled] Authorize the product to restart automatically when utility power recovers after a complete battery discharge.	[Enabled]
	Auto start	[Enabled] [Disabled] The UPS automatically starts up as soon as utility power is available (no need to press the ⏻ button).	[Disabled]

User settings (continued)

Submenu		Available settings	Default settings
On/Off settings (continued)	Energy saving	[Disabled] [100W] ... [1000W] If Enabled, UPS will shut down after 5 minutes of back-up time, if load is less than threshold.	[Disabled]
	Sleep mode	[Enabled] [Disabled] If Disabled, LCD and communication will turn OFF immediately after UPS is OFF. If Enabled, LCD and communication stays ON 90 minutes after UPS is OFF.	[Enabled]
	Remote command	[Enabled] [Disabled] If Enabled, shutdown or restart commands from software are authorized.	[Enabled]
	Bypass standby	[Enabled] [Disabled] Define if output is powered from Bypass in Standby mode.	[Enabled] for 3:1 (8PX and 9PX) models [Disabled] for 1:1 (8KX and 9KX) models
Battery settings	Automatic battery test	In constant charge mode: [No test] [Every day] [Every week] [Every month] In ABM cycling mode: [No test] [Every ABM cycle]	[Every ABM cycle]
	Low battery warning	[0%] ... [100%] The alarm triggers when the set percentage of battery capacity is reached during back-up time.	[20%]

User settings (continued)

Submenu		Available settings	Default settings
Battery settings (continued)	Restart battery level	[0%] ... [100%] If set, automatic restart will occur only when percentage of battery charge is reached. **Note:** Network Management Card settings supersede the LCD settings!	[0%]
	Battery charge mode	[ABM cycling] [Constant charge]	[ABM cycling]
	External battery	[Auto detection] [Manual EBM set.] [Manual battery set.] [No battery]	[Auto detection] Using standard EBM, UPS detects automatically the number of EBM connected
	Deep discharge protection	[Yes] [No] If set to Yes, the UPS automatically prevents battery pack from deep discharge by adapting end of back-up time voltage threshold. Warranty void if set to No.	[Yes]

Extended Battery Modules (EBMs)

An Extended Battery Module allows to extend the run-time or backup-time of the UPS unit. Up to four EBMs can be connected to the UPS.

Note: The base UPS unit is shipped with one EBM. A maxmium of four additional EBMs can be attached to the UPS power module.

Part number	Description
55949BX	Additional Extended Battery Module

Figure 4: Extended Battery Module

HotSwap MBP

The HotSwap Maintenance Bypass Panel or **HotSwap MBP** allows you to service or replace the UPS without interrupting the connected loads.

Standard installations for the HotSwap MBP

Tower installation

Figure 5: Single phase MBP (5594-8KX and 5594-9KX)

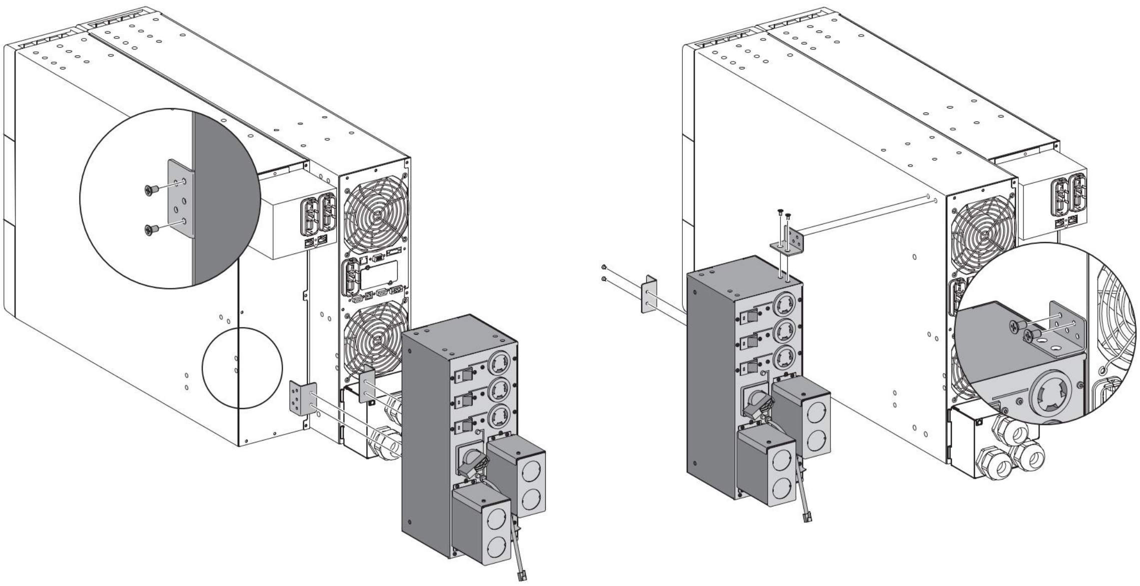


Figure 6: Three phase MBP (5594-8PX and 5594-9PX)

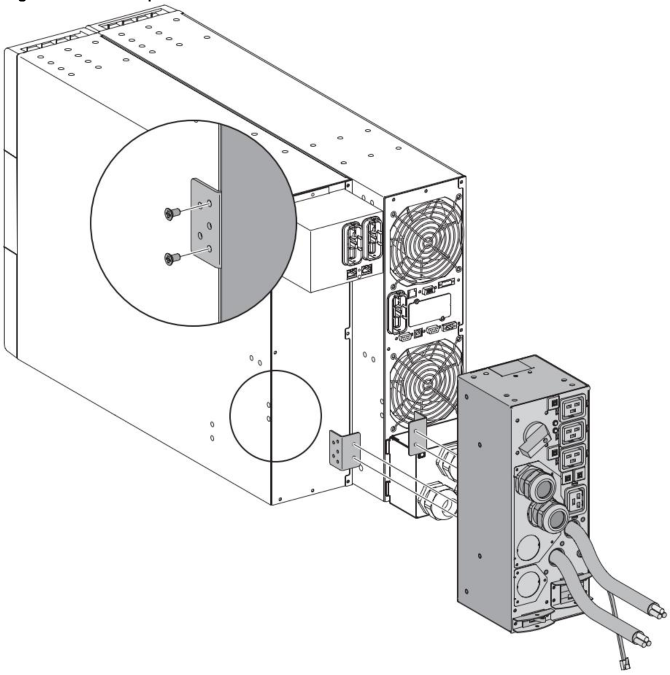
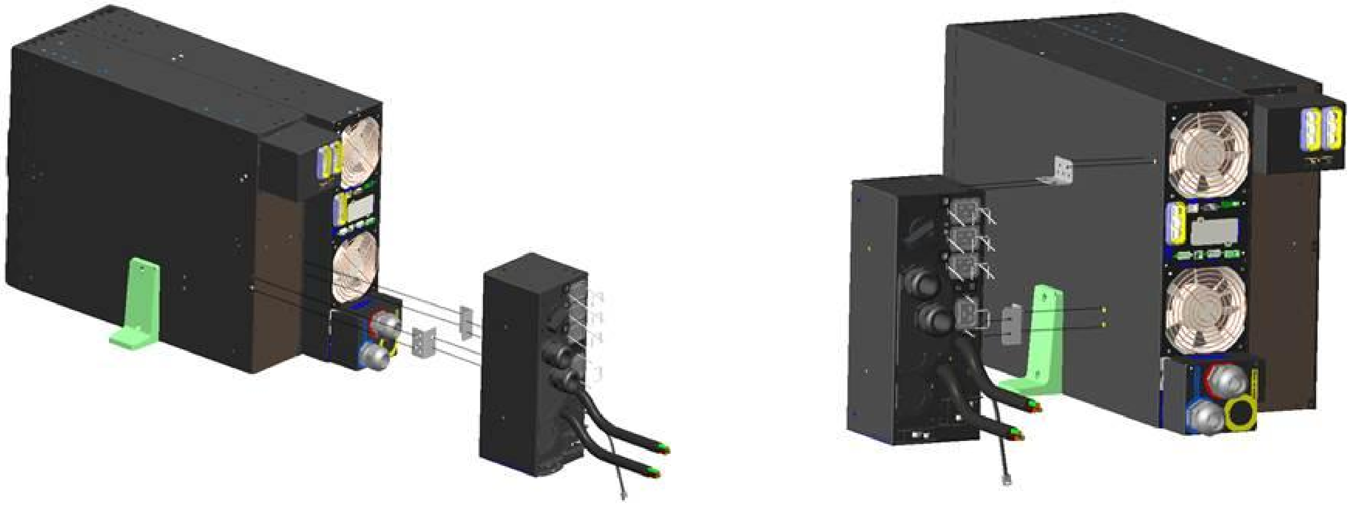


Figure 7: Three phase MBP (5594-8PX and 5594-9PX)



Wall mounting

Figure 8: Single phase MBP (5594-8KX and 5594-9KX)

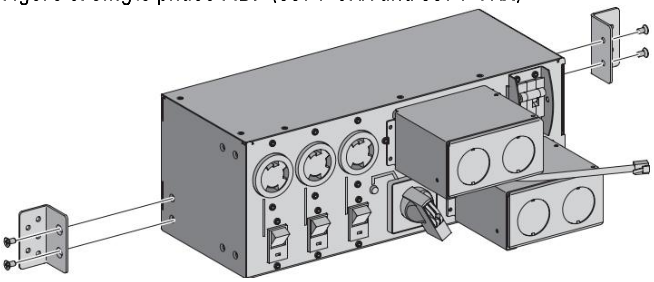
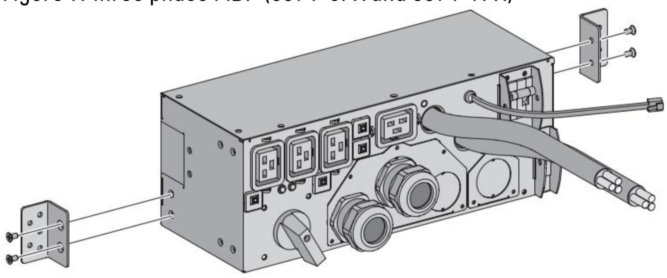


Figure 9: Three phase MBP (5594-8PX and 5594-9PX)

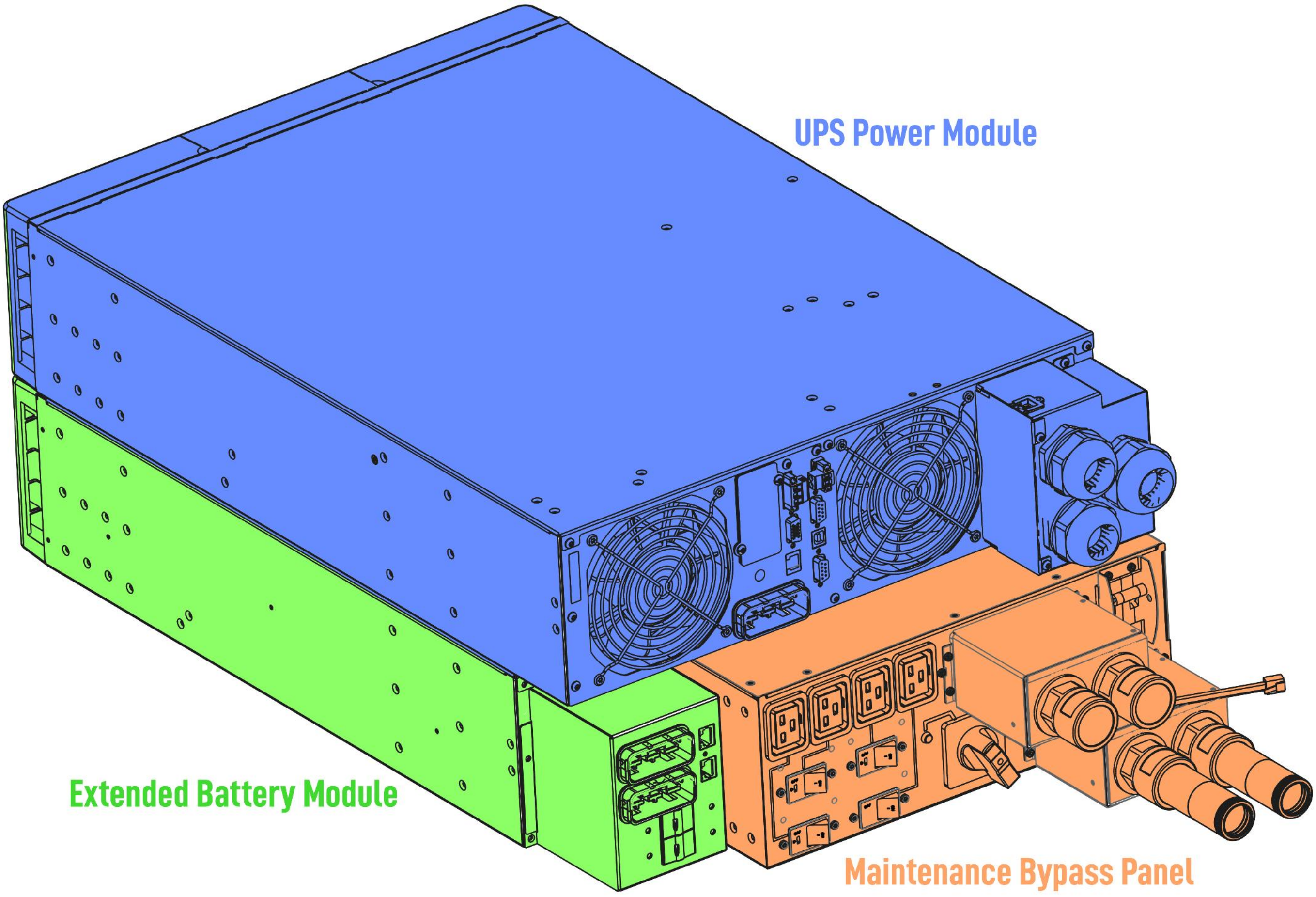


Rack installation

In a rack configuration, the Maintenance Bypass Panel (MBP) should always be mounted behind the extended battery module(s) and *not* behind the UPS.

See Figure 10 on the next page for details.

Figure 10: Recommended space saving MBP rack installation, UPS power module is above EBM



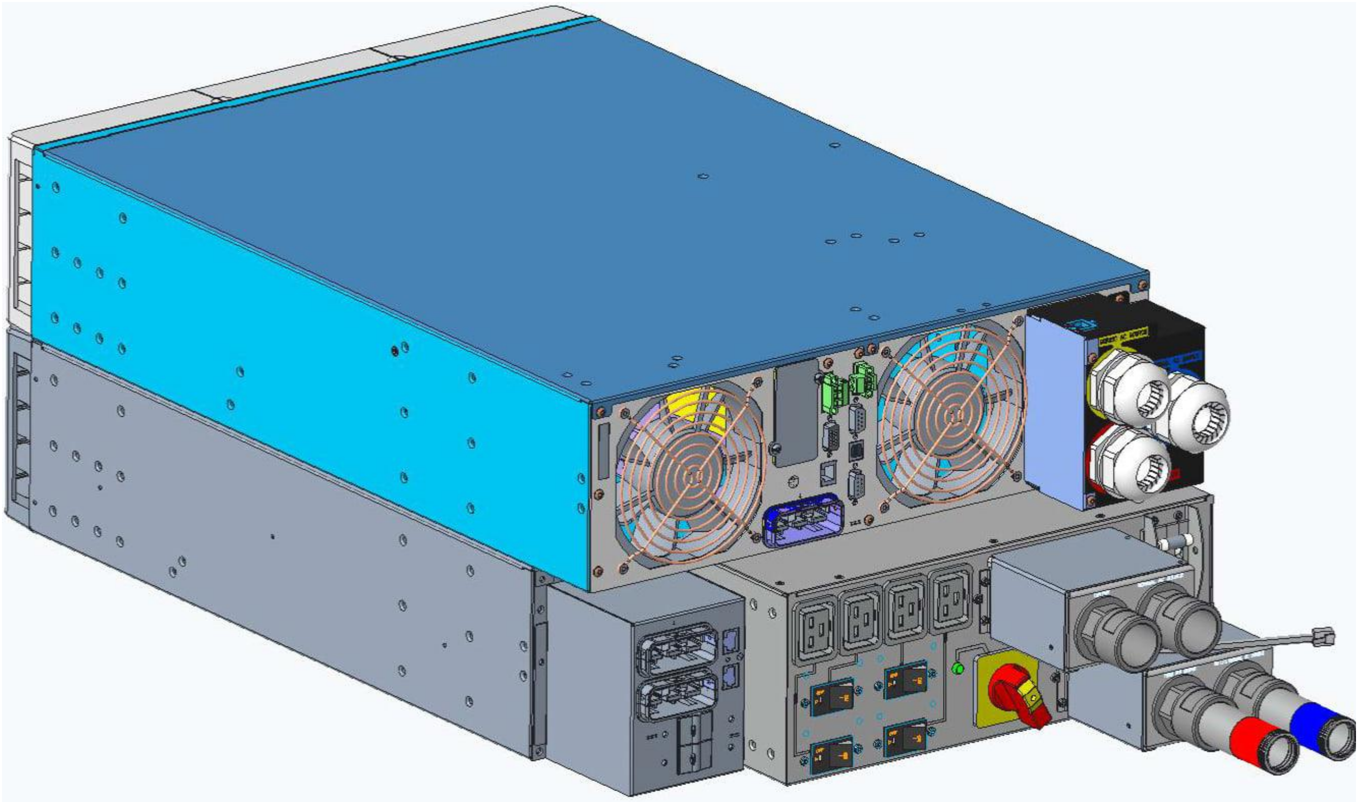


Figure 11. 8 kVA / 11 kVA MBP 1 Phase

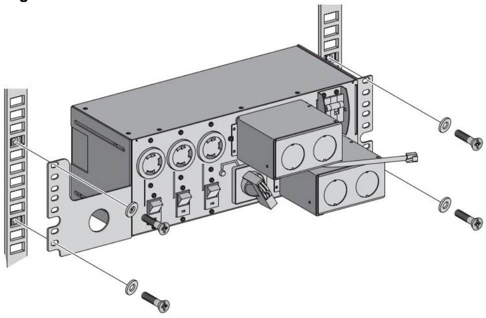
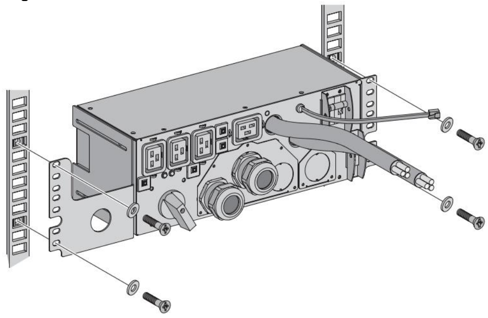
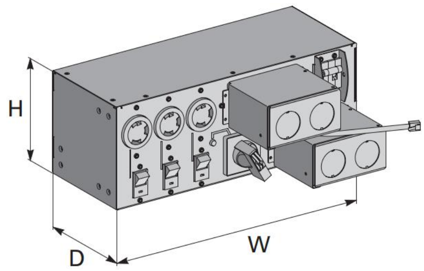
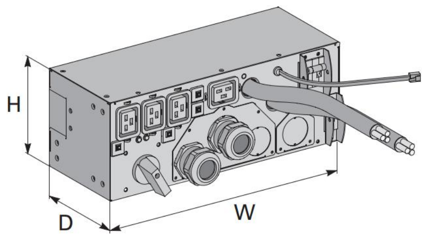


Figure 12. 8 kVA / 11 kVA MBP 3 Phase



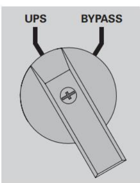
Physical specifications

Machine types and models	Weight (kg / lb)	Dimensions (mm / inch)
8/11k VA 1Phase MBP	6.2 / 13.7	220 x 336 x 130 / 8.7 x 13.2 x 5.1 
8/11k VA 3Phase MBP	5.5 / 12.1	132 x 336 x 130 / 5.2 x 13.2 x 5.1 

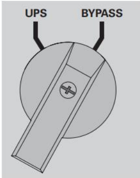
HotSwap MBP controls

The HotSwap MBP has a manual rotary switch with two positions:

- **UPS:** the load is supplied by the UPS, and the UPS is supplied by the normal AC power source.



- **Bypass:** the load is supplied directly by the bypass AC power source.



Two lights indicate the HotSwap MBP power status:

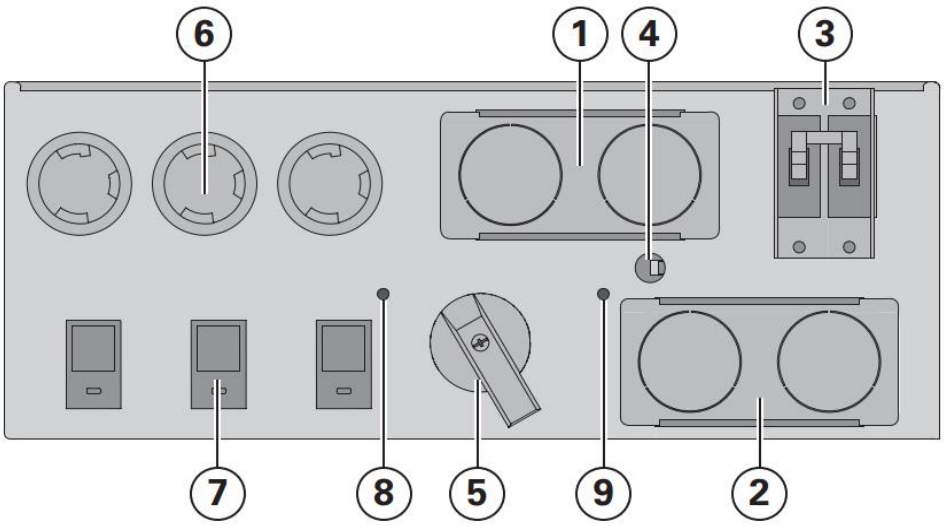
- **UPS supply:** Green light; when active, the UPS output is available, and the Bypass switch can safely be turned to UPS position
- **Bypass mode:** Red light; when active, indicates that the HotSwap MBP is in Bypass mode (Bypass switch turned to Bypass position)

Normal AC source switch and **Bypass AC source switch:** Use to switch off the AC source for the UPS (for UPS maintenance and replacing).

MBP status detection: A signal cable, with RJ11 connector to plug to the UPS, allows the UPS to manage the MBP status and display the following on the UPS display panel:

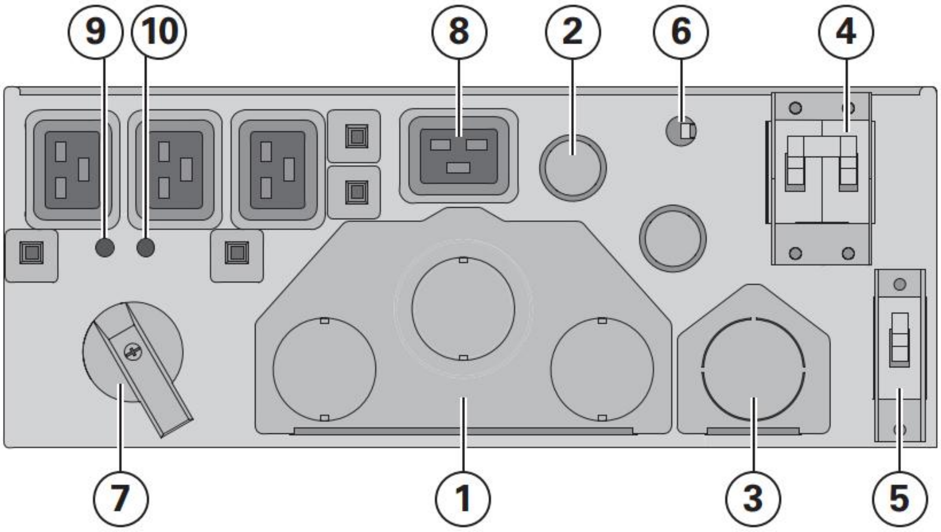
- MBP connection to UPS
- Bypass switch position

Figure 13: Single phase MBP (5594-8KX and 5594-9KX)



① Input/Output terminal blocks
② Input/Output terminal blocks for connection to the UPS
③ Normal AC source switch
④ Signal cable for MBP detection to the UPS
⑤ Bypass switch
⑥ 3x 30A outlets
⑦ 3x 30A circuit breaker
⑧ UPS supply green light
⑨ "Bypass" mode red light

Figure 14: Three Phase MBP Panel description



① Input/Output terminal blocks
② Input/Output cables for connection to the UPS
③ Bypass terminal blocks for connection to the UPS
④ Normal AC source switch
⑤ Bypass AC source switch
⑥ Signal cable for MBP detection to the UPS
⑦ Manual Bypass switch
⑧ 4x C20 16A outlets
⑨ UPS supply green light
⑩ Bypass mode red light

UPS Management Software

The Lenovo UPS Management Software is available for download from Lenovo's support document

https://datacentersupport.lenovo.com/solutions/LNVO-UPS-MGMT

UPP and UPM software for Lenovo UPS

The purpose of the Lenovo Uninterruptable Power Supply Power Protector (UPP) and Lenovo Uninterruptable Power Supply Power Manager (UPM) software is to protect the hardware and integrity of the data when a power event occurs (for instance, loss of power).

The Lenovo UPP software is free of charge. The Lenovo UPM software can be used as free software for basic management or a license can be purchased to enhance its functionality. See the section Differences between UPP and UPM for further details.

This is done by managing and monitoring the hardware for a power event. The UPM software can take action in one of the following ways:

Load Shedding:

- Initiate a virtual machine migration if a host server experiences a power event
- Initiate a Virtual Machine (VM) suspension or shutdown of VM of less priority while keeping more critical VMs live
- Gracefully shut down all VMs and its host server to keep more critical host/VM servers live

Power Capping:

Set user defined power budget as part of a disaster avoidance plan to guarantee a minimum amount of battery run time during a power outage. The power budget is maintained by using the load-shedding capabilities discussed above. It does not affect system performance by reducing processor frequency. Power capping only maintains system load by managing load shedding capabilities.

Move Critical Machines to Back-up Site

The UPM will read environmental (temperature over the limit) or UPS power alarms (utility power loss) and will work with VMware's Site Recovery Manager (SRM) to initiate a disaster recovery plan to initiate a move of critical applications to a back-up data centre location or disaster recovery (DR) site.

Differences between UPP and UPM

Attention! The UPP and UPM software can not be installed on the same server at the same time. Doing so will lead to unpredicted operation of either software or the UPS unit. In such a situation support can not be provided and one of the applications has to be uninstalled.

The UPP software can only be used as a stand-alone software on a single host. The UPM software can be used to manage multiple hosts. The UPM software also has additional features. See the following Lenovo Press articles for further information:

- Power Management Using Lenovo UPS Power Protector (UPP) and UPS Power Manager (UPM)
- Powering and Protecting Nutanix Appliances with Lenovo UPS Units

Chapter 4 Prerequisites for the UPS installation

Attention! Before installing the UPS unit, check the Lenovo DCG support site at

http://datacentersupport.lenovo.com/

for any relevant installation Tips!

Search for either the UPS MT (5594) or the UPS serial number and press the magnifier icon on the far right hand side of the search bar.

This tips can be find in the category "Knowledge Base & Guides".

UPS Units overview

- RT8kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-8KX
- RT11kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-9KX
- RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-8PX
- RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-9PX

Important considerations

These are the important areas of consideration before installing any of these UPS units:

1. No power cord is shipped with these UPS units as they have to be hardwired to utility power. Providing the hardwired power connection is customer responsibility
2. The correct earthing system must be present, the earthing system should be TN-S. For further information see the section “Required electrical earthing systems”.
3. No Residual Circuit Device (RCD) or differential circuit breaker is to be used. For further information see Earth leakage considerations using an RCD in Chapter 12.
4. The maximum leak current can get very big. For the 8 kVA UPS units the maximum leak current is 2 Ampères and for the 11 kVA UPS units the maximum leak current is 2.5 Ampères. For further information see Leak current information in Chapter 12.
5. In case the UPS unit is fed by a Power Generator in order to bridge longer utility power outages the slew rate of the Power Generator must be adjusted. For these UPS units the slew rate is 1 Hz / s. See also Power Generator and UPS units in Chapter 12.
6. If the UPS unit is run in High Efficiency mode, then it is strongly recommended to install voltage and frequency stabilisers as the UPS works in line-interactive mode. See also Line interactive or VI UPS units in Chapter 12.
7. RCDs are not to be used to protect any of the UPS units listed. If, however due to legal requirements an RCD must be used, then a D curve 420 mA RCD is to be installed. For further details refer to Chapter 4 in the section Recommended upstream protection.

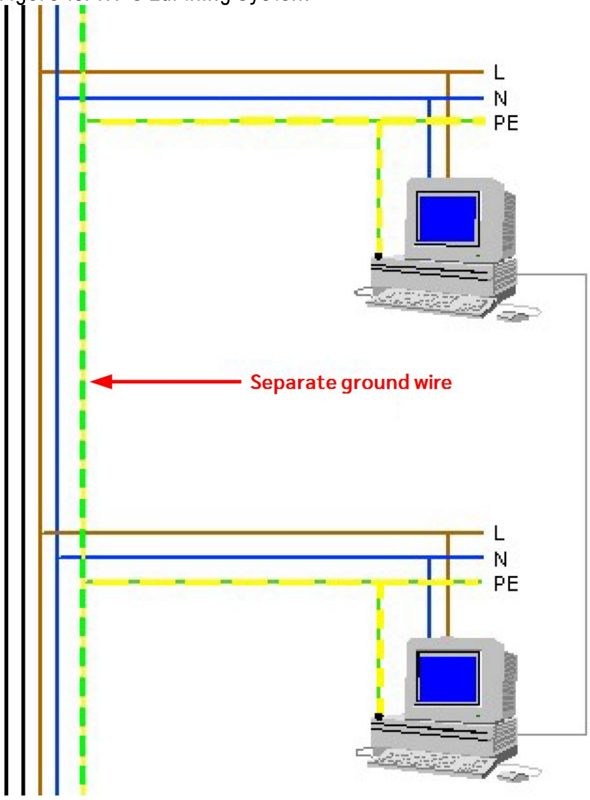
Required electrical earthing systems

TN-S systems

The term TN-S comes from the French Terre Neutre Séparé meaning earth neutral seperated.

The earthing system shown in Figure 15 is called the TN-S system. Typical for a TN-S system is that the neutral conductor (N) and the earth or protective conductor (PE) are run as separate wires. It is often referred to as "five-wire cabling".

Figure 15: TN-S Earthing System



Commonly utility power companies provide the power with 4-poles or 5-poles. In case of 4-pole feed it imperative to separate PE from NE as soon as possible at a suitable point in the power network. This is usually done behind the entry point of the utility power source into the power sub-distributor by installing a central earthing point.

Multi-line-fed power input

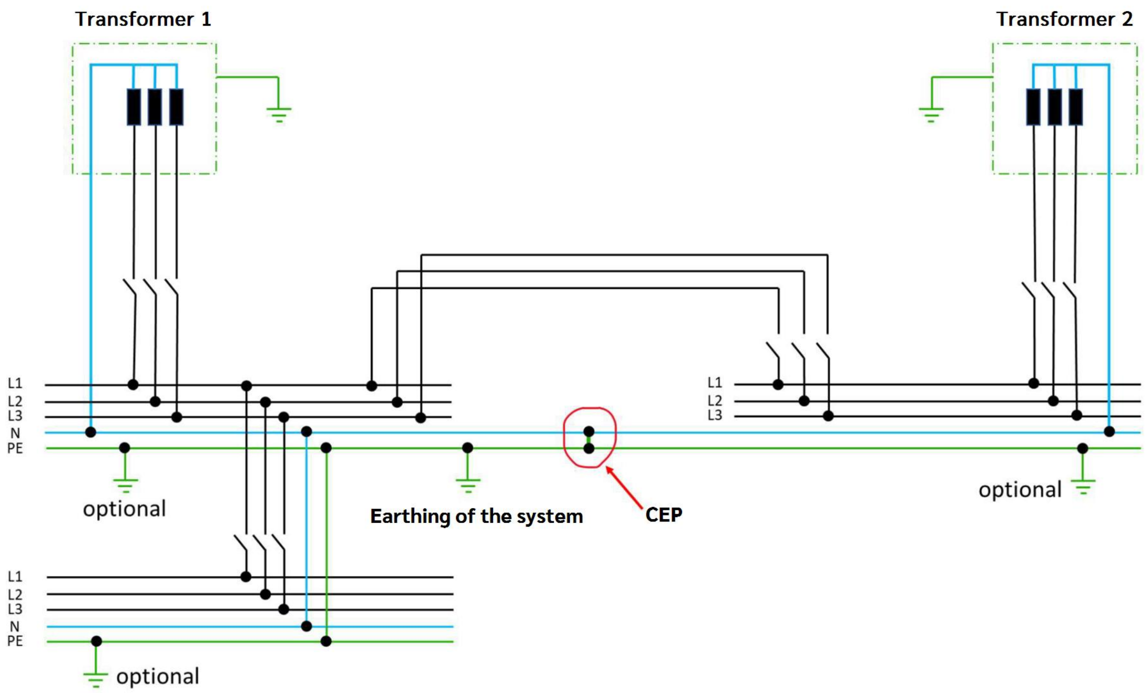
For error free operation it is essential that power supply system is always implemented as a TN-S earthing system. This is also relevant and important when multiple power sources are used. In this respect power sources are not only all feeding points or transformers of the utility power company, which supply electricity to the relevant power supply in question, but particularly also any potential emergency power system and UPS units.

In case of multi-line-fed power input it has to be ensured that **NO MULTIPLE CONNECTIONS** between N and PE system are implemented in the same power supply system, irrespective to whether the emergency power system is up and running or not.

In this set up all N conductors are connected to each other and the N network is only once connected to the PE system.

This connection takes place in the central earthing point (CEP). This CEP is to be implemented at the point with the largest to be expected short-circuit / earth current. It has to be dimensioned accordingly. The CEP is also be implemented such that a measurement / monitoring of the current at this point at any time is possible without any further risk. Figure 16 gives an overview of such an installation.

Figure 16: Multi-line-fed power input



Feed-in points located at a distance from each other and the respective Power supply systems are to be considered as independent TN-S networks and are to be interconnected exclusively via existing PA / earth lines.

The connecting of the N-conductors of these separate networks with each is **STRICLY FORBIDDEN**!

Recommended protective devices and cable cross-sections

Recommended upstream protection

Table 1: Using standard Circuit breakers

UPS Model	Normal and bypass AC inputs not separate	Separate normal and bypass AC inputs	
	Normal AC input	Normal AC input	Bypass AC input
5594-8KX 8 kVA, single phase	D curve, 50 A	D curve, 50 A	D curve, 50 A
5594-9KX 11 kVA, single phase	D curve, 70 A	D curve, 70 A	D curve, 70 A
5594-8PX 8 kVA, three phase	D curve, 50 A	D curve, 20 A	D curve, 50 A
5594-9PX 11 kVA, three phase	D curve, 70 A	D curve, 70 A	D curve, 70 A

Using an RCD

It is strongly recommended to *not* use an upstream RCD device to protect the UPS unit due to the potentially high leak current that can occur!

For additional information see also the section "Important considerations" in this chapter.

When using a Residual Current Device (RCD), also referred to as Residual Current Circuit Breaker (RCCB) or differential Circuit Breaker, it must have a leak current rating of 420 mA.

Attention! A RCCB must be tested once a year with the integrated test button in order to ensure that it is working properly.

RISK OF VOLTAGE BACK FEED.

The system has its own power source (the battery). Isolate the UPS and check for hazardous voltage upstream and downstream during lockout-tagout operation. Terminal blocks might be energized even if the system is disconnected from the AC power source.

Recommended cable cross-sections

Terminal	Terminal wire size rating	Minimum wire size	Tightening torque
All	4-25 mm^2 / 12-4 AWG	10 mm^2 / 8 AWG 105°C 16 mm^2 / 6 AWG 90°C	2.03 Nm / 18 in-lb

Copper wire, solid or stranded.

Attention! It is important to check in a six (6) month interval the torque on the UPS side of the input connector against the specification of 2.03 Nm (18 inch-pounds). If the screws in the UPS utility power input terminal have to be tightened again, users should take caution to maintain torque and not to overtighten the screws in the terminal block. Overtightening of the screws could damage the conductors on both sides of the terminal blocks.

Take a note of the date when the last time the torque was checked and check it again every six (6) months.

Not doing so can lead to an electro-thermal incident that can severely damage both the utility power input wiring and the input terminal block thus making the UPS unit unusable!

Any repair work in order to resolve the hardware issue is not covered by the unit warranty or service contract.

See Figure 17 on the next page for damage observed in case the above instructions are not adhered to.

Attention! (continued)

Figure 17. Damaged input terminals

Attention! Do not hardwire the UPS unit to utility power with amoured cables! This can lead to malfunctioning of the UPS unit. The UPS unit can also get damaged.

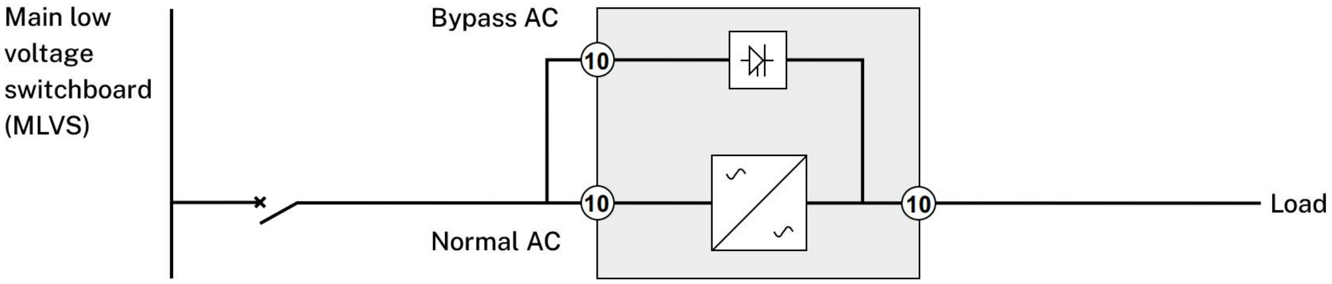
If the UPS unit fails because or gets damaged because of the use of armoured cabling, any repair work in order to resolve the hardware issue is not covered by the unit warranty or service contract.

Figure 18. Incorrect wiring – armored cabling

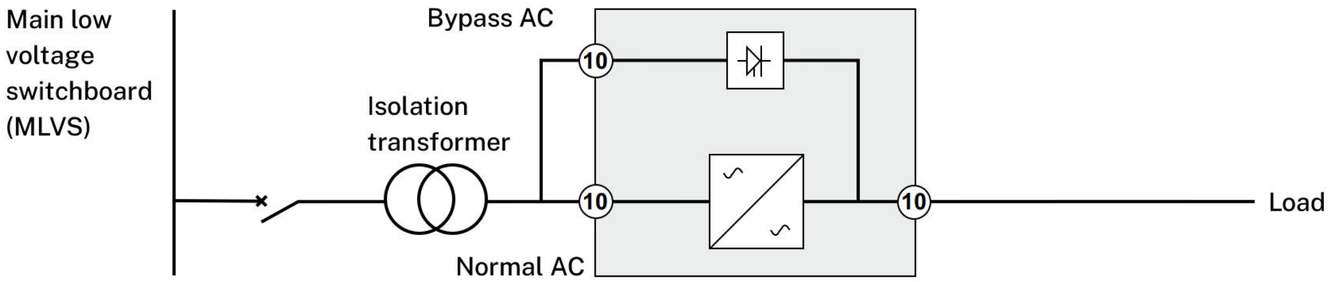
Installation depending on the system earthing arrangement (SEA)

Single phase (1:1) 8 kVA 5594-8KX / 11 kVA 5594-9KX

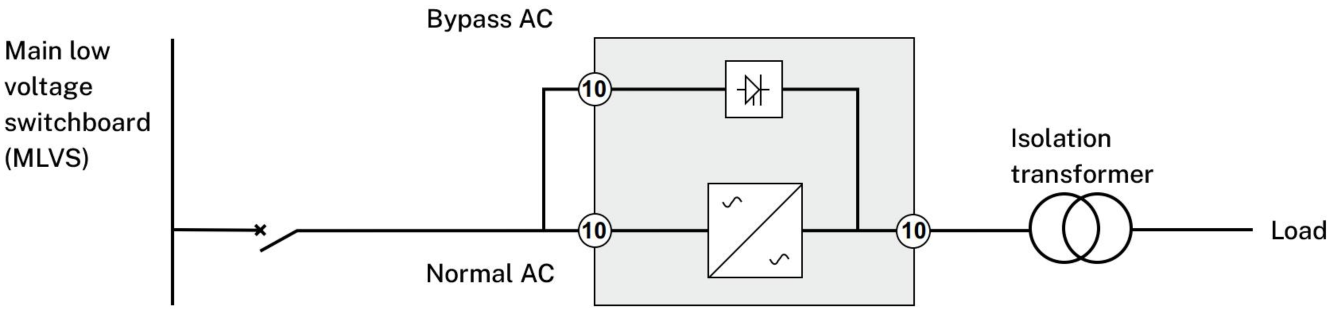
UPS with common Normal and Bypass AC inputs



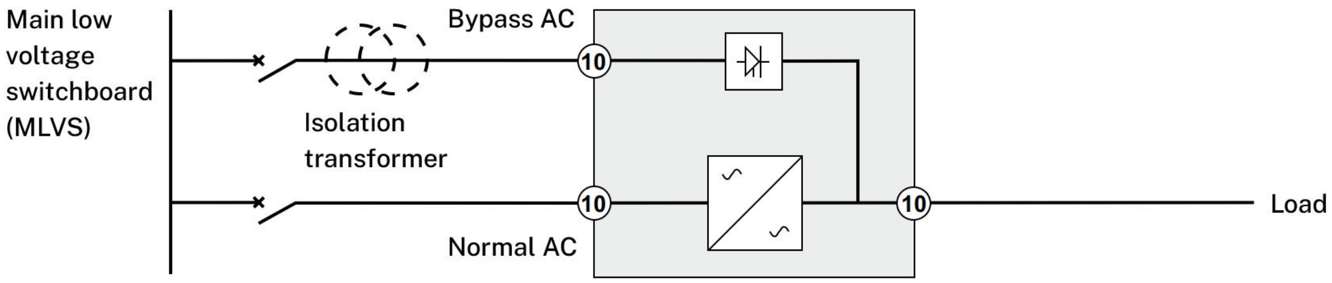
Change in SEA between upstream and downstream or galvanic isolation required



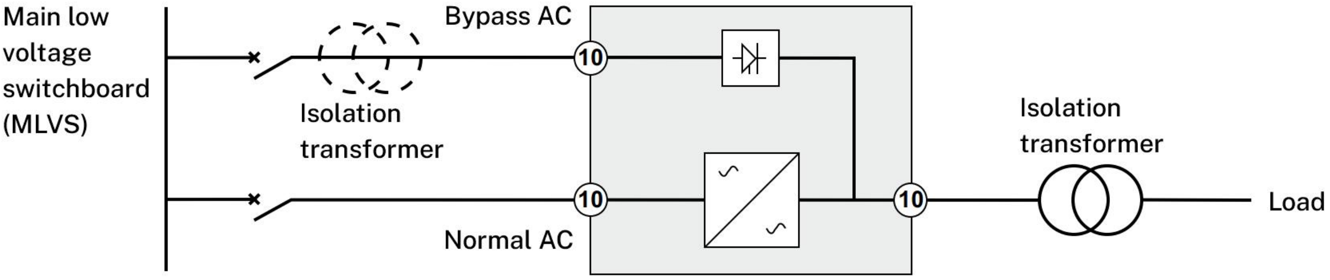
or

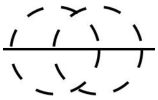


UPS with separate Normal and Bypass AC inputs



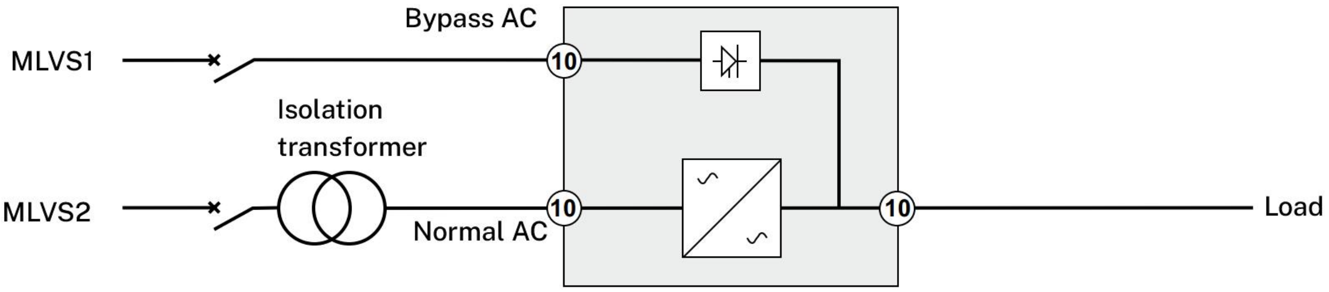
Change in SEA between upstream and downstream or galvanic isolation required

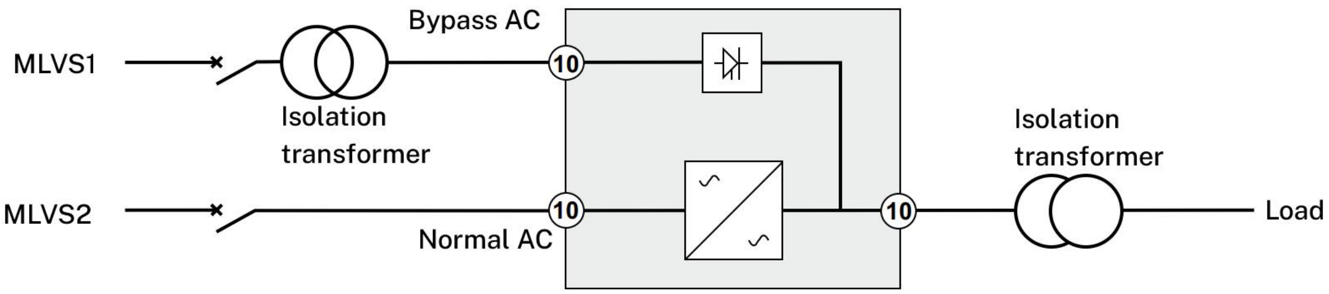



The transformer is not necessary if:

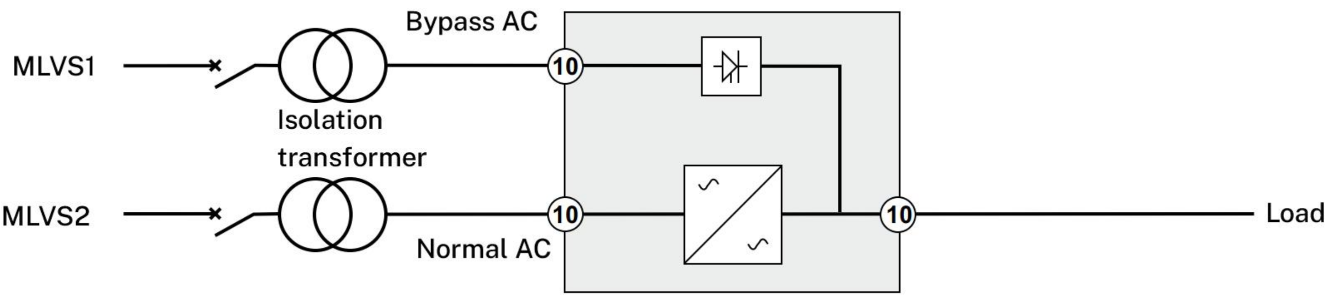
- Normal and Bypass inputs are connected to the same source,
- and wires cross-sections and lengths of Normal and Bypass inputs are identical,
- and upstream protection is provided by only one switch with RCD (Residual Current Device) for Normal and Bypass AC inputs.

UPS with separate Normal and Bypass AC inputs, supplied by separate sources



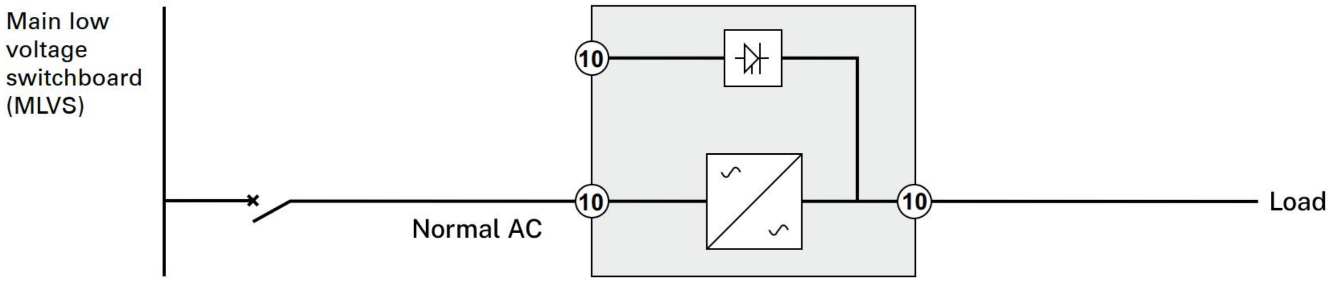


Change in SEA between upstream and downstream or galvanic isolation required



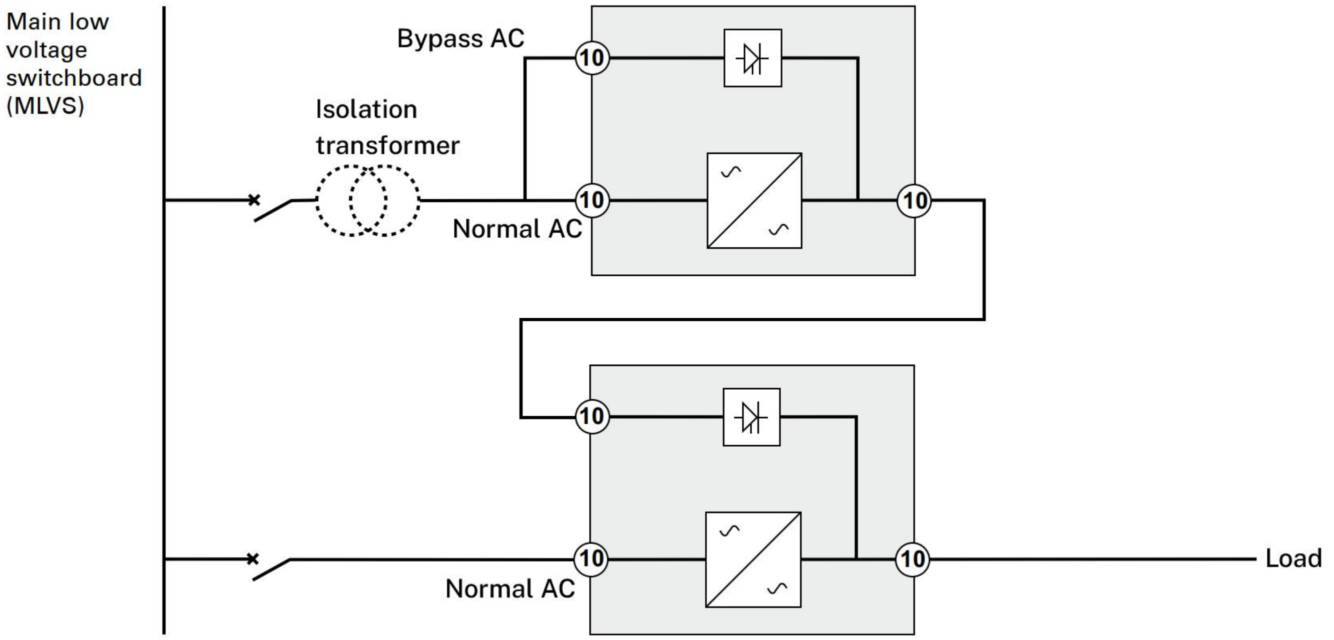
Frequency converter (without Bypass AC input)

Configuration used when the frequency of the application differs from Normal AC (example: marine requirements).



Hot standby

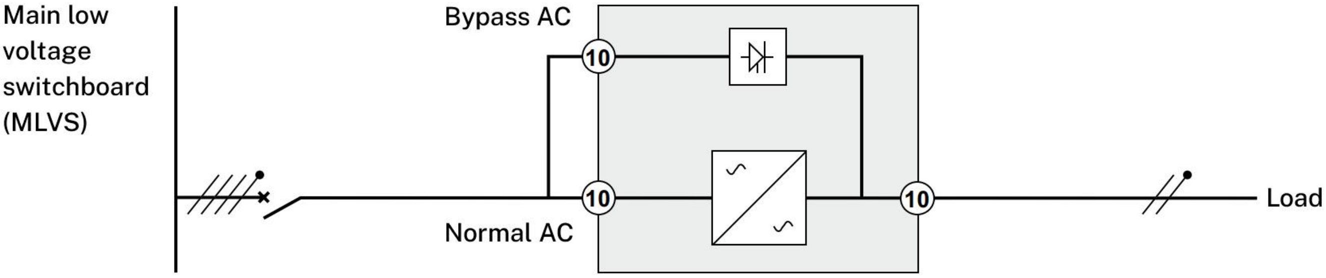
Configuration used to provide N+1 redundancy to critical loads.



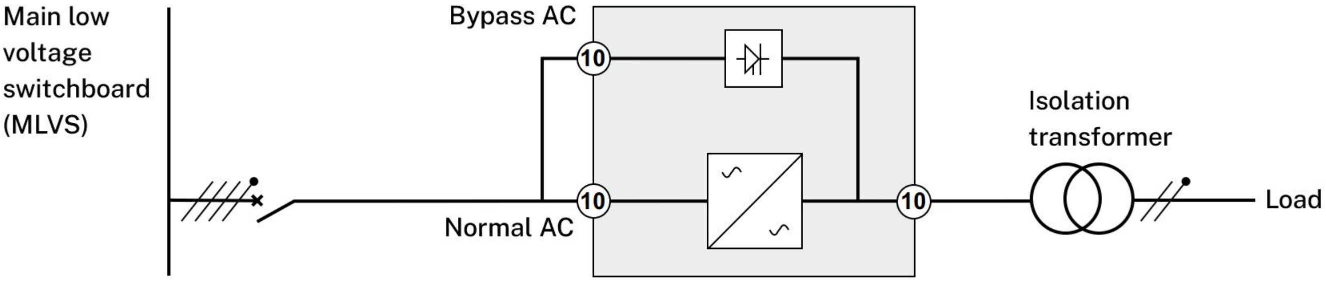
Note: The slew rate needs to be changed on the back up UPS unit in order to avoid synchronisation issues.

Three phase (3:1) 8 kVA 5594-8PX / 11 kVA 5594-9PX

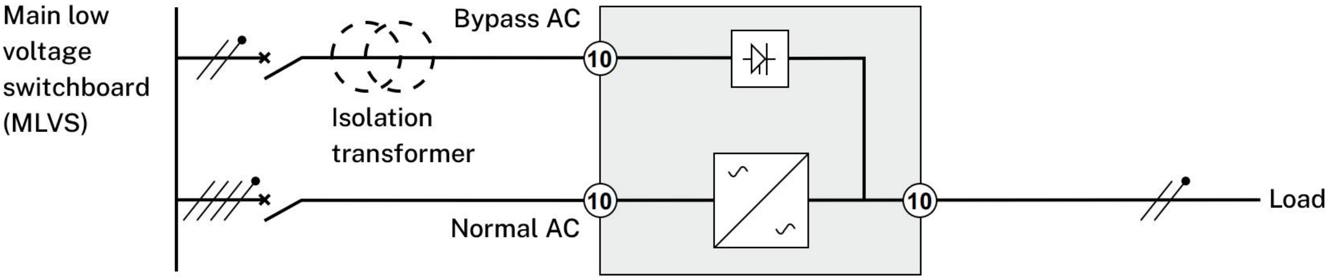
UPS with common Normal and Bypass AC inputs



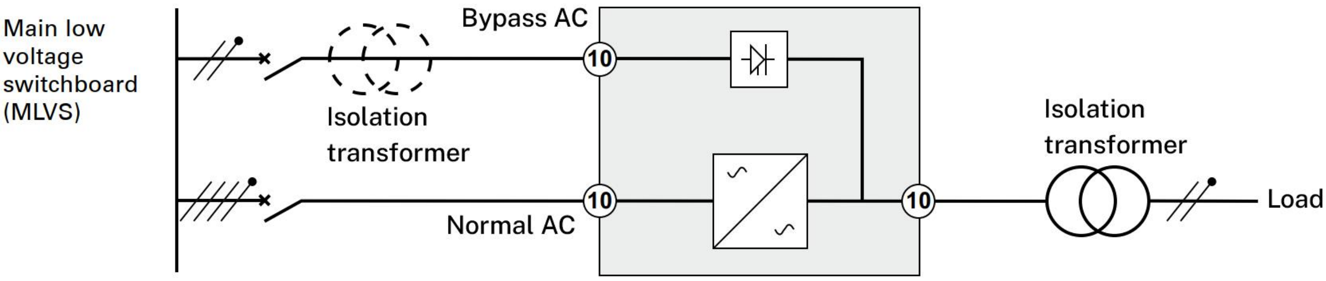
Change in SEA between upstream and downstream or galvanic isolation required

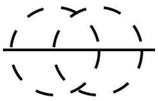


UPS with separate Normal and Bypass AC inputs



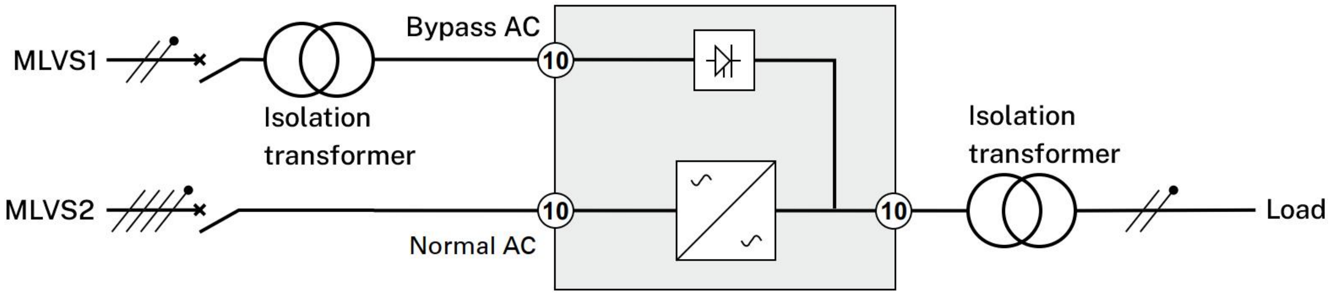
Change in SEA between upstream and downstream or galvanic isolation required



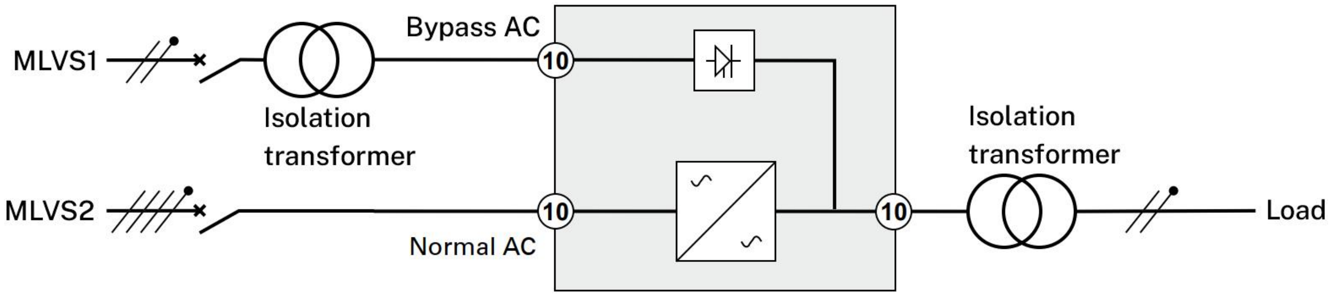
 The transformer is not necessary if:

- Normal and Bypass inputs are connected to the same source,
- and wires cross-sections and lengths of Normal and Bypass inputs are identical,
- and upstream protection is provided by only one switch with RCD (Residual Current Device) for Normal and Bypass AC inputs.

UPS with separate Normal and Bypass AC inputs, supplied by separate sources

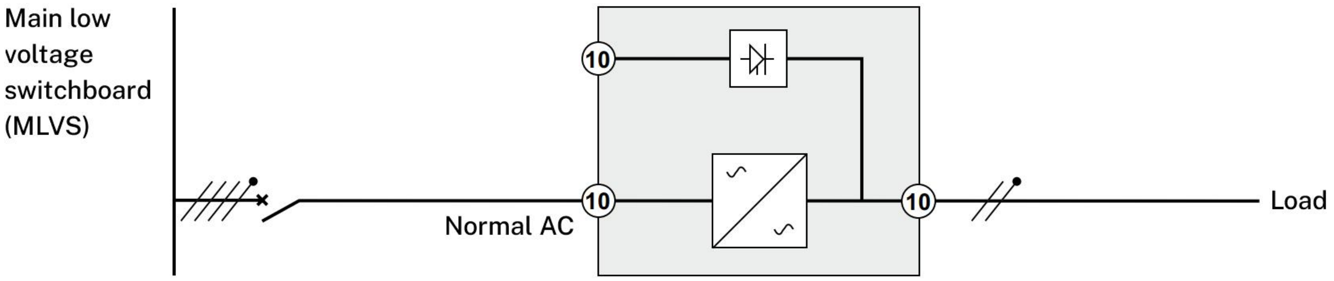


Change in SEA between upstream and downstream or galvanic isolation required



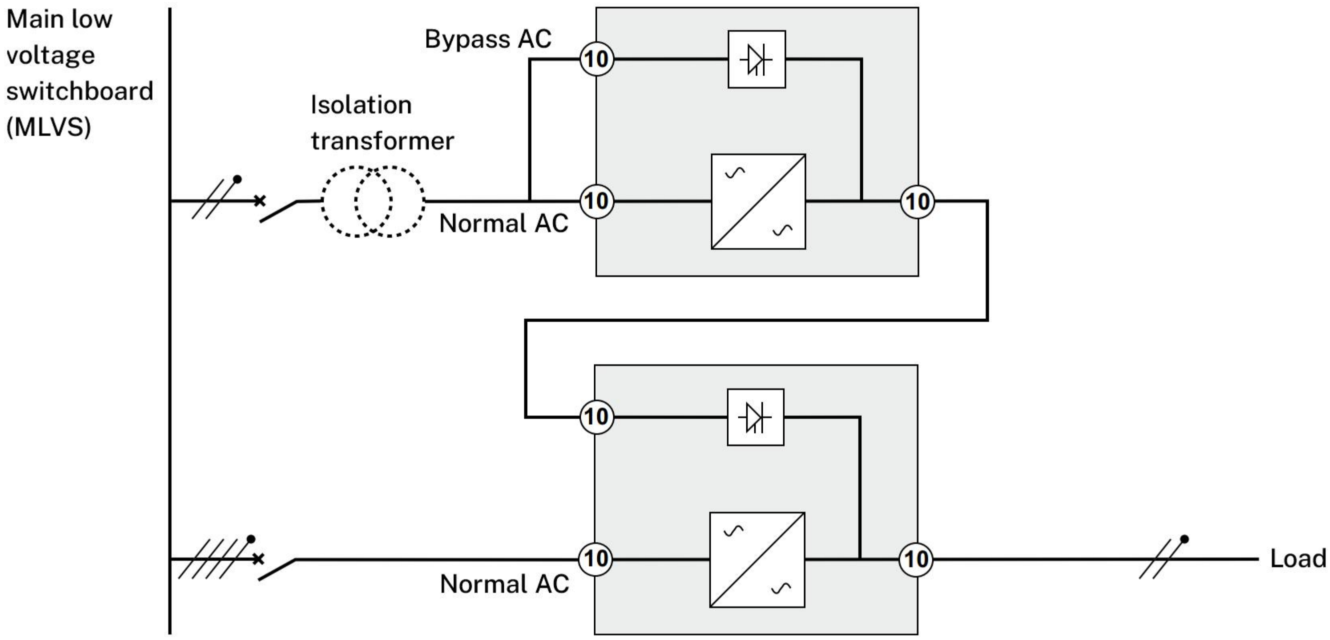
Frequency converter (without Bypass AC input)

Configuration used when the frequency of the application differs from Normal AC (example: marine requirements).



Hot standby

Configuration used to provide N+1 redundancy to critical loads.



Note: The slew rate needs to be changed on the back up UPS unit in order to avoid synchronisation issues.

Chapter 5 Installation

Please review Chapter 4 before commencing with the UPS installation!

DO NOT store the UPS unit or any Extended Battery Modules for longer than 6 (six) months!

If the UPS unit or any Extended Battery Modules are stored for longer than 6 months then it could be that the UPS will not power up after installing it. For additional information see UPS may fail when installed after longer storage time in Chapter 11.

Inspecting the equipment

If any equipment has been damaged during shipment, keep the shipping cartons and packing materials and contact your place of purchase.

Note: Check the battery recharge date on the shipping carton label. If the date has passed and the battery packs were never recharged, do not use the UPS. Contact your service representative.

Unpacking the unit

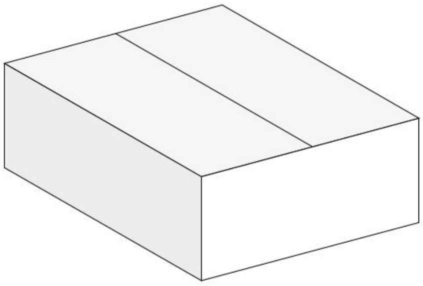
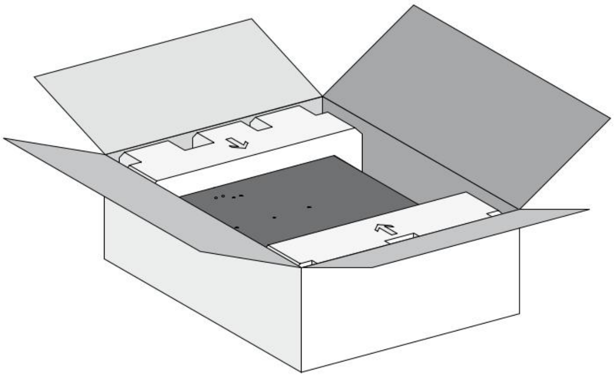
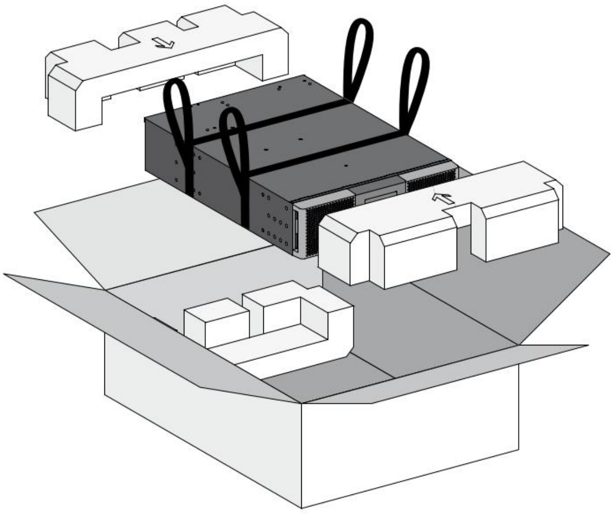
Important: Unpacking the unit in a low-temperature environment might cause condensation to occur in and on the unit. Do not install the unit until the inside and outside of the unit are absolutely dry (hazard of electric shock).

Step 1. Unpack the equipment and remove all packing materials and the shipping carton.

Important: Do not lift the UPS or EBM from the front panel.

Attention! When unpacking and installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO, ROO, serial connectors etc. Make sure that these are not damaged!

See illustration on the following page.

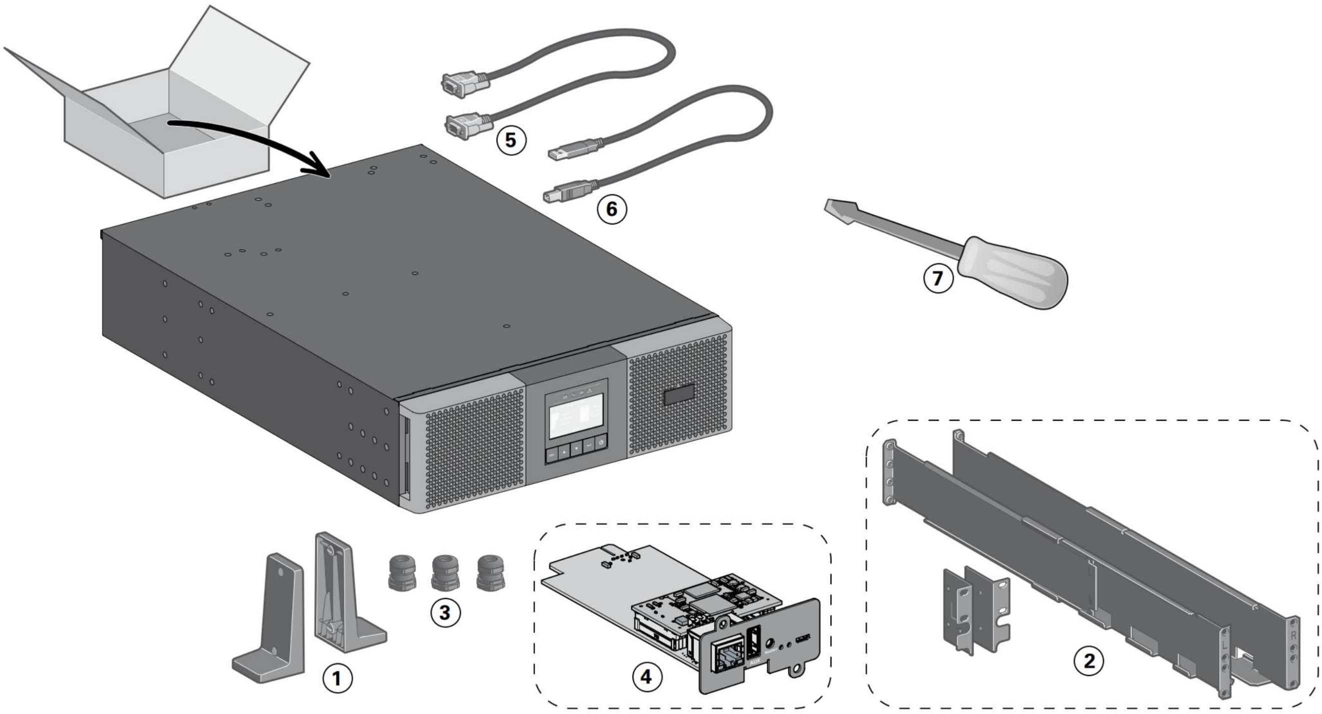





Step 2. Discard or recycle the packaging in a responsible manner, or store it for future use.

Note: Packing materials must be disposed of in compliance with all local regulations concerning waste. Recycling symbols are printed on Lenovo the packing materials to facilitate sorting.

