



BBU (Battery Backup Unit) Module

User Manual (UM1B123000), Revision G

Specification Number: 1B123000

Model Number: B12-3000

The information contained in this document is subject to change without notice and may not be suitable for all applications. While every precaution has been taken to ensure accuracy and completeness herein, Vertiv Group Corp. assumes no responsibility, and disclaims all liability, for damages resulting from use of this information or for any errors or omissions. Refer to other local practices or building codes as applicable for the correct methods, tools, and materials to be used in performing procedures not specifically described in this document.

This document may contain confidential and/or proprietary information of Vertiv Group Corp., and its receipt or possession does not convey any right to reproduce, disclose its contents, or to manufacture or sell anything that it may describe. Reproduction, disclosure, or use without specific authorization from Vertiv Group Corp. is strictly prohibited.

Vertiv and the Vertiv logo are trademarks or registered trademarks of Vertiv Group Corp. All other names and logos referred to are trade names, trademarks or registered trademarks of their respective owners.

© 2019 Vertiv Group Corp. All rights reserved.

TABLE OF CONTENTS

Admonishments Used in this Document.....	4
Important Safety Instructions	5
Safety Admonishments Definitions.....	5
General Safety	5
Voltages.....	5
AC Input Voltages.....	5
DC Output and Battery Voltages	5
Battery	6
BBU Module	6
Hazardous Voltage.....	6
Handling Equipment Containing Static Sensitive Components.....	6
Battery Storage Information	6
Static Warning.....	7
Introduction	9
Overview.....	9
One Line Diagram	9
Specifications	10
Operation	15
Local Indicators.....	15
BBU Module High Voltage Shutdown and Lockout Restart.....	15
Discharging BBU (Battery Backup Unit) Modules to <30% SOC (State of Charge).....	15
Installing BBU Modules.....	17
Learning Mode Calibration	18
Storage and Maintenance Charge	20
Storage Maintenance Charge.....	20
Troubleshooting and Repair	20
Troubleshooting.....	20
Replacement Procedures.....	24

ADMONISHMENTS USED IN THIS DOCUMENT



DANGER! Warns of a hazard the reader *will* be exposed to that will *likely* result in death or serious injury if not avoided. (ANSI, OSHA)



WARNING! Warns of a potential hazard the reader *may* be exposed to that *could* result in death or serious injury if not avoided. This admonition is not used for situations that pose a risk only to equipment, software, data, or service. (ANSI)



CAUTION! Warns of a potential hazard the reader *may* be exposed to that *could* result in minor or moderate injury if not avoided. (ANSI, OSHA) This admonition is not used for situations that pose a risk only to equipment, data, or service, even if such use appears to be permitted in some of the applicable standards. (OSHA)



ALERT! Alerts the reader to an action that *must be avoided* in order to protect equipment, software, data, or service. (ISO)



ALERT! Alerts the reader to an action that *must be performed* in order to prevent equipment damage, software corruption, data loss, or service interruption. (ISO)



FIRE SAFETY! Informs the reader of fire safety information, reminders, precautions, or policies, or of the locations of fire-fighting and fire-safety equipment. (ISO)



SAFETY! Informs the reader of general safety information, reminders, precautions, or policies not related to a particular source of hazard or to fire safety. (ISO, ANSI, OSHA)

IMPORTANT SAFETY INSTRUCTIONS

Safety Admonishments Definitions

Definitions of the safety admonishments used in this document are listed under “Admonishments Used in this Document” on page 4.

General Safety



DANGER! YOU MUST FOLLOW APPROVED SAFETY PROCEDURES.

Performing the following procedures may expose you to hazards. These procedures should be performed by qualified technicians familiar with the hazards associated with this type of equipment. These hazards may include shock, energy, and/or burns. To avoid these hazards:

- a) The tasks should be performed in the order indicated.
- b) Remove watches, rings, and other metal objects.
- c) Prior to contacting any uninsulated surface or termination, use a voltmeter to verify that no voltage or the expected voltage is present. Check for voltage with both AC and DC voltmeters prior to making contact.
- d) Wear eye protection.
- e) Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed.

Voltages

AC Input Voltages



DANGER! This system operates from AC input voltage capable of producing fatal electrical shock.

DC Output and Battery Voltages



DANGER! This system produces DC power and has a battery source connected to it. Although the DC voltage is not hazardously high, the Battery Backup Unit can deliver large amounts of current. Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact an output terminal or exposed wire connected to an output terminal or battery terminal. NEVER allow a metal object, such as a tool, to contact more than one termination at a time, or to simultaneously contact a termination and a grounded object. Even a momentary short circuit can cause sparking, explosion, and injury.

