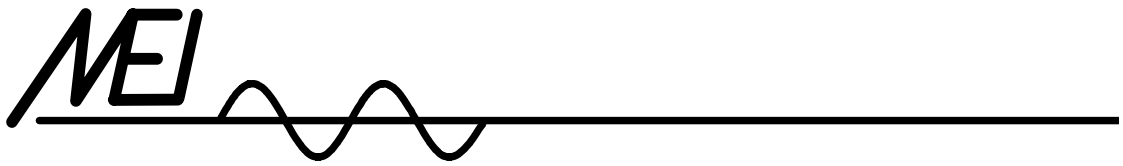

MESTA ELECTRONICS, INC.

Uninterruptible Power System

Owner's Manual

MODELS: UPS10000, UPS15000, UPS20000, UPS25000, UPS30000, UPS50000

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

11020 Parker Drive ▪ N. Huntingdon, PA 15642

412/754-3000

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1. INTRODUCTION

As computers become increasingly fundamental to today's businesses, protection against power disruptions has never been more critical; and since vital data and hardware are threatened by routine sags, surges, spikes, and transients – as well as major blackouts – protection must be constant and instantaneous.

The Mesta UPS system provides this kind of comprehensive protection by maintaining a clean, well-regulated flow of power to critical loads, regardless of the quality of incoming AC line power. It remains in a constant state of readiness, so there is no time delay in compensating for AC line failures.

Unique microcontroller intelligence plus state-of-the-art components and manufacturing procedures yield outstanding capabilities in the Mesta UPS system. Using a proprietary pulse-width-modulation technique, the microcontroller directs the system to produce a very low harmonic, high quality sine wave output – perfectly matched in phase and voltage to the AC power line. The result is a completely seamless transfer of the load from the inverter to the utility and vice versa during a power disturbance or outage.

This seamless transfer feature, combined with high frequency switching and custom magnetics, results in a high operating efficiency of 94 percent at full load, coupled with low harmonic distortion.

Because the microcontroller continually monitors the load and the power line, the Mesta UPS system:

- Starts under load with no damage to itself or the load.
- Handles nonlinear loads – loads that require users of other UPS systems to buy more expensive, higher rated units than they would otherwise need.
- Provides current limiting and short-circuit protection. The UPS provides a 300% overload current limit for a finite time, and a short circuit placed directly across the output will not damage the UPS or the load.

The Mesta UPS system incorporates large scale integration, and its modular design provides for quick and easy maintenance should it ever be needed. Straightforward controls make the Mesta UPS easy to operate; and audible and visual signals provide clear indications of system status. In the event of a power line outage, the system:

- Draws power from the system batteries to continue uninterrupted power to the load until battery energy is depleted (usually 10 – 30 minutes at full load with internal batteries, depending on model number and configuration– see specifications for exact time).
- Sounds an intermittent alarm after ten seconds (the ten-second delay eliminates nuisance alarms from minor fluctuations) and displays on the LCD front panel display the reason for the alarm.
- Sounds another alarm when the usable battery charge has declined to 20 percent of its full capacity.
- Automatically goes into a state of inactivity once regulated output can no longer be maintained due to batteries being fully discharged, waiting for the return of AC line availability. During this state of inactivity the controls will continue to look for the AC power to return in order to restore normal operation. If no AC power returns, however, after 2 hours the entire system will shut down to protect its batteries from deep discharge.

Once the AC power returns, the system's microcontroller employs optimum charging techniques to extend battery life while minimizing charging time. The microcontroller follows a unique algorithm by which it regulates the charging process and enables a minimal recharging time.

WARNING

Your UPS may contains up to twenty (depending on model) 12 volt batteries wired in series providing a total nominal DC voltage of up to 240 volts. This voltage, if present, is used to power the UPS when the AC utility is not available. Because of the presence of this high voltage energy source, even when the UPS is not directly connected to the utility, certain precautions must be taken to avoid possible injury should you need to unlock and enter this unit. Before attempting to unlock or enter the unit, read the section of this manual on **"Maintenance"** for important safety precautions. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads.

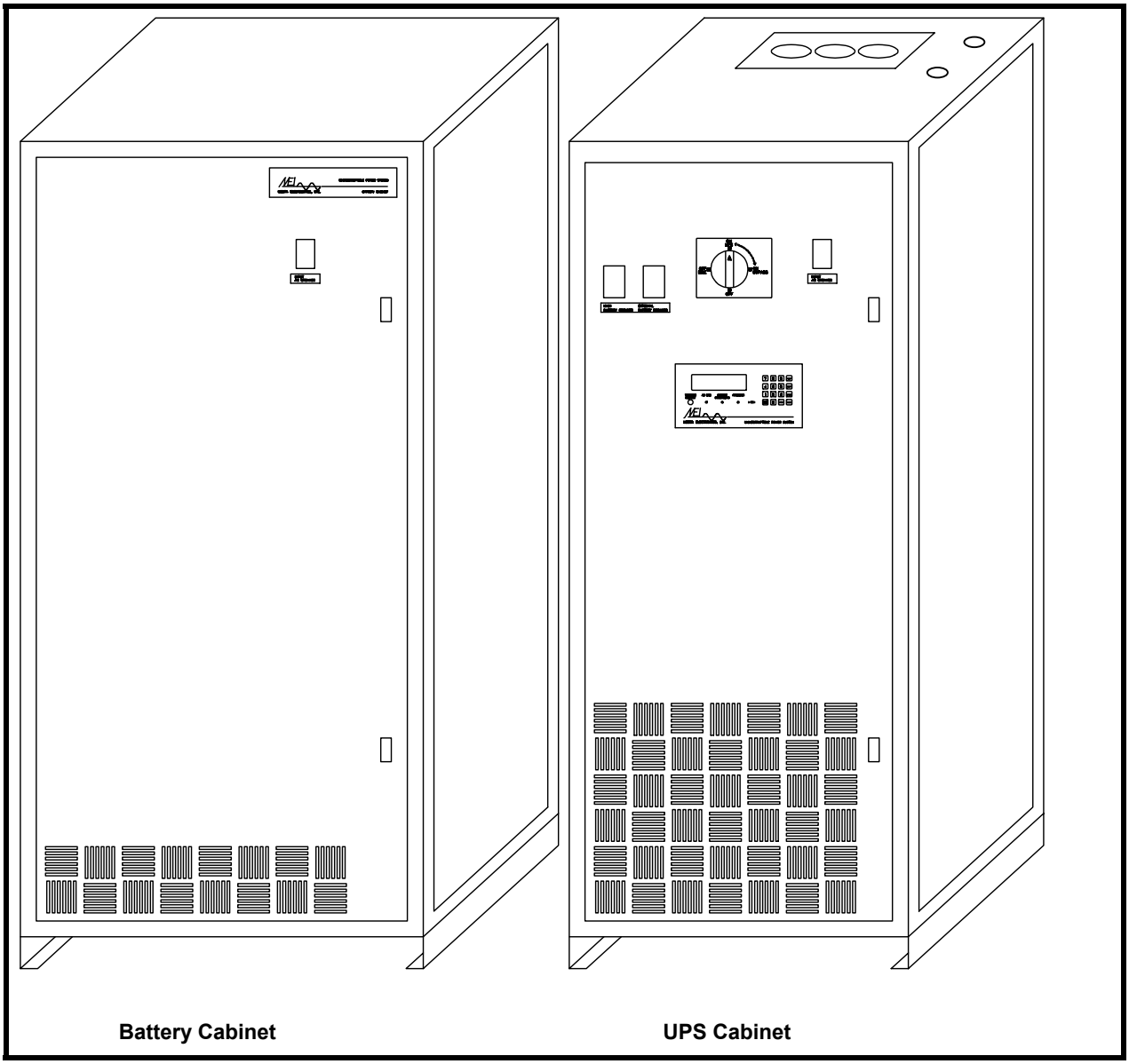
WARNING

Always keep all panels and the front door locked. Always store the keys that unlock the unit in a safe place. DO NOT keep the keys in the lock of the unit where someone unqualified or unsupervised may inadvertently open the main unit or any ancillary units. Leaving the unit unlocked, or leaving keys in the lock, may expose personnel to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads.

2. INSTALLATION

Cabinets – The Mesta Electronics UPS system and optional auxiliary battery cabinets are supplied in cabinets of several sizes, which are indicated by the last digit in the model number. Please reference Appendix A for dimensions of enclosures. If UPS system is configured with internal batteries, Appendix A contains their quantity and capacity.