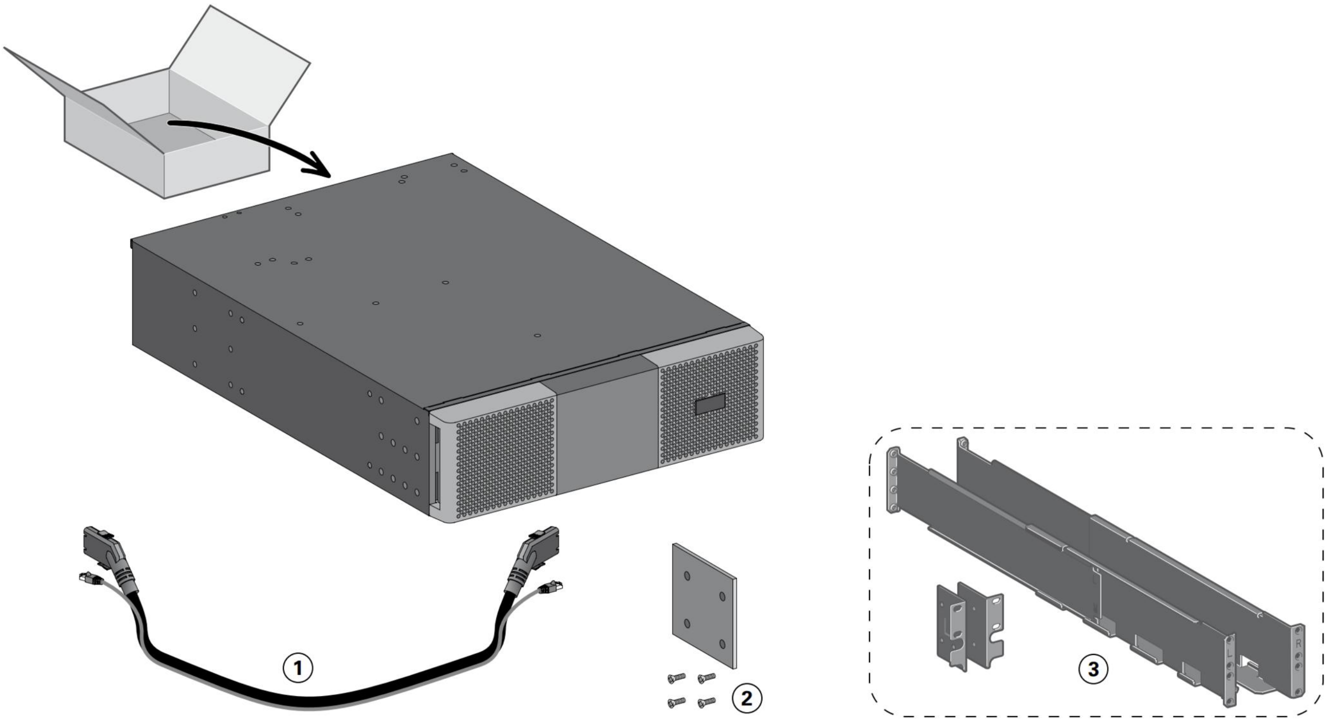
Checking the UPS accessory kit

Verify that the following additional items are included with the UPS:



① 2 supports for the upright (tower) position
② Rail kit for 19-inch enclosures
③ 3x Cable glands for Input/Output connection
④ UPS Network Management Card
⑤ RS232 communication cable
⑥ USB communication cable
⑦ Screwdriver

Verify that the following additional items are included with each EBM:

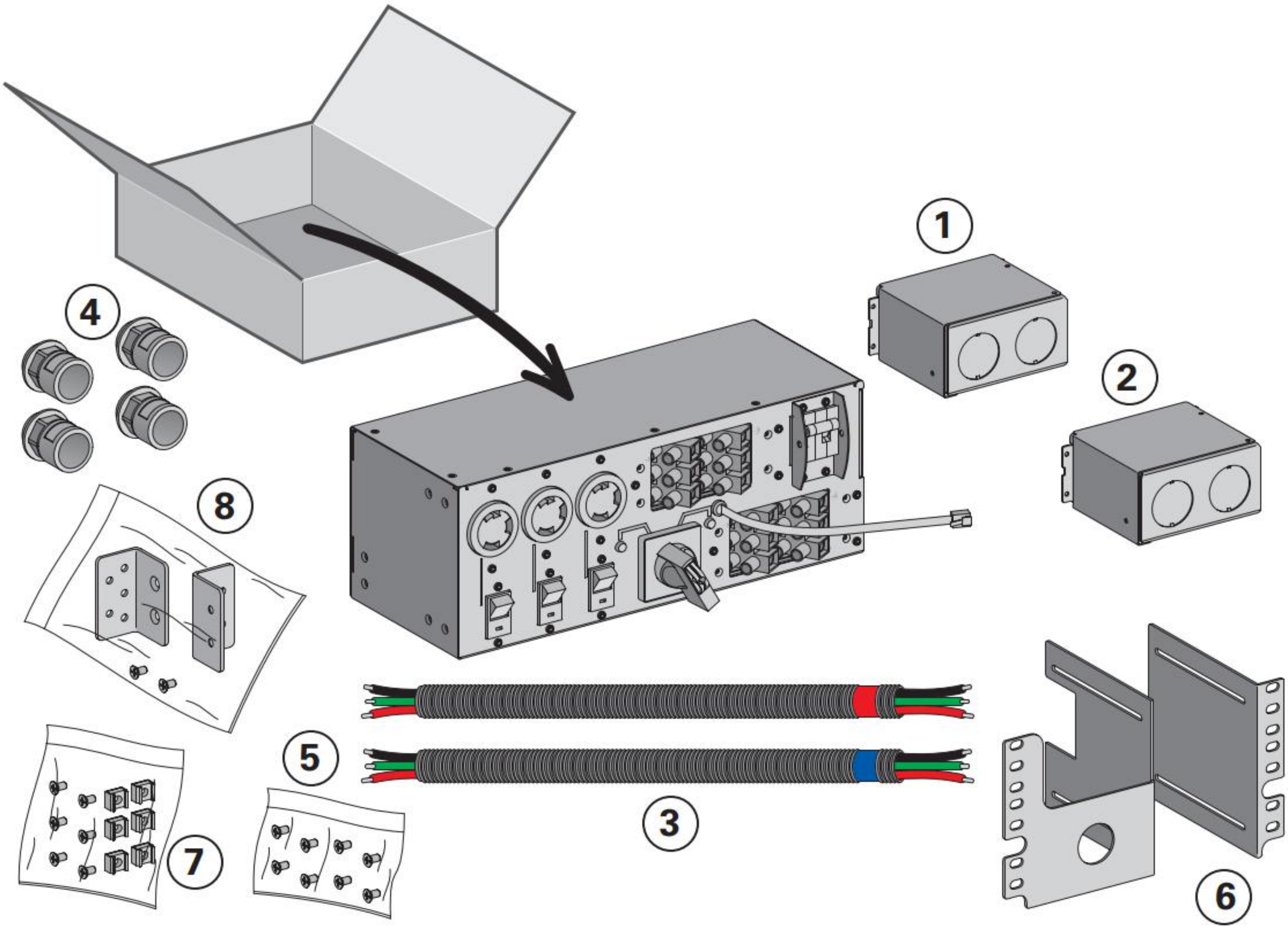


① Battery power cable, with attached battery detection cable
② Stabilizer bracket (4 screws included)
③ Rack kit for 19-inch enclosures

Note: Disregard the EBM installation instructions if you are installing the EBM with a new UPS at the same time. Use the UPS instructions to install both the UPS and the EBM.

Checking the 1:1 HotSwap MBP accessory kit

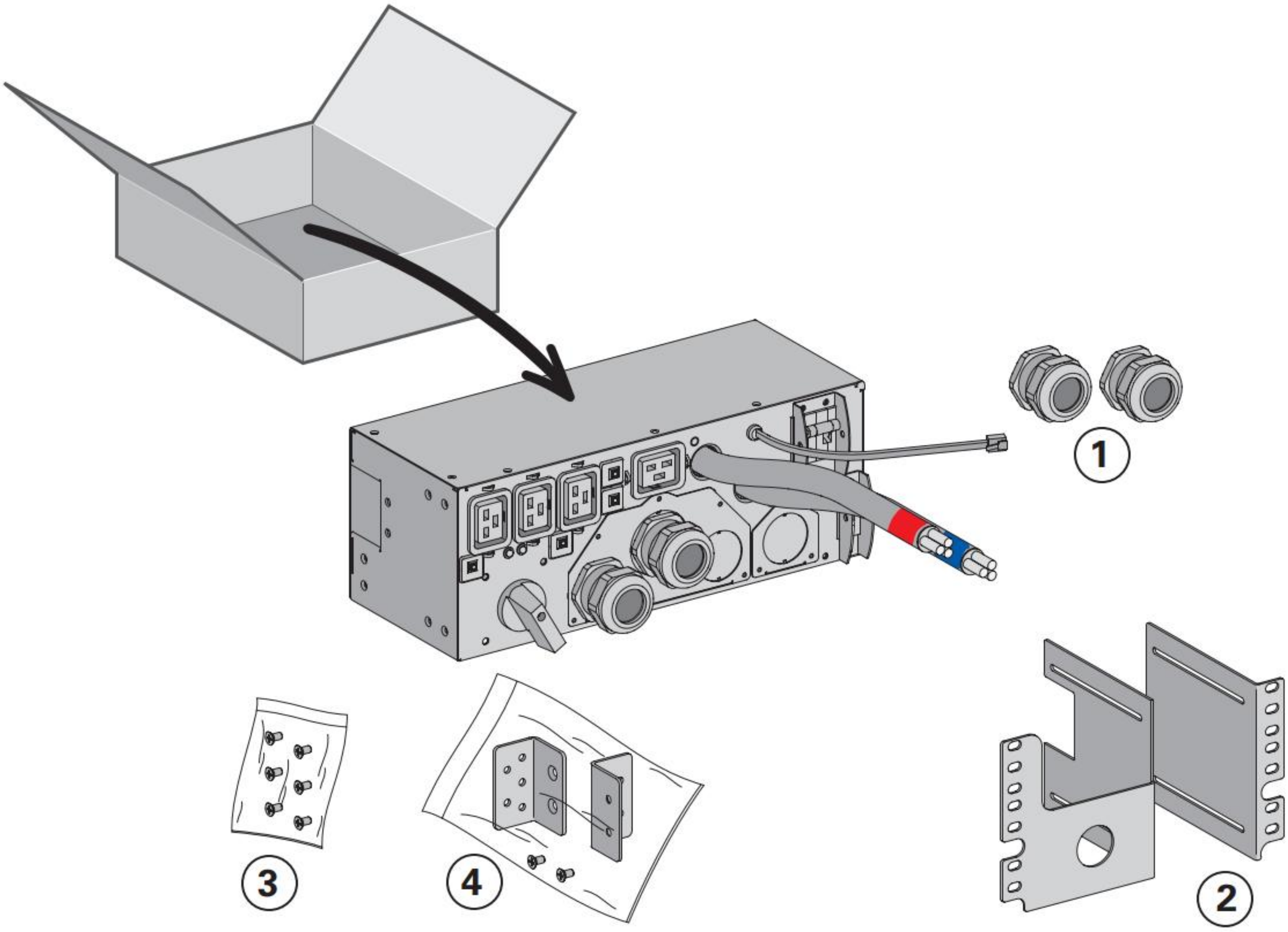
Verify that the following items are included with the 1:1 (single phase 5594-8KX and 5595-9KX) MBP:



① MBP I/O cover
② MBP I/O "UPS connection" cover
③ 2x conduits with internal wires for UPS Input/Output connection
④ 4x conduit fittings
⑤ Fixation kit for MBP I/O covers (including screws)
⑥ Rack kit for 19-inch enclosures
⑦ Fixation kit for Rack mounting (including square nuts and screws)
⑧ Tower and wall mounting kit (including 2 ears and screws)

Checking the 3:1 HotSwap MBP accessory kit

Verify that the following items are included with the 1:1 (three phase 5594-8PX and 5595-9PX) MBP:



① 2x cable glands for UPS Input Bypass connection (optional)
② Rack kit for 19-inch enclosures
③ Square nuts and screws
④ Tower and Wall mounting kit (including 2 ears and screws)

Mechanical mounting

For rack installations, mount the MBP to the rail behind an EBM, just below the UPS. For tower installations, mount the MBP to an EBM.

Connecting the EBM(s)

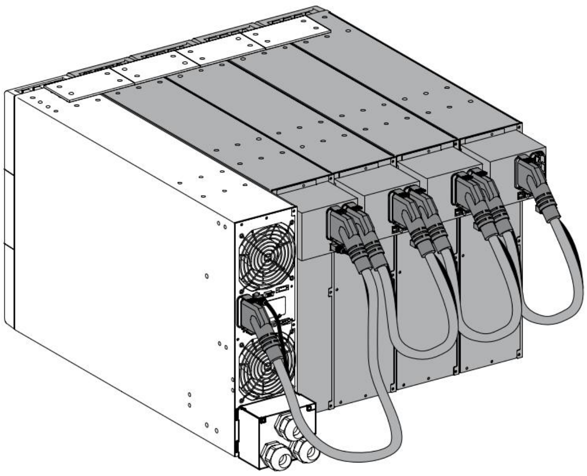
Note: A small amount of arcing might occur when connecting EBMs. This is normal and will not harm personnel. Insert the EBM cable into the battery connector quickly and firmly.

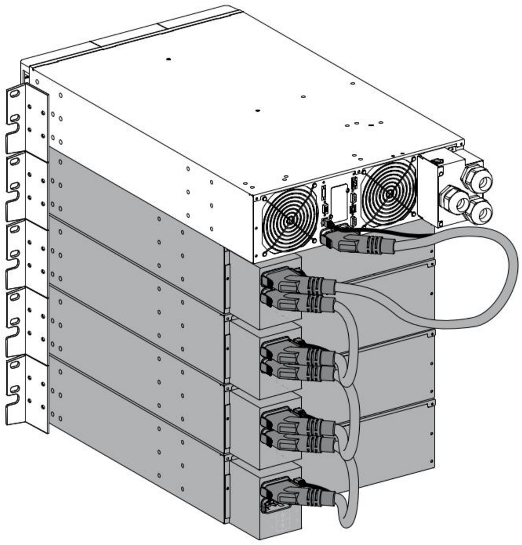
Step 1. Plug the EBM power cable(s) into the battery connector(s). Up to four EBMs can be connected to the UPS.

Step 2. Verify that the EBM connections are tight and that strain relief exists for each cable.

Step 3. Connect the battery detection cable(s) to the connector of the UPS and of the EBM(s).

Step 4. Check that the battery circuit breaker is switched to the "I" (on) position.
This circuit breaker can be put into the "I" whilst the UPS is up and running.





Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

When installing a UPS unit and any additional EBMs as a tower do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

Rack installation

Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

When installing a UPS unit and any additional EBMs into a rack do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

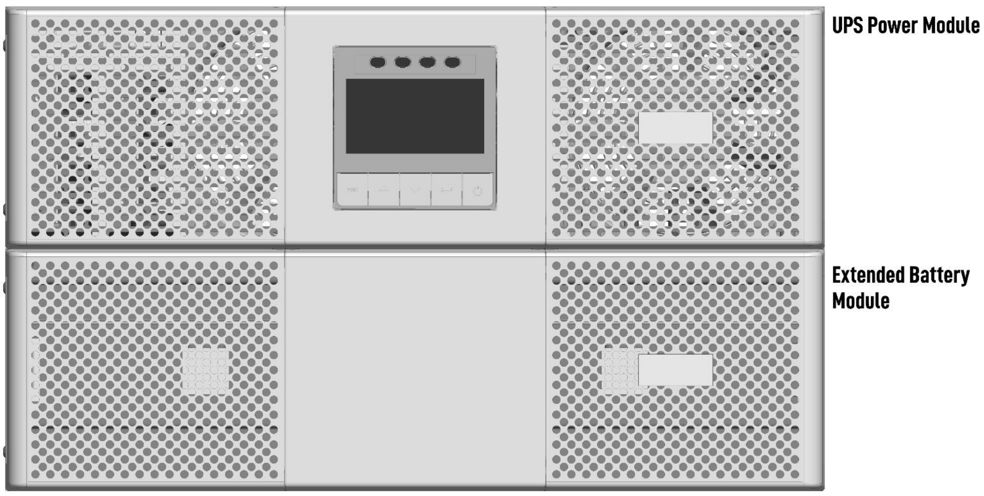
Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

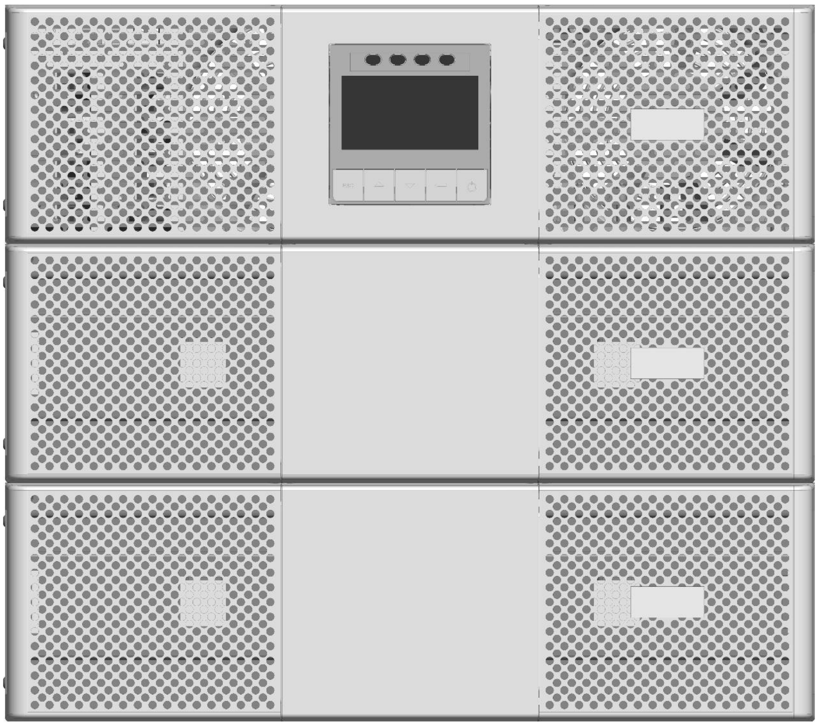
Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

Over the next few pages the images below show how the UPS installation has to look like once the UPS Power Module and all Extended Battery Modules have been installed into the rack.

Base UPS : One UPS Power Module and one Extended Battery Module



UPS : One UPS Power Module and two Extended Battery Modules

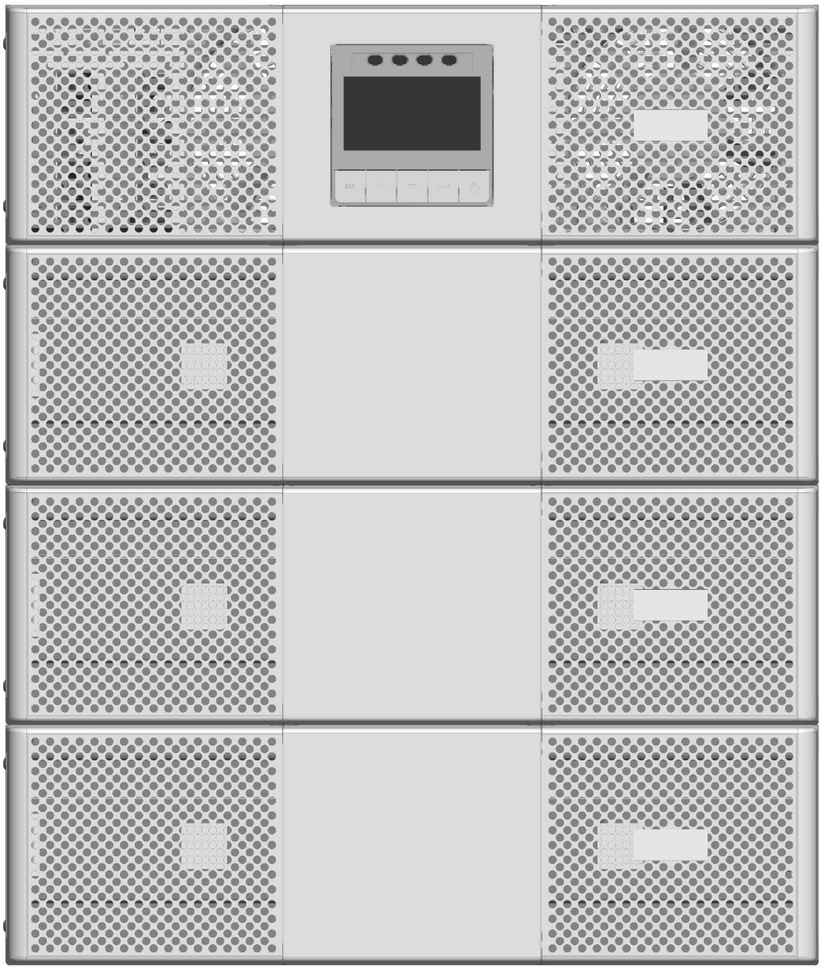


UPS Power Module

Extended Battery Module

Extended Battery Module

UPS : One UPS Power Module and three Extended Battery Modules



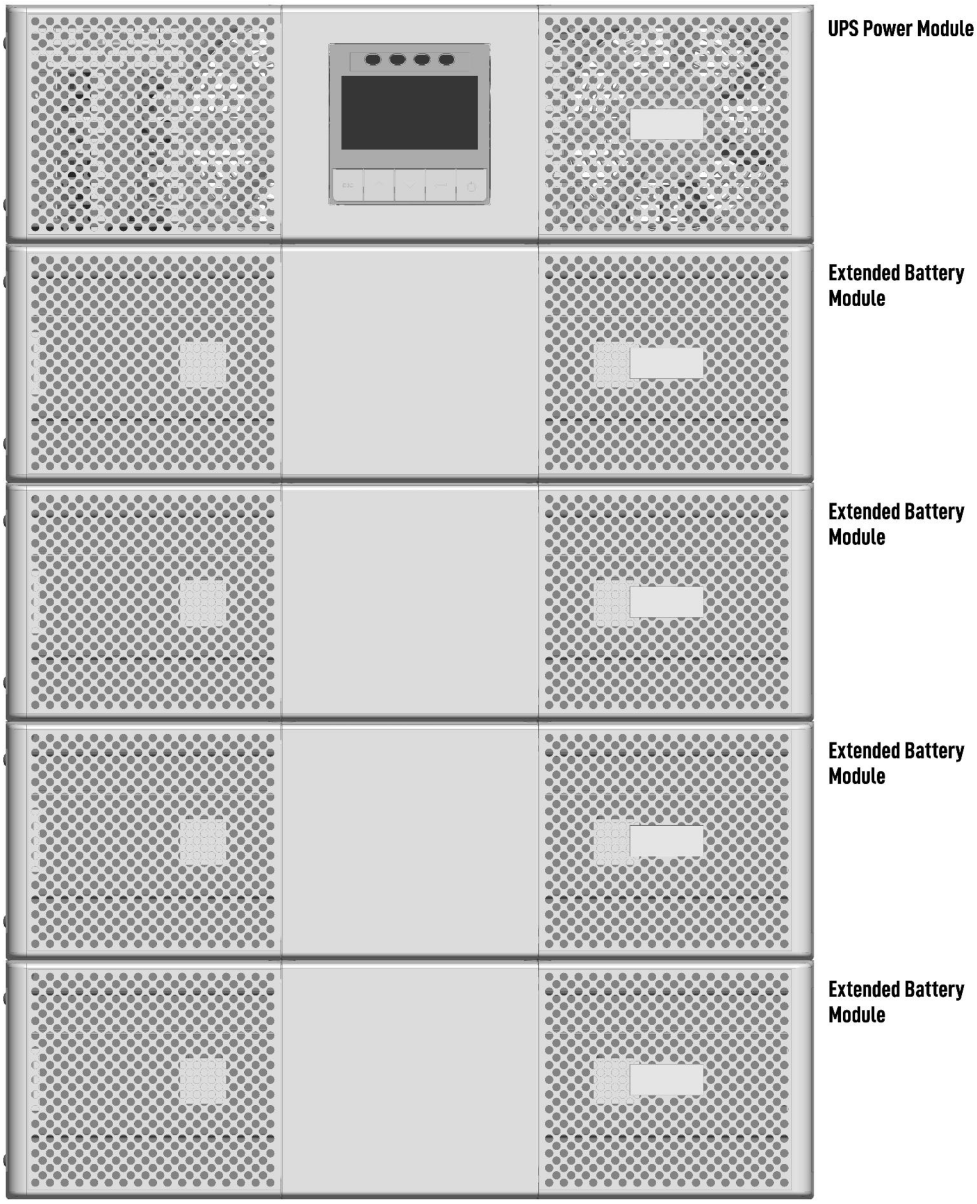
UPS Power Module

Extended Battery Module

Extended Battery Module

Extended Battery Module

UPS : One UPS Power Module and four Extended Battery Modules



Preparing the EBM for rack mounting

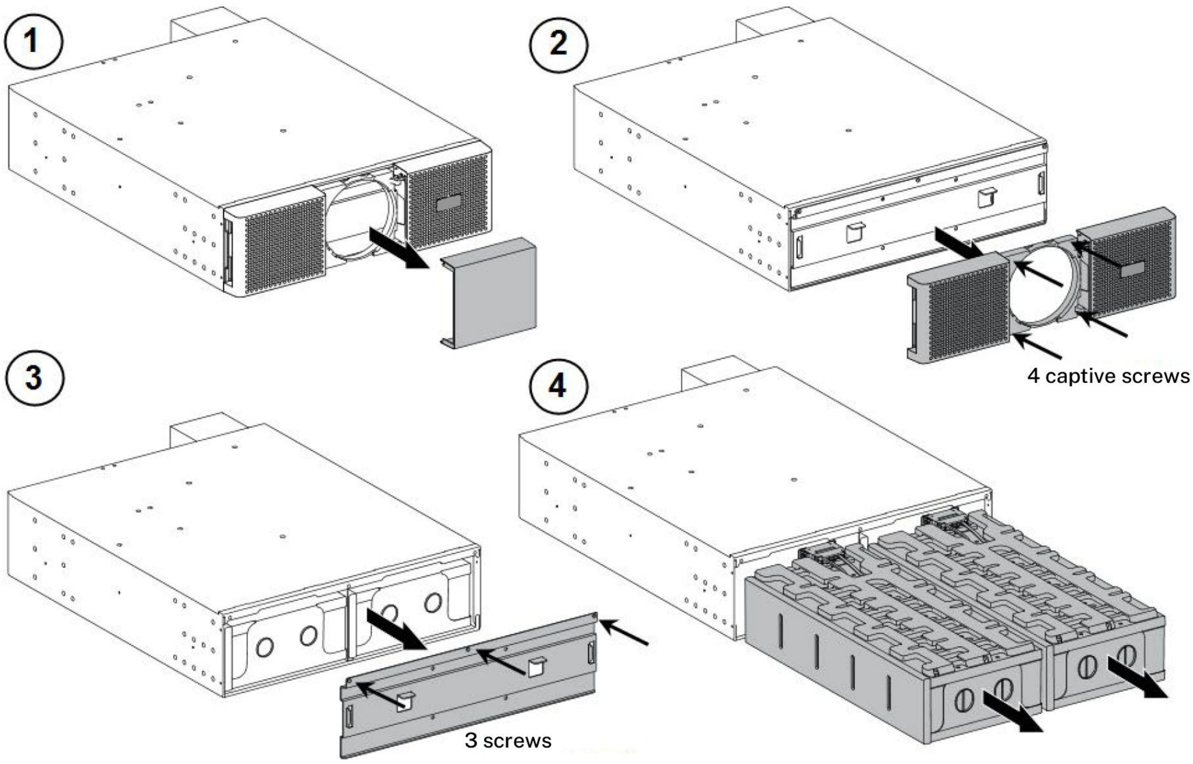
Note: This step requires two people.

The Extended Battery Module is very heavy. To ease its rack mounting, you can remove the battery packs from the EBM by following these steps.

Step 1. Remove the centre section of the front bezel.

Step 2. Remove the four captive screws to open the front bezel.

Step 3. Remove the three screws to pull out the metal protection cover of the battery pack.



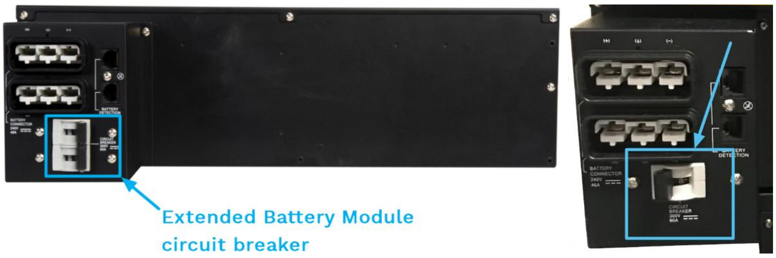
Step 4. Pull out the plastic handle of the left and right battery packs, and slide the packs out slowly on to a flat and stable surface. Use two hands to support the battery packs. Set them aside for reinstalling after that the EBM is rack mounted.

Step 5. Mount the EBM in the rack.

Step 6. If applicable: Make sure that the battery connectors are connected together.

Step 7. Put back the battery packs, screw back the metal protection cover and the front panel, then clip the center cover.

Step 8. Make sure that the EBM battery circuit breaker is turned on.



Rack mounting of UPS, EBM, and accessory modules

Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

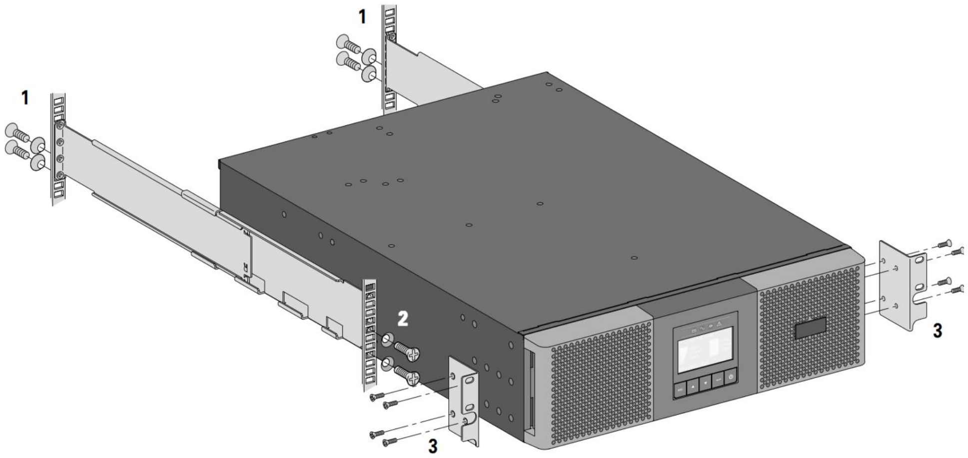
When installing a UPS unit and any additional EBMs into a rack do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

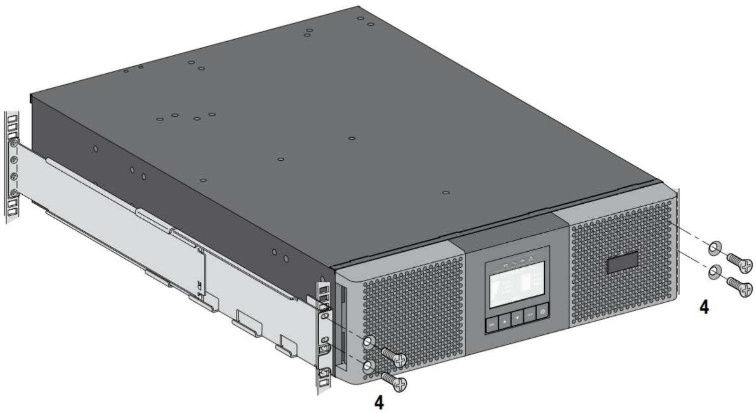
Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

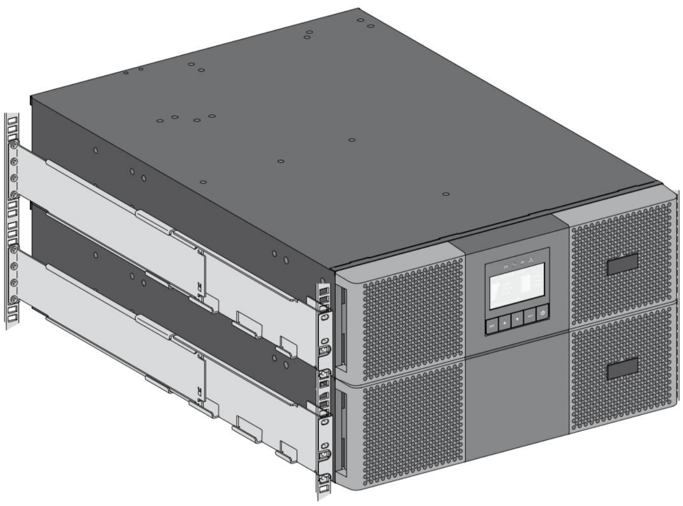
Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

Follow steps 1 to 7 in Preparing the EBM for rack mounting for module mounting on the rails.







The rails and necessary hardware are supplied with the UPS.

Ensure that the relevant battery circuit breakers are turned on. See Figure 19 or Figure 20.

Figure 19: 5594-8KX / 5594-9KX Battery circuit breaker location

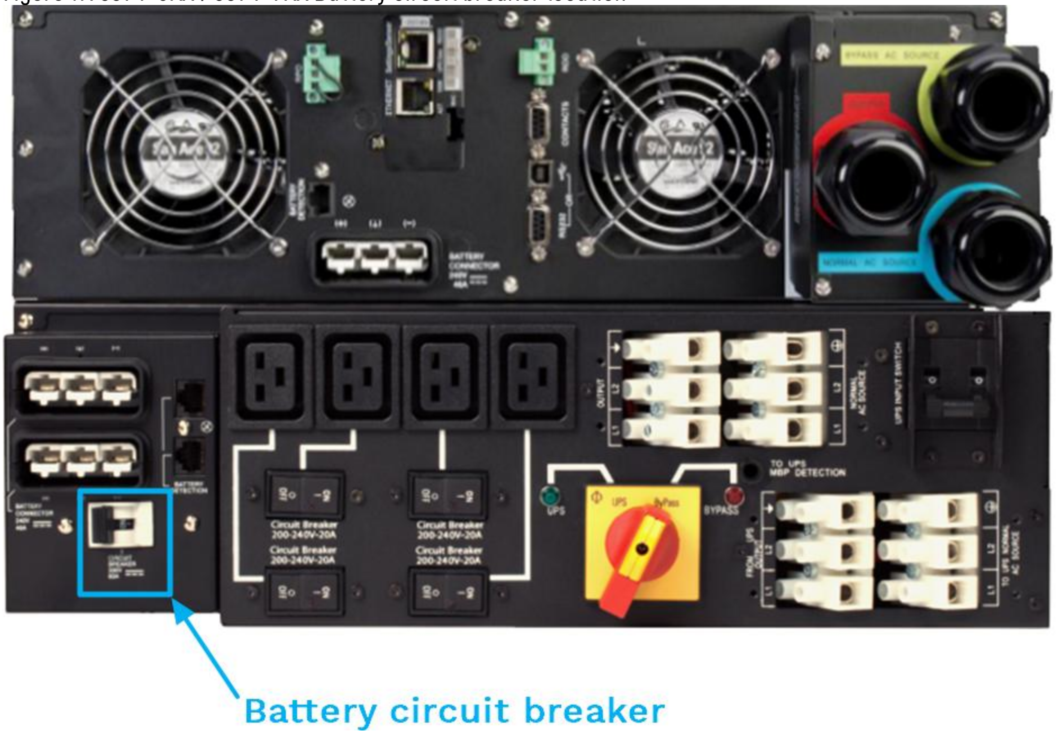
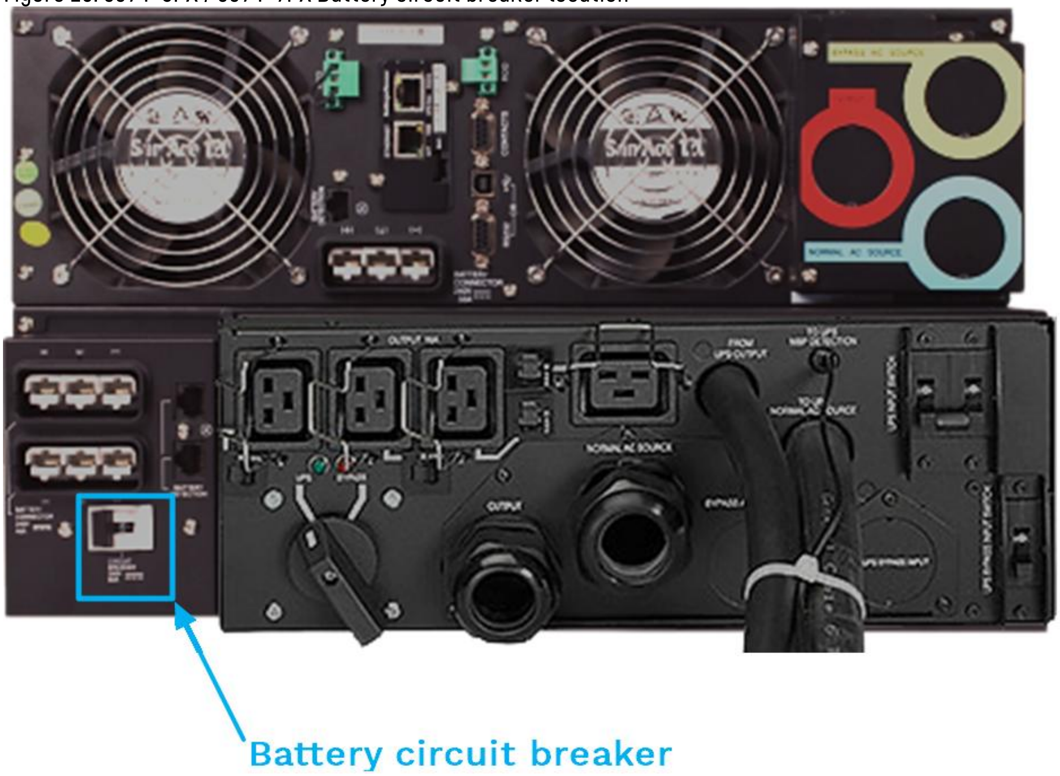


Figure 20: 5594-8PX / 5594-9PX Battery circuit breaker location



For MBP installation see the section "Single Phase HotSwap MBP installation and connection" for 5594-8KX or 5594-9KX and "Three Phase HotSwap MBP installation and connection" for 5594-8PX or 5594-9PX.

Tower installation

Attention! When installing the UPS unit's power module, pay attention to any connectors on the back side of the UPS unit such as RPO and ROO, serial connectors etc. Make sure that these are not getting damaged!

When installing a UPS unit and any additional EBMs as a tower do not leave any gaps between any module! This means that any modules must be mounted adjacent to each other! See also the images in Chapter 5 Installation / Rack Installation for correct UPS installation. This also applies to the tower installation of the UPS units.

Leaving gaps between modules can damage the UPS and any interconnection cables! This can lead to the UPS unit malfunctioning!

Note that the thick power cables running between the UPS power module and any EBM carries a high electrical current of a couple of Ampères!

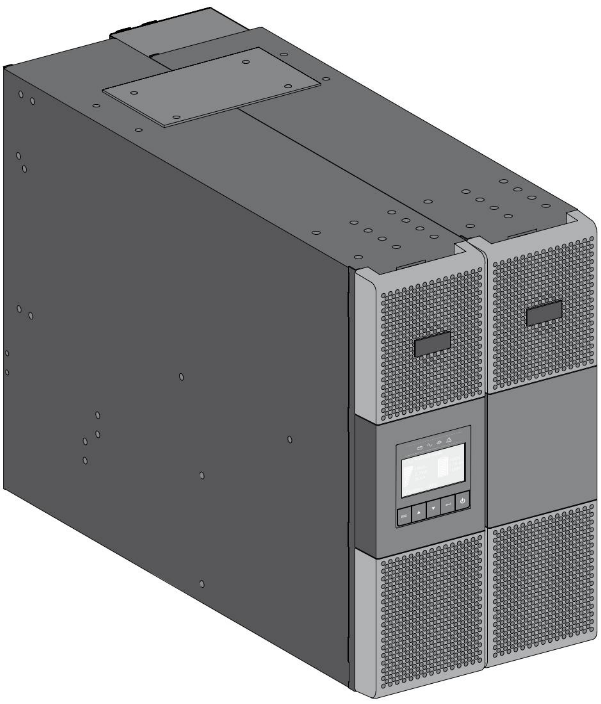
Any damage caused by incorrect physical installation and the subsequent repair work is not covered by UPS warranty or maintenance contract.

To install the unit in a tower configuration:

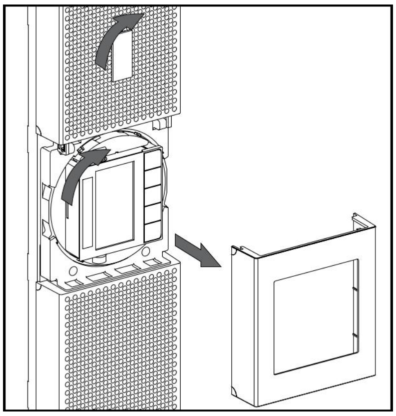
Step 1. Place the UPS on a flat, stable surface in its final location.

Step 2. Always keep 150 mm of free space behind the UPS rear panel.

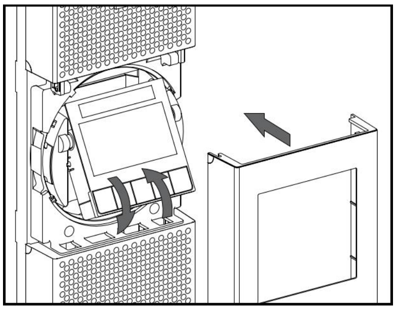
Step 3. If installing additional units, place them next to the UPS in their final location.



Step 4. Adjust the orientation of the LCD panel and the logo, as shown.



Step 5. Adjust the angle of vision of the LCD panel, as shown.



Rack and Tower Kit

All rack mountable UPS units ship with hardware for either installing in a rack or standing upright as a tower. The two kits include:

Rack mount kit:
For mounting the UPS in a rack

- Rack Installation Instructions
- Rail kit for 19-inch enclosures

Note: Because of the weight of the UPS and EBMs, they should not be installed any higher than 5 ft (1.5 m) above the floor. This will allow for easy installation and servicing.

Tower kit:
For standing the UPS upright.

- 2 supports for the upright (tower) position - Tower stands
- Screwdriver

Note: The front LCD display panel will need to be rotated for the image to display horizontal or vertical to suit the UPS units position. Remove the LCD cover and rotate / angle screen as appropriate.

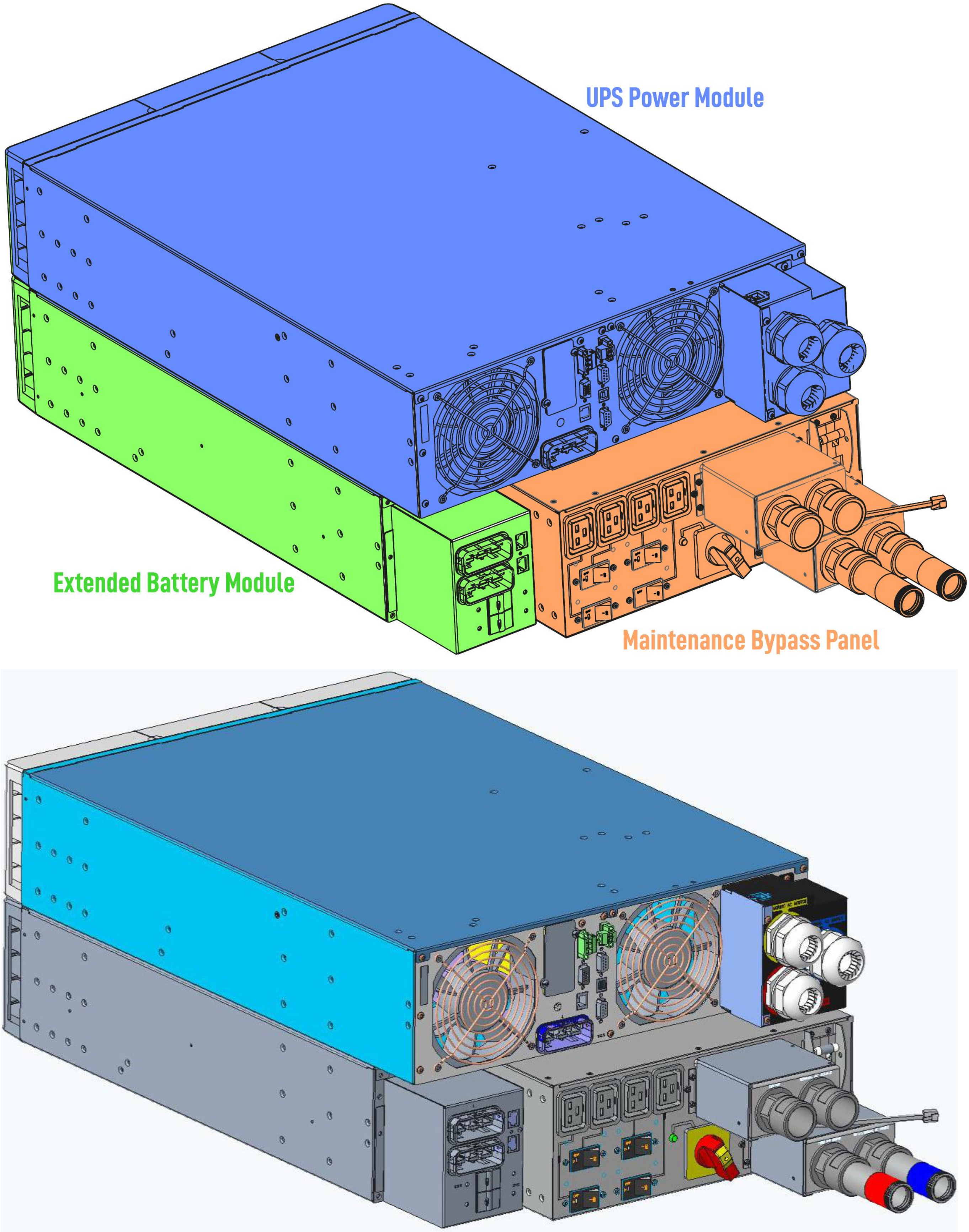
The following images display an example of an upright rack mountable 8000VA UPS with Extended Battery Module:

HotSwap MBP installation and connection

General MBP installation

For both rack and wall installation of the MBP it is strongly recommended to install the MBP behind the first EBM which is underneath the UPS Power Module. See also Figure 21 for details.

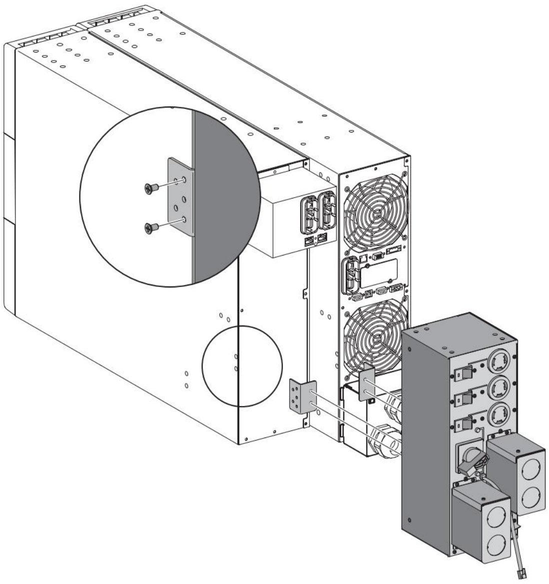
Figure 21: Recommended space saving MBP rack installation, UPS power module is above EBM

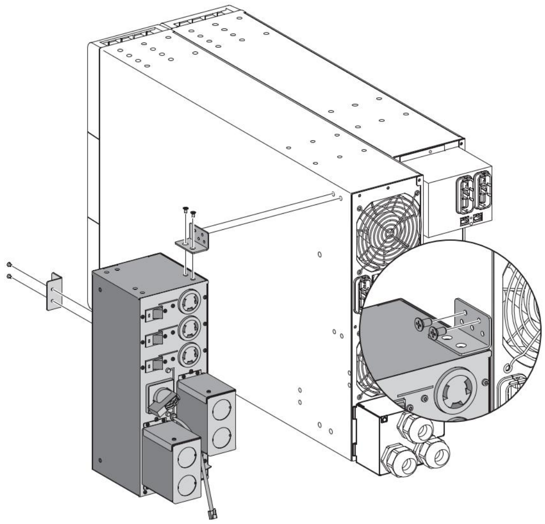


Single Phase HotSwap MBP installation and connection

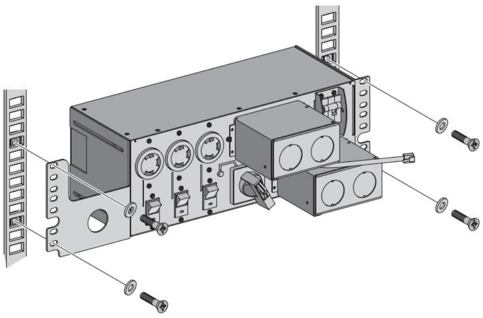
Installation methods

Tower installation

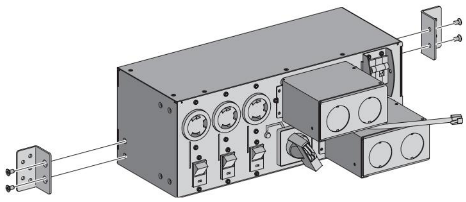




Rack installation

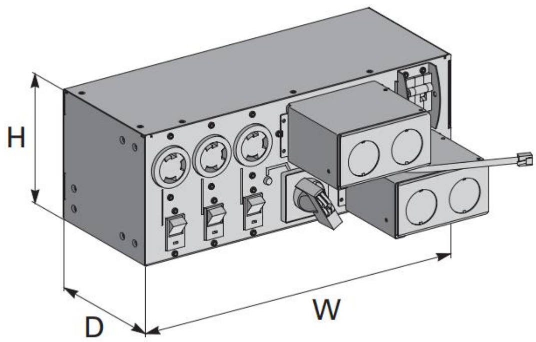


Wall mounting



Physcial specifications

Weight (kg / lbs)	Dimensions (mm / inch) D x W x H
6.2 / 13.7	220 x 336 x 130 / 8.7 x 13.2 x 5.1



Description / Panels

The HotSwap MBP has a manual Bypass rotary switch with two positions:

- **UPS** - the load is supplied by the UPS
- **Bypass** - the load is supplied directly by the AC power source

Two lights indicate the Hotswap MBP power status:

- **UPS supply green light:** when active, the UPS output is available, the Bypass switch can be safely turned to UPS position
- **Bypass mode red light:** when active, indicates that the Hotswap MBP is on "Bypass mode" (Bypass switch turned to Bypass position)

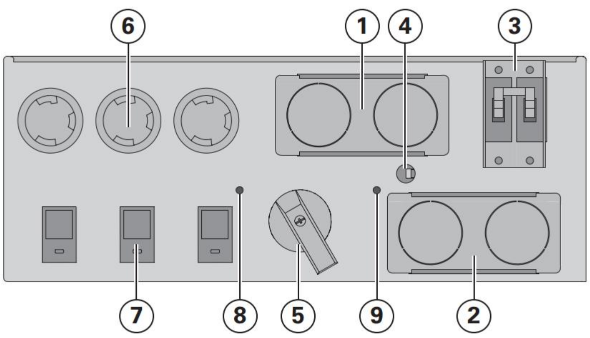
Normal AC source switch

Allows to safely switch off the AC source of the UPS, for UPS maintenance / replacing

MBP status detection

A signal cable, with RJ11 connector to plug to the UPS, allows the communication to the UPS to manage the MBP status, and the indication on UPS display panel of both following status:

- MBP connection to UPS
- Bypass switch position



① Input/Output terminal blocks
② Input/Output terminal blocks for connection to the UPS
③ Normal AC source switch
④ Signal cable for MBP detection to the UPS
⑤ Manual Bypass switch
⑥ 3x 30A outlets
⑦ 30A circuit breaker
⑧ UPS supply green light
⑨ "Bypass" mode red light

Installation

Unpacking the MBP

Unpack the equipment and remove all the packing materials and shipping carton.

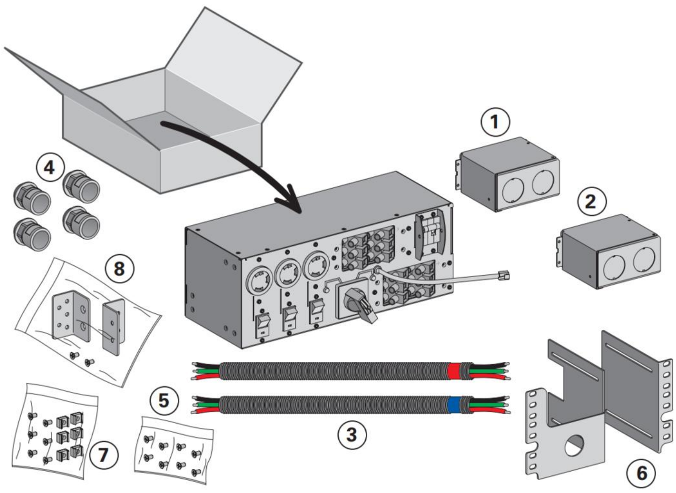
Discard or recycle the packaging in a responsible manner, or store it for future use.

Place the cabinet in a protected area that has adequate airflow and is free of humidity, flammable gas, and corrosion.

Note: Packing materials must be disposed of in compliance with all local regulations concerning waste. Recycling symbols are printed on the packing materials to facilitate sorting.

Checking the accessory kit

Verify that the following additional items are included with the MBP:



① MBP I/O cover
② MBP I/O "UPS connection" cover
③ 2 conduits with internal wires for UPS Input/Output connection (4) (4) conduit fittings
④ Fixation kit for MBP I/O covers (including screws)
⑤ Rack kit for 19-inch enclosures
⑥ Fixation kit for Rack mounting (including square nuts and screws)
⑦ Tower and wall mounting kit (including 2 ears and screws)

Mechanical Mounting

Mount the MBP behind the first EBM underneath the UPS Power Module. This applies to both rack installation or wall installation. See also the section General MBP installation for additional information.

Installation requirements

Recommended protective devices and cable cross-section

Recommended upstream protection

The circuit breaker has to be installed upstream the MBP Normal AC source.

Recommended cable cross-sections

	Terminal position	Wire function	Terminal wire size rating mm / AWG	Minimum input wire size rating	Tightening torque Nm / lb-in
with 8kVA UPS	L1	Phase	4-25 mm² / 12-4 AWG	10 mm² (8 AWG) 105°C 16 mm² (6 AWG) 75°C	2 / 18
	N / L2	Neutral / Phase			
	⏚	Ground			
with 11kVA UPS	L1	Phase	4-25 mm² / 12-4 AWG	16 mm² (6 AWG) 90°C 25 mm² (4 AWG) 75°C	2 / 18
	N / L2	Neutral / Phase			
	⏚	Ground			

Copper wire, solid or stranded.

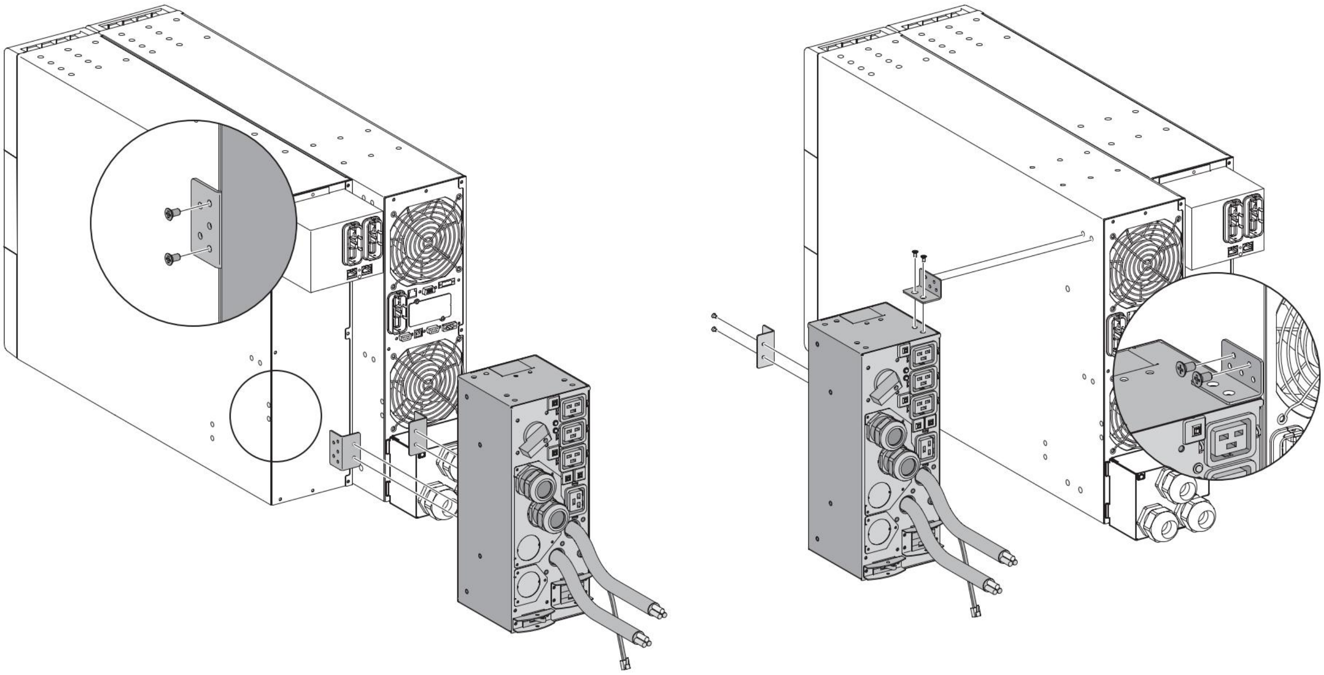
Power cables connection

For additional detailed wiring installation see "Chapter 6 Power cables connection".

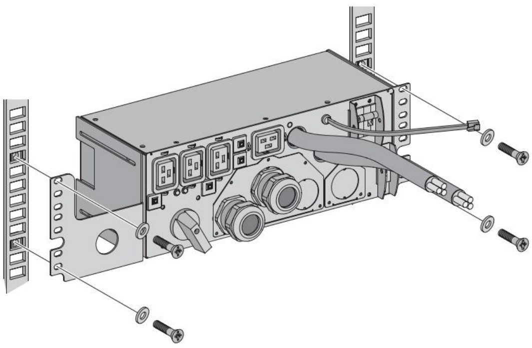
Three Phase HotSwap MBP installation and connection

Installation methods

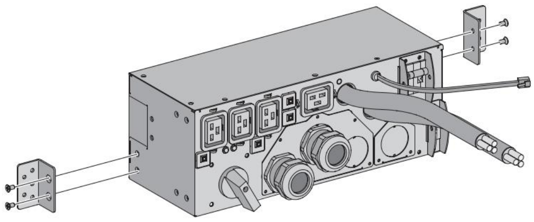
Tower installation



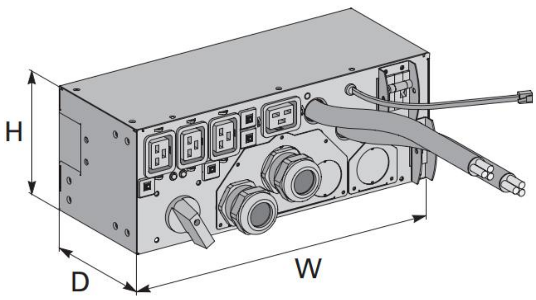
Rack installation



Wall mounting



Weight (kg / lb)	Dimensions (mm / inch) D x W x H
5.5 / 2.1	132 x 336 x 130 / 5.2 x 13.2 x 5.1



Description / Panels

The HotSwap MBP has a manual Bypass rotary switch with two positions:

- **UPS** - the load is supplied by the UPS
- **Bypass** - the load is supplied directly by the AC power source

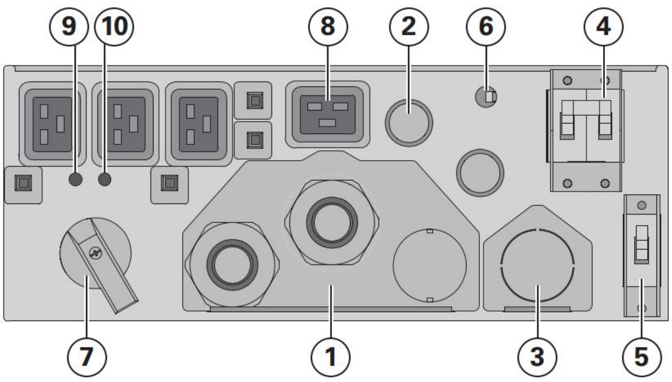
Two lights indicate the HotSwap MBP power status:

- **UPS supply** green light: when active, the UPS output is available, the Bypass switch can be safely turned to UPS position
- **Bypass mode** red light: when active, indicates that the HotSwap MBP is on “Bypass mode” (Bypass switch turned to Bypass position)

Normal AC source switch / Bypass AC source switch (following MBP versions):
Allows to safely switch off the AC source of the UPS, for UPS maintenance / replacing

MBP status detection:
A signal cable, with RJ11 connector to plug to the UPS, allows the communication to the UPS to manage the MBP status, and the indication on UPS display panel of both following status:

- MBP connection to UPS
- Bypass switch position



① Input/Output terminal blocks
② Input/Output cables for connection to the UPS
③ Bypass terminal blocks for connection to the UPS
④ Normal AC source switch
⑤ Bypass AC source switch
⑥ Signal cable for MBP detection to the UPS
⑦ Manual Bypass switch
⑧ 4x 16 A outlets
⑨ UPS supply green light
⑩ **Bypass** mode red light

Installation

Inspecting the equipment

If any equipment has been damaged during shipment, keep the shipping cartons and packing materials for the carrier or place of purchase and file a claim for shipping damage. If you discover damage after acceptance, file a claim for concealed damage.
To file a claim for shipping damage or concealed damage:

1) File with the carrier within 15 days of receipt of the equipment;
2) Send a copy of the damage claim within 15 days to your service representative.

Unpacking the MBP

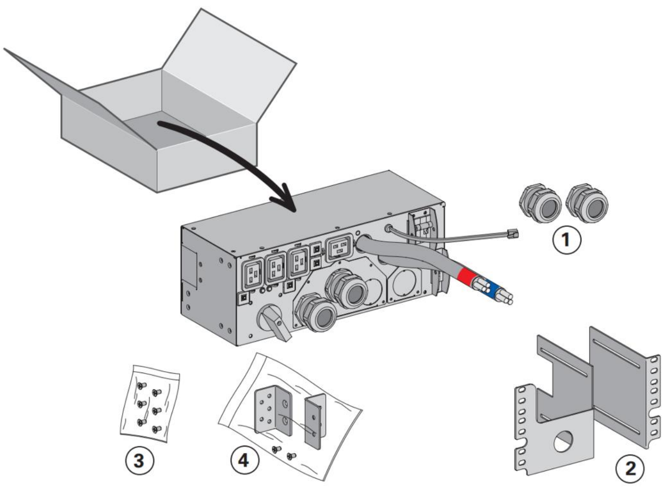
Unpack the equipment and remove all the packing materials and shipping carton.

Discard or recycle the packaging in a responsible manner, or store it for future use. Place the cabinet in a protected area that has adequate airflow and is free of humidity, flammable gas, and corrosion.

Note: Packing materials must be disposed of in compliance with all local regulations concerning waste. Recycling symbols are printed on the packing materials to facilitate sorting.

Checking the accessory kit

Verify that the following additional items are included with the MBP:



① 2x cable glands for UPS Input Bypass connection (option)
② Rack kit for 19-inch enclosures
③ Fixation kit for Rack mounting (including square nuts and screws)
④ Tower and Wall mounting kit (including 2 ears and screws)

Mechanical Mounting

Mount the MBP behind the first EBM underneath the UPS Power Module. This applies to both rack installation or wall installation. See also the section General MBP installation for additional information.

Installation requirements

Recommended protective devices and cable cross-sections

1. Recommended upstream protection

The circuit breaker has to be installed upstream the MBP Normal AC source.

2. Recommended cable cross-sections

Terminal position	Wire function	Terminal wire size rating	Minimum input wire size rating	Tightening torque
L1	Phase	4 - 25 mm^2 (12 - 4 AWG)	10 mm2 (8 AWG) 105 °C 16 mm2 (6 AWG) 90 °C	2 Nm (18 lb in)
L2	Phase			
L3	Phase			
N	Neutral			
⏚	Ground			

Copper wire, solid or stranded.

Power cables connection

For additional detailed wiring installation see "Chapter 6 Power cables connection".

Network Management Card (NMC)

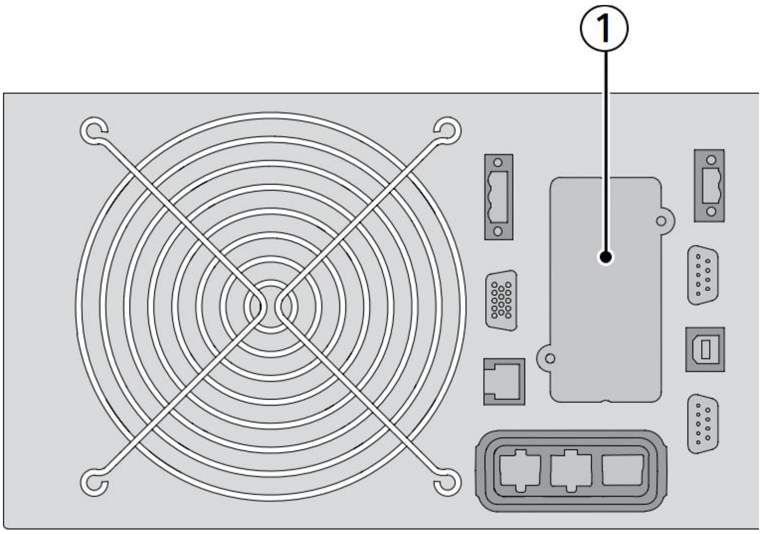
The Network Management Card (NMC) provides convenient over-the-network UPS remote monitoring and management through a standard web browser. The NMC has a 10 / 100 Mbps Ethernet port.

Installing the Network Managment Card

The Network Management Card, in short **NMC**, does not come pre-installed when the UPS is delivered. It has to be installed separately.

Follow these steps to install the UPS Network Management Card if it is not pre-installed.

Note: It is not necessary to shut down the UPS before installing the card.



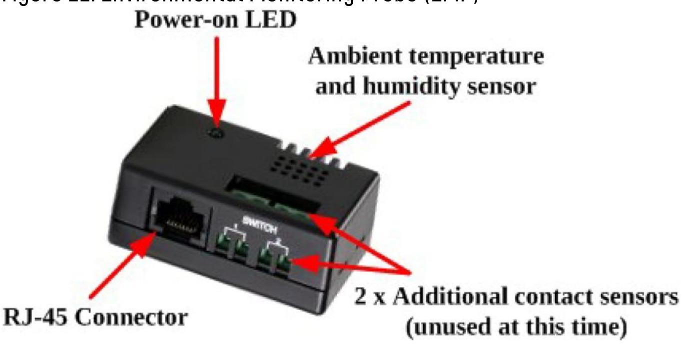
Step 1. Remove the connector panel blank ①, which is secured by two screws.

Step 2. Insert the UPS Network Management Card into the slot. Secure the panel by tightening the two screws.

Environmental Monitoring Probe (EMP)

Figure 22 below displays the Environmental Monitoring Probe (EMP). No UPS ship standard with the probe, and it needs to be ordered separately.

Figure 22: Environmental Monitoring Probe (EMP)



The EMPs purpose is to report on local environmental temperature and humidity at its installed location. For example, if the EMP device is installed at the top of a rack, it will report on the temperature and humidity values at that location.

The optional EMP can be ordered as follows:

Part Number	Feature Code	Description
46M4113	6146	Environmental Monitoring Probe

The device can be installed anywhere on the rack by using either the screws or the self-adhesive hook-and-loop fasteners. Once attached to the rack, connect the CAT5 cable to the UPS or a supported PDU Ethernet connector.

Note: The installation of a Network Management Card (NMC) is required for the EMP to be connected to the device. Refer to the Network Management Card (NMC) section for additional information on the NMC.

Views of the EMP

Figure 23: Front view laying down

Figure 24: Front view standing up

The following figure shows the EMP installed at the top of a rack using the adhesive tape that comes with the device. An Ethernet cable runs back into the rack to a monitored PDU or UPS.

Figure 25: EMP installed at the top of a rack

What's in the box?

Figure 26: EMP shipment box

The Environmental Monitoring Kit (46M4113) is shipped with the following items:

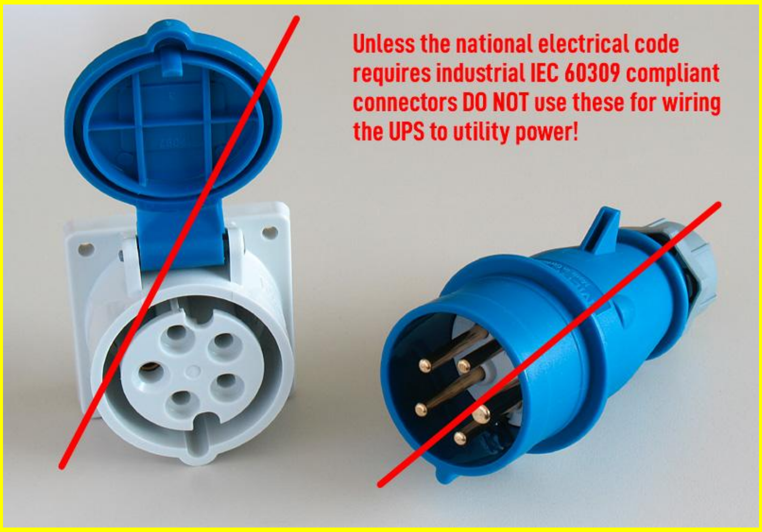
- One Environmental Monitoring Probe (EMP)
- 2 x Screws
- Adhesive tape
- Ethernet cable
- Warranty and Important Notices Flyer, and Environmental Notices CD

Figure 27: Items shipped in the EMP box

Chapter 6 Power cables connection

ATTENTION: This product is not shipped with any power cables. It must be hard-wired with a power cable to utility power. Ensure that a licensed electrician performs the installation per the national electrical code.

Hardwiring the UPS unit to utility power is customer responsibility.



IEC 60309 connectors may have a lower power rating than what is required for the upstream circuit breaker protecting the UPS unit.

