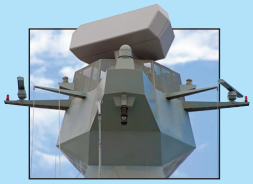
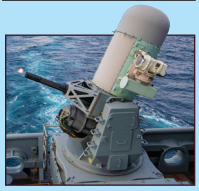
UPS MILITARY FIELD-GRADE

UNINTERRUPTIBLE POWER SUPPLY



Operator's Guide

UPS-1250-270 Series



UPS-1250-1U

N+M Redundancy (optional)

SynQor®

Advancing The Power Curve®

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Hazardous Voltages

The ***INPUT AND OUTPUT POWER*** connectors and cables of the SynQor UPS may have voltages that are 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 UPS ***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 UPS appears to be off.
  - Do not make contact with the terminals of the AC input connector.
  - Always connect the cable to the UPS 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 UPS.
  - If the AC input cable is connected to the source of AC power and not connected to the UPS, 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 ***DC3 OUTPUT*** cable and connector:
  - Do not assume that a hazardous voltage is not present at the terminals of the DC3 OUTPUT connector, even if the UPS appears to be off.
  - Do not make contact with the terminals of the DC3 OUTPUT connector.
  - Connect the DC3 OUTPUT cable to the UPS before the UPS is turned on.
  - If connection of the load to the DC3 OUTPUT cable has exposed conductors, make this connection before connecting the DC3 OUTPUT cable to the UPS.
  - Connections between the DC3 OUTPUT cable and the load should not be accessible.
- For the ***DC INPUT*** cable and connector (if present):
  - The rated DC input voltage of the UPS is below the level considered hazardous.
  - The DC input terminals of the UPS are isolated from the AC input and DC3 OUTPUTs 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 UPS or DC input source appears to be off.*

- For the ***DC1 and DC2*** cable and connectors (if present):
  - The rated DC output voltage of the UPS is below the level considered hazardous.
  - The DC output terminals of the UPS are isolated from the AC input and DC3 OUTPUTs 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 UPS appears to be off.
- For the ***BATTERY PACK*** (if not inserted into the UPS):
  - When the battery pack is not inserted into the UPS, the battery is internally disconnected from the power pins of the battery pack's connector.
  - Even if this disconnection were not present, the DC voltage of the battery is below the level considered hazardous.
  - Do not apply external voltages to the pins of an exposed battery pack connector. It is not possible to charge the battery pack from an external source, and excess voltages could damage internal control circuitry.

Hazardous Energies

The ***INPUT AND OUTPUT POWER*** connectors and cables of the SynQor UPS 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 UPS's chassis or ground. ***DAMAGING ELECTRICAL ARCS*** may result. Care should be taken to avoid accidental electrical contacts of this sort.

When the ***BATTERY PACK*** is not inserted into the UPS, the battery is internally disconnected from the power pins of the battery pack's connector. An electrical contact between any two of these power pins or between any power pin and ground should therefore not be damaging. However, care should take to avoid accidental electrical contacts of this sort.

Battery Pack

The individual ***LITHIUM ION BATTERIES*** contained in the SynQor battery pack are sealed units that are further mechanically protected by the battery pack's chassis and electrically protected by the battery pack'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 battery pack must comply with applicable regulations of the locality. See "Battery Pack - Handling the Battery Pack".

The battery pack 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 SynQor factory for all other questions regarding the UPS 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.

Always use the proper SynQor battery pack. See the battery replacement chart on page 38.

Protection from the Environment

The SynQor UPS 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 UPS or the fan exhausts in the rear panel of the UPS while the UPS is operating.

No User Serviceable Parts

The SynQor UPS has no user serviceable parts inside of it. ***DO NOT REMOVE*** the cover of the UPS or any of its connectors. ***DO NOT OPEN*** the battery pack. Only factory trained personnel should perform repairs.

Product Description

The SynQor UPS-1250 Series is an advanced technology military-grade uninterruptible power supply (UPS) that uses lithium ion 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 provides voltage and frequency conditioning, electrical isolation, and power flow smoothing between the power inputs and its power outputs. It provides battery backed-up power when other power sources are not present.

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 UPS and the battery pack.

The UPS-1250 Series products can draw power from an AC input having a wide range of voltage and frequency levels, or from an optional 28 V nominal DC input. The AC input has priority over the DC input. The UPS provides up to 1250 W of DC output power from up to three DC outputs. The main high voltage DC output (DC3) supplies up to 1250 W, and is user adjustable from 25 - 325 V. The default DC3 OUTPUT voltage is 270 V. An optional DC2 output provides up to 1250 W a fixed 24, 28, or 50 V. An optional DC1 output provides up to 500 W at 12 V, 15 V, 24 V, 28 V, 40 V, or 50 V.

The electronic circuitry within the UPS-1250 Series products is designed, qualified and screened according to SynQor's MIL-COTS Standards. It complies with the requirements of MIL-STD-704F, MIL-STD-1399-300B, MIL-STD-1275D and MIL-STD-461F, as well as IEC-EN61000 specifications for world-wide commercial utility applications.

The UPS-1250 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 UPS-1250 Series products comply with a wide range of testing according to MIL-STD-810G.

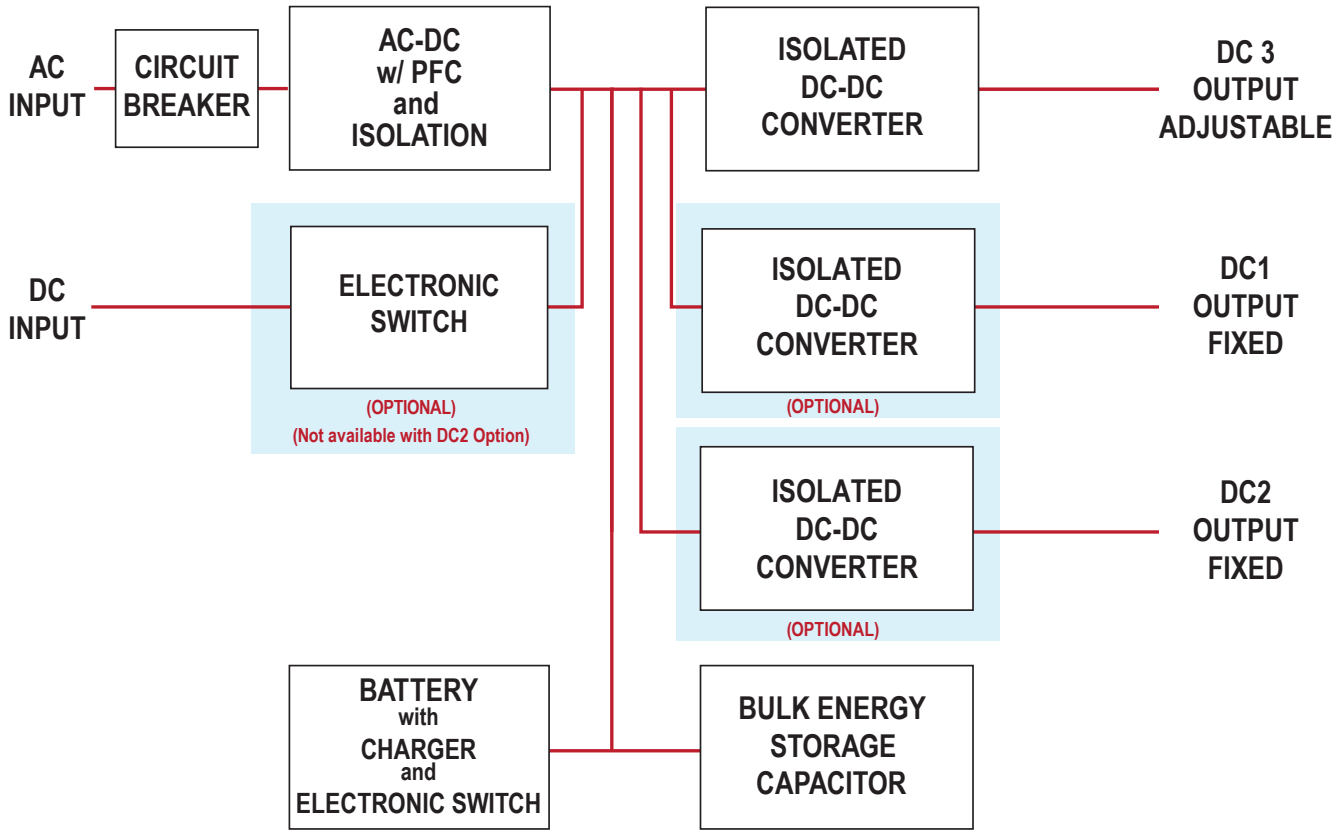
The UPS-1250 Series has a 1U high unit that has a standard battery pack that provides >10 minutes, >13.5 minutes or >16 minutes of full-power run-time.

The SynQor UPS-1250 Series products are designed and manufactured in the U.S.A.

Product Topology

The SynQor UPS-1250 Series products use a true on-line double conversion topology that provides protection to the load from spikes, noise, surges, brownouts, blackouts, etc. in the input power sources. They also provide smoothing of load transients and nonlinear load profiles so that the input power sources are not subjected to these disturbances. There is a seamless transfer from any power source to another so that there is no disruption in the output voltage.

As the figure below shows, there is a nominal 28 V mid-bus within the UPS that draws power from one of up to three power sources: the AC INPUT, the optional DC INPUT or the battery (with that order of priority based on availability). EMI filters are present at all external inputs and outputs.



Power flows from the AC INPUT through an AC-DC converter that has Power Factor Correction (PFC) and high voltage safety isolation. Power flows from the DC INPUT through an electronic switch that is closed when the AC INPUT power is absent and the DC INPUT voltage is within its specified range. Otherwise, a second electronic switch is closed to connect the battery to the mid-bus.

The DC3 OUTPUT is created by an isolated DC-DC converter that draws power from the mid-bus. This DC-DC provides high voltage safety isolation and a tightly regulated, user adjustable output voltage.

Optional DC outputs at various voltage and power levels are available. The DC1 option is limited to 500 W. The DC2 option can deliver up to 1250 W output. When the DC2 option is selected, DC Input is not available. DC1, DC2, and DC3 are isolated from each other.

Bulk energy storage capacitors are connected to the mid-bus to help smooth imbalances in power flow between the inputs and outputs of the UPS.

There is a battery charger circuit that draws power from the mid-bus. It ensures the batteries are normally fully charged and that the various cells are equalized. The battery also contains protection circuitry to avoid damage due to improper charging or discharging, or to excessive temperatures.

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

Part Numbering Scheme and Options

This table shows the part numbering scheme for the full line of SynQor UPS-1250-270 products:

Base Models				
Model Number	**Power**	**Battery Run-Time @Full Power** (80% Power)	**Height** (W x D x H)	**Weight**
UPS-1250-S-1U (1 Standard Battery Pack)	**1250 W**	**>10 min.** (>13 min.)	**1U** (17.00" x 21.60" x 1.73")	**32 lbs.**
UPS-1250-H-1U (1 Standard Battery Pack)	**1250 W**	**>13.5 min.**(>18 min.)	**1U** (17.00" x 21.60" x 1.73")	**33.8 lbs.**
UPS-1250-M-1U (1 Standard Battery Pack)	**1250 W**	**>16 min.** (>22 min.)	**1U** (17.00" x 21.60" x 1.73")	**33.8 lbs.**

Base Models	Options				
	AC Input Freq	**DC3 OUTPUT**	**DC Input / DC2 Output**	**DC1 Output**	**Additional Options**
UPS-1250-S-1U- **UPS-1250-H-1U-** **UPS-1250-M-1U-**	**L** **W**	**270**	**S** **D** **M** **P** **R** **V** **W**	**00** **12** **15** **24** **28** **40** **50**	**-E** **00**

Not all combinations make valid part numbers, contact SynQor for availability. See the Product Summary web page for more options.