Figure 1 UPS System Cabinet Enclosures



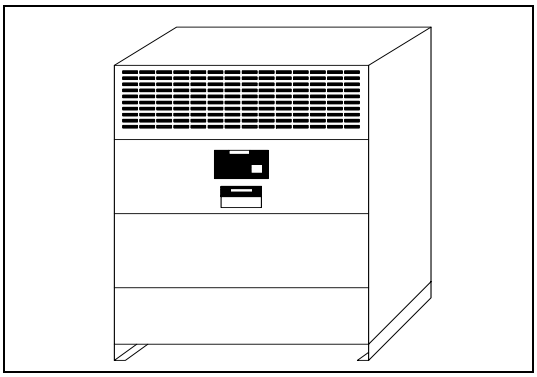
Battery Cabinet **UPS Cabinet**

Unpacking: Before unpacking your unit, examine the shipping carton for damage. If there is any obvious damage, report it immediately to the dealer or carrier. If no damage is found, unpack the unit and inspect it for shipping damage. Again, in case of any damage, report it directly to the dealer or the carrier.

Environment: The MESTA UPS is designed to be used in an environment with a temperature range of 0 to 40 degrees C and relative humidity of 0 to 95%, without condensation. The site should not be excessively dusty or dirty. If the site is excessively dusty or dirty, contact the manufacturer about the possibility of adding external air filters to the front of the unit to filter the intake air to the UPS. If excessive dirt is allowed to enter the unit, the fans and/or heat sink fins could become clogged with dirt, thus requiring excessive maintenance. Clearances should be provided to the top, front and back of the unit so as not to block air inlets and outlets, or rear mounted connectors. Also, keep the top of the unit clear of objects.

Customer-Supplied Wiring

Figure 2 Isolation Transformer



External on-site wiring to supply the UPS must be provided by the customer (See Figure 3). If a Wye service feed is available having the same voltage characteristics as the UPS (e.g. 208/120Y for most systems), a service feed breaker (see Table 1 for ratings) must be installed to protect the internal UPS transfer switch when the UPS is in the "Bypass" mode of operation. If some other voltage configuration, such as a delta feed and/or different voltage, is only available, an isolation transformer (such as one supplied by Mesta Electronics shown in Figure 2) along with a service feed breaker is required. Refer to Table 1 for wire, breaker and transformer ratings for alternative configurations having either 480 or 240 volt service feed available. View A of Figure 3 shows wiring for such an arrangement.

Figure 3 UPS External Wiring

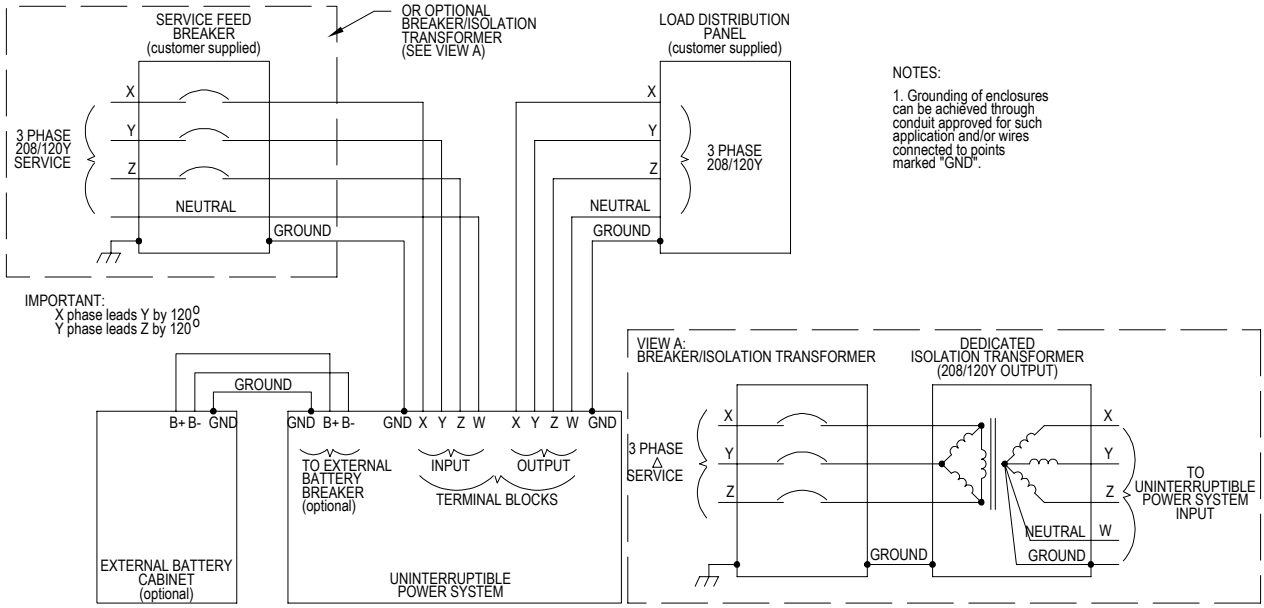


Table 1 Customer Site Breaker & Wiring Requirements

UPS Rating	Rating of Optional Isolation Transformer	480V Input Wiring/ Breaker Amperage (to transformer)	240V Input Wiring/ Breaker Amperage (to transformer)	208/120Y V Input Wiring/Breaker Amperage (to UPS)	208V Output Wiring Amperage (to Distribution Panel)
10KVA	15KVA	20	40	50	50
15KVA	25KVA	30	60	70	70
20KVA	25KVA	40	80	90	90
25KVA	30KVA	45	90	100	100
30KVA	40KVA	60	110	125	125
50KVA	60KVA	90	180	200	200

Table 2 AC Input & Load Wire Size and Torque Requirements

UPS Size	Tool	Allowable wire size	Torque (in-lbs.)	Torque (N-m)
10-30 KVA	3/16" Allen wrench	2/0 AWG – 8 AWG	120	14
50 KVA	5/16" Allen wrench	350 kcmil -6 AWG	275	31

Location of Unit: The UPS should be in close proximity to the protected equipment: the longer the AC wire runs, the more voltage drop and more risk of noise getting back into the system.

Voltage/Power Rating: Make sure that the voltage and power rating match the available line voltage and load requirements. This can be done by comparing the input and output information printed on the rating plate of the UPS with your requirements.

Optional Isolation Transformer Wiring: The wiring instructions are included in the packet of information that accompanies the transformers. The transformer input has taps to adjust for various line voltages that have already been selected and set to the nominal position. If the incoming voltage, however, is other than nominal, other taps can be selected as indicated on the transformer panel. Wiring from the transformer to the UPS must be capable of handling the 208/120Y amperage shown in Table 1.

AC Line Input Wiring: Once the voltage and power ratings are verified as compatible with your setup, and the proper location for the unit has been selected and the unit properly secured there, the UPS is now ready to be wired for AC input power.

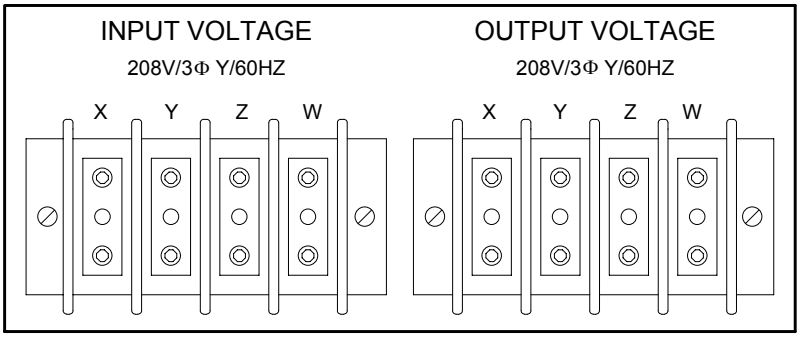
1. On the top of the UPS cabinet there are two pilot holes provided for the incoming and outgoing AC power. The qualified electrician can use the appropriate punch to prepare the cabinet for the type of conduit and connector he's going to be using on-site. Drilling or filing should be avoided, as any metal particles could interfere with the electrical/electronic equipment.

Once the proper wiring is in place (selected to meet current requirements given in Table 1 and within the size range given in Table 2), the input wiring can be connected to the leftmost terminal block marked "INPUT VOLTAGE" on the upper right side of the cabinet. An Allen wrench should be used to torque the lugs to the specifications given in Table 2. The X, Y, and Z phase wires (where X-phase leads Y-phase which in-turn leads the Z-phase, all by 120 degrees) must be connected to the correspondingly marked INPUT VOLTAGE terminals. The neutral wire must be connected to the INPUT VOLTAGE terminal marked W. Additionally, the AC phases are identified internally with tape as follows: X phase is unmarked, Y phase is marked with red tape, Z phase is marked with blue tape, and W phase is marked with white tape. Note that white tape is also used to identify the "+" wiring of the batteries on the left side of the UPS. This battery wiring marked with white tape on the left side of the UPS should not be confused with the neutral AC wiring marked with white tape on the right side of the UPS. If the phase relationship of the input wires is not known, they can be randomly connected to the X, Y, and Z INPUT VOLTAGE terminals, as long as the neutral wire is

connected to the W terminal. If the phase relationship is incorrect (see BAD ROTATION below), the problem is easily corrected by swapping any two of the X, Y, and Z wires. Refer to Figure 3, UPS External Wiring, and Figure 4, AC Wiring Terminal Block.