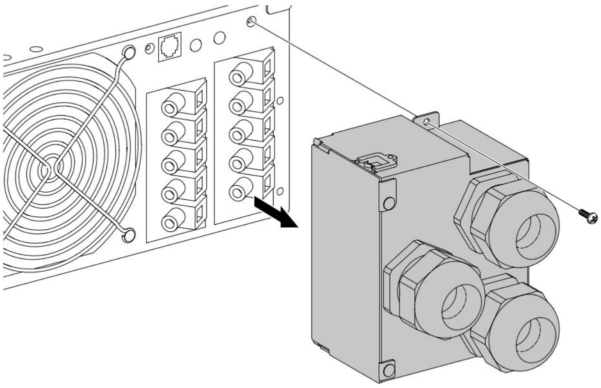
Important: Hardwiring the UPS unit to utility power is customer responsibility.

This connection ***must*** be carried out by qualified and licensed electrician following the national electrical code. Before carrying out any connection, check that the upstream protection devices (Normal AC source and Bypass AC source) are open "**O**" (off).

Always connect the ground wire first.

Important: Before connecting the HotSwap MBP to the UPS, make sure the UPS has been properly shut down. **Always connect the ground wire first.**

Access to terminal blocks on the UPS Power Module



Step 1. Remove the terminal blocks cover (one screw).

Step 2. Punch the knockouts and insert the cables/conduits inside.

Important! High leakage current:
An earth connection is essential before connecting to the power supply!

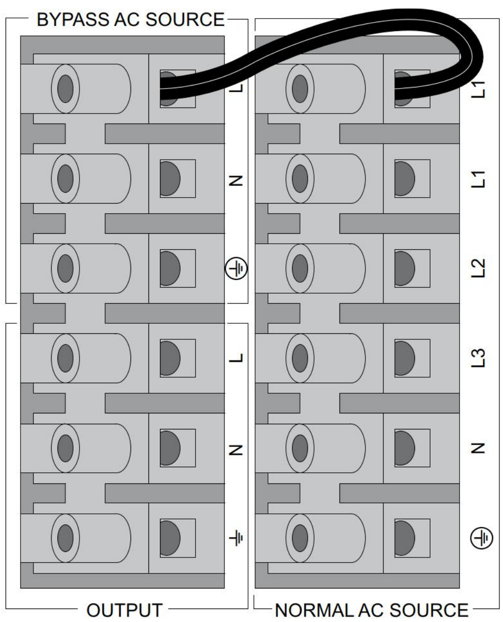
For additional information see Leak current information in Chapter 11.

Three phase UPS units, 5594-8PX and 5594-9PX

This section applies to the following Lenovo UPS units:

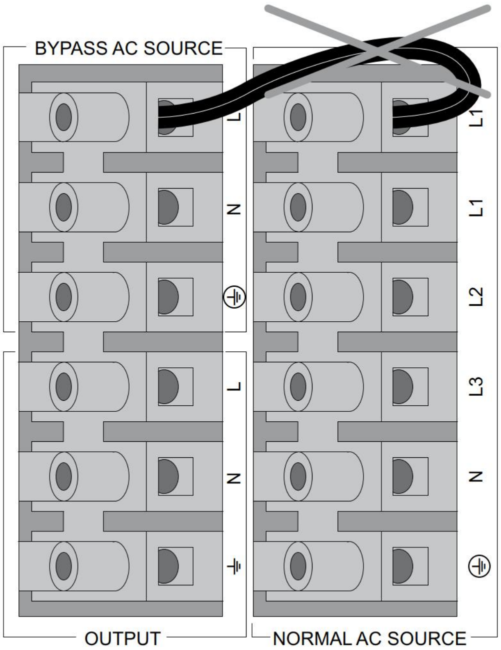
- RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-8PX
- RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-9PX

Common input sources connection



1. Make sure the jumper is connected.
2. Insert the Normal AC cable through the cable gland.
3. Connect the five cables to the Normal AC source terminal blocks.
4. Insert the Output cable through the cable gland.
5. Connect the three cables to the Output terminal blocks.
6. Put back and secure the terminal blocks cover with the screw.
7. Tighten the cable glands.

Separate input source connection

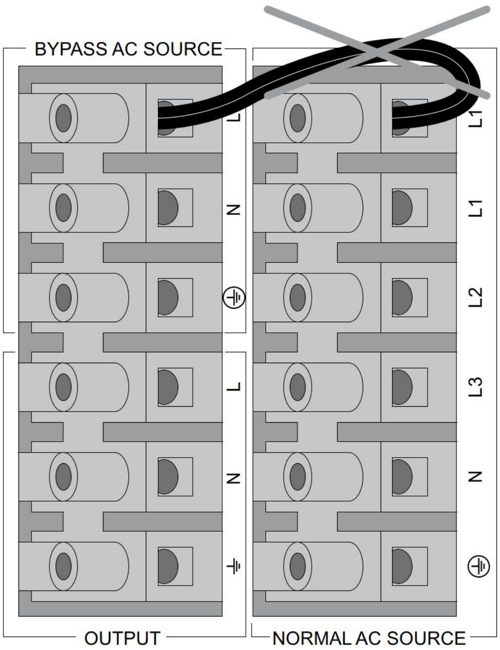


1. Remove the jumper.
2. Insert the Normal AC cable through the cable gland.
3. Connect the five cables to the Normal AC source terminal blocks.
4. Insert the Bypass AC cable through the cable gland.
5. Connect the three cables to the Bypass AC source terminal blocks.
6. Insert the Output cable through the cable gland
7. Connect the three cables to the Output terminal blocks.
8. Put back and secure the terminal blocks cover with the screws.
9. Tighten the cable glands.

Frequency converter connection

Important: This connection must be carried out by qualified electrical personnel. Before carrying out any connection, check that the upstream protection devices (Normal AC source and Bypass AC source) are open "**O**" (off).

Always connect the ground wire first.



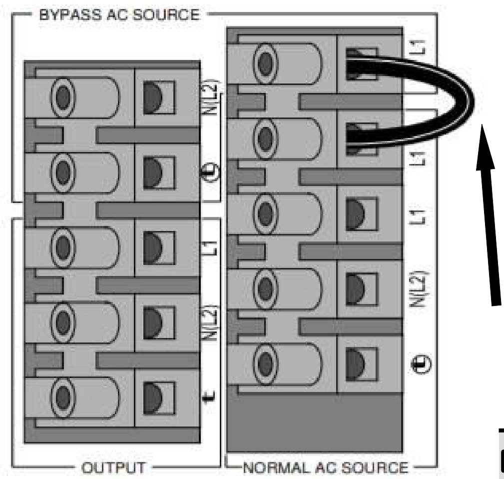
1. Remove the jumper.
2. Insert the Normal AC cable through the cable gland.
3. Connect the five cables to the Normal AC source terminal blocks. **Do not connect anything to the Bypass terminal blocks.**
4. Insert the Output cable through the cable gland.
5. Connect the three cables to the Output terminal blocks.
6. Put back and secure the terminal blocks cover with the screws.
7. Tighten the cable glands.

Single phase UPS units, 5594-8KX and 5594-9KX

This section applies to the following Lenovo UPS units:

- RT8kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-8KX
- RT11kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-9KX

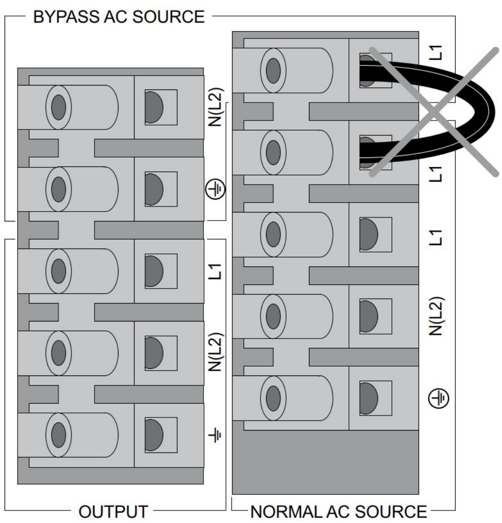
Common input sources connection



1. Make sure the jumper is connected.
2. Insert the Normal AC cable through the cable gland.
3. Connect the three cables to the Normal AC source terminal blocks.
4. Insert the Output cable through the cable gland.
5. Connect the three cables to the Output terminal blocks.
6. Put back and secure the terminal blocks cover with the screw.
7. Tighten the cable glands.

Note: The L1 to L1 connection is needed if a secondary external bypass utility connection is not used.

Separate input source connection

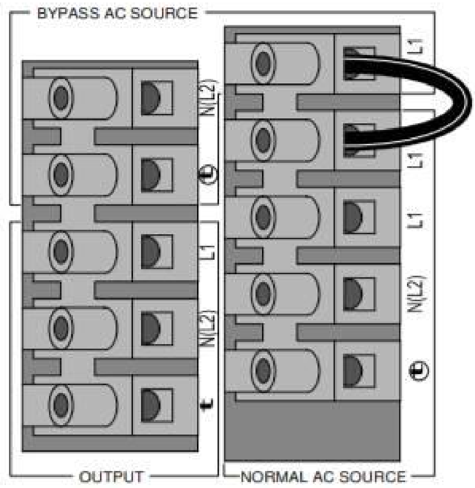


1. Remove the jumper.
2. Insert the Normal AC cable through the cable gland.
3. Connect the three cables to the Normal AC source terminal blocks.
4. Insert the Bypass AC cable through the cable gland.
5. Connect the three cables to the Bypass AC source terminal blocks.
6. Insert the Output cable through the cable gland.
7. Connect the three cables to the Output terminal blocks.
8. Put back and secure the terminal blocks cover with the screws.
9. Tighten the cable glands.

Single Phase UPS frequency converter connection

Important: This connection must be carried out by qualified electrical personnel. Before carrying out any connection, check that the upstream protection devices (Normal AC source and Bypass AC source) are open "**O**" (off).

Always connect the ground wire first.



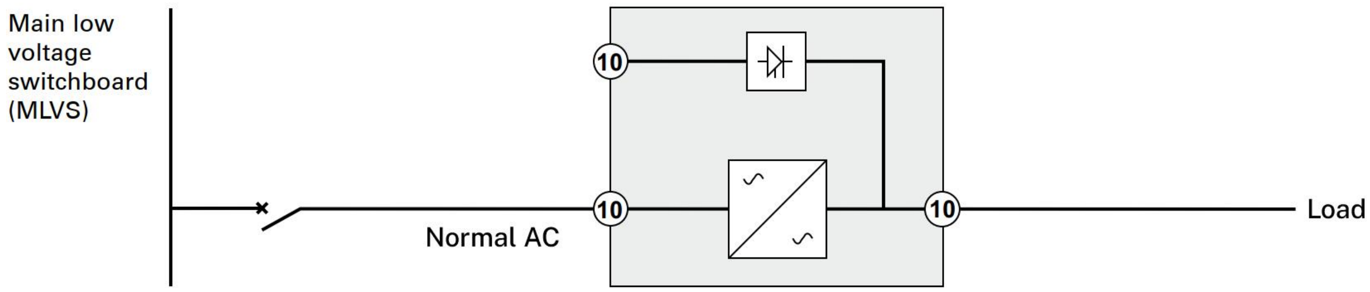
1. Remove the jumper.
2. Insert the Normal AC cable through the cable gland.
3. Connect the three cables to the Normal AC source terminal blocks. **Do not connect anything to the Bypass terminal blocks.**
4. Insert the Output cable through the cable gland.
5. Connect the three cables to the Output terminal blocks.
6. Put back and secure the terminal blocks cover with the screws.
7. Tighten the cable glands.

Figure 28: Wiring preparation single phase UPS unit

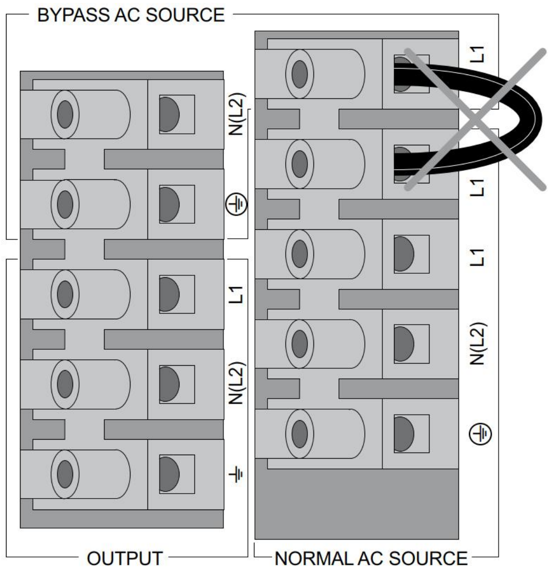
In the above image the red circled area is for the utility power connected to the MBP switch. The area highlighted in yellow is for hardwiring load to it.

The bypass on the UPS terminal block is to be used when a second utility input is present and not used with the MBP box, when a second utility connection is not present the jumper is to remain in place.

For the use of Frequency Converter mode the Bypass terminal needs to be disconnected otherwise the bypass source will be a different frequency than the primary source:



To accomplish this the jumper is removed from the terminal block of the UPS. The above is the diagram for use with frequency converter mode, the UPS bypass input is not tied to the normal AC:



L1 Bypass AC Source information

L1 is the bypass line.

There are two L1 inputs on the input terminal block because the second L1 terminal connection should be jumped from the AC Input terminal block to the Bypass Input terminal block L1 connection, if the same AC source is used for Bypass and the Input of the UPS.

If a different AC source is used for unit Bypass, then the jumper in this connection is not needed and has to be removed. This means a separate L1 line has to be brought directly into the Bypass Input terminal block L1 terminal.

MBP power cables connection

Attention!
- This type of connection must be carried out by qualified electrical personnel.
- Before carrying out any connection, check that the upstream protection device (Normal AC source) is open "**O**" (Off).
- Before proceeding to connect the HotSwap MBP to the UPS, make sure the UPS has been properly shut down.
- Always connect the ground wire first.

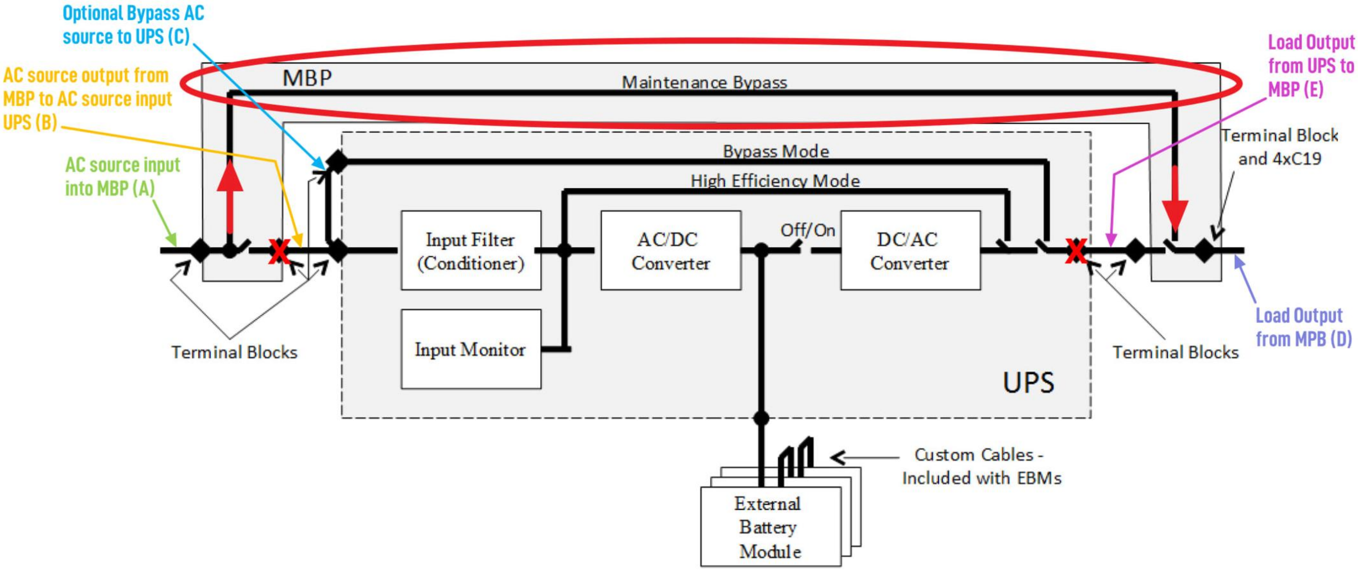
The Maintenance Bypass Panel (MBP) is required and ships standard with all 8kVA and 11kVA UPS models.

The 5594-8KX, 5594-8PX, 5594-9KX, and 5594-9PX UPS units are shipped with three modules:

1. Power Module,
2. Extended Battery Module (EBM), and
3. Maintenance Bypass Panel (MBP)

The MBP is used to bypass the UPS during maintenance or servicing providing wrap-around bypass for UPS service without shutting down the load. An example of this is shown in the figure on the following page in the single phase UPS block diagram.

Figure 29: Block diagram for MBP wiri



Principal connections between MBP and UPS power module

The Figure 29 shows the block diagram on the UPS and Figure 31 both on the next page show the principal connections between the UPS power module and the Maintenance Bypass Panel.

Figure 30: UPS connectors per above block diagram

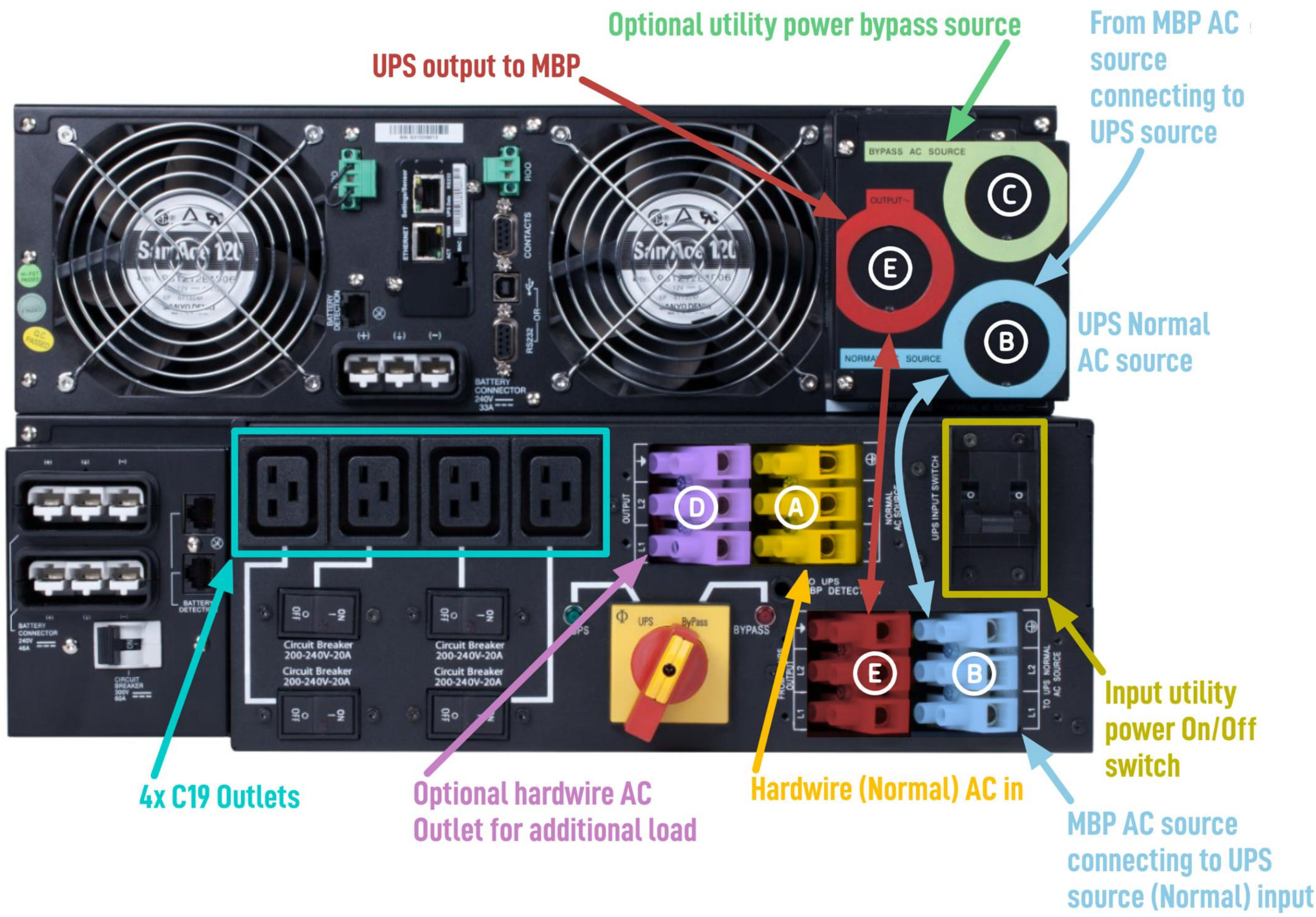
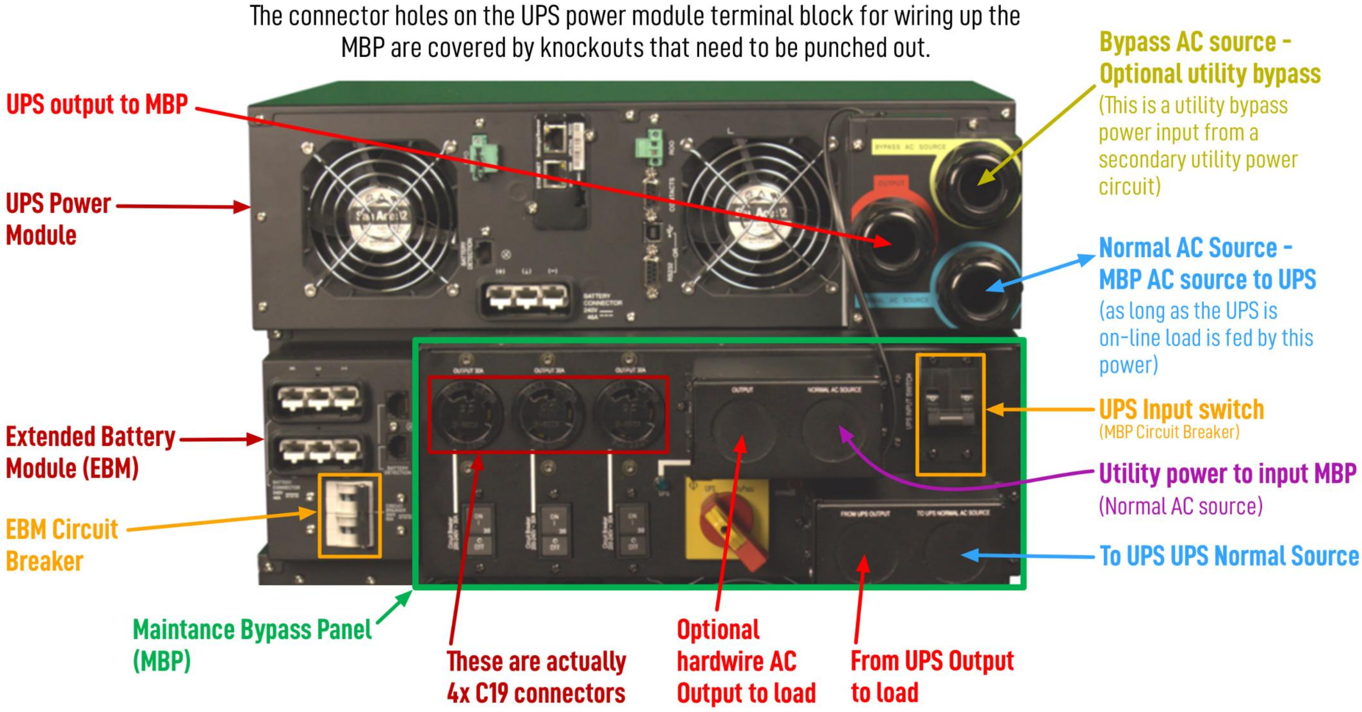
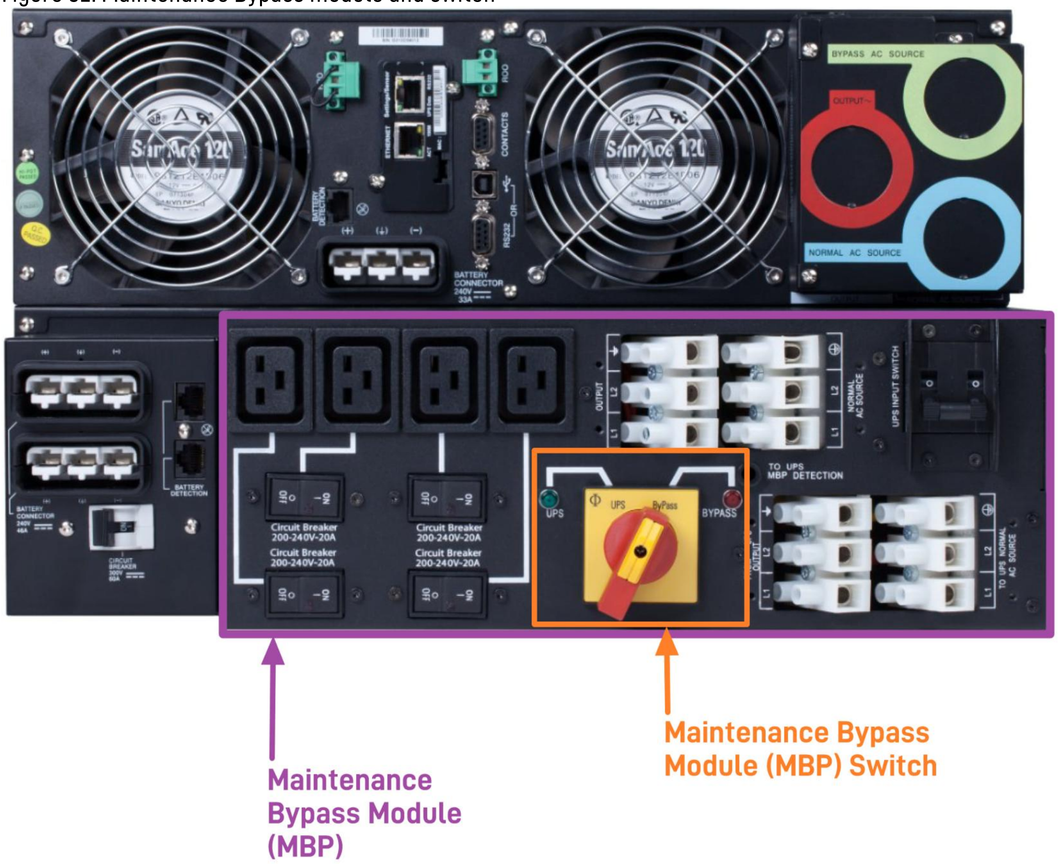


Figure 31: Principal connections - Maintenance Bypass Panel, UPS Power Module



The MBP and the switch for enabling and disabling the Maintenance Bypass mode is shown in the Figure 33 on the next page for the single phase 8/11kVA UPS units.

Figure 32: Maintenance Bypass module and switch



MBP Lights

The Maintenance Bypass module (MBP) light indicators are shown in Figure xx.

Figure 33: MBP switch single phase UPS units

The lights on the MBP represent the following:

Red on means Load is powered directly from Line (AC power source) - the load is not protected by the UPS unit.

This light will be on only when the Normal/Bypass switch is in the Bypass position. It is intended as a reminder that the load is not protected during UPS maintenance.

Green on means the UPS output is feeding the MBP (load supplied by UPS).

This light will be on any time the UPS is providing power and is independent of the position of the Normal / Bypass switch. It is intended as an indicator that it is safe to move the Normal / Bypass switch from the Bypass position to the Normal position when UPS maintenance is complete.

MBP Installation

Electronics Module is mounted directly above the Extended Battery Module, and the MBP should be mounted directly behind the Extended Battery Module. Follow the below rules for installing the MBP:

- Mount the MBP behind the EBM that is shipped with the UPS itself. If there are multiple EBMs attached to the UPS, mount it behind the EBM closest to the UPS power module. The minimum rack depth with UPS/MBP is 900mm (35.4in).

Attention! Do not mount the MBP behind the UPS as you will not be able to attach the cables!

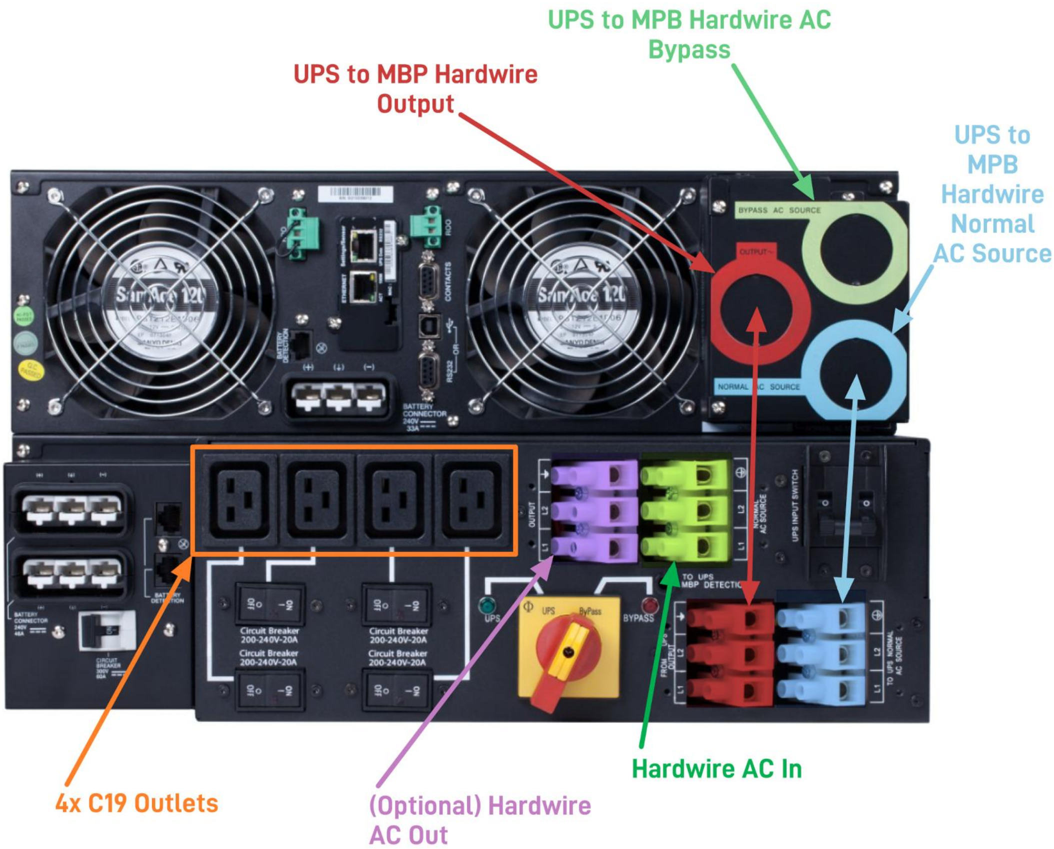
- Connect the cables in the conduits to the terminal blocks **BEFORE** seating the conduits into the collars. This will give you maximum slack in the cables and make connecting to the terminal blocks possible. The conduits can be released from the collars by prying out on the catch tabs on the collars and pulling the conduit.

Attention! Do not pull the cables out of the conduits. The conduit is required for safety and the cables are difficult to get back into the conduits.

Connecting the UPS to the MBP

Attention! Detailed wiring instructions can be found in the sections Single phase MBP power cables connection and Three phase MBP power cables connection of this chapter.

A diagram displaying the hardwire connections and C19 outlets are displayed below.



Note: The Hardwire output (purple) can be used to connect Power Distribution Units (PDUs) to provide additional outlets.

Anything attached to the PDU counts towards the load the UPS protects!

The following are pictures of the rear view of the MBP with and without terminal blocks for UPS 8KX and 9KX.

Figure 34: MBP connectors for 8KX and 9KX

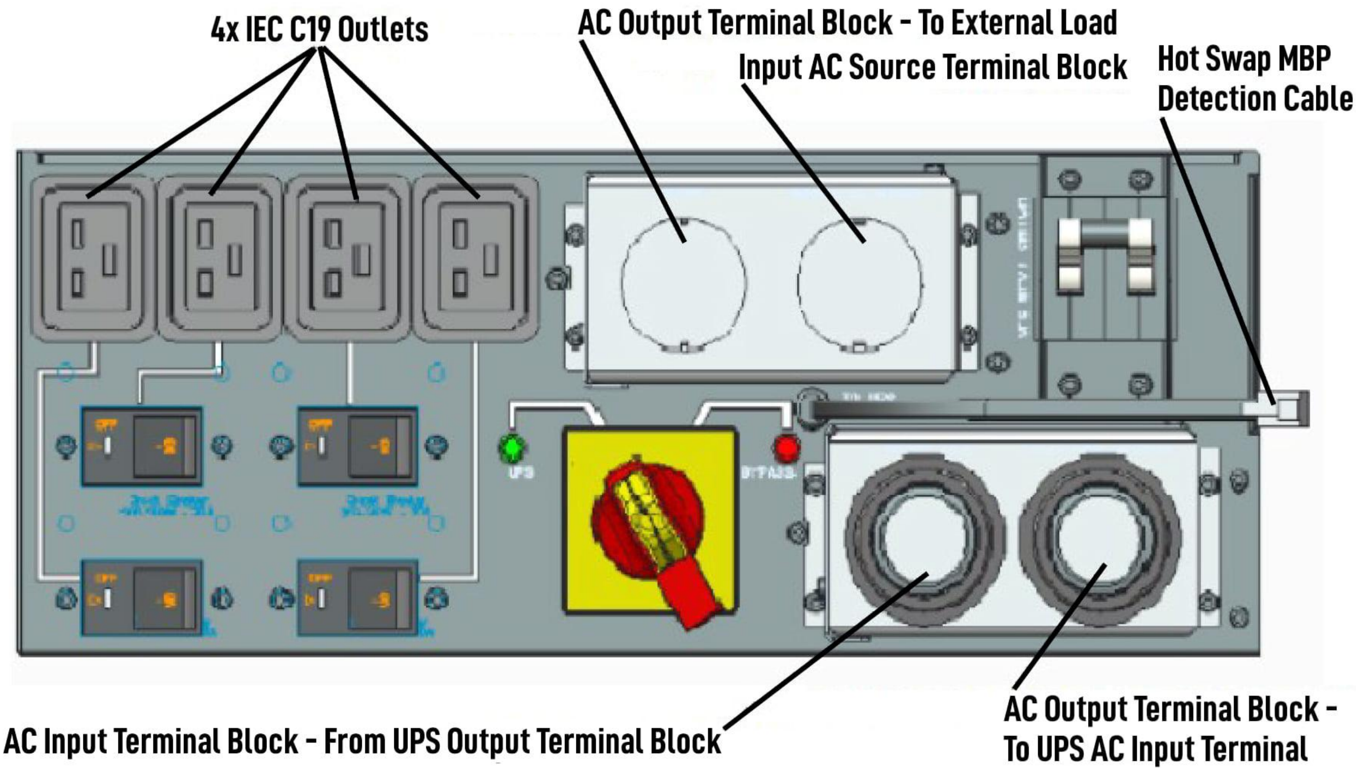


Figure 35: Single phase terminal block connectors

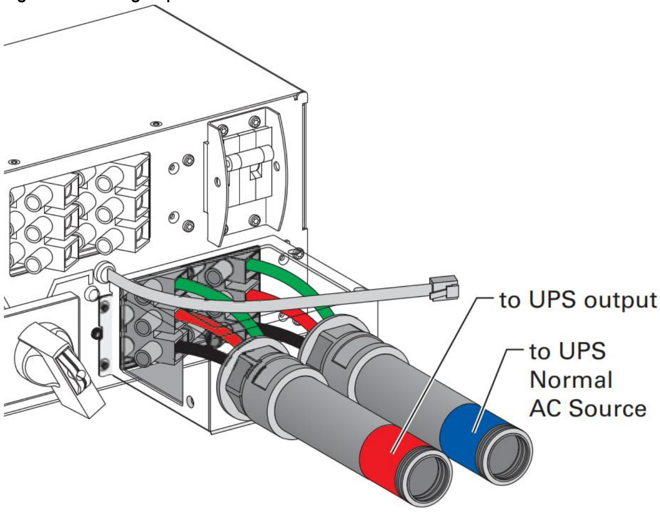
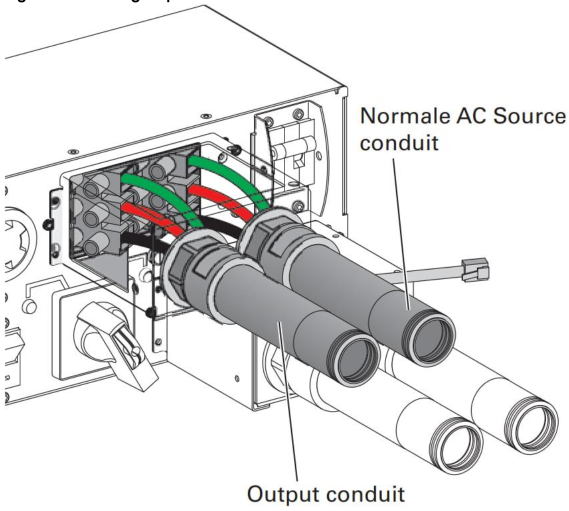


Figure 36: Single phase terminal block connectors



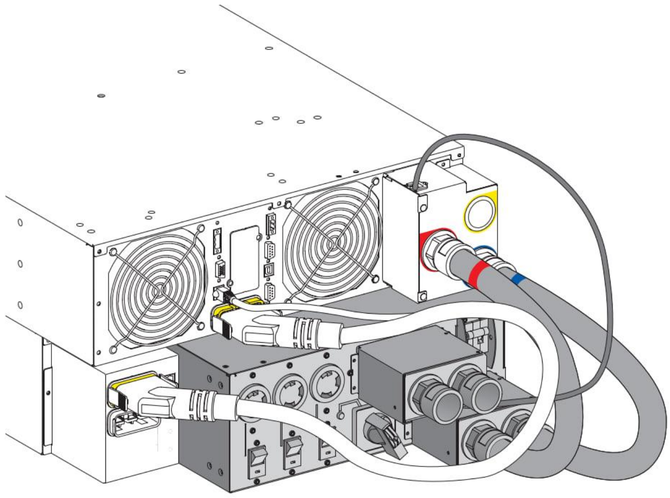


Figure 37: Single phase UPS with MBP connected

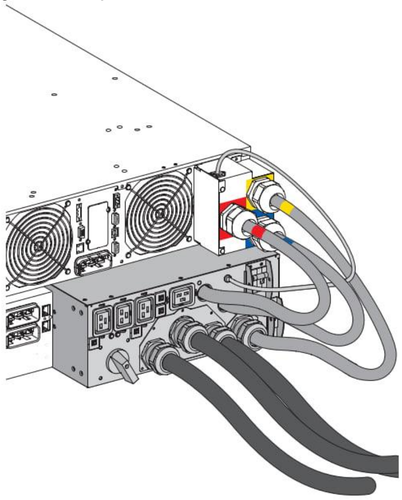


Figure 38: 3 phase UPS w/ MBP connected

The following are pictures of the rear view of the MBP and both UPS Power Module and MPB for the three phase UPS units.

Figure 39: 3 phase 5594-8PX / 5594-9PX Maintenance Bypass Panel

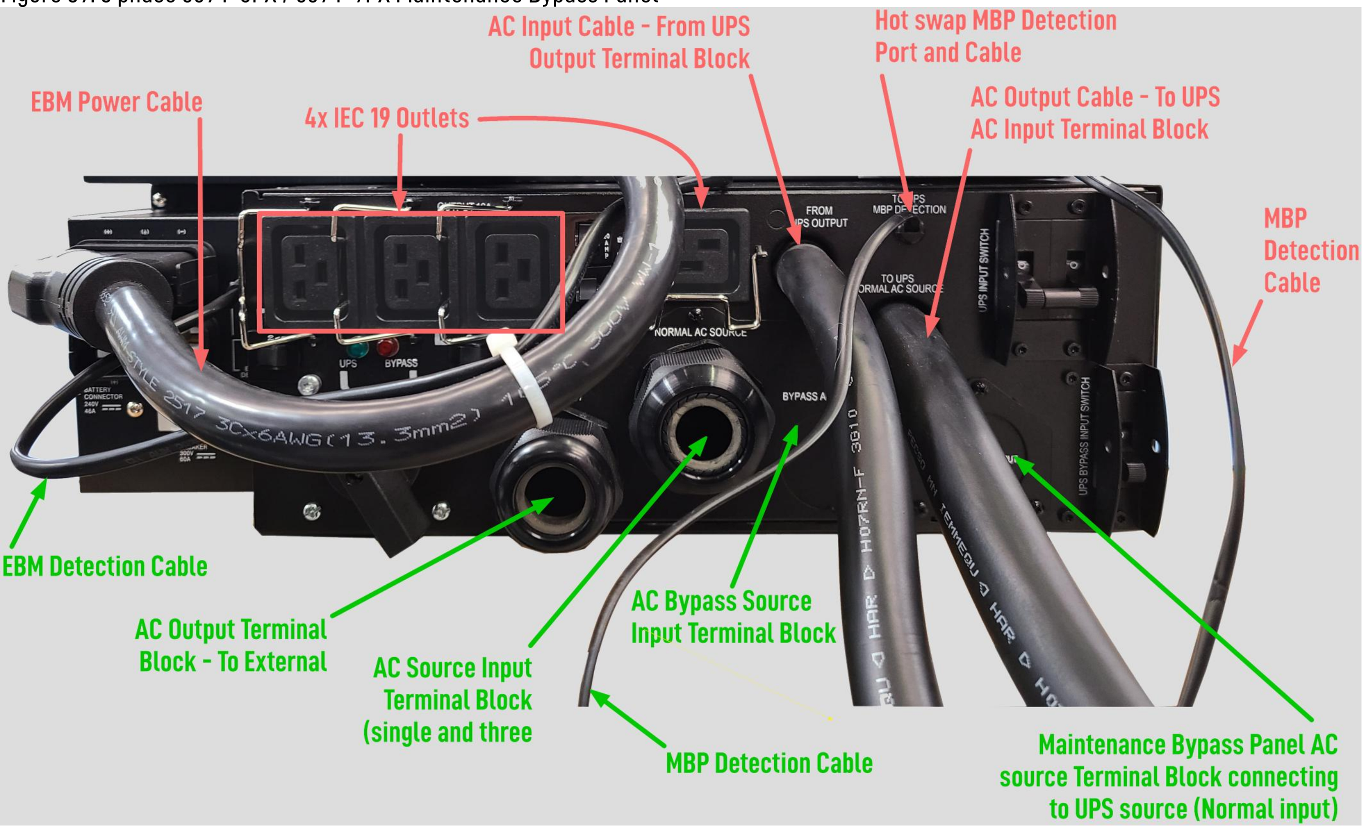
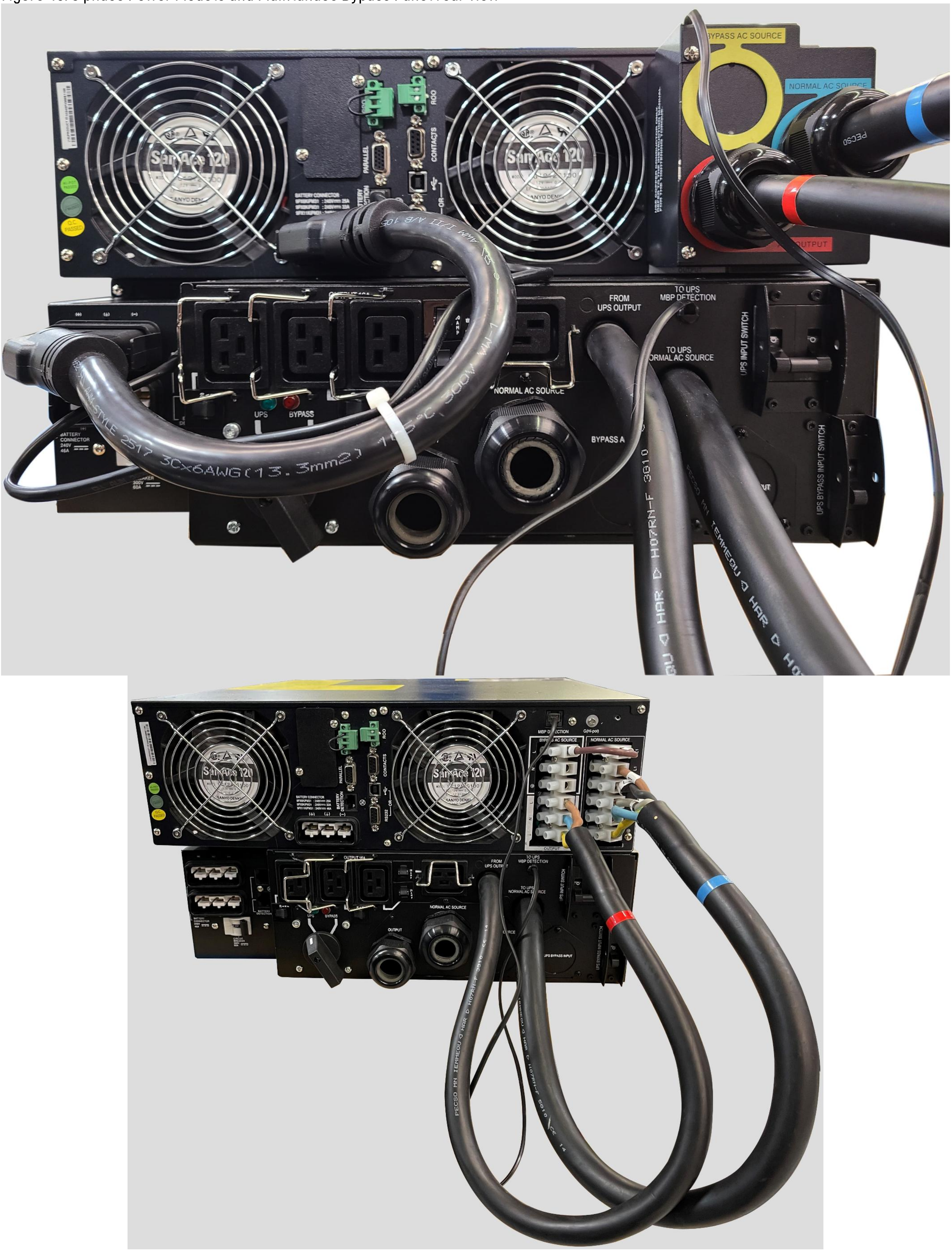
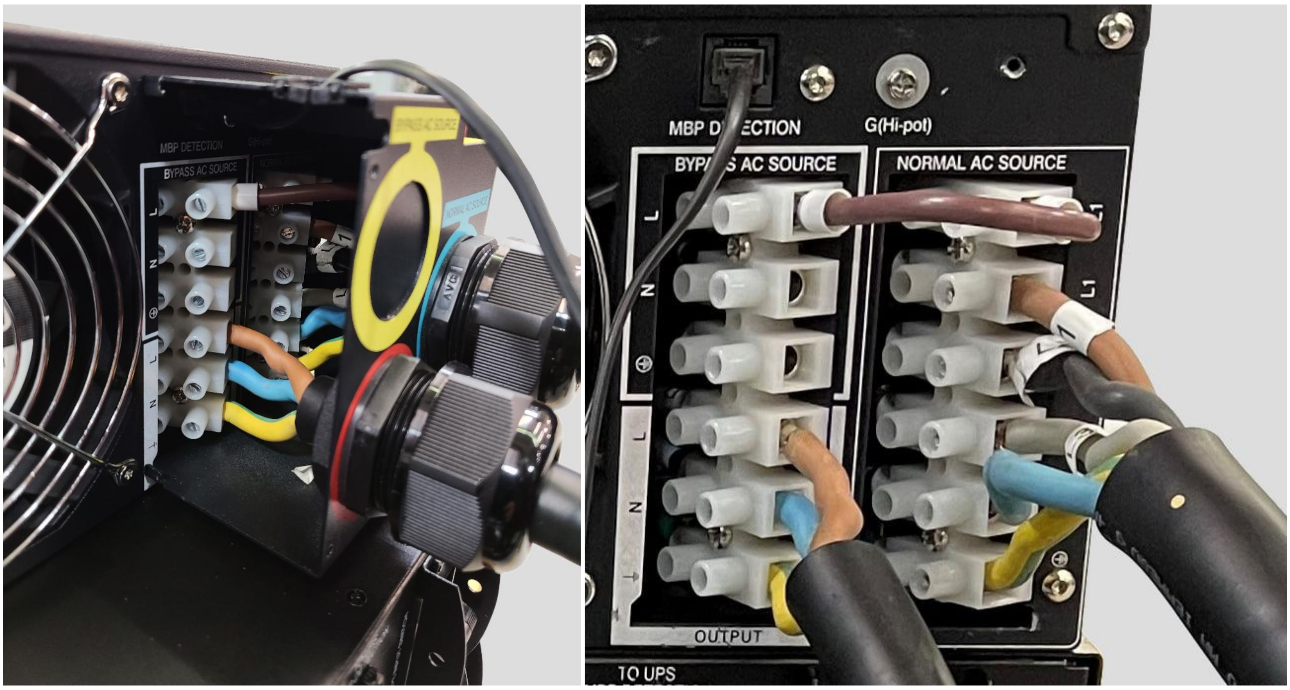


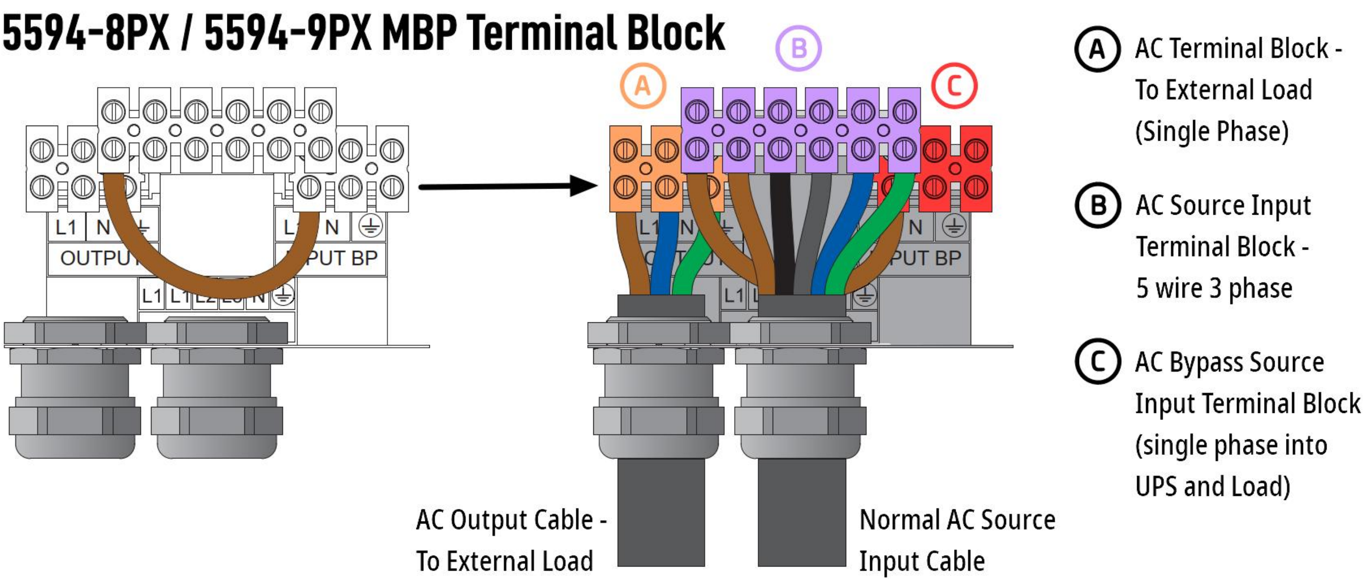
Figure 40: 3 phase Power Module and Maintanace Bypass Panel rear view



The next figure shows the terminal block of the 3 phase UPS. Note that the cover panel through which the power cords go is like a drawer that can be pulled out. It is recommended to ***not*** remove it completely.

Figure 41: 3 phase UPS Power Module terminal block





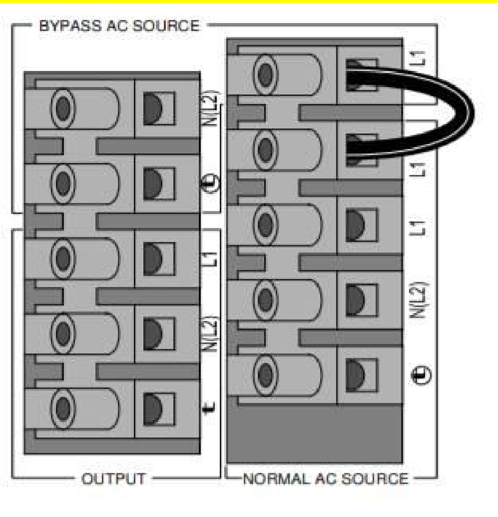
Attention! Detailed wiring instructions can be found in the sections Single phase MBP power cables connection and Three phase MBP power cables connection of this chapter.

Single phase MBP power cables connection

Attention!
- This type of connection must be carried out by qualified electrical personnel
- Before carrying out any connection, check that the upstream protection device (Normal AC source) is open "**O**" (Off)
- Before proceeding to connect the HotSwap MBP to the UPS, make sure the UPS has been properly shut down. See also Shutting down the UPS completely in Chapter 10 UPS maintenance for details.
- Always connect the ground wire first

Pay attention to the pin assignment on the terminal blocks!

UPS Power Module terminal block

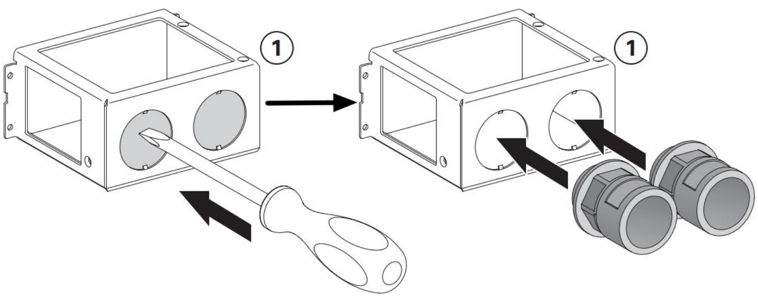


L1
N / L2
PE / GND

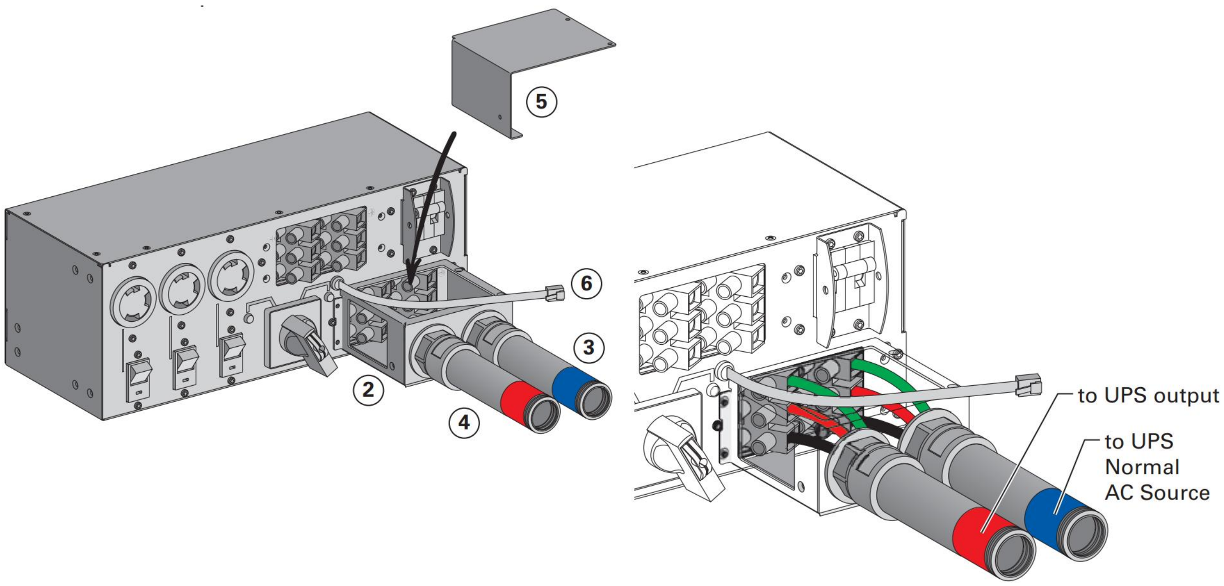
Maintenance Bypass Panel terminal block

PE / GND
N / L2
L1

1. Remove the top cover ⑤ of the MBP I/O "UPS connection" cover ② after removing the 3 screws.
2. Punch the knockouts of the MBP I/O UPS connection cover ② and insert 2 provided conduit fittings inside.

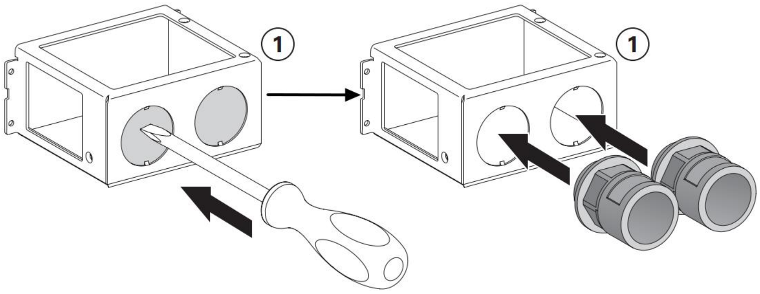


3. Insert the provided conduit with blue colour coding ③, through the "TO UPS NORMAL AC SOURCE" conduit fitting take care to leave the conduit end with blue label on opposite side (for connection to UPS).
4. Connect the 3 wires of this blue colour conduit ③ to the "TO UPS NORMAL AC SOURCE" MBP terminal blocks.
5. Insert the provided conduit with red colour coding ④, through the "FROM UPS OUTPUT" conduit fitting take care to leave the conduit end with red label on opposite side (for connection to UPS).
6. Connect the 3 wires of this red colour conduit ④ to the "FROM UPS OUTPUT" MBP terminal blocks.
7. Put back the MBP I/O "UPS connection" cover ② and secure it with 4 screws on the MBP casing.
8. Put back the top cover ⑤ of the MBP I/O "UPS connection" cover ② and secure it with 3 screws.



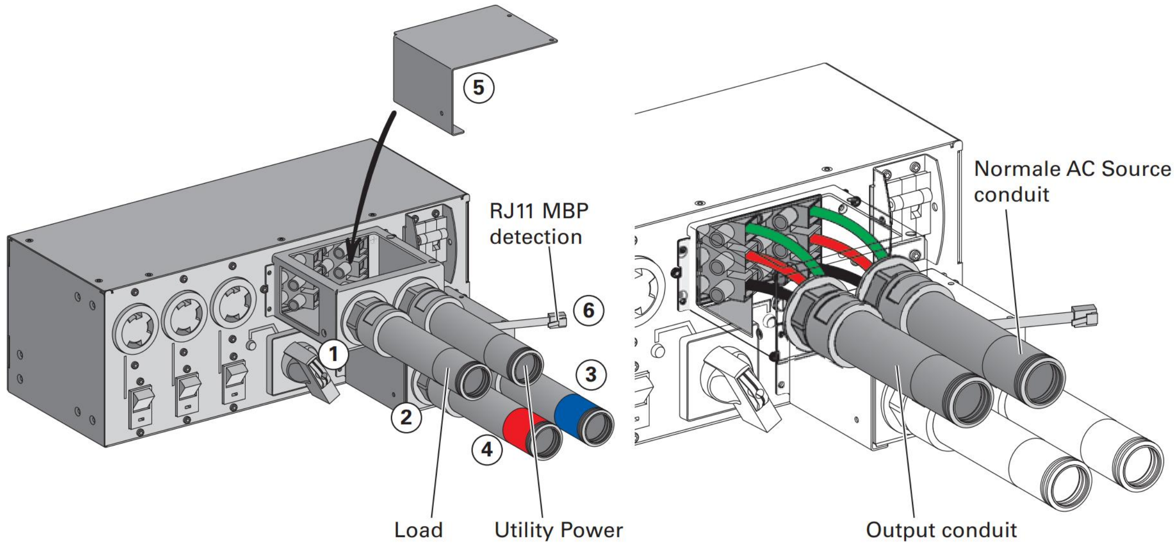
9. Remove the I/O terminal blocks cover of the UPS
10. Punch the Input and Output knockouts of the UPS I/O TB cover and insert 2 provided conduit fittings inside.
11. Insert the conduits ③ and ④ through the previously mounted conduit fittings of the UPS I/O TB cover, following colour coding on the conduits and the UPS I/O TB cover (blue for UPS Input / red for UPS Output) – also do not remove the UPS Input Bypass jumper inside the UPS I/O TB cover
12. Connect the wires of the conduit with blue colour coding 3 to the "NORMAL AC SOURCE" terminal blocks of UPS, and the wires of the conduit with red colour coding 4 to the "OUTPUT" terminal blocks of UPS, see Figure 31 Principal connections - Maintenance Bypass Panel, UPS Power Module for more details

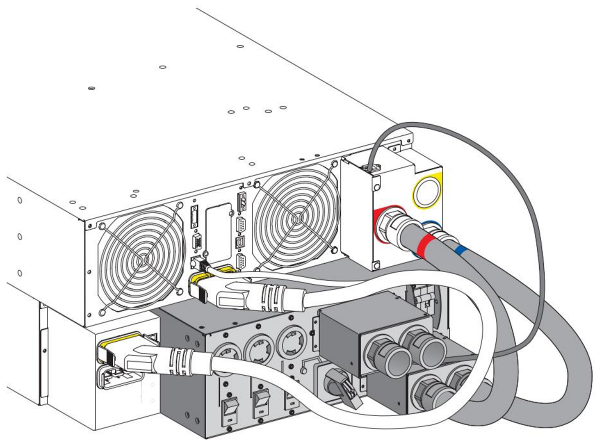
13. Connect the MBP detection cable ⑥ to the specific UPS connector, see Figure 1, item 10.
14. Put back and secure the I/O terminal blocks cover of the UPS.
15. Remove the top cover ⑤ of the MBP I/O cover 1 after removing the 3 screws.
16. Punch the knockouts of MBP I/O cover ① and insert cable glands of UPS (or conduit fittings) inside.



17. Insert the Normal AC source cable through the cable gland (or a conduit through the conduit fitting).
18. Connect the wires to the Normal AC source (Input) terminal blocks of MBP.
19. Insert the Output cable through the cable gland (or a conduit through the conduit fitting).
20. Connect the wires to the Output terminal blocks of MBP.
21. Put back the MBP I/O cover ① and secure it with 4 screws on the MBP casing.
22. Put back the top cover ⑤ of the MBP I/O cover ① and secure it with 3 screws.

23. Tighten the cable glands (if used instead of conduit fittings).



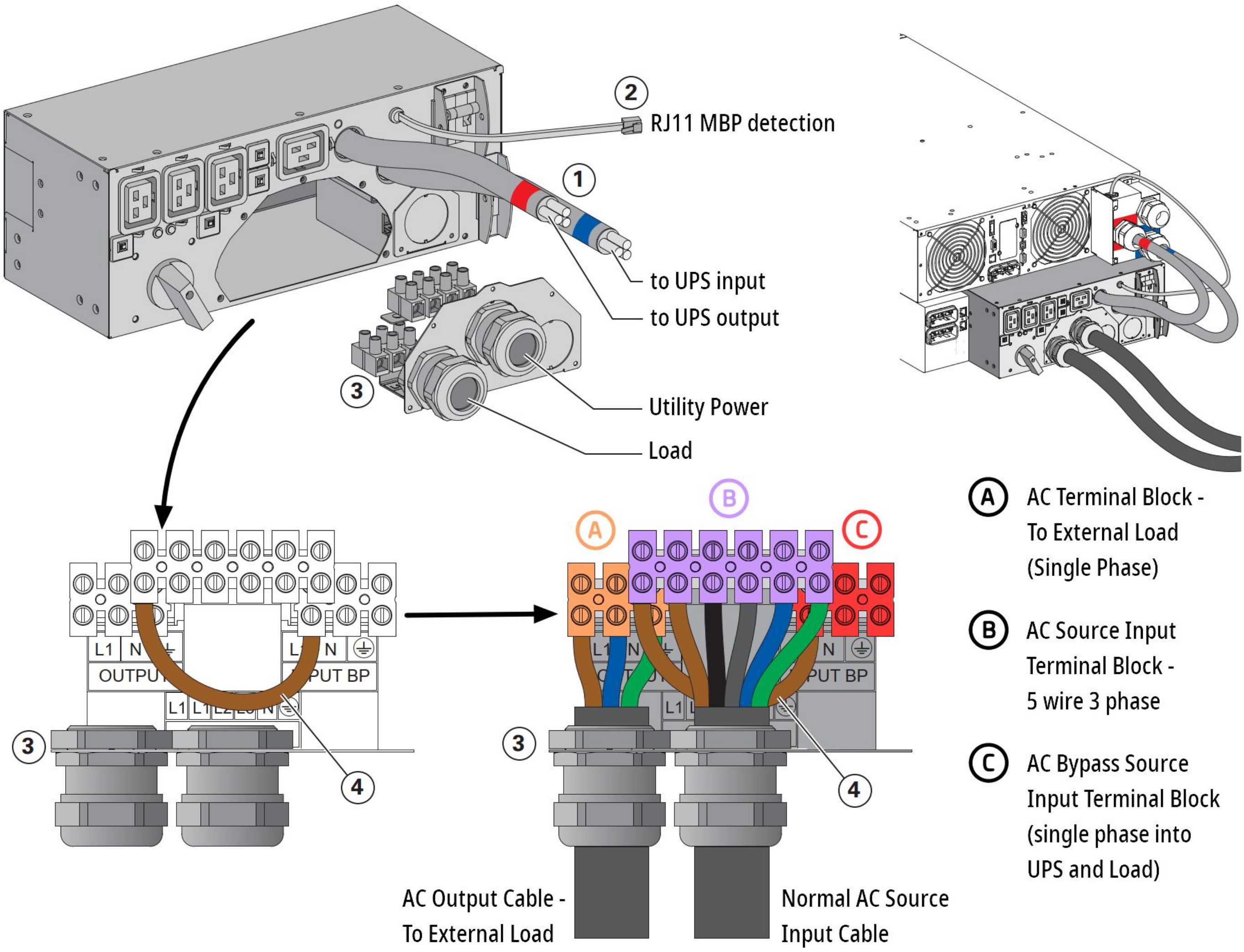


Three phase MBP power cables connection

Attention!
- This type of connection must be carried out by qualified electrical personnel.
- Before carrying out any connection, check that the upstream protection device (Normal AC source) is open "**O**" (Off).
- Before proceeding to connect the HotSwap MBP to the UPS, make sure the UPS has been properly shut down.
- Always connect the ground wire first.

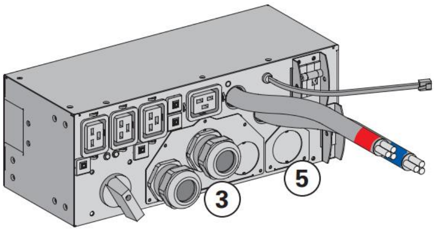
With common Normal and Bypass AC source

1. Connect the 2 integrated power cables ① to the UPS I/O terminal blocks, following colour coding on the cables and the UPS I/O cover (blue for UPS Input / red for UPS Output), see Figure 31 Principal connections - Maintenance Bypass Panel, UPS Power Module to check the UPS terminal blocks connection
2. Connect the MBP detection cable ② to the specific UPS connector, see Figure 2, item 10.
3. Slide the MBP I/O cover ③ after removing the 5 screws, to access to MBP terminal blocks
4. Insert the Normal AC source cable through the cable gland
5. Connect the wires to the Normal AC source (Input) terminal blocks (do not remove the Input Bypass AC jumper ④ and the UPS Input Bypass jumper inside the UPS I/O cover
6. Insert the Output cable through the cable gland
7. Connect the wires to the Output terminal blocks
8. Tighten the cable glands
9. Slide back and secure the MBP I/O cover ③ with the 5 screws

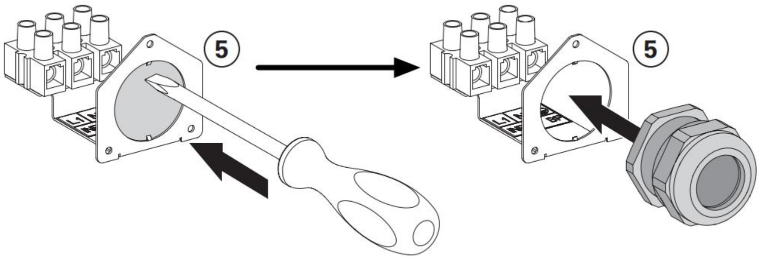


With separate Normal and Bypass AC source

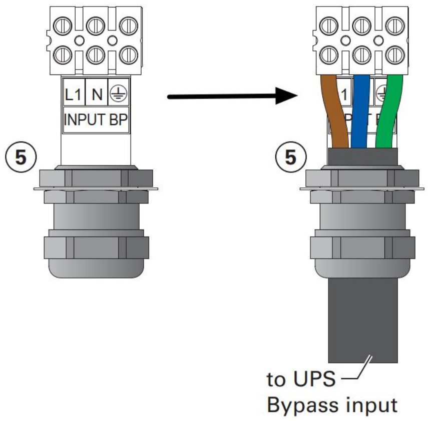
1. Slide the MBP Bypass Input cover ⑤ after removing the 3 screws.



2. Punch the UPS Bypass Input knockout of the MBP Bypass Input cover ⑤ and insert a provided cable gland inside.

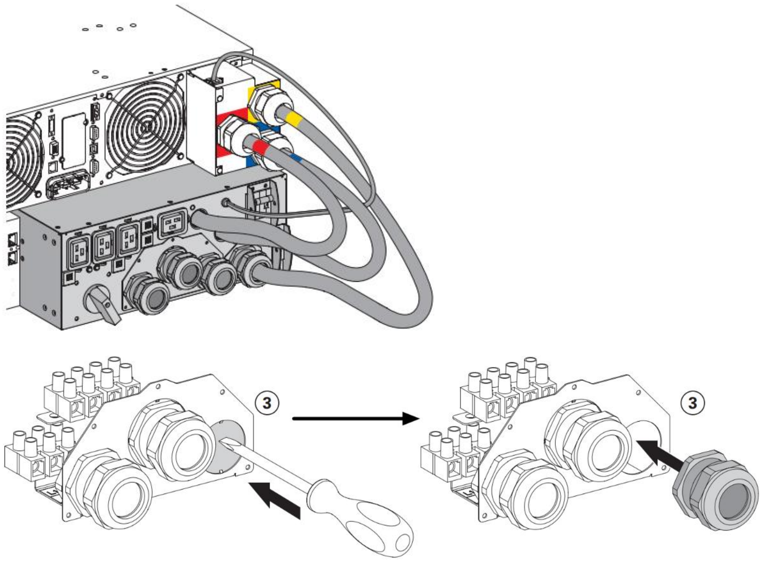


3. Insert a power cable (refer to 3.5 for cable cross-section) through the cable gland of the MBP Bypass Input cover ⑤ (cable not provided in the packaging).
4. Connect the wires to the "Input BP" terminal blocks of the MBP Bypass Input cover ⑤.