Examples:

UPS-1250-S-1U-L270D50-E00, UPS-1250-M-1U-W270M28-E00

Options		
AC input Freq	**L**	47-65 HZ
	W	47-800 Hz
DC3 OUTPUT	**270**	270V Default, 25-325 Vdc
DC Input / DC2 Output	**S**	Not Installed
	D	DC Input
	M	DC2 Out 24 VDC with Droop Share
	P	DC2 Out 24 VDC No Share
	R	DC2 Out 28 VDC with Droop Share
	V	DC2 Out 28 VDC No Share
	W	DC2 Out 50 VDC No Share
DC1 Output	**00**	None
	12	12 V
	15	15 V
	24	24 V
	28	28 V
	40	40 V
	50	50 V
Additional Options	**-E**	Ethernet/SNMP with Configuration Loading
	00	No CE Marking

The UPS-12500 Series of products provide up to 1500 VA and 1250 W of total output power (AC plus DC). The UPS is a 1U high rackmount unit, weighing 32 lbs. or 33.8 lbs. depending on the battery option selected. The battery options provide either >10 minutes, >13.5 minutes, or >16 minutes of battery run-time at full power.

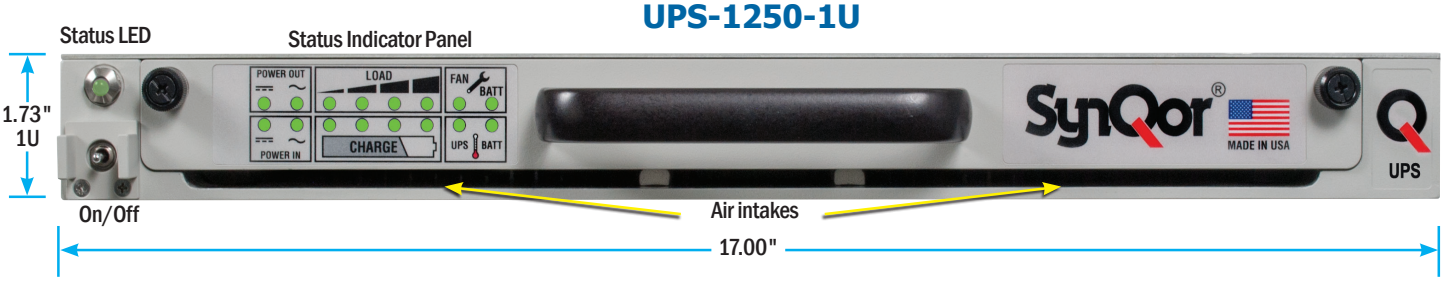
The UPS has various options that can be specified according to the part numbering scheme shown in the table:

- The allowable frequency of the AC INPUT can either be in the 47-65 Hz range (for 50 Hz and/or 60 Hz systems) or in the 360-800 Hz range (for 400 Hz and Variable Frequency systems)
- The DC3 high voltage output of the UPS-1250 Series can be adjusted by the user from 25 V to 325 Vdc. Default is 270 Vdc.
- Two optional DC OUTPUT capabilities are available: DC1 with up to 500 W capability, and DC2 with up to 1250 W capability an optional droop share.
- There is an optional DC INPUT that is specified to comply with MIL-STD-704F and MIL-STD-1275D for 28 V systems. DC2 is not available if DC INPUT is selected.
- RS232 serial port and logic-level I/O communication are included in the standard model. An Ethernet port providing web and SNMP interfaces is also included in the standard model.

Product Specifications

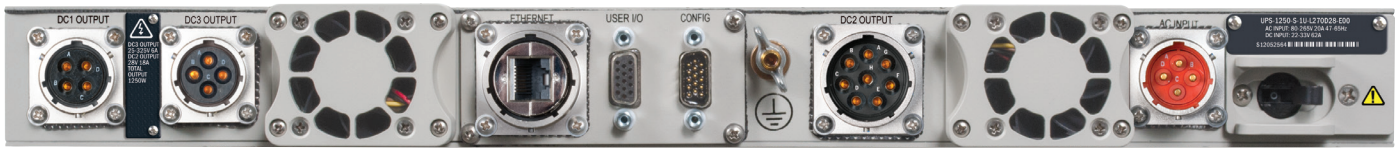
The following pages show the electrical and mechanical specifications of the UPS-1250-S-1U-270 Series of products. Data sheets showing these specifications and other information can be found at the web site **http://www.synqor.com/UPS**.

UPS-1250-1U



UPS-1250-1U DC3 with DC Input/DC1 Output Option

UPS-1250-1U DC3 with DC1 Output/DC2 Output Option



Electrical Characteristics

INPUT CHARACTERISTICS		
Operating AC Input		
Voltage	80-265 Vrms*	
Frequency	47-65 Hz (47-800 Hz Optional)	
Input Power Factor	>0.98 at 47-65 Hz >0.97 at 400 Hz >0.93 at 800 Hz	
Maximum Input Current Continuous	20 A (full load, 85 Vrms)	
AC Input Circuit Breaker Rating (* Power Derating to 80% below 90 Vrms)	25 A	
Operating DC Input (Optional)		
Voltage	22-33 V	
Continuous Maximum Input Current	62 A (full load, 22 V)	
Transient Maximum Input Current	75 A	
OUTPUT CHARACTERISTICS		
Total Output Power Continuous	1250 W	
Maximum DC3 OUTPUT Power	1250 W	
Maximum DC2 Output Power	1250 W	
Maximum DC1 Output Power	510 W	
(Note: Available DC3 power is reduced by power delivered to DC2 and DC1)		
DC 3 Output (Adjustable)		
Voltage Range	25 - 325 V	
Voltage Setpoint (Default)	270 V	
Voltage Setpoint Accuracy	± 3%	
Voltage Setpoint Resolution	1 V	
Voltage Regulation (Over Load & Temperature)	± 5%	
Current limit Range (User Adjustable)	0 - 6.0 A	
Current Limit Resolution	4 mA	
Current Limit Accuracy	± 50 mA	
Short Circuit Protection Trip Current	20 A	
Maximum Output Capacitance	18 mF	
DC1 Output (Optional, Fixed)		
Voltage Regulation (Over Load & Temperature)	± 3%	
Common Voltage/Power combinations (DC1) (Other Options Available)	12 V at 42 A 15 V at 34 A 24 V at 21 A 28 V at 18 A 40 V at 12.5 A 50 V at 10 A	=504 W =510 W =504 W =504 W =500 W =500 W
DC2 Output (Optional, Fixed)		
Voltage Setpoint	± 3%	
No Sharing		
Voltage Regulation (Over Load & Temperature)	-2%	
Common Voltage/Power combinations (DC2)	50 V at 20 A 24 V at 50 A 28 V at 44.6 A	=1000 W =1200 W =1250 W
Droop Share (Output droops vs. load to allow passive sharing among modules.)		
24 V Option		
Voltage Regulation (Over Load & Temperature)	-15% 26 V at 0 A 22 V at 50 A	 =1100 W
28 V Option		
Voltage Regulation (Over Load & Temperature)	-13% 30 V at 0 A 26 V at 48.1 A	 =1250 W

Specifications subject to change without notice.

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, 8, 9, 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
Humidity	Method 507.5 Procedure 2
Mechanical Vibrations of Shipboard Equipment	Method 528 Procedure 1

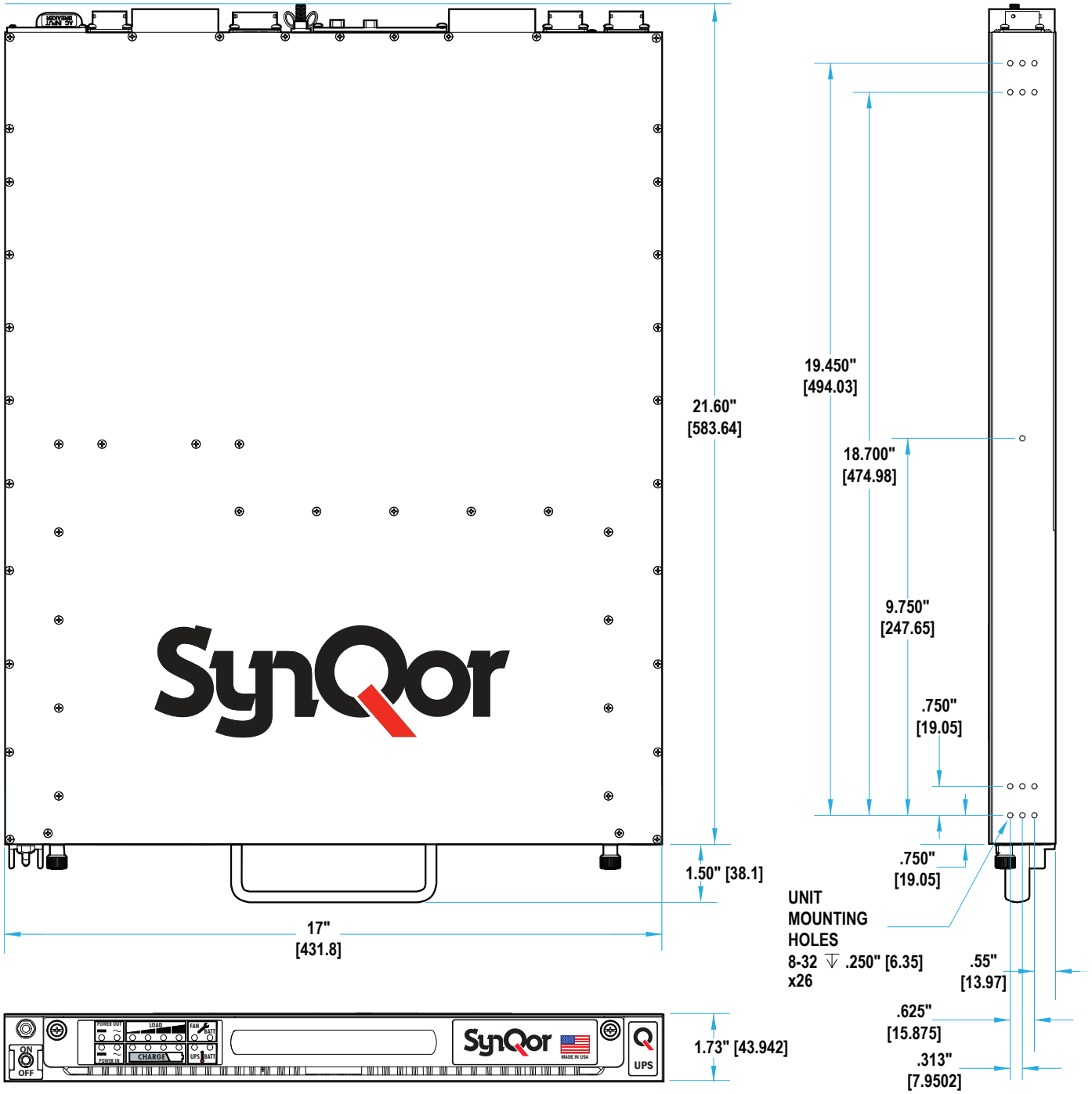
RELIABILITY CHARACTERISTICS MIL-HDBK-217F		
MTBF	100 kHrs	MIL-217F Ground Benign, Ta=25 °C

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	
1U Standard Battery Pack Chassis	
Chassis Size	17.00"W x 21.60"D x 1.73"(1U)H
Case Material	Aluminum
Total Weight	32 lbs. (with chassis & battery)
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	MS3470L18-8P
DC1 Output Connector	MS3470L14-4SW
DC2 Output Connector	MS3470L18-8S
DC3 OUTPUT Connector	MS3470L14-4S
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.

1U Mechanical Diagram



Note:

1) ALL DIMENSIONS IN INCHES [mm]
   TOLERANCES: X.XXIN +/- 0.02 [0.5]
   X.XXXIN +/- 0.010 [0.25]

UPS Efficiency

Figure 1 shows the typical efficiency with which the UPS-1250-270 series uninterruptible power supplies delivers power to its DC3 OUTPUT from a 230 Vrms AC INPUT, an 115 Vrms AC INPUT or a 28 V DC INPUT.