2. A copper lug marked “GND” is supplied on the upper right side of the UPS for the purpose of grounding the cabinet to earth ground. This lug will accommodate wiring between 8 and 2 AWG for units up to and including 30 KVA, and wiring between 8 and 1/0 AWG for systems above 30 KVA. A wire size that meets local electrical codes must be selected and may be routed with the AC supply wiring to the service distribution panel earth ground. Alternatively, a hole can be drilled and tapped on the backside of the cabinet frame (not the panel), near the bottom to provide an external chassis ground. Care should be taken so that metal particles produced by such operation are not allowed to come in contact with any internal electrical components.
3. If the proper rotation has not been selected, the UPS, when turned "ON", will indicate that the incorrect rotation has been chosen. The LCD Display #1 or #2 screens will indicate "AC LINE PROBLEM" on the bottom line, and the status line will read "BAD ROTATION." In this case the electrician will be required to swap two of the X, Y, and Z wires in the UPS input to obtain the correct rotation. **Note:** In addition to checking for proper phase rotation, the UPS will also examine the phase of each leg and the angle between phases. The LCD screen will indicate any problems detected.

Figure 4 AC Wiring Terminal Block



Connecting the Load: Wire the UPS “OUTPUT VOLTAGE” terminals to the load distribution panel, making sure that all loads are off (Refer to Figure 3, UPS External Wiring and Figure 4, AC Wiring Terminal Block). Terminals marked X, Y, and Z refer to the three phases where the X-phase leads the Y-phase which in-turn leads the Z-phase, all by 120 degrees. The W terminal is again the neutral of the 3-phase Wye output. Internal wiring to this terminal block is marked with red (Y-phase), blue (Z-phase), and white (neutral) tape. Refer to Table 1 for current carrying capabilities that this wiring must have and Table 2 for allowable wire size. An Allen wrench should be used to torque the lugs to the specifications given in Table 2.

External Battery Cabinet: If an external battery cabinet is supplied with the UPS system, then an additional DC breaker marked “EXTERNAL BATTERY BREAKER” or “BATTERY BREAKER” will also be supplied on the left side of the UPS cabinet. A qualified electrician can find the pilot hole for the External Battery Cabinet wiring just above this breaker in the UPS cabinet. In the same manner as described for the AC wiring, the electrician would establish the proper punch, install the proper conduit and wiring, and bring the two external battery wires to the External Battery Breaker. See ADDING AUXILIARY BATTERY CABINETS.

WARNING

Extreme caution must again be exercised so that the polarity of the batteries is preserved as it is presented to the breaker. The "+" and "-" lugs on the breaker are indicated with "+" on the left and "-" on the right. The "+" wire will be marked with white tape. If this code is not carefully followed, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

Computer Terminal Connections: It is also suggested, but not required, that you connect a terminal or computer to the RS232 interface (see paragraph 2.2). Through this communications interface you can obtain the same useful data available from the front panel LCD screen, along with some additional diagnostic information.

Remote Status Panel Connections: If the UPS is to be located in a remote area away from personnel, an optional Remote Status Panel may be purchased that can be placed in a location that is observable by personnel. Through its wiring interface to the “RELAY CONTACTS” connector on the back of the UPS, this panel can alert personnel of any problems encountered by the UPS. Wiring instructions are included with the remote status panel.

Preparation for Turn-On: Having wired your UPS to the AC utility, to the load and to external batteries (if so equipped), check the wiring with a continuity meter or other means. You may now begin the Turn-On procedure. See the System Turn-on section of this manual.

2.1 ADDING AUXILIARY BATTERY CABINETS TO YOUR UPS SYSTEM

WARNING

Only qualified technicians or supervised personnel should attempt to connect/disconnect external battery cabinets to/from the UPS models covered by this manual. **ALL** of the following **WARNINGS** and **INSTRUCTIONS** should be read and fully understood prior to undertaking this task. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

If your system is configured with internal batteries, additional battery cabinets may be added to your UPS to extend the backup time of your UPS. If the UPS cabinet does not have internal batteries, than at least one battery cabinet must be incorporated into the UPS system to provide backup energy. It is recommended that only battery cabinets supplied by Mesta Electronics be added so that complete compatibility with your UPS can be guaranteed. Different manufacturers' battery cabinets may possibly be used, but their use should be cleared with Mesta before doing so. **CAUTION** - not checking other battery cabinets with Mesta Electronics may result in serious damage to the UPS and will nullify warranty and UL compliance.

WARNING

Risk of ***Electric Shock***. Do not attempt to connect/disconnect external battery cabinets to/from the UPS unless the UPS external battery breaker and all external battery cabinet breakers are OFF. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

WARNING

Risk of ***Electric Shock*** and ***Fire***. The battery circuit is grounded at the UPS. Do not attempt to additionally ground the battery circuit. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

Before any work is begun on a Mesta External Battery Cabinet, refer to Chapter 9, “External Battery Cabinets”, of this manual for complete instructions and detailed wiring diagrams.

2.2 COMMUNICATIONS LINKS (Rear Panel Hardware Configuration)

The communication hardware connectors on the back panel of the UPS consist of a 25-pin for RS232 compatible or current loop serial communications, a 15-pin for custom I/O, and either a 25-pin for 6 signal level relays or a 12-pin for 4 power relay contacts.

- The serial communications connector provides a means for monitoring and/or controlling the UPS remotely from a computer or terminal via RS232 signaling or 25 ma current loop methods. Two LEDs on the panel just above the RS232 connector are used to diagnostically indicate current flow through the TRANSMIT/RECEIVE portions of the 25 ma current loop communications link if the serial communications is configured in this manner. (Note: current loop is a method of interconnecting terminals and transmitting signals whereby a mark (binary 1) is represented by current on the line, and a space (binary 0) is represented by the absence of current.)
- The custom I/O connector allows for 4 standard dry contact inputs. If a dry contact is used to short pins 1 and 2 of this connector, the UPS will shut down and trip its own breakers. This is referred to as a remote shutdown and is used by fire protection or other safety equipment to turn off the UPS in the event of an emergency. (The remote shutdown is an optional feature. Please contact the factory for activation of this function.) A dry contact across pins 3 and 4 results in an audible alarm reset in the remote status panel should "mode 1" be employed to control the status relays. Pins 14 and 15 provide -12V and +12V supply power to a remote status panel or custom setup. Other pins can be customized for specific requirements of the end user of this equipment.
- The relay contacts connectors have dry contact outputs that can be used by the UPS to control external equipment. The most frequent use is with a remote status panel, where these contacts are used to control the lights and audible alarm on the panel. Your UPS will come with one of two types of relay contacts. If your UPS has a 25 pin connector for relay contacts, your unit is equipped with six low level 24V, 0.1 amp maximum, contacts. If your UPS has a 12 pin connector for relay contacts, your unit is equipped with four power 120VAC, 10 amp maximum contacts.

Figure 5 Rear Panel Hardware Configuration

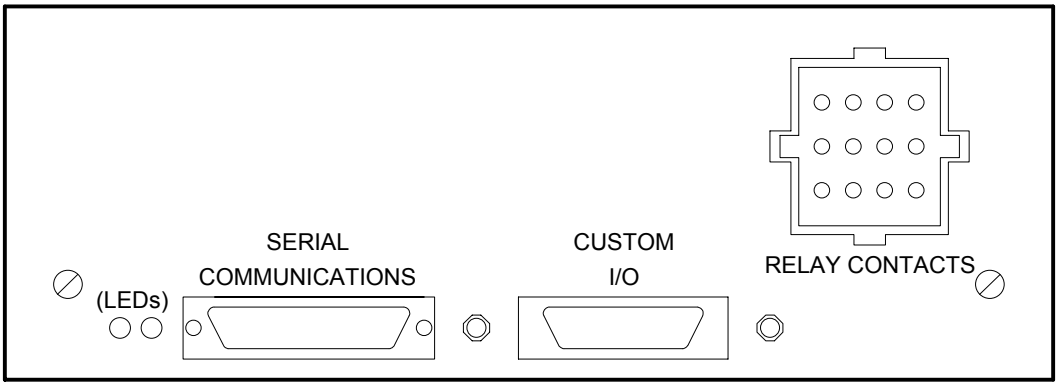


Table 3 RS232 Technical Specification Summary

CONNECTOR:	25 pin D female
FORMAT:	ASCII, 1 start bit(0), 8 data bits, 1 stop bit(1)
BAUD RATE:	1200
PARITY:	None
DUPLEX:	Full
PROTOCOL:	None used. Interface is simple 3 wire (RXDATA, TXDATA, and GND) with no hardware or software handshaking.