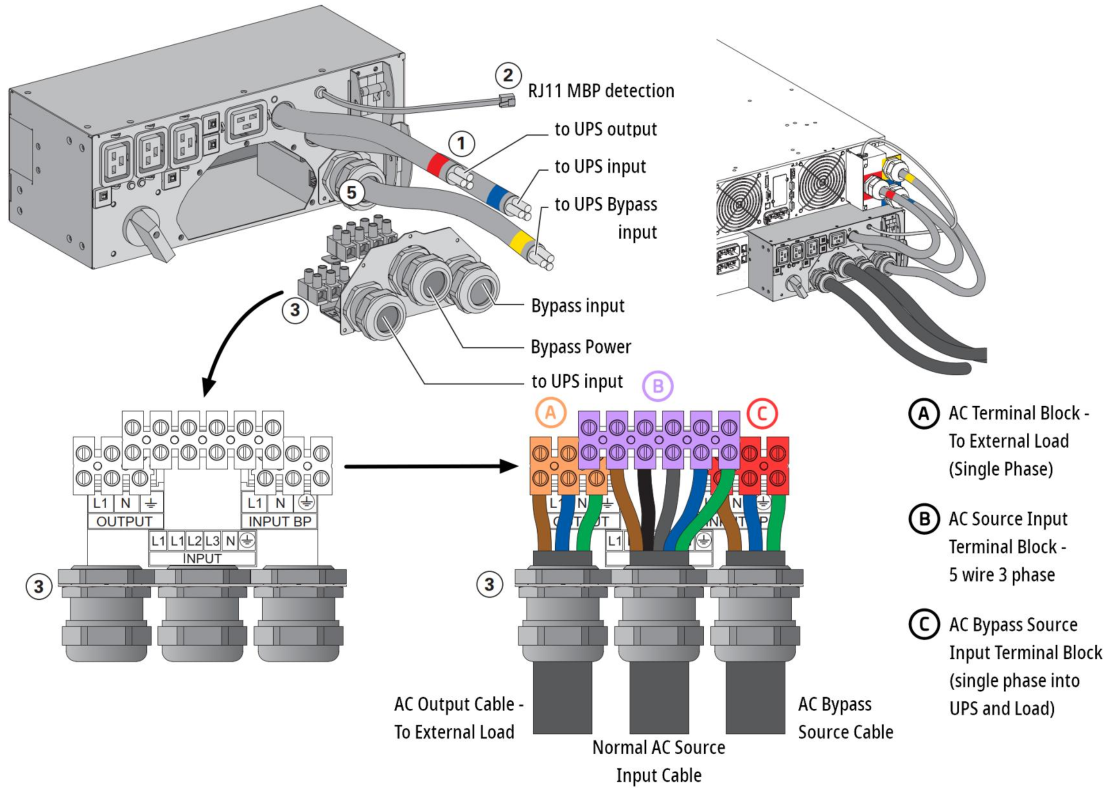


5. Tighten the cable gland.
6. Slide back and secure the MBP Bypass Input cover ⑤ with the 3 screws.
7. Connect the 2 integrated power cables ① and the previously installed Bypass Input power cable to the UPS I/O terminal blocks, following colour coding on the cables and the UPS I/O cover (blue for UPS Input / red for UPS Output / yellow for UPS Input Bypass) – see Figure 31 Principal connections - Maintenance Bypass Panel, UPS Power Module to check the UPS terminal blocks connection (do not forget to also remove the Input Bypass AC jumper on UPS).
8. Connect the MBP detection cable ② to the specific UPS connector, see Figure 2, item 10.
9. Slide the MBP I/O cover ③ after removing the 5 screws, to access to MBP terminal blocks
10. Remove the Input Bypass AC jumper ④

11. Punch the Bypass AC Source knockout of the MBP I/O cover ③ and insert a provided cable gland inside



12. Insert the Normal AC source cable through the cable gland
13. Connect the wires to the Normal AC source (Input) terminal blocks
14. Insert the Bypass AC source cable through the cable gland
15. Connect the wires to the Bypass AC source (Input BP) terminal blocks
16. Insert the Output cable through the cable gland
17. Connect the wires to the Output terminal blocks
18. Tighten the cable glands
19. Slide back and secure the MBP I/O cover ③ with the 5 screws



Chapter 7 Maintenance Bypass Panel Operations

Single Phase MPB

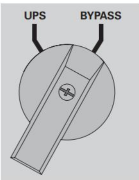
UPS start-up with HotSwap MBP

Note: Verify that the total equipment ratings do not exceed the UPS capacity to prevent an overload alarm.

1. Check that the UPS is correctly connected to the HotSwap MBP (see previous chapter 4).

Attention! **If the UPS if equipped with outlets**, those outlets can no longer be used (loads can only be connected to the MBP outlets or the MBP Output terminal blocks).

2. Verify that the MBP terminal blocks are connected to the AC source.
3. Check that the MBP manual Bypass switch is to the "**Bypass**" position.

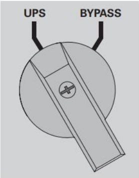


4. Set the upstream circuit breaker (not provided) to the "I" position (On) to switch On the utility power.
5. Verify that the "**Bypass mode**" **red light** of the MBP turns on, indicating that the load is now powered by the AC source.
6. Set the Normal AC source switch of the MBP to the "**I**" position.
7. Verify that the UPS is correctly powered (UPS display panel illuminates).
8. Press the UPS "**ON**" button to start the UPS.
9. Put the UPS in "**internal Bypass mode**" - on the LCD panel select Control - Go to Bypass.
10. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3).
11. Verify that the "**UPS mode**" **green light** of the MBP turns on, indicating that the UPS output power is available on the MBP.

Important! ***Do not*** continue with the next step if the "**UPS mode**" green light of the MBP is still off (the load will be lost).

12. Set the MBP manual Bypass switch to the "**UPS**" position: the "**Bypass mode**" red light of the

MBP turns off, indicating that the load is now powered by the UPS.

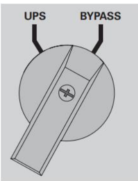


13. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
14. Check that the UPS is in Online mode by checking UPS display panel (see item 1) the load is now protected by the UPS.

UPS replacement with HotSwap MBP

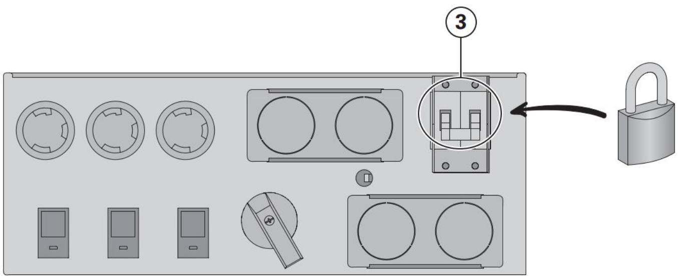
UPS Removing (please follow the **MANDATORY** step below):

1. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass
2. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
3. Set the MBP manual Bypass switch to "**Bypass**" position. The "**Bypass mode**" **red light** of the MBP turns on, indicating that the load is supplied directly by AC source

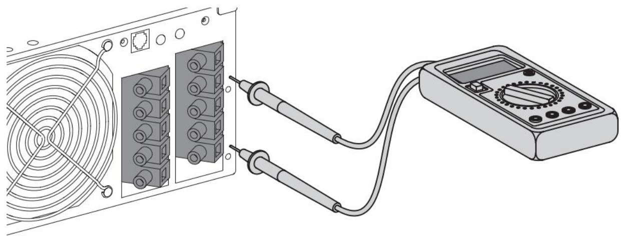


4. Switch the Normal AC source switch of the MBP to the "**O**" position and wait 30 seconds
5. UPS stops, the UPS can now be disconnected, as described below:

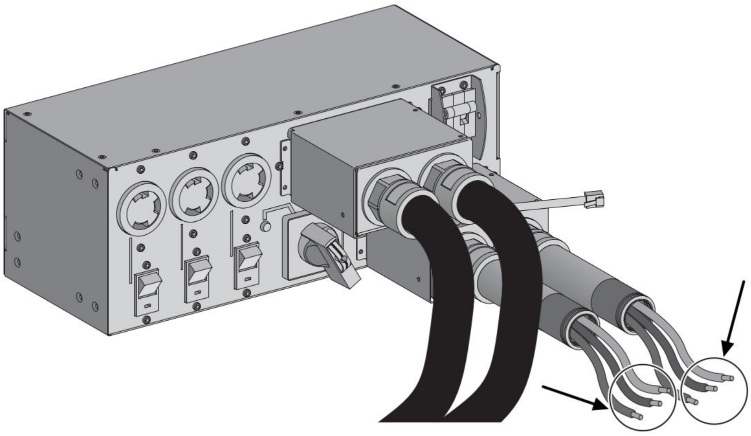
- First lock the Normal AC source switch ③ of the MBP to the "**O**" position (the switch protection frame is able to fit a cable tie or a metallic locker).



- After opening the I/O terminal blocks cover of UPS, check if hazardous voltage is no longer present on UPS terminal blocks by using an electrical safety tester



- Disconnect the MBP conduits, and the MBP detection cable, see Rear panels and Figure 13 (item 4) for details
- On both MBP conduits just disconnected from the UPS, link the internal wires together (line 1 and line 2 wires linked to ground wire)



- Replace the UPS

Hazardous voltage and lost load risk: **do not** manipulate the MBP manual Bypass switch without UPS connected to the MBP power conduits.

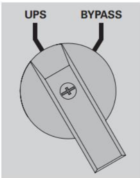
Return to normal operation

1. Check that the new UPS is correctly connected to the MBP, as described below:
   - First check that the Normal AC source switch 3 of the MBP is still locked to the "**O**" position
   - Remove the previously installed safety wires links on both MBP conduits
   - After opening the UPS I/O terminal blocks cover, connect to UPS the MBP conduits, and the MBP detection cable, see Rear panels and Figure 13 (item 4) for details
   - Unlock the Normal AC source switch 3 of the MBP
2. Set the Normal AC source switch of the MBP to the "**I**" position.
3. Verify that the UPS is correctly powered (UPS display panel illuminates).
4. Press the UPS "**ON**" button to start the UPS
5. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass

6. Verify that the UPS is in **Bypass mode** by checking UPS display panel
7. Verify that the "**UPS mode**" **green light** of the MBP turns on, indicating that the UPS output power is available on the MBP.

Important!	***Do not*** continue with the next step if the "**UPS mode**" green light of the MBP is still **Off**, as else the load will be instantaneously disconnected from utility power and thus be lost.

8. Set the MBP manual Bypass switch to the "**UPS**" position: the "**Bypass mode**" **red light** of the MBP turns off, indicating that the load is now powered by the UPS

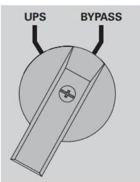


9. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
10. Check that the UPS is in Online mode by checking UPS display panel (see item 1) the load is now protected by the UPS

UPS maintenance with HotSwap MBP

Go to maintenance Bypass operation (please follow the MANDATORY steps below):

1. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass
2. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
3. Set the MBP manual Bypass switch to "**Bypass**" position. The "**Bypass mode**" **red light** of the MBP turns on, indicating that the load is supplied directly by AC source



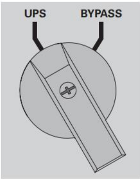
4. Proceed to maintenance operations on UPS, for example replacing the UPS unit

Return to normal operation:

1. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
2. Verify that the "**UPS mode**" **green light** of the MBP is On, indicating that the UPS output power is available on the MBP

Important! ***Do not*** continue with the next step if the "**UPS mode**" **green light** of the MBP is still **Off**, as else the load will be instantaneously disconnected from utility power and thus be lost.

3. Set the MBP manual Bypass switch to the "UPS" position: the "Bypass mode" red light of the MBP turns off, indicating that the load is now powered by the UPS



4. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
5. Check that the UPS is in Online mode by checking UPS display panel (see item 1) the load is now protected by the UPS.

Three Phase MPB

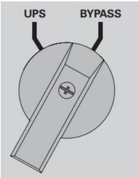
UPS start-up with HotSwap MBP

Note: Verify that the total equipment ratings do not exceed the UPS capacity to prevent an overload alarm.

1. Check that the UPS is correctly connected to the HotSwap MBP (see previous chapter 4).

Attention! **If the UPS if equipped with outlets**, those outlets can no longer be used (loads can only be connected to the MBP outlets or the MBP Output terminal blocks).

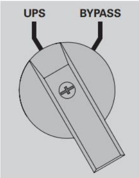
2. Verify that the MBP terminal blocks are connected to the AC source (*).
3. Check that the MBP manual Bypass switch is to the "**Bypass**" **position**.



4. Set the upstream circuit breaker (not provided) to the "**I**" position (On) to switch On the utility power, and also set the Bypass source upstream circuit breaker (not provided) to the "**I**" position (On) to switch on the Bypass power (*).
5. Verify that the "**Bypass mode**" **red light** of the MBP turns on, indicating that the load is now powered by the AC source, or Bypass AC source (*).
6. Set the Normal AC source switch and the Bypass AC source switch (*) of the MBP to the "**I**" position
7. Verify that the UPS is correctly powered (UPS display panel illuminates).
8. Press the UPS "**ON**" button to start the UPS.
9. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass.
10. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3).
11. Verify that the "**UPS mode**" **green light** of the MBP turns on, indicating that the UPS output power is available on the MBP.

Important! ***Do not*** continue with the next step if the "**UPS mode**" **green light** of the MBP is still off (the load will be lost).

12. Set the MBP manual Bypass switch to the "**UPS**" position: the "**Bypass mode**" **red light** of the MBP turns off, indicating that the load is now powered by the UPS.



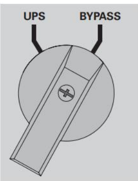
13. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
14. Check that the UPS is in Online mode by checking UPS display panel (see item 1) the load is now protected by the UPS.

(*) only in case of Bypass AC source option connected.

UPS replacement with HotSwap MBP

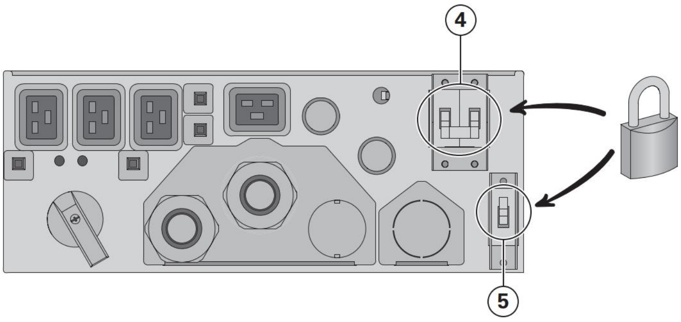
UPS Removing (please follow the **MANDATORY** step below):

Hazardous voltage and lost load risk: do not manipulate the MBP manual Bypass switch without UPS connected via the I/O cord Set ①.

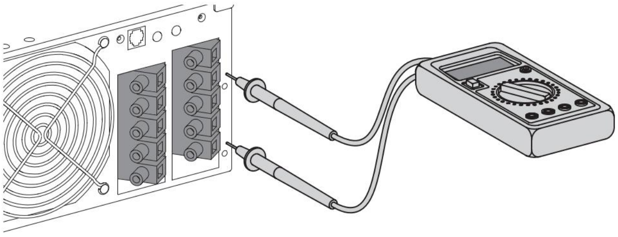
1. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass
2. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
3. Set the MBP manual Bypass switch to "**Bypass**" position. The "**Bypass mode**" red light of the MBP turns On, indicating that the load is supplied directly by AC source, or Bypass AC source (*)


4. Switch the Normal AC source switch and the Bypass AC source switch (*) of the MBP to the "**O**" position and wait 30 seconds
5. UPS stops, the UPS can now be disconnected, as described below:

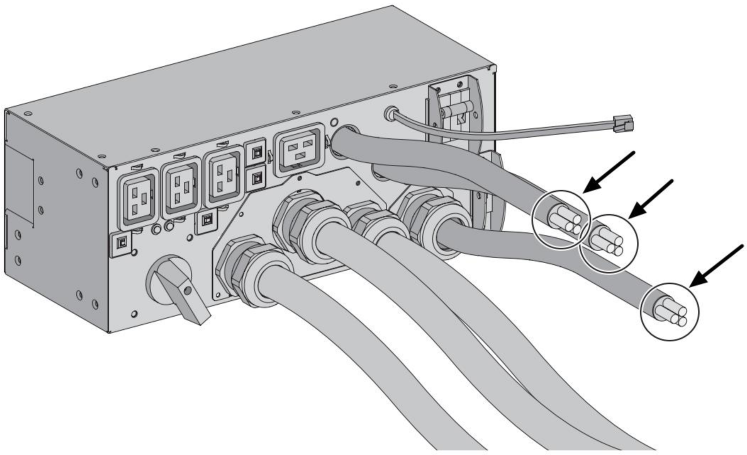
   - First lock the Normal AC source switch 4 and the Bypass AC source switch 5 (*) of the MBP to the "**O**" position (the switch protection frames are able to fit a cable tie or a metallic locker).



- After opening the UPS I/O terminal blocks cover, check if hazardous voltage is no longer present on UPS terminal blocks by using an electrical safety tester.



- Disconnect the MBP power power cables, and the MBP detection cable, see Rear panels, and Figure 14 (item 6) for details.
- On each MBP power cables just disconnected from the UPS, link the wires together (line and neutral wires linked to ground wire).



- Replace the UPS

Hazardous voltage and lost load risk: do not manipulate the MBP manual Bypass switch without UPS connected to the MBP power cables.

(*) only in case of Bypass AC source option connected.

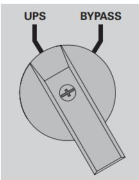
Return to normal operation

1. Check that the new UPS is correctly connected to the MBP, as described below:

   - First check that the Normal AC source switch 4 and the Bypass AC source switch ⑤ [*] of the MBP are still locked to the "**O**" position
   - Remove the previously installed safety wires links on each MBP power cables
   - After opening the UPS I/O terminal blocks cover, connect to UPS the MBP power cables, and the MBP detection cable, see Rear panels, and Figure 14 (item 6) for details
   - Unlock the Normal AC source switch ④ and the Bypass AC source switch ⑤ [*] of the MBP.
2. Set the Normal AC source switch and the Bypass AC source switch [*] of the MBP to the "**I**" position
3. Verify that the UPS is correctly powered (UPS display panel illuminates)
4. Press the UPS "**ON**" button to start the UPS
5. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass
6. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
7. Verify that the "**UPS mode**" **green light** of the MBP turns on, indicating that the UPS output power is available on the MBP.

Important! ***Do not*** continue with the next step if the "**UPS mode**" **green light** of the MBP is still off (the load will be lost)

8. Set the MBP manual Bypass switch to the "**UPS**" position: the "**Bypass mode**" **red light** of the MBP turns off, indicating that the load is now powered by the UPS



9. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
10. Check that the UPS is in Online mode by checking UPS display panel (see item 1) the load is now protected by the UPS

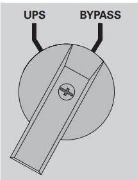
[*] only in case of Bypass AC source option connected

UPS maintenance with HotSwap MBP

Go to maintenance Bypass operation

Please follow the MANDATORY steps below:

1. Put the UPS in "**internal Bypass mode**", see Display Functions / Control - Go to Bypass
2. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
3. Set the MBP manual Bypass switch to "**Bypass**" position. The "**Bypass mode**" **red light** of the MBP turns on, indicating that the load is supplied directly by AC source, or Bypass AC source (*)



4. Proceed to maintenance operations on the UPS

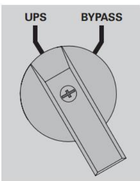
(*) only in case of Bypass AC source option connected.

Return to normal operation

1. Verify that the UPS is in **Bypass mode** by checking UPS display panel (see item 3)
2. Verify that the "**UPS mode**" **green light** of the MBP is On, indicating that the UPS output power is available on the MBP

Important!	*Do not* continue with the next step if the "**UPS mode" green light** of the MBP is off (the load will be lost)

3. Set the MBP manual Bypass switch to the "**UPS**" position: the "**Bypass mode**" **red light** of the MBP turns off, indicating that the load is now powered by the UPS



4. Put the UPS in "**normal mode**", that is into on-line mode, see Display Functions / Control / Go back normal
5. Check that the UPS is in Online mode by checking UPS display panel (see item 1). The load is now protected by the UPS

Chapter 8 Operation

UPS startup and shutdown

Starting the UPS

Note: Verify that the total equipment ratings do not exceed the UPS capacity to prevent an overload alarm.

Attention! ⚠ Before powering up the UPS unit all load that is protected by it must be turned off and remain off until the UPS has completed its startup.

For information on how to power up the attached load see the section Powering up the protected load.

Step 1. Verify that the EBMs are connected to the UPS. See Connecting the EBM(s) in Chapter 5 Installation.
Check that the battery circuit breaker is switched to the "**I**" (on) position.

Step 2. Verify that the UPS terminal blocks are connected to the AC source.

Step 3. Set the upstream circuit breaker (not provided) to the "**I**" (on) position to switch on the utility power. The UPS front panel display illuminates and shows the Lenovo logo.

Step 4. Verify that the UPS status screen shows ⏻.

Step 5. Press the ⏻ button on the UPS front panel for at least 3 seconds.

The UPS front panel display changes status to "`UPS starting...`".

Step 6. Check the UPS front panel display for active alarms or notices. Resolve any active alarms before continuing. See the Troubleshooting section.

If the ⚠ indicator is on, do not proceed until all alarms are clear. Check the UPS status from the front panel to view the active alarms. Correct the alarms and restart if necessary.

Step 7. Verify that the ~ indicator illuminates solid, indicating that the UPS is operating normally and powering the equipment.

See also Chapter 7 UPS start-up with HotSwap MBP on how to power the UPS with an MBP installed.

Note: The EBM will charge to 90% capacity in less than 3 hours. However, the batteries should be allowed to charge for 48 hours after installation or long-term storage.

It is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Starting the UPS on Battery

Note: Before using this feature, the UPS must have been powered by utility power with output enabled at least once. Battery start can be disabled. See the User settings in Chapter 3.

Attention! Before powering up the UPS unit all load that is protected by it must be turned off and remain off until the UPS has completed its startup.

For information on how to power up the attached load see the section Powering up the protected load.

Step 1. Press the power (⏻) button on the UPS front panel until the UPS front panel display illuminates and shows a status of "`UPS starting...`".

The UPS cycles through Standby mode to Battery mode. The battery ( ) indicator illuminates solid. The UPS supplies power to your equipment using batteries.

Step 2. Check the UPS front panel display for active alarms or notices. Resolve any active alarms before continuing. See the Troubleshooting section.

Step 3. Check the UPS status from the front panel to view the active alarms. Correct the alarms and restart if necessary.

Powering up the protected load

All load protected by the UPS unit must be powered up sequentially:

Power up one load has to be powered up and wait until it has completed its POST.
Once the load has fully started, power up the next load until it has completed its POST.
Repeat this sequence until all load has been powered up.

Attention! If these instructions are not followed then this can lead to a high inrush current to the UPS unit. This can lead to an unexpected behaviour, malfunctioning, or in the worst case to damage of the UPS unit!

Shutting down the UPS

Note: Before shutting down the UPS unit all load protected by it must be shut down properly and turned off, unless the UPS is set to bypass and the load is connected to utility power via the MBP.

To shut down the UPS:

Step 1. Press the ⏻ button on the UPS front panel. The UPS goes into Standby mode.

Step 2. Switch the upstream circuit breaker which protects the UPS unit off, that is set it to the "**O**" (off) position to switch off the utility power. This will cut the utility power to the UPS unit.

The UPS turns off.

Monitoring the UPS operating mode

The Lenovo UPS front panel indicates the UPS status through the UPS indicators. See Control panel in Chapter 3.

Operating modes: descriptions

Online mode

When the UPS is operating from utility power, the UPS is in Online mode: the ∿ indicator illuminates solid. The UPS monitors and charges the battery packs as needed and provides filtered power protection to your equipment. High Efficiency and Energy Saving settings take the UPS out of online mode to minimize heat contribution to the rack environment, but reduce the protection of your equipment. See User settings in Chapter 3.

Battery mode

When the UPS is operating without utility power, the alarm beeps once every ten seconds and the battery indicator illuminates solid. The necessary energy is provided by the battery packs. When the utility power returns, the UPS goes to Online mode.

If battery capacity becomes low while in Battery mode, the audible alarm beeps once every 3 seconds. This warning is approximate, and the actual time to shut down might vary significantly. Shut down all applications on the connected equipment because automatic UPS shutdown is imminent. When utility power is restored after the UPS shuts down, the UPS automatically restarts.

Bypass mode

In the event of a UPS overload or internal failure, the UPS powers your equipment directly from utility power. Battery mode is not available and your equipment is not protected; however, the utility power continues to be passively filtered by the UPS. The Bypass indicator illuminates.
Depending on overload conditions, the UPS remains in Bypass mode for at least 5 seconds and will stay in this mode if three transfers to Bypass occur within 20 minutes.

The UPS transfers to Bypass mode when:

- the user activates Bypass mode through the front panel
- the UPS detects an internal failure
- the UPS has an overtemperature condition
- the UPS has an overload condition listed in the Specifications section

Note: The UPS stops operating after a specified delay for overload conditions listed in the Specifications section. However, the UPS remains on to alarm the fault.

Standby mode

When the UPS is turned off and remains connected to the AC source, the UPS is in Standby mode (indicator). Depending if Bypass Standby setting is enabled, the output is powered but not protected. The battery packs recharge when necessary and the communication ports are powered.

Operating modes: summary

The following table summarizes the characteristics of your UPS unit in each operating mode.

Mode	**Online**	**Battery**	**Bypass**	**Standby**
Load	powered	powered	powered	no power
Batteries	charging	discharging	charging	charging
Protection features:				
Power failure	yes	n/a	no	no
Power sag	yes	n/a	no	no

UPS operating modes (continued)

Mode	Online	Battery	Bypass	Standby
Protection features: (continued)				
Power surge	yes	n/a	no	no
Under voltage	yes	n/a	no	no
Over voltage	yes	n/a	no	no
Line noise	yes	n/a	no	no
Frequency variation	yes	n/a	no	no
Switching transients	yes	n/a	no	no
Harmonic distortion	yes	n/a	no	no
Other features:				
Frequency conversion	yes	n/a	no	no
AC source	normal	n/a	bypass	normal

Note: In High Efficiency mode, the UPS is in Bypass mode and transfers to Battery mode in less than 10 microseconds (ms) when utility power fails. Transfers to High Efficiency (HE) mode will be active after 5 minutes of Bypass voltage monitoring: if Bypass quality is not in tolerance, then the UPS will remain in Online mode.

Transferring the UPS between modes

From Online or Battery to Bypass mode. Press any button to activate the menu options, then select `Control` and `Go to Bypass`.

From Bypass to Online or Battery mode. Press any button to activate the menu options, then select `Control` and `Go back normal`.

Setting High Efficiency mode

In High Efficiency mode, the UPS is in Bypass mode and transfers to Battery mode in less than 10 microseconds (ms) when utility power fails. Transfers to High Efficiency (HE) mode will be active after 5 minutes of Bypass voltage monitoring: if Bypass quality is not in tolerance, then the UPS will remain in Online mode.

Note: High Efficiency Mode is a mode of UPS operation that cuts energy usage and operating costs. In HE Mode the UPS is running as a Line Interactive UPS – feeding the input to the output loads and monitoring the input. If the input goes beyond the voltage or frequency ranges, the UPS will revert back to Online double conversion.

Steps to set High Efficiency mode:

Step 1. Put the UPS on Bypass: press any button to activate the menu options, select `Control` → `Go to Bypass`.

Step 2. Then, press [ESC] and select `Settings` In/Out settings → `High Efficiency mode`.

Step 3. Select `Enabled` and ↵ (Enter) to confirm.
The UPS goes into Bypass mode and transfers to Battery mode in the event utility power fails.

Configuring Bypass settings

The following settings are available for configuring Bypass operation for special situations. Normally, these settings will not need to be changed.

Bypass transfer out of tolerance

Step 1. Press any button to activate the menu options, then select `Settings` → `Output settings` → `Bypass transfer`.

Step 2. Select `Enabled` or `Disabled` for `BP AC NOK`, and ↵ (Enter) to confirm. If `Enabled`, the UPS transfers to Bypass even if Bypass AC source is out of tolerance, depending on output mode. If `Disabled`, the UPS output is shut down.

Interrupt time

This setting is displayed to define the break duration during transfer to Bypass, only if transfer out of tolerance is enabled. 10 ms or 20 ms can be selected.

Configuring battery settings

Automatic battery test

Automatic battery tests are done every week in automatic charging mode and at each cycle in Advanced Battery Management (ABM) mode. The frequency of the tests can be modified using the LCD panel: see Automatic battery test in User settings in Chapter 3.

During the test, the UPS goes into Battery mode and discharges the battery packs for 25 seconds under load.

Note: Battery mode is not displayed and battery low alarm does not activate during a battery test.

The battery test might be cancelled due to bad conditions, or fail.

For further information refer to Running a battery test in Chapter 10.

Low battery warning

During discharge, the low battery alarm is activated if the battery capacity goes below 20%. This threshold can be modified using the LCD panel.

External battery setting

The number of Extended Battery Modules (EBMs) is automatically detected, or it can be set manually using the LCD panel: see External battery in User settings in Chapter 3.

Deep discharge protection

This setting is recommended to avoid damaging the battery packs. The warranty is void if deep discharge protection is disabled.

Retrieving the Event log

To retrieve the Event log through the display:

Step 1. Press any button to activate the menu options, then select Event log.
Step 2. Scroll through the listed events.

Retrieving the Fault log

To retrieve the Fault log through the display:

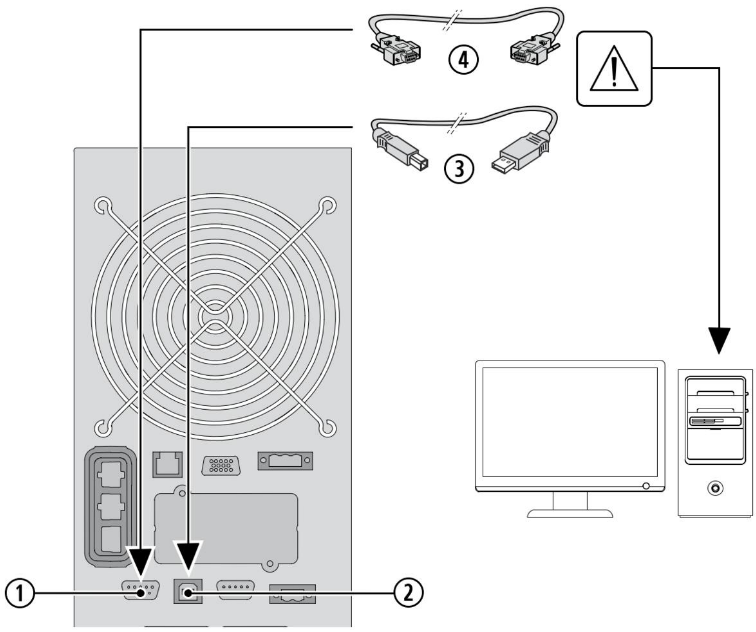
Step 1. Press any button to activate the menu options, then select Fault log.
Step 2. Scroll through the listed faults.

Chapter 9 Communication

Communication ports

Connecting RS232 or USB communication ports

Note: The RS232 and USB communication ports cannot operate simultaneously.



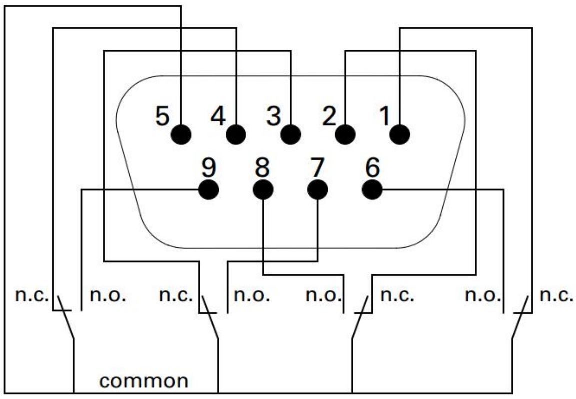
Step 1. Connect the RS232 ④ or USB ⑨ communication cable to the serial or USB port on the computer.

Step 2. Connect the other end of the RS232 ④ or USB 9 communication cable to the RS232 ① or USB communication ② port on the UPS.

The UPS can now communicate with Lenovo power management software.

Relay output contacts

The UPS incorporates four relay outputs; each one is available with a normally closed or open contact.



n.o.: contact normally open

n.c.: contact normally closed

Status active information: (if contact between pin and common is closed)

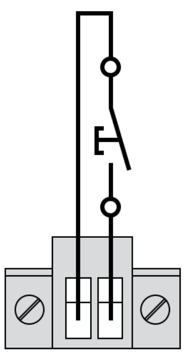
- Pin 1: not on Bypass
- Pin 2: load not protected
- Pin 3: not low battery
- Pin 4: not on Battery
- Pin 5: user common
- Pin 6: on Bypass
- Pin 7: low battery
- Pin 8: load protected
- Pin 9: on Battery

Important: The relay output contacts must not be connected to any utility connected circuits. Reinforced insulation to the utility is required. The relay output contacts have a maximum rating of 250 V_{AC}/5A.

Remote On/Off

Note: For additional information on RPO / ROO / EPO refer to Chapter 12 Helpful information in the section EPO / RPO / ROO.

Remote On/Off allows remote control of the power (⏻) button to switch the UPS on and off.



Normally open

When contact changes from open to closed, the UPS is switched on (or stays on).

When contact changes from closed to open, the UPS is switched off (or stays off).

Note: UPS must start with the regular On/Off switch on the front panel during commissioning.

On/Off control using the power (⏻) button has priority over the remote control.

Then, the ROO fully replaces it, although the On/Off switch will always have priority over the remote control

Remote Power Off

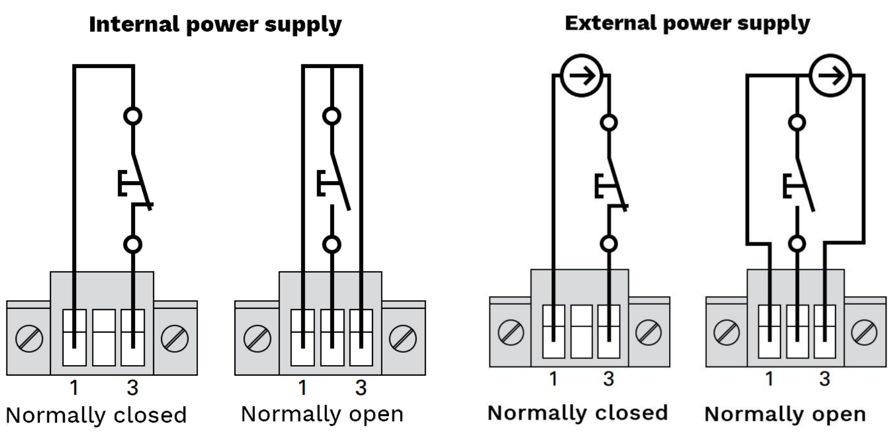
Remote Power Off (RPO) is used to disable the UPS remotely. This feature can be used for unpowering the load and shutting down the UPS by an external event, for example when the room temperature is too high. When RPO is activated, the UPS disables the output and all its power converters immediately. The UPS remains on, to alarm the fault.

Important: The RPO circuit is an IEC 60950 safety extra low voltage (SELV) circuit. This circuit must be separated from any hazardous voltage circuits.

Important notes:
- The RPO *must not* be connected to any utility-connected circuits. The RPO switch *must have* a minimum rating of 27 V_{DC} and 20 mA and be a dedicated latching-type switch not tied into any other circuit. The RPO signal must remain active for at least 250 ms for proper operation.
- To ensure the UPS stops supplying power to the load during any mode of operation, the input power *must be* disconnected from the UPS when the Remote Power Off function is activated.

Note: Leave the RPO jumper wire installed in the RPO port on the UPS if the RPO function is not needed.

RPO connections



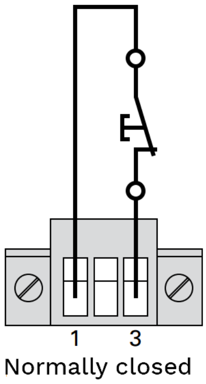
Terminal wire size rating is 0.32-4 mm^2 (22-12 AWG).

Note: Normally closed contact, which stops all power converters in the UPS and the bypass, when it opens up.

To restart the UPS, the contact must be closed and the power (⏻) button must be pressed.

Remote control connection and test

1. Ensure that the UPS is shut down and the utility power is disconnected.
2. Remove the RPO connector from the UPS by loosening the screws.
3. Connect a normally closed volt-free contact between pins 1 and 3 of the connector.



Contact open: shut down of UPS

To return to normal operation, close the external remote shut down contact and restart the UPS from the front panel.

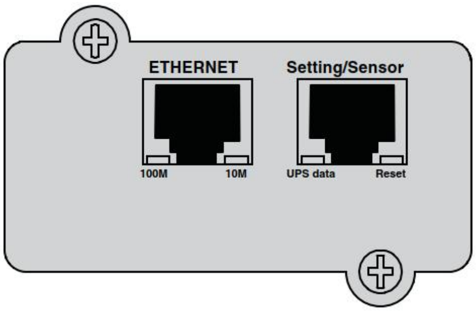
4. Plug the RPO connector into the back of the UPS and fix the screws.
5. Connect and restart the UPS.
6. Open the external remote shut down contact to test the function.

Note: Always test the RPO function before applying your critical load to avoid accidental load loss.

Connectivity card

The UPS Network Management Card (NMC) allows the UPS to communicate in Ethernet environments. The card has SNMP and HTTP capabilities as well as monitoring through a Web browser interface. In addition, an Environmental Monitoring Probe can be attached to obtain humidity, temperature, smoke alarm, and security information.

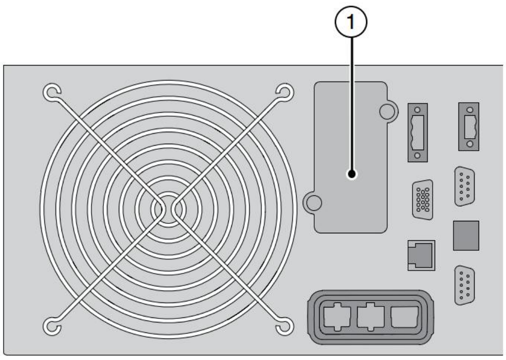
The unit has one available communication bay for the UPS Network Management Card. See Preparing the EBM for rack mounting in Chapter 5 for the location of the communication bay.



UPS Network Management Card

Replacing the communication card

Follow these steps to replace the UPS Network Management Card.



Step 1. Turn off the UPS.

Step 2. Disconnect the network cable.

Step 3. Remove the connector panel blank (①), which is secured by two screws.

Step 4. Insert the UPS Network Management Card into the slot.

Step 5. Secure the panel by tightening the two screws.

Note: The NMC can be hot plugged, that is, it can be installed or removed whilst the UPS unit is up and running.

UPS Management Software

The UPS Management Software can be downloaded from:

https://datacentersupport.lenovo.com/solutions/LNVO-UPS-MGMT

Chapter 10 UPS maintenance

Attention!

Servicing any UPS in the field, is limited to replacement (FRU) or (CRU) parts, for example, batteries, electronic modules, etc.

No repairs of failed UPS component CRU or FRU is to be done in the field.

Opening any FRU or CRU part cover on the UPS for repairs or troubleshooting is not to be performed in the field. This does not include battery compartments for battery replacement.

Personal injury or system damage may occur if any components of the UPS are accessed by individuals.

All UPS unit repairs are limited to what is listed in their replacement parts list.

Accessing the chassis covers of the UPS, including batteries and chassis, by anyone could void the warranty and support of the entire product. This does not include opening battery compartments for battery replacement. Opening up any other partS of the UPS unit will void system warranty!

Because of serious health, safety, and legal issues, any part or parts that are found to be tampered, altered, or damaged due to accessing the chassis or modules could result in the end user being charged for the service of the unit.

This also applies in the event of any health and safety issue or smoke incident of the UPS unit!

Overview

For the best preventive maintenance, keep the area around the equipment clean and dust free. If the atmosphere is dusty, clean the outside of the equipment with a vacuum cleaner. For full battery life, keep the equipment at an ambient temperature of 25 °C (77 °F).

Notes:
- If the UPS requires any type of transportation, verify that the UPS is disconnected from its power source and is turned off.
- The batteries must be disconnected from the UPS.
- The battery pack is rated for a 3-5 year service life.
- The length of service life varies, depending on the frequency of usage and ambient temperature.
- Battery packs used beyond expected service life will often have severely reduced runtimes.
- Replace battery packs at least every 4 years to keep units running at peak efficiency.

Storing the equipment

If you store the equipment for a long period, recharge the battery packs every 6 months by connecting the UPS to utility power. The EBM will charge to 90% capacity in less than 3 hours. However, the battery packs should be allowed to charge for 48 hours after long-term storage or after replacing the batteries.

Check the battery recharge date on the shipping carton label. If the date has passed and the battery packs were never recharged, do not use them. Contact your service representative.

Replacing battery packs

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

When the battery replacement screen is displayed (see illustration), replace the battery packs. Contact your service representative to order new battery packs.

Replace all battery packs in the UPS and any EBMs connected to the UPS at the same time. The replacement battery packs must have no more than 12 month variation between their dates of manufacture and should not have reached or exceeded their shelf life. Dispose of battery packs in accordance with local regulations.

Battery packs can be replaced without turning off the UPS or disconnecting the load. If you prefer to power the UPS down to change the battery packs, see Shutting down the UPS in Chapter 8.

See the section Determining how many battery packs are to be replaced in this chapter for information how many battery packs are to be replaced.

Attention! ***DO NOT DISCONNECT*** a battery pack while the UPS is in Battery mode. Be aware that the UPS can switch to Battery mode at any time and without warning.

Consider all warnings, cautions, and notes before replacing battery packs.

Important:

- Servicing should be performed by qualified service personnel knowledgeable of batteries and required precautions. Keep unauthorized personnel away from batteries.
- Batteries can present a risk of electrical shock or burn from high short circuit current. Observe the following precautions:
    1. Remove watches, rings, or other metal objects,
    2. Use tools with insulated handles,
    3. Do not lay tools or metal parts on top of battery packs,
    4. Wear rubber gloves, boots and protective goggles.
- When replacing battery packs, replace with the same type and number. Contact your service representative to order new battery packs.
- Proper disposal of battery packs is required. Refer to your local codes for disposal requirements.

- Never dispose of batteries in a fire. Batteries might explode when exposed to flame.
- Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes and can be extremely toxic.
- Determine if the battery pack 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 (applicable to equipment and remote battery supplies not having a grounded supply circuit).
- ELECTRIC ENERGY HAZARD. Do not attempt to alter any battery wiring or connectors. Attempting to alter wiring can cause injury.

Determining how many battery packs are to be replaced

Attention! When the UPS unit issues either battery fault message or the reminder to replace the batteries after four years is displayed then all battery packs must be replaced!

The UPS unit can not determine which battery is defective.

Mixing old and new batteries in any UPS installation will lead to a thermal destruction of the UPS unit!

The Lenovo 8 kVA and 11 kVA UPS units (single and three phase) are shipped with a power module to which a battery module is attached to. The battery replacement procedure for this base UPS is identical to the battery replacement procedure for an Extended Battery Module. This battery module is listed as 0 in the table that allows to determine the number of replacement batteries to be ordered.

Lenovo 8 kVA or 11 kVA UPS, single or three phase UPS

Lenovo 8 kVA and 11 kVA Extended Battery Module

The below table details how many batteries are to be replaced for any of the single or three phase 8 kVA or 11 kVA UPS units.

Number of EBMs installed	Number of batteries to be replaced per unit	How many batteries are to be ordered
Base UPS shipped with one EBM	2	2
1	2	4
2	2	6
3	2	8
4	2	10

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

Battery replacement methods

There are two recommended battery replacement methods:

1. Replacing batteries using the Maintenance Bypass Panel
2. Replacing the batteries by powering down the UPS unit

Replacing batteries using the Maintenance Bypass Panel

1. Schedule a maintenance window for both the UPS and the protected load, make sure that all vital data is backed up
2. Switch the UPS to bypass mode, this will transfer the load directly to utility power
3. Remove all batteries from the UPS and any attached Extended Battery Module
4. Install all new batteries into the UPS and attached Extended Battery Module
5. Leave the UPS running in by-pass mode for 48 hours
6. Switch the UPS back to on-line mode after the 48 hours

Replacing the batteries by powering down the UPS unit

1. Schedule a maintenance window for both the UPS and the protected load, make sure that all vital data is backed up
2. Make sure that the load can be run off directly from utility power rather than the UPS
3. Power the UPS off at the UPS front bezel and turn off the upstream circuit breaker
4. Remove all batteries from the UPS and any attached Extended Battery Module
5. Install all new batteries into the UPS and attached Extended Battery Module
6. Turn on the upstream circuit breaker
7. Power the UPS up and let it run in on-line mode for the 48 hours
8. After 48 hours transfer the protected load to the UPS

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

Manually replacing any battery packs

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

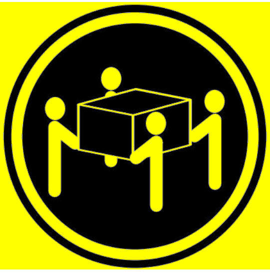
During the 48 hour charge cycle the UPS is not to protect any load!

The Lenovo 8 kVA and 11 kVA UPS units (single and three phase) are shipped with a power module to which a battery module is attached to. The battery replacement procedure for this base UPS is identical to the battery replacement procedure for an Extended Battery Module. This battery module is listed as 0 in the table that allows to determine the number of replacement batteries to be ordered.

Lenovo 8 kVA or 11 kVA UPS, single or three phase

Lenovo 8 kVA and 11 kVA Extended Battery Module

CAUTION:



The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

Battery pack replacement procedure

Attention! When the UPS unit issues either battery fault message or the reminder to replace the batteries after four years is displayed then all battery packs must be replaced!

The UPS unit can not determine which battery is defective.

Mixing old and new batteries in any UPS installation will lead to a thermal destruction of the UPS unit!

Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 / Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

Figure 42: UPS with one base EBM and one additional EBM

Figure 43: Empty EBM chassis, battery connectors are at the back

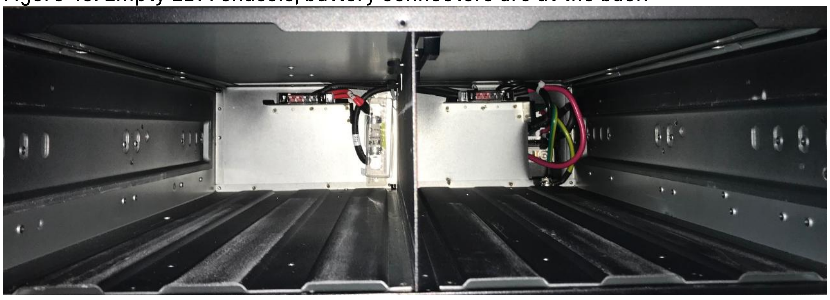
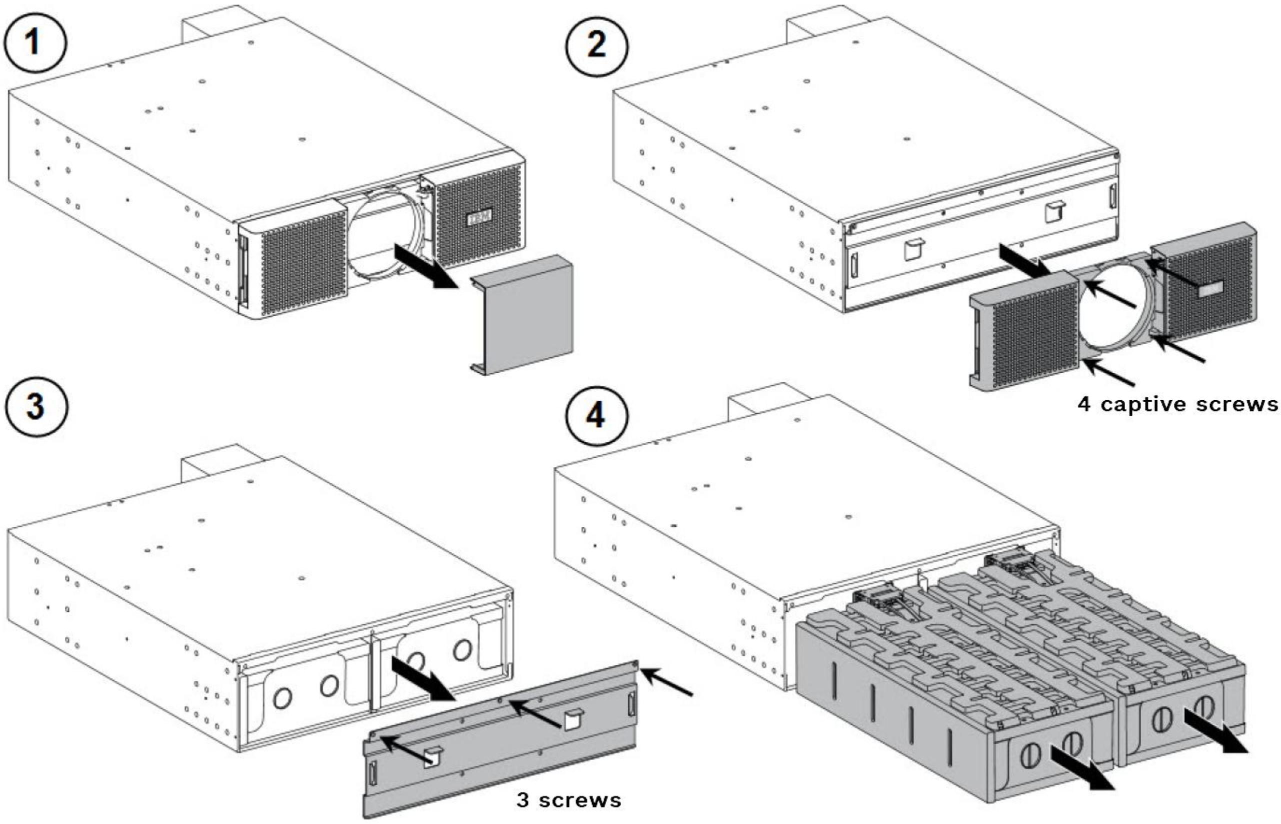


Figure 44: Battery packs installed into an EBM

Figure 45: Battery pack back side with connector



Step 1. Remove the centre section of the front bezel.

Step 2. Remove the four captive screws to open the front bezel.

Step 3. Remove the three screws to pull out the metal protective cover of the battery pack.

Step 4. Pull out the plastic handle of the battery pack, and slide the pack out slowly on to a flat and stable surface. Use two hands to support the battery pack. See "Recycling the used equipment" on page 55 for proper disposal.

Step 5. Verify that the replacement batteries have the same rating as the batteries being replaced.

Step 6. If applicable, make sure the battery connectors are connected

Step 7. Slide the new battery pack into the UPS. Push the battery pack firmly to ensure a proper connection.

Step 8. Screw the metal protective cover back onto the unit.

Step 9. Reinstall the front bezel by tightening the four captive screws.

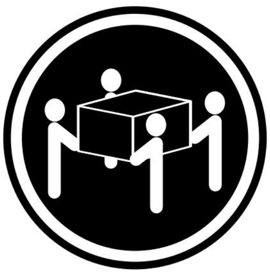
Note: There is some left-to-right slack in the bezel, so ensure that it is lined up correctly before tightening the screws.

Step 10. Snap the center section of the bezel into place.

Step 11. Continue to Testing a new battery pack.

Replacing the EBM(s)

CAUTION:



The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

Attention! Mixing old and new batteries in any UPS installation will lead to a thermal destruction of the UPS unit!

Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

To replace the EBM(s):

Step 1. Remove the center section of the front bezel.

Step 2. Remove the four captive screws to open the front bezel.

Step 3. Remove the three screws to pull out the metal protective cover of the battery pack.

> **Note:** A ribbon cable connects the LCD control panel to the UPS. Do not pull on the cable or disconnect it.

Step 4. Pull out the plastic handle of the battery pack, and slide the pack out slowly on to a flat and stable surface. Use two hands to support the battery pack. See "Recycling the used equipment" on page 55 for proper disposal.

Step 5. Verify that the replacement batteries have the same rating as the batteries being replaced.

Step 6. Slide the new battery pack into the UPS. Push the battery pack firmly to ensure a proper connection.

Step 7. Screw the metal protective cover back onto the unit.

Step 8. Reinstall the front bezel by tightening the four captive screws.

Note: There is some left-to-right slack in the bezel, so ensure that it is lined up correctly before tightening the screws.

Step 9. Snap the center section of the bezel into place.

Step 10. Continue to Testing a new battery pack.

Testing a new battery pack

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

To test a new battery pack:

Step 1. Allow the batteries to charge for 48 hours.

Step 2. Press any button to activate the menu options.

Step 3. Select `Control` → `Start a battery test`.

The UPS starts a battery test if the battery pack is fully charged, the UPS is in Normal mode, that is in on-line mode, with no active alarms, and the bypass voltage is acceptable.

During the battery test, the UPS transfers to Battery mode and discharges the battery pack for 25 seconds. The front panel displays "Battery test in progress" and the percentage of the test completed.

Attention! Once batteries are replaced, it is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Run a manual battery test and then let the batteries charge for 48 hours. See Chapter 3 Display functions under Control / Start battery test for additional information on how to manually start a battery test.

During the 48 hour charge cycle the UPS is not to protect any load!

Clearing the Battery Replacement message

When the battery replacement reminder is displayed and the batteries were replaced, perform these steps in order to clear the reminder message:

1. In the LCD message click on OK with the Enter key

2. Move the cursor to the "No" field and click the Entery key

3. A confirmation message will be displayed that the alarm has been cleared

4. A reminder is displayed that the batteries should be replaced in this month

Note: If in step 2 "Yes" is selected, then a reminder message will be displayed after 30 days that the battery is to be replaced. At that point replace the battery or delay for another month.

Attention! After clearing this message once it is strongly recommended to replace the UPS batteries in order to ensure that the UPS is still able to protect the load as intended!

Running a battery test

Automatic battery tests are done every week in automatic charging mode and at each cycle in Advanced Battery Management (ABM) mode. The frequency of the tests can be modified using the LCD panel. See User settings in Chapter 3 for more details.

Note: Make sure that the Battery mode is not displayed and the battery low alarm does not activate during a battery test.

The automatic discharge test is enabled by default and runs during the transition from `Float` to `Rest` mode. After the test is complete, the charge cycle restarts to completely charge the batteries and then continues to `Rest` mode.

The automatic battery test runs approximately once every three months and does not run again until the next test period. If a manual battery test is requested, the automatic battery test timer is reset so that it does not run for the next test period.

Requirements for successful battery test

In order for a battery test to complete successfully the following minimum requirements must be met:

1. Load must be at last 10% of the rated capacity or greater to run adequate discharge, however 25% is recommended load capacity of the UPS that should be protected by the UPS unit
2. Battery capacity should be ≥ 80 %, that is the battery is charged to at least 80 % of its capacity
3. There is no running alarm (except Battery fault)
4. Load level has not varied by more than +/-10 % (from the initial load level present at the beginning of the test to the end of the test)
5. The bypass voltage is in tolerance for bypass transfer (in case of end of backup, to transfer to bypass)
6. UPS mode must be in Online mode or HE (High efficiency) mode.

These requirements applies to both the UPS itself and any attached EBM(s), that is for all battery packs present in the UPS installation.

UPS can either be in ABM or continuous battery charge mode.

Additional information

For both the automatically and manually started battery tests, the following applies:

The battery test only runs for a short duration to measure the change in voltage over that time period. Without a minimal amount of load, there will not be a measurement of the change of voltage over that time period. Without sufficient load, the battery test cannot determine a bad or weak battery.

As a result of an underload, that is less than 10 % load capacity, the UPS will issue the, `Battery test cancelled UPS Underload.` error and cancel the battery test.

Figure 46: *Cancelled* battery test due to underload

If the UPS in HE mode, the UPS transfers automatically to Online mode and then the test is launched. Once the test is complete, the UPS is enabled to transfer back from Online mode to HE mode.

Replacing the UPS

The HotSwap MBP allows you to service or replace the UPS without interrupting the connected loads.

If the MBP is activated the protected load is directly fed by utility power. This means that the load is not protected by the UPS in case of utility power failure. Therefore it is recommended to plan for a maintenance window for replacing the UPS.

Removing the UPS

Step 1. Press any button to activate the menu options.Then, select `Control` → `Bypass`.

Step 2. Verify that the UPS is in Bypass mode by checking its display panel. The Bypass LED is on: .

Step 3. Move the manual rotary switch on the MBP to the **Bypass** position.

The **Bypass mode** red light on the MBP turns on, indicating that the load is powered directly from utility power or, if so wired, by the Bypass AC source.

Step 4. Pull out the yellow tab on the MBP rotary switch and install a lock to ensure that the switch remains in the **Bypass** position, to prevent the load from losing power during servicing.

Step 5. Switch the MBP's UPS Input switch and UPS Bypass Input switch (3Phase model only) to the **O** (off) position.Install locks to ensure that they remain in the **O** (off) position.

Important: To prevent exposure to hazardous voltage, the switches must remain in the **O** (off) position during servicing and while the UPS is disconnected.

Figure 47: Locking the UPS Input switch (Single Phase UPS)

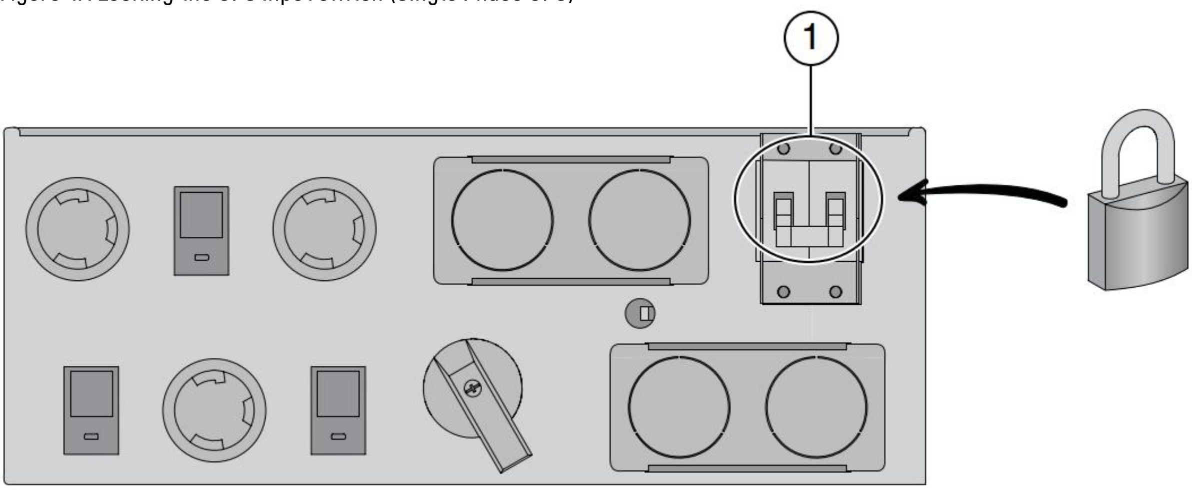
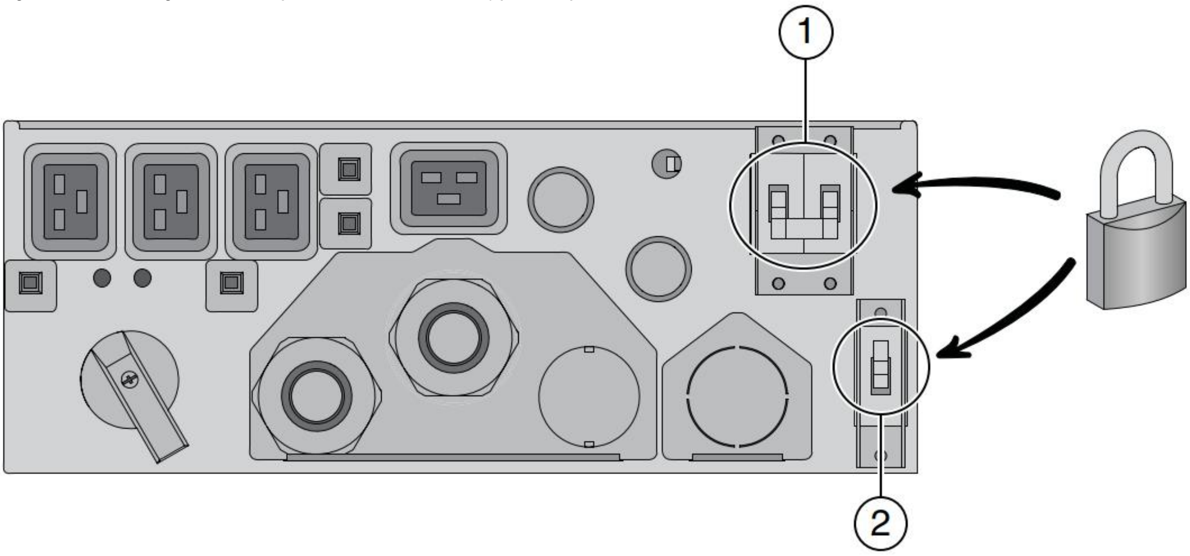


Figure 48: Locking the UPS Input switch and UPS Bypass Input switch (Three Phase UPS)



Step 6. Wait 30 seconds for the UPS to stop functioning.Check the UPS display panel to verify that the UPS is not functional.

Step 7. Remove the access cover on the terminal block cover and use a voltmeter to ensure that hazardous voltage is no longer present.

> **Important:** Proceed only when no hazardous voltage is present on any terminal.

Step 8. Unlock the conduit from the UPS terminal block cover. Then, loosen the set screws holding the cable wires in the terminal block, and remove the cables.

Step 9. Connect the just-exposed wires together to help prevent exposure to hazardous voltage.

Step 10. Remove the UPS battery pack by following the steps in the section "Battery pack replacement procedure".

The UPS can be removed and replaced.

> **Important:** When the UPS is not connected to the MBP, ensure that the MBP manual Bypass switch is locked. DO NOT manipulate the switch unless the UPS is connected to the MBP.

Returning to normal operation

After performing maintenance on the UPS, follow these steps to put the UPS back into service and resume normal operation.

Step 1. ***Single Phase UPS unit only, 5594-8KX and 5594-9KX***

Ensure that the locks are still in place and that yellow tab on the MBP rotary switch is still pulled out and is still **Bypass** in position.

Three Phase UPS unit only, 5594-8PX and 5594-9PX

Ensure that the locks are still in place, holding the MBP's UPS Input switch and UPS Bypass Input switch is in the **O** (off) position.

Important: To prevent exposure to hazardous voltage, the switches must remain in the **O** (off) position during servicing and while the UPS is disconnected.

Step 2. Remove previously installed safety wires links on each MBP power cables. After opening the UPS I/O terminal blocks cover, connect to UPS the MBP power cables, and the MBP detection cable, see Rear panels, Figure 13 (item 4) single phase UPS, Figure 14 (item 6) three phase UPS, and Chapter 6 Power cables connection for more details.

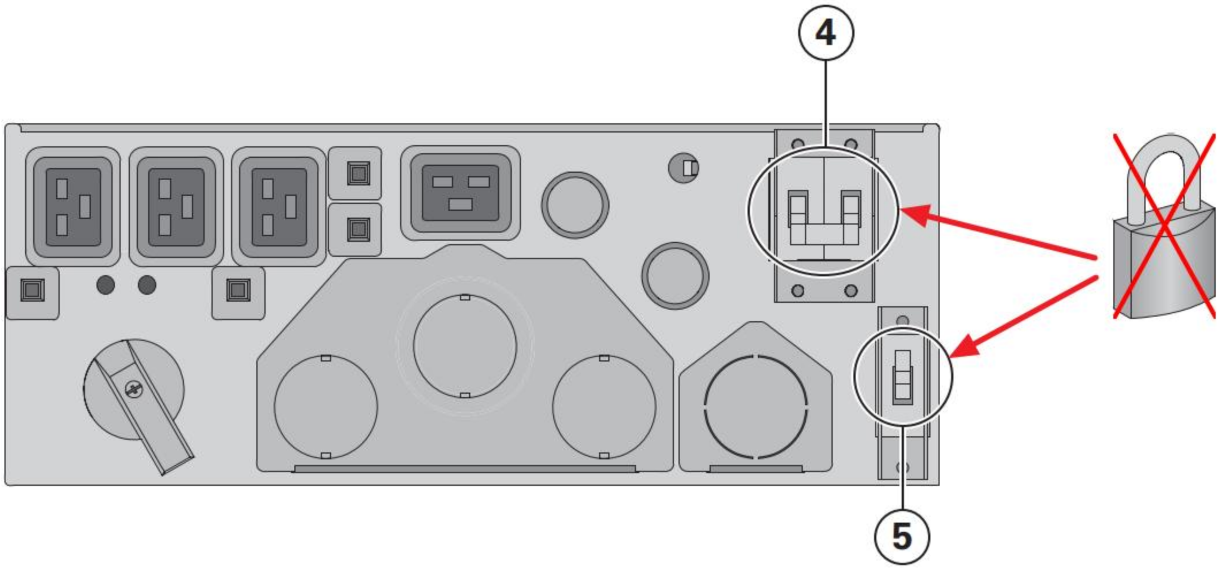
Be sure to connect the UPS AC input cable and UPS output cable properly.

Step 3. Connect the UPS to the MBP. See HotSwap MBP installation and connection in Chapter 5.

Step 4. Verify that all wiring is correct. Then, push the conduits into the terminal block cover until they lock in place. Attach the access cover to the terminal block cover.

Step 5. On the MBP, unlock the Normal AC source switch ④ and the Bypass AC source switch ⑤, and set them to the **1** (on) position.

Figure 49: Remove lock from the UPS unit



Step 6. Wait for the UPS to start functioning.

The display panel illuminates and displays the standby symbol:

Step 7. Press the power (⏻) button to turn on the UPS.

The UPS goes into online mode:

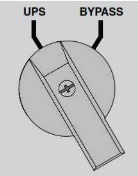
Step 8. Select `Control` → `Go to Bypass`

The UPS goes into internal bypass mode:

Step 9. Verify that the **UPS mode** green light on the MBP is on, indicating that the UPS output power is available to the MBP. Do not continue to the next step if the **UPS mode** green light on the MBP is off. If the green light is off and the manual rotary switch is moved to the UPS position, the load will lose power.

Step 10. ***Single Phase UPS unit only, 5594-8KX and 5594-9KX***
Push the yellow tab on the MBP rotary switch back in.
All UPS units
Move the rotary switch to the the UPS position.

The **Bypass mode** red light on the MBP turns off, indicating that the load is now powered by the UPS.



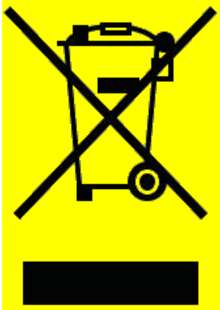
Step 11. On the UPS, select `Control` → `Go back normal` to put the UPS into Online mode.

Step 12. Check that the UPS is in Online mode by checking its display panel. The load is now protected by the UPS.

Recycling the used equipment

Contact your local recycling or hazardous waste centre for information on proper disposal of the used equipment.

Attention!
- DO NOT dispose of batteries in a fire or expose them to temperatures higher than 100 °C (212 °F). Battery packs might explode.
- DO NOT open or mutilate the batteries. Released electrolyte is harmful to the skin and eyes. It can be toxic.
- Dispose of the battery as required by local ordinances or regulations.



DO NOT discard waste electrical or electronic equipment (WEEE) in the trash. For proper disposal, contact your local recycling/reuse or hazardous waste centre.

DO NOT discard the UPS or the UPS batteries in the trash. This product contains sealed lead acid batteries and must be disposed of properly. For more information, contact your local recycling/reuse or hazardous waste centre.

Rebooting the UPS

The UPS unit does not provide a reboot function as such. Rebooting the UPS unit requires a shutdown and restart of the UPS unit.

Shutting down the UPS completely

1. Press the ⏻ On/Off button on the UPS LCD Control Panel at the front. The UPS goes into Standby mode
2. Switch the upstream circuit breaker off which protects the UPS unit. This will cut the utility power to the UPS unit
3. Wait some 15 minutes in order to ensure that there power in the UPS unit itself

Powering up the UPS unit

Instructions on how to power up the UPS without protecting the load see:

Chapter 7 Maintenance Bypass Panel Operations / UPS start-up with HotSwap MBP
or
Chapter 8 Operation / UPS startup and shutdown

Replacing the Front Bezel of a Single Phase UPS unit

This section explains how to replace the front bezel including LCD, CRU 00FP792, of a Single Phase UPS unit.

Applicable UPS units

- Lenovo RT8kVA 6U Rack or Tower UPS (200-240VAC), 55948KX
- Lenovo RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX
- IBM RT8kVA 6U Rack or Tower UPS (200-240VAC), 55948KX
- IBM RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX

Attention!

A maintenance window for both the Uninterruptible Power Supply (UPS) and the load protected by this UPS unit must be scheduled when planning to replace the front bezel with the integrated LCD.

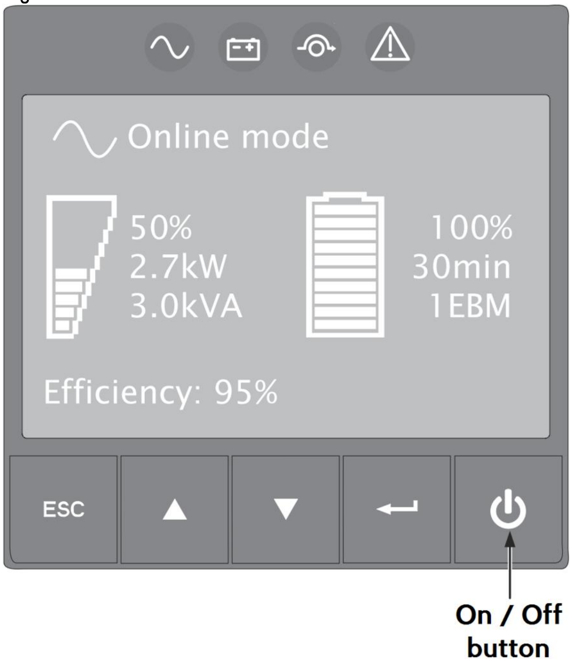
Note: The affected UPS units are to be hard-wired to the utility power. That is no power plugs are used to connect the UPS to utility power.

It is not necessary at all to physically disconnect the UPS unit from utility power, that is to physically disconnect it from the utility power wires.

Connecting and disconnecting the UPS from utility power by hard-wiring and un-wiring must be done by a licensed and qualified electrician. This can not be done by a servicer.