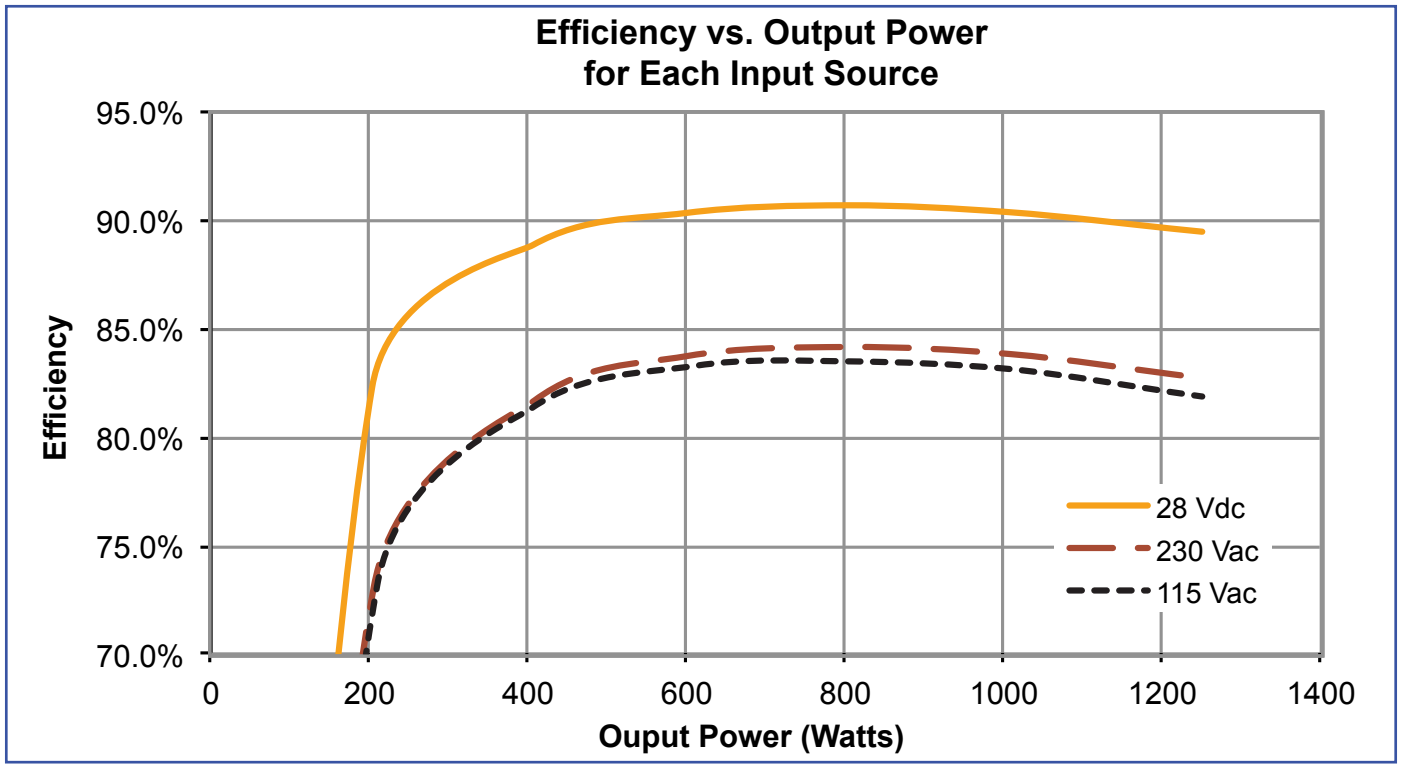


Figure 1

Total Output Power that can be derived from the AC INPUT

The total UPS output power (the DC3 power plus the optional DC1, DC2 power) for the UPS-1250-270 series is rated at 1250 W for an ambient temperature as high as 55 °C (131 °F). It draws this power first from the AC INPUT (if its voltage is within range) and then the DC INPUT (if its voltage is within range) and then from the internal BATTERY PACK (if it has sufficient charge).

However, when the AC INPUT voltage is at the low end of its range (<90 Vrms) or the ambient temperature is at the high end of its range (>45 °C / 113 °F) the UPS will not be able to deliver its full rated output power in the steady-state without switching over to either the DC INPUT (if it is available and >22 Vdc) or its internal battery. Figure 2 indicates the total steady-state output power that the UPS can derive **from the AC INPUT** under these extreme conditions. See Figure 3 for information on transient conditions.

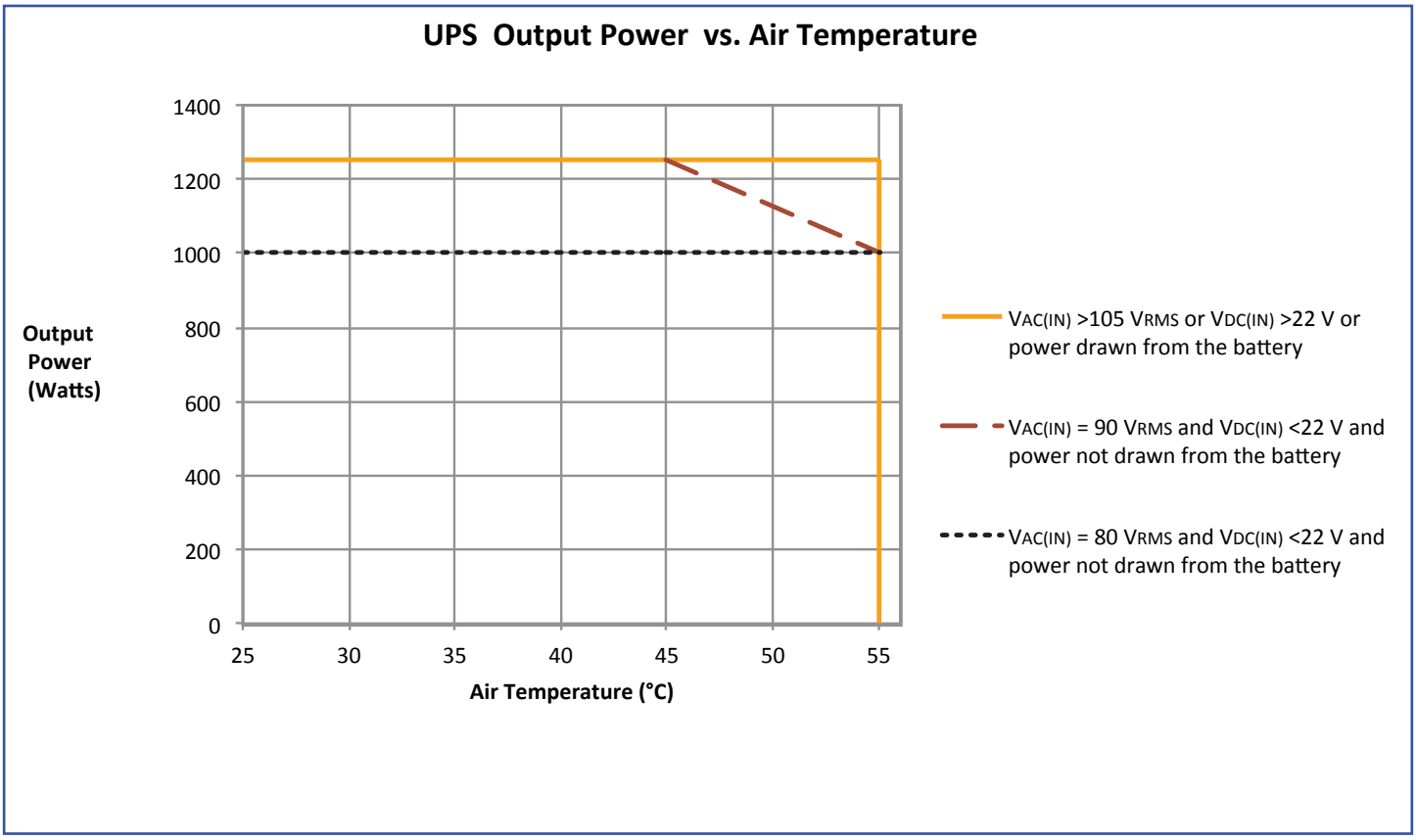


Figure 2

- If the AC INPUT voltage is above 105 Vrms, then the UPS can deliver its full rated output power of 1250 W from the AC INPUT for an ambient temperature as high as 55 °C (131 °F) without needing to switch over to the optional DC INPUT or the internal BATTERY PACK.
- If the AC INPUT is between 90 Vrms and 80 Vrms then the total output power that can be derived from the AC INPUT linearly decreases from 1250 W at 90 Vrms to 1000 W at 80 Vrms (except for at the high end of the ambient temperature range – see below). For example, the total output power that could be derived from the AC INPUT would be 1125 W at 85 Vrms as long as the ambient temperature is not above 50 °C (122 °F). If the total output power is greater than this derated value, the UPS will switch to the DC INPUT (if it is available and >22 V) or the internal BATTERY PACK.
- If the AC INPUT voltage is 90 Vrms **AND** the ambient air temperature is above 45 °C (113 °F), the total output power that can be derived from the AC INPUT linearly decreases from 1250 W at 45 °C (113 °F) to 1000 W at 55 °C (131 °F). For example, the total output power that could be derived from the AC INPUT would be 1125 W at an AC INPUT voltage of 90 Vrms and an ambient temperature of 50 °C (122 °F). A higher output power than this would cause the UPS to switch over to its DC INPUT or the internal BATTERY PACK.

- When the AC INPUT voltage is between 105 Vrms and 90 Vrms **AND** the ambient temperature is between 45 °C and 55 °C, the total output power that can be derived from the AC INPUT can be calculated by linearly interpolating between the curves shown. For example, the total output power that can be derived from the AC INPUT when the voltage is 97.5 Vrms would be 1250 W up to an ambient temperature of 50 °C (122 °F) and then derate to 1125 W at 55 °C (131 °F).

Furthermore, there is a limited (and uncommon) range of AC INPUT voltage between 132 Vrms and 160 Vrms in which the total output power that can be derived from the AC INPUT is also derated, as shown in the graph below.