MESTA SERIAL COMMUNICATIONS:

"DTE" CONNECTOR

SIGNAL	PIN
TX	2
RX	3
GND	7

25 pin connector

<100 feet

IBM PCAT COMPATIBLE COMPUTER

PIN	SIGNAL
2	RX
3	TX
5	GND

9 pin connector

CURRENT LOOP COMMUNICATIONS:

SIGNAL	PIN
ILTXRET	14
ILTXSRC	7
ILRXRET	12
ILRXSRC	11

25 pins

<1 mile

ISOLATED CURRENT LOOP RECEIVER

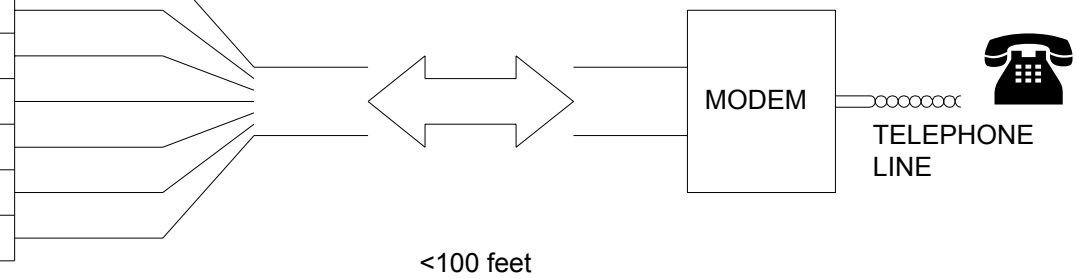
ISOLATED CURRENT LOOP TRANSMITTER

PC

MODEM COMMUNICATION:

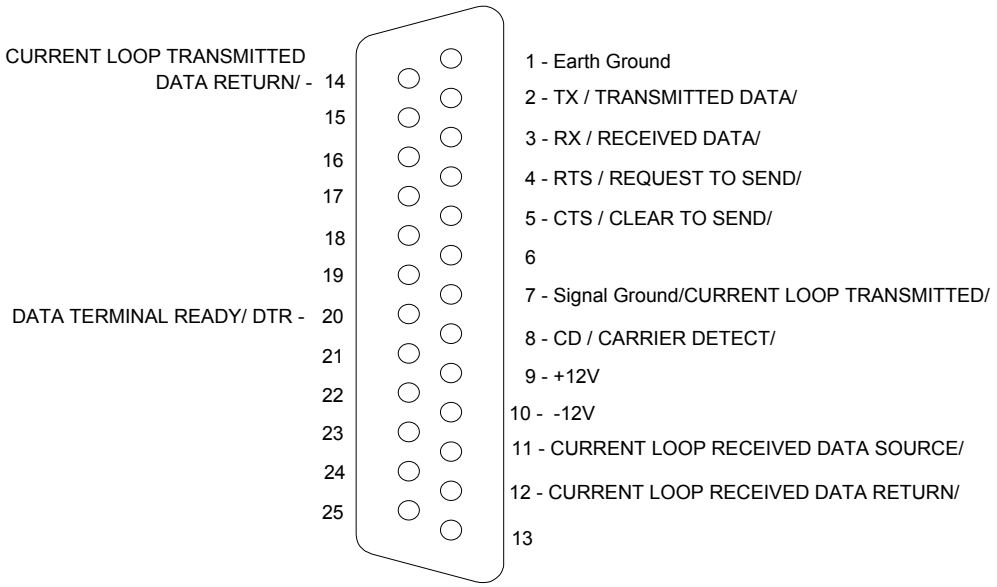
"DTE" CONNECTOR

SIGNAL	PIN
TXD	2
RXD	3
SIG GND	7
RTS	4
CTS	5
DTR	20
CD	8

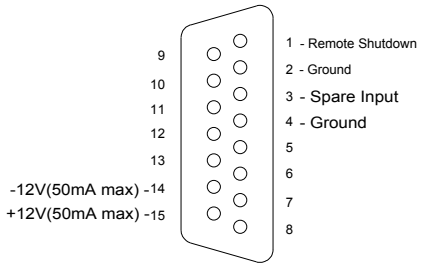


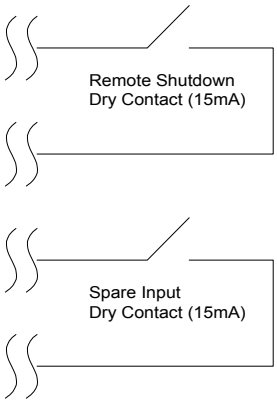
<100 feet

"DTE" CONNECTOR (female - as seen on back panel)**:**

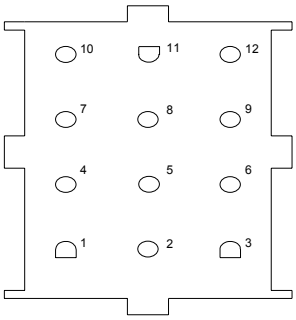


"CUSTOM I/O" CONNECTOR:





LARGE RELAY CONTACTS:



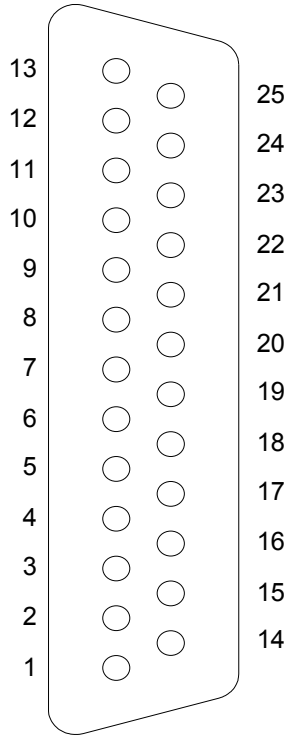
Purchase mating AMP socket 1-480708-0 with suitable pins

RELAY	CONTACTS		
	NC	C	NO
1	3	2	1
2	6	5	4
3	9	8	7
4	12	11	10

NC - Normally closed contact
NO - Normally open contact
C - Common side of contact

Maximum rating of contacts = 120V/10A
See Appendix B for function of relay contacts.

SMALL RELAY CONTACTS:



RELAY	CONTACTS		
	NC	C	NO
1	13	25	12
2	11	23	10
3	9	21	8
4	7	19	6
5	5	17	4
6	3	15	2

: Optional Configuration Available from factory
NC - Normally closed contact
NO - Normally open contact
C - Common side of contact

Maximum rating of contacts = 24V/0.1 Amp
See Appendix B for function of relay contacts.

3. SYSTEM DESCRIPTION

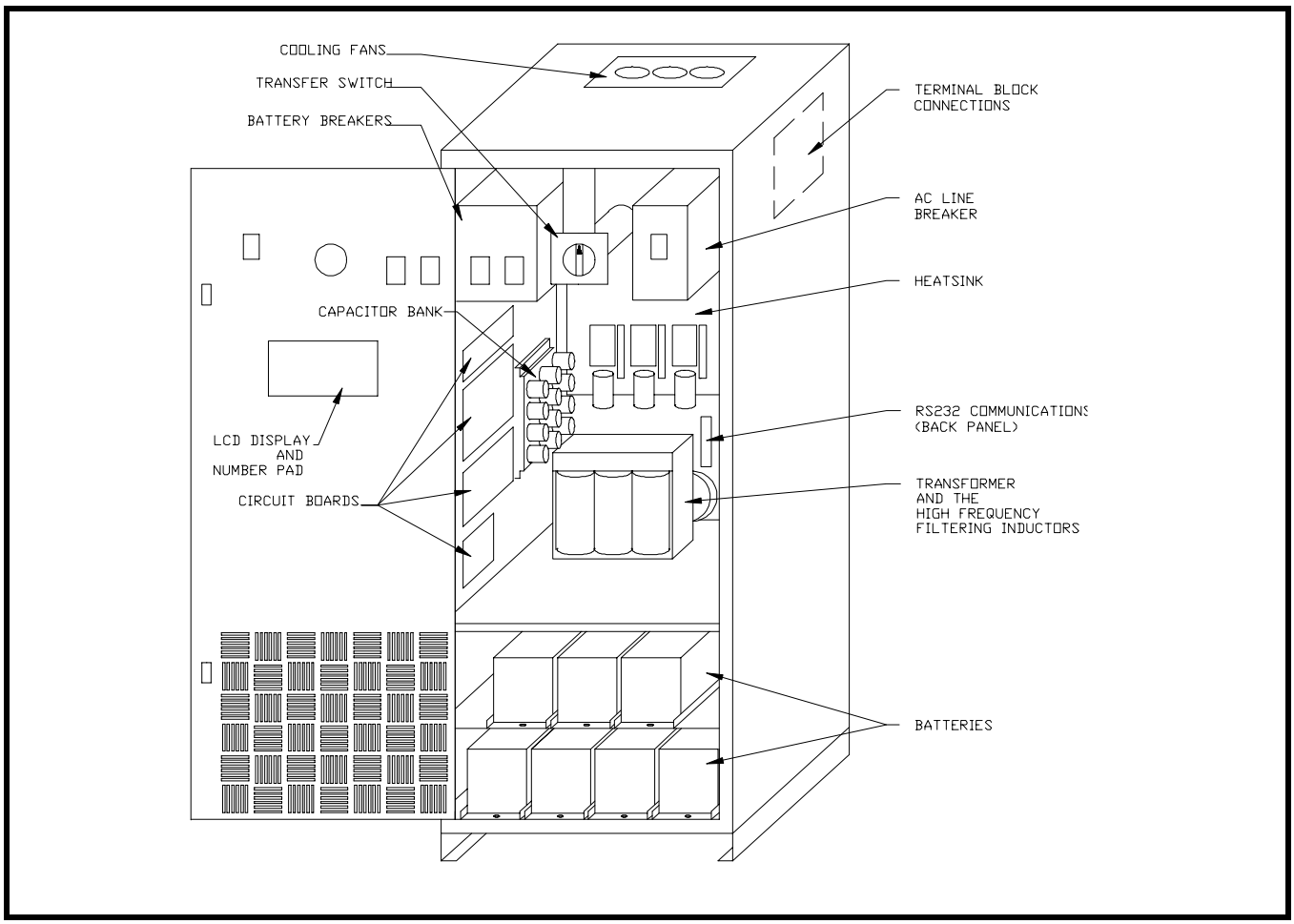
This section points out the main components of the Uninterruptible Power System and discusses the theory of operation of the unit.