Battery

BBU Module



WARNING! The BBU module contains lithium-ion battery cells. Handling and storage precautions MUST be observed. Lithium-ion batteries are considered UN/DOT Class 9 Misc. Hazardous Materials for shipping purposes. Only properly trained personnel are allowed to ship or receive BBU modules.

The BBU module has no user serviceable parts. The lithium-ion battery pack is embedded inside the unit and is not serviceable.

Disposal of the BBU module should follow established customer waste recycling plans for electronics and battery disposal.

The BBU module must be handled carefully. The BBU module is FRAGILE and contains lithium-ion battery cells. If the BBU module shows ANY sign of mechanical damage or abuse, it must not be used or installed. Damaged cells are hazardous and must be taken out of service immediately.

Hazardous Voltage



DANGER! HAZARD OF ELECTRICAL SHOCK.

More than one disconnect may be required to de-energize the system before servicing.

Handling Equipment Containing Static Sensitive Components



ALERT! Installation or removal of equipment containing static sensitive components requires careful handling. Before handling any equipment containing static sensitive components, read and follow the instructions contained on the Static Warning Page.

Battery Storage Information

The BBU (Battery Backup Unit) contains both electronics and a Li-ion battery pack. Proper battery storage procedures are required and MUST be followed to ensure product meets product specifications upon commissioning. See “Environmental Ratings” on page 11 and “Storage and Maintenance Charge” on page 20.

STATIC WARNING



This equipment contains static sensitive components. The warnings listed below must be observed to prevent damage to these components. Disregarding any of these warnings may result in personal injury or damage to the equipment.

1. Strictly adhere to the procedures provided in this document.
2. Before touching any equipment containing static sensitive components, discharge all static electricity from yourself by wearing a wrist strap grounded through a one megohm resistor. Some wrist straps have a built-in one megohm resistor; no external resistor is necessary. Read and follow wrist strap manufacturer's instructions outlining use of a specific wrist strap.
3. Do not touch traces or components on equipment containing static sensitive components. Handle equipment containing static sensitive components only by the edges that do not have connector pads.
4. After removing equipment containing static sensitive components, place the equipment only on static dissipative surfaces such as conductive foam or ESD bag. Do not use ordinary Styrofoam™ or ordinary plastic.
5. Store and ship equipment containing static sensitive components only in static shielding containers.
6. If necessary to repair equipment containing static sensitive components, wear an appropriately grounded wrist strap, work on a conductive surface, use a grounded soldering iron, and use grounded test equipment.

This page is intentionally blank.

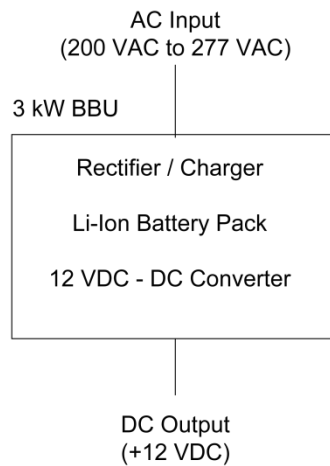
INTRODUCTION

Overview

The BBU (Battery Backup Unit) module provides power during AC utility failures, and can provide additional power on demand. The BBU module is designed to provide at a maximum load of 3 kW, a run time of 90 seconds (longer run times at lower than 3 kW) of 12 VDC power, per module. Note also that the BBU module output current cannot exceed 250 A under any voltage regulation. The BBU module is also capable of providing additional power via discharging in parallel with the rectifier output. In this mode, the BBU can provide additional power for minutes, at a power level exceeding the rectifier power setting.

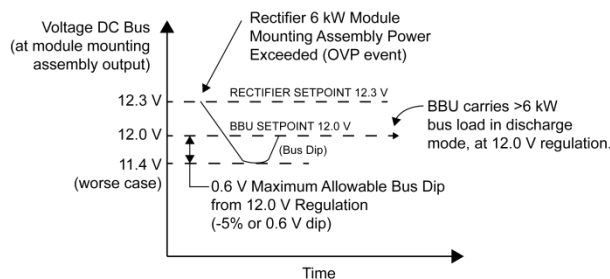
One Line Diagram

Figure 1: One Line Diagram



Back Up Mode:
AC Fails - BBU provides backup power.

Boost Mode:
System Power Draw Exceeds Rectifier Capacity or Preset Limit - the BBU can provide short term power boost.



Theory of Operation:
If AC power fails or if the system requires more power, the BBU detects the state of the bus voltage and reacts to provide power as needed.