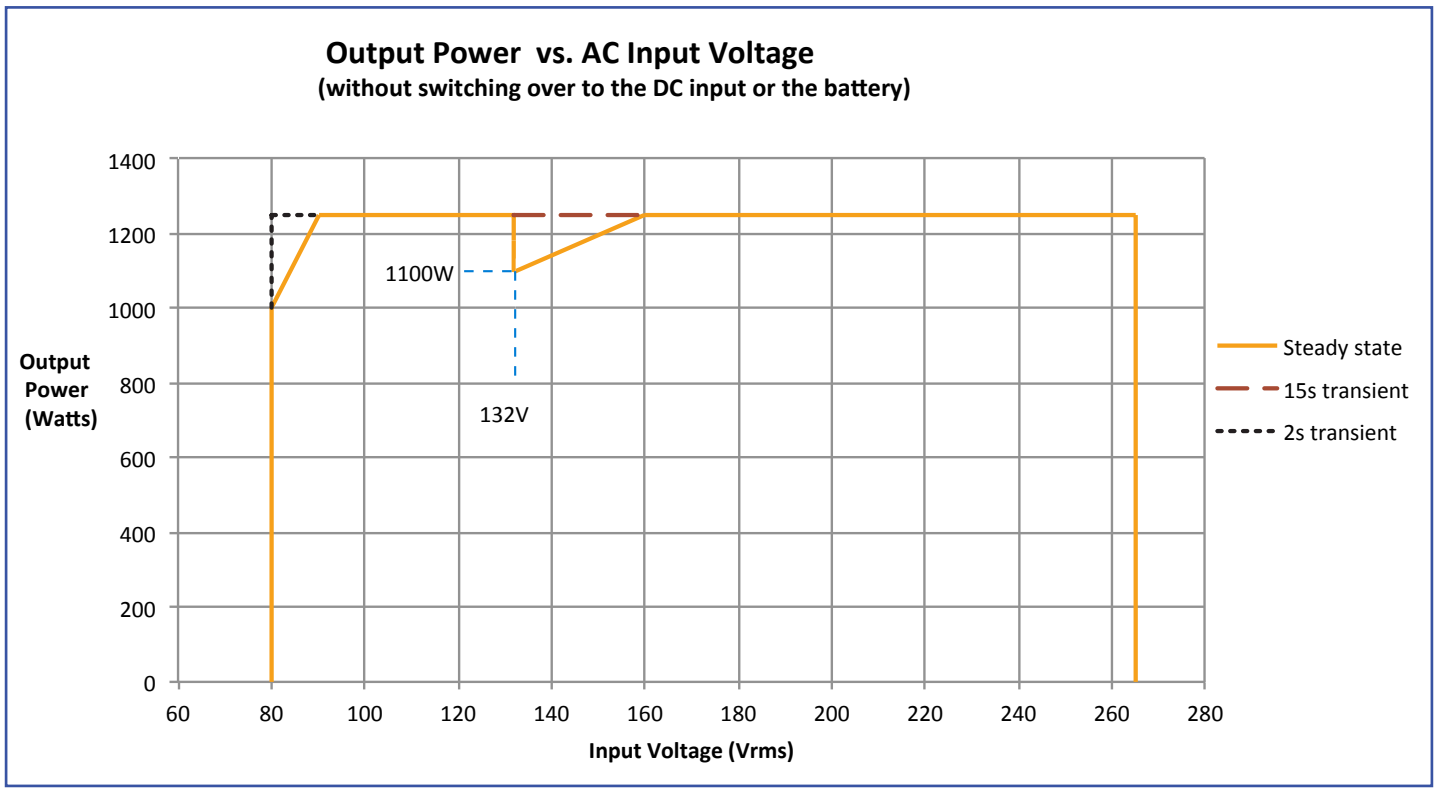


Figure 3

Note that the full rated output power of 1250 W can be derived from the AC INPUT having a voltage within this uncommon range for 15 seconds before the UPS will switch over to the DC INPUT or the BATTERY PACK. Also note that the UPS can drive it full rated power for a 2 second interval even if the AC INPUT voltage drops below 90 Vrms.

Although the DC3 output voltage can be adjusted from 25 V to 325 V, full power is only available above 210V. DC3 output power will be limited the maximum output current of 6A when the output voltage is set below 210 V. See Figure 4 for the available output power vs output voltage.

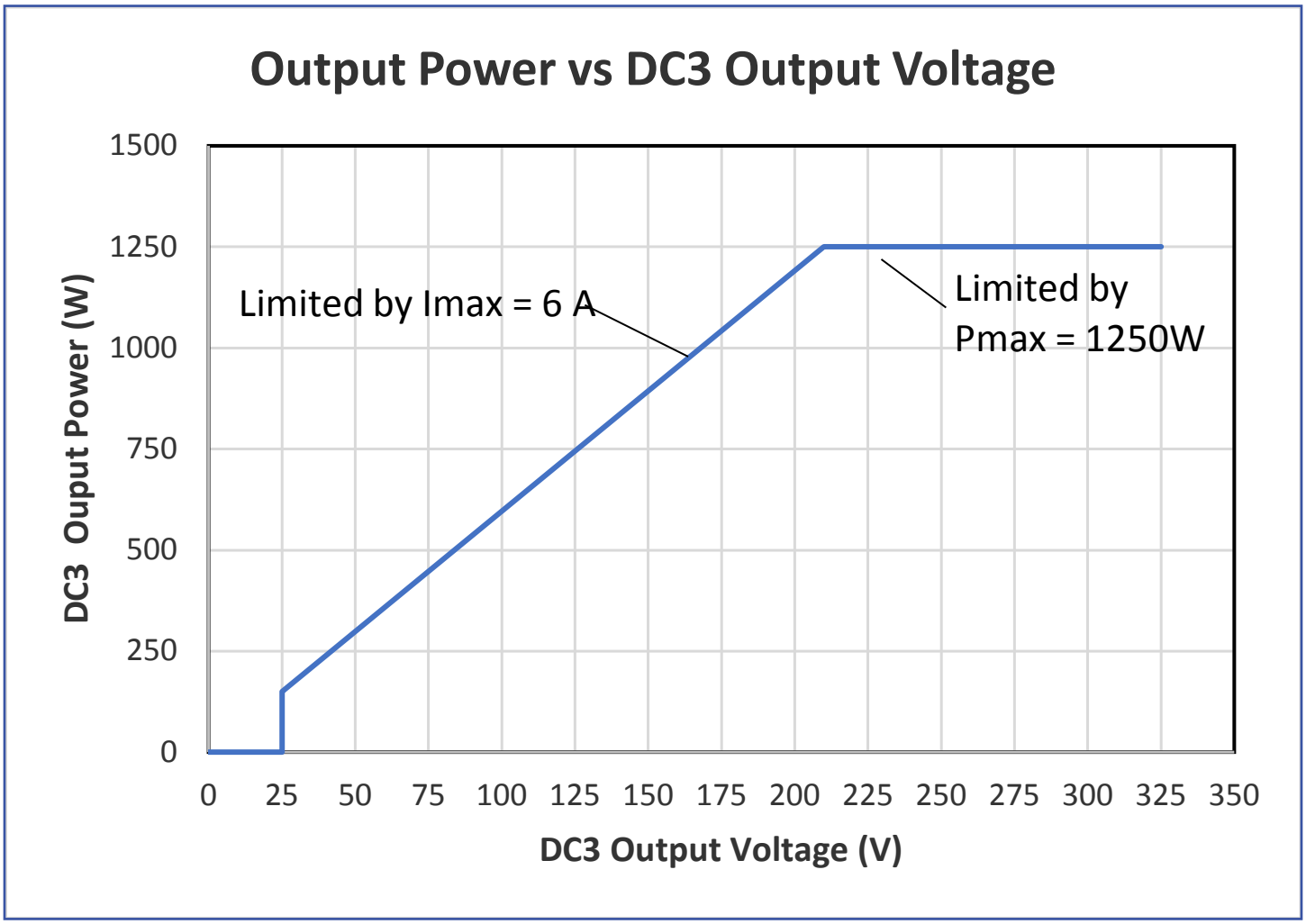
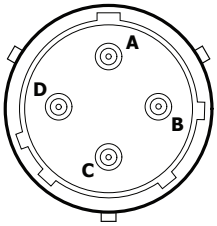


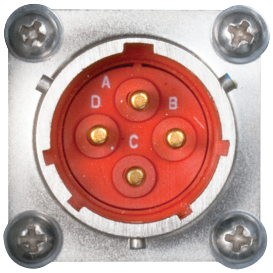
Figure 4

Power Cable Wiring Diagram

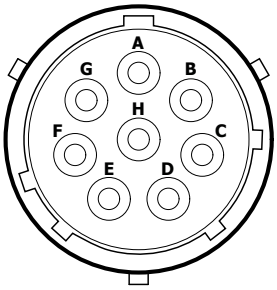
Looking at the rear panel, the UPS connector terminals have the following functions and locations:

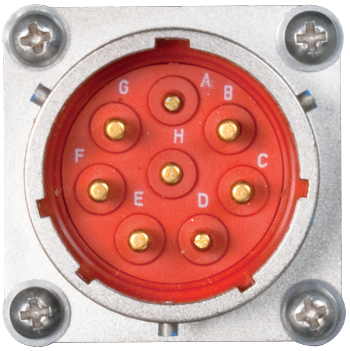
AC INPUT	
Pin	Function
A	Line
B	Neutral
C	No Connect
D	Ground



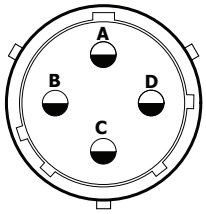


DC INPUT	
Pin	Function
G, F, E	+VIN
B, C, D	VIN Return
A, H	No Connect

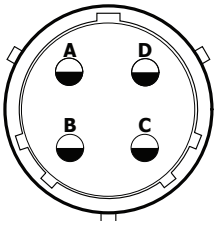




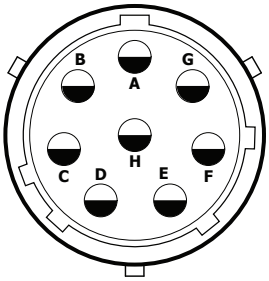
DC3 OUTPUT	
Pin	Function
A	VOUT Return
B	+VOUT
C	No Connect
D	Ground



DC1 OUTPUT	
Pin	Function
C, D	+VOUT
A, B	VOUT Return



DC2 OUTPUT	
Pin	Function
G, F, E	+VOUT
B, C, D	VOUT Return
A, H	No Connect



Power Cable Wire Size

SynQor recommends the following cables for use with the UPS-1250-270 Series:

AC Input:	SYN-9101	UPS connection to NEMA 5-20 Plug, 10’
	SYN-9104	UPS connection to NEMA 5-15 Plug, 10’
	SYN-9102	UPS connection to Hardwire Termination, 10’
DC Input:	SYN-9151	UPS connection to Ring Connectors, 10’
	SYN-9154	UPS connection to NATO Connector, 10’
DC3 OUTPUT:	SYN-9130	UPS connection to Hardwire Termination, 10’
DC1 Output:	SYN-9171	UPS connection to Fork Connectors, 10’
	SYN-9172	UPS connection to Hardwire Termination, 10’
DC2 Output:	SYN-9174	UPS connection to Hardwire Termination, DC2 Output, 10’
	SYN-9175	UPS connection to Fork Connectors, DC2 Output, 10’

Other options may be available. Contact info@synqor.com or visit the website: **http://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 UPS 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 and DC2 Output cables** because the current flowing through it is very high (as high as 65 A for the UPS-1250-270 Series) 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 UPS 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 UPS will switch to the internal battery pack for its power source 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. For 10 ft long cables, SynQor recommends that for the UPS-1250-270 Series:

- The AC INPUT cable have 3 wires (one for the ground) of 12 AWG
- The DC INPUT cable have 6 wires (three for each connection) of 12 AWG
- The DC3 OUTPUT cable have 3 wires (one for ground) of 12 AWG
- The DC2 OUTPUT cable have 6 wires (three for each connection) of 12 AWG
- The DC1 OUTPUT cable have 4 wires (two for each connection) of 12 AWG

Additional details about the effects of a resistance-related voltage drop are included in “Trouble-Shooting Guide - Cable wire resistance is too high”.

Set-Up

The recommended procedure for setting up the UPS is the following:

- Insert the BATTERY PACK (if not already present) and tighten its screws.
- Make sure the AC BREAKER on the rear panel of the UPS is in the OFF position.
- Connect the ground wire to the ground stud on the rear panel of the UPS.
- Connect all OUTPUT cables, first to the UPS and then to the various loads.
- **VERIFY** that the optional DC OUTPUT cable is connected to the UPS and the load with the correct polarity.
- Connect the USER I/O cables.
- Connect all INPUT cables, first to the UPS and then to the various sources.
- An overcurrent protect and disconnect device should be installed on the DC INPUT circuit. An example of a suitable device is a Carling Technologies, C-series, 80 A 65 VDC, CA1-B0-14-680-321-J circuit breaker. (www.carlingtech.com)
- **VERIFY** that the optional DC INPUT cable is connected to the UPS and the source of DC power with the correct polarity.
- Turn on the sources (if they have an upstream breaker).
- Move the AC BREAKER on the rear panel of the UPS to the ON position.

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

Start-Up

- **VERIFY** that all connections to the UPS are correct.
- If either the AC source or the DC source (or both) is present and within specifications, the color of the LED above the ON/OFF switch will be amber. This indicates that the UPS is in standby mode and ready to turn on. The battery pack LEDs will also be appropriately illuminated.
- Momentarily push the ON/OFF switch on the front panel of the UPS upward. The switch can then be released and it will return to its normal (neutral) position.
- The UPS will immediately enable its outputs (assuming there is no fault condition). The color of the LED above the ON/OFF switch will change to green. The LEDs on the battery pack will indicate the amount of power being delivered to the load and the input source from which this power is being drawn.