3.1 PRINCIPAL COMPONENTS

The principal components in the Mesta Electronics UPS system are identified in Figure 6. On the front panel, the 16 key keypad and the LCD readout are found, along with two locks for securing access to the system. Accessible from the front panel, when the door is closed, are the power controls: two battery breakers (Main Battery and optional External Battery), rotating transfer switch, and AC line breaker. On the back of the cabinet are the communications I/O connectors: serial communications port, custom I/O port and ports for dry relay contact outputs.

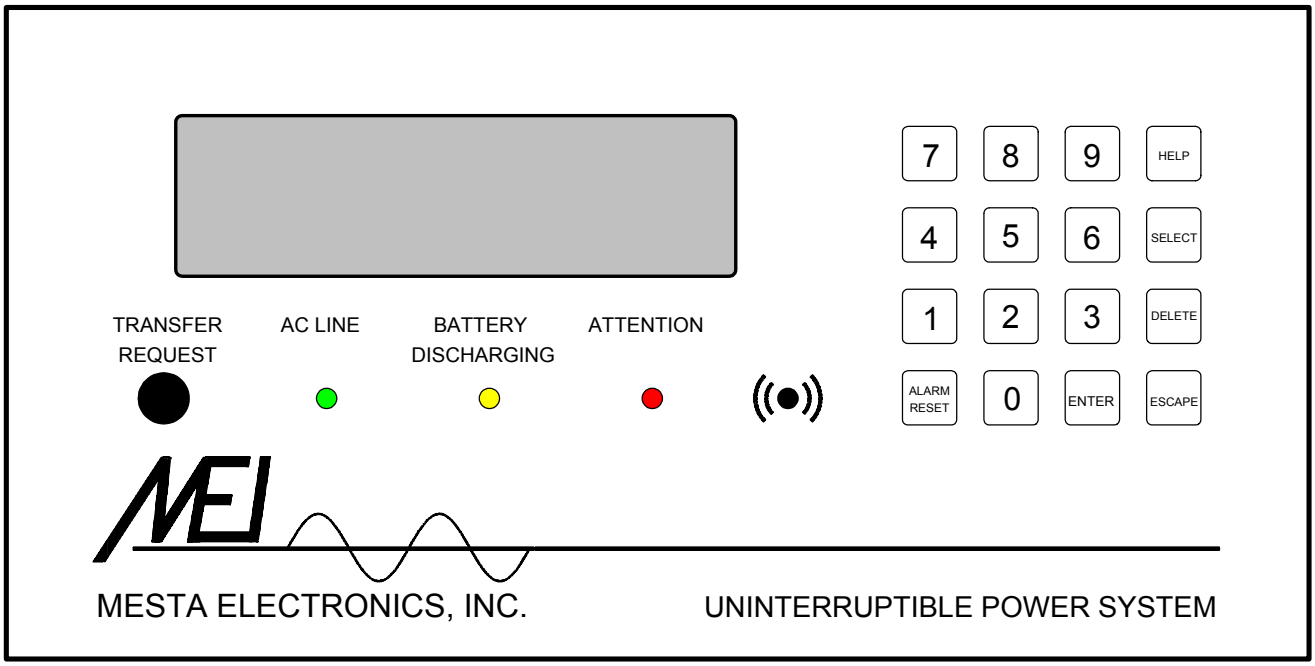
Other major components (from top to bottom) are: cooling fans, terminal block connectors, heat sinks with power semiconductors, circuit boards for controlling the system, capacitor bank, transformer and its high frequency filtering inductors, and battery shelves (size 1 cabinet with 20 batteries is shown). A size 1 cabinet with 18 batteries is similar except the bottom battery shelf has only 3 trays of batteries. A size 2 cabinet is also similar except the 20 battery system has 5 trays of batteries on each of the two shelves, while the 18 battery size 2 cabinet has 5 trays on one shelf and 4 trays on the other shelf. A size 3 cabinet does not contain any internal batteries.

Figure 6 Typical Location of Principal Components



Front Panel – The front panel (see illustration below) provides real time information about the system operation on the liquid crystal display (LCD) screen. The keypad enables the system operator to command the various functions and view a number of informational screens on the 8 line by 40 character LCD display. The TRANSFER REQUEST button is used to initiate a switch between the ON and BYPASS modes. Three lights indicate system status: the availability of AC power, if the batteries are discharging, and an indication that the UPS needs attention. An audible alarm has also been implemented to alert the operator to situations that need attention or the UPS batteries are discharging. The “TRANSFER REQUEST” push-button switch is used to initiate a transfer of the load to/from the UPS and the raw utility.

Figure 7 Front Panel Configuration



3.2 THEORY OF OPERATION

Mesta Electronics was the first to introduce the truly line interactive approach for UPS systems. This is the technique whereby the UPS maintains its output continuously phase locked and voltage equalized with the utility so that the critical load is normally supported by two sources.

The system's operation is as follows: the Mesta UPS’ inverter, when first powered on, converts battery power to AC for the critical load. If the utility voltage is available and within usable voltage and frequency limits, the UPS output is phase locked to the utility, and a solid state switch is activated to connect the output to the utility. At this time, both the utility and the inverter are driving the load, although the inverter output is reduced to slightly below the utility voltage. This enables all of the UPS output power to be derived from the utility while also providing charge current to the batteries through the inverter. Once the batteries are fully charged, the inverter voltage is adjusted closer to the utility voltage to reduce the charging current.

The inverter remains "ON" all of the time that the utility power supplies the load. If the utility power rises, dips, or totally disappears, the inverter will maintain the voltage to the critical load. The solid state switch connecting the UPS output to the utility line is a super-fast turn-off switching device which can be turned off within a microsecond. When the utility goes outside the acceptable voltage, frequency, or slew rate limits (as set for any given application), the switch is opened, thus disconnecting the utility and leaving the load to be powered by the inverter only.

Mesta's inverter uses a unique pulse-width-modulation (PWM) design that results in a sine wave output while being able to power non-linear loads without derating. The unit delivers 300% peak transient overload current (with or without the utility present) for any commonly occurring transient load conditions (such as load equipment being powered up). The unique current-limit used by Mesta even allows the UPS output to be short-circuited. Under a short-circuit or other heavy overload condition, the switch connecting the UPS output to the utility is turned off, and the inverter is current-limited to 300% of the UPS rated output for a specified period of time. If the overload persists beyond this period of time, the UPS electronically shuts down until reset by an operator via the front panel keypad/LCD display. During all such overloads no damage is sustained by the UPS or to any fuses or breakers in the UPS. The UPS will sustain overloads up to 150% rated load for 1 minute and overloads exceeding 150% rated for .34 seconds (10 and 15 KVA systems) or .17 seconds (20 through 30 KVA).

System Block Diagram - Figure 8 on the next page is a block diagram demonstrating the basic operation of the Mesta UPS system.

The heart of the system is the master control, which possesses a 16 bit, 16 MHz microcontroller. It continually monitors all of the important parameters such as input and output currents and voltages, temperatures, and input and output requirements. It instantly commands the inverter through the gate drives to generate a high quality sine wave output to the critical load.

