

EBM

Operator's Guide EBM-1000 Series

MILITARY GRADE EXPANSION BATTERY MODULE



Made in USA



EBM-1000-2U

SynQor[®]

Advancing The Power Curve[®]

Table of Contents

SECTION I

WARNINGS

1.1 Hazardous Voltages.....	1
1.2 Hazardous Energies.....	2
1.3 Hazardous Batteries.....	2
1.4 Protection from the Environment.....	2
1.5 User Serviceable Parts	2

SECTION II

GENERAL PRODUCT INFORMATION

2.1 Product Description.....	3
2.2 Product Topology.....	4
2.3 Part Numbering Scheme and Options	4
2.4 Product Specifications	5
2.5 Electrical Characteristics	6
2.6 Mechanical Diagram	7
2.7 AC and DC Input Power	7
2.8 Power Cable Wiring Diagram.....	8
2.9 Power Cable Wire Size	8

SECTION III

OPERATION

3.1 Set-Up.....	11
3.2 Start-Up.....	13
3.3 Shut-Down.....	13
3.4 Power Cable Connections/Disconnections While Operating.....	14
3.5 Cooling System.....	14
3.6 Front Panel Indicators.....	15
3.6.1 LED Display	15
3.6.1.1 Battery State-of-Charge	16
3.6.1.2 Output Status	16
3.6.1.3 Sources and Charger	17
3.6.1.4 Temperature	19
3.6.1.5 Service Required	20
3.6.1.6 Remote ON/OFF	21
3.6.2 Audible alarm	22
3.7 Operating Environment.....	22

SECTION IV MULTIPLE EBM CONFIGURATIONS

4.1 General Considerations.....	23
4.2 Setup Instructions.....	23
4.3 Multi-unit EBM to UPS-3000 Wiring.....	25
4.4 Multi-unit EBM to UPS-1500 Wiring.....	26
4.5 DC Source Current and Wiring	28
4.6 Multi-unit Operation	28

SECTION V INTERNAL BATTERY

5.1 Battery Technology	29
5.2 Electronic Circuitry within the Battery Pack	29
5.3 Battery Capacity	30
5.4 Storage of the EBM	30
5.5 Internal Battery Pack Replacement	30
5.6 Handling the EBM	31

SECTION VI CONTROL INTERFACE DETAILS

6.1 Control Cable Connections.....	32
6.2 Digital Input/Output Control Signals.....	33
6.3 RS232 Serial Interface.....	34
6.4 Ethernet Interface.....	34

SECTION VII MAINTENANCE

7.1 Battery	35
7.2 Fans	35
7.3 Cleaning	35

SECTION VIII TROUBLE-SHOOTING GUIDE

8.1 Fault Conditions.....	36
8.2 Frequently Asked Questions	39

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1.1 Hazardous Voltages

The **INPUT POWER** connector and cable of the SynQor EBM may have voltage that is unsafe. **INJURY OR DEATH ON CONTACT** may result. Appropriate safety precautions should be taken. All connections should be made in accordance with **LOCAL ELECTRICAL CODES**.

- The EBM **CHASSIS** should be connected to earth or system ground with Ground Stud on the rear panel, see mechanical diagrams.
- **For the AC INPUT cable and connector:**
 - Do not assume that a hazardous voltage is not present at the terminals of the AC input connector, even if the EBM appears to be off.
 - Do not make contact with the terminals of the AC input connector.
 - Always connect the cable to the EBM before it is connected to the source of AC power.
 - Always disconnect the AC input cable from the source of AC power before disconnecting it from the EBM.
 - If the AC input cable is connected to the source of AC power and not connected to the EBM, do not contact the exposed terminals of the AC input cable.
 - Do not assume that the source of AC power is not present.
 - Connections between the AC input cable and the source of AC power should not be accessible.
- **For the DC INPUT cable and connector:**
 - The rated DC input voltage of the EBM is below the level considered hazardous.
 - The DC input terminals of the EBM are isolated from the AC input with reinforced safety insulation.
 - However, never assume the terminals of the DC input connector or the wires of the DC input cable are safe to contact, *even if the EBM or DC input source appears to be off*.
- **For the DC OUTPUT cable and connector:**
 - The rated DC output voltage of the EBM is below the level considered hazardous.
 - The DC output terminals of the EBM are isolated from the AC input with reinforced safety insulation.
 - However, never assume the terminals of the DC output connector or the wires of the DC output cable are safe to contact, even if the EBM appears to be off.

1.2 Hazardous Energies

The **INPUT AND OUTPUT POWER** connectors and cables of the SynQor EBM may be the source of high levels of energy. Do not inappropriately make electrical contact between any terminal of a connector and another, or between any wire of a cable and another, or between any terminal or wire and the EBM's chassis or ground. **DAMAGING ELECTRICAL ARCS** may result. Care should be taken to avoid accidental electrical contacts of this sort.

1.3 Hazardous Batteries

The individual **LITHIUM POLYMER BATTERIES** contained in the SynQor Expansion Battery Module (EBM) are sealed units that are further mechanically protected by the EBM's chassis and electrically protected by the EBM's electronic circuitry. Under normal conditions they do not pose a hazard, but they should not be physically, thermally or electrically abused.

The **TRANSPORT** of the EBM must comply with applicable regulations of the locality. See "Internal Battery - Handling the EBM".

The EBM should be **DISPOSED** in accordance with applicable regulations of the locality or **RETURNED** to a factory-authorized Service Center.

Emergency response contact information for battery damage, leaks, smoke, or fires can be found at the following link: <http://www.SynQor.com/UPS/documents/Contact.pdf> . Please contact the factory for all other questions regarding the SynQor EBM.

CAUTION: Do not dispose of batteries in a fire. The batteries may explode.

1.4 Protection from the Environment

The SynQor EBM is a ruggedly built product having its electronics and battery contained in sealed chambers. It is capable of withstanding harsh levels of mechanical acceleration, shock and vibration, temperature and pressure variations, and exposure to water, salt, sand and dust within the levels specified in the data sheet. **THESE LEVELS SHOULD NOT BE EXCEEDED.**

Do not obstruct the air intake in the front of the EBM or the fan exhausts in the rear panel of the EBM while the EBM is operating.

1.5 User Serviceable Parts

EBM-1000 fans are user replaceable with kits available from SynQor. Please contact the SynQor factory for obtaining fan replacement kits and instructions (40x40x28mm Replaceable Fan Module SYN-9450). The SynQor EBM has no other user serviceable parts inside of it. **DO NOT REMOVE** the cover of the EBM or any of its connectors. Other than the fan assembly replacement, only factory trained personnel should perform repairs.

2.1 Product Description

The SynQor EBM-1000 Series is an advanced technology military-grade expansion battery module that uses lithium polymer batteries and highly efficient power electronic circuitry to achieve a high power level and battery run-time in a low-profile, low-weight, rack-mountable package. It is designed specifically for use with SynQor UPS-1500 and UPS-3000 series uninterruptible power supplies (UPS). The EBM-1000 expands the UPS runtime by supplementing the battery energy available in the UPS battery pack.

A communication/control port is available to permit monitoring and control by a host computer system. Front panel LEDs and an audible alarm provide information on the status of the EBM.

The EBM-1000 Series products contain an internal 500 W battery charger that can draw power from an AC input having a wide range of voltage and frequency levels, or from a 28V nominal DC input.

The EBM supplies up to 3000W to a SynQor UPS-3000 or up to 1500 W to a UPS-1500 from its internal battery. The EBM supplements the energy available in the UPS battery. At full rated UPS output power, a UPS-1500 can achieve >45 minutes of runtime at 1250 W output while a UPS-3000 can achieve >20 minutes of runtime at 2500 W output. Up to three EBM units can be combined for extended run times.

The EBM-1000 DC output connects to the UPS 28V DC input with an accessory power cable. To allow for EBM+UPS system operation from an external 28V DC power source, the EBM includes an external DC input connector. Power from the EBM external DC input connector can both charge the EBM battery and be passed through to the UPS through the EBM-to-UPS accessory power cable. Specific EBM accessory cable models are available for both the UPS-1500 and UPS-3000.

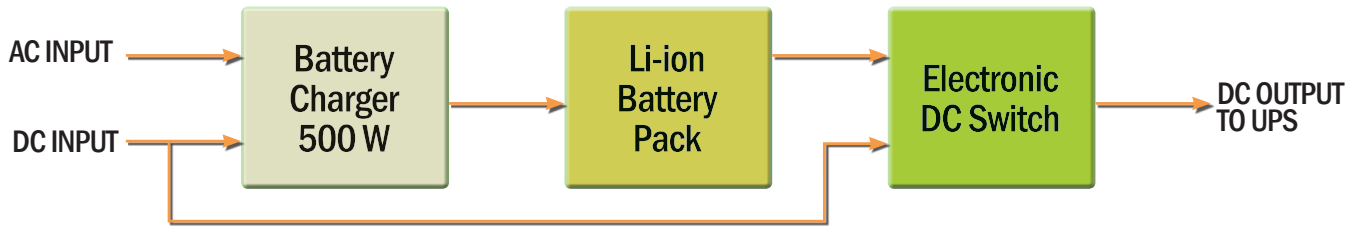
The electronic circuitry within the EBM-1000 Series products is designed, qualified and screened according to SynQor's MIL-COTS Standards. It complies with the requirements of MIL-STD-1399-300B, MIL-STD-1275D and MIL-STD-461F, as well as IEC-EN61000 specifications for world-wide commercial utility applications. It complies with the requirements of MIL-STD-704F with some leading power factor.

The EBM-1000 Series products are designed and manufactured to withstand the harsh environments and use encountered in military applications. The electronic circuitry and battery are contained in a sealed chamber constructed from a die-cast aluminum chassis that is weather-proof and shock-proof. Redundant, water-proof fans on the rear panel draw cooling air over the heat-sink fins below the sealed chamber. Military-grade circular connectors are used, and optional attached connector covers are available for when the cables are not attached. The EBM-1000 Series products comply with a wide range of testing according to MIL-STD-810G.

The SynQor EBM-1000 Series products are designed and manufactured in the U.S.A.

2.2 Product Topology

The EBM-1000 Series products combine the three basic elements shown in the figure below.



An internal 500 W battery charger is supplied by an external source of AC or DC power through rear panel connectors. When an external source of AC or DC power is present, the battery is charged and power is supplied for internal control circuits and displays.

The Li-ion battery pack contains redundant protection circuitry to avoid damage due to improper charging or discharging, or to excessive temperatures. Each individual cell in the battery pack is continuously monitored and charge-equalized during operation. When not in operation (off state) the load on the batteries is completely removed to preserve battery charge and life.

An electronic switch passes DC output power to the SynQor UPS through a rear panel connector. The source of power will be either the external DC input source, if it is present, or the internal battery pack.

There is a communication/control port that provides a digital interface to a host computer system.

2.3 Part Numbering Scheme and Options

This table shows the part numbering scheme for the full line of SynQor EBM products:

PART NUMBERING SYSTEM

Family	Watt Hours	Height	DC Output Voltage	Output Power	Charging Input	Additional Options
EBM	1000	2U	28	3000	W	ECE
EBM	1000: 1000 W Hr	2U: 3.40"	28: 28 Vdc	3000: 3000 W	W: 47-63 Hz / 360-800 Hz	E00: Ethernet / SNMP ECE: Ethernet / SNMP & CE Marking

Part Numbering Example: **EBM-1000-2U-28-3000-W-E00**

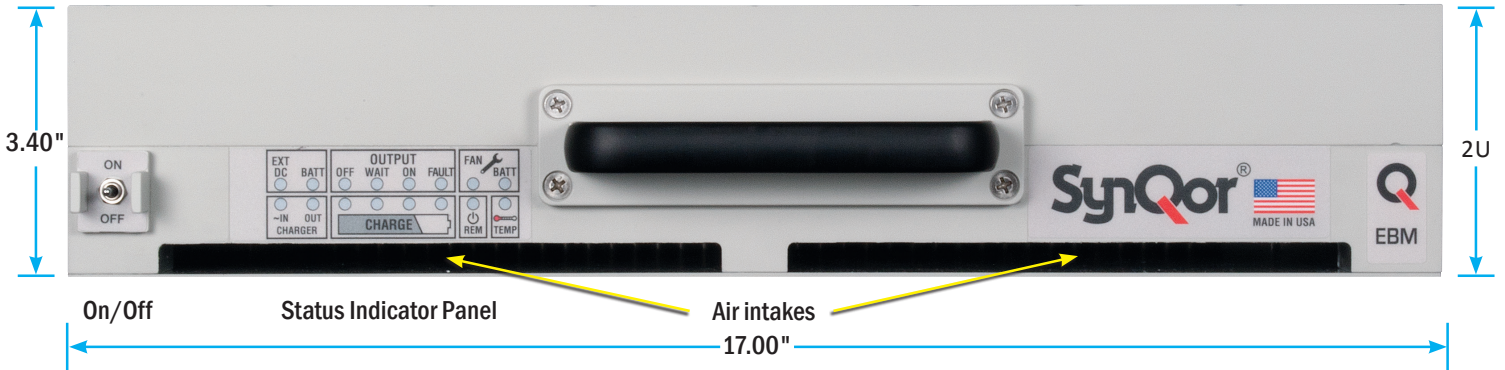
Not all combinations make valid part numbers, please contact SynQor for availability.

CE compliant units are marked as such and include a Declaration of Conformity.