Powering off the UPS unit

Figure 50: UPS LCD Control Panel



1. Press the ⏻ On/Off button on the UPS LCD Control Panel at the front. The UPS goes into Standby mode
2. Switch the upstream circuit breaker off which protects the UPS unit. This will cut the utility power to the UPS unit
3. Do not work on the UPS immediately. Wait some 15 minutes before performing any work on the UPS unit. This will reduce the risk of an electrical accident

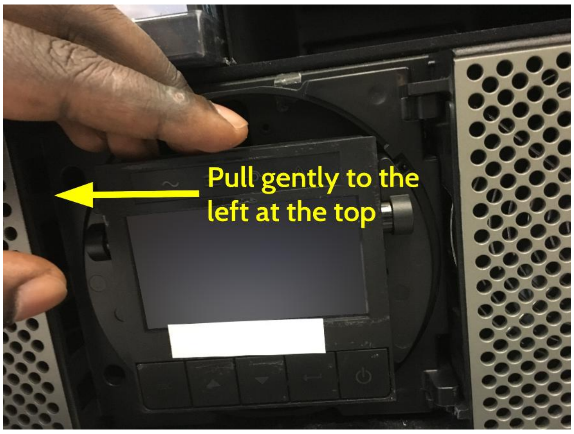
Tools required

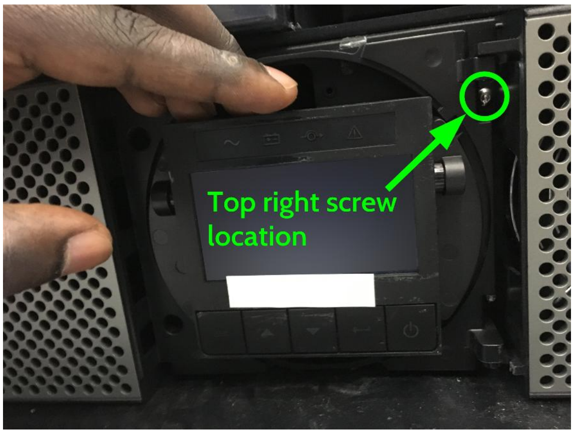
- #10T Torx screwdriver
- Small flat-head screwdriver

Disassembling the LCD Display Bezel

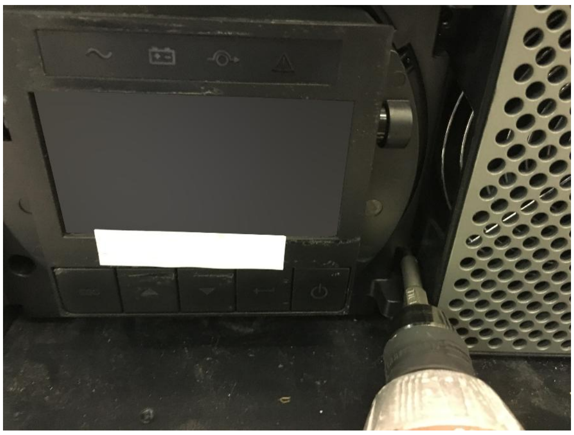
1. Start by grasping the top and bottom portion of the center plastic part of the bezel that encompasses the LCD, and pulling it away from the front of the unit
2. Use the 10T Torx screwdriver to remove the two screws on the left of the display. Take care not to misplace the screws

3. Gently pull the left side of the front panel bezel to the left to expose the screws on the right side of the display. The two screws on the top and bottom right-hand side become visible

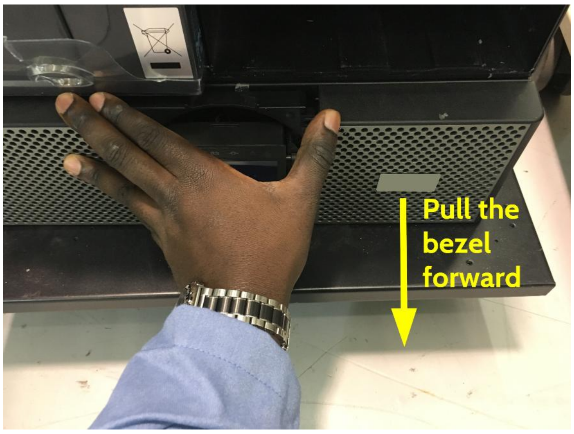


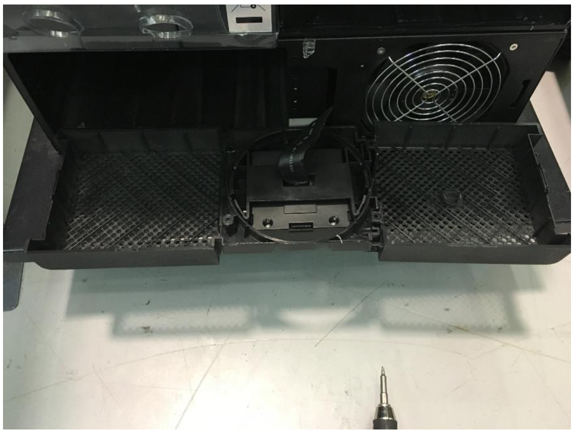


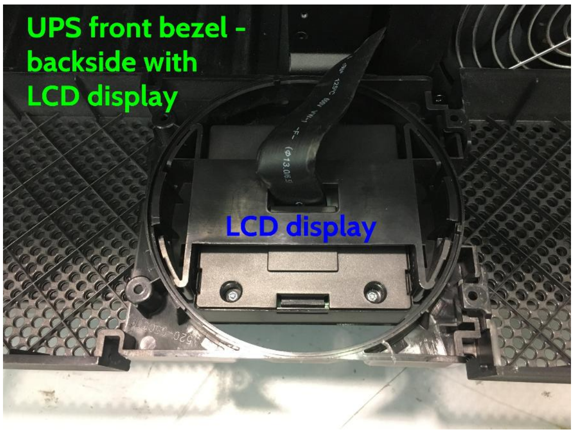
4. Using the T10 Torx screwdriver, remove the two screws on the right-hand side of the display



5. Push the whole front panel bezel slightly to the right and then pull forward

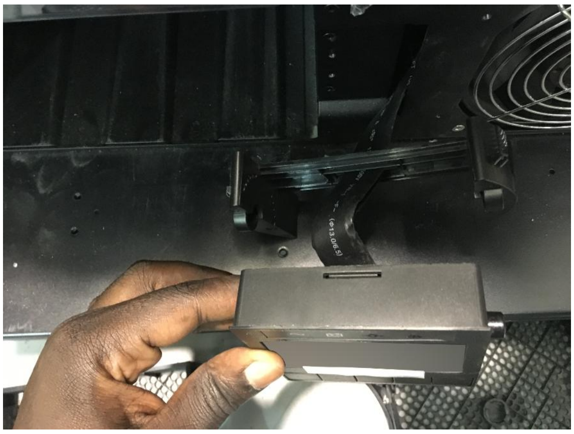




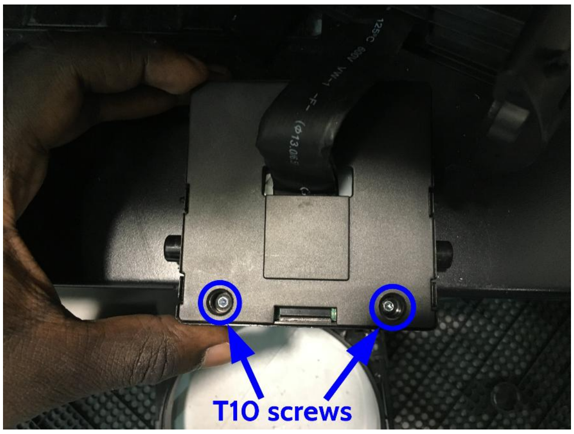


6. Use a flat blade screwdriver to unlatch the display from the frame on one side, the other side should unlatch at the same time. Push the LCD display through the bezel so that it is in front of the bezel

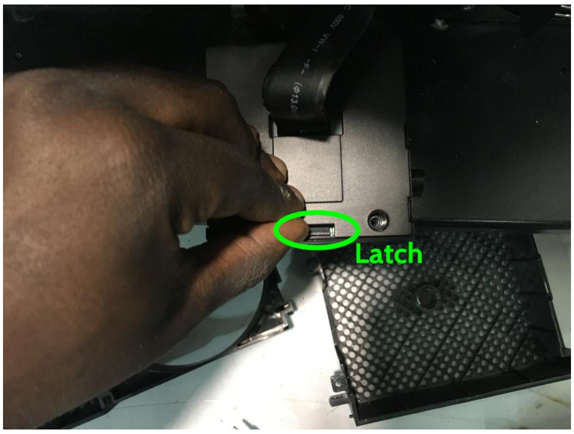
7. Remove the bracket on the back of the display by gently unlatching it from one side. The other side should easily unlatch as well

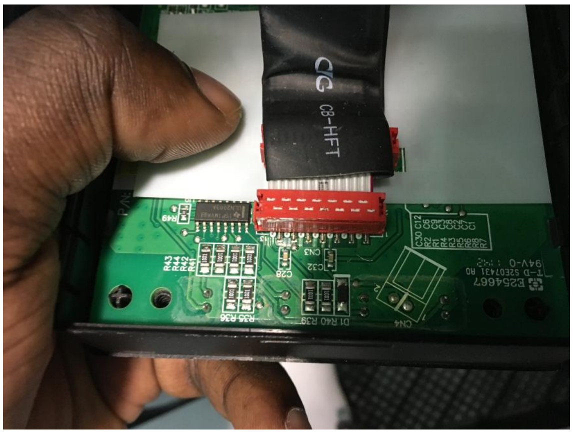


8. Remove the two screws on the back panel using a T10 Torx screw driver

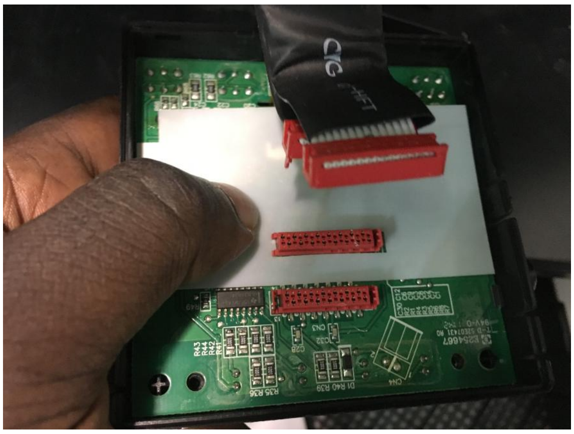


9. Unlatch the back plate from the LCD assembly using the small latch





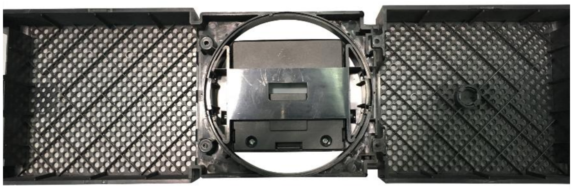
10. Hold the red plug with two fingers and carefully unplug it from the LCD circuit board. Repeat for second plug



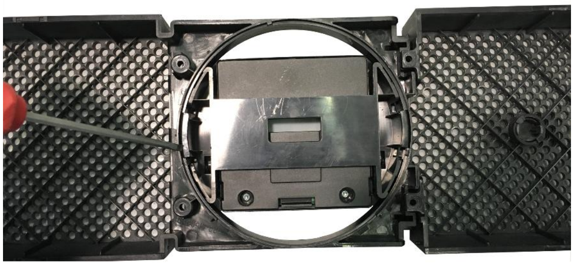
11. Feed the ribbon cable assembly back through the round LCD hole in the bezel. Set the used bezel and LCD assembly aside. They are no longer needed

Assembling the LCD Display Bezel

1. Grab the new LCD bezel assembly and turn it up-side down



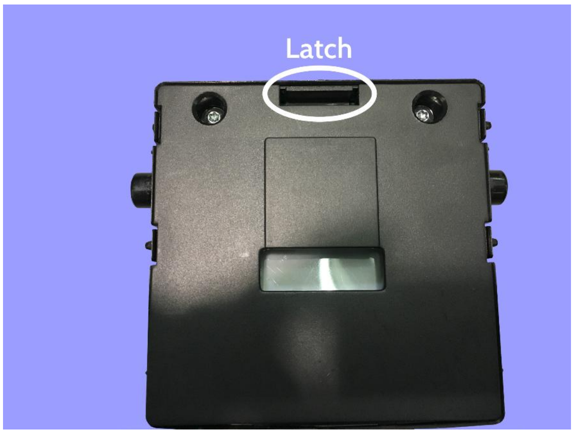
2. Use a flat blade screwdriver to unlatch the display from the frame on one side, the other side should unlatch at the same time. Push the LCD display through the bezel so that it is in front of the bezel



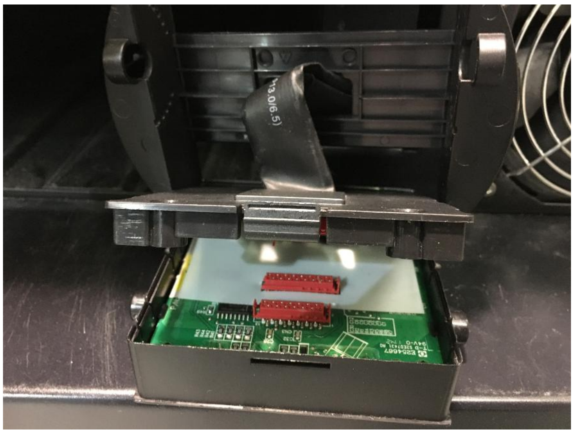
3. Remove the bracket on the back of the display by gently unlatching it from one side. The other side should easily unlatch as well

4. Remove the two screws on the back panel using a T10 Torx screw driver

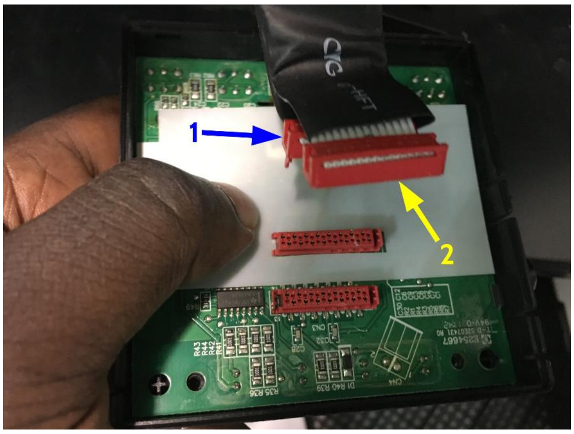
5. Unlatch the back plate from the LCD assembly using the small latch

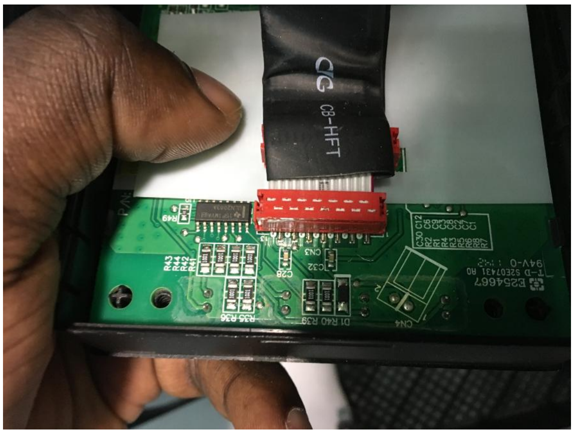


6. Feed the ribbon cable assembly and red plugs though the round LCD hole in the new bezel

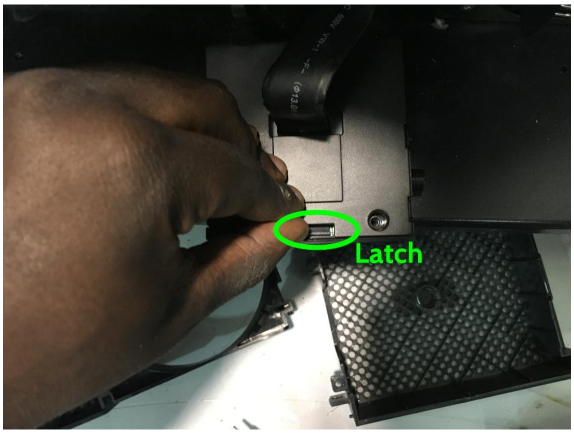


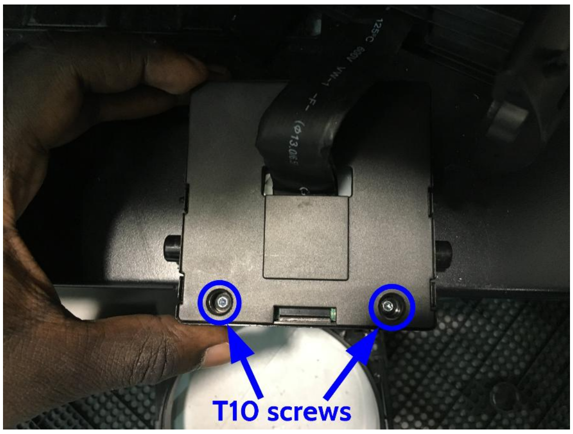
7. Plug in the two red plugs into their corresponding receptacles in the order shown in the below left image



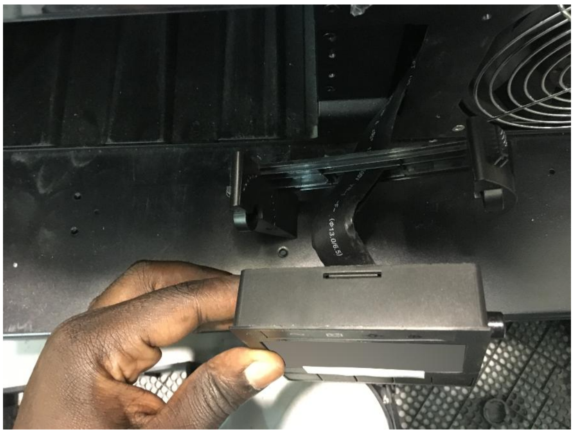


8. Reassemble the LCD display casing and screw it close

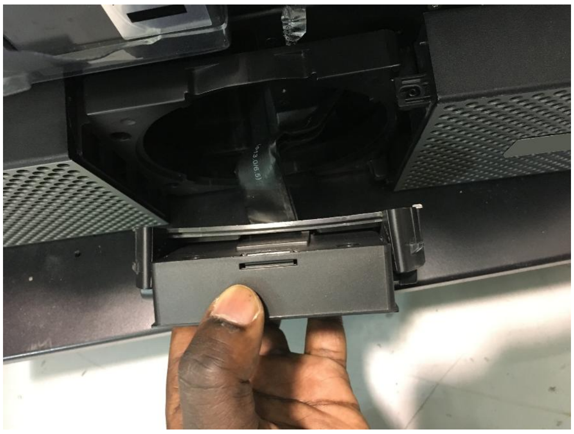


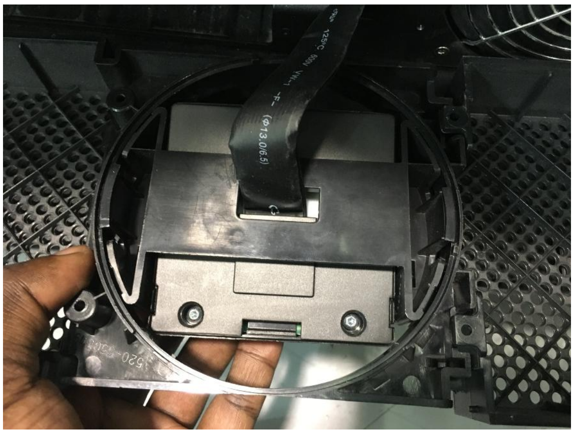


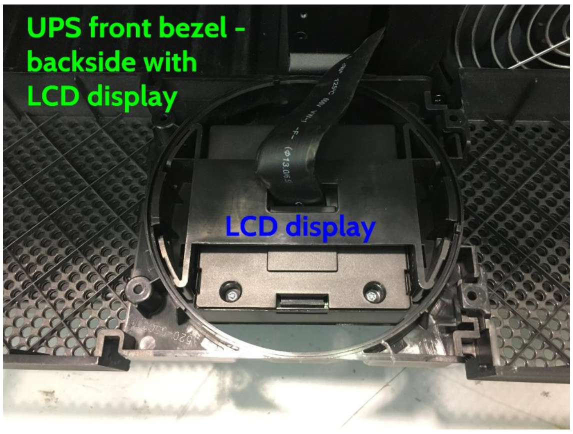
9. Carefully install the LCD assembly back into its holding frame



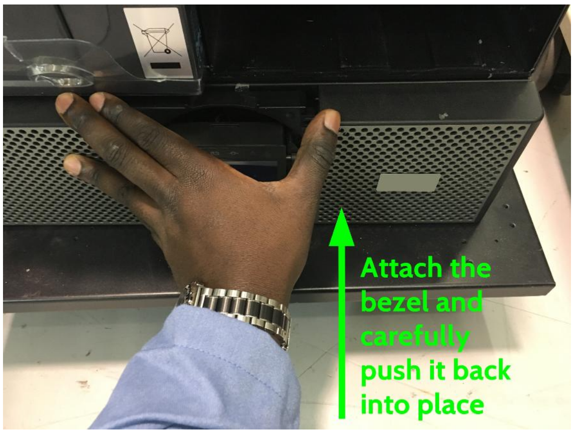
10. Assemble the LCD assembly back into the bezel

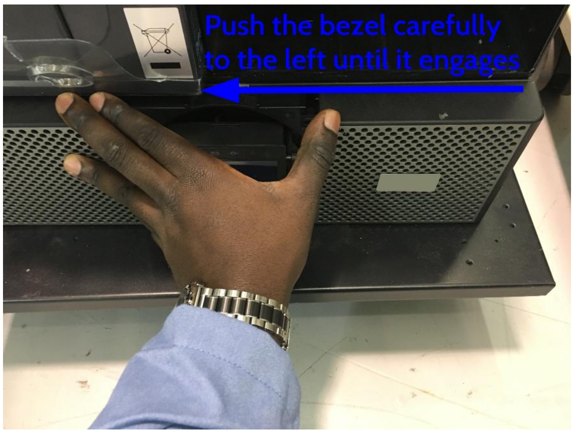




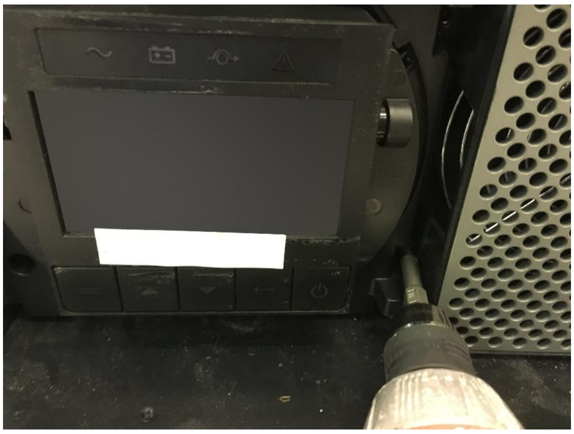


11. Assembling the bezel with the LCD back onto the front of the UPS





12. Use the T10 Torx screwdriver and screw the two screws back on the right hand side of the LCD display. Put the display carefully back into place until it covers the screws on the right hand side



13. Use the T10 Torx screwdriver to screw in the screws on the right hand side


14. Complete assembling the bezel
15. Turn on the upstream utility power circuit breaker to which the UPS is connected to. The UPS front panel display illuminates and shows the Lenovo or IBM logo
16. Verify that the UPS status screen shows ⏻, press ⏻ to restart
17. Press the button on the UPS front panel for at least 3 seconds. The UPS front panel display changes status to "`UPS starting...`"

18. Check the UPS front panel display for active alarms or notices. Resolve any active alarms before continuing. See the Troubleshooting section of the relevant UPS User's Guide
19. If the indicator ⚠ is on, do not proceed until all alarms are clear. Check the UPS status from the front panel to view the active alarms. Correct the alarms and restart if necessary
20. Verify that the ~ indicator illuminates solid, indicating that the UPS is operating normally and powering the equipment.

Replacing the Front Bezel of a Three Phase UPS unit

This section explains how to replace the front bezel including LCD, CRU 01PE445, Three Phase UPS unit.

Applicable UPS units

- Lenovo RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-8PX
- Lenovo RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-9PX
- IBM RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-8PX
- IBM RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-9PX

Attention!

A maintenance window for both the Uninterruptible Power Supply (UPS) and the load protected by this UPS unit must be scheduled when planning to replace the front bezel with the integrated LCD.

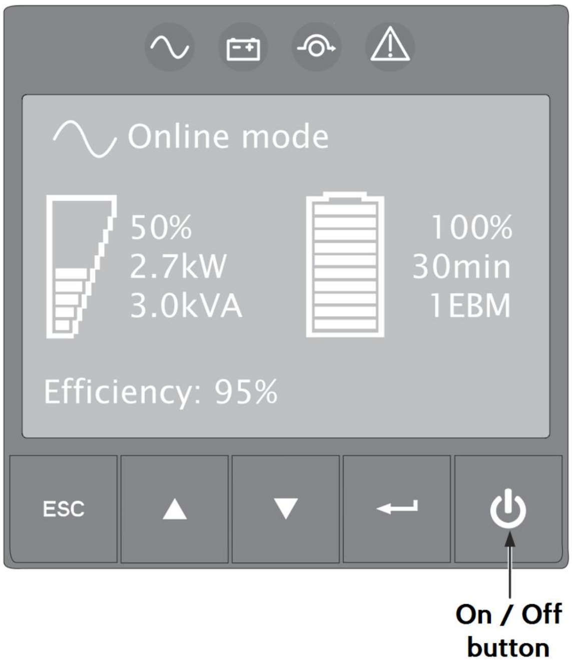
Note: The affected UPS units are to be hard-wired to the utility power. That is no power plugs are used to connect the UPS to utility power.

It is not necessary at all to physically disconnect the UPS unit from utility power, that is to physically disconnect it from the utility power wires.

Connecting and disconnecting the UPS from utility power by hard-wiring and un-wiring must be done by a licensed and qualified electrician. This can not be done by a servicer.

Powering off the UPS unit

UPS LCD Control Panel



1. Press the ⏻ On/Off button on the UPS LCD Control Panel at the front. The UPS goes into Standby mode
2. Switch the upstream circuit breaker off which protects the UPS unit. This will cut the utility power to the UPS unit
3. Do not work on the UPS immediately. Wait some 15 minutes before performing any work on the UPS unit. This will reduce the risk of an electrical accident

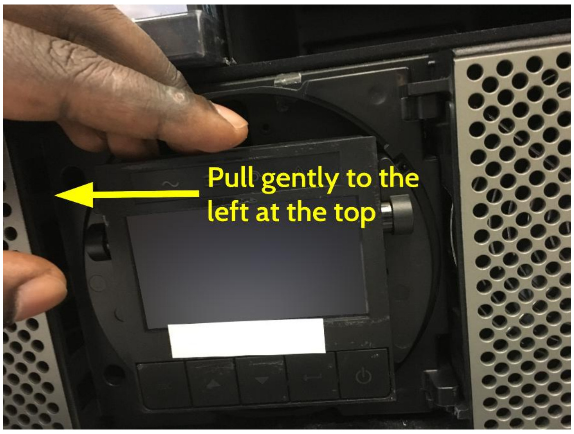
Tools required

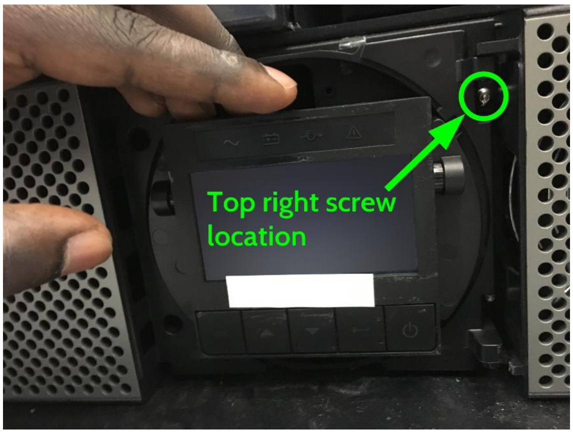
- #10T Torx screwdriver
- Small flat-head screwdriver

Disassembling the LCD Display Bezel

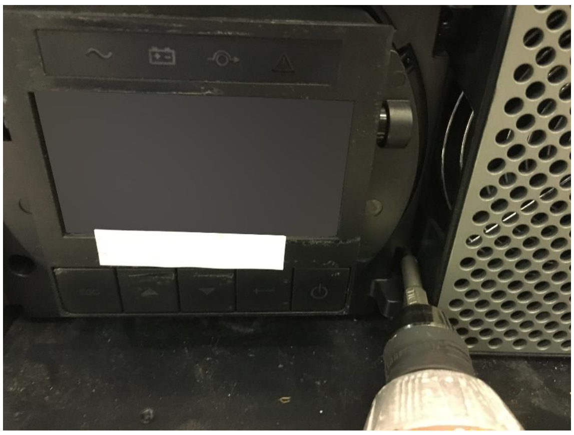
1. Start by grasping the top and bottom portion of the center plastic part of the bezel that encompasses the LCD, and pulling it away from the front of the unit
2. Use the 10T Torx screwdriver to remove the two screws on the left of the display. Take care not to misplace the screws


3. Gently pull the left side of the front panel bezel to the left to expose the screws on the right side of the display. The two screws on the top and bottom right-hand side become visible

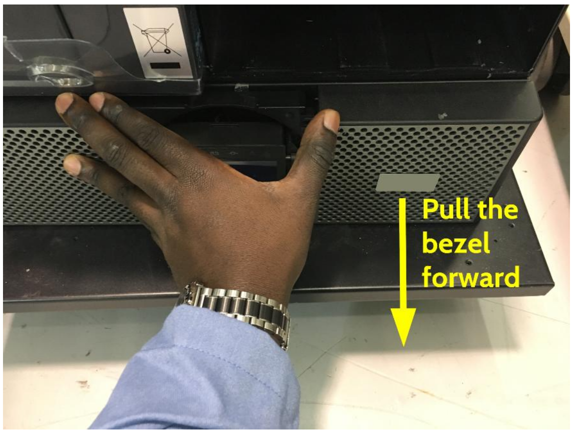


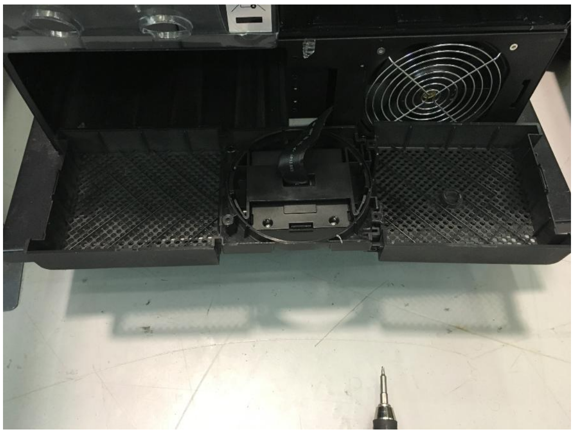


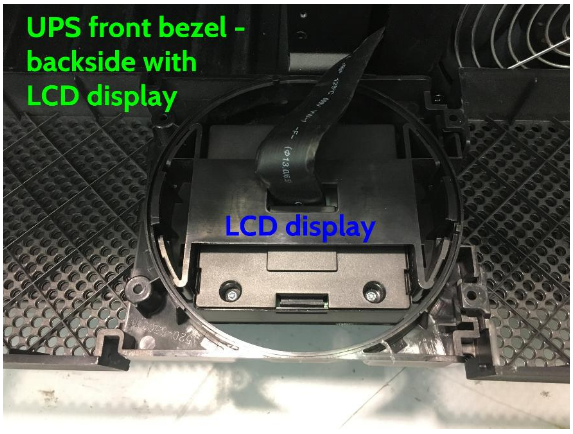
4. Using the T10 Torx screwdriver, remove the two screws on the right-hand side of the display

5. Push the whole front panel bezel slightly to the right and then pull forward



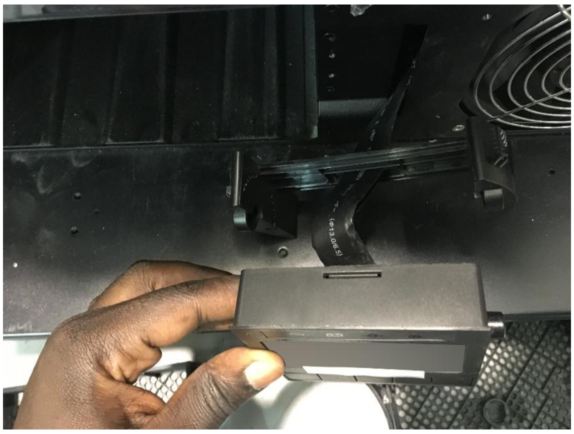




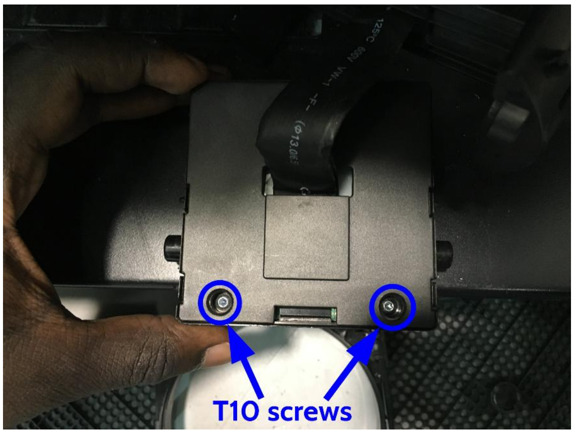
6. Use a flat blade screwdriver to unlatch the display from the frame on one side, the other side should unlatch at the same time. Push the LCD display through the bezel so that it is in front of the bezel

7. Remove the bracket on the back of the display by gently unlatching it from one side. The other side should easily unlatch as well

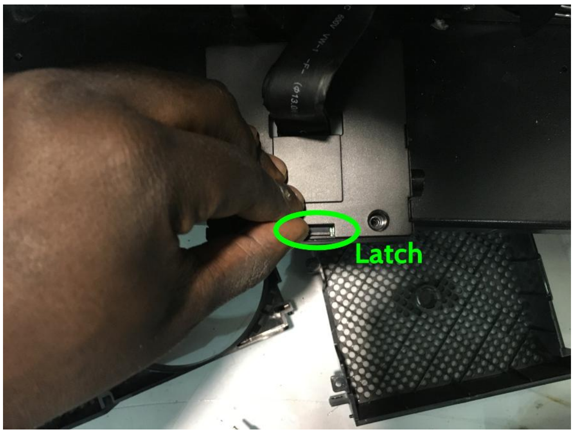


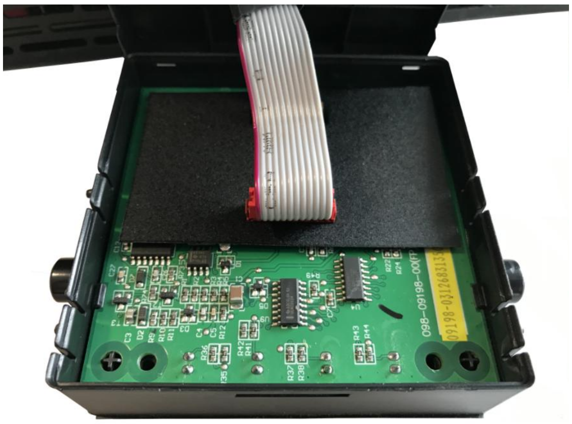


8. Remove the two screws on the back panel using a T10 Torx screw driver



9. Unlatch the back plate from the LCD assembly using the small latch



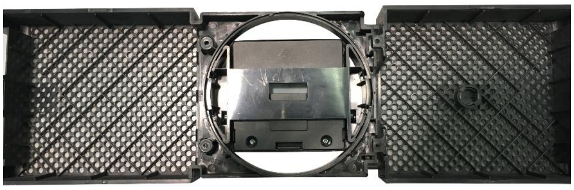


10. Hold the red plug with two fingers and carefully unplug it from the LCD circuit board.

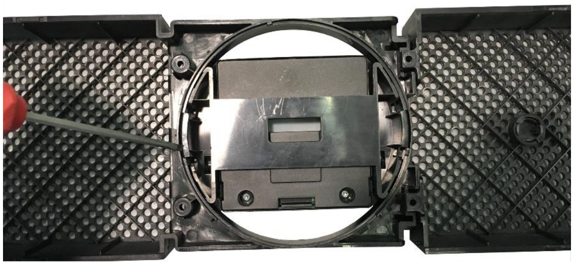
11. Feed the ribbon cable assembly back through the round LCD hole in the bezel. Set the used bezel and LCD assembly aside. They are no longer needed

Assembling the LCD Display Bezel

1. Grab the new LCD bezel assembly and turn it up-side down



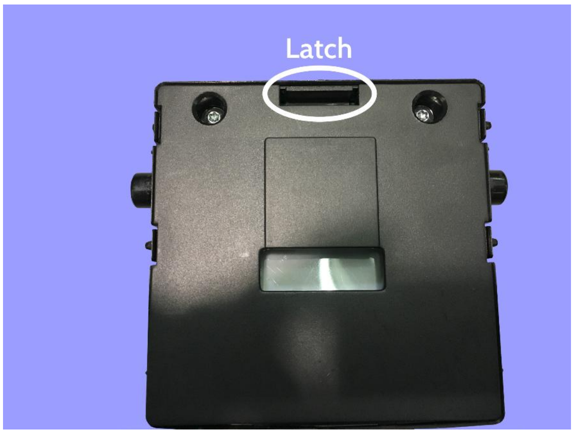
2. Use a flat blade screwdriver to unlatch the display from the frame on one side, the other side should unlatch at the same time. Push the LCD display through the bezel so that it is in front of the bezel



3. Remove the bracket on the back of the display by gently unlatching it from one side. The other side should easily unlatch as well

4. Remove the two screws on the back panel using a T10 Torx screw driver

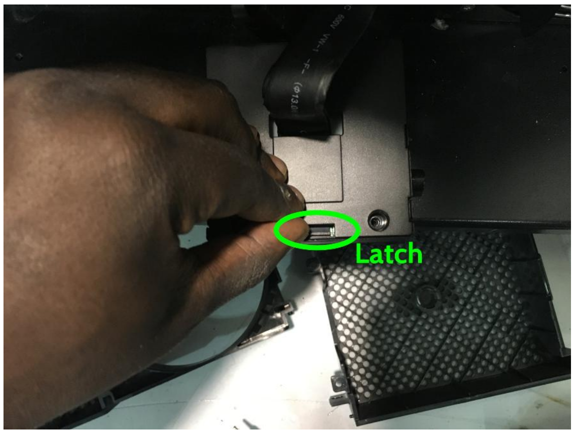
5. Unlatch the back plate from the LCD assembly using the small latch

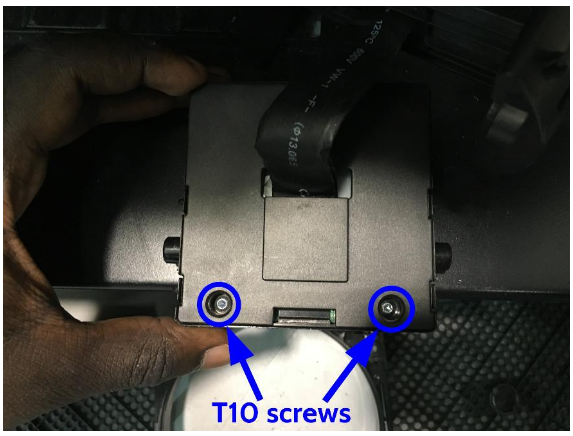


6. Feed the ribbon cable assembly and red plug though the round LCD hole in the new bezel

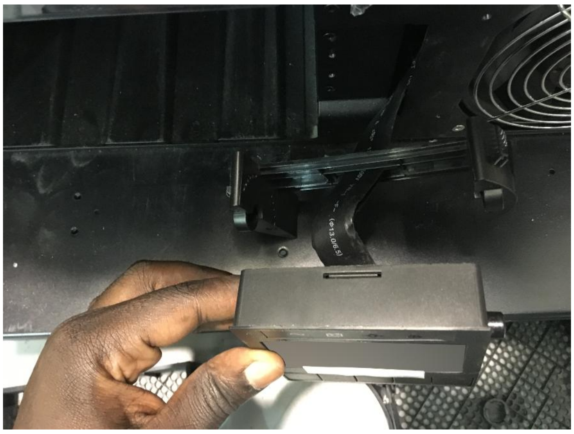
7. Plug in the plug into the corresponding receptacle

8. Reassemble the LCD display casing and screw it close

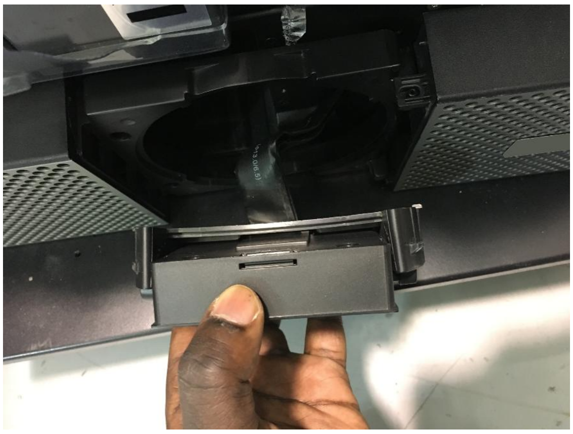
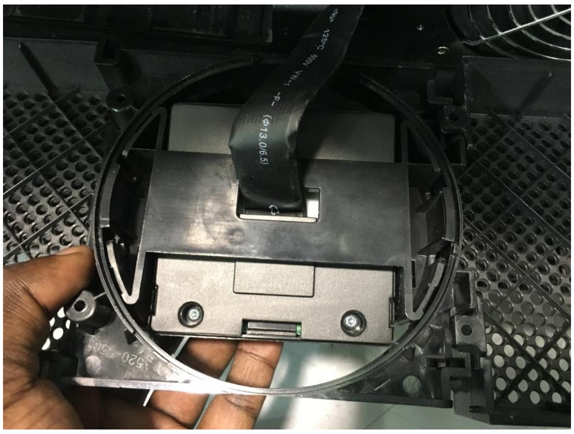
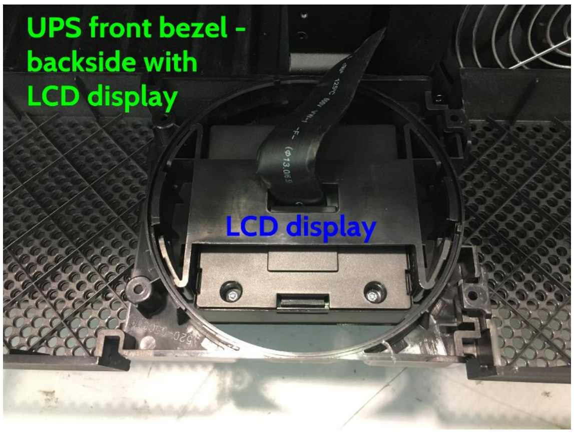




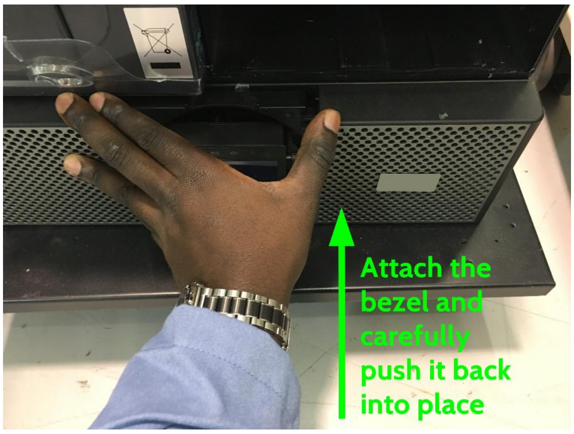
9. Carefully install the LCD assembly back into its holding frame

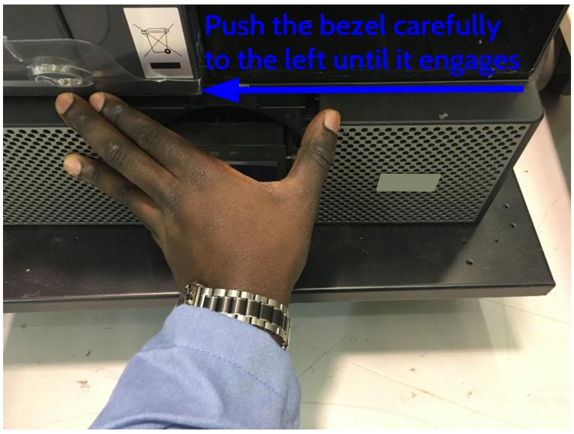


10. Assemble the LCD assembly back into the bezel

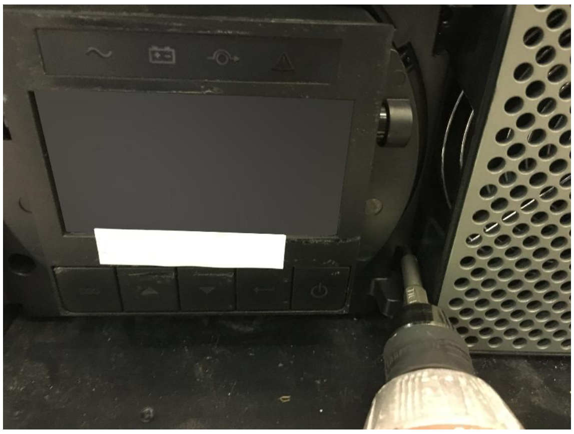




11. Assembling the bezel with the LCD back onto the front of the UPS





12. Use the T10 Torx screwdriver and screw the two screws back on the right hand side of the LCD display. Put the display carefully back into place until it covers the screws on the right hand side



13. Use the T10 Torx screwdriver to screw in the screws on the right hand side


14. Complete assembling the bezel
15. Turn on the upstream utility power circuit breaker to which the UPS is connected to. The UPS front panel display illuminates and shows the Lenovo or IBM logo
16. Verify that the UPS status screen shows X, press X to restart
17. Press the button on the UPS front panel for at least 3 seconds. The UPS front panel display changes status to "`UPS starting...`"

18. Check the UPS front panel display for active alarms or notices. Resolve any active alarms before continuing. See the Troubleshooting section of the relevant UPS User's Guide
19. If the indicator ⚠ is on, do not proceed until all alarms are clear. Check the UPS status from the front panel to view the active alarms. Correct the alarms and restart if necessary
20. Verify that the ~ indicator illuminates solid, indicating that the UPS is operating normally and powering the equipment.

Chapter 11 Troubleshooting

This chapter also gives an overview of known issues and how to resolve them.

The Lenovo UPS is designed for durable, automatic operation. It will alert you whenever operating problems occur. Usually the alarms shown by the control panel do not mean that the output power is affected. Instead, they are preventive alarms intended to alert the user.

- Events are silent status information that are recorded in the Event log. Example = "AC freq in range".
- Alarms are recorded in the Event log and displayed on the LCD status screen with the logo blinking. Some alarms are announced by a beep every 3 seconds. Example: "Battery low".
- Faults are announced by a continuous beep and red LED, recorded in the Fault log and displayed on the LCD with a specific message box. Example: "Out. short circuit."

Use the following troubleshooting chart to interpret alarm conditions.

Alarms and faults

To check the Event log or Fault log:

1. Press any button on the front panel display to activate the menu options.
2. Press the ↓ button to select Event log or Fault log.
3. Press Enter (↵) to review the selected log.
4. Scroll through the listed events or faults.

The following table describes conditions that are logged.

Condition	Possible cause	Action
Online mode 	Normal operation.	None.
Battery mode LED is On.  1 beep every 10 seconds.	A utility power failure has occurred, an upstream circuit breaker is tripped, or the input power cord (if so wired) is unplugged.	Check the input power source and connections.

Alarms and faults (continued)

Condition	Possible cause	Action
Battery low LED is On.  1 beep every 3 seconds.	The UPS has been in Battery mode too long. This warning is approximate, and the actual time to shut down might vary significantly. Depending on the UPS load and the number of Extended Battery Modules (EBMs), the "Battery Low" warning might occur before the battery packs reach 20% capacity.	Shut down equipment.
No battery LED is On.  Beep continuous.	The batteries are not connected, or the circuit breaker on the batteries is off.	Connect all EBMs properly. Both batter power and battery detection cables must be connected. If the condition persists, contact your service representative.
Battery fault (Battery test failed)  LED is On. Beep continuous.	The battery test is failed because of a bad battery pack, because the battery pack is not connected battery pack, or because the battery minimum voltage is reached in Advanced Battery Management (ABM) cycling mode.	Verify that all battery packs are properly connected. Start a new battery test: if the condition persists, contact your service representative.
Battery test cancelled UPS Underload.  Error message displayed in LCD panel.	Batter test is cancelled.	Criteria for a battery test to complete successfully is not met and the UPS cancelled the test. See Running a battery test for further details.

Alarms and faults (continued)

Condition	**Possible cause**	**Action**
Batteries disconnected 	The UPS does not recognize internal battery packs.	If the condition persists, contact Lenovo support.
	The battery packs are not connected.	Verify that all battery packs are connected properly. If the condition persists, contact Lenovo support.
End of battery life 	The battery has reached end-of-life.	The batteries must be replaced now. Contact Lenovo support for battery-pack replacement. See also Determining how many battery packs are to be replaced in Chapter 10 for additional information.
Bypass mode  LED is on.	An overload or a fault has occurred, or a command has been received to put the UPS into Bypass mode.	Check for one of the following alarms: over temperature, overload or UPS failure. Check whether a remote operator has issued a command the UPS into Bypass mode.
Power overload or Overload  or  LED is On. Beep continuous.	Power requirements exceed the UPS capacity (greater than 100 % of nominal; see also Appendix A. Specifications for additional information.	Remove some of the equipment from the UPS. The UPS continues to operate, but it might switch to Bypass mode or shut down if the load increases. The alarm resets when the condition becomes inactive.

Alarms and faults (continued)

Condition	Possible cause	Action
UPS over temperature LED is On. 1 beep every 3 seconds. At the warning level, the UPS generates the alarm but remains in the current operating state. If the temperature rises another 10°C, the UPS transfers to Bypass mode or shuts down if Bypass is unusable.	The UPS internal fan has failed.	If the UPS transferred to Bypass mode, the UPS will return to normal operation when the temperature drops 5°C below the warning level. If the condition persists, shut down the UPS. Clear vents and remove any heat sources. Allow the UPS to cool. Ensure the airflow around the UPS is not restricted. Restart the UPS. If the condition continues to persist, contact your service representative.
The UPS does not start.	A utility power failure has occurred, an upstream circuit breaker is tripped, or the input power cord (if so wired) is unplugged.	Check utility power, circuit breakers, and input connections.
	The Remote Power Off (RPO) switch is active or the RPO connector is missing.	If the UPS Status menu displays the "Remote Power Off" notice, inactivate the RPO input.
Input wiring bad / Output wiring bad LED is On. Beep continuous.	Input/Output cables are not connected to the correct terminal blocks.	Check wiring connections and ensure that all Input/Output cables are connected correctly, for example, neutral-to-neutral and ground-to-ground.

Alarms and faults (continued)

Condition	Possible cause	Action
MBP disconnected	The HotSwap MBP is not detected.	If the HotSwap MBP is connected to the UPS, check that the detection connector is correctly plugged.
Event 	A UPS event occurs. Example: During remote Power off, the RPO contact has been activated to shut down the UPS and now prevents restart.	Set the contact back to its normal position and press the power (⏻) button to restart.
UPS fault 	An internal failure occurred.	Record the alarm message and the UPS serial number, then contact Lenovo support.
Emergency OFF 	A problem with the Remote Power Off (RPO) exists.	Check RPO on the UPS back side and if installed the Kill switch at the remote location. For further information see the section Emergency Off error displayed on LCD in this chapter.

Silencing the alarm

Step 1. Press the Escape [ESC] button on the front panel display to silence the alarm.

Step 2. Perform the applicable action to resolve the alarm condition. If the alarm status changes, the alarm beeps again, overriding the previous alarm silencing.

Running a battery test

Automatic battery tests are done every week in automatic charging mode and at each cycle in Advanced Battery Management (ABM) mode. The frequency of the tests can be modified using the LCD panel. See User settings in Chapter 3 for more details.

Note: Battery mode is not displayed and battery low alarm does not activate during a battery test.

The automatic discharge test is enabled by default and runs during the transition from `Float` to `Rest` mode. After the test is complete, the charge cycle restarts to completely charge the batteries and then continues to `Rest` mode.

The automatic battery test runs approximately once every three months and does not run again until the next test period. If a manual battery test is requested, the automatic battery test timer is reset so that it does not run for the next test period.

Requirements for successful battery test

In order for a battery test to complete successfully the following minimum requirements must be met:

1. Load must be at last 10% of the rated capacity or greater to run adequate discharge, however 25% is recommended load capacity of the UPS that should be protected by the UPS unit
2. Battery capacity should be ≥ 80 %, that is the battery is charged to at least 80 % of its capacity
3. There is no running alarm (except Battery fault)
4. Load level has not varied by more than +/-10 % (from the initial load level present at the beginning of the test to the end of the test)
5. The bypass voltage is in tolerance for bypass transfer (in case of end of backup, to transfer to bypass)
6. UPS mode must be in Online mode or HE (High efficiency) mode.

These requirements applies to both the UPS itself and any attached EBM(s), that is for all battery packs present in the UPS installation.

UPS can either be in ABM or continuous battery charge mode.

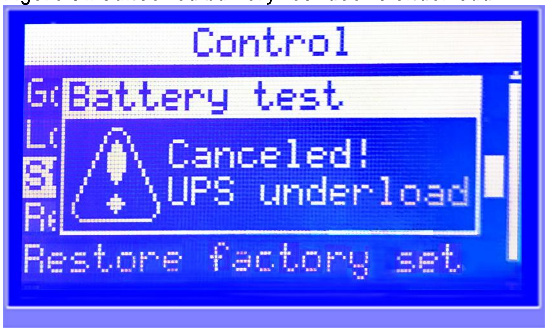
Additional information

For both the automatically and manually started battery tests, the following applies:

The battery test only runs for a short duration to measure the change in voltage over that time period. Without a minimal amount of load, there will not be a measurement of the change of voltage over that time period. Without sufficient load, the battery test cannot determine a bad or weak battery.

As a result of an underload, that is less than 10 % load capacity, the UPS will issue the, `Battery test cancelled UPS Underload.` error and cancel the battery test.

Figure 51: Cancelled battery test due to underload



If the UPS in HE mode, the UPS transfers automatically to Online mode and then the test is launched. Once the test is complete, the UPS is enabled to transfer back from Online mode to HE mode.

UPS may fail when installed after longer storage time

Issue

Users, installers, and servicers installing a new Lenovo Uninterrupted Power Supply (UPS) unit from stock, may find that the UPS will not power on or gives an immediate or near immediate low battery alarm or error message.

Solution

Replace all batteries of the affected UPS unit. For additional information on the correct UPS battery replacement procedure see Replacing battery packs in Chapter 10.

The batteries for this UPS unit can be hot-swapped.

After replacing the UPS batteries the UPS must be running for at least 48 hours without protecting any load in order to ensure proper UPS battery functionality.

Note: The EBM will charge to 90% capacity in less than 3 hours. However, the batteries should be allowed to charge for 48 hours after installation or long-term storage.

It is important to run a charge cycle of 48 hours to ensure the capacity and runtime is synchronized. Two battery tests are performed during that portion of the ABM cycle, three measurements are performed and will ensure there are no bad cells in the battery string.

The battery algorithm needs a known starting point for ABM functionality, battery test and the estimated runtime to be reasonable. Charging the batteries for 48 hours ensures those functions are set correctly and advised for any start-up to ensure the batteries are good and the timers are setup correctly.

Additional information

All internal batteries for all UPS units are charged to approximately 80 percent prior to shipping. The UPS is shipped with the internal battery connector disconnected, as to avoid premature discharge of the battery. The battery is expected to last at least six (6) months from manufacture date, before requiring a recharge of the battery. Should the UPS be kept in storage after that first recharge, subsequent recharge(s) should be repeated every six months. Batteries must be connected before and disconnected after each recharge. However, it is recommended, the batteries should not be recharged more than twice. This may limit the overall battery storage period to not more than 18 months.

The recharge period for a battery is 48 hours without any load attached to the UPS.

UPS Storage information	
Storage Temperature	+ 10° to + 40° C / + 50° to + 104° F
Storage Relative Humidity	0 % to 95 %
Storage Elevation	0 - 15,000 meters (0 - 49,212 feet)

If the storage time is longer than the recharge date, the battery of the UPS unit may drain completely. In this case, the batteries cannot be recharged anymore. The battery is considered to be damaged and must be replaced. The replacement of such failing batteries and Extended Battery Modules is not covered by unit warranty or service contract.

Batteries not detected after installation of one or more EBMs

Issue

The UPS is equipped with one or more Extended Battery Module(s), EBMs.

When powering up the UPS unit the error LED of the UPS is lit and the UPS will sound a continuous beep which may need to be manually silenced. This is an indication that the UPS does not detect the batteries.

The EBM circuit breaker is in the "Off" position.

Solution

In order to connect one or more EBMs correctly to a UPS unit two connections are required, one for the actual power connect and the EBM detection cable. Once the connection has been made the EBM circuit breaker needs to be switched to the "On" position. The EBM circuit breaker can also be switched to the "On" position if the UPS unit is already in production.

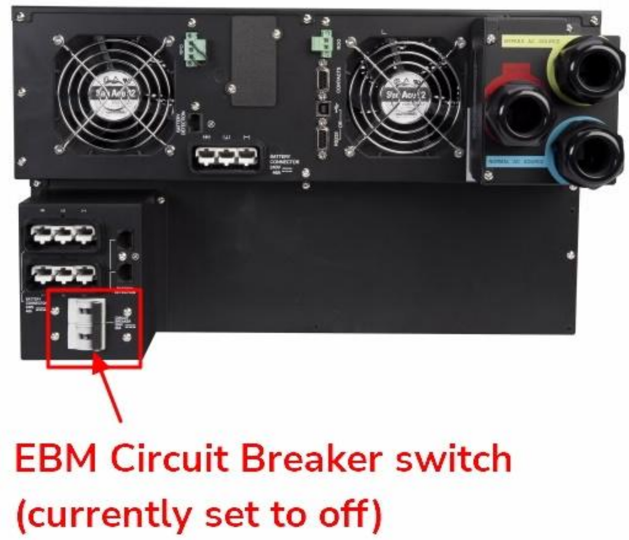


Figure 52: New EBM CB design

Sources of "No Battery" alarm

The No Battery alarm can come for the following reasons

1. If applicable: Battery cable in front of UPS is not joined together. It has to be connected regardless of UPS chassis replacement

2. Internal setting calibration error of the UPS. This requires a UPS Chassis replacement
3. Mechanical issue with battery pack (faston coming loose). Requires Battery pack replacement
4. Battery has exceeded its recharge date and the string voltage is too low to recognize the battery is connected
5. Battery has past its useful life but has not yet had a battery test to fail. It would show No Battery in between battery testing algorithms
6. Incomplete or wrong EBM installation
7. The relevant circuit breaker has not been turned on

Single phase (1:1) UPS units

Battery circuit breaker

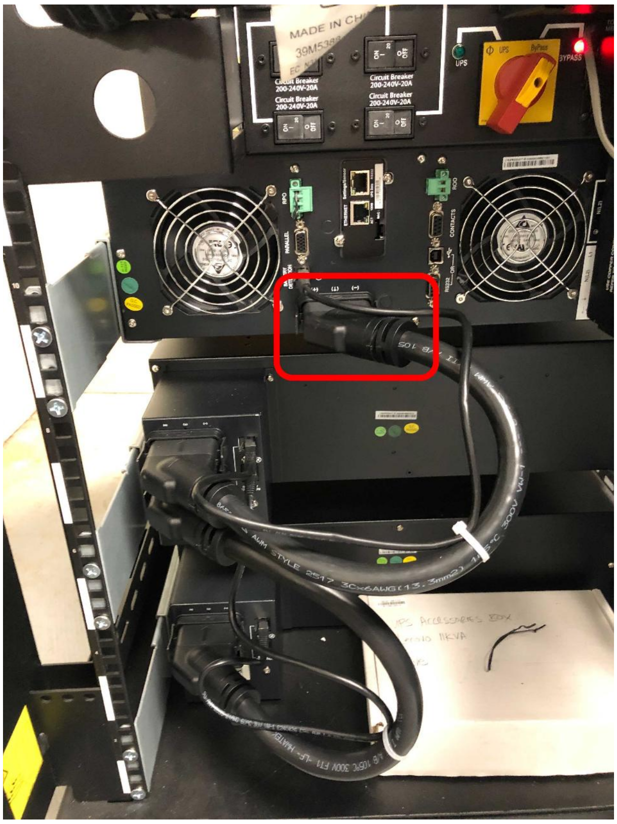
Three phase (3:1) UPS units

Battery circuit breaker

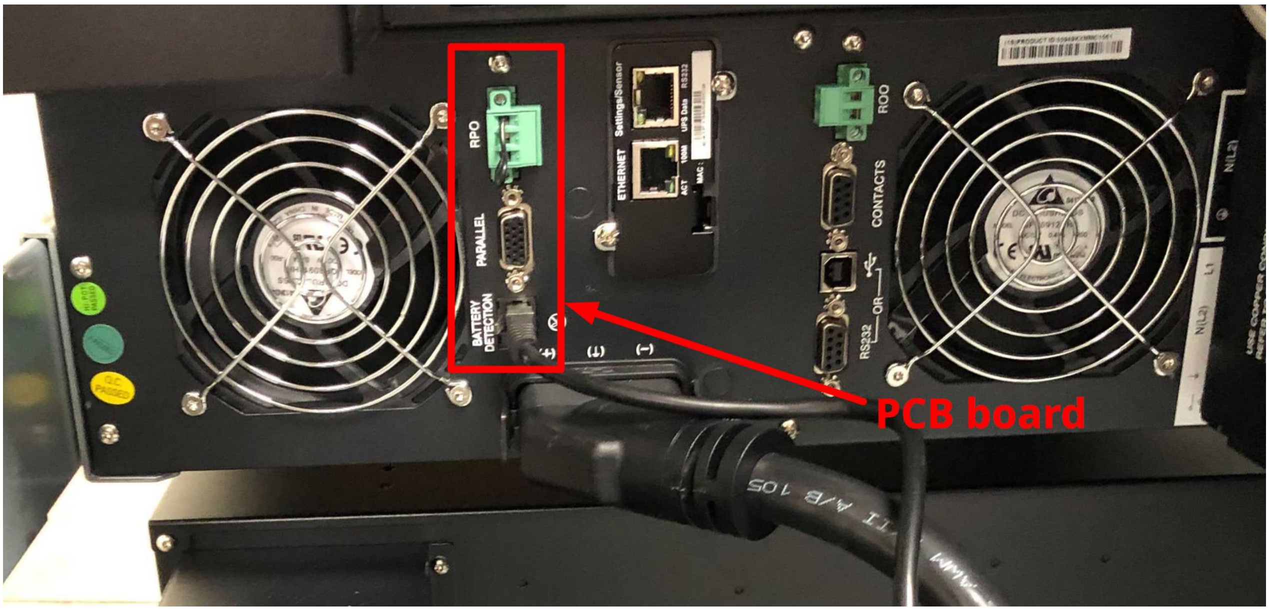
Extended Battery Module circuit breaker

8. The UPS including EBMs has been installed into the rack with gaps:

This will put strain on the EBM power cables shown below:



Leaving gaps between the UPS modules does put a lot of strain onto the connectors of the power cables. Above of the power cable connector on the UPS power module – highlighted in red in the above left image – there is a vertical PCB board on which the RPO connector, the serial RS-232 DB-9 connector and the battery detection connector is located. See image on the next page.



The power connector under stress can cause damage to this PCB-A or cause problems with the ground connection of the communication port which uses an RJ-45 connector.

In the below image it is shown that the actual cable became lose which causes an RPO fault, the “Emergency Off” message is displayed on the LCD panel of the UPS unit. This will prevent the UPS unit to go on-line and protect the load.

Besides causing an RPO issues, that is the UPS may issue an “Emergency Off”, a “No battery” fault can be displayed at the same time:

Note that the EBM power cables which are 400 mm / 15.75” long have been designed to interconnect the UPS power module and any EBMs when the UPS power module and EBMs are installed into the rack without any gaps.

Installing the UPS unit into the rack without gaps may resolve these issues.

If an EPO alert, shown on the UPS LCD panel as `Emergency OFF`, existed, then the user must clear the EPO alert from the LCD before the load will be available to start. Once the EPO alert has been cleared the UPS is in standby and needs to be powered up via the UPS power on button ⏻.

If re-installing the UPS power module adjacent to the EBMs does not cure the issue, then the power module has to be replaced. This replacement is not covered by the base UPS warranty or any service contract taken out.

UPS "Configuration Fault in Memory" Error Displays

Issue

After shutting down the Uninterruptible power supply (UPS) unit and turning it on again the Uninterruptible power supply displays the following error message:

```
Configuration fault in memory
```

This message may also be displayed after a power outage when the Uninterruptible power supply (UPS) is turned back on again.

During the shutdown process of the UPS, the batteries may have been disconnected from the UPS prior to it fully shutting down.

The UPS is operating normally.

Solution

In order to clear the error message the batteries including any Extended Battery Module (EBM) of the UPS have to remain connected to the UPS and the UPS unit needs to be completely powered down until it reaches the all blank Liquid-crystal display (LCD) state. Wait some additional three (3) minutes and then power the UPS unit up again.

This is necessary because during the shutdown sequence, the configuration parameters are saved into a nonvolatile Random-access memory (RAM) location so that they will be permanently remembered for the next startup.

If the battery is disconnected before the save of this information is complete the error message

```
Configuration fault in memory
```

will be displayed during the next power up of the UPS unit. This is because an unexpected checksum error has been detected by the UPS unit.

Clearing the Error Message "Para. cable lost 0xC16"

Information

It may be that that the affected UPS unit has been incorrectly configured to “hot standby” a feature that currently can not be ordered from Lenovo. As a result of this configuration change the UPS will display the following in the LCD panel:

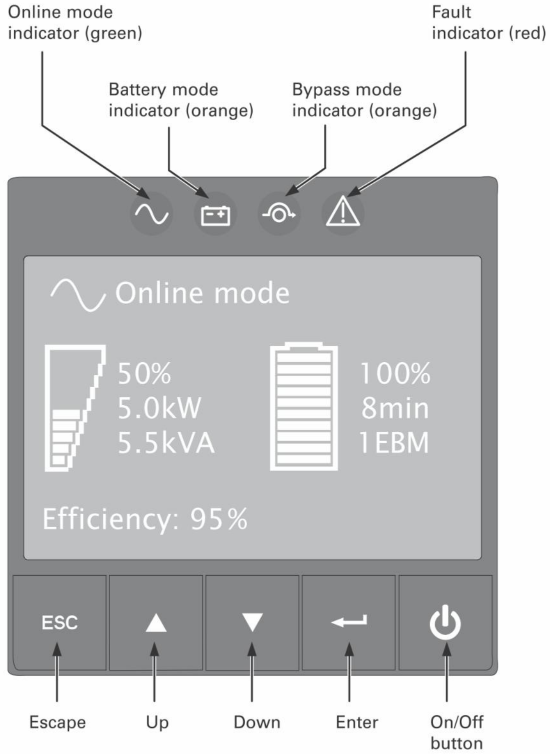
This message indicates that the required parallel cable has not been installed and the UPS was not connected to its partner UPS.

Solution

This issue can be resolved by either reconfiguring the UPS unit as single or unitary UPS unit or by resetting it to factory defaults in case changing it to unitary UPS unit does not work.

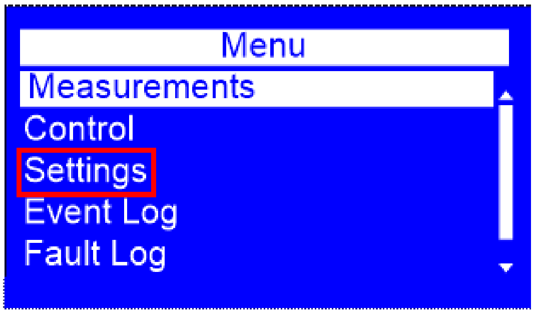
Changing UPS back to unitary UPS unit

UPS LCD Control Panel

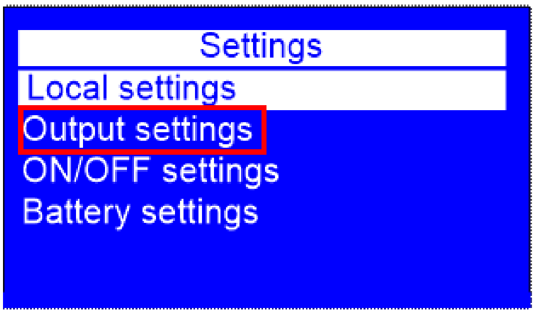


Steps

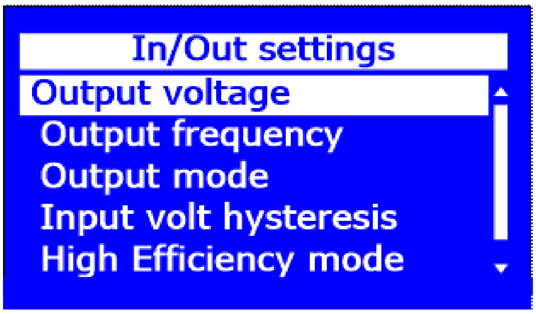
1. Press enter button on LCD Control Panel in order to enter Menu screen
2. Scroll to Settings menu by using the Up or Down button and press Enter



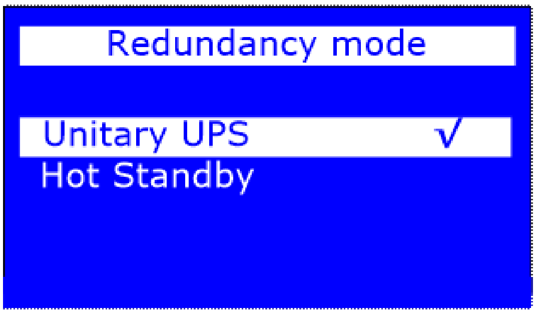
3. Scroll to In/Out settings



4. Scroll to Redundancy mode (not pictured), press enter



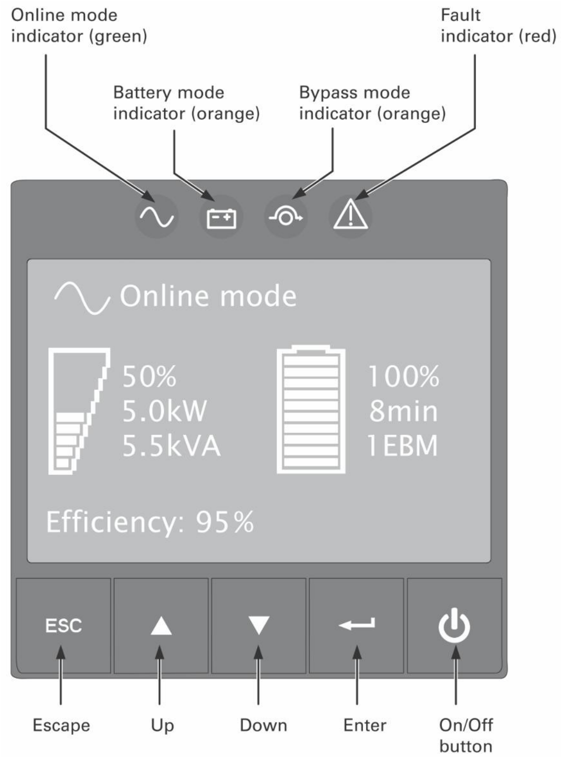
5. Toggle to Unitary so it is highlighted with check mark



6. Press ESC button to exit the menus

Resetting UPS to factory defaults

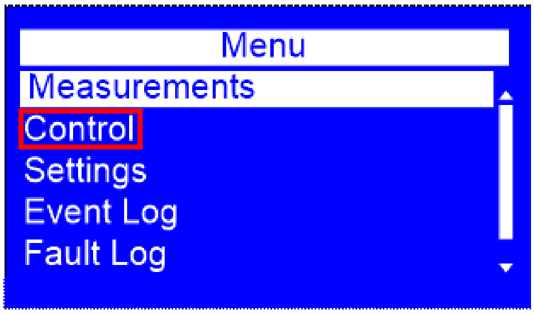
UPS LCD Control Panel



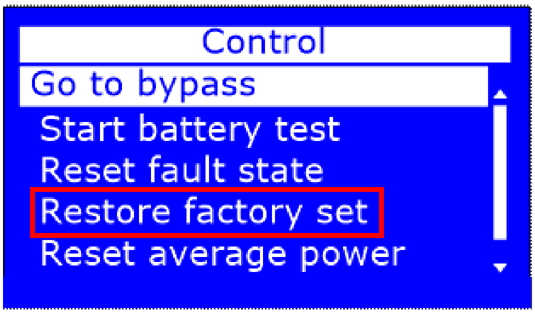
Steps

1. Press enter button to enter Menu screen

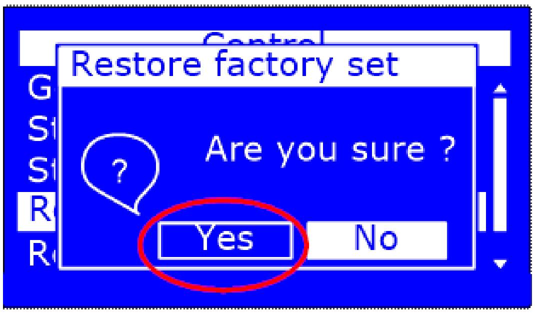
2. Scroll to Control menu, press enter



3. Scroll to Restore factory set, press enter



4. Toggle to YES to confirm



3:1 UPS unit operating in bypass mode, no output

The 3:1 UPS units require a precise installation as the Maintenance Bypass Panel (MBP) must always be installed with these UPS units. Verify that the installation is correct. See Three Phase HotSwap MBP installation and connection in Chapter 5 for further information.