The three phase inverter bridge consists of isolated power IGBT (insulated gate bipolar transistor) devices capable of operating at a high carrier frequency with minimal switching and "ON" losses. The voltage interface PC board receives the input, output and battery voltages and properly interfaces them with the master control.

The keypad and LCD, as well as the remote communication blocks, constitute and provide the means by which the user can communicate with the UPS. The LCD screen consists of an 8 line by 40 character display, making it possible for various instructions and diagnostic comments. The remote communications block consists of an isolated RS232 communications protocol for either a voltage or current loop interface. A number of status relay contacts are also provided.

The gate drives are optically isolated devices with both positive and negative supplies that properly drive the IGBT power devices on and off as commanded by the master. The LC filter reduces the high frequency harmonics produced by the inverter to the system transformer, and keeps them to a minimal component of the output voltage.

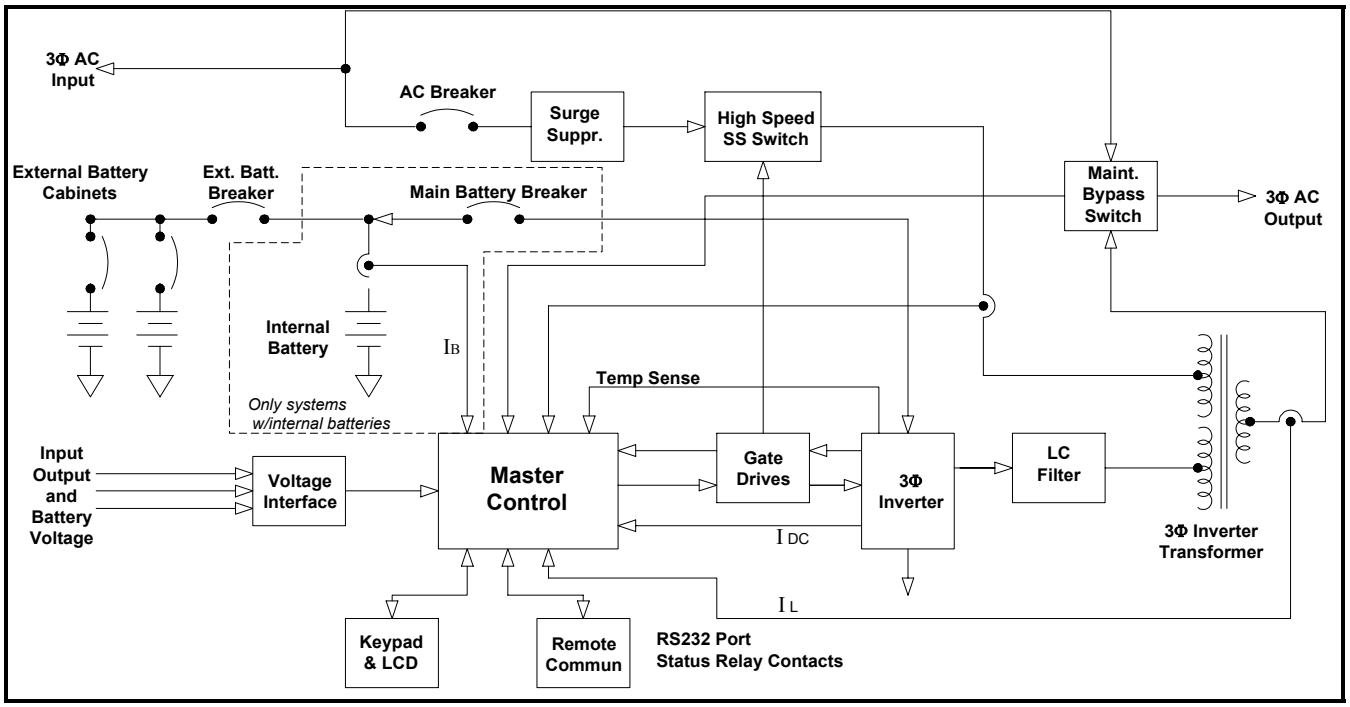
Surge suppression circuitry on the AC line input provides for input surge/spike protection as per IEEE C62.41-1980 (formerly IEEE 587) to protect the UPS and the load from being damaged by high voltage spikes that may occur on the utility feed. The high speed solid state switch is the block containing three IGBT modules along with proper protection which, when gated "ON", permits the utility to coexist with the inverter output.

The three phase system transformer has three isolated windings: the inverter, the AC input and AC output. Both the inverter and AC input windings are connected as a Delta while the output is connected in a Wye (Y) configuration.

The Transfer Switch permits the user to completely bypass the UPS. When the switch is in the "On Bypass" position, the load is driven directly by the utility; thus, the operator can shut the UPS down to perform maintenance. In order for the Transfer switch to go to or to leave the “On Bypass" position, the master controller must be consulted by pressing the transfer request button and following the instructions on the display. In fact, the Transfer Switch can not be turned unless the master control assures proper phase lock and voltage equalization between the inverter output and the utility.

The master controller monitors internal and external battery currents, which enables the microcontroller to determine: a) that the external batteries or battery breakers, if used, are functioning, and b) proper charging current is sent to the battery systems. The heat sink, inside ambient and room temperatures are monitored for the protection of the equipment itself.