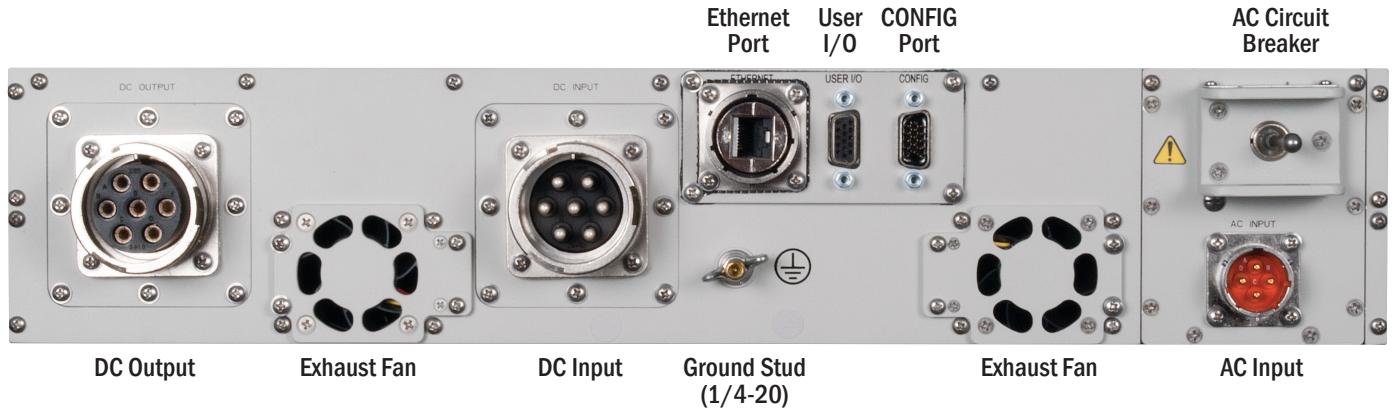
2.4 Product Specifications

The following pages show the electrical and mechanical specifications of the EBM-1000 Series of products. Datasheets showing these specifications and other information can be found at the website <http://www.synqor.com/EBM>.

EBM-1000-2U-28 Front Panel



EBM-1000-2U-28 Rear Panel



2.5 Electrical Characteristics

INPUT CHARACTERISTICS

AC Input - Charging

Voltage	85-264 Vrms
Frequency	47-63 Hz / 360-800 Hz
Input Power Factor	0.99 typical at 47-63 Hz 0.97 typical at 400 Hz
Maximum Input Current	8 A Continuous 20 Apk Inrush 10 A Internal circuit breaker rating

DC Input - Charging and Pass Through

Voltage	22-33 V ¹
Maximum Input Current with UPS-1500	25 A Charging only ² 67 A Pass through only, EBM fully charged 91 A Pass through plus charging
Maximum Input Current with UPS-3000	25 A Charging only ² 134 A Pass through only, EBM fully charged 140 A Pass through plus charging

- 1) The minimum DC input voltage varies with load. See Applications Section.
- 2) The maximum input charging current may be reduced by user commands via EBM communication interfaces. DC output must be turned on for DC input charging.

OUTPUT CHARACTERISTICS

DC Input Pass Through

Maximum Output Power 3000 W continuous

Battery Discharge

UPS Output Power and Run Time	2500 W >20 min. 1250 W >45 min.
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LITHIUM-POLYMER BATTERY CHARACTERISTICS

Total Battery Energy Storage 1000 Whrs

Recharge Time 3 hrs From 0% to 90% charge

Temperature Range for Recharge: 0 °C to 45 °C

Internal heaters maintain battery temperature above 0°C when AC or DC input power is present. Battery charging only enabled below +45 °C.

ENVIRONMENTAL CHARACTERISTICS MIL-STD-810G

Temperature Methods 501.5, 502.5

Operating Temperature	-20 °C to +55 °C
Non-operating Temperature	-40 °C to +65 °C

Altitude Method 500.5

Operating	0 - 18,000 ft
Non-operating	0 - 40,000 ft

Environmental Tests

Shock/Drop	Method 516.6, Procedures 1,4,6
Temperature Shock	Method 503.5, Procedure 1
Vibration	Method 514.6, CAT 5, 7, 24
Fungus	Method 508.6
Salt Fog	Method 509.5
Sand and Dust	Method 510.5, Procedures 1,2
Rain	Method 506.5, Procedure 1
EMI	MIL-STD-461F
Humidity	Method 507.5, Procedure 2
Mechanical Vibrations of Shipboard Equipment	Method 528, Procedure 1

RELIABILITY CHARACTERISTICS MIL-HDBK-217F

MTBF	313 kHrs	MIL-217F Ground Benign, Ta=25 °C
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ELECTROMAGNETIC CAPABILITY MIL-STD-461F

CE101	30 Hz - 10 kHz
CE102	10 kHz - 10 MHz
CS101	30 Hz - 150 kHz
CS106	10 kHz - 40 GHz
CS114	10 kHz - 200 MHz
CS116	10 kHz - 100 MHz
RE101	30 Hz - 100 kHz
RE102	10 kHz - 18 GHz
RS101	30 Hz - 100 kHz
RS103	2 MHz - 40 GHz

MECHANICAL CHARACTERISTICS

Chassis

Chassis Size	3.40"(2U)H x 17.00"W x 22.28"D
Case Material	Aluminum
Total Weight	61 lbs.

Connectors

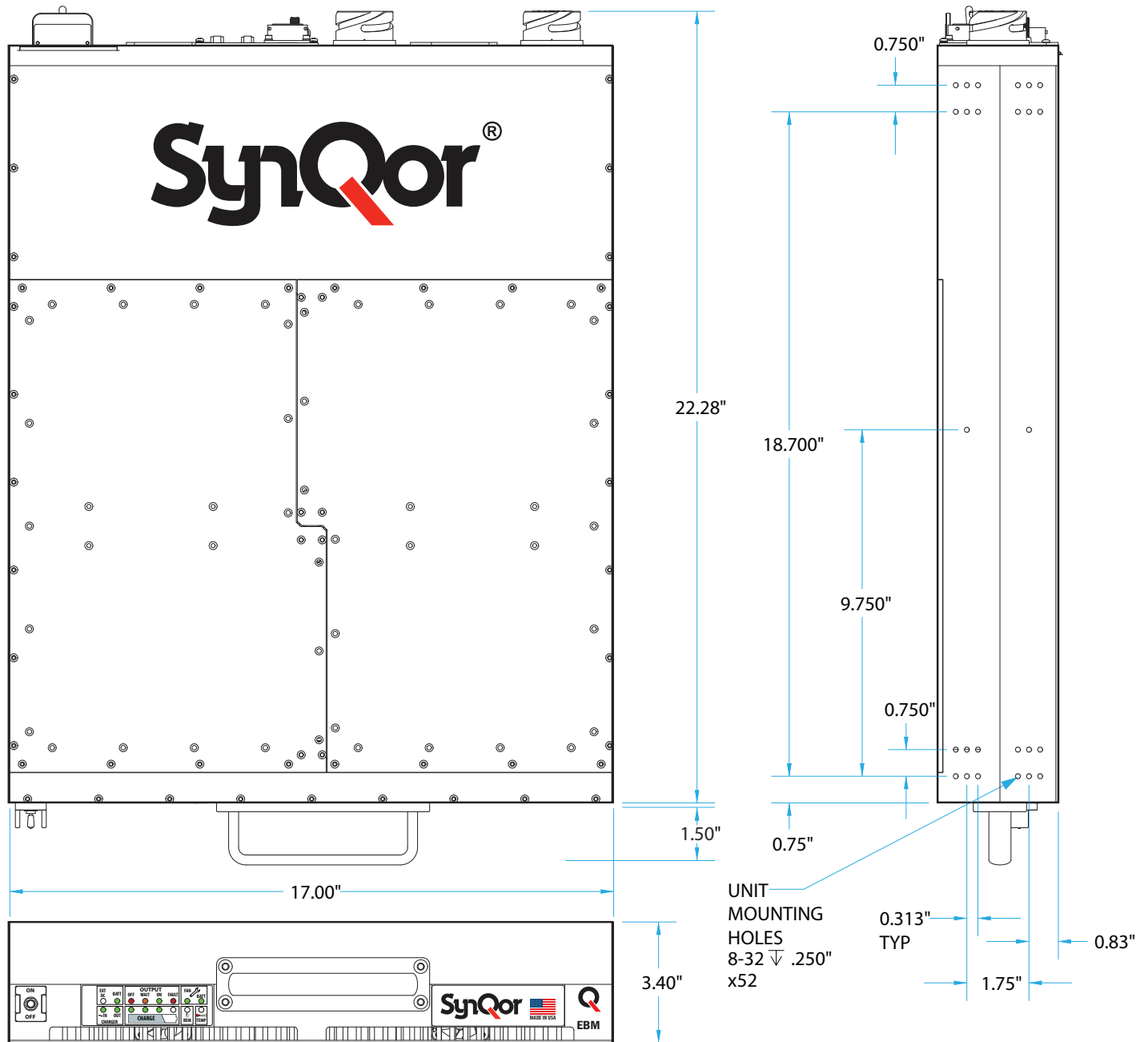
AC Input Connector	MS3470L14-4P
User I/O Ports	HD DB15 Female
Configuration I/O Port	HD DB15 Male
Ethernet Port	Amphenol RJF22N00, Code B
DC Input Connector	CA02COME24-10PB
DC Output Connector	CA02COME24-10SB

Cooling Exhaust Fans

Sound Pressure Level (SPL)	54 dB(A)
Air Flow	0.67(m ³ /min) 23.7 CFM

Two fans in system, above specs are for each fan separately.

2.6 Mechanical Diagram



2.7 AC and DC Input Power

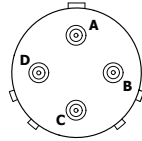
The EBM requires AC and/or DC input power to charge the internal battery. Whenever AC input power is present it will be used to charge the battery. The AC input source may be loaded up to 600 W by the EBM.

If DC input power is present and the DC output is on, then the DC input will be used to charge the battery. The DC input source may be loaded up to 600 W for battery charging in addition to the power supplied to the connected UPS.

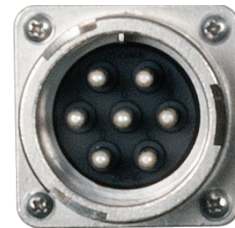
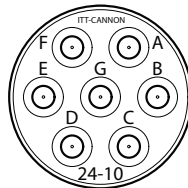
2.8 Power Cable Wiring Diagram

Looking at the rear panel, the EBM-1000 connector terminals have the following functions and locations. Note that the DC Output connectors have a Cable Sense terminal. This Cable Sense terminal must be connected to one of the Vout Return pins in the mating cable.

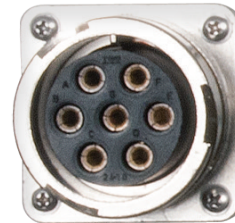
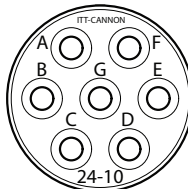
AC INPUT	
Pin	Function
A	Line
B	Neutral
C	No Connect
D	Ground



DC INPUT	
Pin	Function
F, E, D	+Vin
A, B, C	Vin Return
G	No Connect



DC OUTPUT	
Pin	Function
F, E, D	+Vout
A, B, C	Vout Return
G	Cable Sense



2.9 Power Cable Wire Size

SynQor recommends the following cables for use with the EBM-1000 Series:

Power Cable	
AC Input, NEMA 5-15 Plug, 10' length	SYN-9104
AC Input, Hardwire, 10' length	SYN-9102
DC Input, Hardwire, 10' length	SYN-9155
EBM DC Output to UPS-3000 DC Input, 2.5' length	SYN-9182
EBM DC Output to UPS-1500 DC Input, 2.5' length	SYN-9183
EBM DC Output, Hardwire, 4' length, for 1500 W load ¹	SYN-9185
EBM DC Output, Hardwire, 4' length, for 3000 W load ¹	SYN-9184

Note 1: These cables are for multi-unit application.

Other options may be available. Contact info@synqor.com or visit the website www.synqor.com for more information. If it is necessary to develop custom cables for your application, please read through the following section for some important considerations. Damage caused by improper wiring of cables will not be covered under SynQor's warranty.

Both the input and output cables of the EBM carry substantial current, and since the wires in these cables have resistance the current flowing through them causes a voltage drop from one end of the cable to the other. In other words, the voltage across the cable at its downstream end is smaller than the voltage across the cable at its upstream end. Mathematically, the amount that the voltage drops is equal to the resistance of the cable's wire multiplied by the current flowing through the wire. It is therefore **important** to make sure that the **resistance of the cable's wire is small** enough to keep this voltage drop to an acceptably small value.

While this is an issue for all of the power cables, **it is particularly important for the DC Input, DC Output cables** because the current flowing through it is very high (as high as 140 A) and the voltage across it is already relatively small (as low as 22 V). In fact, a common problem that arises (when the DC INPUT cable has too small a wire) is that the voltage seen at the DC INPUT of the EBM falls below the minimum specified value of 22 V even though the voltage at the source of the DC power is greater than 22 V. Under this condition the EBM will switch to the internal battery pack even though the voltage at the DC source of power appears to be available and at a proper level.

The resistance of a wire depends directly on its length. A wire twice as long as another will have twice the resistance, holding all other things constant. The resistance also depends on the reciprocal of the cross-sectional area of the wire, which in turn depends on the square of the wire's diameter. A wire with half the diameter of another will therefore have four times the resistance, holding all other things constant.

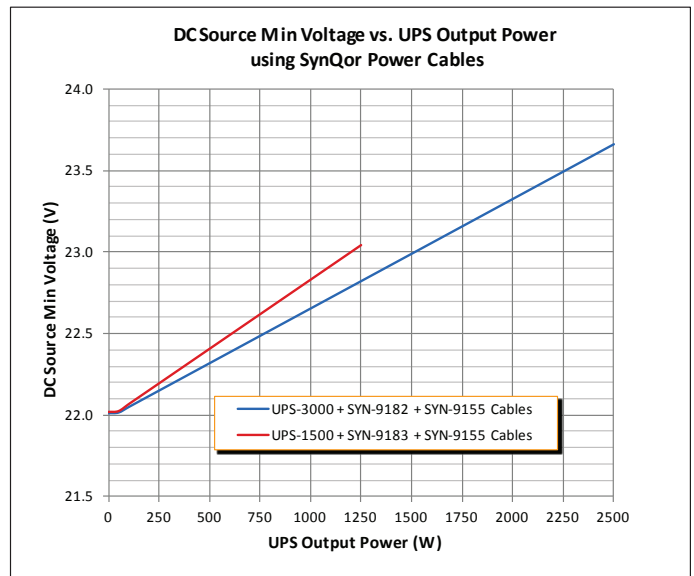
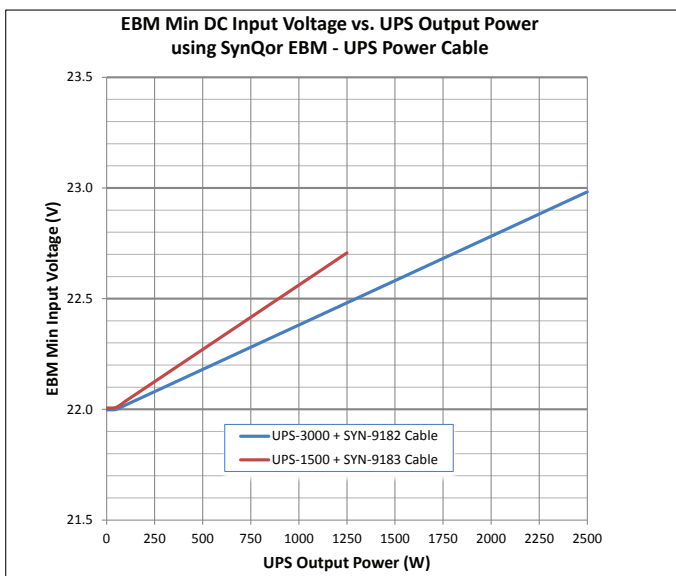
Therefore, the longer a cable is, the more important it is that the wire's diameter be large. Alternatively, a cable can have multiple pairs of wires to achieve a larger "effective wire diameter". This second approach gives a more flexible cable. SynQor recommends that the following cables be used with the EBM-1000:

UPS Model	Function	Power Conductors	Conductor Usage
All	EBM AC Input	3 wires of 14 AWG, 10' length	1 wire per AC connection, 1 protective earth ground
UPS-1500	EBM DC Input	6 wires of 10 AWG, 10' length	3 wires per DC connection
	EBM Output to UPS Input	6 wires of 12 AWG, 2.5' length	3 wires per DC connection. Note: Jumper pins G-B at EBM with 22 AWG for cable sense.
UPS-3000	EBM DC Input	6 wires of 8 AWG, 10' length	3 wires per DC connection.
	EBM Output to UPS Input	6 wires of 8 AWG, 2.5' length	3 wires per DC connection. Note: Jumper pins G-B at EBM with 22 AWG for cable sense.