Note: If no input power sources are available the UPS 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 LED above the ON/OFF switch and the battery pack's LEDs will initially all be off. When the ON/OFF switch is pushed to the ON position, all of these LEDs will be appropriately illuminated.

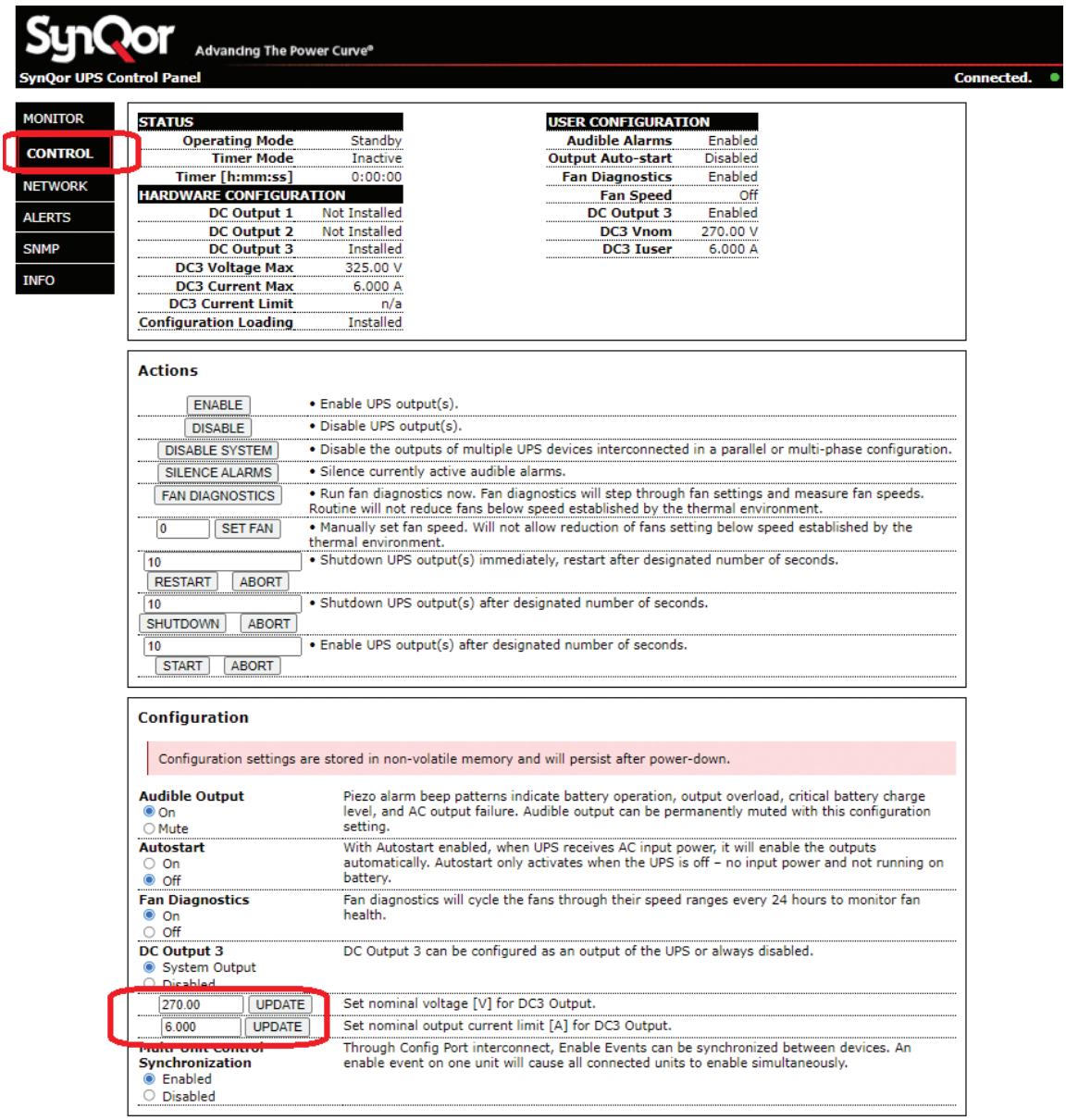
Shut-Down

- 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 and shut down.
- The battery pack LEDs will either be appropriately illuminated (if one or both input power sources are present) or they will be off (if no power sources are present).
- It is not necessary to move the AC BREAKER on the rear panel of the UPS to the OFF position.

Setting DC3 OUTPUT Voltage and Current

The UPS-1250-270 Series has a user settable DC3 OUTPUT. The output voltage can be set from 25V to 325V. Note that full power (1250W) is only available whebn the output voltage is set in the range 210-325V since the output current is limited to 6.00A. The output current can be set from 0.05A to 6.00A. At higher output voltage, the current will be limited below 6.00A since the UPS-1250-270 is rated to 1250W. See the figure below.

The output voltage can be set through the web page or through the RS-232 interface. To set the voltage through the web page, navigate to the control page. Under "Configuration", enter the desired output voltage in volts and the desired current limit in amps. Click update to apply the changes. These values are stored in non-volatile memory, and do not need to be reentered after the UPS-1250 is power cycled.



To set the voltage through the RS-232 interface, configure the RS-232 terminal by following the procedure described in section VI. Using a third party terminal application such as HyperTerminal, send the following commands:

SET DC3 IMAX x [mA]
SET DC3 VOUT x [V]

Example: Set Vout to 200V, Imax to 3A.

SynQor>SET DC3 VOUT 200
Flash Updated.

SynQor>SET DC3 IMAX 3000
Flash Updated.

NOTE that after each command the system will return "Flash Updated". This indicates that the values have been stored in non-volatile memory, and do not need to be reentered when the UPS-1250 is power cycled.

Power Cable Connections/Disconnections While Operating

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

However, the SynQor UPS is capable of having any of its input or output power cables connected at any time (if safely done), including when the UPS is turned on and delivering power to the load. For instance:

- Even if the UPS is turned on, one can connect or disconnect the input power cables without harming the UPS or disrupting power delivery to the load. If no input power source is available, the UPS will draw power from the battery pack. When there is an external source of power connected to the UPS, the unit will draw power from that source, choosing the AC INPUT source first, if present, and then the optional DC input source. The transfer from one source of power (including the battery) to another is seamless.

- Even if the UPS is turned on, one can connect or disconnect an output power cable without harming the UPS or disrupting power delivery to a load that might be connected to the other output.

  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 UPS, 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 cable** because its current is so high. Disconnecting this cable while a large current is flowing is **not recommended**.

  ALSO NOTE that when the UPS is turned on and delivering power to a load, and then another piece of equipment is connected to the same output, it is possible that this connection will momentarily disrupt the quality of the UPS's output voltage. For instance, consider the case where the DC3 OUTPUT power cable has a terminal strip that allows several loads to be connected to it. If the UPS is turned on and delivering power to several of these loads and then another load is connected to the terminal strip, it is possible that this new load will momentarily draw a large surge of current as it starts up. If this happens, the output of the UPS could reach its maximum current limit, and the UPS will reduce its output voltage to keep the current from getting any larger. This reduction in voltage will be corrected once the new load reaches its normal mode of operation, but in the mean time the reduction of the UPS's output voltage might cause one or more of the other loads to malfunction. Whether or not this will be a problem depends on the characteristics of the various loads.

Cooling System

The SynQor UPS-1250-270 Series products are cooled by fans that draw air into the intake below the battery pack on 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 UPS cooling while extending the life of the fan bearings. Under low ambient temperature and/or low UPS output power the fans will be driven at a low speed. If the ambient temperature and output power are such that the UPS 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. There is an LED on the front panel of the battery pack that indicates the speed of the fans.

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 battery pack. 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 UPS has two fans to provide redundancy for these exposed, moving components. With only a single operating fan the UPS 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.

Front Panel Indicators

To indicate the status of the UPS and its battery pack, there is one LED above the ON/OFF switch on the left side of the front panel of the UPS and an additional 16 LEDs on the front panel of the battery pack. There is also an audible alarm. These indicators are described in this section.

LEDs

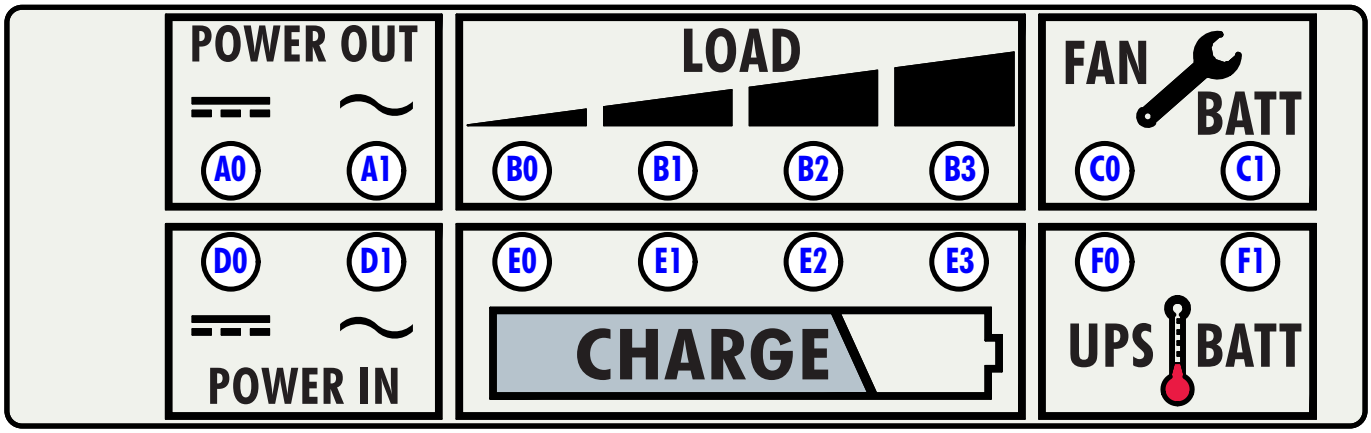
LED above the ON/OFF switch

This LED has four possible indications, according to the table below:

LED Appearance	Description	Indication
	Green	**UPS is Running** *(Outputs are Enabled)*
	Amber	**UPS is on Standby** *(Outputs are Enabled)*
	Red	**UPS has a Fault Condition**
	Off	**UPS is Off**

LEDs on the Battery Pack

Each battery pack has 16 LEDs, as shown below, that indicated the status of the battery pack and of the operation of the UPS:



Power-In Indicators (LEDs in positions D0 and D1)

The LED in position D0 indicates the status of the optional DC INPUT and the LED in position D1 indicates the status of the AC INPUT, according to the table below:

LED Appearance	Description	Indication
	**Green**	*Input is Ready to Provide Load Power*
	**Pulsing Green**	*Input is the One Presently Selected as the Source of Power*
	**Amber**	*Input has Returned within Range and Diagnostic Tests are Being Performed*
	**Off**	*Input is Not within Range (Or the DC INPUT Option is not Installed)*

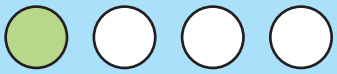
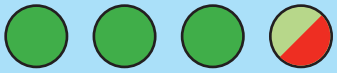
Power-Out Indicators (LEDs in positions A0 and A1)

The LED in position A0 indicates the status of the optional DC OUTPUT and the LED in position A1 indicates the status of the DC3 OUTPUT, according to the table below:

LED Appearance	Description	Indication
	**Green**	*UPS is On and the Output Voltage is Within Range*
	**Amber**	*UPS is On but the Output Voltage is Out of Range*
	**Red**	*UPS is Off and the Output Voltage is Within Range*
	**Off**	*UPS is Off (Or the DC OUTPUT Option is not Installed)*

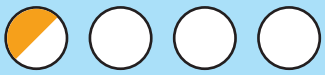
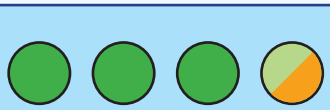
Load Power Indicators (LEDs in positions B0 – B3)

The LEDs in positions B0 through B3 indicate the total output power of the UPS (The DC3 OUTPUT power plus the optional DC OUTPUT power) according to the table below:

LED Appearance	Description	Indication
	*B0 Dimmed Green;B1-B3 Off*	*Total Load Power <25%*
	*B0 Green; B1 Dimmed Green; B2-B3 Off*	*Total Load Power <50%*
	*B0, B1 Green; B2 Dimmed Green; B3 Off*	*Total Load Power <75%*
	B0, B1, B2 Green; B3 Dimmed Green	*Total Load Power <100%*
	*B0; B1; B2 Green; B3 Blinking Red*	*Total Load Power ≥100%*

Battery State-of-Charge Indicators (LEDs in positions E0 – E3)

The LEDs in positions E0 through E3 indicate the state-of-charge of the internal battery pack, as well as whether the battery pack is on standby or being charged **(Blinking Amber)** or discharged **(Blinking Red)**, according to the table below.