Specifications

DC Output Ratings

- Voltage Adjustment Range: The output voltage is adjustable from 11.7 VDC to 13.2 VDC via the associated controller. The output voltage setpoint will be a configured offset (typically 300 mV) less than the 1R123000 rectifier voltage setpoint.
- Output Current: 250 A at 12 VDC to 227 A at 13.2 VDC.
- Output Power: 3000 W at $V_{out} \geq 12$ VDC.
- Regulation:
 - a) Static: Steady state regulation is $\pm 1\%$ as controlled within the BBU module for any and all combinations of load from no load to full load, input voltage, and input frequency at a constant ambient temperature. The associated system controller may provide improved regulation.
 - b) Dynamic Load: For any step load change within the range of 10% to 90% of full load within 50 microseconds, per Telcordia GR-947-CORE, the maximum voltage transient will not exceed 5% of the initial steady state voltage within 250 microseconds ± 10 microseconds. Recovery to within $\pm 1\%$ of the initial steady state voltage does not exceed 4 milliseconds.
- Hold Up Time: 90 seconds at 3 kW (longer at lower loads).

AC Input Ratings

- Voltage: Nominal 200 VAC to 277 VAC, single phase, 50 Hz / 60 Hz, with an operating range of 176 VAC to 310 VAC. Acceptable input frequency range is 45 Hz to 65 Hz.
- Harmonic Content (THD): Meets EN 61000-3-12.
- Inrush Current: Meets EN 61000-3-1-2. Under the above conditions, standard AC distribution circuit breakers will not trip.
- Typical Input Data: 60 Hz Input: Refer to **Table 1**.

Table 1: Typical Input Data, 60 Hz Input

Nominal Input Voltage	Input Watts	Input Current (Amperes)	Input VA
200 VAC	105 W	0.55 A	112 VA
	Standby Power (≈ 30 W)	0.16 A	32 VA
208 VAC	105 W	0.53 A	112 VA
	Standby Power (≈ 30 W)	0.15 A	32 VA
240 VAC	105 W	0.46 A	112 VA
	Standby Power (≈ 30 W)	0.12 A	32 VA



NOTE! System output is initially adjusted to 12 volts DC as measured at the system sense points at 50% of full load and nominal input. “Percent of Full Load” refers to percent of 250 A.

Environmental Ratings

- Operating Ambient Temperature Range: 0 °C to +45 °C (+32 °F to +113 °F).
- Storage Ambient Temperature Range: 5% RAC and 85% relative humidity.
 - a) 1 Year: -20 °C to +25 °C (-4 °F to +77 °F)
 - b) 3 Months: -25 °C to +40 °C (-13 °F to +104 °F)
 - c) 1 Week: -40 °C to +60 °C (-40 °F to +140 °F)
- Relative Humidity: This BBU module is capable of being operated and stored in an ambient relative humidity range of 0% to 95%, non-condensing.
- Altitude: This BBU module is capable of operating in an altitude range of -200 feet to 10,000 feet. The maximum operating ambient temperature should be de-rated by 3 °C per 1000 feet above 6000 feet.
- Ventilation Requirements: The BBU module is fan cooled and utilizes front to back forced ventilation. A BBU module must be mounted so ventilating openings are not blocked and temperature of the air entering the BBU module does not exceed the operating ambient temperature range stated above.
- EMI/RFI Suppression:
 - a) BBU modules operating in an approved module mounting assembly conforming to the requirements of FCC rules Part 15, Subpart B, Class A for radiated and conducted emissions limits.
 - b) BBU modules operating in an approved module mounting assembly conforming to the requirements of European Norm, EN55022, and Class A for radiated and conducted emissions limits.
- Surge Protection: Compliance with EN61000-4-5 Installation Class 4, and capable of withstanding surges per ANSI/IEEE C 62.41 1999 Category B3 across the input terminals.



NOTE! *This level of protection is a widely used standard for telecommunications and data center power equipment. As with all such equipment, it is the end user's responsibility to provide an adequately sized surge suppression device at the commercial power service entrance of the building that reduces all incoming surges to levels below the classes/categories stated for the equipment.*

- ESD Protection: Meets EN 61000-4-2 and Telcordia GR-1089-CORE R2-1, R2-2, R2-3, O2-4.
- Single BBU Module Audible Noise: At +25 °C (+77 °F) ≤ 60 dB(A) (Measurement made at 60 cm (2') distance in front of BBU module and at same horizontal line of the middle of BBU module).

Compliance Information

- The BBU module is RoHS compliant.

Standard Features

- Type of Power Conversion Circuit: High frequency.
- Input Protection:
 - a) Low Input Voltage: The BBU module charger section shuts down and reports not charging, low input voltage. No local indicator illuminates for decreasing input voltage. The BBU module automatically restarts when the input voltage returns to within the normal operating range. A low input voltage condition does not trip the recommended input protection device.