When operating in the DC pass-through mode, SynQor UPS-1500 and UPS-3000 models require a 22-33 V DC input voltage. The table below shows the effects of resistance related voltage drop and its effect on the DC voltage allowed at the EBM DC input connector or at the end of the DC input cable (DC Source) for full power operation.

UPS Type	UPS Load	EBM-UPS Power Cable	EBM DC Input Voltage	EBM-DC Source Power Cable	DC Source Voltage
UPS-1500	1250 W	SYN-9183	22.7 - 33.0 V	SYN-9155 (10')	23.0 - 33.0 V
UPS-3000	2500 W	SYN-9182	23.0 - 33.0 V	SYN-9155 (10')	23.7 - 33.0 V

The following graphs show this same effect as a function of UPS loading



3.1 Set-Up

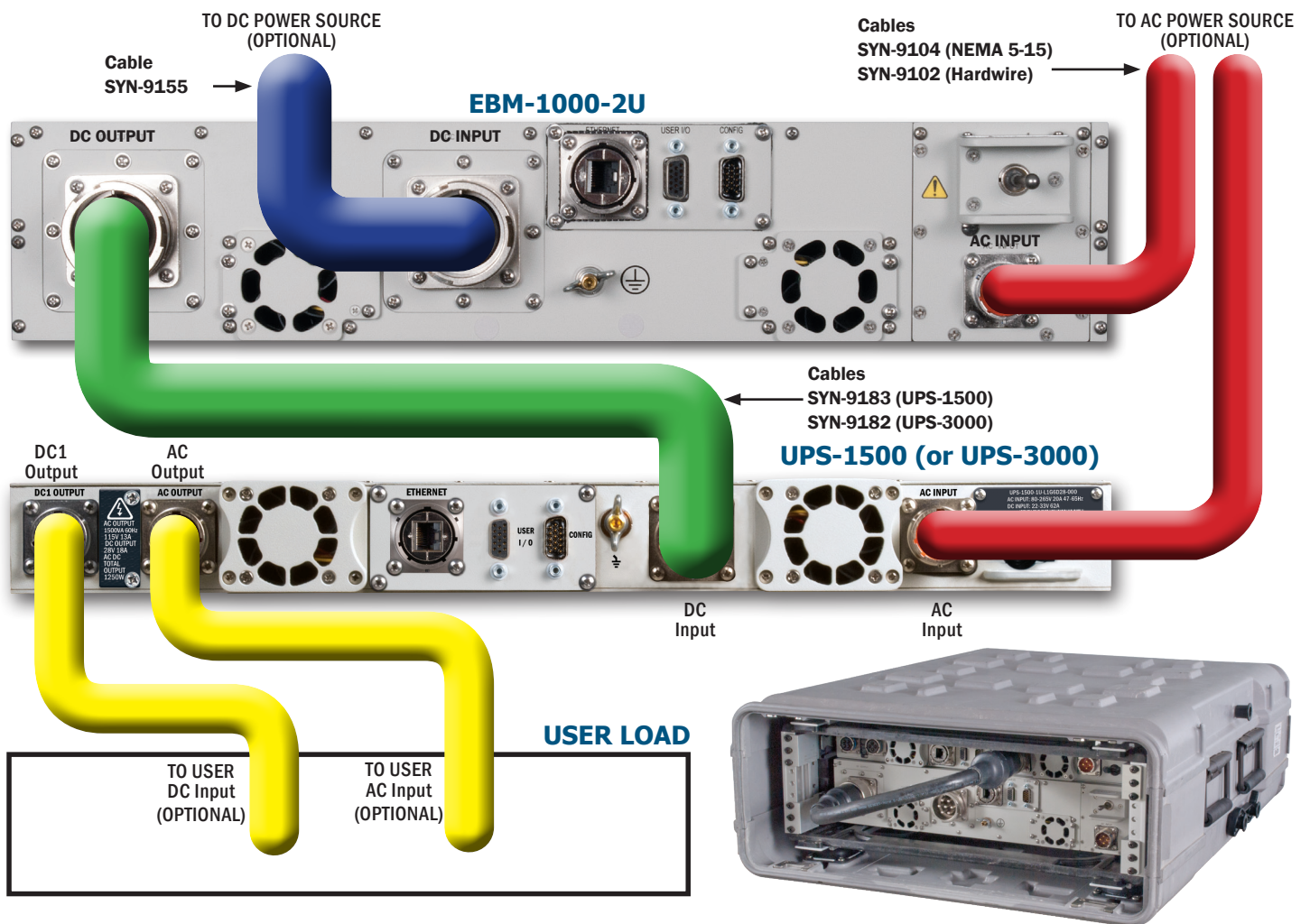
The recommended procedure for setting up the EBM with a UPS is the following. For more details on UPS set-up, refer to the specific UPS Operator’s Guide:

http://www.synqor.com/UPS/documents/UPS-3000_User_Guide.pdf

http://www.synqor.com/UPS/documents/UPS-1500_User_Guide.pdf

- Make sure the AC BREAKERS on the rear panel of the EBM and UPS are in the OFF position and that the UPS and EBM outputs are off. At this point there should be no lit LED indicators on either the EBM or the UPS.
- Connect the ground wire to the ground stud on the rear panel of the EBM.
- Refer to the following diagram and table to help decide which input power cables will be used for a given application (wire colors for demonstration purposes only):

EBM & UPS POWER CONNECTIONS



EBM/UPS INPUT CABLE CONFIGURATIONS			
EBM DC	EBM AC	UPS AC	OPERATION
Used	Not used	Not used	This case has only a DC source connected.
			When DC source is present and the EBM output is on, the UPS receives power from the DC source to power the load and the EBM charges its internal battery.
			If subsequently the DC source is removed, the EBM will continue to supply DC power to the UPS from its internal battery until the battery depletes or the DC source returns.
Not used	Used	Used	This case has only an AC source connected.
			When AC source is present the EBM and UPS receive power from the AC source. The EBM AC input cable will only supply EBM charging power of approximately 600 W maximum, whereas the UPS AC input cable will supply the full load of the UPS.
			If the EBM output is on, and subsequently the AC source is removed, then the EBM will continue to supply DC power to the UPS from its internal battery until the battery depletes or the AC source returns.
Used	Used	Used	This case has both AC and DC sources connected.
			This use case implies there are both AC and DC sources of power and that either or both may be present. If both the AC and DC sources are present, then the EBM may use either or both to charge the battery. The EBM output must be on to charge from the DC Source.
			If the EBM output is on, and subsequently the AC source is removed with DC source present, the EBM will continue to supply DC power to the UPS and charge its internal battery from the DC source until the AC source returns.
			If the EBM output is on, and subsequently both the AC and DC sources are removed, then the EBM will continue to supply DC power to the UPS from its internal battery until the battery depletes or the AC source returns.


- Connect the EBM DC OUTPUT cable, first to the EBM and then to UPS.
- Connect the UPS AC OUPUT and/or DC OUTPUT cables.
- Connect the USER I/O cables, if those features are to be used.
- Connect all INPUT cables, first to the EBM and then to the UPS.
- An overcurrent protect and disconnect device should be installed on the DC INPUT circuit. An example of a suitable device is listed below.

External Overcurrent and Disconnect Device Description
Carling Technologies, F-series, 175 A 125 VDC, FA1-B0-14-917-12A-BG circuit breaker. (www.carlingtech.com)
Sensata/Airpax, JLE-series, 175 A 65 VDC, JLE-1-1-52-1-F1-175 circuit breaker. (www.sensata.com)

- If the optional DC INPUT cable is present, **VERIFY** that it is connected to the EBM and the source of DC power with the correct polarity.
- Turn on the sources (if they have an upstream breaker).
- Move the AC BREAKERS on the rear panel of the EBM and the UPS to the ON position.

Note: Be careful to not toggle the front panel ON/OFF switches during the setup. Doing so could cause the EBM or UPS to turn on and present a voltage at its output.

3.2 Start-Up

- **VERIFY** that all connections to the EBM are correct.
- If either the AC source or the DC source (or both) is present and within specifications, the front panel LED status display on the EBM will be active.
- Momentarily push the ON/OFF switch on the front panel of the EBM upward. The switch can then be released and it will return to its normal (neutral) position.
- The EBM will immediately enable its DC output. The EBM front panel display will indicate the output is ON with a green ON LED. The UPS front panel display will indicate the presence of input from the EBM with a green  POWER IN LED.
- Momentarily push the ON/OFF switch on the front panel of the UPS upward to activate the UPS output(s). The switch can then be released and it will return to its normal (neutral) position.

Note: If no input power sources are available the EBM can still be turned on. It will draw power from the internal battery for as long as the battery has charge left in it. This is sometimes referred to as a “COLD START” in the industry. Under this condition, the EBM display will initially be dark. When the ON/OFF switch is pushed to the ON position for 3 seconds or more, the EBM output will turn on and the display LEDs will be appropriately illuminated.

3.3 Shut-Down

- Shut down the equipment connected to the UPS.
- Push the ON/OFF switch on the front panel of the UPS downward and hold it in this position for 1 second (or more). The color of the LED above the ON/OFF switch will change to amber (if one or both input power sources are present) or it will be off (if no power sources are present). The switch can then be released to return to its normal position.
- The UPS will disable its outputs.
- It is not necessary to turn the EBM output OFF. In normal usage the EBM is left connected to its AC and/or DC source with its output ON to keep the battery charged and to be ready to supply the UPS in the event of a source power interruption.
- It is not necessary to move the AC BREAKER on the rear panel of the UPS or EBM to the OFF position.
- If the UPS is not in use and neither AC nor DC source is present, then the EBM may be turned OFF by pushing the ON/OFF switch on the front panel downward and holding it in this position for 1 second (or more). This will cause the EBM display to go dark and the battery to “sleep”, thereby preventing self-discharge.

3.4 Power Cable Connections/Disconnections While Operating

For safety reasons, it is highly recommended that the input and output power cables be connected to the EBM before the source of AC or DC input power is turned on, and before the EBM is turned on (see **Section I: Warnings** and the **SET-UP** section above). Similarly, it is **highly recommended** to first turn off the EBM and the sources of input power before any power cables are disconnected from the EBM.

However, the SynQor EBM is capable of having any of its input or output power cables connected at any time (if safely done), including when the EBM is turned on and delivering power to the load (UPS). For instance, even if the EBM is turned on, one can connect or disconnect the input power cables without harming the EBM or disrupting power delivery to the load (UPS). If no input power source is available, the EBM will draw power from its internal battery pack. When there is an external source of DC power connected to the EBM, the unit will draw power from that source. The transfer from external source of DC power to the internal battery is seamless.

Note: that disconnecting an input or output power cable while that cable is handling power will likely cause an arc to form as the terminals are pulled apart. This arcing is not harmful to the EBM, although if done enough times it will degrade the connector to the point where it will need to be replaced. This problem is particularly acute for the **DC INPUT and DC OUTPUT cables** because their current is so high. Disconnecting this cable while a large current is flowing is **not recommended**.

3.5 Cooling System

The SynQor EBM-1000 Series products are cooled by fans that draw air into the intake below the front panel and exhaust it out the two fan ports on the rear panel. Care should be taken to ensure there is no obstruction to this airflow, either at the front intake or the rear exhaust ports. Similarly, care should be taken to avoid obstructing the fan blades.

The speed of the cooling fans is automatically controlled to provide adequate EBM cooling while extending the life of the fan bearings. Under low ambient temperature and/or low EBM output power the fans will be driven at a low speed. If the ambient temperature and output power are such that the EBM cannot otherwise maintain its specified maximum temperature for its internal circuitry, the fans will momentarily be driven at a speed that exceeds their rated long-term running speed.

If the ambient temperature is low enough (for the level of power being delivered to the load), the fans may not be on. This is not a malfunction. It is done to preserve the life of the fans. If the fans are off, check the Fan Service Required LED on the front panel of the EBM. If it is GREEN, the fans are functioning properly and simply not needed under the present conditions.

The fans are weather-proof and water-proof.