LED Appearance			Indication
Standby	Discharging	Charging	
	NA	NA	*Battery Charge <10%*
			*Battery Charge <25%*
			*Battery Charge >25%*
			*Battery Charge >50%*
			*Battery Charge >75%*
	NA	NA	*Battery Charge =100%*
	NA	NA	*Battery Charge =100% (Cell Balancing is Occurring)*

UPS Cooling System Indicator (LED in position F0)

The LED in position F0 indicates the temperature and status of the cooling system for the UPS according to the table below:

LED Appearance	Description	Indication
	**Green**	*Moderate UPS Temperature (Fans Running at 33%)*
	**Blinking Green**	*Warm UPS Temperature (Fans Running at 67%)*
	**Amber**	*Elevated UPS Temperature (Fans Running at 100%)*
	**Red**	*Maximum UPS Temperature (Fans Running at 110%)*

Battery Pack Temperature Indicator (LED in position F1)

The LED in position F1 indicates the temperature of the battery pack (and its availability to be charged or discharged because of its temperature) according to the table below:

LED Appearance	Description	Indication
	**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*
	**Red**	*Battery is too Hot to be Charged or Discharged*

Fan Service Required Indicator (LED in position C0)

The LED in position C0 indicates whether the two cooling fans in the rear panel of the UPS are OK or if their performance is degraded, according to the table below:

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)

The LED in position C1 indicates whether the battery pack is OK or if its storage capacity has been degraded compared to its rated value, according to the table below:

LED Appearance	Description	Indication
	**Green**	*Battery Pack is OK*
	**Amber**	*Battery Pack's Calculated Maximum Storage Capacity is <75% of its Rated Value*
	**Red**	*Battery Pack's Calculated Maximum Storage Capacity is <50% of its Rated Value*

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	*UPS is Drawing Power From the Battery Pack*
Two	*Load Power is greater than or approaching 100% Rated Power*
Three	*DC3 OUTPUT Voltage is Low UPS May Need to be Turned Off and Back On to Reset DC3*
Four	*UPS is Drawing Power From the Battery Pack and the Remaining Charge is <10%*

Hot Swapping the Battery Pack

The battery pack can be removed from the UPS and it, or another one, can be inserted into the UPS without disrupting the delivery of power to the load as long as a source of input power is available. This feature is referred to as "hot swapping" in the industry. It can be used to replace a battery pack that needs servicing, or to replace a drained battery pack with a spare, fully charged one if additional back-up protection must be ensured before the drained battery pack will have time to be recharged.

Of course, if there is no source of input power available and the UPS is therefore drawing power from the battery, then the removal of the battery pack would cause the UPS's outputs to shut down until a recharged battery pack is inserted.

Operating Environment

The SynQor UPS-1250-270 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 UPS will shut down if it is too hot.

The UPS (with cables connected or connector covers installed and the battery pack 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	▪ 15,000 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	▪ 10 cycles; >10°C/minute
506.5	Rain	I	▪ 4” rain/hour ▪ 40 mph wind velocity
507.5	Humidity	NA	▪ >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
514.6	Vibration	Category 7	▪ General Exposure
514.6	Vibration	Category 8	▪ C-130 Aircraft level
514.6	Vibration	Category 9	▪ General Exposure
514.6	Vibration	Category 24	▪ PSD = 0.04 g^2/Hz; 20-2000 Hz ▪ Operating
516.6	Shock	I, IV and VI	▪ 20 g/20 ms; 40 g/11 ms; 75 g/6 ms ▪ 48 inch drop in transit case ▪ 30 degree tilt and drop
528	Mechanical Vibrations of Shipboard Equipment	I	▪ Operating

Multiple UPS Configurations

The UPS-1250-270 has three DC outputs that can be combined to provide the following functionality:

- Higher Output power
- N+M redundancy
- Balanced load for a 3-Phase systems

The DC1 outputs are not parallelable between multiple modules. A direct parallel connection of DC1 outputs from different modules will result in a circulating power between the two UPS devices. Diode-ORing devices added externally at the DC1 outputs will prevent any circulating power. However, the outputs will still not necessarily share the load current equally

DC3 uses digital current sharing to ensure the load is balanced. Units typically share output power within ±3%. Up to 32 units can have their DC3 OUTPUTs connected in parallel, with N+M redundancy.

DC2 uses droop share to ensure the load is balanced. Units typically share output power within ±5%. Up to 3 units can have their DC2 outputs connected in parallel.

Parallel Connection of Outputs: DC3

The DC3 OUTPUT can be placed in parallel with the proper configuration cable. This cable provides digital current sharing for all connected units.

Sharing is optimized when the output resistance is matched between all parallel units. The output cables should have the same construction, similar length, and be connected at a single point.

N+M Redundancy - Ideal Diode

The ideal diode on the DC3 OUTPUT provides N+M redundancy when multiple units are placed in parallel. An N+M redundant system consists of N units to supply the maximum load, and M additional units to provide redundancy. Typically, one additional unit is used for redundancy giving “N+1 redundancy”.

During normal operation, all N+M units will deliver power to the load. Should one unit fail, the remaining units will increase their output current to continue to power the load. The failed unit can be removed and replaced to restore the redundancy level of the system to its original design. The replacement unit can be inserted into a live, operating system, but for safety reasons it is recommended that all units in the system be disabled first.

In addition to N+M redundancy, the ideal diode prevents power from flowing into the unit during normal operation. This ensures that power cannot circulate between multiple units when the outputs are in parallel. The digital communications ensures the load is shared evenly.

Configuration Cables

Configuration cables are necessary for paralleling the DC3 OUTPUT. They provide the following features:

- Synchronized start up, shut down, and fault recovery
- Digital communication for load sharing
- Up to 32 units in parallel.

The table below lists configuration cables for systems of 2-5 units. Contact the factory for configuration cables that support more than five units in parallel.

Configuration Cables for Paraleling	
2 Units Parallel, 3′	SYN-9341
3 Units Parallel, 6′	SYN-9343
4 Units Parallel, 9′	SYN-9344
5 Units Parallel, 12′	SYN-9345

Parallel Connection of Outputs: DC2

The DC2 output can be put in parallel simply by connecting the output cables of each unit together. The units share current by the semi-regulated droop characteristic of DC2. Typical sharing accuracy is ±5%. Worst case sharing accuracy is ±10%. Due to the wide range sharing accuracy, it is only practical to put three DC2 outputs in parallel.

Sharing is optimized when the output resistance is matched between all parallel DC2 outputs. The output cables should have the same construction, similar length, and be connected at a single point.

Configuration cables are not required for load sharing, but may be used for synchronized enable and disable of the DC2 output. Use SYN-9341 for two units in parallel, SYN-9343 for three units.

On/Off Control - Parallel Systems

When several units are connected in parallel with a configuration cable, any “on” front panel switch actuation will cause all outputs to turn on at once. In addition, the “remote-on” rear panel signal can be used for a coordinated start. Any “off” front panel switch actuation will cause that specific unit be turned off. All other units will continue to deliver power, assuming the load can be supported with one less unit.

For coordinated shutdown, the user must send “SYSTEM DISABLE” over RS-232. See Section V of the Owner’s guide for details on the RS-232 interface. See the UPS User Commands document for more information on the “SYSTEM DISABLE” command.

Connection of AC and/or DC INPUTS

There are several ways that the AC and/or DC INPUTS of multiple UPS units can be connected to sources of power:

- They could be connected to the same AC and/or DC source, respectively.
- They could be connected to different AC and/or DC sources, respectively.

All that is necessary is to ensure that the input voltage falls within the specified range of the AC and/or DC INPUTS of the individual UPS units.

Furthermore, the individual AC and/or DC INPUT cables can be first combined into a single cable (of appropriate minimum wire size), or they can be left as separate cables, each connected to the desired AC or DC source.

Note that the UPS input circuit breaker disconnects the unit from the AC input bus should a UPS experience a hardware fault on its input stage.

3-Phase AC INPUT Source

When three UPS units are used (with their DC OUTPUTS connected in parallel), each UPS unit's AC INPUT can be connected to a different phase of a 3-Phase source. There are two different ways to do this:

- each UPS unit's AC INPUT can be connected from a line (i.e., L1 or L2 or L3) of the AC source to the neutral wire of the AC source (assuming it is present), or
- each UPS unit's AC INPUT can be connected from one line of the AC source to another (i.e., L1 to L2, L2 to L3, or L3 to L1)

Either connection scheme is acceptable, as long as the resultant input voltage falls within the specified range of the AC INPUT of the individual UPS units.

If DC3 OUTPUTs are connected in parallel, the load on each AC INPUT phase will be balanced typically within ±5%.

If the DC2 outputs are connected in parallel, the load on each AC INPUT phase will be balanced typically within ±7%.

Wiring Caution

WARNING: *LETHAL VOLTAGES MAY BE PRESENT ON UPS DC3 OUTPUT CONNECTIONS. ALWAYS REMOVE BATTERY PACKS AND INPUT POWER BEFORE MAKING MULTI-UNIT DC3 OUTPUT CONNECTIONS. ALL DC3 OUTPUT CABLE CONNECTORS MUST BE INSTALLED DURING OPERATION AS A DISCONNECTED CABLE CONNECTOR MAY HAVE EXPOSED VOLTAGE PRESENT FROM ANOTHER UNIT IN THE GROUP .*

Battery Technology

The battery packs for the UPS-1250 Series contain Lithium Ion 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 a UPS application. Lithium Ion batteries are used in many military applications.

Electronic Circuitry within the Battery Pack

The SynQor 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.

There are two battery packs offered for the SynQor UPS products: BAT-0200 and BAT-0400. These packs have 3 and 4 battery segments, respectively. The BAT-0200 and BAT-0400 batteries are applicable to the UPS-1250-[S,H,M]-[1U,2S], UPS-1500-[S,H,M]-[1U,2S], UPS-3000-[S,H,M]-2U devices.

The protection features provided by the electronic circuitry include:

- **Maximum Current Limit** when the battery is being charged/discharged
- **Charging/Discharging Protections** to avoid over-charging/discharging of the battery
- **Charging/Discharging Lockout** if the battery is too hot or too cold
- **Disconnect** of the battery from the battery pack's terminals when the pack is not inserted into the UPS

Battery Capacity

SynQor offers multiple battery packs in a sub-1U high form factor, the BAT-0200 and the BAT-0400. The BAT-0200 weighs 10 lbs. and has 3 battery segments. The BAT-0400 weighs 11.8 lbs. and has 4 battery segments. All battery packs will recharge in about two hours. The run-time as a function of UPS load power is shown on the below table.

Total UPS Output Power	BAT-0200 Run-Time	BAT-0400-H Run-Time	BAT-0400-M Run-Time
100% Rated Power	> 10 Minutes	> 13.5 Minutes	> 16 Minutes
80% Rated Power	> 13 Minutes	> 18 Minutes	> 22 Minutes
60% Rated Power	> 21 Minutes	> 27 Minutes	> 34 Minutes

Storage of the Battery Pack

The storage temperature range of the battery pack (whether it is inserted in the UPS or stored separately)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 optimal storage temperature is below 35°C. Storage above this temperature will accelerate battery degradation.