During start up the UPS logs 0x60D

Issue

During UPS start up the error 0x60D is logged. The UPS may issue a "No battery" and the battery test will end with the error, "Failed. No battery".

Solution

The battery is not connected to the UPS – there is a *DC breaker* that needs to be engaged, the *DC voltage cable* to the UPS and the *battery detection cable*. All 3 are needed to be correct for the battery to be recognized.

0x60D means that the unit was shut down before the EEPROM was fully written – to clear this error, the Battery must be connected. Once the battery is recognised and connected, disconnect the input utility, wait until the LCD goes blank and then disconnect the battery (DC Breaker). The EEPROM will write the checksum and the 0x60D will be cleared.

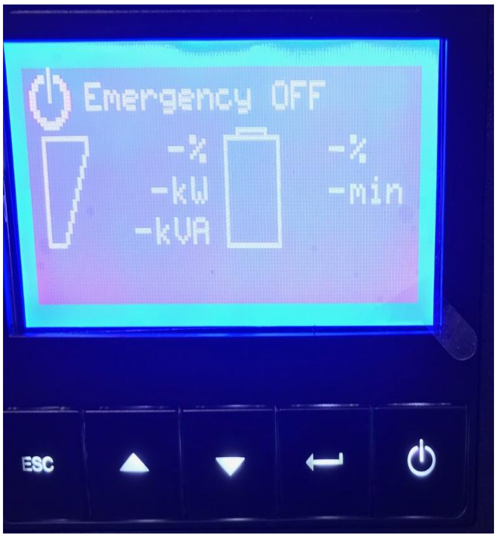
Additional information

This issue is a configuration fault on the 100 Mbps Network Management Card.

Emergency Off error displayed on LCD

Issue

After installing and powering up the UPS unit the “Emergency Off” error is displayed on the LCD panel.



Solutions

Power off the UPS unit.

First check that the green “Remote Power Off” (RPO) connector on the UPS back side is not damaged. Use a screw driver in order to reseat the small black wire.

Figure 53: Single Phase 8 kVA / 11 kVA UPS RPO location

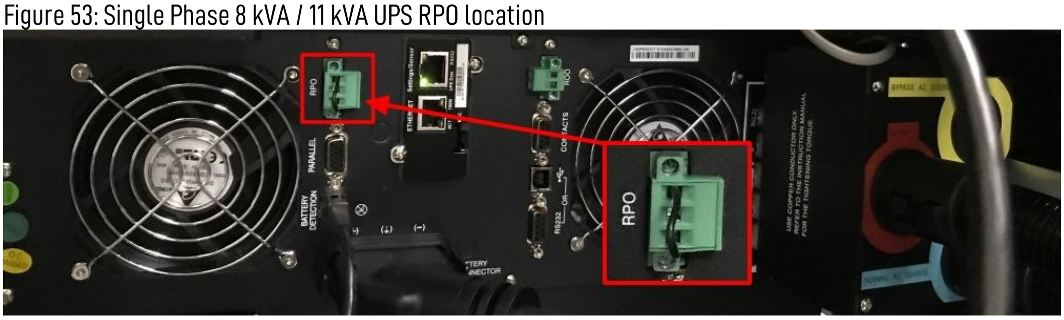


Figure 54: Three Phase 8 kVA / 11 kVA UPS RPO location

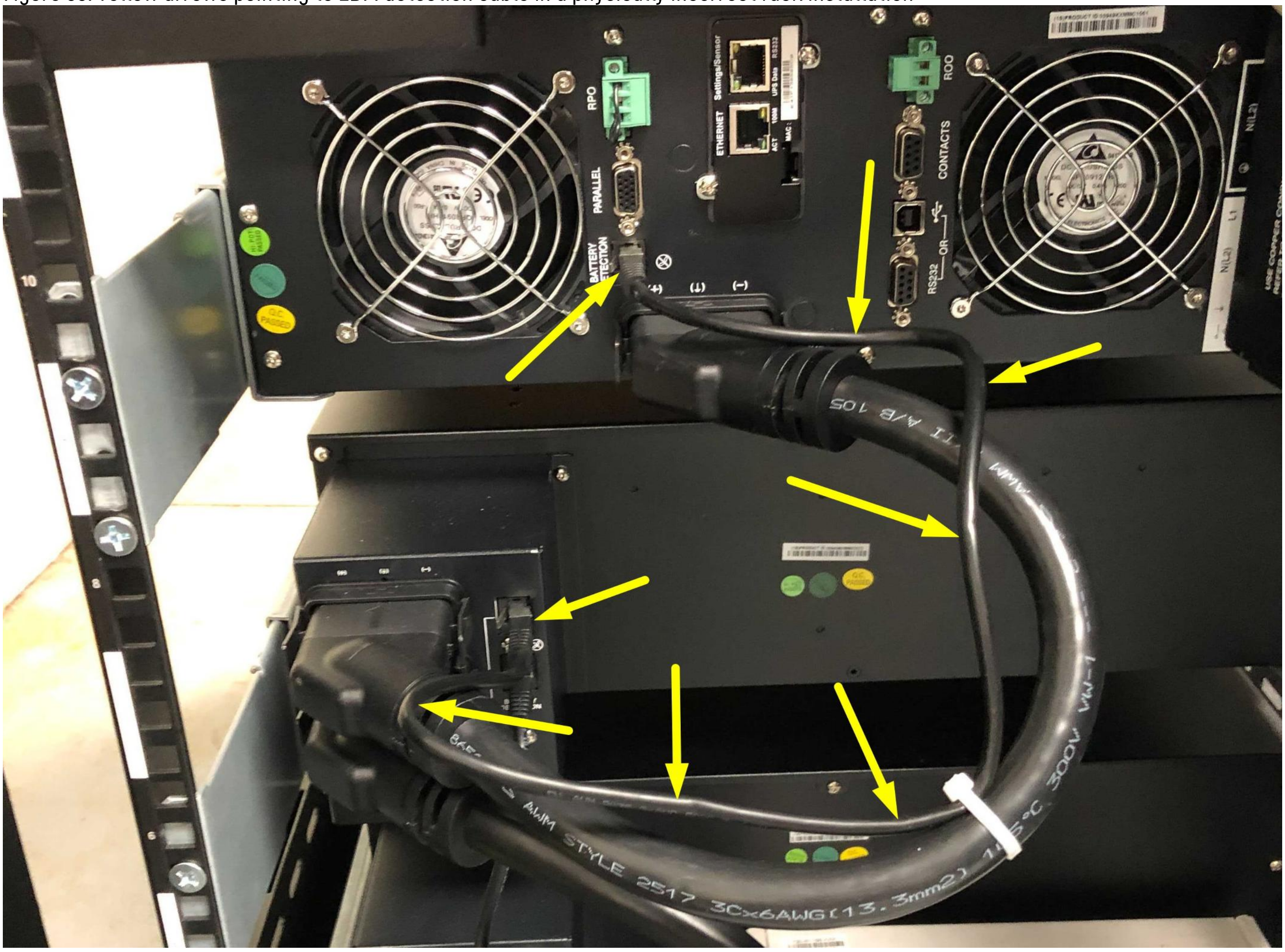
Second if installed check for any fault on the remote power off switch (Kill switch, Emergency stop button) in the remote location.

Make sure that the physical installation of the UPS unit in a rack has been done correctly. If it is not done correctly the UPS may issue a combined “Emergency Off” and “No battery” error. See Sources of "No Battery" alarm for additional information.

Replacing a broken EBM detection cable

It is not necessary to completely replace the EBM Power cord CRU 00FP795 when the EBM detection cable is broken.

Figure 55: Yellow arrows pointing to EBM detection cable in a physically incorrect rack installation



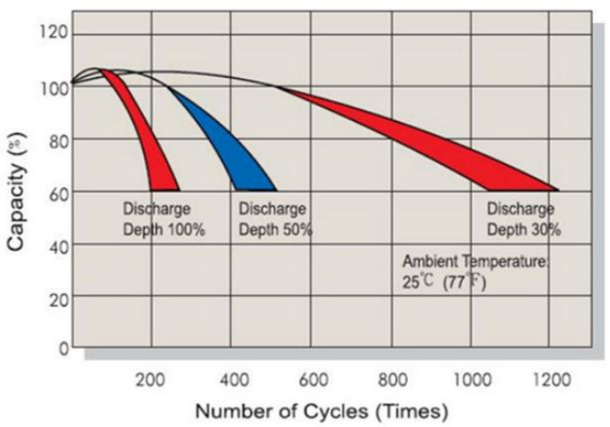
As a replacement a CAT 5 straight through Ethernet cable can be used.

Reasons for premature battery failure

The forecasted lifespan of the VRLA Battery is typically 3 to 5 years, but this fluctuates greatly due to the several factors including:

- ambient temperature
- placement
- maintenance
- battery chemistry
- cycling

When first installed the battery is at 100 % of the rate capacity; however each discharge and charge cycle will little by little reduce the capacity of the battery. The depth of discharge (DOD) will determine by how much a battery's capacity is reduced. The graph shows the evolution of battery function as number of cycles and depth of discharge for a shallow-cycle lead acid battery. A deep-cycle lead acid battery should be able to maintain a cycle life of more than 400 even at DOD of 50 %.



The UPS discharges at a maximum 1.6V_{PC} of 2.3V_{PC} of the battery voltage, so there are btween 250 to 400 cycles during the useful life of the battery (3-5 years) when using ABM.

Over time, battery capacity degrades due to sulfation of the battery and shedding of active material. The degradation of battery capacity depends most strongly on the interrelationship between the following parameters:

- the charging/discharging regime which the battery has experienced
- the Depth of Discharge of the battery over its life
- its exposure to prolonged periods of low discharge
- the average temperature of the battery over its lifetime. Frequent discharges can degrade the lifespan

Service and support

Note: For additional information on how to get support see Appendix C. Getting help and technical assistance.

If you have any questions or problems with the UPS, call your Local Distributor or Lenovo DCG support.

Have the following information ready when you call for service:

- Equipment type and model number
- Serial number
- Firmware version number
- Date of failure or problem
- Symptoms of failure or problem
- Customer address and contact information

Note: For critical applications, immediate replacement might be available. Call your local service representative or the distributor nearest you.

Chapter 12 Helpful information

This chapter contains additional helpful information for the UPS installation, usage, and maintenance.

Circuit Breakers to be used

Important

- Unless stated otherwise: All circuit breaker ratings provided in this document are for the maximum rating to be chosen, e. g. if a circuit breaker of 63 Amps is recommended, ***do not*** install a circuit breaker with a higher rating, e. g. 70 Amps, or lower rating, e.g. 50 Amps
- When installing an Uninterruptible Power Supply, UPS, unit always follow all national and local electrical codes and laws
- Ensure that the correct electrical earthing system for IT systems is in use. It is strongly recommended that a proper and correctly installed TN-S earthing system is used
- Additional information on the use of RCCB / RCD / ELCB / Differential (Lock) Circuit Breaker / GFCI can be found in the Notes section on the next page and in the section RCCBs in IT environments

Additionally see the following sections for further information:

Power Environment
Earth leakage considerations using an RCD
D curve circuit breaker

RT8kVA and RT11kVA 6U UPS units

Recommended circuit breaker for the RT8kVA and RT6kVA 6U Rack or Tower Uninterruptible Power Supplies.

These UPS units haves to be hardwired to utility power.

Applicable UPS units

- RT8kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-8KX
- RT11kVA 6U Rack or Tower UPS (200-240V_{AC}), 5594-9KX
- RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-8PX
- RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415V_{AC}), 5594-9PX

Recommended circuit breaker

UPS Model	**Normal and bypass AC inputs not separate**	**Separate normal and bypass AC inputs**	
	Normal AC input	**Normal AC input**	**Bypass AC input**
5594-8KX 8 kVA, single phase	D curve, 50 A	D curve, 50 A	D curve, 50 A
5594-9KX 11 kVA, single phase	D curve, 63 / 70 A	D curve, 63 / 70 A	D curve, 63 / 70 A
5594-8PX 8 kVA, three phase	D curve, 50 A	D curve, 20 A	D curve, 50 A
5594-9PX 11 kVA, three phase	D curve, 63 / 70 A	D curve, 63 / 70 A	D curve, 63 / 70 A

Notes:

- See also the section Important for additional information on CB rating
- For this UPS unit the ground wire must be connected first!
- An RCD is ***not*** to be used, see also the explanatory letter from Eaton Corporation
- When having to use an RCD, the leak current rating must be 420 mA
- When using the Maintenance Bypass Panel (MBP), then only the UPS is to be protected by an RCD, however the MBP ***must*** not be protected by an RCD

RCCBs in IT environments

Residual current circuit breakers (RCCB), also known as Residual Current Device (RCD), Earth Leakage Circuit Breaker (ELCB), Differential (Lock) Circuit Breaker, or GFCI (Ground Fault Circuit Interrupter device).

In many areas residual current circuit breakers (RCCB) are mandatory to be used as defined by local law, standards or technical connection terms and conditions as provided by the utility power company. From a technical perspective, it RCCBs primarily serve as a protection from indirect contact with utility power and in certain situation as fire protection.

The use of RCCBs in modern IT environments is to be viewed critically.

RCCB

In simple terms, an RCCB monitors the sum of the currents flowing into and out one protected part of the electrical network simultaneously at the same time. This is only done on the active lines, that is L1, L2, L3 and N. The residual current (delta current) in this measurement is limited by the threshold of the residual current circuit breaker. In case this threshold is exceeded the RCCB opens all connections on all active lines of the monitored / protected area. In short the power on all lines will be cut.

The current that flows via the protective conductor (PE) is not monitored by the RCCB and therefore is not included in the vector sum! If as a result of the design of power supplies for example the filter leakage currents are discharged against PE then the result will be fault currents, that is residual currents. These are recognised by the RCCB. Due to the number and type of devices in IT environments substantial residual current flow can occur which leads to a quick triggering of the RCCB. This will inevitably lead to a complete shutdown of the monitored IT environment, leading to a total failure of the said IT environment not considering the fact that there may actually not be a technical fault present nor the likelihood is given of direct utility power contact by a user!

The same shutdown will happen when a user must test the RCCB in regular intervals by pressing the test button as compulsory set out by the RCCB manufacturer.

Furthermore, it has been observed that often problems arise with UPS systems, provided that these are protected by means of RCCBs. Please refer to the documentation provided by the UPS manufacturer.

All the above also applies to the in recent years more popular becoming RCBOs, that is Residual current operated Circuit-Breaker with over-current protection, which are also known as GFCI (ground fault circuit interrupter).

Alternative Methods

From the perspective of the IT system the optimal solution to this problem is to abstain from using either RCCBs or RCBOs / GFCIs for the power supplied to data centres or computer rooms. The standard wall sockets as they are very common in offices or house holds still have to be protected by an RCCB.

The fact that the IT system is not RCCB / RCBO / GCFI protected can be easily done at the access points by installing sings.

Whilst from a technical perspective it would be good to not use any RCCB / RCBO / GCFI it may partly be not possible due to legal requirements. In such an instance alternative methods should be considered.

One solution is to use residual current monitors. These monitors work similarly to an RCCB: The vector sum of all currents on all active lines (L1, L2, L3 and N) are monitored. If the threshold of the residual current monitor is exceeded then the utility power will not be cut off but a control signal is generated which can be processed as needed. For example an optical and / or acoustic warning can be activated in the affected room / area. Additionally a warning / alarm message can be sent to the IT maintenance team.

If however legal requirements stipulate that RCCBs must be used then it is strongly recommended to use RCCBs with the highest possible trip fault currents and longest possible trip delay times are to be chosen.

Earth leakage considerations using an RCD

This section examines one of the most common site issues with UPS systems, which is the tripping of the earth leakage protection, Residual Current Device (RCD) also known as an Earth Leakage Circuit Breaker (ELCB) or Differential (Lock) Circuit Breaker.

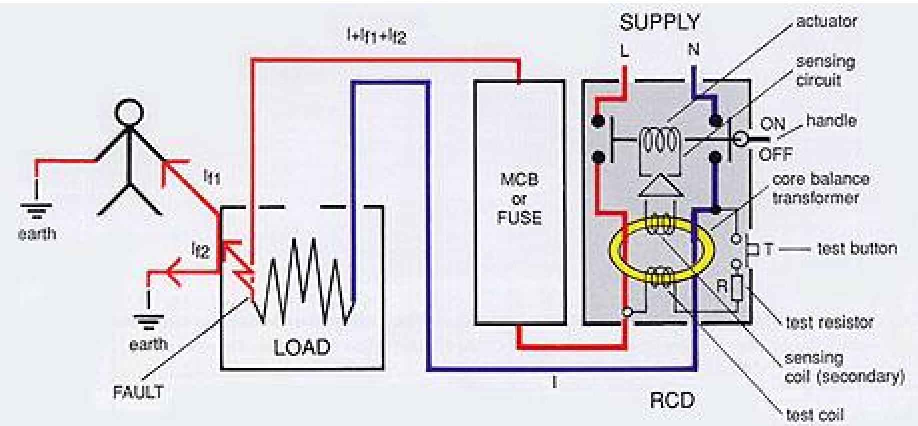
Overview

One of the most common site issues with UPS systems is the tripping of the earth leakage circuit breakers ELCB / RCD. To examine this in greater detail, we need to look at this device:

ELCBs contain a core-balance transformer and work on the following simple principal:

If the current which goes out on the phase does not return on the neutral, or on another phase, in the event of a three phase type, it will be detected as an earth fault through an imbalance in the core balance transformer and this imbalance will activate a tripping coil so that the circuit will be disconnected. Therefore, if one comes in contact with a live appliance, the current, which flows through this person to return to earth, is sufficient to trip a 30 mA RCD instantly.

Principles of Operation of a Standard RCD / ELCB / Differential (Lock) CB



Schematic diagram of an RCD connected to earth fault showing the principle parts of the installation.

Most Common Problems

When a customer calls with a problem with a tripping RCD, one should never assume that the UPS unit is faulty without doing the required troubleshooting.

1. The EN50091 permits a leakage of up to 3.5 mA per pluggable appliance. If there are 10 appliances connected with an average 3 mA per appliance, the RCD can still be tripping even without a faulty appliance. In this case try and ascertain if it still trips when the UPS is connected on it's own, if possible on a dedicated RCD.

   If this is the case, the UPS chassis requires replacement, if not, then the electrical installation and other appliances have to be checked.
2. There are also issues when power electronics are connected. Some SMPS loads cause high leakage after being switched on. In such cases it is recommend that a selective type of RCD is used. These RCD's have a slight delay, which allows them to overcome this relative short period of earth leakage.
3. In a new electrical installation RCD's may trip due to an error in the wiring, such as neutral wires being mixed up at distribution board.

Tripping Currents

The most common tripping current for an RCD is 30 mA but there are also types with a tripping of 10 mA and 100 mA tripping current to offer shock protection.

There is also a 300 mA and 500 mA, which gives overall protection against risk of fire from electrical faults in wiring etc. These are usually used at the main distribution board in a TT network, where the main fuse may not react fast enough in the event of a short circuit to earth.

Recommended RCDs

The following table shows what leak current ratings RCDs have to have with what UPS power rating.

UPS Power rating in kVA	RCD leak current	Curve type
≤ 3 kVA	30 mA	D
> 3 kVA to 11 kVA, hard wired	**Do not** use an RCD	Not applicable

Attention! UPS units with a power rating greater than 3 kVA are not to be protected by an RCD. These UPS units comply with IEC-62040 which allows a maximum leak current of 5 % of the maximum input current limit of these UPS units. This is why when wiring these kind of UPS units to utility power the ground connection must be made first.

The maximum RCD that exists allows for a leak current of 420 mA.

For further information see IEC-62040 (has to be paid for) and the letter from Eaton Corporation.

Notes:

- Refer to the relevant UPS installation guide for Ampère ratings of any CB or RCD for a specific UPS unit
- Only the UPS unit itself can be protected by an RCD, a maintenance panel has to be protected by a standard CB
- If an RCD is in use then no other CB is to be used
- An RCD must be tested at least once a year, which can lead to a shutdown of the protected load

Eaton Corporation
8609 Six Forks
Road Raleigh, NC
27615

```
Date: Monday, February 8, 2021
To:   Lenovo and valued partners
From: Lee Nino, Eaton DPQ Engineering Manager
```

Subject UPS Leakage current and Residual Current Devices

There have been on-going questions regarding the use of Residual current devices upstream from an Eaton UPS for applications. This document also applies to any Lenovo 5594 and IBM 5594 hardwired UPS unit. The intent of this letter is to clearly state Eaton s recommendation for such application requests.

Residual Current Devices (RCD) provide protection from electric shock. An RCD works on the principle of comparing currents in live conductors passing through a current transformer and determining the amount of current imbalance.

Uninterruptable Power Supplies (UPS) have an ordinary leakage current due to the hardware architecture, the internal battery and input filtering required for signal noise cancellation. This leakage current is typically < 3.5mA. However, for fixed higher power systems over 3kVA the leakage current allowed in the IEC-62040 specification Touch Current and Protective Conductor Current can be up to 5% of the input current. Such UPS systems with a leakage current over 3.5mA have a warning label cautioning that the ground connection is essential before connecting the other conductors.

Eaton does not recommend the placement of RCD upstream from UPS systems with a leakage current higher than 3.5mA. There are RCDs available with sensitivity up to 420mA but will still not meet the 5% input current limit allowed by IEC-62040 section 5.1.

Best regards

Lee Nino
Engineering Manager DPQ
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More information concerning UPS systems can be found at http://www.eaton.com/UPS,

RCD application guide: https://www.eaton.com/content/dam/eaton/products/electrical-circuit-protection/circuit-breakers/xeffect-rccb/eaton-rcd-application-guide-br019003en-en-us.pdf

How to avoid high inrush currents, example - SMPS

Besides high leakage currents Switched-mode Power Supplies can also cause high inrush currents. One method how to overcome this issue is described in the section “Most Common Problems” in step 2 of this chapter.

The following UPS units can be switched from IT-mode (Network mode) to Industrial-mode in order to reduce the impact of high inrush currents:

- Lenovo RT5kVA 3U Rack or Tower UPS (200-240VAC), 5594-5KX
- Lenovo RT6kVA 3U Rack or Tower UPS (200-240VAC), 5594-6KX
- Lenovo RT8kVA 6U Rack or Tower UPS (200-240VAC), 55948KX
- Lenovo RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX
- IBM RT5kVA 3U Rack or Tower UPS (200-240VAC), 5594-5KX
- IBM RT6kVA 3U Rack or Tower UPS (200-240VAC), 5594-6KX
- IBM RT8kVA 6U Rack or Tower UPS (200-240VAC), 55948KX
- IBM RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX

What to do if circuit breaker still trips when changing UPS operation mode

The UPS units mentioned in the at this chapter have a Start On Bypass function, that is in case start the UPS in bypass mode, switch it to UPS conditioning. This will help overcome the startup of the SMPS causing a trip.

Steps on the LCD menu

From the Main Menu scroll to `Control` and press ↵ (Enter)
Scroll to `Go to Bypass` and press ↵ (Enter)
Once in bypass the menu entry will change to `Go back to Normal`, select it and press ↵ (Enter)

Types of MCB based on Number of Poles

Another practical way of distinguishing MCBs is by way of the number of poles supported by the circuit breaker. Based on that, following types exist:

1. **Single Pole (SP) MCB:** A single pole MCB provides switching and protection only for one single phase of a circuit.
2. **Double Pole (DP) MCB:** A two Pole MCB provides switching and protection both for a phase and the neutral.
3. **Triple Pole (TP) MCB:** A triple/three phase MCB provides switching and protection only to three phases of the circuit and not to the neutral.
4. **3 Pole with Neutral [TPN (3P+N) MCB]:** A TPN MCB, has switching and protection to all three phases of circuit and additionally Neutral is also part of the MCB as a separate pole. However, Neutral pole is without any protection and can only be switched.

5. **4 Pole (4P) MCB:** A 4 pole MCB is similar to TPN but additionally it also has protective release for the neutral pole. This MCB should be used in cases where there is possibility of high neutral current flow through the circuit as in cases of an unbalanced circuit.

D Curve Circuit Breaker

Attention! This chapter is provided as reference and explanation. Always follow all national and local electrical codes and laws of your country!

A miniature or molded - case circuit breaker (MCB) is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by over-current or overload or short circuit. Its basic function is to interrupt current flow after protective relays detect a fault.

DIN EN 60898-1 (VDE 0641-11):2006-03 stipulates per chapter 9.10.2.4:

A current equal to 10 In is passed through all poles starting from cold. The opening time must not be less than 0.1 s or not more than

- **4 s for rated currents above 10 A up to and including 32 A,**
- **8 s for rated currents up to and including 10 A and above 32 A**

After this test a current equal to 20 In is then passed through all poles, again starting from cold. The circuit-breaker must trip within 0.1 s.

Furthermore the circuit breaker must be tested according to chapter 9.10.1.2 of DIN EN 60898-1 (VDE 0641-11):2006-03.

Note that these tests are to be carried out in a controlled environment.

Please check with your local electrical standards body for further information on circuit breaker testing.

These MCBs are use in industrial / commercial uses where current inrush can be very high.

Low-voltage circuit breakers

Low-voltage (less than 1,000 V_{AC}) types are common in domestic, commercial and industrial application, and include:

Miniature circuit breaker (MCB) - rated current not more than 100 A. Trip characteristics normally not adjustable. Thermal or thermal-magnetic operation.

There are three main types of MCBs:

- Type B - trips between 3 and 5 times full load current.
- Type C - trips between 5 and 10 times full load current.
- Type D - trips between 10 and 20 times full load current.

Standard current ratings

Circuit breakers are manufactured in standard sizes, using a system of preferred numbers to cover a range of ratings. Miniature circuit breakers have a fixed trip setting; changing the operating current value requires changing the whole circuit breaker. Larger circuit breakers can have adjustable trip settings, allowing standardized elements to be applied but with a setting intended to improve protection. For example, a circuit breaker with a 400 ampere "frame size" might have its over-current detection set to operate at only 300 amperes, to protect a feeder cable.

International Standards, IEC 60898-1 and European Standard EN 60898-1, define the rated current I_n of a circuit breaker for low voltage distribution applications as the maximum current that the breaker is designed to carry continuously (at an ambient air temperature of 30 °C). The commonly available preferred values for the rated current are 6 A, 10 A, 13 A, 16 A, 20 A, 25 A, 32 A, 40 A, 50 A, 63 A, 80 A, 100 A, and 125 A. The circuit breaker is labelled with the rated current in amperes, but excluding the unit symbol, A. Instead, the ampere figure is preceded by a letter, B, C, or D, which indicates the instantaneous tripping current - that is, the minimum value of current that causes the circuit breaker to trip without intentional time delay (i.e., in less than 100 ms), expressed in terms of I_n.

For the purpose of this section, only Type D are explained.

UPS units and emergency power systems

UPS units

UPS units are devices which charge up their batteries during normal supply of power by the utility provider and supply the protected load with electricity in case the utility power fails. The most common UPS design and operation modes are off-line, line-interactive and on-line double conversion.

For UPS systems supplied with three-phase current (delta connection), L1, L2, L3 and PE are being used. In such a set up the N is usually not required. The PE is rigidly connected from input to output.

With three-phase alternating current (Y connection) L1, L2, L3, N and PE are available. In this set up N and PE of the input are permanently connected to N and PE of the output. The single-phase design of the UPS unit must be connected accordingly.

The N of the input must be rigidly connected to the N of the output, otherwise it will lead to the floating of N (Y point shift) which will lead to massive disturbances of the fed electronic devices. N and PE must **NOT BE BRIDGED** in the UPS!

UPS units without a bypass circuit can be built using isolated transformers. In this case only the PE is to be connected. Such a UPS unit is to be considered a TN-S earthing system and is **NOT TO BE CONNECTED** the normal power supply provided by the utility provider in front of the equipment. As an example the UPS unit should **NOT BYPASS** a local, dedicated, power distribution box for protecting any load. According to the rules applicable to TN-S earthing system N and PE are to be bridged in these UPS units.

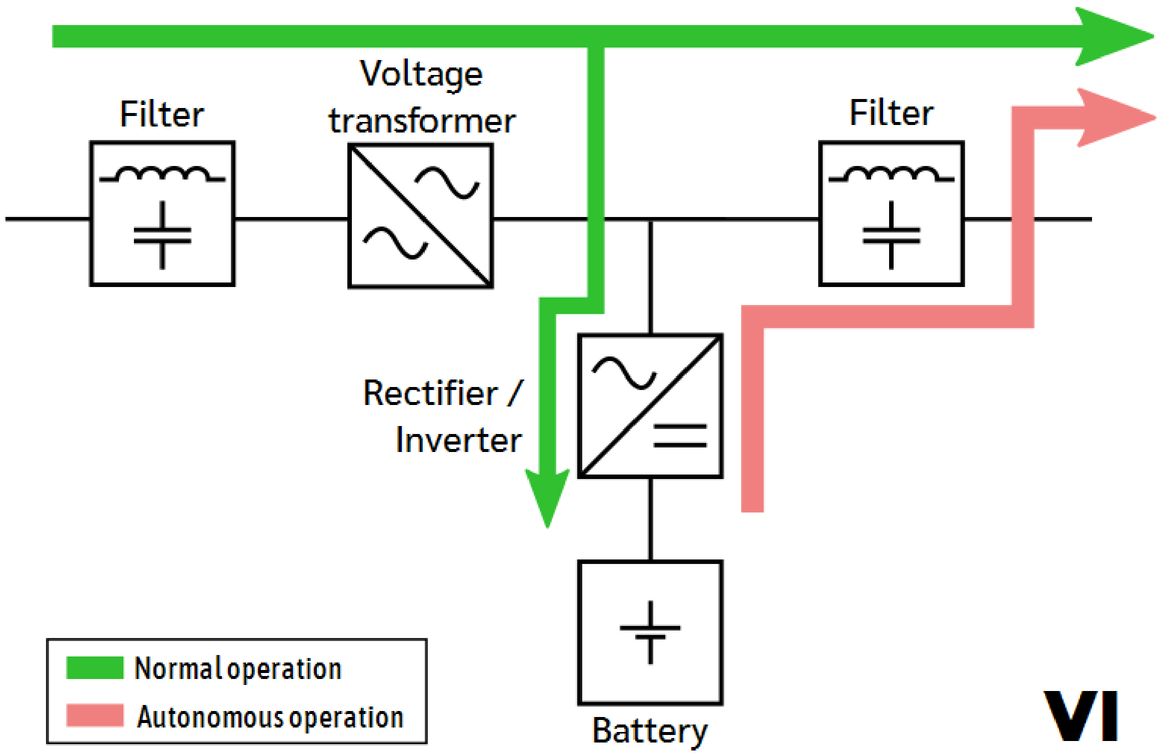
Line interactive or VI UPS units

VI stands for Voltage Independent from mains supply. Other names for this UPS types are line-interactive, single-conversion or delta-conversion UPS units.

A Bidirectional inverter generates from the AC input voltage the DC voltage for charging the batteries as required and AC voltage from the UPS batteries in case of utility power failure.

The frequency of the input voltage, if it is present, is identical to that of the output voltage. The switchover time from mains to battery operation is between 2 and 4 ms.

Figure 56: Work principle of a *VF* UPS unit



The Line-Interactive UPS is the most common UPS used for small business, Web, and departmental servers. In this design, the battery-to-ac power converter (inverter) is always connected to the output of the UPS. Battery charging is provided by operating the inverter in reverse during times when the input AC power is normal. When the input power fails the transfer switch opens and the power flow is from battery to the UPS output. The fact that the inverter is always connected to the output provides additional filtering and yields reduced switching transients

Line-interactive UPS systems use automatic voltage regulation (AVR) to correct abnormal voltages without switching to battery. (Regulating voltage by switching to battery drains your backup power and can cause batteries to wear out prematurely.) The UPS detects when voltage crosses a preset low or high threshold value and uses transformers to boost or lower the voltage by a set amount to return it to the acceptable range.

In "line" mode (i.e. when not operating from battery), line-interactive UPS systems typically regulate output within ±8 – 15 % of the nominal voltage (e.g. 120, 208, 230 or 240 volts). On-line UPS systems typically regulate voltage within ±2 – 3 %.

During an outage, line-interactive UPS systems typically transfer from line power to battery-derived power within two to four milliseconds, which is more than fast enough to keep all but a small percentage of the most power-sensitive equipment operating without interruption.

When operating from battery power, a line-interactive UPS system generates the waveform of its AC output.

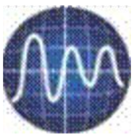
A line-interactive UPS unit can only compensate for a limited set of utility power problems. It is strongly recommended to install voltage and frequency stabilisers in order to avoid damage or incorrect operation of the UPS unit.

Line interactive UPS units protect for 5 common power issues – Power Failure, Power Sage, Power Surge, Under voltage, and Over voltage.


Power failure


Power sag


Power surge


Under voltage

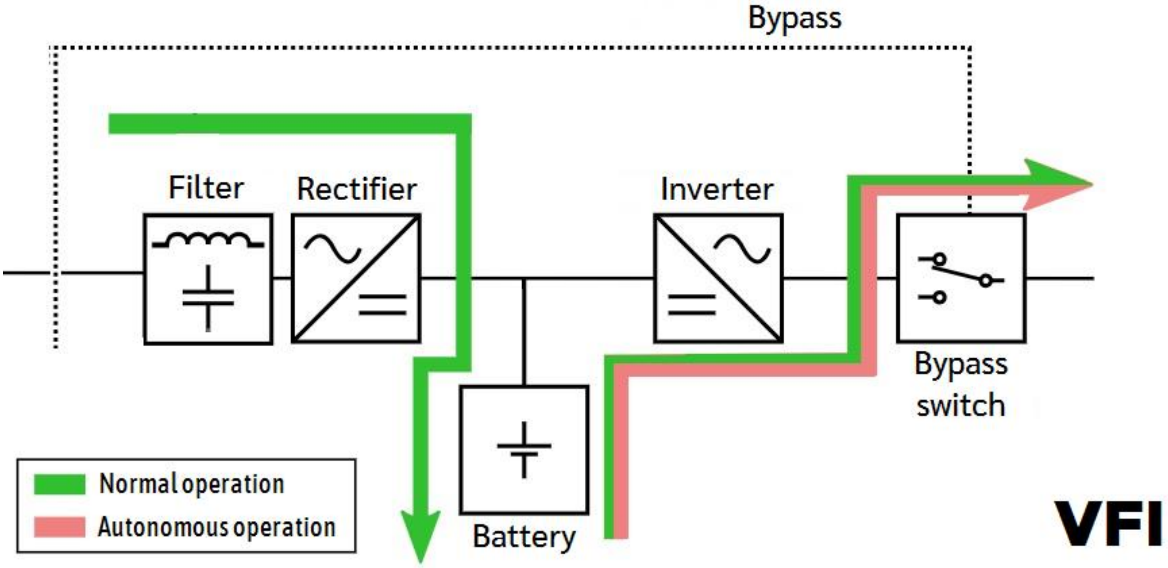

Over voltage

Online or VFI UPS units

VFI stands for Voltage and Frequency Independent from mains supply. This type of UPS is referred to as an online or double conversion UPS unit. UPS units of this design permanently route the input voltage via a rectifier. The generated DC is fed to both the UPS batteries and the inverter which in turn generates the AC voltage for the output. This design ensures that there are no switching times in case of failure of supply by the power utility provider. This type of UPS is the best choice for very sensitive devices that are to be protected.

On-line UPS units will only pass the input power to their output in case it is switched to bypass mode for maintenance purposes.

Figure 57: Work principle of a VFI UPS unit



For a Double Conversion On-Line UPS the primary power path is the inverter instead of the AC mains. In the design of Double Conversion On-Line operation, failure of the input AC does not cause activation of the transfer switch, because the input AC is not the primary source, but is rather the backup source. Therefore, during an input AC power failure, on line operation results in no transfer time. The on line mode of operation exhibits a transfer time when the power from the primary battery charger/battery/inverter power path fails. This can occur when any of the blocks in this power path fail. The inverter power can also drop out briefly, causing a transfer, if the inverter is subjected to sudden changes in the load, or if the inverter experiences an internal control "glitch".

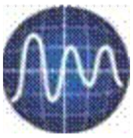
Double Conversion On-Line UPS systems do exhibit a transfer time, however On-Line UPS transfers are not related to AC input power failures as they are in a standby UPS. Both the battery charger and the inverter convert the entire load power flow in this design, which causes undesirable heat and results in reduced efficiency.

On-line double conversion UPS units protect for these power issues - Power Failure, Power Sage, Power Surge, Under voltage, Over voltage, Line noise, Switching transients, Frequency variation, and Harmonic distortion.


Power failure


Power sag


Power surge


Under voltage


Over voltage


Line noise


Switching transients


Frequency variation


Harmonic distortion

Emergency power systems

The key task of an emergency power system is to provide power during a prolonged supply failure of the feed provided by the power utility company by using one or more power generators. Such electrical power consuming devices can be ventilating or refrigeration or cooling systems, fire-fighting lifts, emergency lighting but also UPS units.

Usually the emergency power generators are powered by internal combustion engines most of which will use Diesel engines. The start up of these generators can take a considerable amount of time. This delay time and some additional time reserve needs to be considered when dimensioning a suitable on-line double-conversion UPS unit. This overall time frame (delay and reserve time) that needs to be considered is also referred to as autonomy time.

Multi-line-fed power input

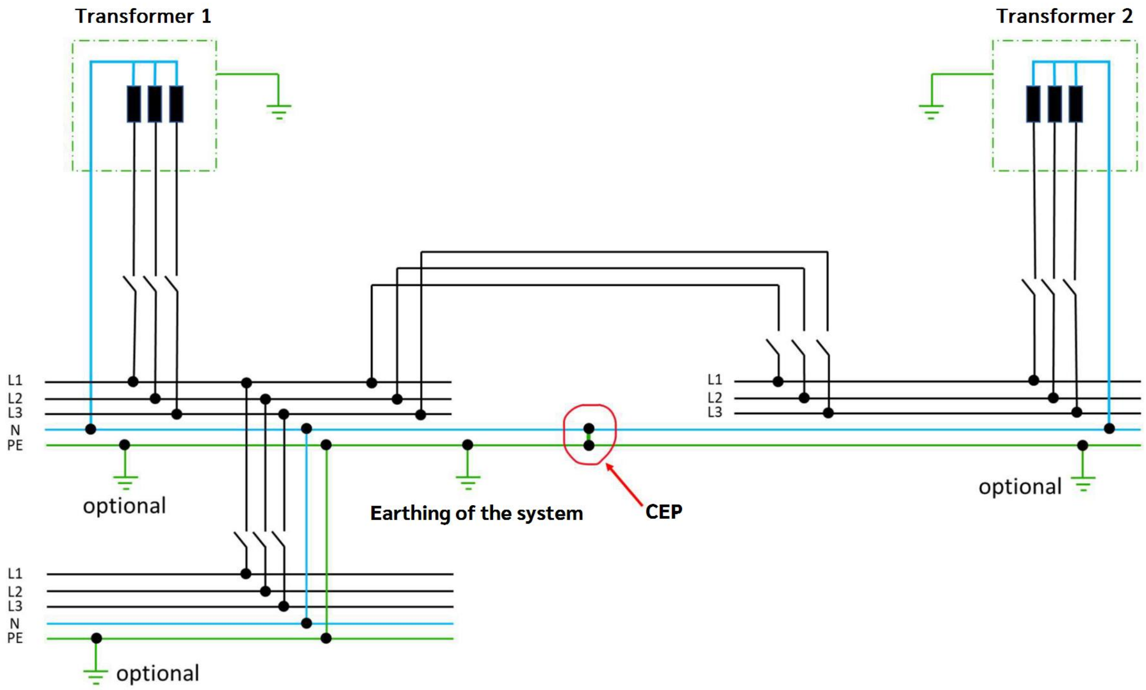
For error free operation it is essential that power supply system is always implemented as a TN-S earthing system. This is also relevant and important when multiple power sources are used. In this respect power sources are not only all feeding points or transformers of the utility power company, which supply electricity to the relevant power supply in question, but particularly also any potential emergency power system and UPS units.

In case of multi-line-fed power input it has to be ensured that **NO MULTIPLE CONNECTIONS** between N and PE system are implemented in the same power supply system, irrespective to whether the emergency power system is up and running or not.

In this set up all N conductors are connected to each other and the N network is only once connected to the PE system.

This connection takes place in the central earthing point (CEP). This CEP is to be implemented at the point with the largest to be expected short-circuit / earth current. It has to be dimensioned accordingly. The CEP is also be implemented such that a measurement / monitoring of the current at this point at any time is possible without any further risk. Figure 58 gives an overview of such an installation.

Figure 58: Multi-line-fed power input



Feed-in points located at a distance from each other and the respective Power supply systems are to be considered as independent TN-S networks and are to be interconnected exclusively via existing PA / earth lines.

The connecting of the N-conductors of these separate networks with each is **STRICLY FORBIDDEN!**

Power Environment

Introduction

The presented work provides an overview of the discussed topics Electrical earthing systems, Residual Current Circuit Breakers (RCCBs), UPS Units, Emergency Power Systems (Electrical Power Generators) and does not claim to provide complete information.

Electrical earthing systems

The descriptions of the different electrical earthing systems summarised below can also be retrieved from the majority of utility power companies, the relevant professional associations and qualified specialist companies, e.g.

http://de.electrical-installation.org/dewiki/Eigenschaften_von_TT-,_TN-_und_IT-Systemen

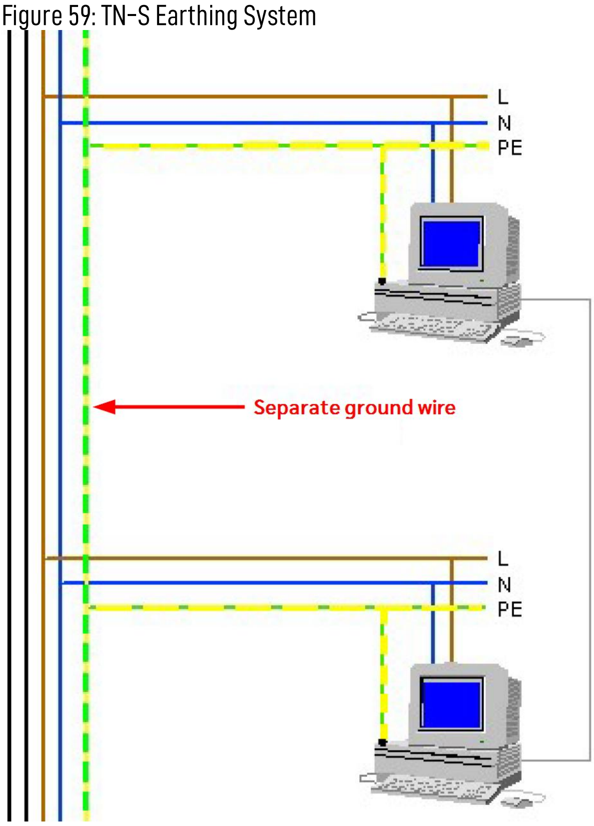
Note: Everything stated on electrical earthing systems in this chapter applies to both A/C and D/C power grids.

TN-S systems

The term TN-S comes from the French Terre Neutre Séparé meaning earth neutral seperated.

The earthing system shown in Figure 59 is called the TN-S system. Typical for a TN-S system is that the neutral conductor (N) and the earth or protective conductor (PE) are run as separate wires. It is often referred to as "five-wire cabling".

Figure 59: TN-S Earthing System



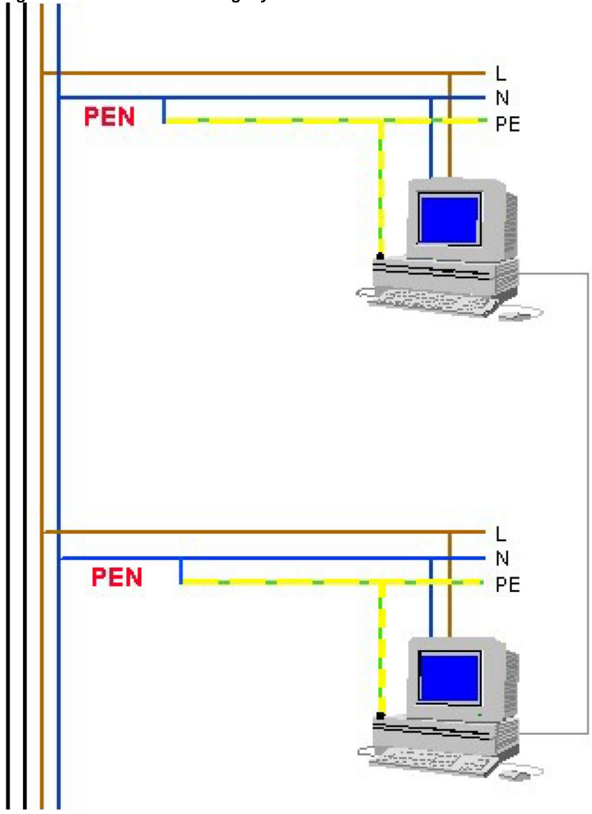
Commonly utility power companies provide the power with 4-poles or 5-poles. In case of 4-pole feed it imperative to separate PE from NE as soon as possible at a suitable point in the power network. This is usually done behind the entry point of the utility power source into the power sub-distributor by installing a central earthing point.

TN-C system

The term TN-C comes from the French Terre Neutre Combiné meaning earth neutral combined.

The earthing system shown in Figure 60 is called the TN-C system. Typically, N and PE are combined in the same wire. Whilst this yields cost reductions it should only be used for distribution networks rather than IT environments as else this will inevitably lead to problems.

Figure 60: TN-C Earthing System

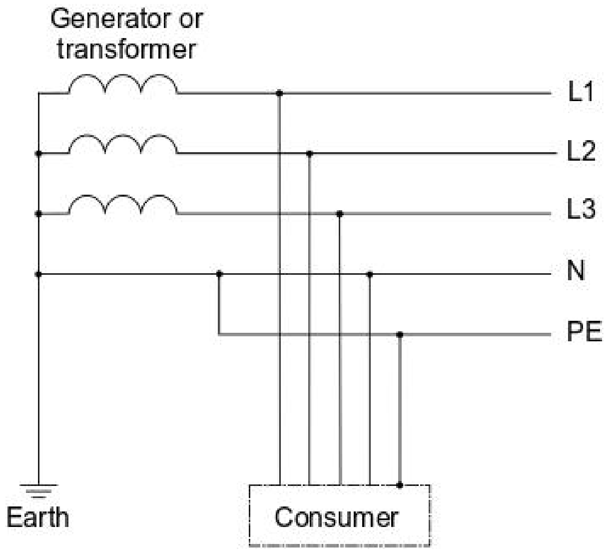


Commonly utility power companies provide the power with 4-poles (L1, L2, L3, PEN). The separation of the N and PE conductors is not implemented in these earthing systems. The separation is usually done in close proximity to a Residual Current Circuit Breaker (RCCB).

TN-C-S system

The term TN-C-S comes from the French Terre Neutre Combiné Séparé meaning earth neutral seperated. Figure 61 shows an overview of the TN-C-S earthing system.

Figure 61: TN-C-S Earthing System



A TN-C-S earthing system is given when parts of the utility power is supplied with four poles and others are supplied in five poles. This represents a combination of a TN-S and TN-C earthing system with all the disadvantages of the latter.

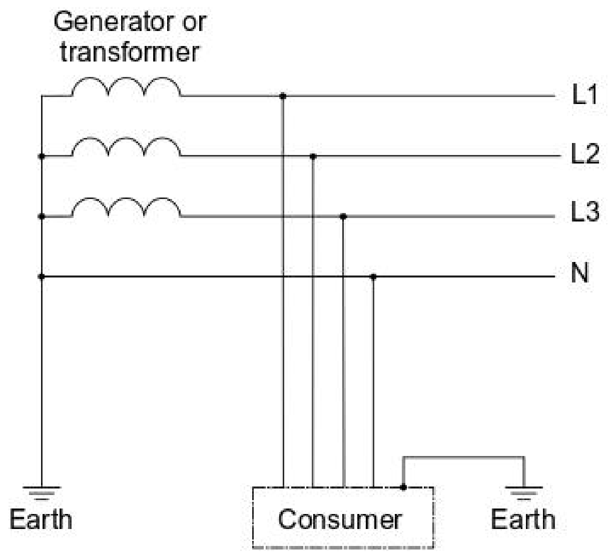
TT system

The term TN-TT comes from the French Terre-Terre and is shown in Figure 62.

In a TT earthing system, the protective earth connection for the user is provided by a local earth electrode, (sometimes referred to as the Terra-Firma connection) and there is another independently installed at the generator or transformer. The connection of the PE of the building and the transformer is done without any wires via the ground itself. There is no connection between N and PE in the Power supply system of the customer. The utility power is supplied at the transformer to the customer with 4-poles (L1, L2, L3, N). In order for a TT earthing system to work safely without any problems in an IT environment it is imperative that flawless earth connectors with low impedance are used. The power supply unit in the building itself must be implemented as a TN-S earthing system.

Due to the way the TT system works RCDs (GFCIs, Ground Fault Circuit Interrupter device) must be installed.

Figure 62: TT Earthing System



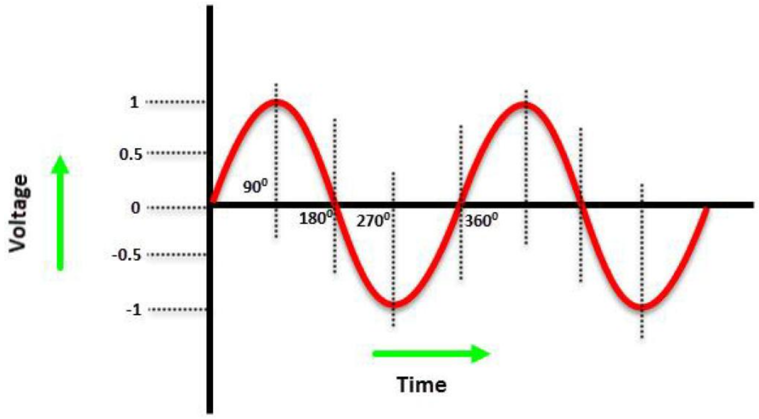
IT system

In an IT (isolated earth, derived from the French term isolé-terre) earthing system, the electrical distribution system has no connection to earth at all, or it has only a high impedance connection. Protection is provided by Potential control and insulation monitoring. In the event of an insulation fault, an alarm is generated which is responded to with mandatory troubleshooting and problem resolution. In the case of another Insulation fault or the persistence of the first fault, the power to systems is switched off. The IT system offers the highest possible continuity for the operation of a facility, but it is more complex to set up and operate. IT systems are therefore used primarily in the chemical industry and in hospitals (e.g. intensive care units and operating theatre).

Single-, Split-, and 3-Phase information

Single Phase System

Background



A single-phase AC power system consists of:

- The phase wire (also known as Line or Live) and neutral wire
- The phase wire carries the current to the load
- The neutral wire provides the return path of the current
- Voltage and current takes the shape of a sinusoidal wave at a frequency of 60 Hz (USA) or 50 Hz

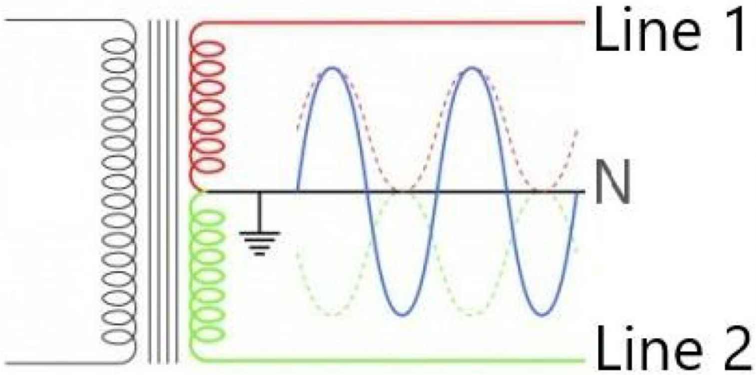
Wiring Colour Codes

NEC for US and Canada			IEC for Europe	
Single Phase 120 V_{AC} Wire Colours			Single Phase 230 V_{AC} Wire Colours	
Wire function	**Wire Colour**		**Wire Colour**	
Phase or Line	Black		Brown	
Neutral	White		Blue	
Earth Ground	Green	Yellow	Green	Yellow

2 Phase or Split-Phase Systems

This is very common in the United States of America.

Background



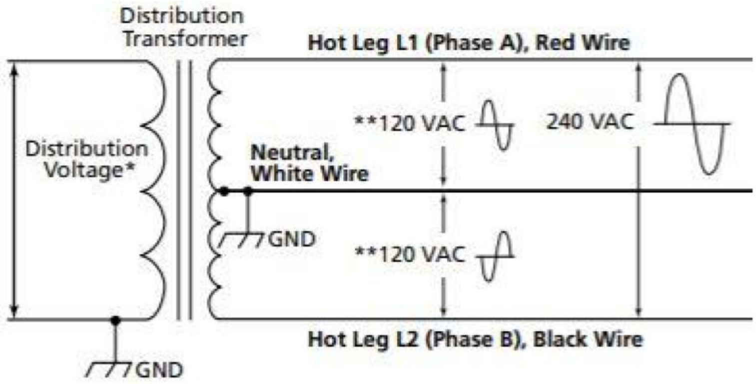
A split phase system has the following properties:

- At the output side there are three wires. Two lines that are 180° out of phase with each other and a center tap neutral
- This configuration can be created by having a step-down transformer with center tapped secondary winding
- If loads are balanced between each phase, then the neutral current is zero
- Neutral is connected to earth ground at the power supply end

Wiring Colour Codes

NEC for US and Canada		
Split Phase 120 V_{AC} Wire Colours		
Wire function	**Wire Colour**	
Phase or Line 1	Black	
Phase or Line 2	Red	
Neutral	White	
Earth Ground	Green	Yellow

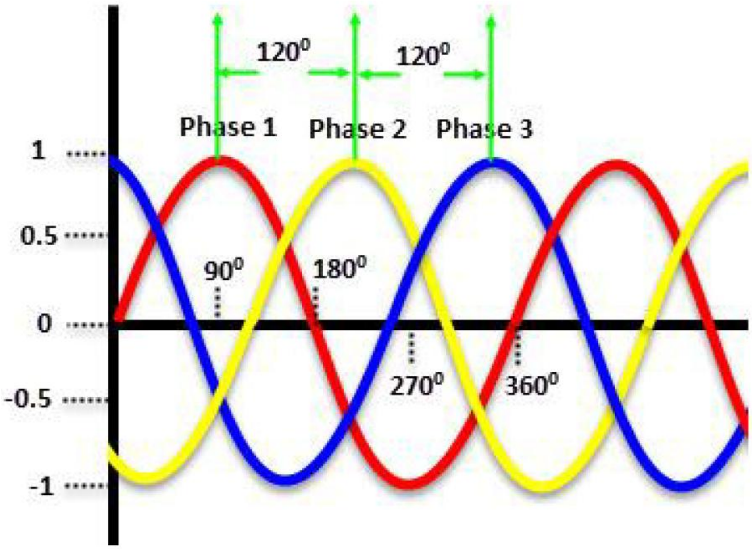
Diagram



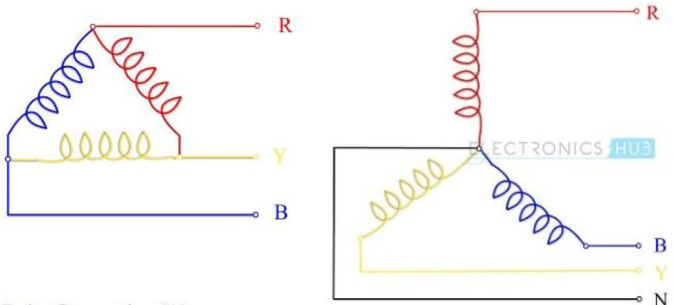
Typical North American split phase configuration produces 120 V_{AC} from Phase A and B to neutral and 240 V_{AC} from Phase A to Phase B.

3 Phase Systems

Background



- For a three Phase AC Power system it has:
- Three power lines that are 120° out of phase with each other
- If loads are balanced across phases, then the neutral current is zero
- Two types in Delta or Wye circuit configurations



Delta Connection (Δ)

Star Connection (Y or WYE)

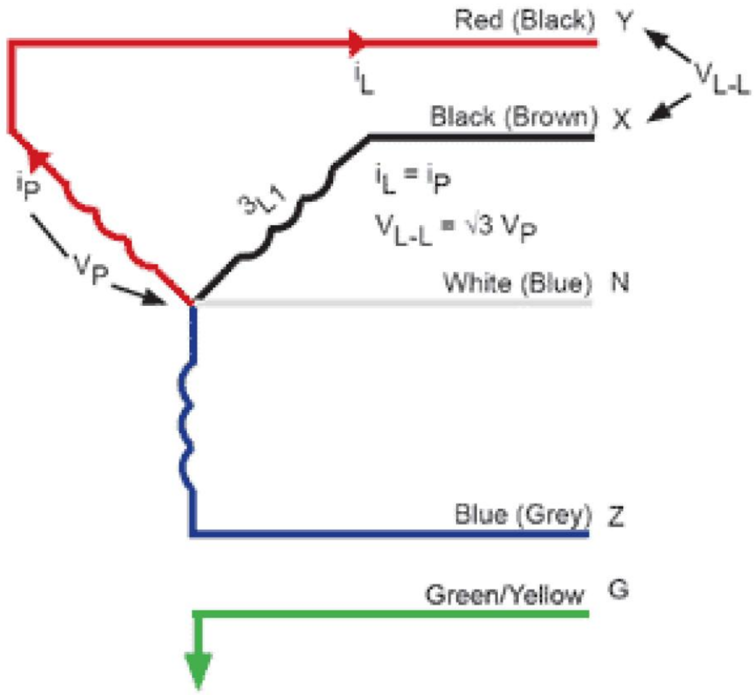
- Delta configuration lacks a neutral

Wiring Colour Codes

NEC for US and Canada			IEC for Europe	
Wire function	**Wire Colour**		**Wire Colour**	
Phase 1 or Line 1	Black		Grey	
Phase 2 or Line 2	Red		Black	
Phase 3 or Line 3	Blue		Brown	
Neutral	White	Grey	Blue	
Earth Ground	Green	Yellow	Green	Yellow

Diagram

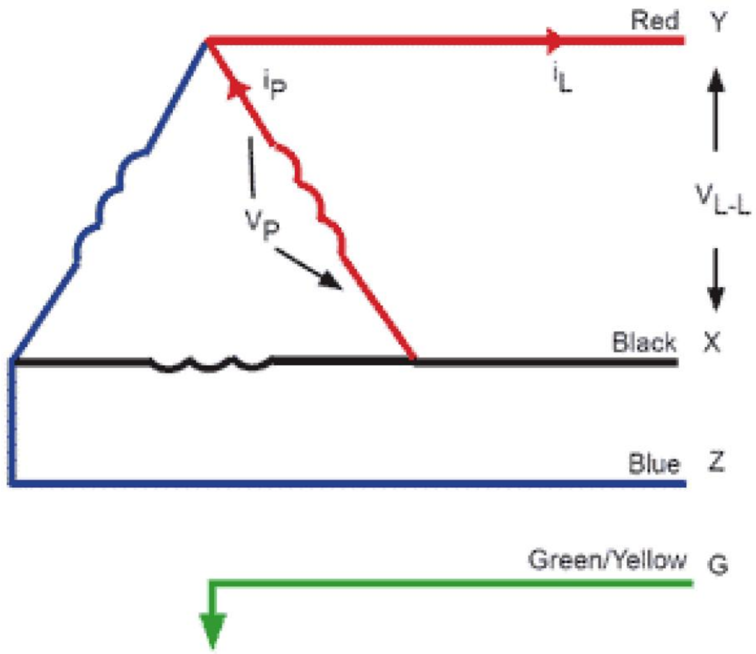
3 Phase WFE (Y)



- Phases or hot lines: X, Y, Z
- Neutral: N
- Ground: G

Common 3phase Y voltages V_{L-N} /V_{L-L} (V_{AC})	
North America	120/208 or 277/480
International	230/400

3 Phase Delta (Δ)



- Phases or hot lines: X, Y, Z
- Ground: G

Common 3-phase Δ voltages V_{L-L} (V_{AC})	
North America	208 or 240
International	230

PE – Protective Earth

In most European countries Protective Earth (PE) is in use instead of Earth Ground for grounding. PE is a fail safe circuitry with the sole purpose to protect persons against potential electric shock. The wire colour is yellow/green.

Abbreviations

IEC - International Electrotechnical Commission (EU, UK and other nations)
NEC - NEC (National Electrical Code (US & Canada)

Daisy chaining / cascading UPS units

What is daisy chaining / cascading UPS units

Daisy chaining or cascading of two UPS units is when the input power connector of a downstream – also called slave or secondary – UPS unit is connected to the output power connector of an upstream – also master or primary – UPS unit.

In this section the term "cascading" instead of "daisy chaining" is used.

Example:
The C20 input connector of a 3 kVA UPS unit, 5594-3KX (RT3kVA 2U Rack or Tower UPS, 200-240VAC), is connected to a C19 output connector of a 5 kVA UPS unit, 5594-5KX (RT5kVA 3U Rack or Tower UPS, 200-240VAC).

Symptoms

Either the upstream / master UPS unit or the downstream / slave UPS unit or both may be operating incorrectly or appear to be faulty.

Additional information

In such a setup, the master UPS unit is also referred to as primary or upstream UPS unit whilst the slave UPS unit is referred to as secondary or downstream UPS unit.

When cascading UPS units, UPS controllers will work against each other and this will cause harmonic distortions on power lines.

Under no circumstances should one (1) UPS unit input be attached directly or indirectly to the output of another UPS unit as the current draw of the second UPS unit may cause a distortion of the output voltage waveform of the first UPS unit, which could cause the second UPS unit to detect this as a power fluctuation resulting in it going onto battery power and continually cycling between battery and normal operation.

The current draw of the second UPS unit when charging the batteries could also cause the upstream UPS unit to go into an overload condition. The results of feeding one (1) UPS unit from the output of another could have other more disastrous results.

The size and type of the upstream UPS unit does not matter as any UPS unit can be caused to fail in such an installation.

By cascading UPS units, another point of failure will be introduced into a system that is already backed up by a UPS unit.

If issues arise, no assistance can be given for such a setup.

If any of the affected UPS units get damaged and repair is required, the repair work is not covered by warranty or an existing maintenance agreement / service contract.

Reasons why UPS daisy chaining may be considered

Redundancy

Added redundancy or reliability is a good target especially when considering a single UPS can be a single point of failure. A mathematically-based probability study shows that placing UPS units in cascade then this increases the chance of failure, as failure rates are combined to present the new failure rate. A more practical way of thinking about it is, if the UPS closest to the load fails or has a catastrophic failure then the remaining UPS provides no value even if it is still operating.

Runtime

Batteries are stored energy and the bigger and larger the battery bank, the more runtime is provided. But for customers looking for more runtime from an existing UPS, there are no shortcuts. Plugging a UPS into another UPS is very likely to prevent one or both of the UPSs from working correctly due to inverter compatibility issues. In this type of scenario, the UPS closest to the load doesn't recognize the first UPS unit power as sufficient and both UPSs go to battery, defeating the intent.

The run time of a UPS can be extended by adding extended battery modules (EBMs) to the UPS unit.

Surge Protection

Every UPS should have an adequate level of surge protection for most applications. But some customers may be in difficult environments where thunderstorms are frequent or industrial equipment within their building wreaks havoc on their electrical system. In either case, cascading UPS units does not help mitigate, or clamp, incoming surges. In fact, cascading the UPS units could create some new challenges to the system. Note that the UPS is designed to be self-sacrificing in regards to surges. That means if the surge is too much for the first UPS, that UPS will take itself offline and the system will go down regardless.

For sites with known issues, it is best to consult with a qualified and licensed electrician to develop a multi-stage approach. Surge protection at the UPS is best when paired with surge protection at the panel board and customers worried about lighting should explore if lightning arrestor solutions are appropriate.

Power Generator and UPS units

In order for a UPS unit to function properly with a Power Generator the slew of the UPS unit needs to be considered and the Power Generator needs to be adjusted accordingly. The slew rates of the UPS units is listed in the below table.

UPS Name	Machine Type and Model	Slew Rate	HE Mode Slew Rate
RT8kVA 6U Rack or Tower UPS (200-240VAC)	5594-8KX	1 Hz / s	0.5 Hz / s
RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)	5594-8PX	1 Hz / s	0.5 Hz / s
RT11kVA 6U Rack or Tower UPS (200-240VAC)	5594-9KX	1 Hz / s	0.5 Hz / s
RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)	5596-9PX	1 Hz / s	0.5 Hz / s

The slew rate allows the UPS to synchronise to the utility power or the power supply.

In order for the UPS to transfer to bypass under fault, the UPS automatically synchronises its waveform to follow the supply.

If the supply changes, the slew rate is the rate the UPS speeds up or slows down its frequency to match the supply. This speed is limited to avoid damage to the load by the UPS changing speed too fast.

When the Generator is feeding a UPS, the UPS can follow it within its slew rate and frequency limits. Outside of this, the UPS will alarm that the bypass is out of tolerance, as it cannot make a no break transfer.

The tolerance of the bypass is narrow as it is within the limits to feed the load. The tolerance of the rectifier may be far larger, therefore does not necessarily mean the UPS will switch to battery.

Considerations

1. **Assess the generator frequency.** Every UPS has a set input voltage and frequency window that, if exceeded, will cause the UPS to go onto battery. If a generator's frequency range is too wide for the UPS to accept, the UPS may interpret the generator

as an unstable power source. If this occurs, the UPS remains on battery permanently, which will ultimately cause the battery to fail and drop your load.

2. **Increase the generator size.** Using the proper size of generator is essential to ensuring the safety of both the UPS load and an organisation's personnel during a lengthy outage. Many companies expect the generator to accommodate air conditioning, emergency lighting, communications and other vital services. Yet if the generator isn't large enough, it won't be able to hold voltage and frequency within input tolerances when the UPS comes online.

   The bigger the generator engine, the more stable the frequency and therefore the more it can handle as the UPS comes off battery. With that in mind, whenever budgets permit, it is wise to increase the generator size and also allow for some potential growth with the generator-friendly UPS. The general recommendations for UPS models up to 25 kW are as follows:

   - 2 times the total load (including the UPS, A/C, and all other equipment that must remain online) for natural gas-powered and mechanical governor generators.
   - 1.5 times the total load for propane or diesel-powered generators and those with an electronic governor.

Attention! When dimensioning a UPS unit and / or a power generator always consider the reactive load and not only the active load!

3. **Consider the fuel source.** The most common generator fuel options include propane, natural gas and diesel, each of which comes with its own set of own advantages and disadvantages. Natural gas-operating generators can be slower to respond and may need to be sized larger than their propane counterparts. Diesel is widely considered the best fuel and is predominately used for 50 kW and larger generator solutions. However, it has a short storage life and its cost can strain budgets.

4. **Don't overlook the governor.** Portable generators are equipped with a governor which limits the speed of fuel being delivered to the engine to a safe level amid load changes. Electronic governors are quick to respond, while mechanical governors are slower and can also cause calibration challenges.

5. **Consider the UPS topology.** The type of UPS will also affect UPS generator compatibility and configuration, as not all can compensate for frequency variations without relying on the battery. Both standby and line-interactive UPS units use battery power to prevent frequency variations from affecting the protected load. A double-conversion, online UPS, on the other hand, recreates the sine wave and filters frequency

variations as part of its normal operation, thereby preserving battery life. Because it constantly rectifies AC to DC and then inverts the DC back to AC, the online UPS produces an output that corrects for voltage and frequency deviations. For this reason, double-conversion technology is the most common for critical load applications and the most advantageous type of system for generator integration.

6. **Consult with the manufacturers.** Often you can avoid a range of potential problems and the UPS not working on generator power by first ensuring that the generator manufacturer has tested and approved the product's intended use with UPS units. To ensure that the optimal UPS/generator size match is achieved, it is wise to consult with both the UPS and the generator manufacturer prior to finalising a purchase. In addition, capacities of prospective loads to be protected can generally be found in the manufacturer's specifications.