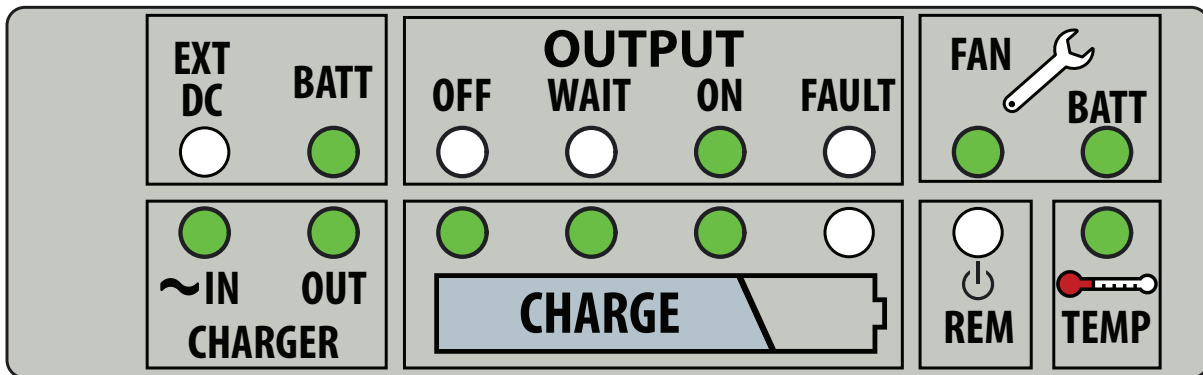
The EBM has two fans to provide redundancy for these exposed, moving components. With only a single operating fan the EBM is still able to deliver 100% rated power at an ambient temperature as high as 40 °C, and it is able to deliver 80% of its rated power at an ambient temperature as high as 55 °C.

3.6 Front Panel Indicators

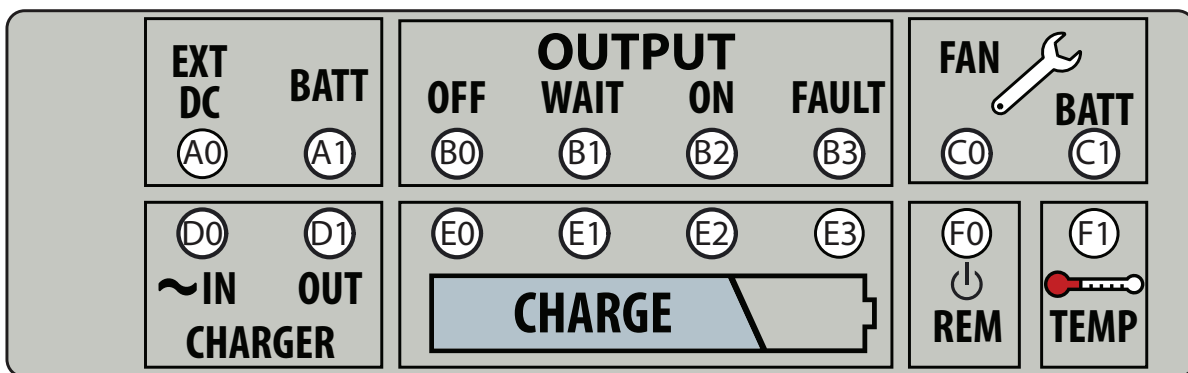
To indicate the status of the EBM and its internal battery pack, there are 16 LEDs on the front panel. There is also an audible alarm. These indicators are described in this section.

3.6.1 LED Display

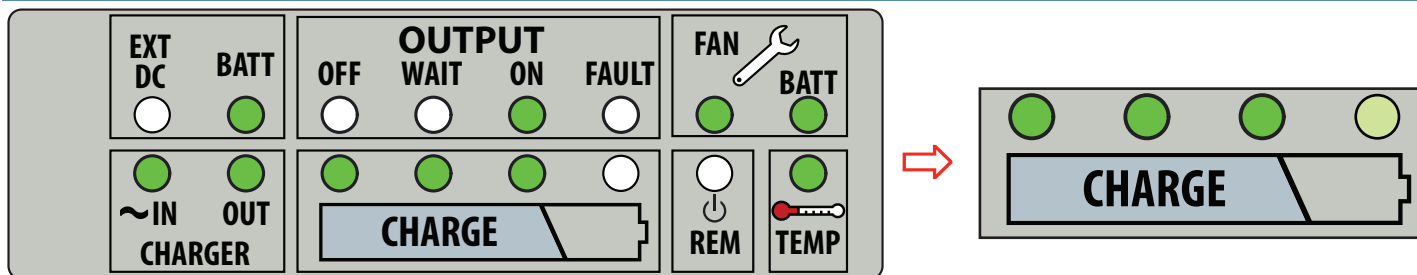
The front panel LED display indicates the operational status of the EBM. A typical display of **normal operation** is shown below. Here, the EBM is receiving AC power to charge the internal battery and the DC output to the UPS is on. The battery is showing at least 75% charge level.



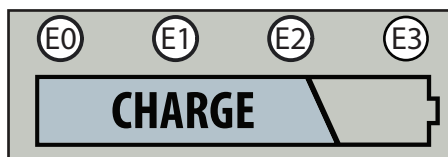
The display is divided into functional sections separated by rectangular borders as described below. For reference, the LED indicators are given alpha-numeric designators as shown below:



3.6.1.1 Battery State-of-Charge



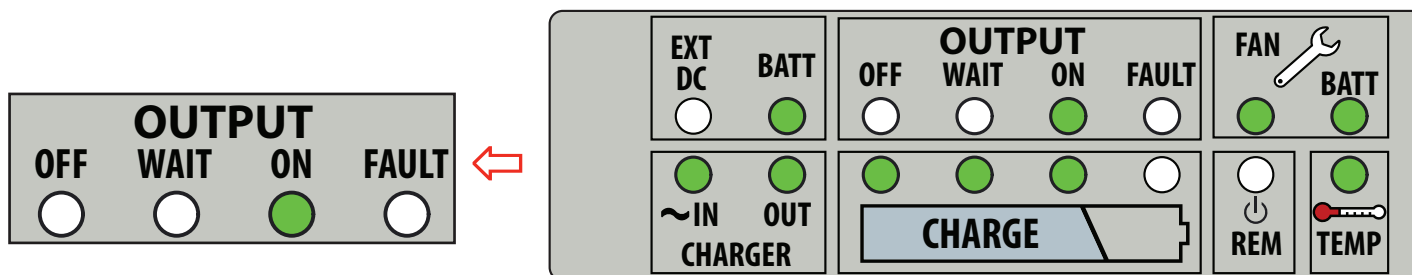
This display section shows the charge level of the EBM internal battery as a left-to right 4-LED bar-graph with 25% increments. The above example shows at least 75% of full charge. The right-most lit LED in the bar-graph will light dimly if the charge is less than a full 25% increment. If there is less than 10% charge remaining, then the final LED lit (left-most) will flash red or amber as described in the table below.



• Battery State-of-Charge Indicator (LEDs in position E0 – E3)

Appearance				Description	Indication
E0	E1	E2	E3		
●	●	●	●	Solid Green	Battery Charge = 100%
●	●	●	◐		100% > Battery Charge > 75%
●	●	◐	○		75% > Battery Charge > 50%
●	◐	○	○		50% > Battery Charge > 25%
◐	○	○	○		25% > Battery Charge > 10%
◐	○	○	○	Blinking Red	Battery Charge < 10%, Discharging
◐	○	○	○	Blinking Amber	Battery Charge < 10%, Charging

3.6.1.2 Output Status



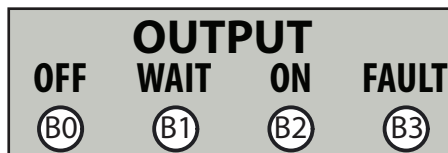
This display section shows the state of the EBM DC output. The above example shows the output ON, which is the way the EBM-1000 is used when it is expected to provide normal or back-up power to a connected UPS. By design only one of the OFF (red), WAIT (amber), ON (green), or FAULT (red) LEDs are lit. Momentarily toggling the front panel switch up or down will move between the OFF and ON LEDs being lit.

If the output were to experience a fault condition while ON, such as a short circuit load, then

output would immediately disable and the FAULT LED (red) would light.

The WAIT LED lights to indicate that the EBM output is OFF, but will turn ON automatically when the battery has sufficient charge. This might occur with AC as the only source following a battery discharge event.

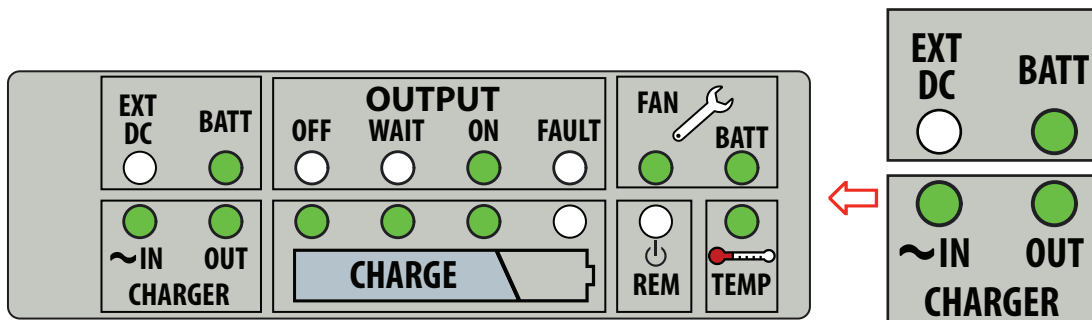
More details are provided in the following table.



• Output Indicator (LEDs in position B0 – B3)

LED Designations				Description	Indication
B0	B1	B2	B3		
Red	White	White	White	Red	The EBM 0 is OFF
White	Amber	White	White	Amber	The EBM output is OFF, but will turn ON automatically when the battery has sufficient charge
White	White	Green	White	Green	The EBM output is ON
White	White	White	Red	Red	There is an output FAULT, such as short circuit or overload. The output is OFF but will automatically retry to turn ON after a delay

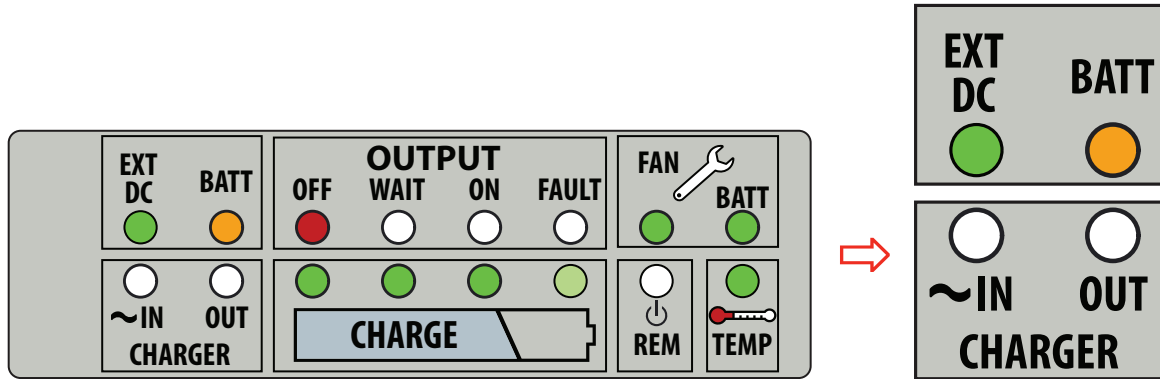
3.6.1.3 Sources and Charger



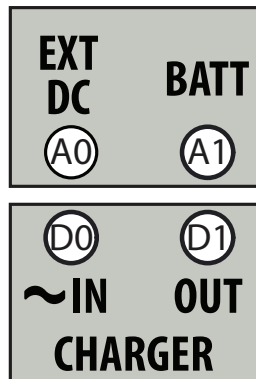
This display section shows the states of the three possible EBM sources (AC, DC, and battery) and the battery charger. In the above example the AC source is present and charging the battery. No DC source is present. The battery is ready to deliver load if the load exceeds the charger 500 W output capability.

If the DC source was also present then all 4 of these LEDs would be lit green. Note that a source which goes out of valid voltage range will have its associated LED turn amber. The EBM may take 15 seconds to re-validate a source and turn its LED back to green.

A special case to consider is when the DC source is present, the AC source is not present, and the EBM output is OFF. **The EBM output must be ON to charge the battery from a DC source.** So in this case, with the output OFF, the battery will go into “sleep” after 60 seconds to prevent self-discharge. The BATT LED will then change to amber, while the EXT DC LED will remain green and the ~IN and OUT CHARGER LEDs will be unlit. This is shown in the diagram below.



More details are provided in the following tables.



• Sources and Charger Indicator (LED in positions A0, A1, D0, D1)

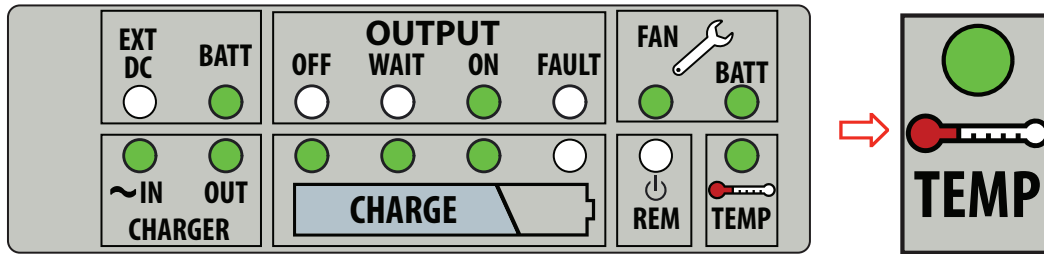
LED A0 EXT DC	Description	Indication
	Unlit	No valid DC source is present.
	Solid Green	Valid DC source is present and is not delivering power to output.
	Pulsing Green	Valid DC source is present and is delivering power to output.
	Amber	Out of range (invalid) DC source present.

LED D0 ~ IN	Description	Indication
	Unlit	No valid AC charging source is present.
	Solid Green	Valid AC charging source is present.

LED D1 Charger Out	Description	Indication
	Unlit	No battery charging.
	Solid Green	Battery is float-charging from external source.
	Pulsing Green	Battery is rapid-charging from external source.

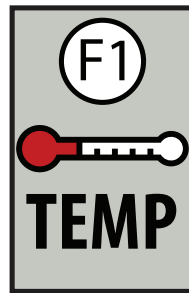
LED A1 BATT	Description	Indication
	Solid Green	Battery "awake" and ready for sourcing to UPS.
	Pulsing Green	Battery is delivering power to output.
	Amber	Battery "sleeping" and unavailable for sourcing to UPS.
	Red	Battery unavailable due to internal fault such as temperature beyond allowable range.

3.6.1.4 Temperature



This section displays internal EBM-1000 temperature status, primarily as it affects the battery. The TEMP LED changes color and flashes depending on the temperature levels. In the above example, all readings are near the center of their allowable operating ranges and the TEMP LED is steady green.