- b) High Input Voltage: The BBU module charging section shuts down if the input voltage increases above 315 VAC. The BBU module automatically restarts when the input voltage returns to within the normal operating range.
- c) Power Interruption: An AC power interruption only affects the charging capability of the BBU. The BBU is INTENDED FOR AC INTERRUPTION.
- Output Protection:
 - a) ORing Diode: The BBU module contains an internal ORing diode to prevent internal fault from affecting bus voltage.
 - b) High Voltage Shutdown: If BBU module output voltage exceeds a preset value, the BBU module shuts down and locks out regardless of load. Manual restart is then required (by turning AC power to the BBU module off or by removing the BBU module, waiting 30 seconds or more [until the LEDs on the BBU module extinguish], then turning AC power to the BBU module on or re-inserting the BBU module).
- BBU Module DC/DC Converter Failure: The BBU module has an interleaved DC/DC converter. If one card of the DC/DC converter fails, the BBU module derates its power level and a yellow LED indicator illuminates. If two or more of the cards in the DC/DC converter fails, the BBU module reports a failure to the associated controller and an alarm indicator (red) illuminates.
- Startup Time: The BBU module has two startup modes.
 - a) Initialization Time: The BBU can have up to a 30 minute initialization time. This occurs after an outage or upon first installation of the device.
 - b) Backup Startup: Backup once fully inserted the battery will provide remaining available capacity.
 - c) Charging Startup:
 - Startup charging time (from AC on until charging of the cells): ≤ 8 seconds.
 - The charging time to Remaining Available Capacity (RAC) is three (3) hours.



NOTE! The BBU's rated capacity is 3kW (250A @ 12V) for 90 seconds (which is 75Wh). Remaining Available Capacity (RAC) is the percentage of the rated capacity that is available for the BBU to deliver.

- The BBU module will not suffer any damage when subjected to repetitive AC voltage on/off operations.
- Paralleling: This BBU module may be connected in parallel with any BBU module adjusted to the same output voltage. Up to twenty-seven (27) BBU modules can be connected in parallel in one system.
- BBU Module Load Sharing: The BBU module shares load with other like BBU modules operating in parallel (maximum twenty-seven [27] BBU modules). The BBU's are designed to load share between themselves within a range of ± 10 A of the average BBU's output current.
- Imbalanced of BBU Module Output Current:
 - a) When the average current of all BBU modules is greater than 20% of full rated current, and the difference between local BBU current and average current is greater than 16% of full rated current, the yellow protection indicator will illuminate.
 - b) When the average current of all BBU modules is greater than 20% of full rated current, and local BBU current is less than 2% of full rated current, then the red fault indicator will illuminate.

- Hot Swappable: The BBU module is designed to be plug-and-play. The BBU module can be inserted or removed from a live DC power system with no damage. When the BBU module is plugged into the system, the system output voltage will not be affected.
- Cooling: Each BBU module contains one (1) fan for front-to-back forced convection cooling.
 - a) Fan Fault Protection: The BBU module shuts down and its alarm indicator (red) flashes if the fan fails. Fan failure is detected and reported to controller. The fan is not field replaceable.
 - b) Fan Control: Fan speed is continuously variable. When input voltage is within normal range, the built-in processor adjusts fan speed according to the BBU module's internal temperature and output power. For example, a higher temperature or output power increases the fan speed. Fan speed control can be disabled via the controller. The BBU module will self-protect if ambient temperature goes too low or too high.
- Over-Temperature Protection: The BBU module provides overtemperature protection by stopping the BBU discharge and reporting a failure status to the associated controller. The BBU module recovers automatically.
- Communication Failure: The BBU module's warning indicator (yellow) flashes if it cannot communicate with its associated controller. During a communication failure the BBU module output voltage will be adjusted to the last communicated controller's output voltage setting (the BBU module stores this value each time the controller sends it). The BBU module will adjust output voltage and other operations once normal communication is restored.
- Monitoring Function: The BBU module has a built-in advanced DSP (Digital Signal Processor) that monitors and controls the operation of the BBU module. The DSP also communicates with the associated controller in real time through the CAN bus. **Table 2** lists the different commands and information exchanged between the BBU module and the controller.

Table 2: Exchange of Information between BBU and Controller

Commands / Signals that can be Received by the BBU Module from the Controller	Information Gathered by the Controller from the BBU Module
<ul style="list-style-type: none"> • Turn On/Off • Output Voltage Adjustment • Fan Speed Control Enable/Disable 	<ul style="list-style-type: none"> • Output Voltage • Output Current • Output Power • Core Temperature • AC Status • DC Status • Fan Status • Rated Output • Model Number • Serial Number • Remaining Available Capacity • Time to Charge • Running Time • End-of-Life Status • Learning Mode Status • Protection Alarms (High Temperature Protection, etc.)