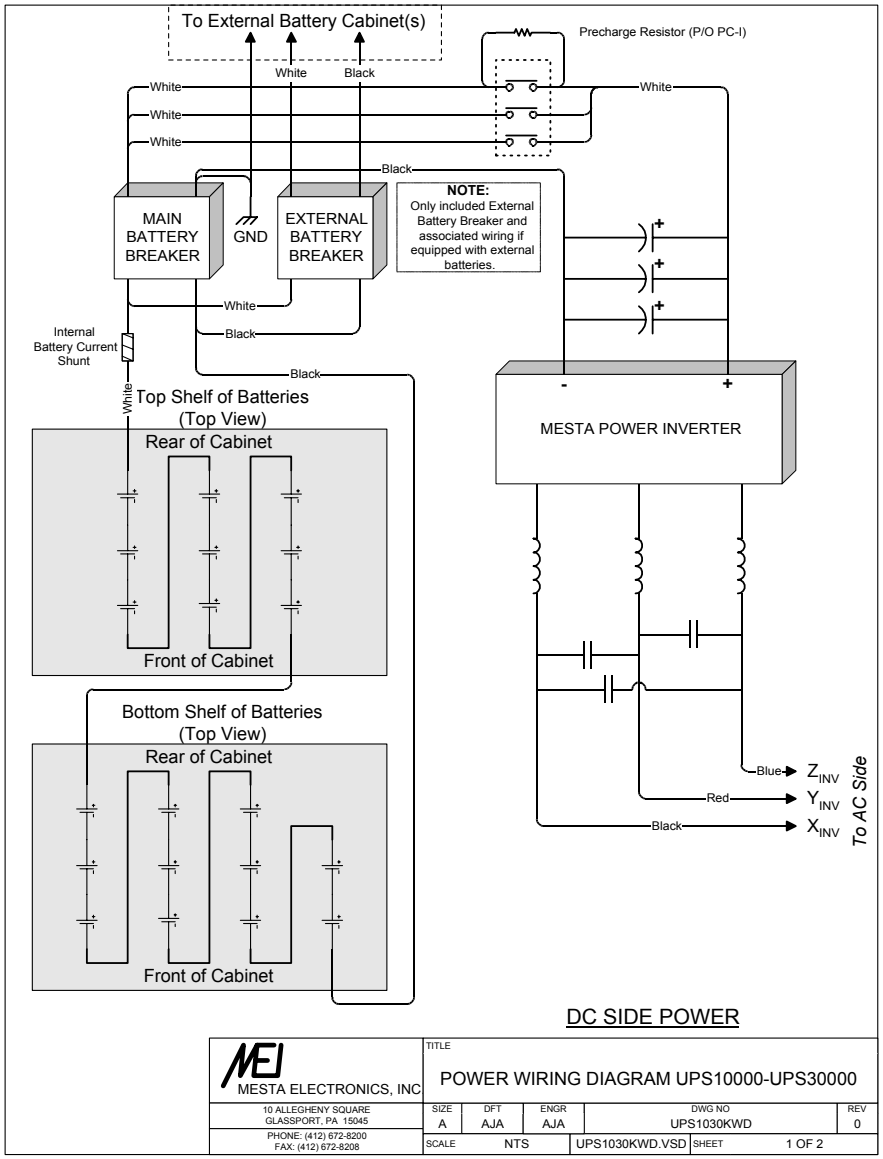
Figure 8 System Block Diagram



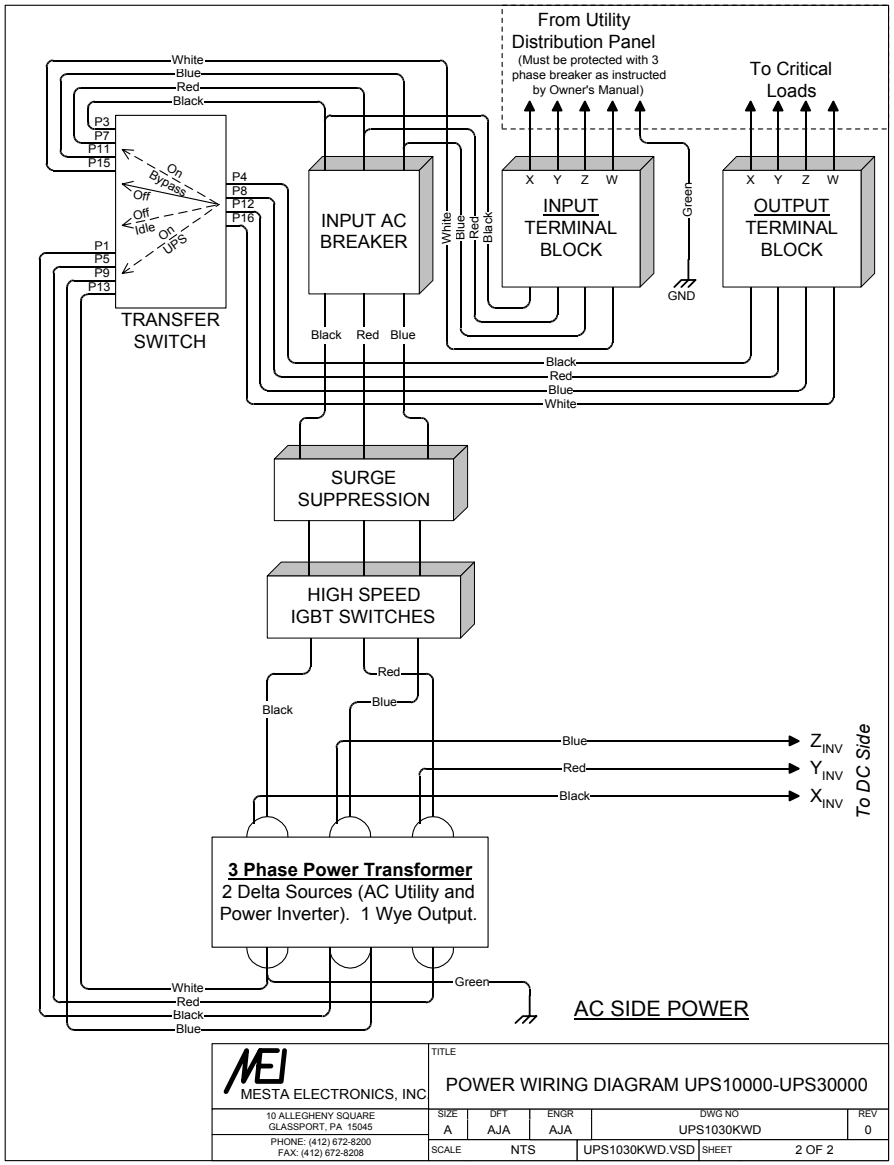
System Power Wiring Diagrams – The system power wiring diagrams are found in Figures 9A and 9B. These wiring diagrams are for a size 1, 20 battery UPS. Similar diagrams can be found posted on the inside of the door of the UPS. Figure 9A shows the wiring associated with the DC voltage circuitry whose major components consist of the internal batteries, DC breaker(s), DC Power contactor, inverter, and inverter output filtering. A size 1, 18 battery UPS has identical wiring, except the group of 2 batteries on the right side of the lower shelf does not exist. A size 2, 20 battery UPS also has identical wiring except the batteries are configured in groups of two because each tray has two 65 amp-hr batteries instead of three 38 amp-hr batteries. A size 2, 20 battery UPS has 10 trays of batteries, five trays on each shelf. A size 2, 18 battery UPS has 9 trays of batteries with 5 trays on one shelf and 4 trays on the other shelf. The AC voltage circuitry shown in Figure 9A is identical for all UPS sizes. It contains AC voltage circuitry whose main components consist of the AC input and output terminal blocks, AC breaker, transfer switch, input surge suppression, AC IGBT switches for switching on and off the input AC, and the 3-phase power transformer.

Figure 9 Power Wiring Diagrams

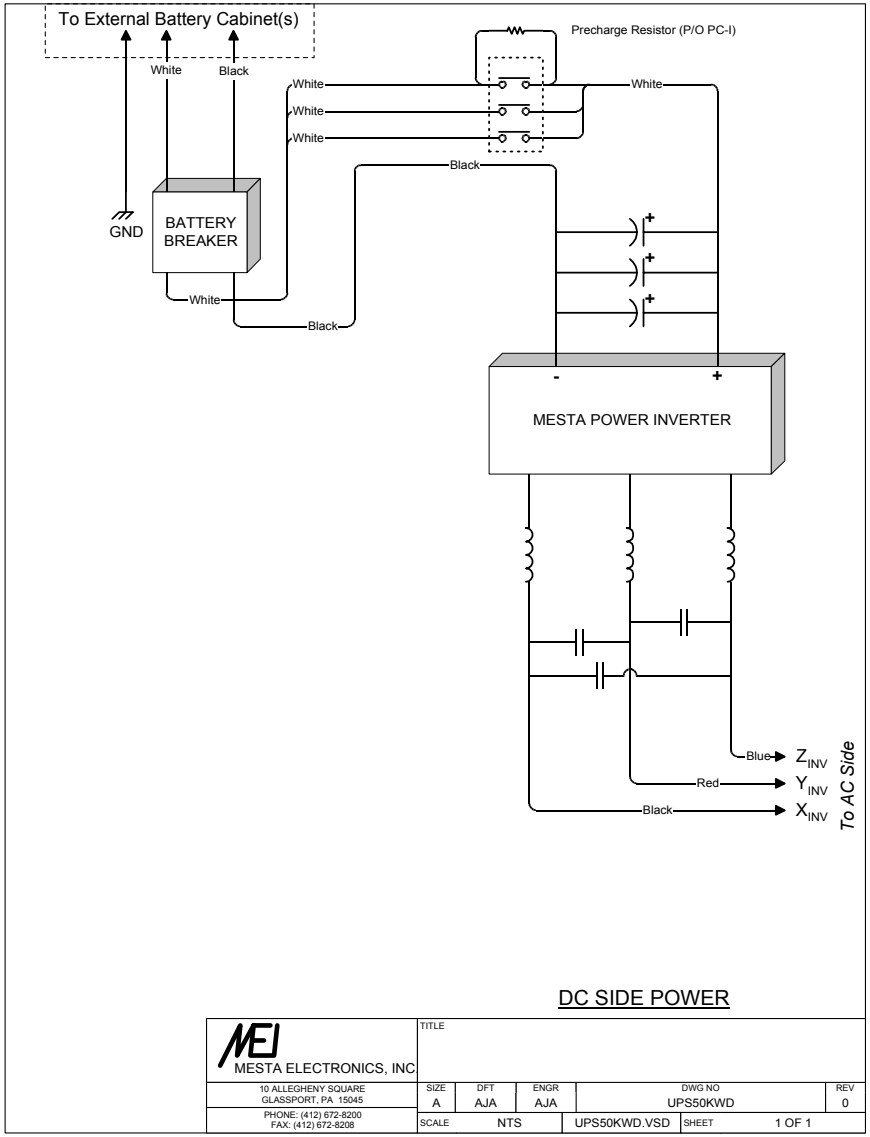
9a) DC Power Wiring w/ Internal Batteries