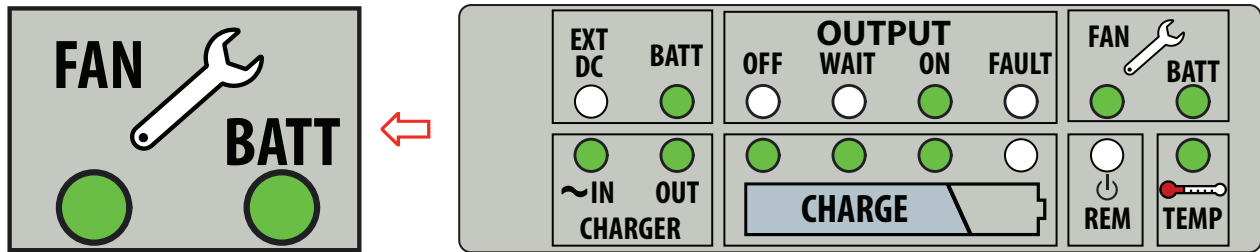
More details are provided in the following table.



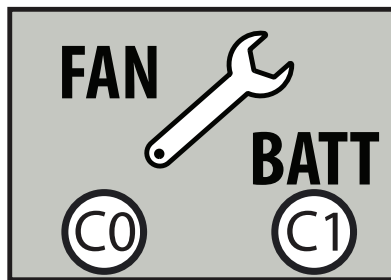
• Temperature Indicator (LED in position F1)

LED Appearance	Description	Indication
	Red	Battery is too Hot to be Charged or Discharged
	Blinking Red	Battery is too Cold to be Charged or Discharged
	Blinking Amber	Battery is too Cold to be Charged
	Green	Battery Temperature is Within its Specified Operating Range
	Amber	Battery is too Hot to be Charged

3.6.1.5 Service Required



This display section shows service alerts for the fans and battery. In the above example, both the FAN and BATT LEDs are green indicating **no service is required**. If degraded performance of either the fan or battery is detected, the associated LED will change color to amber or red as detailed below.



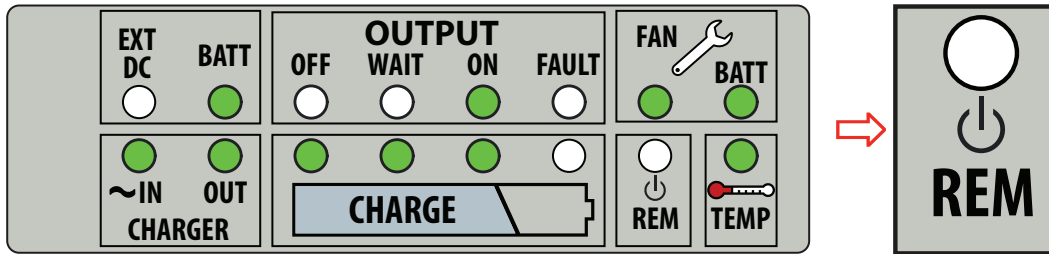
• Fan Service Required Indicator (LED in position C0)

LED Appearance	Description	Indication
	Green	Both Fans are OK
	Amber	One or Both Fans Have Recently Had Degraded Performance and Diagnostic Tests are Being Performed
	Red	One or Both Fans Presently Have Degraded Performance

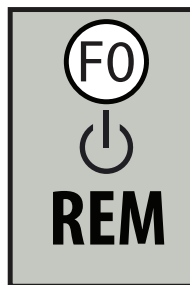
• Battery Pack Service Required Indicator (LED in position C1)




LED Appearance	Description	Indication
	Green	Battery is OK
	Amber	Battery's calculated maximum storage capacity is <75% of its rated value
	Red	Battery's calculated maximum storage capacity is <50% of its rated value
	Unlit	Battery's storage capacity presently unavailable, but will be re-calculated the next time charge reaches > 50%

3.6.1.6 Remote ON/OFF



This display section has one LED to indicate the status of the remote ON/OFF input, available to the user via the USER I/O rear panel connector. This input is described in the “Digital Input/Output Control Signals” section of this document. Intended for use with an external 3-position momentary toggle similar to the front panel ON/OFF control, or the electronic equivalent, there are 3 REM LED states displayed. In the above example, there is no remote control command and the REM LED is unlit. This is equivalent to the front panel momentary toggle switch being in its center-off position. The REM LED will light red or green as described in the following table.



LED F0 REM	Description	Indication
	Unlit	Remote control inputs inactive
	Green	Remote Start input active
	Red	Remote Stop input active

3.6.2 Audible alarm

For critical situations a pattern of audible tones will be repeated every 5 seconds, according to the table below. This audible alarm can be silenced by holding the ON/OFF switch on the front panel in the “UP” position until a chirp is heard. A new alarm condition will cause the audible alarm to be reactivated. Contact Factory for instructions on how to permanently silence the alarm.

Number of Tones in Pattern	Indication
One	EBM is drawing power from the battery pack
Two	Load power is greater than or approaching 100% rated power
Three	Fault appears on the DC output. Fault will auto-reset after delay.
Four	EBM is drawing power from the battery pack and the remaining charge is <10%

3.7 Operating Environment

The SynQor EBM-1000 Series is designed for the extreme environmental conditions of military and aerospace applications. All the electronic circuitry and the battery pack are contained in a sealed, weather-proof, shock-proof chamber constructed of die-cast aluminum. Only the redundant, water-proof cooling fans are exposed to the environment. Protection circuitry ensures that the battery is not charged or discharged if it is too hot or too cold. The EBM will shut down if it is too hot.

The EBM (with cables connected or connector covers installed) has been qualified to the following requirements of MIL-STD-810G:

MIL-STD-810G Test Method	Name	Procedure	Details
500.5	Low Pressure	I, II and III	▪ 18,000 ft. operating ▪ 40,000 ft. storage
501.5	High Temperature	I and II	▪ +55°C operating ▪ +65°C storage
502.5	Low Temperature	I and II	▪ -20°C operating ▪ -40°C storage
503.5	Temperature Shock	I	▪ 12 cycles; -20°C to 65 °C
506.5	Rain	I	▪ 4" rain/hour ▪ 40 mph wind velocity
507.5	Humidity	II	▪ >95%
508.6	Fungus	NA	▪ 28 day test
509.5	Salt Fog	NA	▪ 5% salt solution ▪ 2 cycles (24 hr wet/24 hr dry)
510.5	Sand and Dust	I and II	▪ 20 mph blowing dust ▪ 40 mph blowing sand
514.6	Vibration	Category 5	▪ 5Hz (300 RPM) ▪ Loose Cargo
		Category 7	▪ General Exposure
		Category 24	▪ PSD = 0.04 g ² /Hz; 20-2000Hz ▪ Operating
516.6	Shock	I, IV and VI	▪ 20g/11ms; 40g/sawtooth ▪ 48 inch drop in transit case ▪ 45 degree tilt and drop
528	Mechanical Vibrations of Shipboard Equipment	I	▪ Operating

4.1 General Considerations

Up to three SynQor EBM units can be combined to achieve extended UPS run-times.

The EBMs' DC Input and DC Output cables must be connected in electrical parallel, respectively, and a circuit protector must be externally provided between the EBMs and the UPS.

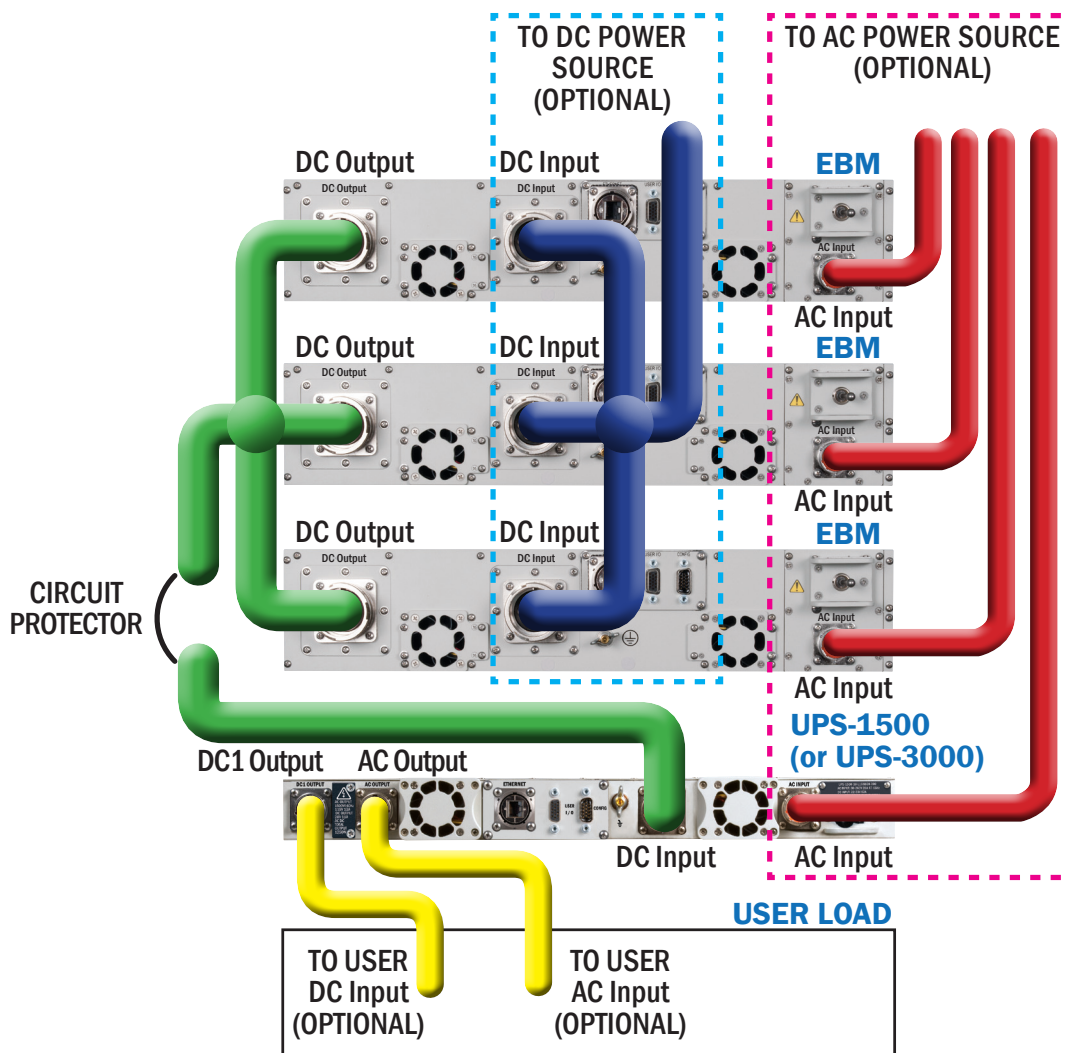
Another supported combination is one EBM and two UPS-1500s.

There is a restriction on how far apart the UPS and EBMs can be. The longest distance through cabling from any EBM to UPS must be less than 8 feet (2.5 m). In general, shorter is better, as this reduces voltage drops due to wiring inductance (transients) and resistance (steady-state). Refer to the following wiring diagrams for details.