Battery Pack Replacement

UPS-1250-S-1U and UPS-1500-S-1U products ship with the BAT-0200 battery pack. UPS-1250-H-1U and UPS-1500-H-1U products ship with the BAT-0400-H battery pack. UPS-1250-M-1U and UPS-1500-M-1U products ship with the BAT-0400-M battery pack. However, the three packs are interchangeable; for example, a BAT-0400-M battery may be installed in an existing UPS-1500-S-1U device as an upgrade to the performance. The table below shows the applicable battery packs for various series of SynQor UPS devices. Always use the proper SynQor battery pack.

UPS Series	BAT-0200	BAT-0400-%
UPS-1250-[S,H,M]-[1U,2S]	Qty. 1	Qty. 1
UPS-1500-[S,H,M]-[1U,2S]	Qty. 1	Qty. 1
UPS-3000-[S,H,M]-2U	Qty. 2	Qty. 2

Handling the Battery Pack

The operating temperature range of the battery pack 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 UPS is equipped with internal battery heaters which activate to keep the cells above 0°C in cold ambient temperatures. Therefore, the UPS can be used at ambient temperatures as low as -40°C when input power is available to operate the battery heaters.

Additionally, the BAT-0400-M pack has the capability of powering the battery heaters from internal battery energy. This enables coldstart operation down to an ambient temperature as low as -40°C. During coldstart self-heat, the battery heaters run in a high power mode capable of bringing the battery to operational temperature in about 3.5 minutes.

When the battery pack is not inserted into the UPS, the internal electronic circuitry disconnects the battery from the pack's power terminals. Nevertheless, care should be taken to avoid making metal contact with (or between) any of these terminals.

The battery pack has its own aluminum chassis that protects its battery cells and internal electronic circuitry from the environment when the pack is not inserted into the UPS. However, care should be taken to ensure this chassis and the exposed power terminal strip is not subjected to extreme mechanical shock or to excessive moisture.

UPS battery packs must be shipped per Federal DOT Regulations as a Class 9 Fully Regulated Hazardous Material. The battery pack must not be installed in the UPS when being shipped, and it 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 labeled per applicable Federal DOT Requirements. A UPS may be shipped using standard shipping methods if it does not contain a battery pack. Please contact SynQor for further assistance.

The battery pack 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 SynQor factory for all other questions regarding the UPS battery pack.

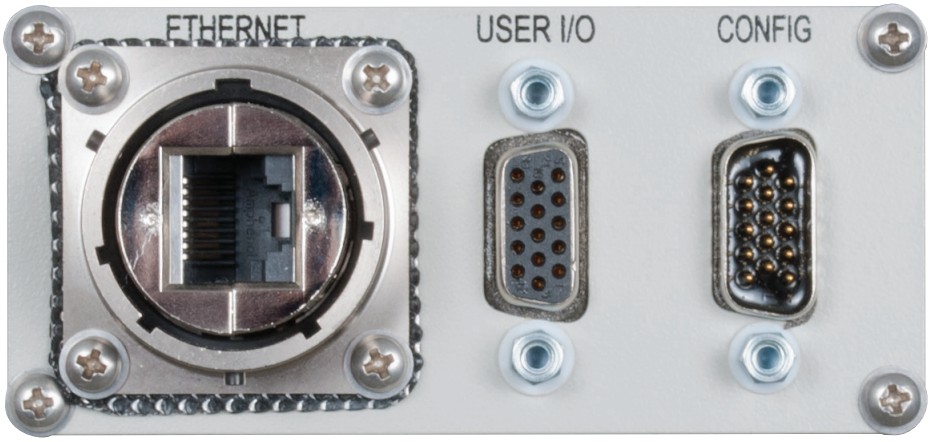
CAUTION: Do not dispose of batteries in a fire. The batteries may explode.

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

Always use the proper SynQor battery pack. See the battery replacement chart on page 38.

Control Cable Connections

There are two high-density (three-row) DB15 connectors located on the rear panel of the UPS:

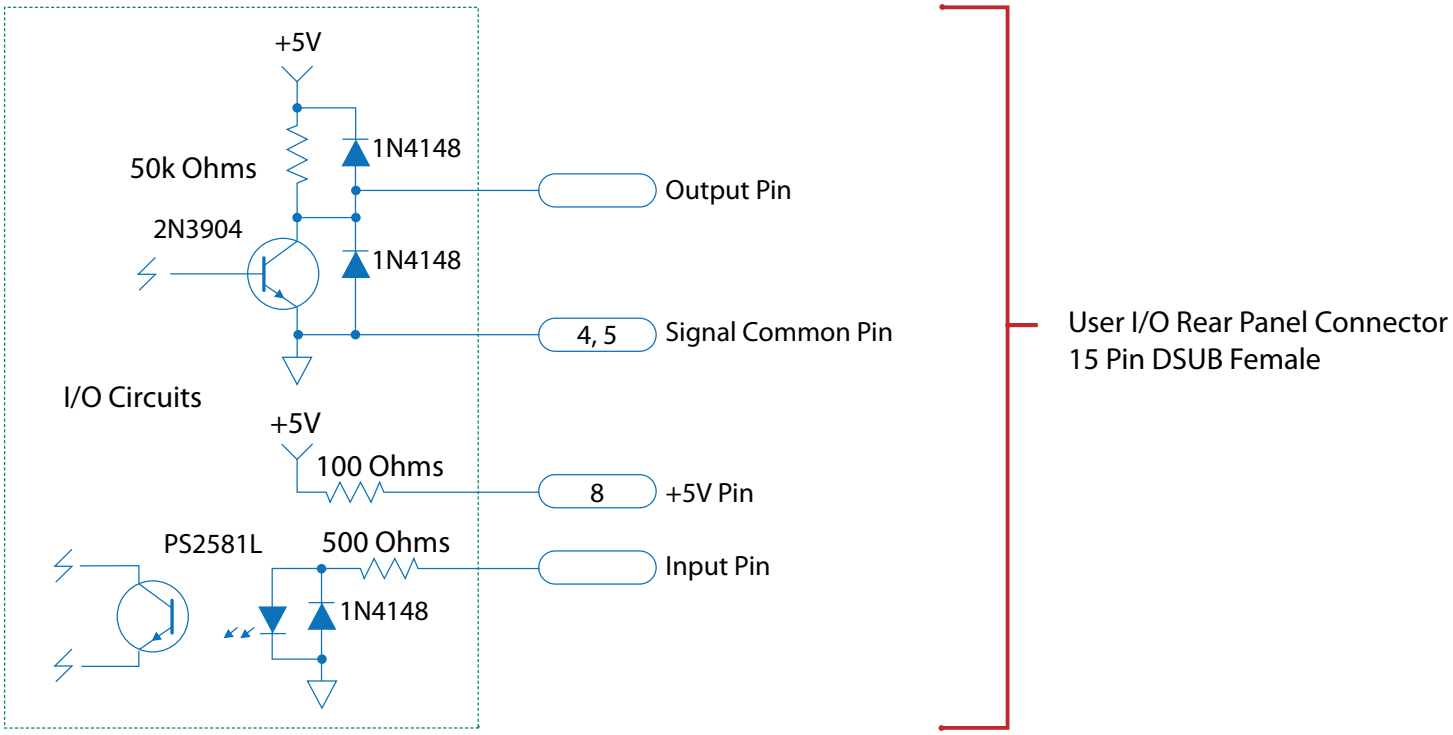


The User I/O female DB15 connector on the left is for a connection to a host/system computer so that it can control the UPS and receive information regarding the status of the UPS.

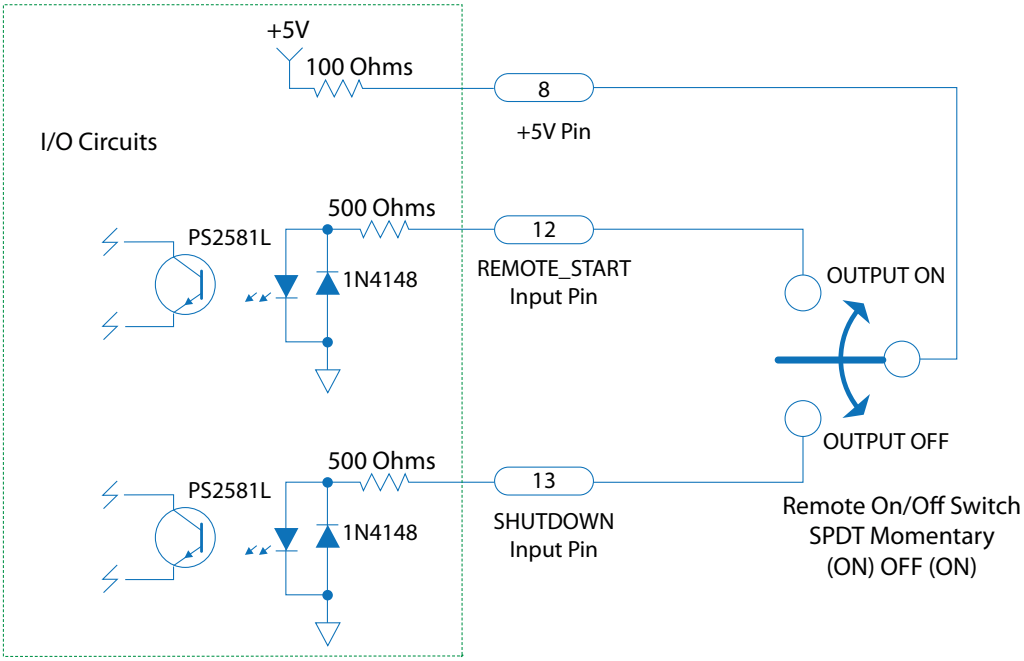
The Configuration male DB15 connector on the right is for a connection between one SynQor UPS and another when, for instance, they have their outputs connected in parallel and they therefore need to communicate and coordinate with each other.

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



Note: A 2PDT or 3PDT switch may be substituted for single control of 2 or 3 UPS machines, respectively.

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)
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 UPS is drawing power from its battery
$\overline{\text{OUT\_OK}}$	14	Open collector* output where “low” indicates DC3 OUTPUT voltage is within range
$\overline{\text{OVER\_TEMP}}$	15	Open collector* output where “low” indicates that the UPS is at or above its maximum temperature
REMOTE_START	12	Drive this line “high” with ≥ 5mA to enable the UPS outputs
SHUTDOWN	13	Drive this line “high” with ≥ 5mA to disable the UPS outputs

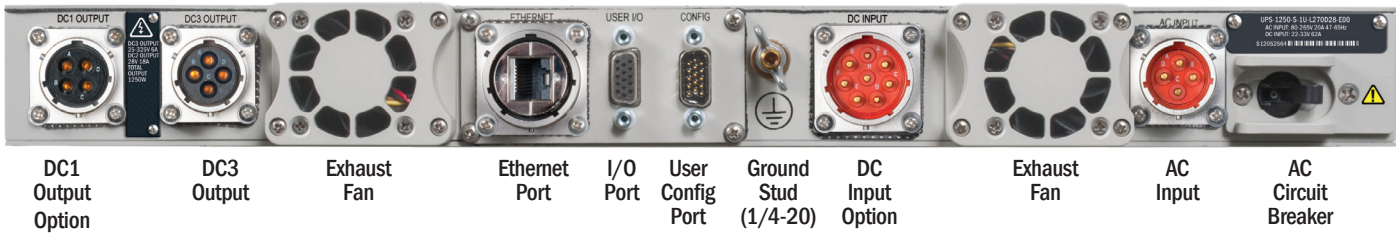
*with an internal 50 kΩ Pull-up Resistor to 5 V and ESD Protection Diodes.