Addtional solutions

The UPS won't operate online when powered by generator.

A common characteristic of generators is the normal output voltage distortion when supplying power to non-linear loads such as computers. This output voltage distortion can be interpreted by the UPS as unacceptable power quality, forcing the UPS to transfer to battery operation. When the load is transferred to the battery, naturally the generator distortion will be reduced or disappear, leading the UPS to attempt to transfer back to line operation. When the load is reapplied to the generator, the distortion will return, leading the UPS to once again transfer to battery. This cycle may repeat indefinitely at intervals of approximately 4 seconds. The answer in this case is to choose a generator which will not distort, when the nonlinear computer load is applied.

See Step 2 Increase the generator size in the Considerations section of this chapter for additional information.

The UPS stays on battery power while attached to a generator

This is generally due to the generator being undersized. To prevent voltage distortion and complications with a UPS, the generator must be selected so that it will supply the peak current required by the computer load, not only the average current. It has been determined experimentally that this typically requires that the generator have a rating at least 3 to 5 times the rating of the entire load to be connected to the generator. However, due to wide differences in output impedance for generators, it is not possible to specify an over-sizing factor that guarantees compatibility with all systems.

See Step 2 Increase the generator size in the Considerations section of this chapter for additional information.

The UPS keeps transferring on line to on battery power

Using non-linear loads with a smaller generator will result in the output waveform of the generator to be very distorted. This distortion will most likely result in the UPS product frequently transferring back and forth from On-Line to On-Battery.

See Step 2 Increase the generator size in the Considerations section of this chapter for additional information.

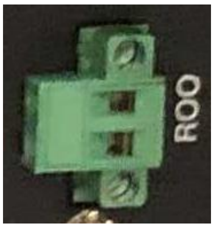
EPO / RPO / ROO

An Emergency Power Off, **EPO**, requires that the DC connection be opened as well as the load going off. The UPS designs do not disconnect the DC (Battery) by physical (breaker or contactor). This means that Emergency Power Off does not exist with these UPS units. Instead a Remote Power off, **RPO**, is available.

The Remote On/Off, **ROO**, is different in that it can turn the load output on and off by opening or closing the contact points on the back of the UPS.

When an **RPO** is activated (opening the contact points), once it is deactivated, the user must clear the EPO alert, shown on the UPS LCD panel as `Emergency OFF`, from the LCD before the load will be available to start. Once the EPO alert has been cleared the UPS is in standby and needs to be powered up via the UPS power on button ⏻. The ROO does not require this reset action.

All UPS units are equipped with an RPO and an ROO connector:



Example – attaching a PDU to a UPS unit

Note: *Only* single phase PDUs can be attached to the UPS.

The output from the hardwire connection is limited by the input current limits of the system; however a PDU can be connected through the hardwired connection.

The output of the hardwire connection is the output path which can be online double conversion or set to the bypass through the menu control function.

The hard wiring output from the Maintenance Bypass (MBP) can be used in addition to the receptacles on the MBP. They both connect to the output of the UPS/Utility. That hard wiring output can be a PDU as long as it does not exceed the rating of the UPS/Utility and would have the proper circuit protection per local electrical codes.

It is important to not overload the UPS unit and to follow local laws and regulations with respect to attaching a PDU to a UPS unit.

Attachment points

Figures 61 and 62 show the attachment points of the 1:1 and the 1:3 8 kVA and 11 kVA UPS units.

Figure 63: Load outlet for 8 kVA, 5594-8KX, and 11 kVA UPS, 5594-9KX, single phase

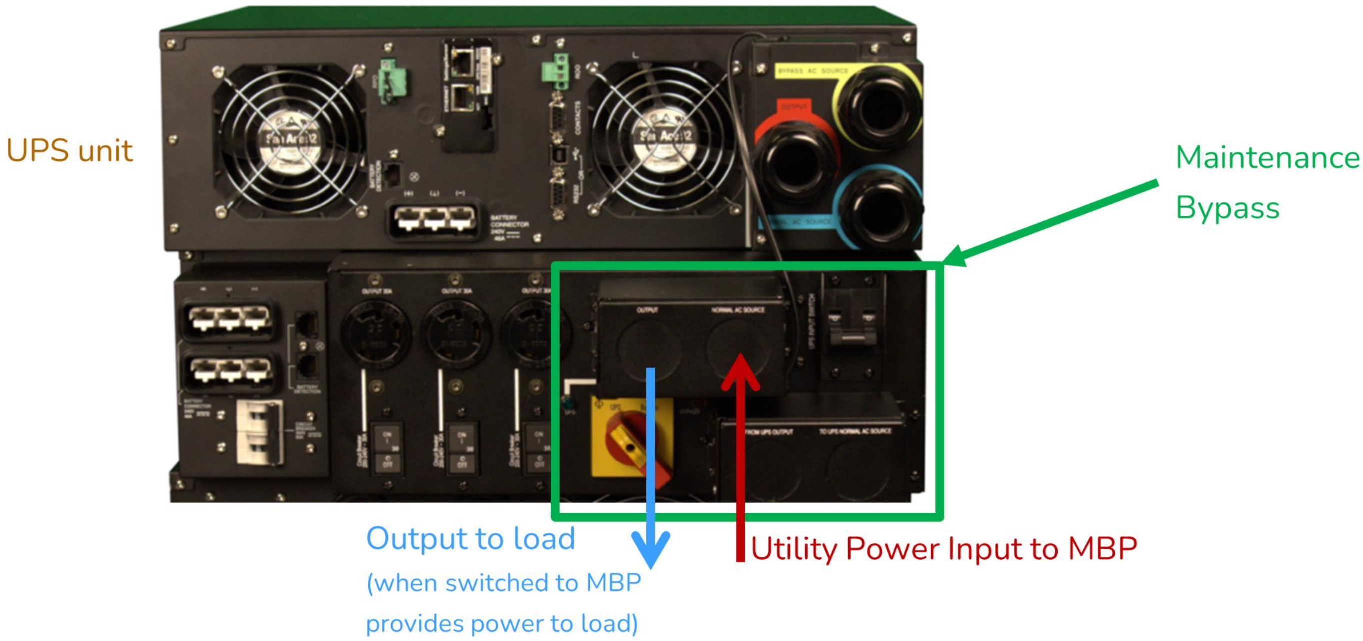


Figure 64: Load outlet for 8 kVA, 5594-8PX, and 11 kVA UPS, 5594-9PX, three phase

Maintenance Bypass (MBP) output to load

Leak current information

These hard wired UPS units can have the following maximum leak current:

UPS Unit	Maximum leak current
RT8kVA 6U Rack or Tower UPS, single phase 5594-8KX (5594RU8 A543)	Up to 5 % of input current, maximal 2 A, see IEC 62040
RT8kVA 6U 3:1 Phase Rack or Tower UPS 5594-8PX (5594RU8 A546)	Up to 5 % of input current, maximal 2 A, see IEC 62040
RT11kVA 6U Rack or Tower UPS, single phase 5594-9KX (5594RU8 A544)	Up to 5 % of input current, maximal 2.5 A, see IEC 62040
RT11kVA 6U 3:1 Phase Rack or Tower UPS 5594-9PX (5594RU8 A547)	Up to 5 % of input current, maximal 2.5 A, see IEC 62040

For the hardwired UPS units, the ground connection is the first connection that ***must*** be made during wiring up the UPS unit to utility power. This will reduce significantly the risk or prevent electrical shock from indirect contact with utility power. For additional installation instructions refer to Chapter 5 Installation. That the maximum leak current is so high is covered by IEC 62040, Section 5.1.

For additional information, see the letter from Eaton Corporation.

Because of the expected high leak current it is not recommended to use an upstream RCD / differential circuit breaker. If, however due to legal requirements an RCD must be used, then a D curve 420 mA RCD is to be installed. Please note that an RCD has to be tested once a year by pressing its test button. A better choice to RCDs are RCBOs, that is Residual current operated Circuit-Breaker with over-current protection, which are also known as GFCI (ground fault circuit interrupter). See also Earth leakage considerations using an RCD for additional information.

During normal operation these UPS units usually have a small leak current, quite often below 400 mA. The maximum defined leak current is the worst case scenario. Therefore the maximum leak current must be considered before installing the UPS unit.

When an electrical device draws more current than the circuit breaker is rated for, then the circuit breaker will trip. The same happens with an RCD. When the current difference is larger than what the RCD allows for, then the RCD will trip.

Measuring the leak current

Attention! The measuring and certification of leakage current values is a task and involves a lot of set up work. Installing the hardware and starting measuring leakage current will not yield the desired results.

The leak current is influenced by a number of parameters such as:

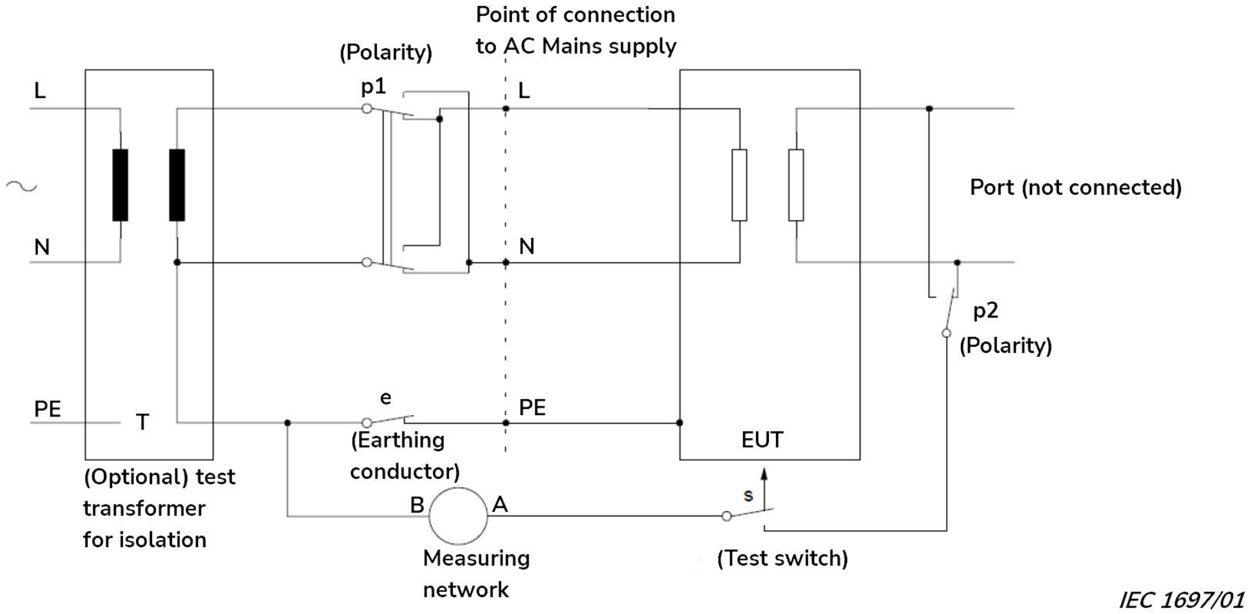
- Was the measurement taken when load was attached to the UPS unit? If yes, then this load contributes to the leak current; that is the leak currents of all devices are summed up.
- What electrical grounding system is in use? For example, TT, TN-S, etc.
- Leakage current can also come from the source side of the UPS.
- Leakage current can come from anywhere in the utility power network.

If a leakage current has been measured without load attached to the UPS unit, then this is indicative that leakage current from other devices is measured at this point in time. In that case, an isolation transformer must be placed between the source utility power and the UPS unit.

If a leakage current has been measured without load attached to the UPS unit, then this is indicative that leakage current from other devices is measured at this point in time. In that case, an isolation transformer must be placed between the source utility power and the UPS unit.

The measurement of leakage current is also defined within the UL specification and requires the setup to be exactly as shown; otherwise the measurement is inaccurate. In addition, leakage current is additive, so the leakage current of connected loads to the UPS add to the UPS leakage current.

Set up diagram for measuring leak current as defined in IEC 1697/01



EUT ... Equipment under test

Notes:
- The test transformer for isolation is mandatory for measuring the UPS leak current
- The leak current for a 3:1 UPS unit must be measured on input phase by input phase

High Efficiency Mode

High Efficiency Mode, in short HE Mode, is a mode of UPS operation that cuts energy usage and operating costs. In HE Mode the is UPS running as a Line Interactive UPS – feeding the input to the output loads and monitoring the input. If the input goes beyond the voltage or frequency ranges, the UPS will revert back to Online double conversion.

Note: If the UPS unit is run in High Efficiency mode, then it is strongly recommended to install voltage and frequency stabilisers as the UPS works as line-interactive UPS unit.

Industrial and Network / IT mode

Industrial mode

- By default on EMEA products
- Overload & Inrush current always causes a transfer to bypass mode.
- In industrial mode, the philosophy is to transfer to Bypass as soon as possible (***priority is load service continuity***). Then return to inverter when overload or inrush decreases to normal.

Network [IT] mode

- By default on US products
- Overload & Inrush current are managed by the inverter if at all possible.
- In Network mode, the philosophy is to provide a ***good quality signal to the load*** as long as possible (priority is not to transfer to unprotected Bypass unless forced to do so due to inverter constraints).

Differences between Industrial and IT mode

The unit is set to IT mode by default. Industrial mode starts the output on bypass power as soon as the input mains is energized. Once the power button of the UPS is set, the load will be supported by the UPS online double conversion circuitry. The overall intention in IT mode is to switch to bypass such that any current fault can be cleared upstream from the UPS and continue to support the load.

- Industrial mode: the philosophy is to transfer to Bypass as soon as possible (priority is load service continuity)
  Overload and Inrush current (short circuit) always transferred on bypass
- Network mode: the philosophy is to provide a good quality signal to the load as long as possible (priority is not to transfer to unprotected Bypass).
  Overload and Inrush current (short circuit) are managed by the inverter

Mode		Inv->Stop	Inv->Bypass	Inv->bypass->Inv
Industrial Mode	Overload	✗	✓	✗
	Short circuit	✗		✓
IT mode (default)	Overload	✗		✓
	Short circuit	✓	✗	

The voltage and frequency range where transfer to bypass is a defined range on each product – for example, a 120 V output UPS may have a bypass range from 90 V to 140 V – some sensitive IT equipment may need a constant voltage and frequency or risk damage. Care should be taken whether the load could be damaged by transferring to unregulated bypass.

Industrial mode does work well in an electricity environment where inrush currents are an issue however care must be taken as the entire node connected to the upstream breaker may open dropping all loads.

Take for example, one load segment has a localized short circuit (the load has a short and is malfunctioning), in ***IT mode***, the inverter will provide line cycles such that the load segment will fault out and not transfer to bypass and the remaining load segments will be protected.

In ***Industrial mode*** this case would transfer to bypass and the upstream breaker may open to break the fault and the UPS will go on battery and may still experience the short and turn off the output for all load segments.

LCD Menu languages for setting UPS mode

English	**French**	**German**	**Spanish**
Industrial	Industriel	Industriemodus	Industrial
Network	Réseau informatique	IT-Modus	Network
English	**Russian**	**Portoguese**	**Italian**
Industrial	Промышлен.	Industrial	Industriale
Network	IT	Rede	Rete

Additional information on UPS firmware update

Note: Currently no firmware update for any Lenovo 5594 and 5595 UPS unit is available for download. If a new firmware is to be applied Lenovo will provide a tech tip with according information.

To perform a firmware update, the load must be in standby mode (Load off) but connect to the utility power. Once the update is complete the UPS can be returned to operating mode (Load on). This means that during the period of the firmware update, the Lenovo UPS unit does not protect the attached load. Instead the load is running directly from utility power. The firmware update takes around 10 minutes.

If this is an issue, a down time window for the protected load has to be scheduled.

Note: No downtime is needed for updating the Network Management Card.

Advanced battery management

This UPS unit comes with the Advanced Battery Management (ABM) function. ABM is a set of charger controls and automated battery tests. The cyclic charging schemes enable periods of time when the battery is being fully charged and periods of time when the charger is disabled.

The life of the battery depends on the ambient temperature, the number of duty cycles, and the prevention of internal corrosion of a battery. Internal battery corrosion is caused by current flowing through the battery. Internal corrosion can be reduced if the battery is charged and discharged as little as possible. When the battery is charged only when necessary, it is called intermittent charging. After the battery is fully charged, it has the following charge cycles:

2 days charging
28 days resting
2 days charging
28 days resting

Intermittent charging means that corrosion is occurring only during the 2-day charging cycle. This means that 90% of the time there is no additional corrosion. During this 30-day cycle, the battery voltage drops by less than 2 %, which has no effect on the backup time of the UPS. During the resting time, the ABM function constantly monitors the battery status. If the voltage drops below a predetermined alarm level, the charging cycle is started again. The same happens if the UPS is needed during the rest period to backup a power failure. This increases the battery life by an average of 50 %.

If the voltage per cell reaches 2.1 volts on the batteries within the first 10 days of the rest period, a battery failure alarm occurs.

If the voltage per cell reaches 2.1 volts after the first 10 days of rest, the batteries are charged again for two days. In this case, the rest cycle might be shorter than 28 days as the batteries age.

The ABM function has no impact on the daily operation of the UPS.

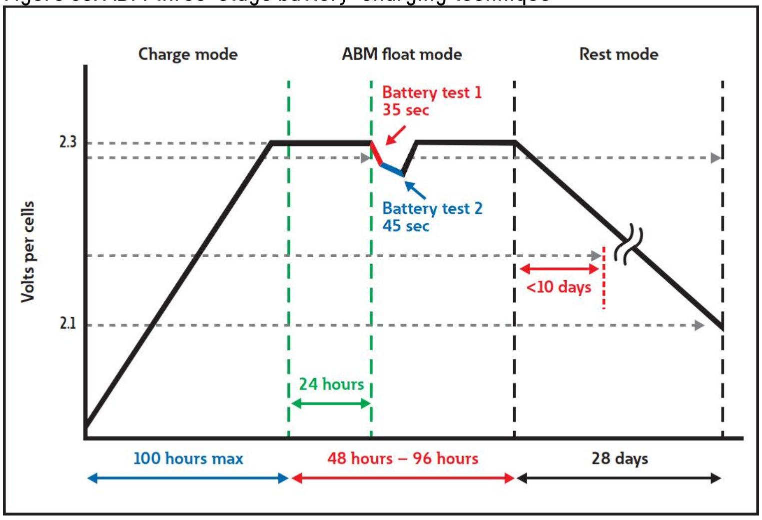
This feature is permanently in operation by default. The ABM charging function can be turned off through the battery charge mode menu by selecting the Constant Charge mode via the UPS LCD panel.

How ABM works

Three-stage charging: ABM increases battery life by 50 % via a three-stage charging process. The microprocessor-controlled technology rapidly charges the battery via the following three steps. (See Figure 65)

- **Charge:** A rapid constant current charge brings the battery to near full capacity in approximately three hours compared to 15 or more hours with many other UPSs.
- **Float:** Next, a constant voltage trickle-charge (of 2.3 volts per cell), similar to that used in other UPS units, continues for approximately 48 hours or until the batteries are solidly "topped off".
- **Rest:** At this point, the charger is turned off.

Figure 65: ABM three-stage battery-charging technique



The charger is turned on again when required due to use or natural decay during extended periods of non-use. This means that UPS units with ABM technology are more energy efficient, only being charged on an average of a few minutes a day. Since UPS batteries use the same technology as car batteries, a simple correlation can be observed. It is easy to see that car batteries, which are charged on when the car is running, typically last two to three times longer than traditional UPS batteries due to the "rest" state that occurs when the car is not running. If car batteries were constantly trickle-charged, they too would last less than two years.

Advanced notification: ABM is the only technology currently available that reliably provides true advanced notification prior to battery failure.

Before the days of sealed, maintenance-free batteries, you could check the battery's electrolyte with a hydrometer to determine its ability to retain a charge. Now, with sealed batteries, the only way to measure battery capacity is to discharge the cell. To accomplish this, ABM technology periodically initiates a brief discharge cycle to check the internal impedance which is calculated and compared to the ideal. In addition, the open-cell voltage and decay rate of the battery are continuously monitored after every charging cycle. Further, during a utility failure, the actual capacity of the battery is measured and compared to the expected capacity. When any of these three tests detect a significant change from the normal, the microprocessor indicates, well in advance, when the battery needs to be replaced.

UPS Batteries

Attention!

When the UPS unit issues a battery fault alert, *all* batteries for the UPS installation have to be replaced. This must include the following:

- All batteries internal to the UPS unit
- All batteries in any Extended Battery Module (EBM) attached to this UPS unit

The UPS unit cannot determine which battery is defective. It can only report the fact that a battery is defective.

Never mix *old* and *new* batteries in the UPS unit or its EBMs.

Mixing old and new batteries in a UPS installation

- Will lead to a thermal destruction of the UPS unit
- It cannot be guaranteed that the UPS is able to provide the required and configured run time in case of a power outage/fault that would switch the UPS to battery operation

When replacing UPS batteries it is *strongly recommended* to wear eye protecting goggles and acid resistant gloves and shoes as leaking acid from batteries can cause injury!

Battery warranty statement

Most current warranty statement on Leonovo UPS batteries is available via

https://datacentersupport.lenovo.com/documents/UM924396

Replacement responsibility

UPS batteries are classified as Tier 1 CRU, Customer Replaceable Units. This means that UPS batteries are to be replaced by the customer, in other words it is the customer's responsibility to replace the batteries. The UPS batteries can be replaced by a System Service

Representative for the customer under standard warranty, however this service may have to be paid for by the customer. Replacing a Tier 1 CRU does not require any tools.

Running a battery test

Automatic battery tests are done routinely in automatic charging mode and at each cycle in Advanced Battery Management (ABM) mode. The frequency of the tests can be modified using the LCD panel. See User settings in Chapter 3 for more details.

Note: Battery mode is not displayed and battery low alarm does not activate during a battery test.

The automatic discharge test is enabled by default and runs during the transition from `Float` to `Rest` mode. After the test is complete, the charge cycle restarts to completely charge the batteries and then continues to `Rest` mode.

The automatic battery test runs approximately once once a moth as part of the ABM cycle and does not run again until the next test period. If a manual battery test is requested, the automatic battery test timer is reset so that it does not run for the next test period.

Requirements for successful battery test

In order for a battery test to complete successfully the following minimum requirements must be met:

1. Load must be at last 10% of the rated capacity or greater to run adequate discharge, however 25% is recommended load capacity of the UPS that should be protected by the UPS unit
2. Battery capacity should be ≥ 80 %, that is the battery is charged to at least 80 % of its capacity
3. There is no running alarm (except Battery fault)
4. Load level has not varied by more than +/-10 % (from the initial load level present at the beginning of the test to the end of the test)
5. The bypass voltage is in tolerance for bypass transfer (in case of end of backup, to transfer to bypass)
6. UPS mode must be in Online mode or HE (High efficiency) mode.

These requirements applies to both the UPS itself and any attached EBM(s), that is for all battery packs present in the UPS installation.

UPS can either be in ABM or continuous battery charge mode.

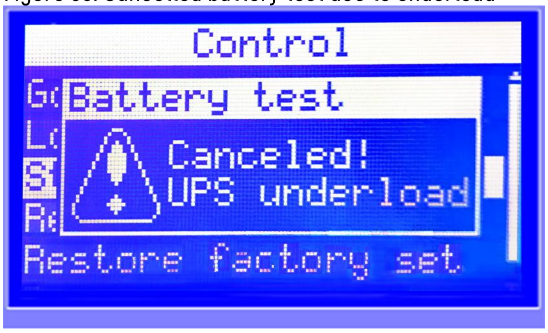
Additional information

For both the automatically and manually started battery tests, the following applies:

The battery test only runs for a short duration to measure the change in voltage over that time period. Without a minimal amount of load, there will not be a measurement of the change of voltage over that time period. Without sufficient load, the battery test cannot determine a bad or weak battery.

As a result of an underload, that is less than 10 % load capacity, the UPS will issue the, `Battery test cancelled UPS Underload.` error and cancel the battery test.

Figure 66: Cancelled battery test due to underload



If the UPS in HE mode, the UPS transfers automatically to Online mode and then the test is launched. Once the test is complete, the UPS is enabled to transfer back from Online mode to HE mode.

Battery / UPS storage

All internal batteries for all UPS units are charged to approximately 80 percent of their capacity prior to shipping. The UPS is shipped with the internal battery connector disconnected, in order to avoid premature discharge of the battery. The battery is expected to last at least six (6) to eight (8) months from manufacture, before requiring a recharge of the battery. Should the UPS be kept in storage after that first recharge, subsequent recharge(s) should be repeated every six months to eight months. Batteries must be connected before and disconnected after each recharge. However, it is recommended, the batteries should not be recharged more than twice. This may limit the overall battery storage period to not more than 24 months.

The recharge period for a battery is 48 hours without any load attached to the UPS.

UPS Storage information	
Storage Temperature	+ 10° to + 40° C / + 50° to + 104° F
Storage Relative Humidity	0 % to 95 %
Storage Elevation	0 - 15,000 meters (0 - 49,212 feet)

If the storage time is longer than the recharge date, the battery of the UPS unit may drain completely. In this case, the batteries cannot be recharged any more. The battery is considered to be damaged and must be replaced.

When to replace a battery

The life time of a UPS battery is heavily affected by a number of factor such as:

- Environment temperature
- Environment humidity
- Depth of discharge
- Frequency of discharge, that is how often the UPS switches to battery and back to utility power and how fast

If a UPS battery fails prior to the four year period, then the UPS will issue an according alarm.

The routine self-battery test is meant to alarm if the battery has degraded such that it is unable to protect the load any longer No percentage of battery load degradation is provided.

Note: Replace a battery only when the UPS informs you to do so.

If the UPS unit issues a battery error / fault then the battery / batteries should be replacedas soon as possible.

This means is that the battery has failed an UPS battery test, and in case of power failure it may not provide the estimated backup time.

The battery tests are designed such in order to try to detect a bad battery as soon as it's possible to distinguish a difference in the battery, but it is impossible to know exactly how bad the batteries are since battery test is usually run only monthly, or less if the user selects less.

Once the battery is deemed faulty, the run time could change significantly. If the battery is just starting to get weak in its capacity, the difference in runtime could be small at this time, but if there some dead cells or dead whole batteries, the run time could be much shorter.

UPS Battery Technical Brief

Introduction

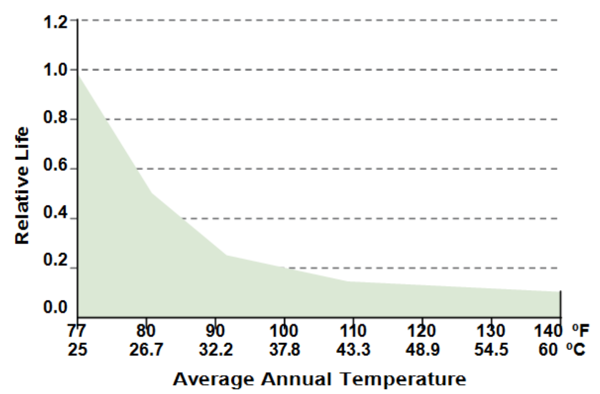
Battery in an Uninterruptible Power System (UPS) is the most vulnerable part of the system. In fact, battery failure is a leading cause of load loss. Knowing how to maintain and manage your UPS batteries will extend their life and save you time and potential trouble in the future.

Four factors that affect battery life

Batteries have limited life, usually showing a slow degradation of capacity until they reach 80 percent of their initial rating, followed by a comparatively rapid failure. Regardless of how or where a UPS is deployed, and what size it is, there are four primary factors that affect battery life: ambient temperature, battery chemistry, cycling and service.

1. Ambient temperature

The rated capacity of a battery is based on an ambient temperature of 25 °C (77 °F). It's important to realize that any variation from this operating temperature can alter the battery's performance and shorten its expected life. To help determine battery life in relation to temperature, remember that for every 8.3 °C (15 °F) average annual temperature above 25 °C (77 °F), the life of the battery is reduced by 50 percent.



Optimum operating temperature for a VRLA battery is 25°C (77°F). High ambient temperature allows unnecessary large quantities of charge current to flow which results in a shorter service life.

2. Battery chemistry

UPS batteries are electrochemical devices whose ability to store and deliver power slowly decreases over time. Even if you follow all the guidelines for proper storage, usage and maintenance, batteries still require replacement after a certain period of time.

3. Cycling

During a utility power failure, a UPS operates on battery power. Once utility power is restored, or a switch to generator power is complete, the battery is recharged for future use. This is called a discharge cycle. At installation, the battery is at 100 percent of rated capacity. Each discharge and subsequent recharge reduces its relative capacity by a small percentage. The length of the discharge cycle determines the reduction in battery capacity.

Lead-acid chemistry, like others used in rechargeable batteries, can only undergo a maximum number of discharge/recharge cycles before the chemistry is depleted. Once the chemistry is depleted, the cells fail and the battery must be replaced.

4. Maintenance

Battery service and maintenance are critical to UPS reliability. A gradual decrease in battery life can be monitored and evaluated through voltage checks, load testing or monitoring. Periodic preventive maintenance extends battery string life by preventing loose connections, removing corrosion and identifying bad batteries before they can affect the rest of the string.

Even though sealed batteries are sometimes referred to as maintenance-free, they still require scheduled maintenance and service. Maintenance-free simply refers to the fact that they don't require fluid.

Without regular maintenance, your UPS battery may experience heat-generating resistance at the terminals, improper loading, reduced protection and premature failure. With proper maintenance, the end of battery life can be accurately estimated and replacements scheduled without unexpected downtime or loss of backup power.

Battery life: design life vs. actual life

Determining battery life can be a tricky business. It's often promoted based on design life, defined as how long the battery can be expected to perform under ideal conditions.

Estimating actual battery life relies on taking into consideration the four factors that can impact affect it.

What can go wrong with batteries?

Condition	Cause
Plate separation	Repeated cycling (charging and discharging), damage during handling and shipping, and overcharging
Grid corrosion	Normal aging, operating in an acidic environment and high temperatures
Internal short circuit	Heat (plates expand causing shorts), separator failure, handling and shipping, and grid corrosion
External short circuit	Human error (shorting terminals) and leaks

What can go wrong with batteries? (continued)

Condition	Cause
Sulfation of plate	Sitting discharged for an extended period, not on charge or being undercharged
Excessive gassing	Often due to high temperature or overcharging
Drying out	Excessive gassing, high temperatures or overcharging

Battery disposal

Batteries that are replaced can still contain a significant amount of hazardous waste, including the electrolyte and lead. Therefore, you must comply with EPA guidelines for the disposal of all UPS batteries. There are essentially two main categories of disposal, one for spent batteries and another for spills. The primary ways to handle these two categories are:

Spent batteries:
Send to secondary lead smelter for recycling.

Spilled batteries:
Place neutralized leaked material into sealed containers and dispose of as hazardous waste, as applicable. Large water-diluted spills, after neutralization and testing, should be managed in accordance with approved local, state and federal requirements. Consult your state environmental agency and/or the EPA.

Recycling:
One of the most successful recycling efforts in the world is for lead- acid batteries. According to Battery Council International, more than 96 percent of lead-acid batteries were recycled between 1997 and 2001. Many states require lead-acid batteries be recycled, and several options exist to dispose of used batteries, including:

- Check your local phone book for a local recycler, or search for a recycler at https://www.earth911.com
- Some automotive stores accept batteries for recycling.
- Many municipalities have dump or recycling locations that will accept batteries for recycling. When disposing of batteries in this manner, be sure to get a dated receipt clearly detailing what batteries were dropped off, including quantities with the recycler's full name, address and phone noted in the unlikely event you get audited

Battery maintenance for extended life

Quantifying the combined effect of the four factors that affect battery life discussed in the previous page is difficult. You need a way to determine when a battery is near the end of its useful life so you can replace it while it still works, before the critical load is left unprotected.

The only sure way to determine battery capacity is to perform a battery run-down test. The module is taken off line, connected to a load bank and operated at rated power until the specified runtime elapses or the unit shuts down due to low battery voltage. If battery capacity is less than 80 percent of its rated capacity, the battery should be replaced.

Thermal scanning of battery connections during the battery run-down test identifies loose connections. This test gives you the chance to see the battery during an extended, high-current discharge. Scanning should take place during discharge and recharge cycles.

An effective UPS battery maintenance program must include regular inspections, adjustments and testing, with thorough records kept of all readings.

Spot replacement of batteries

Batteries in series are similar to a string of holiday lights. When one unit fails, the entire string no longer works. When a battery or group of batteries connected in a series ceases to work, not only is the battery string no longer functional, but it can be difficult to determine which battery has failed.

While the four factors affecting battery life play a large role in determining when a battery is vulnerable to failure, there’s no precise way to ensure that battery failure can be predicted. The only way to identify bad batteries early enough for spot replacement is through continuous battery monitoring and scheduled maintenance. Once a battery fault has been reported, replace all batteries in the base UPS unit and in all attached EBMs, if any are attached.

Lead-acid batteries: good for the environment?

Which commonly used product has the highest rate of recyclability? Paper? Only 73 percent of paper is recycled for reuse. Aluminum at 54 percent and glass at 25 percent also fall short of the leader. More than 96 percent of all battery lead is recycled. Lead-acid batteries top the list of most highly recycled consumer product.

The processes for lead-acid battery recycling support agriculture needs and enhance energy conservation. Beyond the successful reuse of nearly 100 percent of the battery components, lead recycling facilities harness radiant heat from their furnaces to offset traditional heating costs. Residual sulfur trapped during recycling is processed into fertilizer. Even the plastic casings are crushed into pellets and are used to manufacture new battery covers and cases.

Recycling lead is also more energy efficient than smelting or mining new lead. The recycled lead can be refined into new alloy repeatedly, giving it unmatched sustainability and cost stability - a trait unlike most raw materials.

Battery FAQ

1. What is the "end of useful life"?
The IEEE defines "end of useful life" for a UPS battery as being the point when it can no longer supply 80 percent of its rated capacity in ampere-hours. When your battery reaches 80 percent of its rated capacity, the aging process accelerates and the battery should be replaced.

2. What about battery disposal?
It's imperative that your service technicians adhere to EPA guidelines for the disposal of all UPS batteries. Remember, it's the owner's responsibility to make sure these guidelines are followed.

3. My UPS has been in storage for over a year. Are the batteries still good?
As batteries sit unused, with no charging regimen, their battery life will decrease. Due to the self-discharge characteristics of lead-acid batteries, it's imperative that they're charged periodically during storage or permanent loss of capacity will occur. To prolong shelf life without charging, store batteries at 10 °C (50 °F) or less.

4. What is the difference between hot-swappable and user-replaceable batteries?
Hot-swappable batteries can be changed out while the UPS is running. User-replaceable batteries are usually found in smaller UPS units and require no special tools or training to replace. Batteries can be both hot-swappable and user-replaceable. Please check your user's guide for details on your UPS batteries.

5. How is battery runtime affected if I reduce the load on the UPS?
The battery runtime will increase if the load is reduced. As a general rule, if you reduce the load by half, you triple the runtime.

6. If I add more batteries to a UPS, can I add more load?
Adding more batteries to a UPS can increase the battery runtime to support the load, but it doesn't increase the UPS capacity. Be sure your UPS is adequately sized for your load, then add batteries to fit your runtime needs.

7. What is the average lifespan of UPS batteries?
The standard lifespan for VRLA batteries is three to five years; for wet-cell batteries it's up to 20 years. However, expected life can vary greatly due to environmental conditions, number and depth of discharge cycles, and adequate maintenance. Having a regular schedule of battery maintenance and monitoring will ensure you know when your batteries are reaching their end-of-life.

8. Why are batteries disconnected on small, single-phase UPS units when they are shipped?

This is so that they're in compliance with Department of Transportation (DOT) regulations.

9. Is it safe to transport sealed batteries?

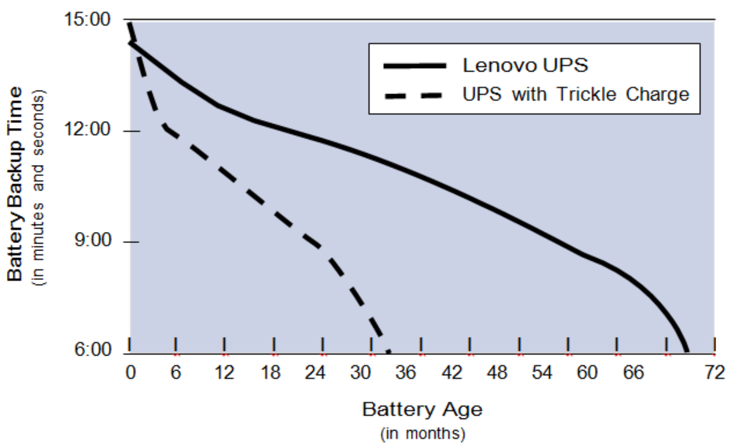
VRLA batteries marked as "non-spillable" are safe and approved for all transportation methods as long as the container is free of blemishes and local DOT regulations are followed.

10. How can I determine the age of a battery?

Batteries shipped on or after January 1, 2000 have a four-digit shipping code with the first two digits as the year and the following two as the month in which the battery was shipped from the factory. For example, a code of 1710 would be interpreted as 2017, October.

Extending battery service life

Lenovo UPS units uses a unique three-stage charging technique that significantly extends battery service life and optimizes recharge time compared to traditional trickle charging. An integrated battery management system tests and monitors battery health and remaining lifetime and provides advance notification to guide preventive maintenance. Optional temperature compensated charging monitors temperature changes and adjusts the charge rate accordingly to properly charge the battery and greatly extend battery life. With remote monitoring of the UPS and battery system, Lenovo is able to respond to alarms and real-time battery data to avert potential battery problems.



Although batteries are sold with a variety of published life spans, the fact is, some demonstrate a useful life of as little as three to five years. Lenovo UPS units employ battery charging technology that significantly increases the life of UPS batteries.

Using the UPS on a ship

This UPS unit is ***not*** suitable for use in a marine environment, i.e. onboard ships. For information on UPS units suitable for marine environment visit

http://powerquality.eaton.com/Products-services/Backup-Power-UPS/Marine/default.asp

Correct power up procedure

After installing or after the UPS has been shutdown the following power on procedure is to be followed:

1. Power up the UPS and wait until it has completely started up
2. If the UPS has been started up after a power outage, it is strongly recommended that the batteries are charged up to at least 80 % before letting the UPS protect any load
3. Power up each protected load individually until that load has fully completed its POST and the operating system has loaded, e.g. if there are three servers protected, turn on one server and wait until the operating system has loaded, then repeat this step with the next server until all protected servers are started up

Powering up all protected loads at the same time may cause a high current inrush via the UPS. By powering up each load separately and waiting for its start up to complete the chances of a high current flow via the UPS unit will be avoided. This reduces or eliminates any damage to the UPS unit itself and no circuit breaker will trip.

Servicing the UPS unit

Servicing any UPS in the field, is limited to replacement (FRU) or (CRU) parts, for example, batteries, electronic modules, etc.

No repairs of failed UPS component CRU or FRU is to be done in the field.

Opening any FRU or CRU part cover on the UPS for repairs or troubleshooting is not to be performed in the field. This does not include battery compartments for battery replacement.

Personal injury or system damage may occur if any components of the UPS are accessed by individuals.

All UPS unit repairs are limited to what is listed in their replacement parts list.

Accessing the chassis covers of the UPS, including batteries and chassis, by anyone could void the warranty and support of the entire product. This does not include opening battery compartments for battery replacement.

Because of serious health, safety, and legal issues, any part or parts that are found to be tampered, altered, or damaged due to accessing the chassis or modules could result in the end user being charged for the service of the unit.

This also applies in the event of any health and safety issue or smoke incident of the UPS unit!

Chapter 13 Parts listing

Attention!

Servicing any UPS in the field, is limited to replacement (FRU) or (CRU) parts, for example, batteries, electronic modules, etc.

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This also applies in the event of any health and safety issue or smoke incident of the UPS unit!

Parts listing for the 8 kVA and 11 kVA UPS units

The following replaceable components are available for the product.

Replaceable components consist of consumable parts, structural parts, and customer replaceable units (CRUs):

- **Consumable parts:** Purchase and replacement of consumable parts (components such as printer cartridges, that have depletable life) is your responsibility. If Lenovo acquires or installs a consumable part at your request, you will be charged for the installation.

- **Structural parts:** Purchase and replacement of structural parts (components such as the top cover) is your responsibility. If Lenovo acquires or installs a structural part at your request, you will be charged for the installation.

- **Tier 1 customer replaceable unit (CRU):** Replacement of Tier 1 CRUs is your responsibility. If Lenovo installs a Tier 1 CRU at your request without a service contract, you will be charged for the installation.

- **Tier 2 customer replaceable unit:** You may install a Tier 2 CRU yourself or request Lenovo to install it, at no additional charge, under the type of warranty service that is designated for your installation.

For information about the terms of the warranty and getting service and assistance, see the Warranty Information document.

RT8kVA 6U 3:1 Phase Rack or Tower UPS, 5594-8PX, Parts

Part description	CRU part number	Type
Power Module	00FP735	Tier 1
Maintenance Bypass Panel (MBP)	00FP804	Tier 1
UPS Bezel Spare (includes LCD)	01PE445	Tier 1
UPS Battery Module, see the section Determining how many battery packs are to be replaced in Chapter 10 for additional information	00FP798	Tier 2
EBM Power Cord 400 mm / 15.75” 240V (includes EBM detection cable)	00FP795	Tier 1
4 Post Rail Kit	00FP796	Tier 2
Tower pedestal feet	00FP825	Tier 1
Ship Bracket	00FP827	Tier 1

RT8kVA 6U Rack or Tower UPS, 5594-8KX, Parts

Part description	CRU part number	Type
Power Module	00FP732	Tier 1
208 V Maintenance Bypass Panel (MBP)	00FP791	Tier 1
UPS Bezel Spare (includes LCD)	00FP792	Tier 1
UPS Battery Module, see the section Determining how many battery packs are to be replaced in Chapter 10 for additional information	00FP798	Tier 2
EBM Power Cord 400 mm / 15.75” 240V (includes EBM detection cable)	00FP795	Tier 1
4 Post Rail Kit	00FP796	Tier 2
Tower pedestal feet	00FP825	Tier 1
Ship Bracket	00FP827	Tier 1

RT11kVA 6U 3:1 Phase Rack or Tower UPS, 5594-9PX, Parts

Part description	CRU part number	Type
Power Module	00FP736	Tier 1
Maintenance Bypass Panel (MBP)	00FP804	Tier 1
UPS Bezel Spare (includes LCD)	01PE445	Tier 1
UPS Battery Module, see the section Determining how many battery packs are to be replaced in Chapter 10 for additional information	00FP798	Tier 2
EBM Power Cord 400 mm / 15.75” 240V (includes EBM detection cable)	00FP795	Tier 1
4 Post Rail Kit	00FP796	Tier 2
Tower pedestal feet	00FP825	Tier 1
Ship Bracket	00FP827	Tier 1

RT11kVA 6U Rack or Tower UPS, 5594-9KX, Parts

Part description	**CRU part number**	**Type**
Power Module	00FP733	Tier 1
208 V Maintenance Bypass Panel (MBP)	00FP791	Tier 1
UPS Bezel Spare (includes LCD)	00FP792	Tier 1
UPS Battery Module, see the section Determining how many battery packs are to be replaced in Chapter 10 for additional information	00FP798	Tier 2
EBM Power Cord 400 mm / 15.75” 240V (includes EBM detection cable)	00FP795	Tier 1
4 Post Rail Kit	00FP796	Tier 2
Tower pedestal feet	00FP825	Tier 1
Ship Bracket	00FP827	Tier 1

RT8kVA and RT11kVA Extended Battery Module, 5594-9BX

Part description	**CRU part number**	**Type**
EBM 240 V chassis (does not include batteries)	00FP734	Tier 2
EBM Bezel Spare	00FP793	Tier 1
Battery Module, see the section Determining how many battery packs are to be replaced in Chapter 10 for additional information	00FP798	Tier 2
EBM Power Cord 400 mm / 15.75” 240V (includes EBM detection cable)	00FP795	Tier 1
4 Post Rail Kit for EBM	00FP796	Tier 2

Network Management Card

Part description	CRU part number	Type
Network Management Card 100 Mbps	46M4112	Tier 1
Network management Card setup cable (serial communication cable), 100 Mbps card	81Y2372	Tier 1
Environmental Monitoring Probe (EMP)	41Y9210	Tier 1

Appendix A. Specifications

UPS Specifications

The Lenovo 6U Rack or Tower UPS, model 5594-8KX and model 5594-9KX, are single phase UPS units.

The 6U Rack or Tower UPS, model 5594-8PX and model 5594-9PX, are three phase UPS units with a wye connected load between 380V and 415V. The input is three phase, the output is single phase.

Basic functionality

These UPS units are Online double conversion UPS units which can be manually switched to High Efficiency mode in which these UPS units operate as Line interactive UPS units.

Online double conversion UPS units

Online UPS units are also referred to as VFI UPS units. VFI stands for Voltage and Frequency Independent from mains supply. This type of UPS is referred to as an online or double conversion UPS unit. UPS units of this design permanently route the input voltage via a rectifier, that is the primary path for the power is always via the UPS inverter. During normal operation the utility AC is never fed through to the protected load. This means that the protected load is isolated from the actual input utility AC.

The generated DC is fed to both the UPS batteries and the inverter which in turn generates the AC voltage for the output. This design ensures that there are no switching times in case of utility power failure.

Switching times may occur when:

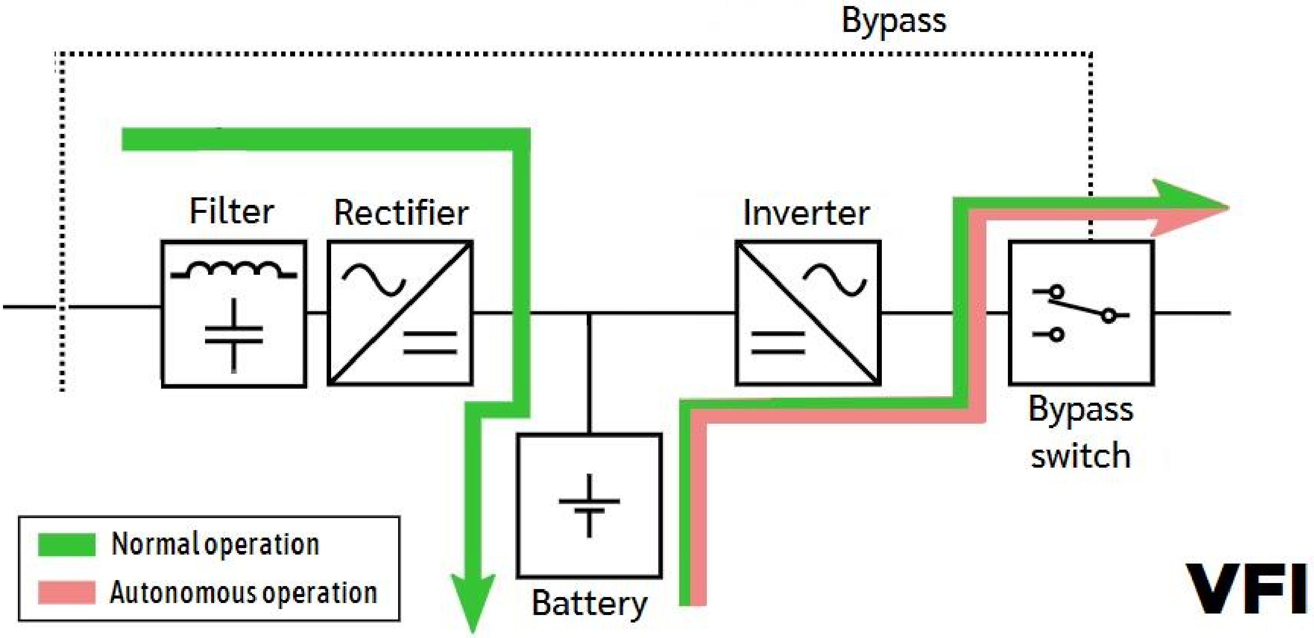
- battery charger or a battery or inverter power path fails
- unexpected and sudden change of load happens
- the inverter suffers from an internal control glitch

In this UPS topology both the inverter and the battery charger continuously convert the input power to DC and then back to AC. This leads to undesirable heat generation which as to be dissipated. This results in reduced UPS operation efficiency.

This type of UPS is the best choice for very sensitive devices that are to be protected.

On-line UPS units will only pass the input power to their output in case it is switched to bypass mode for maintenance purposes.

Figure 67: Work principle of an Online Double Conversion (VFI) UPS unit



Line interactive UPS units

Line interactive UPS units are also referred to as VI UPS units. VI stands for Voltage Independent from mains supply. Other names for this UPS types are line-interactive, single-conversion or delta-conversion UPS units.

The input utility power is passed through the UPS directly to the load. A Bidirectional inverter generates from the AC input voltage the DC voltage for charging the batteries as required and AC voltage from the UPS batteries in case of utility power failure.

An automatic voltage regulator, **AVR**, can correct abnormal voltages on the input utility AC without the need to switch to battery operation. The AVR will engage when input AC is outwith a preset lower or higher input voltage window. In case of the input voltage being below the lower threshold the UPS will boost the voltage and in case it is above the maximum input threshold it lower or buck the voltage. These voltage corrections are achieved with transformers.

Noise filters and suppressors in the UPS can also protect from electromagnetic line noise as well as unexpected surge in utility power due to e.g. lighting strikes.

The frequency of the input voltage, if it is present, is identical to that of the output voltage.

Due to the design of this UPS topology switching times from utility power to battery power occurs. The switching time can be between 2 ms to 10 ms.

On-line double conversion UPS units protect for these power issues - Power Failure, Power Sage, Power Surge, Under voltage, Over voltage, Line noise, Switching transients, Frequency variation, and Harmonic distortion.

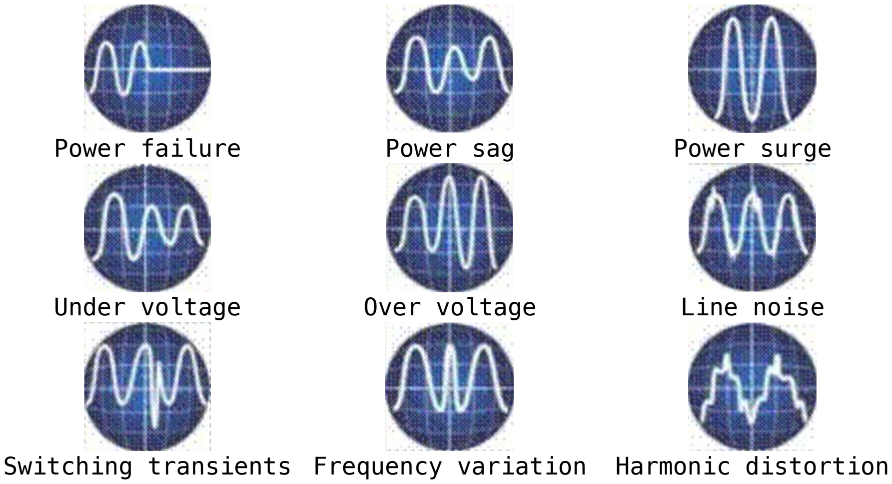
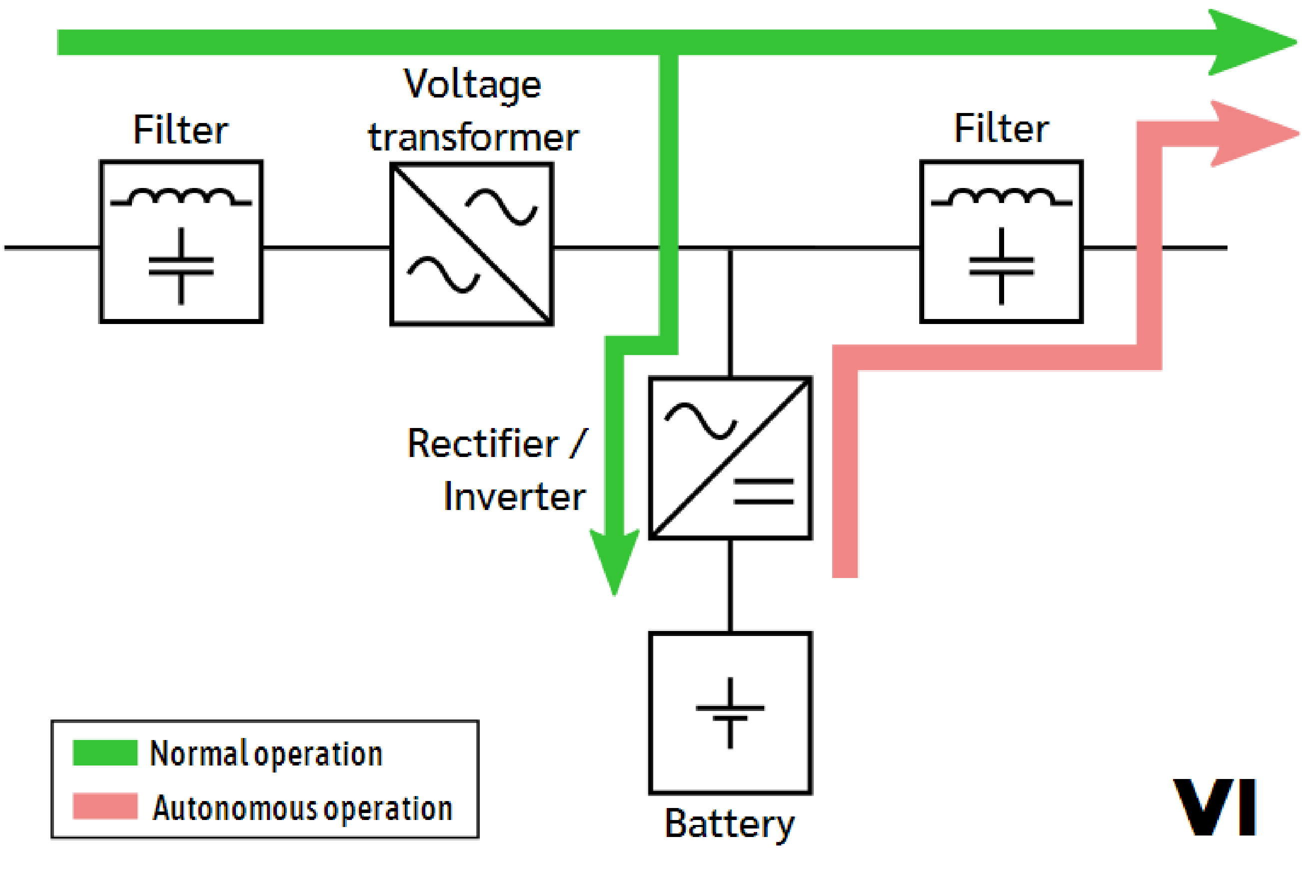


Figure 68: Work principle of an Line interactive (VI) UPS unit



The Line-Interactive UPS is the most common UPS used for small business, Web, and departmental servers. In this design, the battery-to-ac power converter (inverter) is always connected to the output of the UPS. Battery charging is provided by operating the inverter in reverse during times when the input AC power is normal. When the input power fails the transfer switch opens and the power flow is from battery to the UPS output. The fact that the inverter is always connected to the output provides additional filtering and yields reduced switching transients

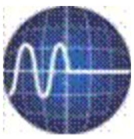
Line-interactive UPS systems use automatic voltage regulation (AVR) to correct abnormal voltages without switching to battery. (Regulating voltage by switching to battery drains your backup power and can cause batteries to wear out prematurely.) The UPS detects when voltage crosses a preset low or high threshold value and uses transformers to boost or lower the voltage by a set amount to return it to the acceptable range.

In "line" mode (i.e. when not operating from battery), line-interactive UPS systems typically regulate output within ±8 – 15 % of the nominal voltage (e.g. 120, 208, 230 or 240 volts). On-line UPS systems typically regulate voltage within ±2 – 3 %.

During an outage, line-interactive UPS systems typically transfer from line power to battery-derived power within two to four milliseconds, which is more than fast enough to keep all but a small percentage of the most power-sensitive equipment operating without interruption.

When operating from battery power, a line-interactive UPS system generates the waveform of its AC output.

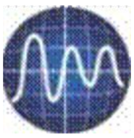
Line interactive UPS units protect for 5 common power issues – Power Failure, Power Sage, Power Surge, Under voltage, and Over voltage.



Power failure

Power sag

Power surge



Under voltage

Over voltage

Attention! When operating any of the 8 kVA or 11 kVA UPS units in HE (High Efficiency) Mode then these UPS units work as line-interactive UPS units. In this case it is strongly recommended to install frequency and voltage stabilisers as line-interactive UPS units can not compensate for all utility power problems and may get damaged!

Additional protection

The 8000VA and 11000VA UPS units are designed such that in case of an unexpected extreme power surge the UPS will take the hit. In that case an internal component will blow and render the UPS defective. In that case no more power will be provided to the load thus protecting the load from that power surge.

An additional safety mechanism prevents users from accidentally powering down the UPS unit via its power button.

Overview

8 kVA UPS units

Specification	RT8kVA 6U Rack or Tower UPS (200-240VAC)	RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
General		
Part Number	5594-8KX 5594-RU8, FC A543	5594-8PX 5594-RU8, FC A546
Country	World Wide	
Form factor	6 U Rack or Tower	
Topology	Online, double conversion, sine wave output HE (High Efficiency) mode: Line interactive	
EBM Support	Yes (55949BX)	Yes (55949BX)
EPOW connector	Yes	Yes
MBP required	Yes, single phase, shipped with UPS	Yes, three phase, shipped with UPS
Network Management Card	Yes, shipped with UPS in the box, needs to be installed	Yes, shipped with UPS in the box, needs to be installed
VA/Watts rating	8000 VA 7200 W	8000 VA 7200 W
Efficiency (on utility power)	Online mode: Up to 94.5% High efficiency mode: Up to 98%	

Overview - 8 kVA UPS units (continued)

Specification	RT8kVA 6U Rack or Tower UPS (200-240VAC)	RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
General		
Leakage current	Leakage current of the equipment is up to 5% of input current for the leakage current defined by the Input ground to UPS chassis per the UL standard 60950 5.1 Touch current and protective conductor current. For additional information see the section Leak current information in Chapter 12.	
Energy Star compliant	Yes	No
Electrical input		
Input voltage	200 - 240 V_{AC}, 1-Phase	380 - 415 V_{AC}, 3-Phase
Input frequency	50 – 60 Hz	50 – 60 Hz
Frequency slew rate	1 Hz / s 0.5 Hz / s HE Mode	1 Hz / s 0.5 Hz / s HE Mode
Max input amperage	40 A	40 A
Input connector	Hardwired terminal block	
Input line cord	Onsite wiring required	
Electrical output		
Output voltage settings	200/208/220/230/240 V_{AC}	
Output frequency	50/60 Hz	
Output power capacity	200 - 240 V_{AC}: 8000 VA/7200 W	
Output connectors	4x IEC 320-C19 (16 A) (on the MBP)	
Battery type	Valve Regulated Lead Acid (VRLA): Maintenance-free, sealed, leak-proof	
Battery management	ABM technology or temperature-compensated charging method (user selectable), automatic battery test and deep discharge protection, and automatic recognition of external battery units	
Battery replacement	Hot-swap standard and extended battery modules	
External battery support	Up to 4 (PN 55949BX)	

Overview - 8 kVA UPS units (continued)

Specification	RT8kVA 6U Rack or Tower UPS (200-240VAC)	RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
Batteries		
Typical backup times	See the Backup / Run time Tables	
Communications and management		
USB port (Type B) [*)]	Yes	Yes
RS-232 serial port (RJ-45) [*)]	Yes	Yes
10/100 Mbps Ethernet port (RJ-45) [*)]	Yes (on the Network Management Card)	
Environmental monitoring	Optional with Environmental Monitoring Probe, 46M4113 (connects to the Network Management Card)	
Management software	UPS Power Manager and UPS Power Protector	
Control panel	Intelligent 5-button graphical LCD	
LED indicators	Online, On Battery, Bypass, and Fault	
Remote On/Off and Power Off	Remote On/Off and Remote Power Off terminal block connectors	

[*)] **Attention!** The communication ports are exclusive!
It is not possible to use two or all three simultaneously!

11 kVA UPS units

Overview - 11 kVA UPS units

Specification	RT11kVA 6U Rack or Tower UPS (200-240VAC)	RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
General		
Part Number	5594-9KX 5594-RU8, FC A544	5594-9PX 5594-RU8, FC A547
Country	World Wide	
Form factor	6 U Rack or Tower	
Topology	Online, double conversion, sine wave output HE (High Efficiency) mode: Line interactive	
EBM Support	Yes (55949BX)	Yes (55949BX)
EPOW connector	Yes	Yes
MBP Required	Yes, single phase	Yes, three phase
Network Management Card	Yes, shipped with UPS in the box, needs to be installed	Yes, shipped with UPS in the box, needs to be installed
VA/Watts rating	11000 VA 10000 W	11000 VA 10000 W
Efficiency (on utility power)	Online mode: Up to 94.5% High efficiency mode: Up to 98%	
Transfer time	Online mode: 0 ms (no break) High efficiency mode: 10 ms maximum (due to loss of utility power)	
Leakage current	Leakage current of the equipment is up to 5% of input current for the leakage current defined by the Input ground to UPS chassis per the UL standard 60950 5.1 Touch current and protective conductor current. For additional information see the section Leak current information in Chapter 12.	
Energy Star compliant	Yes	No

Overview - 11 kVA UPS units (continued)

Specification	RT11kVA 6U Rack or Tower UPS (200-240VAC)	RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
Electrical input		
Input voltage	200 - 240 V_{AC}, 1-Phase	380 - 415 V_{AC}, 3-Phase
Input frequency	50 – 60 Hz	50 – 60 Hz
Frequency slew rate	1 Hz / s 0.5 Hz / s HE Mode	1 Hz / s 0.5 Hz / s HE Mode
Max input amperage	50 A	50 A
Input connector	Hardwired terminal block	
Input line cord	Onsite wiring required	
Electrical output		
Output voltage settings	200/208/220/230/240 V_{AC}	
Output frequency	50/60 Hz	
Output power capacity	• 200-208 V AC: 10000 VA/9000 W • 220 V AC: 11000 VA/9900 W • 230-240 V AC: 11000 VA/10000 W	
Output connectors	4x IEC 320-C19 (16 A) (on the MBP)	
Batteries		
Battery type	Valve Regulated Lead Acid (VRLA): Maintenance-free, sealed, leak-proof	
Battery management	ABM technology or temperature-compensated charging method (user selectable), automatic battery test and deep discharge protection, and automatic recognition of external battery units	
Battery replacement	Hot-swap standard and extended battery modules	
External battery support	Up to 4 (PN 55949BX)	
Typical backup times	See the Backup / Run time Tables	

Overview - 11 kVA UPS units (continued)

Specification	RT11kVA 6U Rack or Tower UPS (200-240VAC)	RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
Communications and management		
USB port (Type B) *)	Yes	Yes
RS-232 serial port (RJ-45) *)	Yes	Yes
10/100 Mbps Ethernet port (RJ-45) *)	Yes (on the Network Management Card)	
Environmental monitoring	Optional with Environmental Monitoring Probe, 46M4113 (connects to the Network Management Card)	
Management software	UPS Power Manager and UPS Power Protector	
Control panel	Intelligent 5-button graphical LCD	
LED indicators	Online, On Battery, Bypass, and Fault	
Remote On/Off and Power Off	Remote On/Off and Remote Power Off terminal block connectors	

*) **Attention!** The communication ports are exclusive!
It is not possible to use two or all three simultaneously!

Physical specifications

	Dimensions (H x W x D)	Weight (kg / lb)
RT8kVA and RT11kVA 6U UPS	130 mm (5.1 in) x 441 mm (17.4 in) x 700 mm (27.6 in)	8kVA 1-phase (55948KX): 19 kg (42 lb) 8kVA 3-phase (55948PX): 23 kg (51 lb) 11kVA 1-phase (55949KX): 21 kg (46 lb) 11kVA 3-phase (55949PX): 23 kg (51 lb)
Extended Battery Module	130 mm (5.1 in) x 441 mm (17.4 in) x 680 mm (26.8 in)	65 kg (143 lb)

Operating Environment

The RT8kVA and RT11kVA 6U Rack or Tower UPS units are supported in the following environments:

- Temperature (operation): 0 - 40 °C (32 - 104 °F), with linear derating for altitude
- Relative humidity: 0 - 95%
- Maximum altitude (operation): 3,000 m (9,843 ft)

Note: These UPS units ***are not*** supported in a maritime environment.

Power Module

Model	Power Module
5594-8PX, 5594-8KX	8000VA / 7200 W at 200 V, 208 V, 220 V, 230 V, 240 V, 250 V output
5594-9PX, 5594-9KX	10000VA / 9000 W at 200 V, 208 V, 250 V output
	11000VA / 9900 W at 220 V output
	11000VA / 10000 W at 230 V, 240 V output

Extended Battery Module

Model	Configuration	EBM Voltage	For power ratings
5594-9BX	Rack / Tower	240 V_{DC}	8000 – 11000 VA

Electrical input

Nominal frequency	50/60 Hz auto-sensing
Frequency range	50 Hz : 40 - 60 Hz before transfer to battery 60 Hz : 50 - 70 Hz before transfer to battery
Bypass voltage range	-20 % / +15 % of nominal value (default)
Noise filtering	MOV for normal and common mode noise

Electrical input on a per UPS model basis

Model	Default input (Voltage/Current)	Selectable input Voltage range	Voltage at 100% Load
5594-8PX	400 V / 11 A	350 V, 360 V, 380 V, 400 V, 415 V, 430 V	305 V - 478 V
5594-9PX	400 V / 15.3 A		
5594-8KX	208 V / 36.6 A	200 V, 208 V, 220 V, 230 V, 240 V, 250 V	176 - 276V
5594-9KX	208 V / 45.5 A		

Input tolerances information

The acceptable Bypass Voltage range is -20 % and +15 % of the nominal value (default).

The input voltage acceptable range doesn’t change and ranges always from 176 V_{AC} to 276 V_{AC}, which is a wider range because the UPS can still perform OK at these levels.

For example if the input is 240 V_{AC} and the input setting is set to 208 (default), then the input value needs to be changed to 240 in the LCD menu in order to avoid alarms or incorrect UPS function.

Power Surge Information

UPS unit	IEEE ANSI C62.41	kV	Joule
5594-8PX	B2	4	885
5594-8KX	B2	4	885
5594-9PX	B2	4	885
5594-9KX	B2	4	885

Note: Any Extended Battery Module does not have any influence on the surge rate as these are attached to the UPS unit and not utility power.