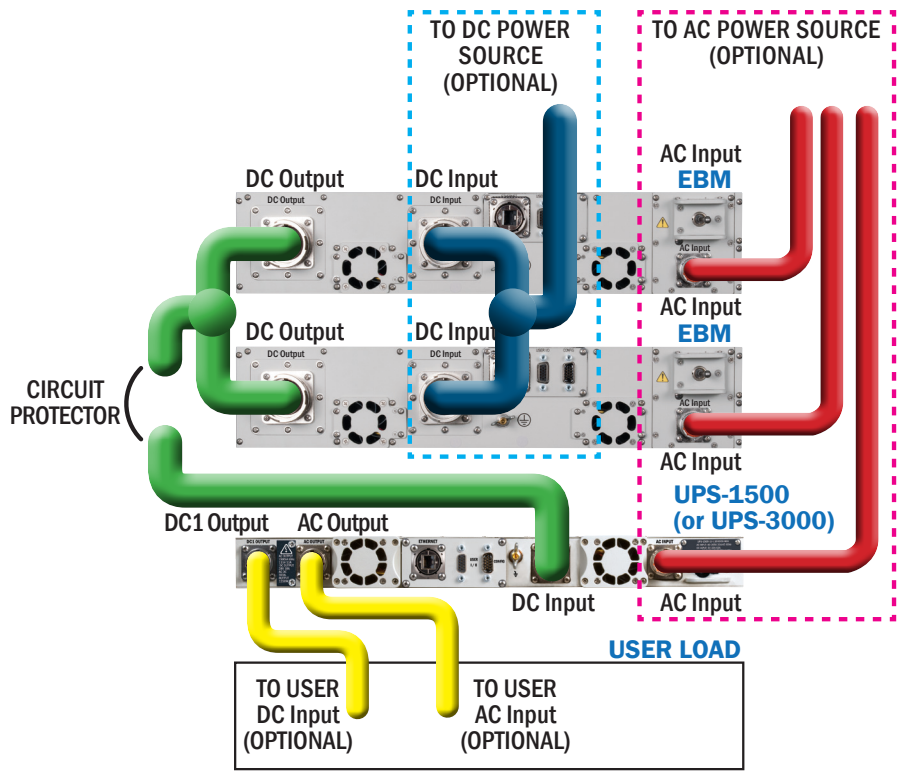
4.2 Setup Instructions

EBM & UPS POWER CONNECTIONS MULTI-UNIT 1 LINE DIAGRAMS

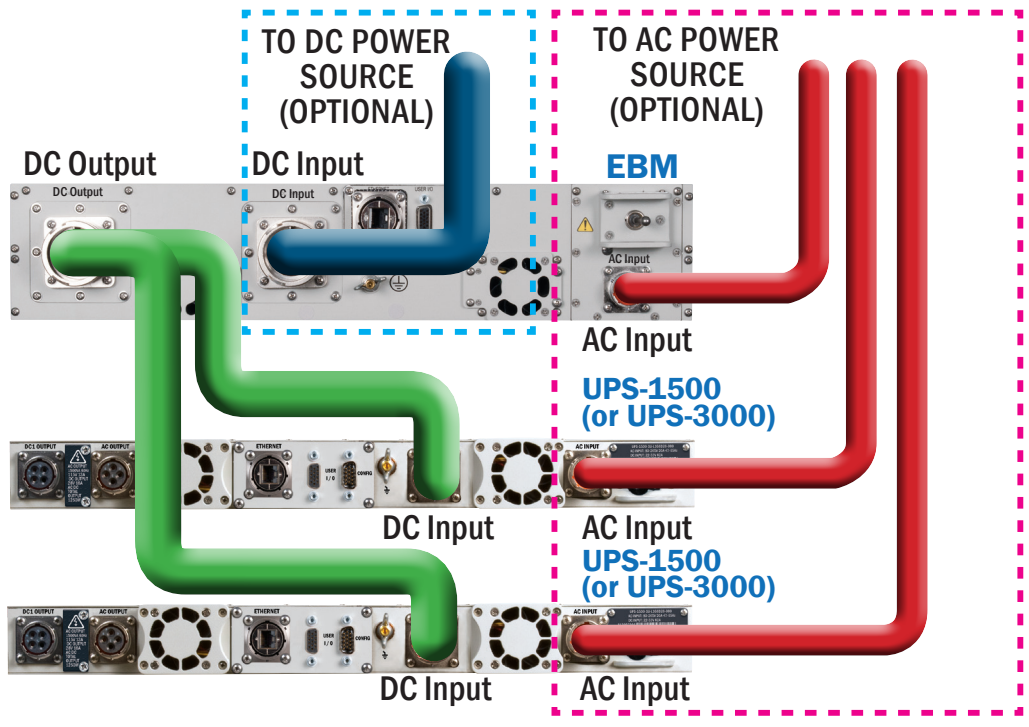
THREE EBM UNITS COMBINED



TWO EBM UNITS COMBINED



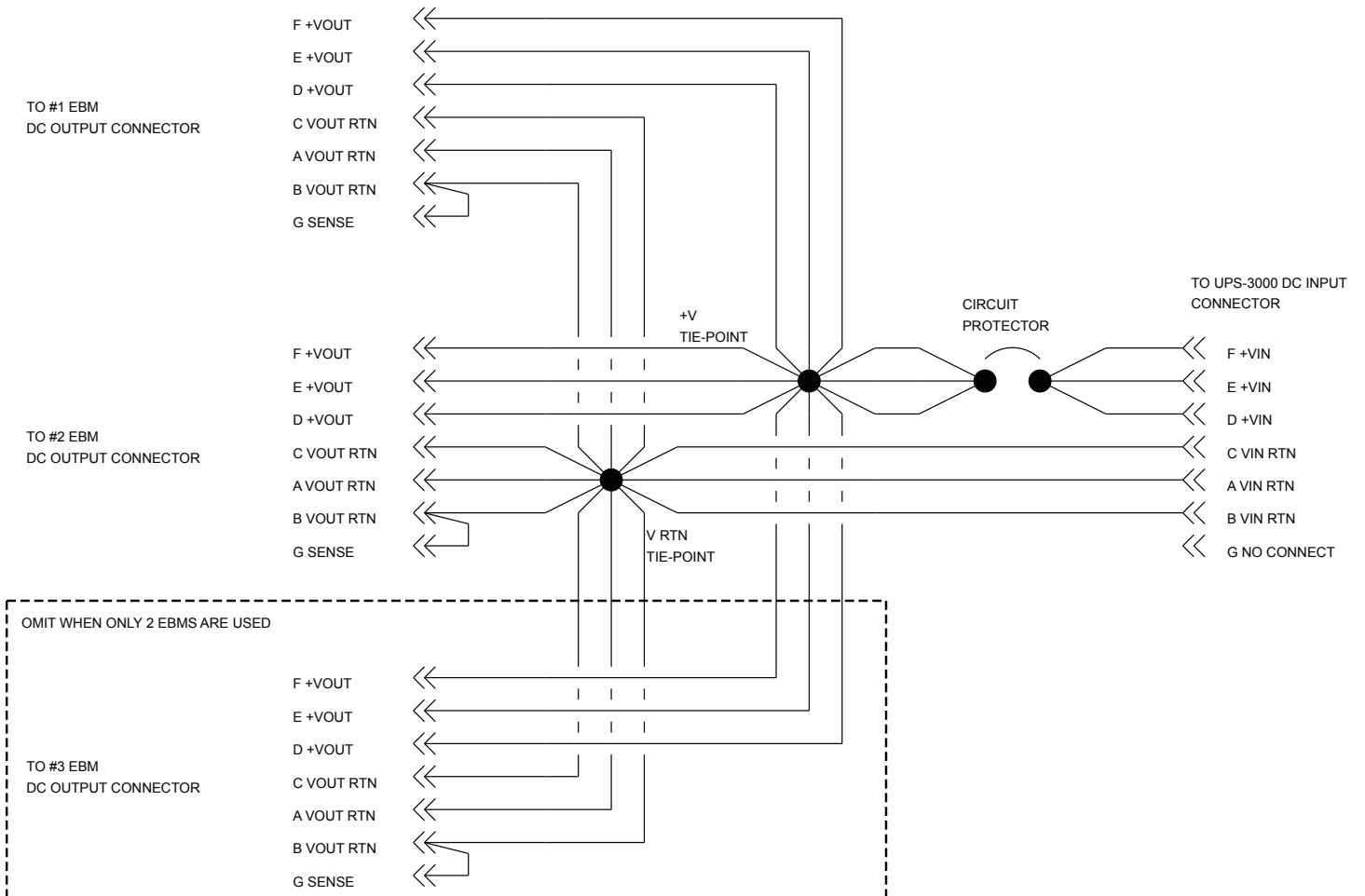
EBM & 2X UPS-1500 POWER CONNECTIONS MULTI-UNIT 1 LINE DIAGRAM



The previous figures show the basic power wiring for a 2 or 3 unit EBM combination and for a single EBM with 2X UPS-1500 combination. The UPS and EBM AC input cables must each meet the requirements of a single unit application. The EBM DC output to UPS DC input cables may be constructed as shown in the following diagrams.

4.3 Multi-unit EBM to UPS-3000 Wiring

MULTI-UNIT EBM TO UPS-3000 POWER WIRING

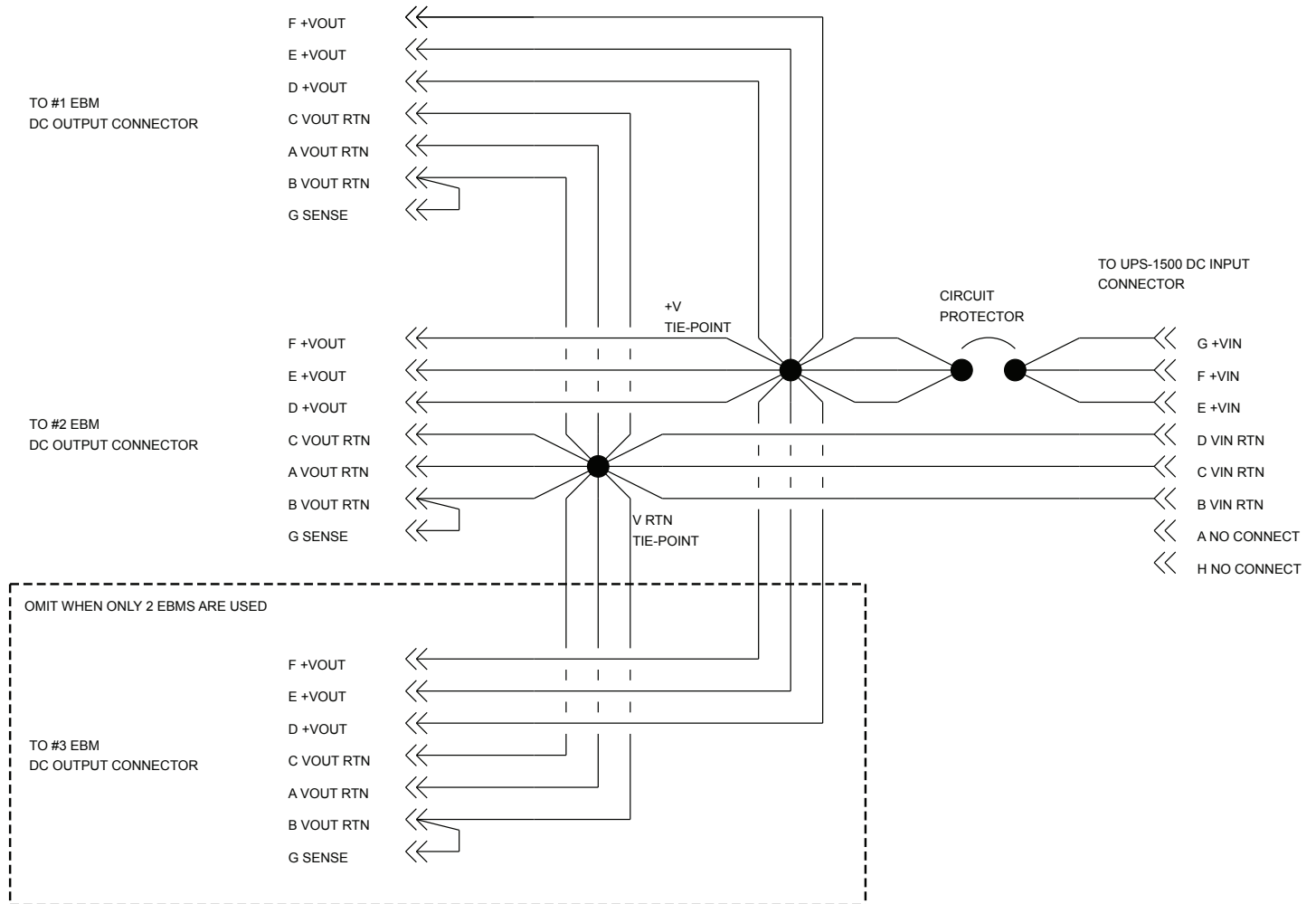


NOTES:

1. All wire # 8 AWG except #22 AWG at pin G SENSE.
2. TIE-POINTS and CIRCUIT PROTECTOR see 33 VDC 125 ADC continuous maximum.
3. UPS side connector: ITT CANNON CB6UHST4-24-10SSA34 or equivalent.
4. EBM side connectors: ITT CANNON CB6UHST-4-24-10PSA34 or equivalent.
5. Longest path EBM-TO-UPS must be less than 8 feet (2.5m).
6. CIRCUIT PROTECTOR EXAMPLE: Carling Technologies, 150A 125VDC, FA1-B0-14-815-12A-BG

4.4 Multi-unit EBM to UPS-1500 Wiring

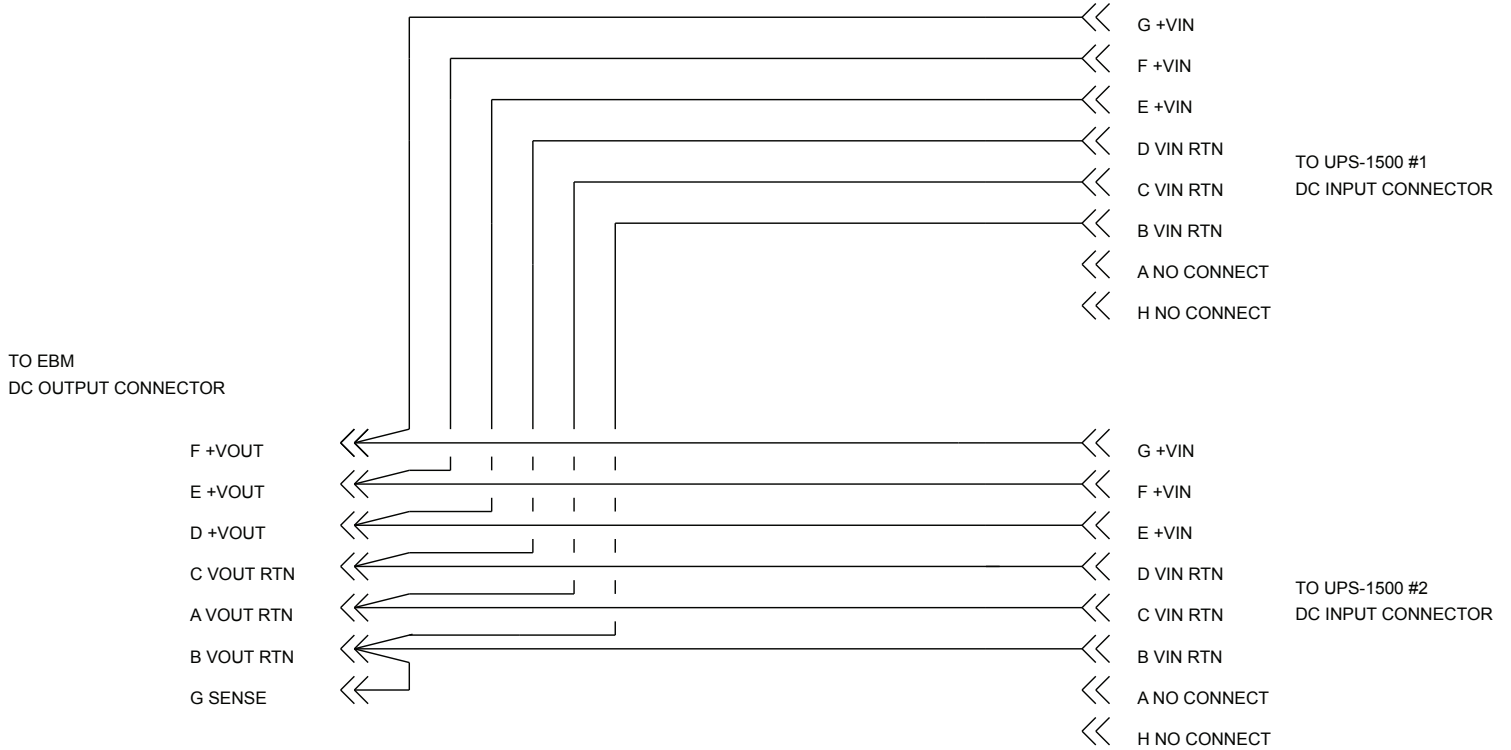
MULTI-UNIT EBM TO UPS-1500 POWER WIRING



NOTES:

1. All wire # 12 AWG except #22 AWG at pin G SENSE.
2. TIE-POINTS and CIRCUIT PROTECTOR see 33 VDC 62 ADC continuous maximum.
3. UPS side connector: Amphenol MS3476L18-8S-UHST3 or equivalent.
4. EBM side connectors: ITT CANNON CB6UHST-4-24-10PSA34 or equivalent.
5. Longest path EBM-TO-UPS must be less than 8 feet (2.5m).
6. CIRCUIT PROTECTOR EXAMPLE: Carling Technologies, 80A 65VDC, CA1-B0-14-680-321-J

EBM TO TWO UPS-1500 POWER WIRING



NOTES:

1. All wire # 12 AWG except #22 AWG at pin G SENSE.
2. UPS side connectors: Amphenol MS3476L18-8S-UHST3 or equivalent.
3. EBM side connector: ITT CANNON CB6UHST-4-24-10PSA34 or equivalent.
4. Longest path EBM-TO-UPS must be less than 8 feet (2.5m).