Mechanical Specifications

- Weight: 4.13 kg (9.1 lbs).
- Dimensions (H x W x D): 124 x 41.4 x 450 mm (4.9 x 1.6 x 17.7 inches).
- Local Controls: None.
- Local Status and Alarm Indicators: (see also **Table 3**).
 - a) Power (Green)
 - b) Warning (Yellow)
 - c) Alarm (Red)

BBU Module Battery Backup Times

3 kW of 12 VDC power at a maximum load of 3 kW, a run time of 90 seconds (longer run times at lower than 3 kW), per module.

OPERATION

Local Indicators

Location and Identification: Refer to **Figure 2**.

Description: There are three (3) alarm and status indicators located on the BBU module's front panel. The functions of these indicators are as shown in **Table 3**.


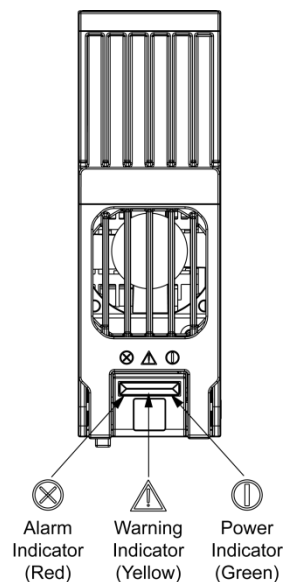
 **NOTE!** DC voltage must be present at the BBU module output terminals (from battery or an operating BBU module) or AC voltage at the input terminals for local indicators to illuminate.

Figure 2: BBU Module Local Indicators Locations



BBU Module High Voltage Shutdown and Lockout Restart

Procedure




1. Turn AC power to the BBU module off or remove the BBU module, wait 30 seconds or more (until the LEDs on the BBU module extinguish), then turn AC power to the BBU module on or re-insert the BBU module.

Discharging BBU (Battery Backup Unit) Modules to <30% SOC (State of Charge)

- BBU (Battery Backup Unit) Modules **shipped after September 2017** have firmware that allows the BBU to be discharged to <30% SOC (State of Charge) via the SCC Controller.

This feature is performed as required to meet regulations to ship the BBU Modules by air. Refer to the latest air transportation regulations for specific criteria that must be met. Refer to the SCC Controller instruction manual (UM1M520HNA) for a procedure to discharge the BBU modules to <30% SOC (State of Charge) and also a procedure to determine the BBU shipped date.

Table 3: BBU Module Local Indicators

Indicator	Normal State	Alarm State	Alarm Cause
	Power (Green)	On	Off No input voltage. BBU has failed or shut down (due to end-of-life, self-protect for temperature, input voltage, etc.). Unable to deliver 12 VDC.
			Slow Flashing BBU is operational but cannot provide DC power (due to no remaining capacity, in learning mode, or BBU is disabled by the controller). Unable to deliver 12 VDC.
			Flashing The BBU module is being identified by the controller.
	Warning (Yellow)	Off	On AC input under/over voltage. BBU overcurrent condition. BBU DC output abnormal warning. BBU charging problem warning. BBU discharging problem warning. BBU near end-of-life. Moderate load sharing imbalance. BBU module not inserted into the slot completely. BBU has no Remaining Available Capacity (RAC) (RAC is at 0). BBU charging or discharging failure. BBU module over-temperature or under temperature protection
			Flashing Loss of communication with controller.
	Alarm (Red)	Off	On Output over-voltage shutdown. Severe load sharing imbalance. BBU charging is disabled. BBU discharging is disabled. Ambient temperature too high or too low. BBU end-of-life. AC input voltage outside the normal range (AC high input voltage or AC low input voltage). BBU overcurrent condition. Internal processor error. Cells out of balanced.
			Flashing Fan not operating (BBU module shuts down).

Installing BBU Modules

The BBU module is hot swappable. The BBU module can be installed or removed with the system operating.



WARNING! To prevent damage to the latching mechanism, ensure the handle is in the open position when installing or removing a BBU module. NEVER hold the handle in the closed position when installing a BBU module into a module mounting assembly.



NOTE! The BBU module locks into the module mounting assembly through a latch located on the underside of the module. The latch and module handle are interactive. Pushing the handle up into the module's front panel causes the latch to extend to the locking position. Clicking the handle to pop it out from the module's front panel causes the latch to retract.