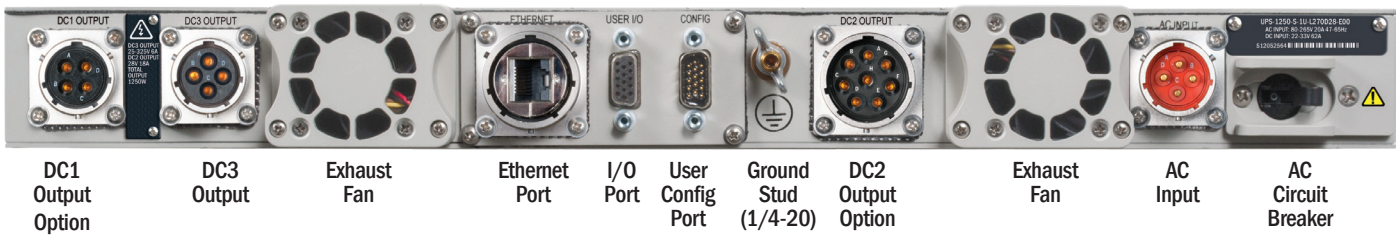
RS232 Serial Interface

The same User I/O female high-density DB15 connector also provides for an RS232 interface between the UPS and the host/system computer. The interface has a 115.2k 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 readback of UPS's state, as well as the configuration and control of the UPS's operation. The port can be used from a standard terminal interface, or from a custom computer application.





Readback information that is available:

- AC Input Voltage
- AC Input Current
- AC Input Frequency
- DC Input Voltage
- DC3 OUTPUT Voltage
- DC3 OUTPUT Current
- DC3 OUTPUT Power
- Total 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
- DC3 OUTPUT Voltage Setpoint
- DC3 OUTPUT Current Limit

For a detailed description of the terminal interface see the SynQor website at:
http://www.SynQor.com/UPS/documents/UPS_User_Commands.pdf

Ethernet Interface

The Ethernet interface provides a web page based user interface for monitoring and control of the UPS. The user can configure email alerts for UPS 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 UPS and a host computer by including a DHCP server internal to the UPS.

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

Battery

The lithium ion battery cells in the battery pack do not need any maintenance. In particular, unlike a lead acid battery a lithium ion battery does not need to 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 SynQor factory for all other questions regarding the UPS 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.

Always use the proper SynQor battery pack. See the battery replacement chart on page 38.

Fans

The fans on the rear panel have sealed bearings that do not require any maintenance.

Cleaning

The UPS-1250-270 unit has a sealed chamber for its electronics and the battery pack 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. **ALSO NOTE** that care should be taken to not get excess liquid on the switch of the AC BREAKER on the back panel.

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.

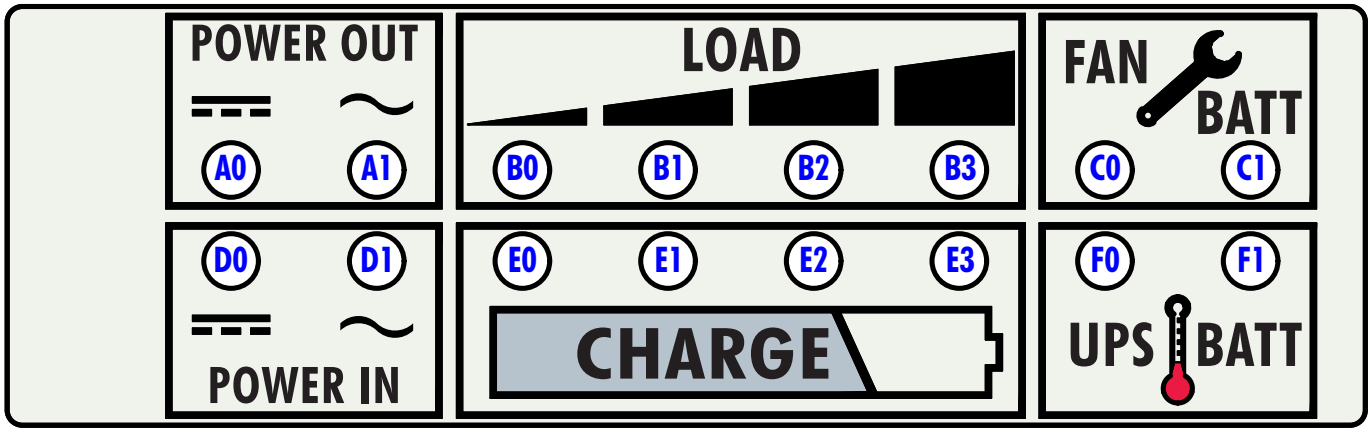
Fault Conditions

The SynQor UPS has no user-serviceable parts within it. 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 UPS to not operate as desired. These external conditions can likely be corrected by the user.

The 16 LEDs on the front panel of the battery pack are the best and first place to look to determine what might be wrong with the UPS. 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 battery pack 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)
D1: **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.
	LED is a STEADY GREEN and not a PULSING GREEN. UPS is instead running off the optional DC INPUT or the BATTERY	•The AC INPUT voltage is within its proper range but the UPS is not selecting it for its source of power. •The AC INPUT voltage and the total load power may exceed the power derating curves given earlier in this Guide. •The AC INPUT cable may have too much series resistance. Thicker wire should be used.
D0: **DC INPUT Power LED**	LED is OFF	•The optional DC INPUT is not available on this unit. •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.
A1: **DC3 OUTPUT Power LED**	LED is OFF	•The UPS is OFF and needs to be turned ON.
	LED is AMBER	•The DC3 OUTPUT load is higher than 1250 W by enough to trigger the power limit circuitry. •The DC3 OUTPUT is shorted within the cable or a load.
	LED is RED	•The UPS has been turned OFF, but due to a malfunction within the UPS it is still running and providing an DC3 OUTPUT voltage. •Some other source of voltage is connected to the DC3 OUTPUT and is powering it when the UPS is not.
A0: **DC OUTPUT Power LED**	LED is OFF	•The optional DC OUTPUT is not available on the unit. •The UPS is OFF and needs to be turned ON.
	LED is AMBER	•DC1 load is higher than 500W, or DC2 load is higher than 1250W •DC1 or DC2 is shorted within the cable or load •Some other source is connected to DC1 or DC2
	LED is RED	•The UPS has been turned OFF, but due to a malfunction within the UPS it is still running and providing an DC OUTPUT voltage. •Some other source of voltage is connected to the DC OUTPUT and is powering it when the UPS is not

LED	Indication	Possible Problem(s)
B0 – B3: LOAD POWER LEDs	B3 is BLINKING RED	•Total UPS load power is greater than or approaching 1250 W. The UPS may still be delivering its specified output voltage because the load power is not high enough to trigger the power limit circuitry.
	B0 – B3 are all OFF	•No power is being delivered to the load. •The UPS is OFF and needs to be turned ON. •The loads or output cables are not connected. •The loads are all turned off. •The loads are simply not drawing any appreciable power at the time.
F0: UPS Cooling System LED	LED is BLINKING GREEN	•Indicates that the fans are running at 67% of their rated speed. There is no problem.
	LED is AMBER	•Indicates that the fans are running at 100% of their rated speed. There is no problem, but the unit is operating at a high ambient temperature and a high load combination.
	LED is RED	•Fans are running at 110% of rated speed to keep the unit cool. The maximum recommended temperature may be exceeded, but the fans are keeping things cool enough to avoid triggering the over-temperature shut-down circuitry.
F1: Battery Pack Temperature LED	LED is BLINKING RED	•The battery is too cold to be charged or discharged without damage. •If the UPS 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 UPS needs to draw power from it. •If the UPS 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 UPS 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.

LED	Indication	Possible Problem(s)
C0: Fan Service Required LED	LED is AMBER	•One or both fans have recently had degraded performance but seem to be ok now. The UPS 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 UPS'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 UPS's battery run-time will therefore be similarly reduced. •The battery pack should be replaced at the earliest convenient time.
All 16 LEDs:	All LEDs are OFF	•The battery pack is not fully inserted into the UPS with its thumb screws tightened. •The terminal on the battery pack is damaged or dirty. •The battery pack is defective and needs to be replaced.
Audible Alarm: (pattern repeats every 5 seconds)	One tone	•The UPS is drawing power from the battery pack and is discharging it. •Sources of power should be restored or preparations made to shut down the loads
	Two tones	•The total UPS load power is above 1250 W. •Loads should be reduced if this condition persists.
	Three tones	•The DC3 OUTPUT voltage is low. This occurs when the DC3 OUTPUT is overloaded and begins acting as a current source with the user programmed current limit. •In rare cases, the DC3 OUTPUT may be latched off. This occurs when the DC3 experiences 10 short circuit events within 10 seconds of each other. To reset the DC3 OUTPUT, the UPS must be turned OFF and then ON
	Four tones	•The UPS is drawing power from the battery pack and its remaining charge is <10% of its rated charge. •Sources of input power should be restored or the loads should be shut down.

Two other conditions should be mentioned:

- The fans are off when the UPS is running

  It is normal for the fans to be off, even if the UPS is running and delivering power to the load, as long as the temperature of the UPS 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 UPS 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 UPS does not respond to this signal for approximately 1 second. This is done to ensure that the UPS is not accidently turned off. If the user does not hold the ON/OFF switch in the OFF position for a full second before releasing it, the UPS will not turn off.

Other possible situations that are the result of external issues that a user could likely correct are related to:

- Loads that draw a large surge of current at start-up

  When the UPS is running and powering one or more loads connected to its DC3 OUTPUT, and then an additional load of the DC3 OUTPUT is turned on. If this newly started load draws a large surge current at start-up, it can cause the current limit of the UPS's DC3 OUTPUT to be triggered, and the DC3 OUTPUT voltage will then drop. This drop could cause the existing loads to be disturbed. Furthermore, if the voltage drops far enough, the UPS will turn off it DC3 OUTPUT and initiate a new start-up sequence. This latter action would cause the power flow to the existing loads to be interrupted.

  If this disruption of existing loads is a problem, then the solution is to make sure the loads that display this start-up surge characteristic are all started first, or that all loads are started at the same time.

- Cable wire resistance is too high:

  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 either 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 65 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.

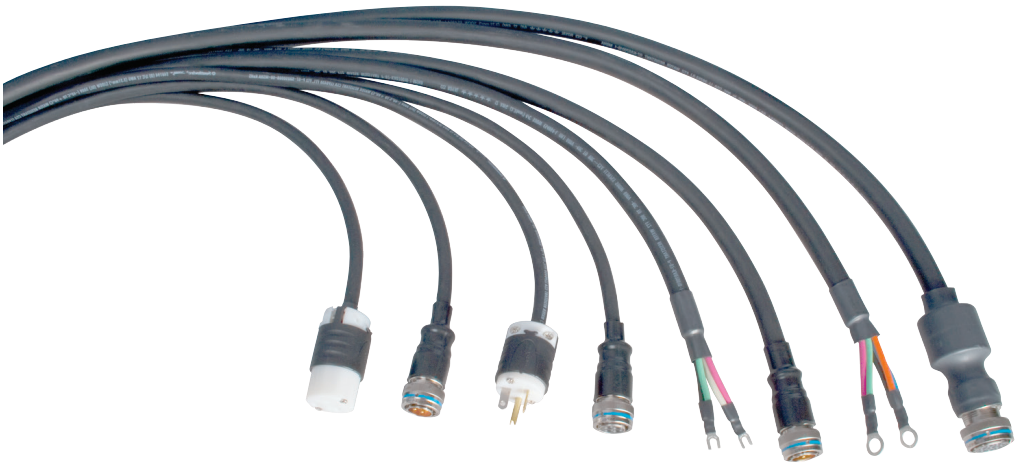
  - Assume the AC INPUT source is not present, but the DC INPUT source is

- The UPS, 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 UPS sees that the voltage at the DC INPUT is within its specified range, and enables its outputs.
- As the load then draws power, the UPS 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 UPS to fall below 22 V, then the UPS will determine that the DC INPUT is out of range and will switch over to drawing power from the internal Battery Pack.
- Since the UPS 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 UPS 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 UPS 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.

This same problem can also occur for the AC INPUT if the voltage at the AC source is close to the specified 80 Vrms minimum limit. In this case the UPS will try ten times before stopping for a one minute interval.

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.



UPS MILITARY FIELD-GRADE

UNINTERRUPTIBLE POWER SUPPLY

Operator's Guide

UPS-1250-270 Series

Made in USA

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