4.5 DC Source Current and Wiring

The EBM's DC input connections, if used, must be connected in electrical parallel. This connection can be located anywhere between the DC source and the EBMs. Each EBM in a multi-unit scheme may draw the full DC input pass-through current to the UPS plus its own battery charger current, as listed in the Electrical Characteristics Section. However, the sum DC input current of all the EBMs in a multi-unit scheme will not exceed the DC input pass-through current to the UPS **plus** the sum of the individual EBM charger currents. This current is also the maximum source current and the maximum current in the wires from the parallel connection to the source. The following chart shows the current levels to be expected:

Power Level	Individual EBM Maximum Input Current	DC Source Maximum Input Current
UPS-1500 + 2 x EBM	91.8 A	117 A
UPS-1500 + 3 x EBM	91.8 A	143 A
UPS-3000 + 2 x EBM	143 A	184 A
UPS-3000 + 3 x EBM	143 A	209 A
2 x UPS-1500 + 1 x EBM	143 A	143 A

The maximum input charging current may be reduced by user commands via EBM communication interfaces. Reducing the charging current in this manner reduces the maximum DC source current shown above, but increases the battery re-charging time.

4.6 Multi-unit Operation

Operation of multi-unit EBMs is similar to that of a single unit. For normal usage, where the EBMs are expected to provide normal or back-up power to a connected UPS, all the EBM outputs should be turned ON. Conversely, if the EBMs are being set up or are to be taken out of service, then all the EBM outputs should be turned OFF.

The multi-unit EBM scheme does not require the individual battery charges to be matched when a battery discharge event begins. This is because EBMs contain electronic "ideal diodes" in their output circuits, preventing back drive from one battery to another, and allowing the full charge available in each EBM battery to be utilized.

Multiple EBMs placed in parallel cannot be used to increase the total available power above 3000W. When operating on battery power, the EBMs will naturally share current based on the state-of-charge of the batteries, but there is no scheme to enforce this. With multiple EBMs in parallel, one module will be called upon to deliver the full load power at some point during operation. Therefore, the total load cannot exceed the rated load of a single unit.

5.1 Battery Technology

The internal battery pack for the EBM-1000 Series contains Lithium Polymer rechargeable batteries. For a given amount of energy storage they are much smaller and lighter than a lead-acid battery. They are capable of very high discharge rates and fast recharging, and can do so over many cycles and over a long life. As such they are very suitable for the EBM/UPS application. Lithium Polymer batteries are used in many military applications.

5.2 Electronic Circuitry within the Battery Pack

The SynQor internal battery pack has electronic circuitry within it that:

- Controls the charging (including the equalization charging) of the battery
- Separates the battery cells into multiple segments
- Provides protection of the battery
- Runs diagnostics on the battery
- Controls the battery pack's front panel LED indicators

The purpose of separating the battery cells into multiple segments is to allow the battery pack to remain useful even if one of its battery cells fails. In a normal battery configuration, the failure of a single cell would disable the entire battery. The SynQor battery packs are designed with their battery cells arranged in segments that can be disconnected from the other segments by the internal electronic circuitry. Therefore, if a battery cell fails in one segment, the battery pack can still operate with the remaining segments (at a reduced battery run-time) until the battery pack can be serviced.

The battery pack in the EBM-1000 has 14 segments, so a failure of a battery cell would still allow at least 13/14ths of the battery pack's run-time to be available.

The protection features provided by the electronic circuitry include:

- **Maximum Current Limit** when the battery is being charged/discharged
- **Charging/Discharging Limit** to avoid over-charging/discharging of the battery
- **Charging/Discharging Disable** if the battery is too hot or too cold

5.3 Battery Capacity

The SynQor EBM battery pack has approximately 1000 W-Hours of energy storage and a recharge time of <4 hours. Its run-time, as a function of connected UPS load power, is:

1250W Load on UPS-1500 at Output		EBM Run-Time
100% Rated Power		> 45 minutes
80% Rated Power		> 58 minutes
60% Rated Power		> 94 minutes
2500W Load on UPS-3000 at Output		EBM Run-Time
100% Rated Power		> 20 minutes
80% Rated Power		> 26 minutes
60% Rated Power		> 42 minutes

5.4 Storage of the EBM

The storage temperature range of the EBM-1000 is -40°C to +65°C (-40°F to +150°F). Care must be taken to ensure this range is not exceeded or the battery's energy storage capacity and/or life may be degraded.

5.5 Internal Battery Pack Replacement

The EBM-1000 internal battery pack is not user replaceable. If batteries require service or replacement the entire EBM-1000 unit must be returned to SynQor or a factory-authorized Service Center.

5.6 Handling the EBM

The operating temperature range of the EBM-1000 is -20°C to +55°C (-4°F to +130°F). The battery pack's internal electronic circuitry will disable the battery if the cell temperatures are outside this temperature range. The SynQor EBM-1000 is equipped with internal battery heaters which activate to keep the cells above 0°C in cold ambient temperatures.

The storage temperature range of the EBM-1000 is -40°C to +65°C (-40°F to +150°F). Long term storage outside this temperature range will lead to a permanent reduction in the battery's energy storage capacity.

The EBM-1000 must be shipped per Federal DOT Regulations as a Class 9 Packing Group II Hazardous Material. The EBM-1000 must be packaged in the original SynQor Shipping Carton (including inner protective inserts) which has been approved for shipping this product. The shipping carton must be appropriately labelled per applicable Federal DOT Requirements. Please contact SynQor for further assistance.

The EBM-1000 should be disposed in accordance with applicable regulations of the locality or returned to a factory-authorized Service Center.

Emergency response contact information for battery damage, leaks, smoke, or fires can be found at the following link: <http://www.SynQor.com/UPS/documents/Contact.pdf> . Please contact the factory for all other questions regarding the EBM-1000 internal battery pack.

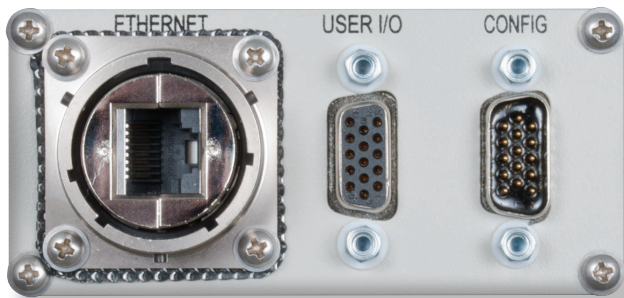
CAUTION: Do not dispose of batteries in a fire. The batteries may explode.

CAUTION: Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.

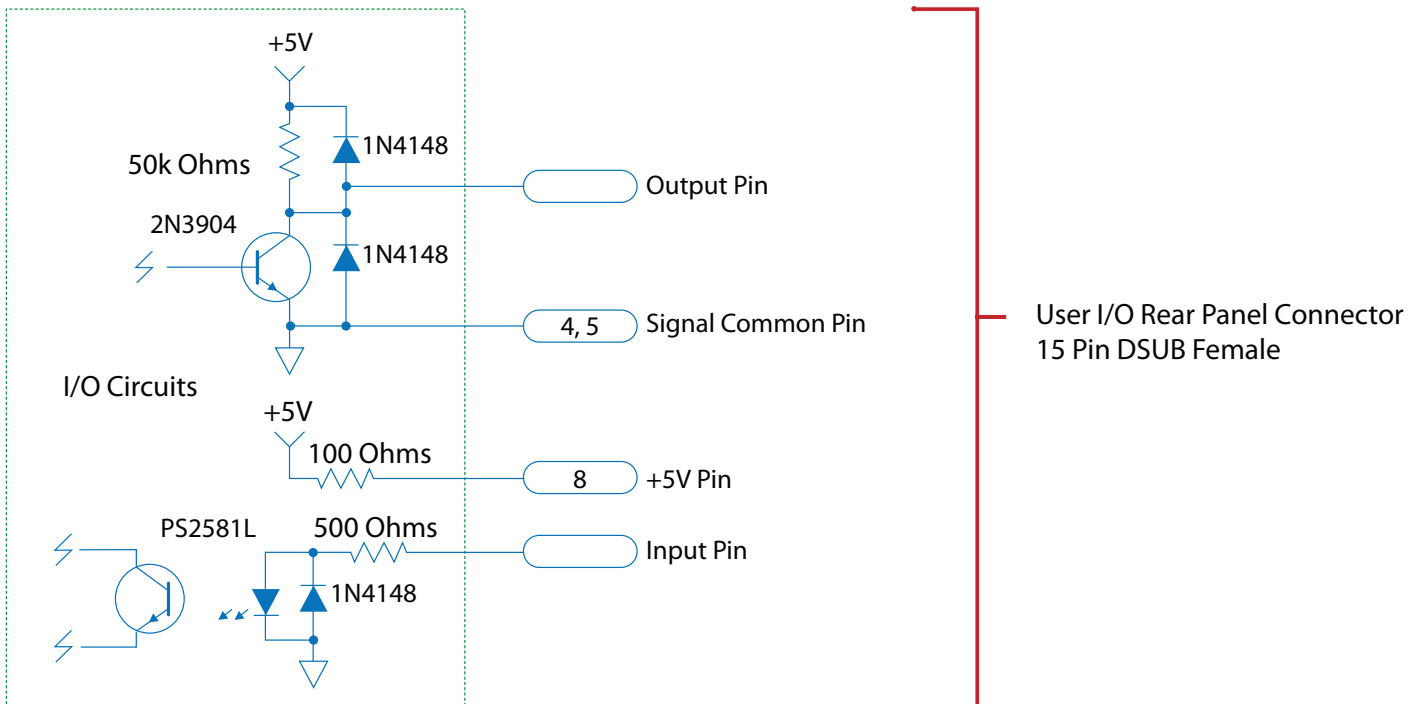
6.1 Control Cable Connections

There are two high-density (three-row) DB15 connectors located on the rear panel of the EBM: The User I/O female DB15 connector on the left is for an optional connection to a host/system computer so that it can control the EBM and receive information regarding the status of the EBM. The Configuration male DB15 connector on the right provides for synchronized startup and shutdown operation of multiple interconnected units, using the SYN-9322 or SYN-9323 cable. See description on page 34.

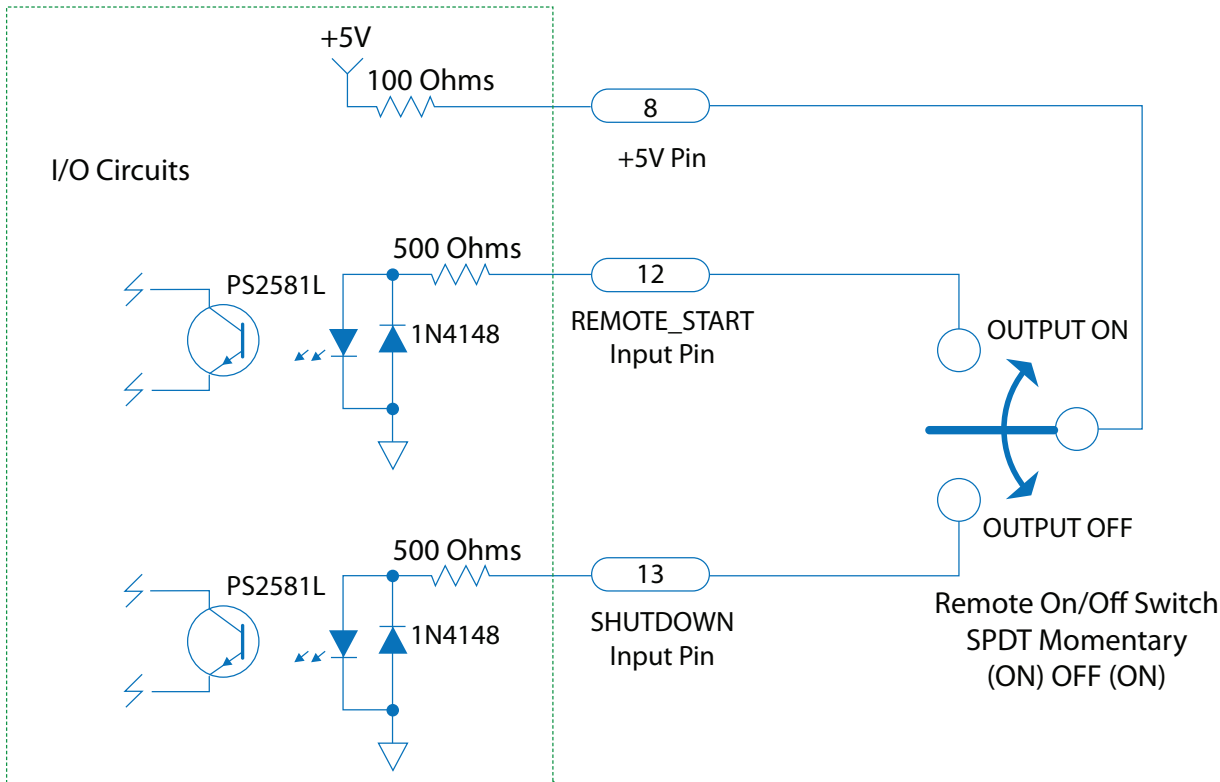
The designation/location of the pins for the User I/O female high-density DB15 connector is shown below:



Internal User I/O Circuits



Remote On/Off Switch Connections



6.2 Digital Input/Output Control Signals

There are 2 input and 5 output digital signals available on the User I/O female high-density DB15 connector. The pin assignments and functions of these digital I/O signals are as follows:

Signal	Pin Number	Function
+5 V	8	Bias voltage with minimal current drive usable as a pull-up voltage for the open collector output signals (100Ω source resistance). Load must be < 35 mA
GND	4 and 5	Ground reference for all digital inputs and outputs
$\overline{\text{LOW_BATT}}$	6	Open collector* output where "low" indicates battery charge level is <10%
$\overline{\text{ACIN_GOOD}}$	7	Open collector* output where "low" indicates AC Input voltage is within range
$\overline{\text{ON_BATT}}$	9	Open collector* output where "low" indicates the EBM is drawing power from its battery
$\overline{\text{OUT_OK}}$	14	Open collector* output where "low" indicates DC Output voltage is within range
$\overline{\text{OVER_TEMP}}$	15	Open collector* output where "low" indicates that the EBM is at or above its maximum temperature
REMOTE_START	12	Drive this line "high" with ≥ 5mA to enable the EBM outputs
SHUTDOWN	13	Drive this line "high" with ≥ 5mA to disable the EBM outputs

*with an internal 50 kΩ Pull-up Resistor to 5 V and ESD Protection Diodes.