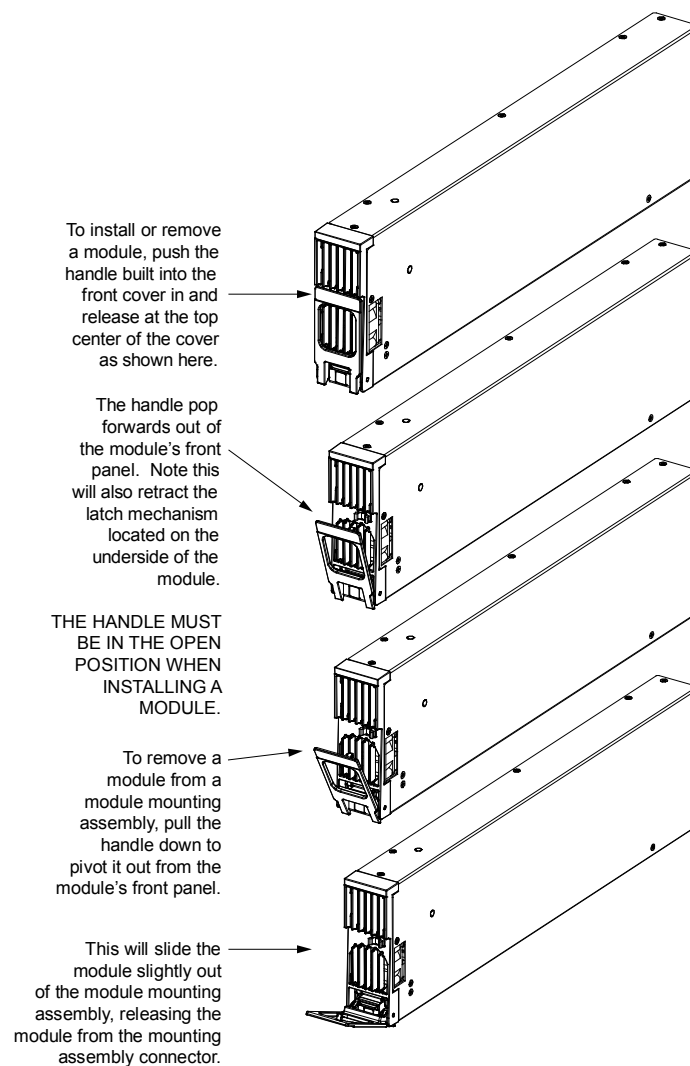
NOTE! For safety, the unit rear connector output DC pins are disabled until "awakened" inside the module mounting assembly.

Refer **Figure 3** as this procedure is performed.


Procedure

1. Unpack the BBU module.
2. Note the model number located on the front of the module. Ensure the correct module is being installed.
3. If present, remove the blank cover panel from the module mounting position into which a BBU module is to be installed.
4. Place the BBU module into an unoccupied mounting position without sliding it in completely.
5. Push the handle built into the BBU module's front cover in and release at the top center of the cover as shown in in **Figure 3**. This pops the handle forward out of the BBU module's front panel (this will also retract the latch mechanism located on the underside of the BBU module).
6. Push the BBU module completely into the module mounting assembly.
7. Push the handle into the front panel of the BBU module. This will lock the BBU module securely to the module mounting assembly.
8. Repeat the above steps for each BBU module being installed in the system.
9. After the BBU modules are physically installed in the module mounting assembly(s), they are ready for operation immediately after power is supplied to them.
10. Certain functions (i.e. current limit, addressing) may require adjustment when adding or replacing a BBU module. Refer to the power system's documentation for instructions.

Figure 3: Installing or Removing a BBU Module



Learning Mode Calibration

 **NOTE!** The BBU will not start/continue learning mode if the ambient temperature goes below +10 °C (+50 °F).

To ensure the accuracy of the remaining available capacity data reported by the BBU, the BBU will periodically request a learning mode calibration. The accuracy of a BBU's remaining available capacity is dependent on a variety of factors, including temperature, discharge rates, discharge duration; so the accuracy of the remaining available capacity value without learning mode cannot be predicted.

The BBU will request learning mode calibration approximately every three (3) months. The frequency of learning mode requests will increase as the BBU nears its end of service life and may occur as frequently as once a month. The BBU request for learning mode will be routed to the SCC controller. The BBU will wait until the SCC controller indicates that it can start the learning mode calibration or that it should skip this calibration. When the BBU requests learning mode, it will turn on the yellow LED.

The request can stay outstanding for any amount of time. After the BBU gets the command to skip or do the calibration, the BBU will restart the time delay to the next request. For example, there is a new BBU which requests learning mode in early January. The request stays pending until early March, when the calibration is done. The next learning mode calibration request will occur in early June.

During learning mode calibration, the BBU is unavailable. It will not provide power boost or backup during learning mode. Note that the other BBU's in a module mounting assembly can provide power while one BBU is in learning mode. The BBU does not need to be moved to a different module mounting assembly for learning mode calibration.