Electrical input connections

Model	Input connection	Input cable
55594-8PX, 5594-8KX	Hardwired	Not provided
5594-9PX, 5594-9KX		

Electrical output

All models	Normal mode	Battery mode
Voltage regulation	±1 %	±1 %
Efficiency	> 98 % (High Efficiency mode) > 94.5 % for 8-11kVA models	> 91 %
Frequency regulation	Sync with line ±5 % of nominal line frequency (outside this range: ±0.5 %	±0.5 % of auto-selected nominal frequency
Frequency	50 or 60 Hz, auto-sensing or configurable as a frequency converter	
Output overload	100-102 % : no alarm 102-110 % : load transfers to Bypass mode after 2 minutes 110-125 % : load transfers to Bypass mode after 1 minute 125-150 % : load transfers to Bypass mode after 10s	
Output overload (Bypass mode)	100-125 % : no alarm 125-150 % : UPS shuts down after 1 minute	
Voltage waveform	Sine wave	
Harmonic distortion	< 2 % THDV on linear load < 5 % THDV on non-linear load	

Transfer time	Online mode: 0 ms (no break); UPS operates in online-dobule conversion mode High Efficiency mode: 10 ms maximum (due to loss of utility power) UPS operates in line interactive mode
Power factor	0.9
Load crest ratio	3 to 1

Input / Output specifications

RT8kVA 6U Rack or Tower UPS (200-240VAC), 5594-8KX or 5594-RU8 FC A548					
Input voltage range	200 V_{AC} – 240 V_{AC}				
Output voltage range	200 V_{AC} – 240 V_{AC}				
V_{in}	200 V_{AC}	208 V_{AC}	220 V_{AC}	230 V_{AC}	240 V_{AC}
Volt-Ampère (VA)	8000	8000	8000	8000	8000
Watts (W)	7200	7200	7200	7200	7200
I_{out}(max) (A)	40	38.5	36.4	34.8	33.3
Receptacles	4 x IEC 320 C19, 1 Hardwire Out				

RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-8PX or 5594-RU8 FC A546					
Input voltage range	380 V_{AC} – 415 V_{AC}				
Output voltage range	200 V_{AC} – 240 V_{AC}				
V_{in}	200 V_{AC}	208 V_{AC}	220 V_{AC}	230 V_{AC}	240 V_{AC}
Volt-Ampère (VA)	8000	8000	8000	8000	8000
Watts (W)	7200	7200	7200	7200	7200
I_{out}(max) (A)	40	38.5	36.4	34.8	33.3
Receptacles	4 x IEC 320 C19, 1 Hardwire Out				

RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX or 5594-RU8 FC A544					
Input voltage range	200 V_{AC} – 240 V_{AC}				
Output voltage range	200 V_{AC} – 240 V_{AC}				
V_{in}	200 V_{AC}	208 V_{AC}	220 V_{AC}	230 V_{AC}	240 V_{AC}
Volt-Ampère (VA)	10000	10000	11000	11000	11000
Watts (W)	9000	9000	9900	10000	10000
I_{out}(max) (A)	50	48.1	50	47.8	45.8
Receptacles	4 x IEC 320 C19, 1 Hardwire Out				

RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-9PX or 5594-RU8 FC A547	
Input voltage range	200 VAC – 240 VAC
Output voltage range	200 V_{AC} – 240 V_{AC}

Input / Output specifications RT11kVA 6U 3:1 UPS (continued)

RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-9PX or 5594-RU8 FC A547					
Vin	200 VAC	208 VAC	220 VAC	230 VAC	240 VAC
Volt-Ampère (VA)	10000	10000	11000	11000	11000
Watts (W)	9000	9000	9900	10000	10000
Iout(max) (A)	50	48.1	50	47.8	45.8
Receptacles	4 x IEC 320 C19, 1 Hardwire Out				

Electrical output connections

Model	**Output connection**	**Output cable**
5594-8PX, 5594-8KX	4 x IEC 320 C19 via MBP, 1 Hardwire Out	Not provided
5594-9PX, 5594-9KX		

AC input and output, Single-phase models

	5594-8KX	**5594-9KX**
AC Input power	200-240 VAC, 50/60 Hz, 1 ph, 40 A	200-240VAC, 50/60Hz, 1ph, 50A
AC Output power	50/60 Hz, Single phase 200 V_{AC}, 8000 VA, 7200 W, 40.0 A 208 V_{AC}, 8000 VA, 7200 W, 38.5 A 230 V_{AC}, 8000 VA, 7200 W, 34.8 A 240 V_{AC}, 8000 VA, 7200W, 33.3 A	50/60Hz, Single phase 200 V_{AC}, 10000 VA, 9000 W, 50.0 A 208 V_{AC}, 10000 VA, 9000 W, 48.1 A 230 V_{AC}, 11000 VA, 10000 W, 47.8 A 240 V_{AC}, 11000 VA, 10000 W, 45.8 A

AC input and output, Three-phase models

	5594-8PX	**5594-9PX**
AC Input power	350/360/380/400/415/430 VAC, 50/60 Hz, three phase, 13.3 A	350/360/380/400/415/430VAC, 50/60 Hz, 3 phase, 16.7 A
AC Output power	50/60 Hz, single phase 200 V_{AC}, 8000 VA, 7200 W, 40.0 A 208 V_{AC}, 8000 VA, 7200 W, 38.5 A 220 V_{AC}, 8000 VA, 7200 W, 36.4 A 230 V_{AC}, 8000 VA, 7200 W, 34.8 A 240 V_{AC}, 8000 VA, 7200 W, 33.3 A 250 V_{AC}, 8000 VA, 7200 W, 32.0 A	50/60 Hz, single phase 200 V_{AC}, 10000 VA, 9000 W, 50.0 A 208 V_{AC}, 10000 VA, 9000 W, 48.1 A 220 V_{AC}, 11000 VA, 9900 W, 50.0 A 230 V_{AC}, 11000 VA, 10000 W, 47.8 A 240 V_{AC}, 11000 VA, 10000 W, 45.8 A 250 V_{AC}, 10000 VA, 9000 W, 40.0 A

Weights and dimensions, Power Module

Machine Type - Model	D x W x H (mm / inch)	Weight (kg / lbs)
5594-8PX, 8 kVA	700 x 440 x 130 (27.6 x 17.3 x 5.1)	23 / 51
5594-8KX, 8 kVA	700 x 440 x 130 (27.6 x 17.3 x 5.1)	19 / 42
5594-9PX, 11 kVA	700 x 440 x 130 (27.6 x 17.3 x 5.1)	23 / 51
5594-9KX, 11 kVA	700 x 440 x 130 (27.6 x 17.3 x 5.1)	21 / 46

Minimum rack depth for UPS with Maintenance Bypass Panel: 900 mm (35.4 inches)

Weights and dimensions, Extended Battery Module including batteries

Machine Type – Model	D x W x H (mm / inch)	Weight (kg / lbs)
5594-9BX	680 x 440 x 130 (26.8 x 17.3 x 5.1)	65 / 143

Environmental and safety standards

EMC certifications	IEC/EN 62040-1: 2008 IEC/EN 62040-2: 2006 Cat. C2 IEC/EN 62040-3: 2011
EMC (Emissions) - for output cable < 10 m	CISPR22 Class A AS/NZS 22 Class A IEC 61000-3-2 (-3-12) IEC 61000-3-3 (-3-11)
EMC (Immunity)	IEC 61000-2-2 IEC 61000-4-2, Level 3 IEC 61000-4-3, Level 3 IEC 61000-4-4, Level 4 (also on signal ports) IEC 61000-4-5, Level 4, Criteria B IEC 61000-4-6, Level 3 IEC 61000-4-8, Level 4
Agency markings	CE / C-Tick
Operating temperature	0 to 40 °C (32 to 104 °F) in Online mode, with linear derating for altitude
Storage temperature	0 to 40°C (32 to 104°F) with batteries -15 to 60 °C (5 to 140 °F) without batteries
Transit temperature	-25 to 55 °C (-13 to 130 °F)
Relative humidity	0 to 95 % no condensing

Environmental and safety standards (continued)

Operating altitude	Up to 3,000 meters (9,843 ft) above sea level with 10 % derating per 1000m
Transit altitude	Up to 10,000 meters (32,808 ft) above sea level
Audible noise	< 48 dBA at 1 metre typical for 6-8kVA models < 50 dBA at 1 metre typical for 11kVA model

Battery, EBM

Extended Battery Module (EBM)	
Rating	240VDC 20 x 12V, 9 Ah
Fuse	80 A
Type	Sealed, maintenance-free, valve-regulated, lead-acid, with minimum 3-year float service life at 25 °C (77 °F).
Monitoring	Advanced monitoring for earlier failure detection and warning
Battery port	External three-pole SBS75G White connector on Power Module for connecting to EBM
EBM battery cable length	40 cm (15.75 in)

Communication options

Communication bay	1 available independent communication bay for connectivity
Compatible connectivity cards	UPS Network Management Card (included)
Communication ports	RS-232 (DB9): 1200-19200 bps USB: 19200 bps
Relay output contacts	4 relay outputs (normally open or normally closed)
Remote On/Off	2 pins jumper (normally open)
Remote Power Off	3 pins jumper (normally open or normally closed)

Hotswap MBP specifications

	8 / 11 kVA, Single phase	**8 / 11 kVA, Three phase**
Input	Terminal blocks	
Input bypass	n/a	Terminal blocks
Output	4x C19 + Terminal blocks	

Hotswap MBP specifications (continued)

	8 / 11 kVA, Single phase	8 / 11 kVA, Three phase
Overall dimensions D x W x H (mm / in)	172 x 336 x 130 mm / 6.8 x 13.2 x 5.1 in Minimum rack depth for UPS with MBP: 900 mm (35.4 inches)	
Weight (kg / lb)	6.2 / 13.7	5.5 / 12.1
Nominal voltage	200 - 240 V ~	350 - 430 V ~
Frequency	50/60 Hz	
Input nominal current	50 A	
Maximal power	11000 VA	
Safety Standards	IEC/EN 62040-1 / Ed.1: 2008. UL 1778 4th edition	IEC/EN 62040-1 / Ed.1: 2008
EMC	IEC 62040-2 / Ed.2: 2005. EN 62040-2 / Ed.2: 2006. FCC part 15 Class A	IEC 62040-2 / Ed.2: 2005 EN 62040-2 / Ed.2: 2006
Performance	IEC/EN 62040-3 / Ed.2.0: 2011	
ESD	IEC 61000-4-2 : level 3	
Radiated field	IEC 61000-4-3 : level 3	
EFT	IEC 61000-4-4 : level 4	
Fast transients	IEC 61000-4-5 : level 4	
Electromagnetic field	IEC 61000-4-6 : level 3	
Conducted magnetic field	IEC 61000-4-8 : level 4	
Marking	cULus Listed / CE	CE
Operating temperature	0 to 40 °C (32 to 104 °F)	
Storage temperature	-15 to 60 °C (5 to 140 °F)	
Transit temperature	-25 to 55 °C (-13 to 130 °F)	
Humidity	0 to 95 % non-condensing	
Operation Altitude	Up to 3,000 m (9,843 ft) above sea level with 10 % derating per 1000 m	
Transit Altitude	Up to 10,000 m (32,808 ft) above sea level	

Recommended upstream protection (normal upstream source)

UPS power rating	Upstream CB	Upstream RCD [(*)]
8000 VA	D curve – 50 A	D curve – 50 A, 420 mA
11000 VA	D curve – 70 A	D curve – 70 A, 420 mA

(*) The use of an RCD with any of these UPS units is strongly discouraged due to the high leak currents. For futher information see the section Leak current information in Chapter 12.

Recommended upstream protection (bypass AC source)

UPS power rating	Upstream CB
8000 VA	D curve – 50 A
11000 VA	D curve – 70 A

Front and back view

The following figures are the front and back view of the 8000VA and 11000 VA UPS units with EBM and MBP, 4xIEC 320 C19 outlets.

Figure 69: Front view rack

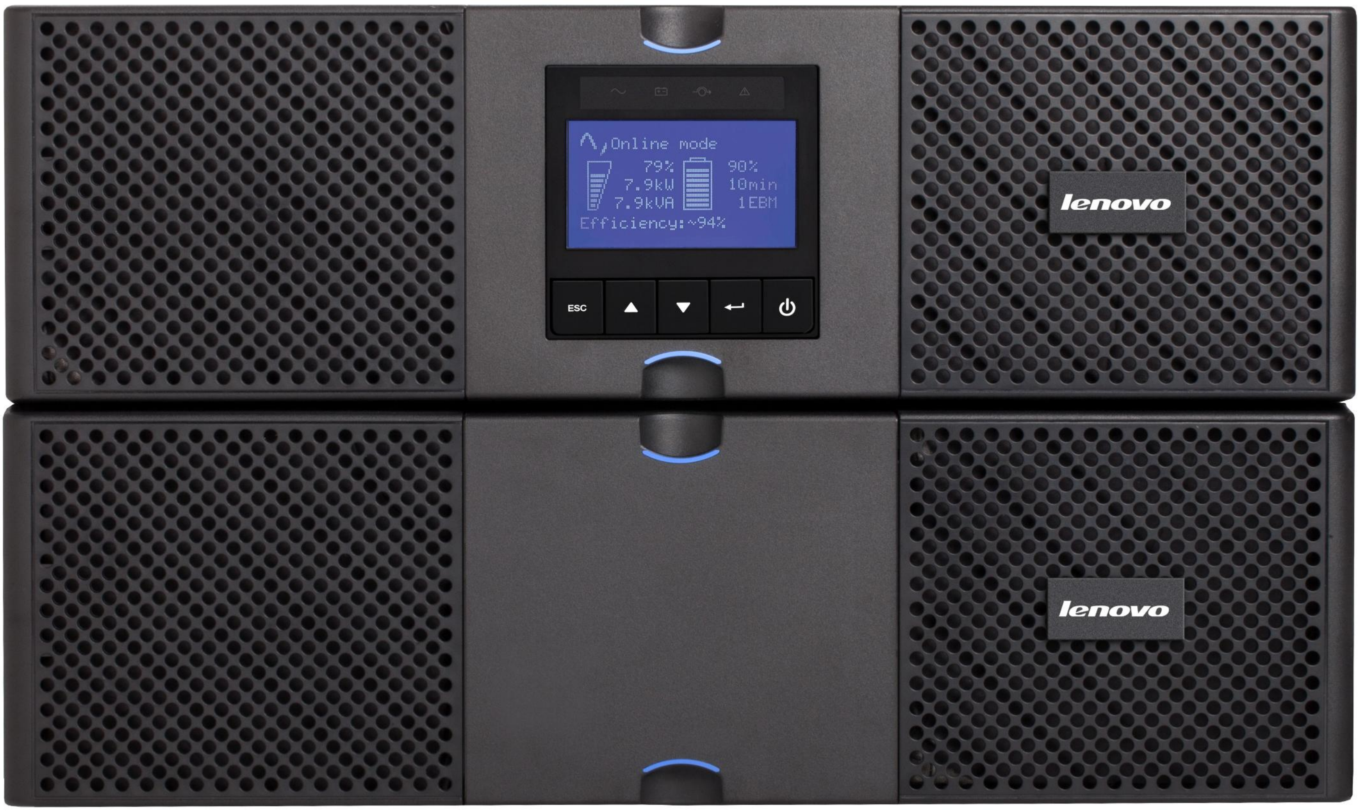


Figure 70: Single phase UPS rear view with EBM (5594-8KX and 5594-9KX)

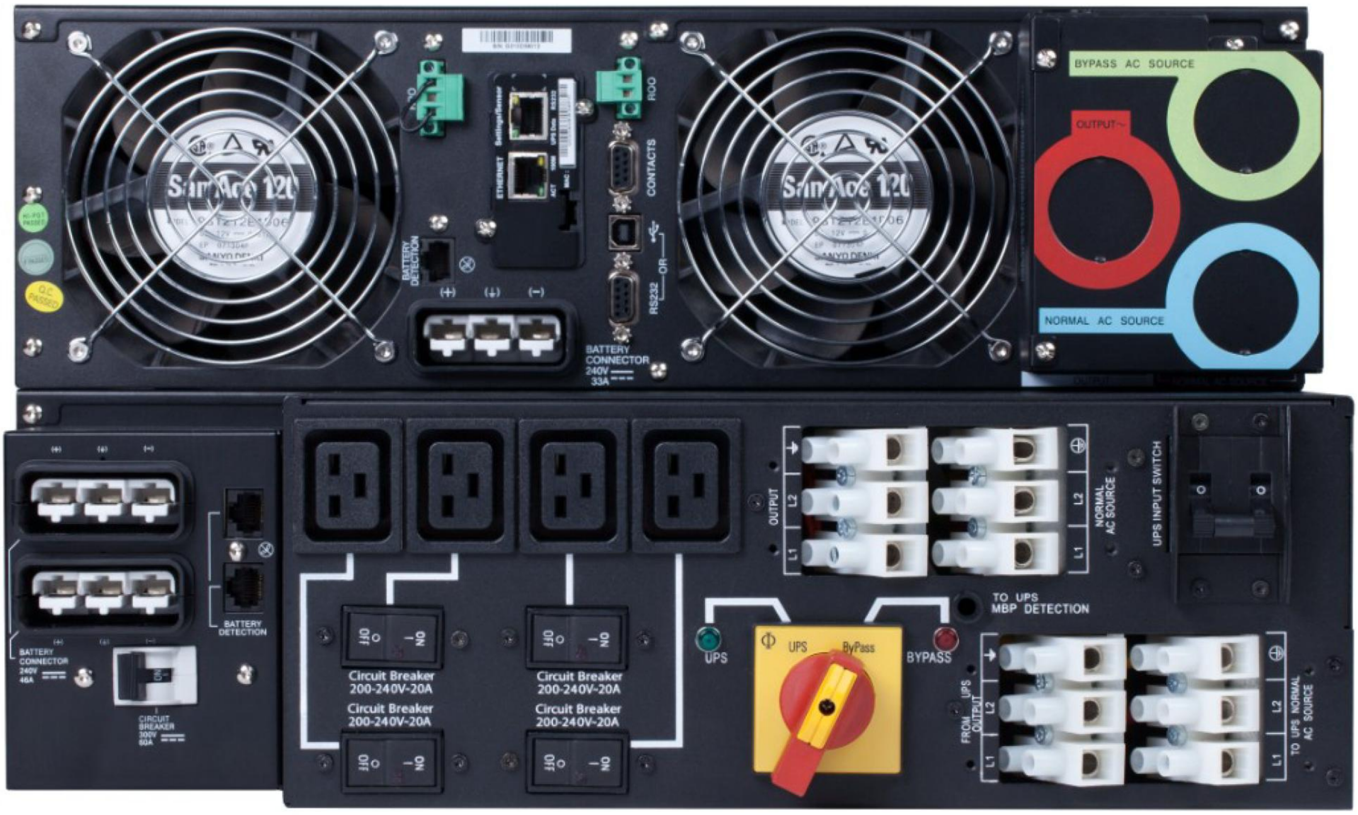


Figure 71: Single phase UPS rear view with EBM with input / output terminal block attached (5594-8KX and 5594-9KX)

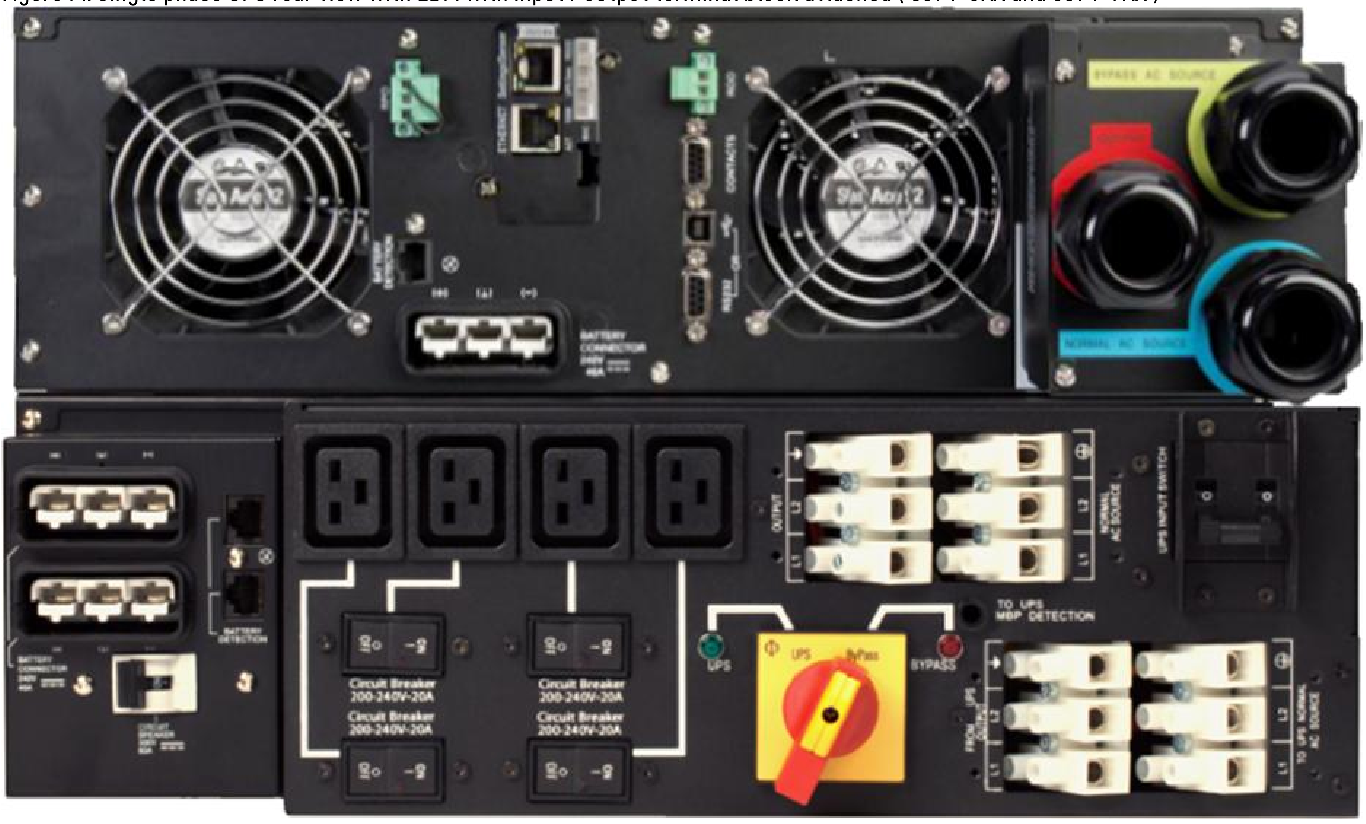
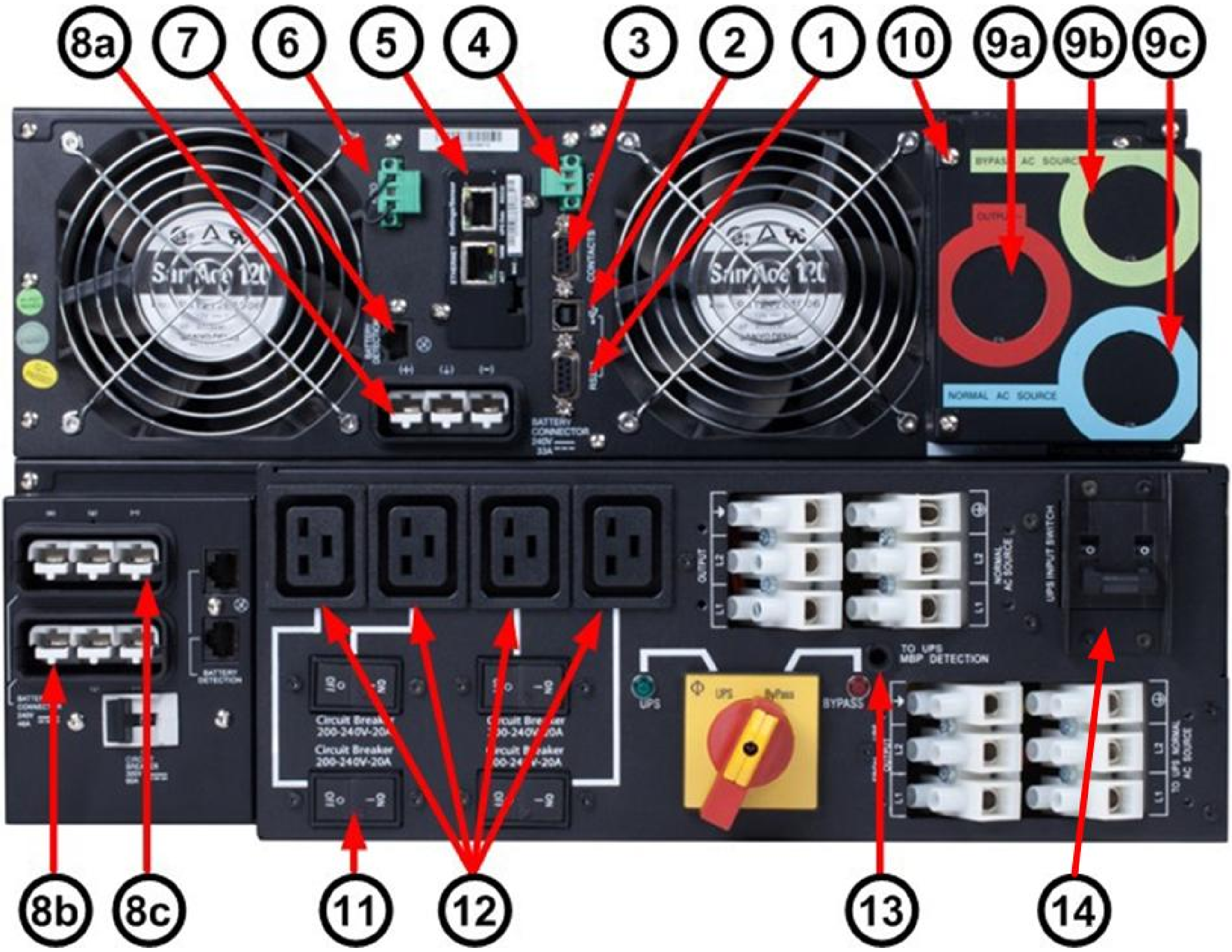


Figure 72: Three phase UPS with MPB attached (5594-8PX and 5594-9PX)

Figure 73: Extended Battery Module for 8 kVA and 11 kVA single and three phase UPS

Outlet Diagram

The following section shows the outlets on the rear of a UPS and MBP with 4 x C19 outlets.



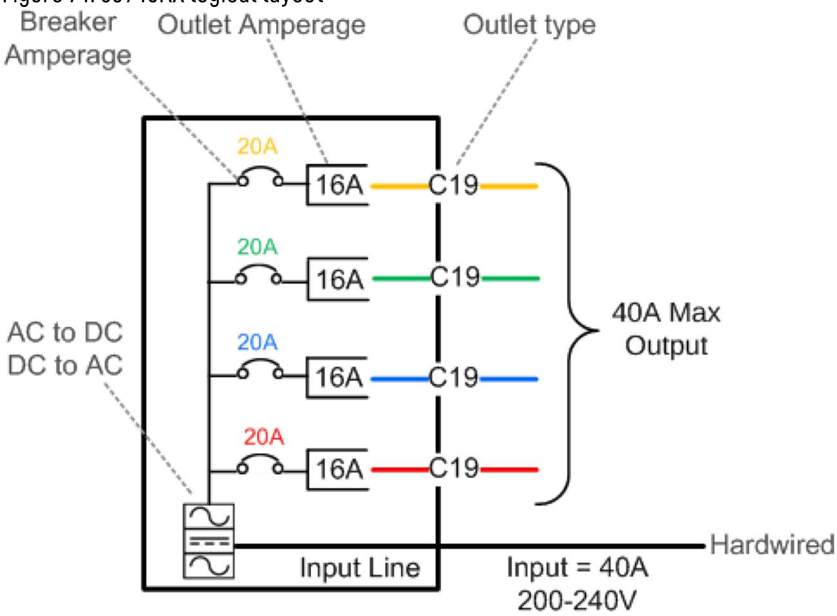
1 RS232 communication port
2 USB communication port
3 Dry (relay) contacts communication port
4 Connector for Remote On/Off (ROO) control
5 Slot where UPS Network Management Card (NMC) is installed
6 Connector for Remote Power Off (RPO) control
7 Connectors for automatic recognition of battery module
8 Connector for battery module power:
   8.a Connector EBMs (up to 4)
   8.b EBM to EBM connector
   8.c EBM to UPS connector
9 Terminal blocks for AC power input and output:
   9.a Output
   9.b Bypass input
   9.c Input
10 Connector for Hot-swap detection
11 Circuit breakers
12 4x Groups: 20A outlets for connection of equipment
13 MBP detection
14 MBP circuit breaker

Logical diagrams

The following figures show the logical layout of the UPS outlets and input line cord.

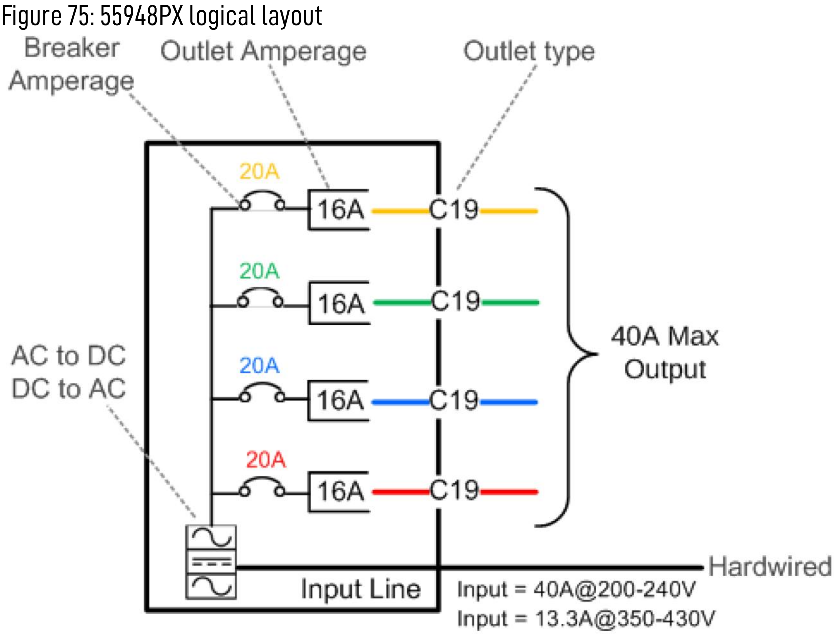
55948KX (8000VA/7200W)

Figure 74: 55948KX logical layout



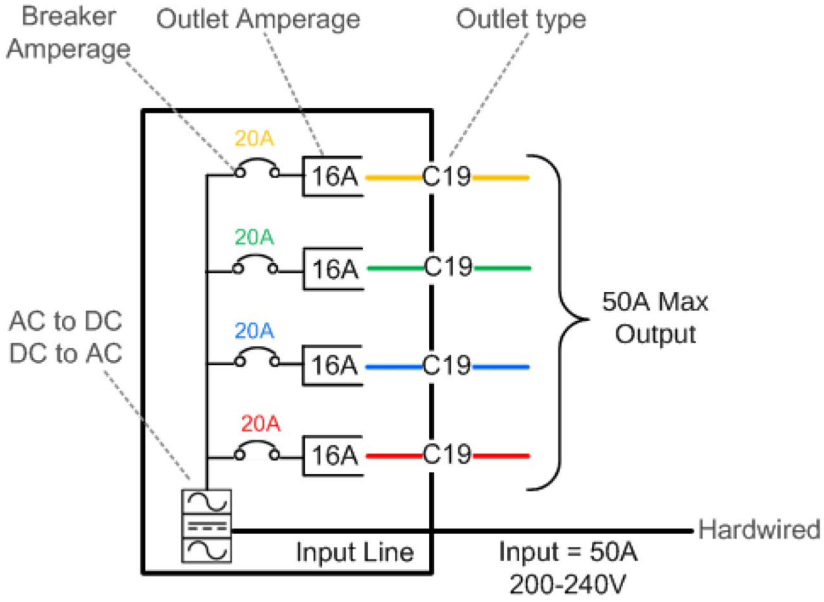
55948PX (8000VA/7200W)

Figure 75: 55948PX logical layout



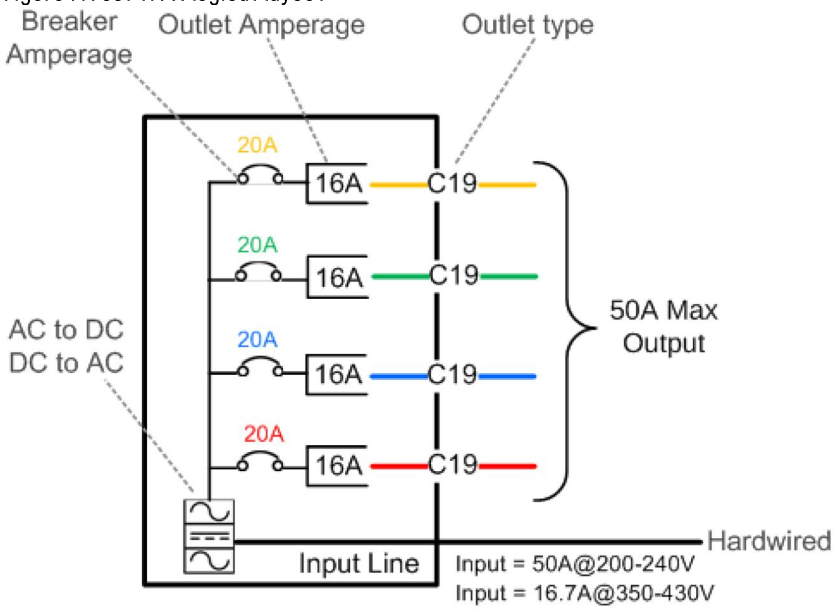
55949KX (11000VA/10000W)

Figure 76: 55949KX logical layout



55949PX (11000VA/10000W)

Figure 77: 55949PX logical layout



Extended Battery Module (EBM) Connection

The connection for the 8000VA and 11000VA UPS to Extended Battery Module (EBM) is shown below. Up to 4 EBMs can be daisy chained together off 1 UPS.

Refer to the Backup / Run time tables section for the 8000 VA and 11000 VA UPS units for details on the additional minutes of run time the EBM(s) will provide at various loads.

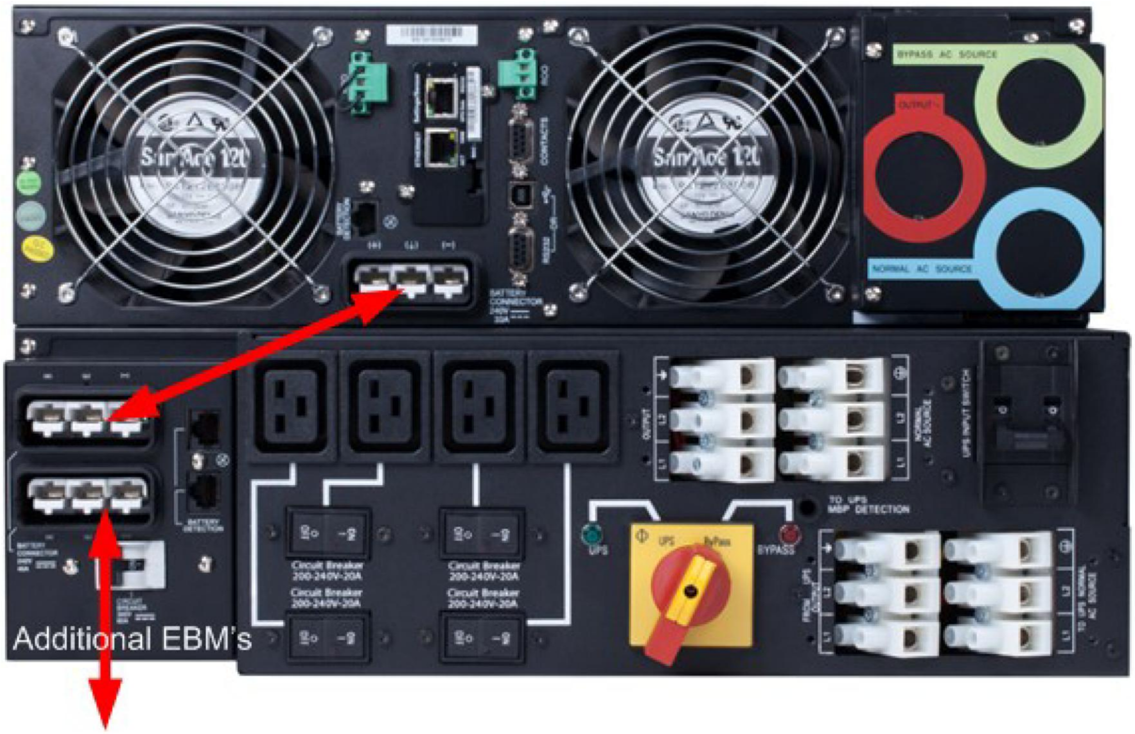


Figure 78: Rack EBM connection example

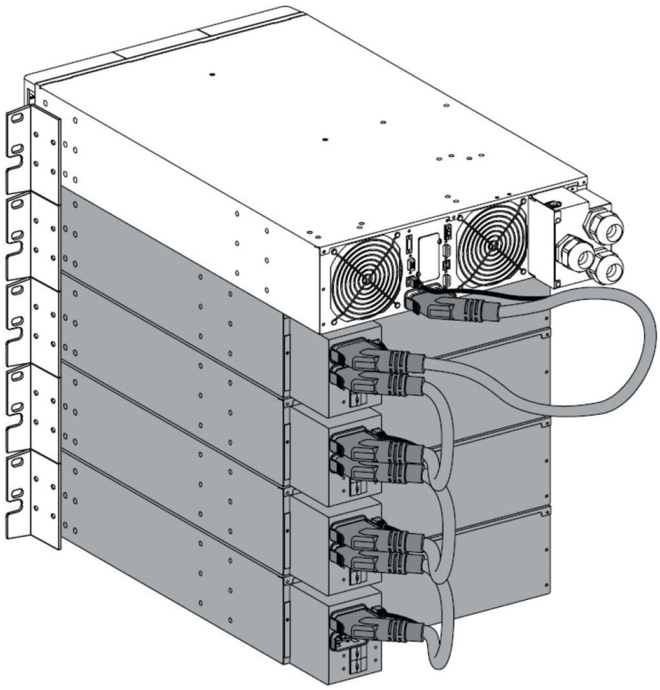
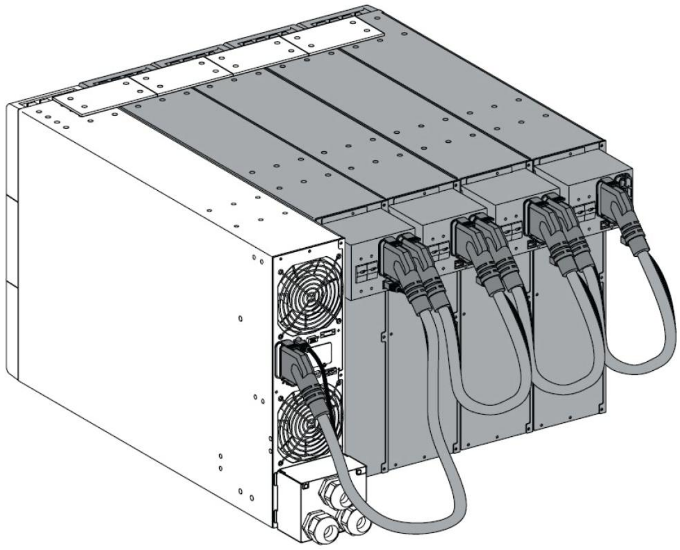


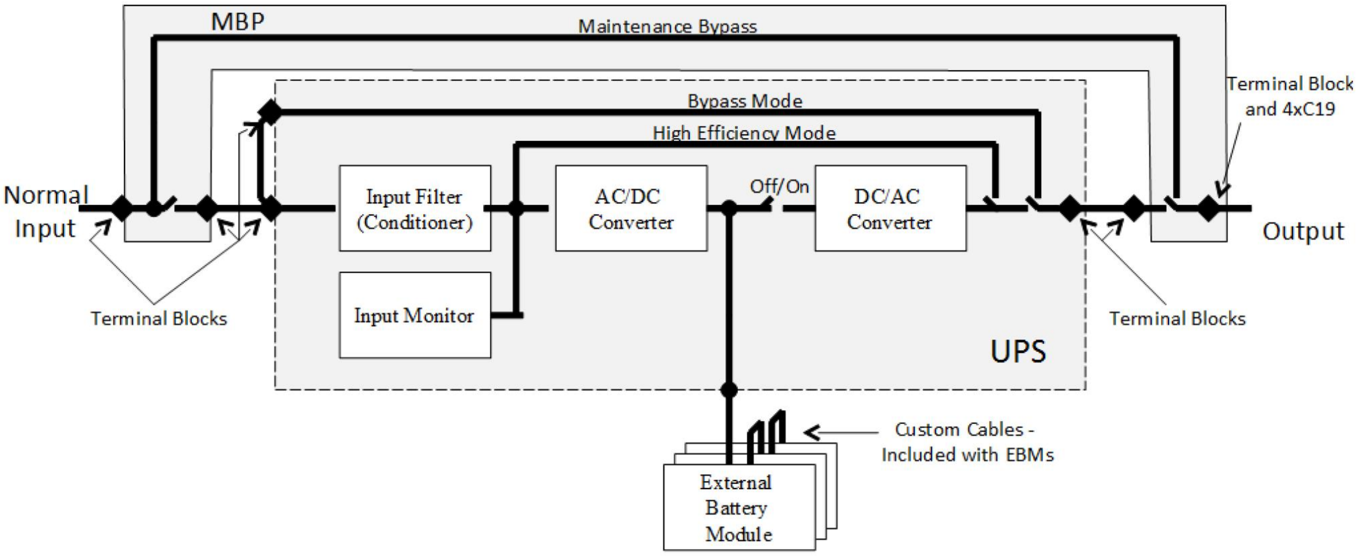
Figure 79: Tower EBM connection example



Block Diagram with Maintenance Bypass Module (MBP)

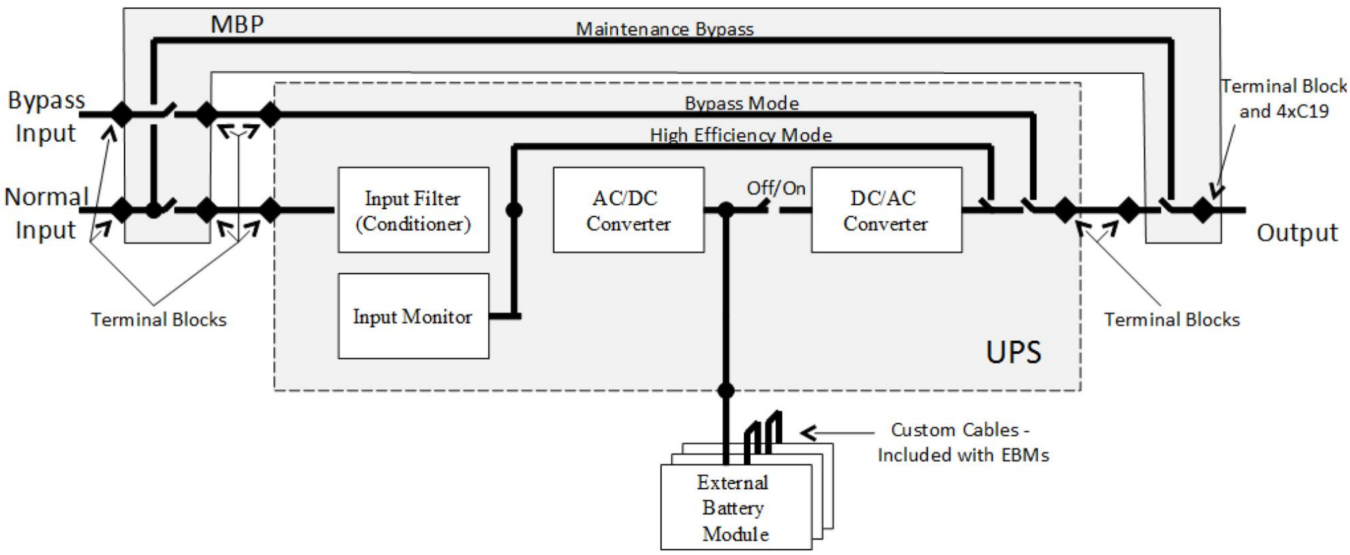
The following figure represents the block diagram for the 8000VA and 11000 UPS single phase.

Note: This is Double Conversion: Converts AC to DC to AC.



The following figure represents the block diagram for the 8000VA and 11000VA UPS three phase.

Note: This is Double Conversion: Converts AC to DC to AC.



For additional information on the Maintenance Bypass module, refer to the Chapter 7 Maintenance Bypass Operation.

Optional Accessories

The 8000VA and 11000 UPS units can be ordered with the following optional accessories:

Part Number	Feature Code	Description
46M4113	6146	Environmental Monitoring Probe (EMP)
55949BX	A545	Extended Battery Module (EBM) (Max qty 4)

Enviornmental Monitoring Probe

Figure 80: Environmental Monitoring Probe (EMP)

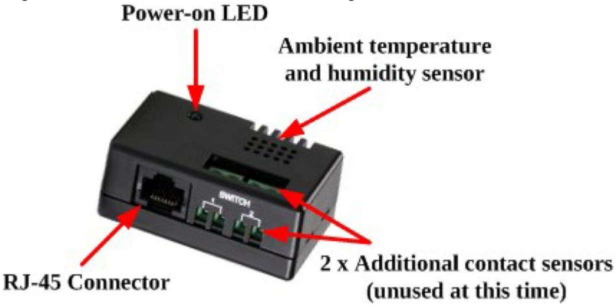


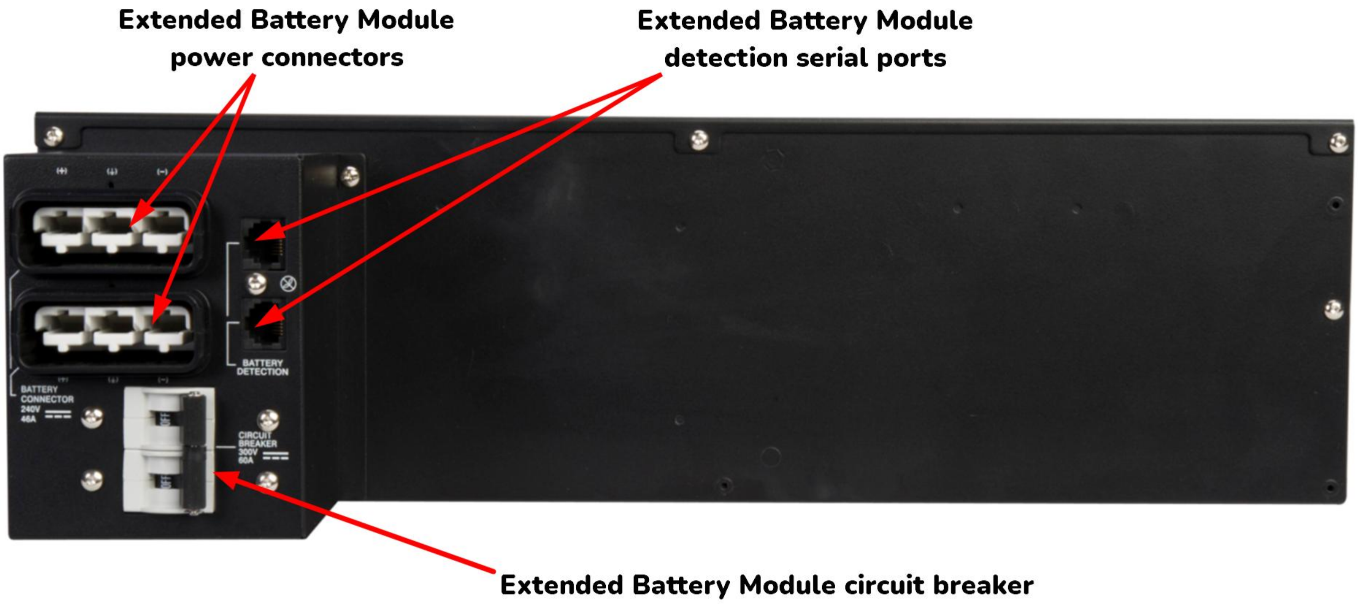
Figure 80 shows the Environmental Monitoring Probe (EMP). It needs to be ordered separately.

The EMPs purpose is to report on local environmental temperature and humidity at its installed location. For example, if the EMP device is installed at the top of a rack, it will report on the temperature and humidity values at that location.

The device can be installed anywhere on the rack by using either the screws or the self-adhesive hook-and-loop fasteners. Once attached to the rack, connect the CAT5 cable to the UPS or a supported PDU Ethernet connector.

Note: The installation of a Network Management Card (NMC) is required for the EMP to be connected to the device.

Extended Battery Module (EBM)



Newer EBMs are shipped with a different designed circuit breaker switch:

Backup / Run Time Tables

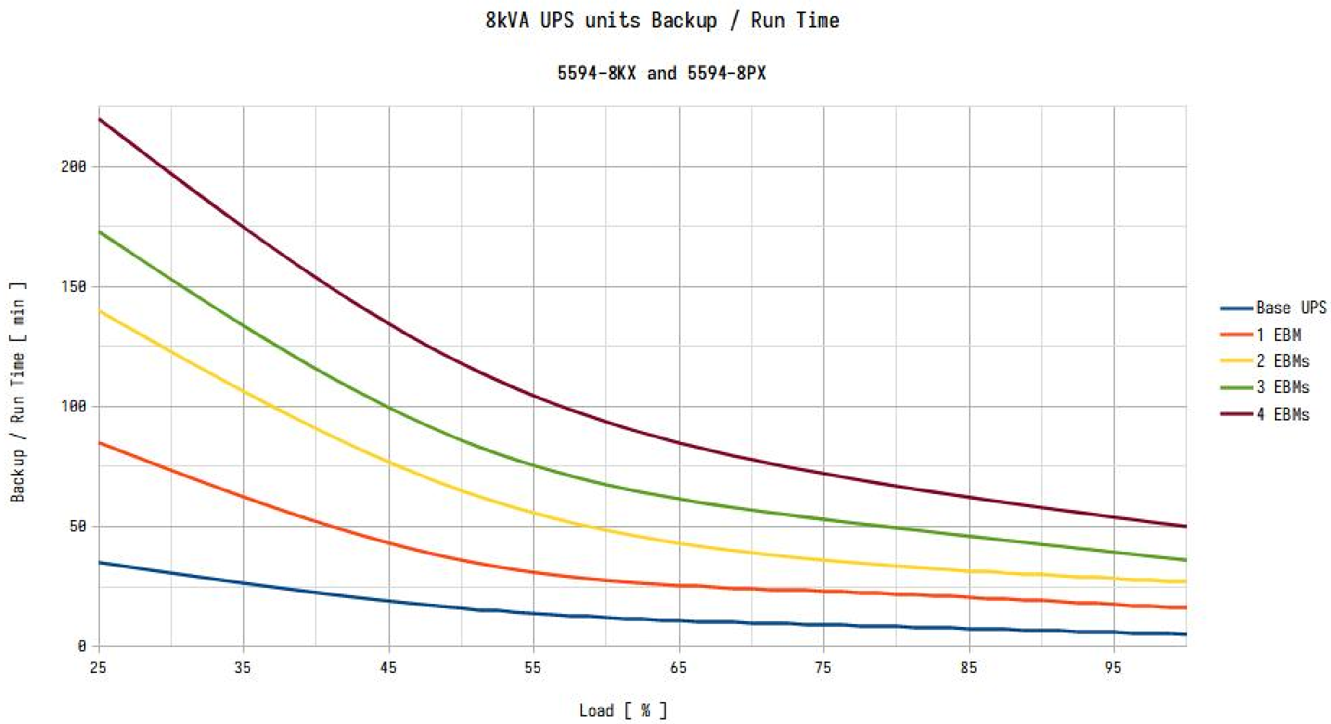
8kVA UPS units

The below table is for the

- Lenovo and IBM RT8kVA 6U Rack or Tower UPS (200-240VAC), 5594-8KX
- Lenovo and IBM RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-8PX

UPS units.

Load		Backup / Run Time in minutes				
Percent	**Watt**	**Base UPS**	**1x EBM**	**2x EBMs**	**3x EBMs**	**4x EBMs**
25 %	1800 W	35	85	140	173	220
50 %	3600 W	16	36	65	86	118
75 %	5400 W	9	23	36	53	72
100 %	7200 W	5	16	27	36	50



Note: The backup / run times in the above table has been measured with fresh, new batteries. The battery backup / run times are approximate and will vary with equipment, configuration, battery age, and temperature.

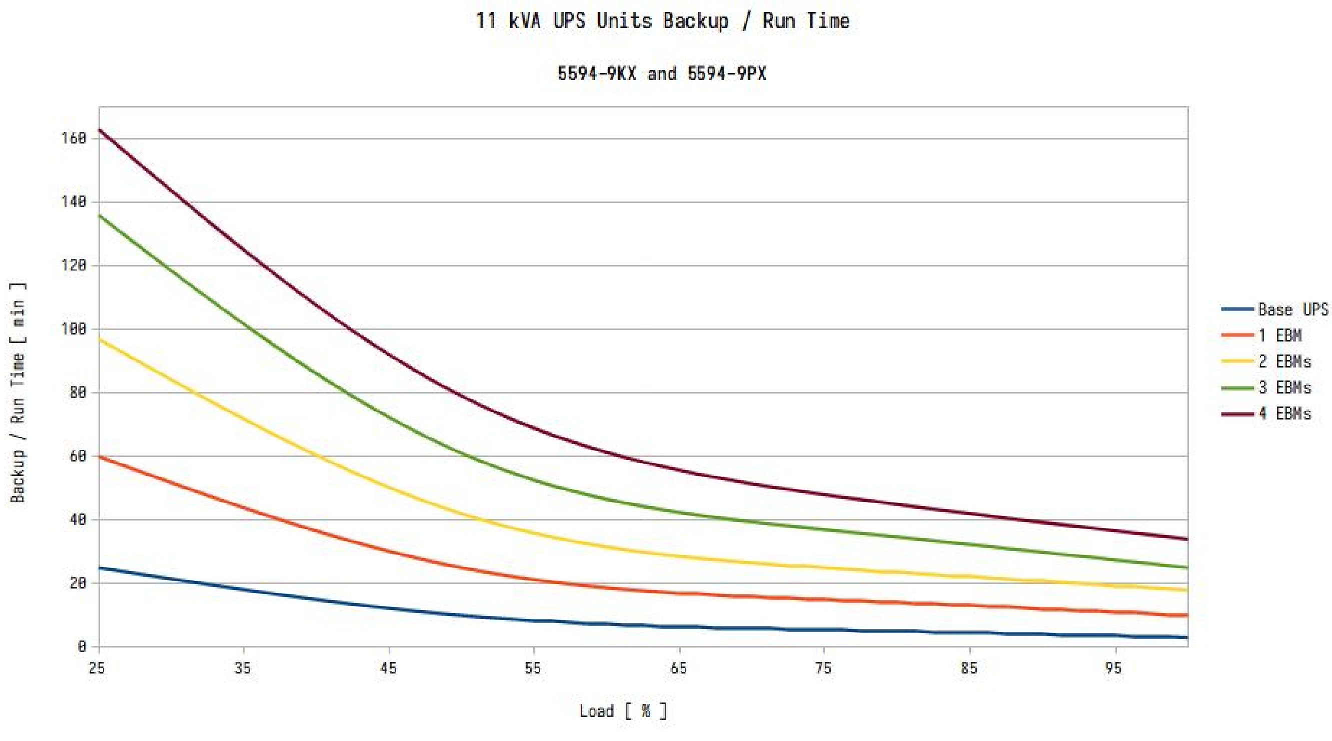
11 kVA UPS units

The below table is for the

- Lenovo and IBM RT11kVA 6U Rack or Tower UPS (200-240VAC), 5594-9KX
- Lenovo and IBM RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC), 5594-8PX

UPS units.

Load		Backup / Run Time in minutes				
Percent	**Watt**	**Base UPS**	**1x EBM**	**2x EBMs**	**3x EBMs**	**4x EBMs**
25 %	2500 W	25	60	97	136	163
50 %	5000 W	10	25	42	61	79
75 %	7500 W	5.5	15	25	37	48
100 %	10000 W	3	10	18	25	34



Note: The backup / run times in the above table has been measured with fresh, new batteries. The battery backup / run times are approximate and will vary with equipment, configuration, battery age, and temperature.

Appendix B Information sources

Chapter 3

Images used in Required electrical earthing systems

Figure 15, Figure 16	Ingenieur Matthias Habsburg-Lothringen, retired power specialist at IBM Austria

Chapter 5

IEC 60309 Plug photograph taken from
https://en.wikipedia.org/wiki/IEC_60309

Chapter 9

Bezel replacement procedure

Replacing the Front Bezel of a Single Phase UPS unit and Replacing the Front Bezel of a Three Phase UPS unit provided by Paul E Sagun, retired Eaton engineer, and Reginal Greene, Eaton engineer.

Chapter 10

Reasons for premature battery failure

Image of battery discharge depending on temperature taken from KaiYing Power Supply & Electrical Equip Co., Ltd. (LONGWAY Battery) at

http://www.longwaybattery.com/products002.html

Emergency Off error displayed on LCD

Kill switch image obtained from:
https://en.wikipedia.org/wiki/Kill_switch#/media/File:Emergency_stop_button.jpg

Chapter 11

Circuit breaker to be used

Earth leakage considerations using an RCD, modified FAQ from Schneider Electric at

https://www.apc.com/us/en/faqs/FA156793/

Images UPS units

Figure 56 Figure 57	German Wikipedia https://de.wikipedia.org/wiki/Unterbrechungsfreie_Stromversorgung

Images Power Environment

Figure 58, Figure 59, Figure 60	Ingenieur Matthias Habsburg-Lothringen, retired power specialist at IBM Austria
Figure 61 Figure 62	English Wikipedia https://en.wikipedia.org/wiki/Earthing_system

Power Environment

The majority of this section was provided by Ingenieur Matthias Habsburg-Lothringen, retired Power Environment Specialist and Installation Planning Representative, System z & Power Systems HW CE / SSR, IBM Austria. Additional information on earthing systems was retrieved in December 2020 from the following Wikipedia article:

https://en.wikipedia.org/wiki/Earthing_system

Additional information sources for the Circuit Breaker section

English Wikipedia article on Circuit Breakers, retrieved February 20th, 2017
https://en.wikipedia.org/wiki/Circuit_breaker

D Curve Circuit breaker information provided courtesy of VDE e. V. (Verband der Elektrotechnik, Elektronik und Informationstechnik), Germany.

Studyelectrical.com
http://www.studyelectrical.com/2014/07/miniature-circuit-breakers-mcb-types-characteristic-curves.html

UPS Units

Additional information on Line-interactive and On-Line Double conversion UPS units has been obtained from:

https://blog.tripplite.com/line-interactive-vs-on-line-ups-systems

https://www.sweetwater.com/insync/line-interactive-ups/

https://www.sweetwater.com/insync/double-conversion-line-ups/

Section Single-, Split-, and 3-Phase information

The information in the section Single-, Split-, and 3-Phase information in Chapter 11 was obtained from the following web pages with permission of the respective owner where applicable:

Wire Colour Codes
https://www.electricaltechnology.org/2013/12/three-phase-electrical-wiring.html

Three Phase Diagrams
http://power.apitech.com/engineering-tools.aspx
(Not available anymore)

Background information
https://www.electronicshub.org/difference-between-single-phase-and-three-phase/

Split Phase Systems Background
https://www.allaboutcircuits.com/textbook/alternating -current/chpt-10/single-phase-power-systems
(Not available anymore)

Split-Phase Diagram
https://www.samlexamerica.com/support/documents/ WhitePaper-20240VACSingleSplitPhaseandMultiWireBranchCircuits .pdf
(Not available anymore)

Protective Earth
https://av-info.eu/index.html?https&&&av-info.eu/power/functional-earth.html

Appendix A

Figure 67 Figure 68	German Wikipedia https://de.wikipedia.org/wiki/Unterbrechungsfreie_Stromversorgung

Third party and additional images

Images from external resources:

	https://commons.wikimedia.org/wiki/File:IEC_60417-5019.svg
	https://publicdomainvectors.org/
	https://publicdomainvectors.org/
	https://ec.europa.eu/growth/single-market/ce-marking_en#:~:text=The%20letters%20'CE'%20appear%20on,health%2C%20and%20environmental%20protection%20requirements
	https://en.wikipedia.org/wiki/Recycling_codes#/media/File:Plastic_Recycling_Code_01_PET.svg
	https://publicdomainvectors.org/

Flag images

All images of flags in this document were obtained from:

https://flagpedia.net/download

LCD panel images

All LCD panel pictures were provided by Eaton Corporation, Lee Niño and Elizabeth T Bagnas.

LCD panel replacement procedures

All images were provided by Paul E Sagun, retired Eaton engineer.

Any other photographs

Some rack installation and error message photographs were provided by Andrey Pivnev (IBM Russia) and Brent Raven (School District 6 Rocky Mountain, Canada) with the help of Charles Coleman (School District 6 Rocky Mountain, Canada).

All other UPS photographs were provided by Eaton Corporation.

Circled Font used in images

The Circle Outline PhotoSupply font has been used in the following images -

- Figure 30
- Image "5594-8PX / 5594-9PX MBP Terminal Block"
- Three phase MBP cable connection, "With common Normal and Bypass AC source", underneath step 9
- Three phase MPB cable connection "With separate Normal and Bypass AC source", underneath step 19

This font is free for Personal and Commercial use. It is available for download from:

https://www.photoshopsupply.com/fonts/circle-font

Appendix C. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about Lenovo products, you will find a wide variety of sources available from Lenovo to assist you.

Use this information to obtain additional information about Lenovo and Lenovo products, and determine what to do if you experience a problem with your Lenovo system or optional device.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself.

If you believe that you require warranty service for your Lenovo product, the service technicians will be able to assist you more efficiently if you prepare before you call.

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Check for updated software, firmware, and operating-system device drivers for your Lenovo product. The Lenovo Warranty terms and conditions state that you, the owner of the Lenovo product, are responsible for maintaining and updating all software and firmware for the product (unless it is covered by an additional maintenance contract). Your service technician will request that you upgrade your software and firmware if the problem has a documented solution within a software upgrade.
- If you have installed new hardware or software in your environment, check http://www.lenovo.com/us/en/serverproven/ to make sure that the hardware and software is supported by your product.
- Go to http://www.lenovo.com/support to check for information to help you solve the problem.
- Gather the following information to provide to the service technician. This data will help the service technician quickly provide a solution to your problem and ensure that you receive the level of service for which you might have contracted.
- Hardware and Software Maintenance agreement contract numbers, if applicable
- Machine type number (Lenovo 4-digit machine identifier)
- Model number
- Serial number
- Current system UEFI, firmware, and software levels
- Other pertinent information such as error messages and logs

- Go to http://datacentersupport.lenovo.com and check for information to help you solve the problem.
  - Check the Lenovo forums at https://forums.lenovo.com/t5/Datacenter-Systems/ct-p/sv_eg to see if someone else has encountered a similar problem.
- Go to https://datacentersupport.lenovo.com/supportphonelist in order to call Lenovo support

You can solve many problems without outside assistance by following the troubleshooting procedures that Lenovo provides in the online help or in the Lenovo product documentation. The Lenovo product documentation also describes the diagnostic tests that you can perform. The documentation for most systems, operating systems, and programs contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the documentation for the operating system or program.

Customer responsibilities for code installation

The customer is responsible for installation of code.

"Code" can refer to firmware, uEFI, IMM, BIOS, device drivers, utility programs and diagnostics.

Customer responsibilities

You are responsible for downloading or obtaining from the Lenovo support site, and installing designated Machine Code (microcode, uEFI, IMM, basic input/output system code (called "BIOS"), utility programs, device drivers, and diagnostics delivered with a Lenovo ThinkSystem) and other software updates in a timely manner from the Lenovo Internet Web site or from other electronic media, and following the instructions that Lenovo or IBM provides. You may request Lenovo or IBM to install Machine Code changes; however, you may be charged for that service, depending on the service contract in place.

Lenovo may release changes to the Machine Code. The Machine Code changes are available for download by selecting your product from either a Lenovo support web site.

You may also obtain updated code by contacting your Lenovo or IBM representative.

If the machine does not function as warranted and your problem can be resolved through your application of downloadable Machine Code, you are responsible for downloading and installing these designated Machine Code changes as Lenovo or IBM specifies. If you would prefer, you may request Lenovo or IBM to install the downloadable Machine Code changes; however, you may be charged for that service, depending on the service contract in place.

For further information see also these support documents:

- Before you call Lenovo Service
- Lenovo Warranty Policies
- Lenovo ThinkSystem Firmware and Driver Update Best Practices - An Introduction

Lenovo Data Center (DCG) Server support phone numbers are listed at

https://datacentersupport.lenovo.com/supportphonelist

Using the documentation

Information about your Lenovo system or optional device is available in the product documentation. That documentation can include printed documents, online documents, readme files, and help files.

See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. Lenovo maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.lenovo.com/support.

All Lenovo ThinkSystem documentation is available at http://thinksystem.lenovofiles.com/help/index.jsp and all Lenovo System x documentation is available at https://systemx.lenovofiles.com/help/index.jsp.

Getting help and information from the World Wide Web

Up-to-date information about Lenovo products and support is available on the World Wide Web.

On the World Wide Web, up-to-date information about Lenovo systems, optional devices, services, and support is available at http://www.lenovo.com/support.

Gathering information needed to call Support

If you require warranty service for your Lenovo product, the service technicians will be able to assist you more efficiently if you prepare the appropriate information before you call. You can also go to http://datacentersupport.lenovo.com/warrantylookup for more information about your product warranty.

Gather the following information to provide to the service technician. This data will help the service technician quickly provide a solution to your problem and ensure that you receive the level of service for which you might have contracted:

- Hardware and Software Maintenance agreement contract numbers, if applicable
- Machine type number (Lenovo 4-digit machine identifier)
- Model number
- Serial number
- Current system UEFI and firmware levels
- Other pertinent information such as error messages and logs
- If needed, a copy of the purchase invoice

Collecting service data

To clearly identify the root cause of a server issue or at the request of Lenovo Support, you might need collect service data that can be used for further analysis. Service data includes information such as event logs and hardware inventory.

Service data can be collected through the following tools, unless stated otherwise in this document:

- **Lenovo XClarity Provisioning Manager**
  Use the Collect Service Data function of Lenovo XClarity Provisioning Manager to collect system service data. You can collect existing system log data or run a new diagnostic to collect new data.

- **Lenovo XClarity Controller**
  You can use the BMC Web user interface or the CLI to collect service data for the server. The file can be saved and sent to Lenovo Support.
  - For more information about using the Web interface to collect service data, see https://sysmgt.lenovofiles.com/help/index.jsp?topic=%2Fcom.lenovo.systems.management.xcc.doc%2Fproduct_page.html&cp=2.
- **OneCLI inventory**
  For supported operating systems (Windows Server, SuSE Linux Enterprise Server, and Redhat Enterprise Linux), collect a OneCLI inventory from within the Operating System. OneCLI is available from

  https://support.lenovo.com/solutions/lnvo-tcli

  and the OneCLCI User's Guide is available from

  http://sysmgt.lenovofiles.com/help/topic/toolsctr_cli_lenovo/onecli_bk.pdf

Contacting Support

You can contact Support to obtain help for your issue.

You can receive hardware service through a Lenovo Authorized Service Provider. To locate a service provider authorized by Lenovo to provide warranty service, go to https://datacentersupport.lenovo.com/serviceprovider and use filter searching for different countries. For Lenovo support telephone numbers, see https://datacentersupport.lenovo.com/supportphonelist for your region support details.

Appendix D. Notices

Lenovo may not offer the products, services, or features discussed in this document in all countries. Consult your local Lenovo representative for information on the products and services currently available in your area.

Any reference to a Lenovo product, program, or service is not intended to state or imply that only that Lenovo product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any Lenovo intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any other product, program, or service.

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Linux is a registered trademark of Linus Torvalds.

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Recycling information

Lenovo encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. Lenovo offers a variety of programs and services to assist equipment owners in recycling their IT products. For information on recycling Lenovo products, go to: http://www.lenovo.com/recycling.

Particulate contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document.

Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If Lenovo determines that the levels of particulates or gases in your environment have caused damage to the device, Lenovo may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

See Table 2 on the following page for further information.

Table 2: Limits for particulates and gases

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2[1] • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60% [2]. • The room must be free of conductive contamination such as zinc whiskers.
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-1985 [3] • Silver: Corrosion rate of less than 300 Å in 30 days

[1] ASHRAE 52.2-2008 - *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[2] The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction.

[3] ANSI/ISA-71.04-1985. *Environmental conditions for process measurement and control systems: Airborne contaminants*. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.

Telecommunication regulatory statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact a Lenovo representative or reseller for any questions.

Electronic emission notices

When you attach a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Lenovo is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility. Lenovo cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the installation of option cards from other manufacturers.

This product has been tested and found to comply with the limits for Class A equipment according to European Standards harmonized in the Directives in compliance. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Lenovo, Einsteinova 21, 851 01 Bratislava, Slovakia

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Germany Class A statement

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG (früher 89/336/EWG) zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der Lenovo empfohlene Kabel angeschlossen werden. Lenovo übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der Lenovo verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der Lenovo gesteckt/eingebaut werden.

Deutschland:

Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Betriebsmitteln
Dieses Produkt entspricht dem „Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln“ EMVG (früher „Gesetz über die elektromagnetische Verträglichkeit von Geräten“). Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln, EMVG vom 20. Juli 2007 (früher Gesetz über die elektromagnetische Verträglichkeit von Geräten), bzw. der EMV EU Richtlinie 2014/30/EU, für Geräte der Klasse A.

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutsche n EMVG das EG-Konformitätszeichen - CE - zu führen. Verantwortlich für die Konformitätserklärung nach Paragraf 5 des EMVG ist die Lenovo (Deutschland) GmbH, Meitnerstr. 9, D-70563 Stuttgart.

Informationen in Hinsicht EMVG Paragraf 4 Abs. (1) 4: **Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.**

Nach der EN 55032: „Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen und dafür aufzukommen."

Nach dem EMVG: „Geräte dürfen an Orten, für die sie nicht ausreichend entstört sind, nur mit besonderer Genehmigung des Bundesministers für Post und Telekommunikation oder des Bundesamtes für Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Störungen zu erwarten sind." (Auszug aus dem EMVG, Paragraph 3, Abs. 4). Dieses Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Anmerkung: Um die Einhaltung des EMVG sicherzustellen sind die Geräte, wie in den Handbüchern angegeben, zu installieren und zu betreiben.

Japanese electromagnetic compatibility statements

Japan VCCI Class A statement

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

VCCI-A

This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

Japanese Electrical Appliance and Material Safety Law statement (for detachable AC power cord)

本製品およびオプションに電源コード・セットが付属する場合は、
それぞれ専用のものになっていますので他の電気製品には使用しないでください。

JEITA harmonics guideline – Japanese Statement for AC power consumption (W)

定格入力電力表示 (社) 電子情報技術参照委員会　家電・汎用品高調波抑制対策ガイドライン 実行計画書に基づく定格入力電力値：　W お手持ちのユニットの定格入力電力値(W)はユニットの電力装置に添付 されている電源仕様ラベルをご参照ください

JEITA harmonics guideline - Japanese Statement of Compliance for Products Less than or Equal to 20A per phase

JEITA 高調波電流抑制対策適合品表示 (JEITA harmonics statements – Japan)
定格電流が 20A/相以下の機器 (For products where input current is less than or equal to 20A per phase).

日本の定格電流が 20A/相以下の機器に対する高調波電流規制高調波電流企画 JIS C 61000-3-2 適合品

JEITA harmonics guideline – Japanese Statement of Compliance for Products More than 20A

定格電流が 20A/相を超える機器 (For products where input current is less than 20A / Phase of one PSU, but total system power is over 20A / Phase).

本製品は、1 相当たり 20A を超える機器ですが、個々のユニットが「高調波電流 規格 JIS C 61000-3-2 適合品であり、 本製品はその組み合わせであるため、「高調波電流規格 JIS C 61000-3-2 適合品 」としています

Japan Electronics and Information Technology Industries Association (JEITA) statement

高調波ガイドライン準用品

JEITA harmonics guideline - Japanese statement of compliance for products less than or equal to 20 A per phase:
JEITA harmonics guideline - Japanese statement of compliance for products more than 20 A:

Korea Communications Commission (KCC) statement

이 기기는 업무용(A 급)으로 전자파 적합
기기로서 판매자 또는 사용자는 이 점을 주의
하시기 바라며, 가정외의 지역에서 사용하는 것을
목적으로 합니다.

This is electromagnetic wave compatibility equipment for business (Type A). Sellers and users need to pay attention to it. This is for any areas other than home.

Russia Electromagnetic Interference (EMI) Class A statement

ВНИМАНИЕ!
Настоящее изделие относится к оборудованию класса A. При использовании в бытовой обстановке это оборудование может нарушать функционирование других технических средств в результате создаваемых индустриальных радиопомех. В этом случае от пользователя может потребоваться принятие адекватных мер.

People's Republic of China Class A electronic emission statement

中华人民共和国 “A 类” 警告声明

声 明
此为 A 级产品。在生活环境中，
该产品可能会造成无线电干扰。
在这种情况下，可能需要用户对其
干扰采取切实可行的措施。

Taiwan Class A compliance statement

警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。

Taiwan BSMI RoHS declaration

單元 Unit	限用物質及其化學符號 Restricted substances and its chemical symbols					
	鉛 Lead (PB)	汞 Mercury (Hg)	鎘 Cadmium (Cd)	六價鉻 Hexavalent chromium (Cr^{+6})	多溴聯苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
機架	○	○	○	○	○	○
外部蓋板	○	○	○	○	○	○
機械組合件	–	○	○	○	○	○
空氣傳動設備	–	○	○	○	○	○

Taiwan BSMI RoHS declaration (continued)

單元 Unit	限用物質及其化學符號 Restricted substances and its chemical symbols					
	鉛 Lead (PB)	汞 Mercury (Hg)	鎘 Cadmium (Cd)	六價鉻 Hexavalent chromium (Cr^{+6})	多溴聯苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
內存模塊	–	○	○	○	○	○
處理器模組	–	○	○	○	○	○
鍵盤	–	○	○	○	○	○
調製解調機	–	○	○	○	○	○
監視器	–	○	○	○	○	○
滑鼠	–	○	○	○	○	○
電纜組合件	–	○	○	○	○	○
電源	–	○	○	○	○	○
儲備設備	–	○	○	○	○	○
電池匣組合件	–	○	○	○	○	○
電池	–	○	○	○	○	○
有 mech 的電路卡	–	○	○	○	○	○
無 mech 的電路卡	–	○	○	○	○	○
雷射器	–	○	○	○	○	○

備考 1. “超出 0.1 wt%”及” 超出 0.01 w%”係指限用物質之百分比含量超出百分比含量基準值。
Note 1: “exceeding 0.1 wt%” and “exceeding 0.01 wt%” indicate that the percentage content of the restricted substance exceeds the reference percentage value of presence condition.

備考 2. “○”係指該項限用物質之百分比含量未超出百分比含量基準值。
Note 2: “○”indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

備考 3. “-“係指該項限用物質為排除項目。
Note 3: The “-“ indicates that the restricted substance corresponds to the exemption.

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