6.3 RS232 Serial Interface

The same User I/O female high-density DB15 connector also provides for an RS232 interface between the EBM and the host/system computer. The interface has a 115.2 k baud with eight data bits, no parity bit and one stop bit. The pin assignments and functions for this RS232 interface are as follows:

Signal	Pin Number	Function
GND	4 and 5	Ground reference for RX and TX signals
RX	3	RS232 DCE/UPS Device Receive signal
TX	2	RS232 DCE/UPS Device Transmit signal

The RS232 port provides read back of EBM's state, as well as the configuration and control of the EBM's operation. The port can be used from a standard terminal interface, or from a custom computer application.

Read back information that is available includes:

- DC Input Voltage
- DC Output Power
- Battery Voltage
- Battery State of Charge
- Battery Predicted Run Time
- Number of Battery Cycles
- External Switch Input Status
- Fan RPM
- Internal Temperatures

Parameters that are controllable through the interface:

- Output enable / disable
- Fan diagnostics
- Alarm enable / disable

For a detailed description of the terminal interface see the SynQor website at:

http://www.SynQor.com/UPS/documents/EBM_User_Commands.pdf

6.4 Ethernet Interface

The Ethernet interface provides a web page based user interface for monitoring and control of the EBM. The user can configure email alerts for EBM alarm conditions. The interface also exposes an SNMP interface compliant to RFC-1628.

The Ethernet interface supports 10BASE-T and 100BASE-T standards. It utilizes a standard RJ-45 connector, also allowing a metallic sealable circular military outer housing. The interface supports auto-negotiation, polarity correction, and Auto-MDIX (detection and use of straight through or cross-over cables).

IP address assignment can be done via DHCP or user entry of a static address. The interface also supports a direct connection between the EBM and a host computer by including a DHCP server internal to the EBM.

For a detailed description of the Ethernet port and SNMP implementation see the SynQor website at: http://www.synqor.com/ups/documents/EBM_Ethernet_SNMP_UG.pdf

7.1 Battery

The lithium polymer battery cells in the EBM internal battery do not need any maintenance. In particular, unlike a lead acid battery a lithium polymer battery does not need to be re-charged on a regular basis to avoid degradation of its energy storage capacity. Care should only be taken in ensure that they are not stored at a temperature outside their specified storage temperature range of -40°C to +65°C (-40°F to +150°F).

Emergency response contact information for battery damage, leaks, smoke, or fires can be found at the following link: <http://www.SynQor.com/UPS/documents/Contact.pdf> . Please contact the factory for all other questions regarding the EBM internal battery.

CAUTION: Do not dispose of batteries in a fire. The batteries may explode.

CAUTION: Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.

The EBM internal battery is not user replaceable or user serviceable.

7.2 Fans

The fans on the rear panel have sealed bearings that do not require any regular maintenance. Fan assemblies are user replaceable with kits available from SynQor. Please contact the SynQor factory for obtaining fan replacement kits.

7.3 Cleaning

The EBM-1000 unit has a sealed chamber for its electronics and the internal battery that is weather-proof. Only the fans on the rear panel are exposed to the environment, and these fans are also weather-proof. The unit can therefore be cleaned without concern of getting liquids inside the chamber. **NOTE**, however, that if the cables have been removed from the connectors the connectors should have their covers installed. If they are not, then care should be taken to not get excess liquid on the connector terminals.

Cleaning should be done either with soap and water or with an isopropyl alcohol and water mixture. A soft cloth should be used.

Do not immerse the unit in water to clean it.

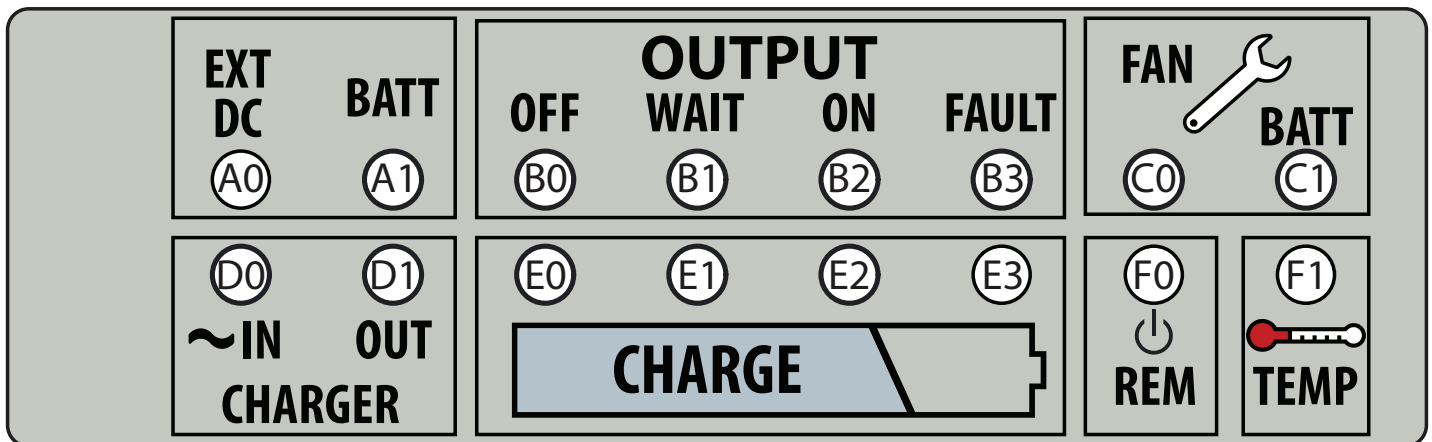
8.1 Fault Conditions

The SynQor EBM has no user-serviceable parts except the fan assemblies. If it has an internal malfunction only a factory trained personnel should attempt to repair it.

There are, however, several external conditions that could cause the EBM to not operate as desired. These external conditions can likely be corrected by the user.

The 16 LEDs on the front panel are the best and first place to look to determine what might be wrong with the EBM. The table on the next several pages is therefore organized by what these LEDs indicate, and for each indication there is a listing of what might possibly be wrong.

The front panel LED array is shown below. The designations of the 16 LEDs in this array are used in the following table.



LED	Indication	Possible Problem(s)
D0: AC INPUT Power LED	LED is OFF	The AC INPUT power source is not turned on. The AC INPUT cable is not connected or it is wired wrong. The AC Breaker on the rear panel is OFF. The AC INPUT voltage is either too low or too high.
A0: EXT DC INPUT Power LED	LED is OFF	The DC INPUT power source is not turned on. The DC INPUT cable is not connected or it is wired wrong. The DC INPUT cable is connected to the DC source with the wrong polarity. The DC INPUT voltage is either too low or too high The DC INPUT cable may have too much series resistance. Thicker wire should be used.
F1: Temperature LED	LED is BLINKING RED	The battery is too cold to be charged or discharged without damage. If the EBM is running from the AC INPUT or the DC INPUT the battery will eventually be warmed up and this condition will go away.
	LED is BLINKING AMBER	The battery is too cold to be charged without damage, but it can be discharged if the EBM needs to draw power from it. If the EBM is running from the AC INPUT, the DC INPUT or the battery, the battery will eventually be warmed up and this condition will go away.
	LED is STEADY AMBER	The battery is too hot to be charged without damage, but it can be discharged if the EBM needs to draw power from it. If the ambient temperature is within its specified range the battery will eventually cool down and this condition will go away.
	LED is STEADY RED	The battery is too hot to be charged or discharged without damage. If the ambient temperature is within its specified range the battery will eventually cool down and this condition will go away.
C0: Fan Service Required LED	LED is AMBER	One or both fans have recently had degraded performance but seem to be ok now. The EBM is running a diagnostic test.
	LED is RED	One or both fans presently have degraded performance, even if they are running, and service is recommended at the earliest convenient time. Ensure that the fan blades are not obstructed from turning
C1: Battery Pack Service Required LED	LED is AMBER	The battery pack's calculated maximum energy storage capacitor is <75% of its rated value. The EBM's battery run-time will therefore be similarly reduced. The battery pack should be replaced at the earliest convenient time if this derated battery run-time is unacceptable.
	LED is RED	The battery pack's calculated maximum energy storage capacitor is <50% of its rated value. The EBM's battery run-time will therefore be similarly reduced. The battery pack should be replaced at the earliest convenient time.

- **The fans are off when the EBM is running**

It is normal for the fans to be off, even if the EBM is running and delivering power to the UPS, as long as the temperature of the EBM is low enough. If the Fan Service Required LED (C0) is green, both of the fans are OK, even if they are not running.

- **The EBM does not turn off when the ON/OFF switch is pushed down**

When the ON/OFF switch on the front panel is pushed down, the EBM does not respond to this signal for approximately 1 second. This is done to ensure that the EBM is not accidentally turned off. If the user does not hold the ON/OFF switch in the OFF position for a full second before releasing it, the EBM will not turn off.

- **The EBM continually tries and fails to connect to a DC or AC source due to high cable wire resistance:**

As mentioned in the section “Power Cables Wire Size”, the resistance of a power cable’s wires gives a voltage drop from the upstream to the downstream end of the cable. This voltage drop, if large enough, will cause the UPS to determine that the voltage at its AC INPUT or its DC INPUT is below its minimum specified value, even though the corresponding voltage at the source of AC or DC power is within the specified range.

This problem is particularly possible for the DC INPUT, since the DC INPUT current is so high (as much as 140 A at full power) and the DC INPUT voltage is so low (as low as 22 V).

The phenomenon that may be displayed is the following.

- Assume the AC INPUT source is not present, but the DC INPUT source is.
- The EBM, before it turns on, does not draw any power or current from the DC INPUT, and therefore the voltage drop across the DC INPUT cable is zero.
- The EBM sees that the voltage at the DC INPUT is within its specified range, and enables its outputs.
- As the load then draws power, the EBM begins to draw current from the DC INPUT cable. This current causes a voltage drop to appear across the cable.
- If the voltage at the DC source is close to, but still above, its 22 V minimum, but the voltage drop across the cable is large enough for the voltage at the DC INPUT of the EBM to fall below 22 V, then the EBM will determine that the DC INPUT is out of range and will switch over to drawing power from the internal pack.
- Since the EBM no longer draws current from the DC INPUT, the voltage drop across the DC INPUT cable goes back to zero volts.
- After a while, the EBM decides the DC INPUT voltage is back within its proper range, and begins to draw a current from the DC INPUT.
- The cycle above repeats itself for a total of three times, at which point the EBM stops trying to draw power from the DC INPUT for one minute. After this one minute another set of 3 cycles are repeated, followed by another stop for one minute, and so on.

The solution to this problem is to make sure that the cable has wires of sufficient diameter, or “gauge” for the length of the cable. The longer the cable, the bigger diameter the wire should have.

See the section “Power Cable Wire Size” for recommended cable wire sizes.

8.2 Frequently Asked Questions

Question 1:

How do I make the EBM output automatically turn -on?

Answer 1:

Reference the SynQor EBM Terminal Commands Guide. The ASTART ENABLE command will enable auto-start mode. The factory setting is ON by default.

Question 2:

I am trying to “COLD START” the EBM with the front panel toggle switch but the EBM goes off as soon as I release the toggle. Why is that?

Answer 2:

One possibility is that the output cable is disconnected or is incorrectly wired. Verify that the output cable includes the required Cable Sense jumper. This jumper prevents an EBM in transit from inadvertently being turned on. The front panel FAULT LED will light red with the toggle switch held up (ON) if this is the case.

Another possibility is that the battery is fully discharged. In this case an AC or DC source must be provided to charge the battery first.

Another possibility is that the toggle switch was not held in the on position for long enough. The “COLD START” process may require the switch be held for 3 seconds in the up (ON) position before releasing.

Question 3:

When I first apply a DC source, the front panel BATT LED and DC IN LED are green, but then The BATT LED turns amber after a minute. Is there a problem with the battery?

Answer 3:

This behavior is normal if the EBM output is OFF and there is no AC source present. The EBM can only charge the battery from a DC source when the output is ON. To prevent the battery from self-discharging, the battery will “sleep” after a delay.

Question 4:

Why does the front panel ~IN LED not turn green even after I have supplied AC source power?

Answer 4:

One possibility is that the EBM rear panel AC input circuit breaker is in the OFF position.

Another possibility is that the AC input voltage is beyond the range acceptable for the EBM. Note that the EBM may take 15 seconds to validate an input source and turn its associated LED indicator green.

Question 5:

Does the UPS connected to the EBM use its battery to extend runtime?

Answer 5:

Yes. The full charge of both the EBM and the UPS batteries is usable. During a battery run event, the EBM will discharge its battery first, followed by the UPS discharging its batteries.

Question 6:

How do I turn off the beeper?

Answer 6:

This audible alarm can be silenced by holding the ON/OFF switch on the front panel in the “UP” position until a chirp is heard. A new alarm condition will cause the audible alarm to be reactivated. Reference the SynQor EBM Terminal Commands Guide. The ALARM DISABLE command will disable the alarm.

Question 7:

How long can the EBM to UPS cable be?

Answer 7:

The EBM DC Output to UPS DC Input cable maximum length is 8 ft (2.5 m).

Question 8:

Does SynQor provide multi-unit EBM output cables?

Answer 8:

SynQor provides detailed multi-unit cable wiring diagrams in the EBM Operator’s Guide but does not offer these cables pre-made.

EBM

Operator's Guide

EBM-1000 Series

MILITARY GRADE EXPANSION BATTERY MODULE



Made in USA

006-0006918

02/21/2018

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