For learning mode calibration, the BBU needs to be in a module mounting assembly, with AC applied.

The BBU will not start learning mode if:

- There is no AC.
- The BBU is discharging.
- There is an abnormal condition (like the ambient temperature goes out of range).

The BBU will stop learning mode if:

- There is a loss of AC.
- The DC bus collapses.
- There is an abnormal condition (like the ambient temperature goes out of range).
- EPO.
- The BBU is pulled out of the module mounting assembly.
- Another BBU is inserted into the module mounting assembly.
- The SCC sends the command to stop learning mode.

When the BBU starts learning mode calibration, the red LED will be on; the green and yellow LED's will be off.

Learning mode calibration takes 4-7 hours to complete.

Learning Mode and the SCC Controller

When the SCC controller gets a request for learning mode from a BBU, it will send an SNMP trap to the RMS, to indicate that a BBU has requested learning mode. The `battBatteryState` field will indicate that the BBU requested learning mode. The SCC controller will also change its status in the update traps to indicate that there is an alarm. The yellow LED on the SCC controller will turn on.

The RMS can use the SNMP set command to set `batteryLearningModeStart .N` to 1 (where N is the number of the BBU) to command the BBU to start learning mode calibration. It can also set `batteryLearningModeStart .N` to 0 to command the BBU to skip this learning mode request.

If the BBU starts calibration, the SCC will send an SNMP trap to indicate that the BBU is not available. During calibration, the BBU's `battBatteryState` will indicate that the BBU is in the learning mode calibration. During learning mode calibration, the RMS can abort the calibration by setting `batteryLearningModeStart .N` to 0. This will leave the calibration request outstanding, but the BBU will stop learning mode.

After calibration is completed, the SCC controller will send an SNMP trap to indicate that the BBU is now available. It will also send a trap to indicate whether or not the learning mode calibration was successful.

If the BBU skips calibration, the SCC controller will send an SNMP trap to indicate that the learning mode request is no longer active.

The yellow LED on the SCC controller will stay lit during the learning mode request and while the BBU is doing the calibration. When the BBU skips or completes learning mode, the yellow LED on the SCC controller will be turned off.

STORAGE AND MAINTENANCE CHARGE

Storage Maintenance Charge

When the BBU is not plugged into a rack, there will be no external LEDs illuminated to conserve power. Periodically, the BBU needs a refreshing charge.

- Storage: 5% RAC and 85% RH.
- 1 year Storage for Environment -20 °C to +25 °C (-4 °F to +77 °F).

Procedure for Recharge

1. Place BBU in 12V Module Mounting Assembly.
2. Turn on power to 12V Module Mounting Assembly.
3. Monitor RAC of the BBU, when it reaches 5% RAC extract the BBU and replace to storage.

TROUBLESHOOTING AND REPAIR

Troubleshooting

BBU Module Imbalanced Load Sharing

When multiple BBU modules are operating in parallel, the BBU's are designed to load share between themselves within a range of ± 10 A of the average BBU's output current. If current sharing imbalance among the BBUs is suspected, (either yellow or red indicator LED illuminated), and load share is found to be greater than ± 10 A of the average BBU current, check if the BBU modules are properly seated in the module mounting assembly.

If the current sharing imbalance still persists following the verification suggested above, replace the BBU module exhibiting the current imbalance.

BBU Module Fault Symptoms and Troubleshooting

The fault indicators that can be displayed by the BBU module are as follows. Refer to **Table 4** for a list of possible causes and corrective actions.

- Power Indicator (Green) OFF
- Power Indicator (Green) Flashing
- Warning Indicator (Yellow) ON
- Warning Indicator (Yellow) Flashing

- Alarm Indicator (Red) ON
- Alarm Indicator (Red) Flashing

Table 4: BBU Module Troubleshooting

Table 4


Symptom		Possible Cause(s)	Suggested Action(s)
	Power Indicator (Green) On	Able to deliver 12 VDC.	No action required.
	Power Indicator (Green) Off	No input voltage.	Make sure there is input voltage.
		BBU has failed or shut down (due to end-of-life, self-protect for temperature, input voltage, etc.).	Replace the BBU module.
		Unable to deliver 12 VDC.	Replace the BBU module.
	Power Indicator (Green) Slow Flashing (25% ON and 75% OFF)	BBU is operational but cannot provide DC power (due to no remaining capacity, in learning mode, or BBU is disabled by the controller). Unable to deliver 12 VDC.	Check to see if in learning mode or disabled by the controller, if not replace the BBU module.
Power Indicator (Green) Flashing (50% ON and 50% OFF)	BBU is being identified by the controller.	--	

Table 4



	Warning Indicator (Yellow) On	AC input under/over voltage.	Correct the AC input voltage to within the acceptable range.
		BBU overcurrent condition.	Correct the overcurrent condition.
		BBU DC output abnormal warning. BBU charging problem warning. BBU discharging problem warning.	Remove the BBU module, wait 30 seconds or more (until the LEDs on the BBU module extinguish), then re-insert the BBU module. If BBU module fails to start or shuts down again; replace the BBU module.
		BBU near end-of-life.	--
		Moderate load sharing imbalance.	Check if the BBU module is properly seated in the module mounting assembly. If this does not correct the fault, replace the BBU module.
		BBU module not inserted into the slot completely.	Remove and properly insert the BBU module.
		BBU has no Remaining Available Capacity (RAC) (RAC is at 0).	Make sure there is input voltage, let BBU charge.
		BBU charging or discharging failure.	Replace the BBU module.
		BBU module over-temperature or under temperature protection.	Fan rotor blocked: remove any object that may be blocking the fan. Ventilation blocked (inlet or outlet): remove any object that may be blocking the inlet or outlet. Ambient temperature too high or too low or BBU module inlet too close to a heat or cooling source: correct the ambient temperature or relocate the heat or cooling source.
	Warning Indicator (Yellow) Flashing	Loss of communication with controller.	Check the CAN communication cables between module mounting assemblies. Remove and properly insert the BBU module.

Table 4

	Alarm Indicator (Red) On	Output over-voltage shutdown. Severe load sharing imbalance.	Remove the BBU module, wait 30 seconds or more (until the LEDs on the BBU module extinguish), then re-insert the BBU module. If BBU module fails to start or shuts down again; replace the BBU module.
		BBU charging is disabled. BBU discharging is disabled.	
		Ambient temperature too high or too low.	Correct the ambient temperature.
		BBU end-of-life.	The BBU reaches end-of-life when the BBU is no longer able to provide 3kW for 90 seconds. Replace the BBU module.
		AC input voltage outside the normal range (AC high input voltage or AC low input voltage).	Correct the AC input voltage to within the acceptable range.
		BBU overcurrent condition.	Correct the overcurrent condition.
		Internal processor error.	Replace the BBU module.
		Cells out of balanced.	--
	Alarm Indicator (Red) Flashing	Fan not operating (BBU module shuts down).	Replace the BBU module.

Replacement Procedures

BBU Module Replacement

The BBU module is hot swappable. The BBU module can be installed or removed with the system operating.



DANGER! Take care when removing a BBU module that was in operation, as BBU module surfaces could be very hot.



WARNING! To prevent damage to the latching mechanism, ensure the handle is in the open position when installing or removing a BBU module. NEVER hold the handle in the closed position when installing a BBU module into a module mounting assembly.



NOTE! The BBU module locks into the module mounting assembly through a latch located on the underside of the module. The latch and module handle are interactive. Pushing the handle up into the module's front panel causes the latch to extend to the locking position. Clicking the handle to pop it out from the module's front panel causes the latch to retract.

Refer **Figure 3** as this procedure is performed.

Procedure

1. Performing this procedure may activate external alarms. Do one of the following. If possible, disable these alarms. If these alarms cannot be easily disabled, notify the appropriate personnel to disregard any alarms associated with this system while this procedure is performed.
2. Push the handle built into the BBU module's front cover in and release at the top center of the cover as shown in in **Figure 3**. This pops the handle forward out of the BBU module's front panel (this will also retract the latch mechanism located on the underside of the BBU module).
3. Pull the handle down to pivot it out from the module's front panel. As you pull the handle down, the module will slide out of the module mounting assembly, releasing the module from the mounting assembly connector.
4. Remove the BBU module from the module mounting assembly.
5. Place the replacement BBU module into the mounting position without sliding it in completely.
6. Push the handle built into the BBU module's front cover in and release at the top center of the cover as shown in in **Figure 3**. This pops the handle forward out of the BBU module's front panel (this will also retract the latch mechanism located on the underside of the BBU module).
7. Push the BBU module completely into the module mounting assembly.
8. Push the handle into the front panel of the BBU module. This will lock the BBU module securely to the module mounting assembly.
9. Certain functions (i.e. current limit, addressing) may require adjustment when adding or replacing a BBU module. Refer to the power system's documentation for instructions.
10. After the BBU modules are physically installed in the module mounting assembly (s), they are ready for operation immediately after power is supplied to them. Verify that the BBU modules are operating normally.
11. Enable the external alarms, or notify appropriate personnel that this procedure is finished.

12. Ensure that there are no local or remote alarms active on the system.