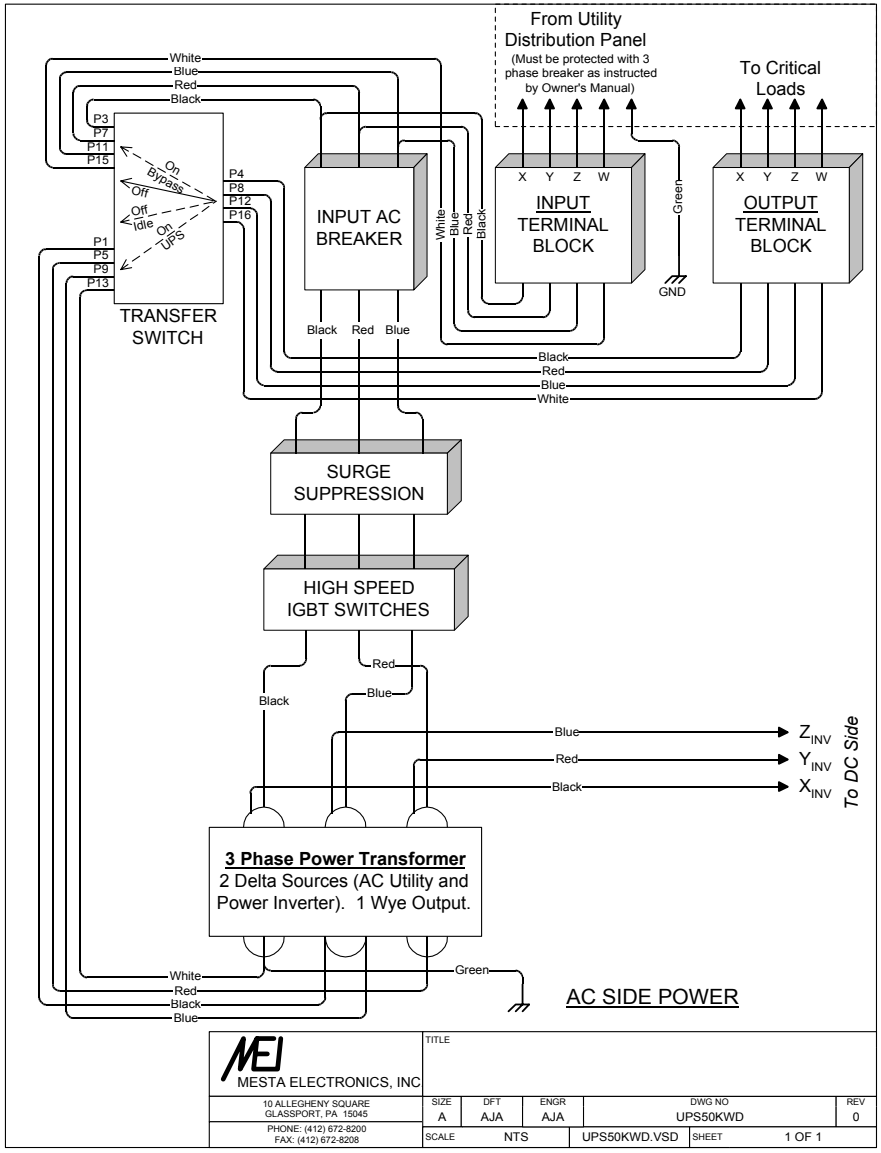
9b) AC Power Wiring w/ Internal Batteries



9c) DC Power Wiring w/o Internal Batteries



9d) AC Power Wiring w/o Internal Batteries



System Circuit Boards - The system circuit boards are shown in Figure 10. The circuitry represented here is primarily located on the left side of the UPS and consists of all PC-boards in the unit (except the IGBT drivers that are located on the heat sink) and power circuitry located in the same vicinity. The external battery breaker BR2 (included only in units requiring external battery cabinets) and the main battery breaker BR1 are shown in the top of this diagram. The switch next to these two breakers is a DC contactor. It is commanded by the microcontroller and is used for connecting the batteries to the inverter. Its physical location is in the top left of the cabinet, behind the battery breakers. Following is a list of the control PC-boards that appear in this figure:

PC-P: The PC-P board is the main power supply board. It takes the DC battery voltage to produce a +24VDC source via the use of a step-down chopper. This voltage source is used to energize various power components such as the DC contactor. It also supplies power to an onboard high frequency inverter, which produces a 20V/25kHz square wave. This square wave is used to power all of the PC-boards in the unit. Boards requiring power contain small, high frequency transformers that provide needed galvanic isolation between the circuitry on the board and the rest of the UPS system. The output of each transformer is rectified and regulated to the desired voltage levels needed by that board.

PC-L: The PC-L board is the logic power supply. This board generates the highly regulated and filtered $\pm$12V and +5V used to support the main control logic from the 20V/25kHz square wave power source.

PC-C: The PC-C board houses the UPS 16-bit microcontroller that controls the entire UPS operation. This board contains circuitry to condition all system signals that are monitored by the microcontroller as well as driver circuitry to allow the microcontroller to control all system components. The microcontroller's firmware is stored in two EPROMs (Erasable Programmable Read Only Memory), marked "H" and "L". These EPROMs contain the program executed by the microcontroller to control the UPS operation.

FP1: FP1 is the front panel mounted on the door of the UPS. It consists of the 8 line by 40 character liquid crystal display (LCD) and a small interface PC-board PC-F. PC-F contains the three status lights (LEDs), the keypad interface and the audible alarm associated with the front panel.

PC-I: The PC-I board contains interface circuitry that convert high system voltages (DC and AC) to control level voltages that can be further processed by circuitry on the PC-C control board. It also contains precharging resistors, which are used to charge the large amount of capacitance of the inverter in a controlled manner when the UPS is powered up. Once this capacitance is charged to a voltage that is close to that of the batteries, the DC power contactor is closed to complete the connection between the batteries and the power inverter.

PC-R: The PC-R board provides the rear panel interfacing for the serial communications port, the custom I/O and the relay contacts. It is located on the rear panel of the unit.

PC-S: The final board shown is PC-S, which is the shunt board. It measures the current coming from the internal batteries using resistive shunt SH1. This board is only included in systems with internal batteries.

PC-X, PC-Y, PC-Z: These 3 identical PC boards are located on the heat sink and are not shown in Figure 10. They connect to PC-C through connectors P1, P2, and P3, respectively, of PC-C. These boards convert the IGBT control signals produced by PC-C to isolated gate signals needed to turn on and off the IGBT power devices. Each board controls three IGBTs: the two IGBTs in one of the three poles of the power inverter and one of the three AC line IGBT switches needed to connect/disconnect the UPS from the AC utility.

Figure 10 System Circuit Boards

Figure 10a) System with Internal Batteries

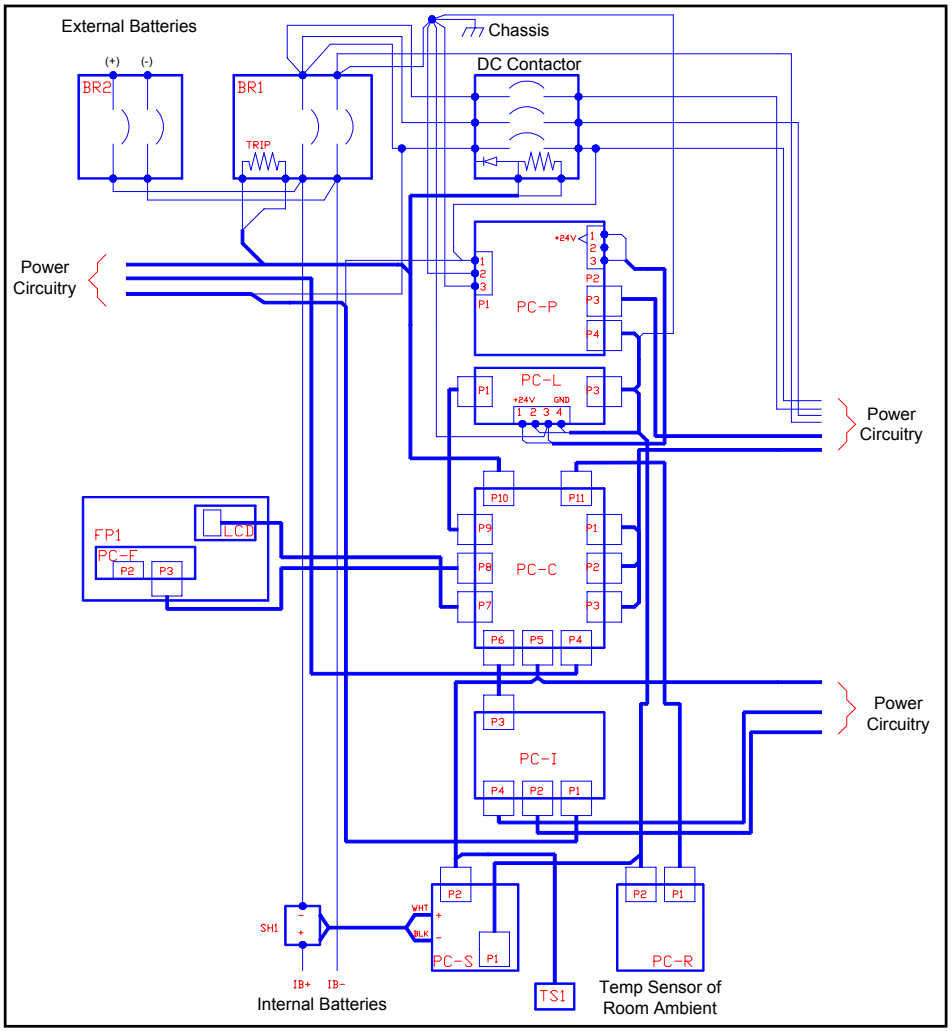
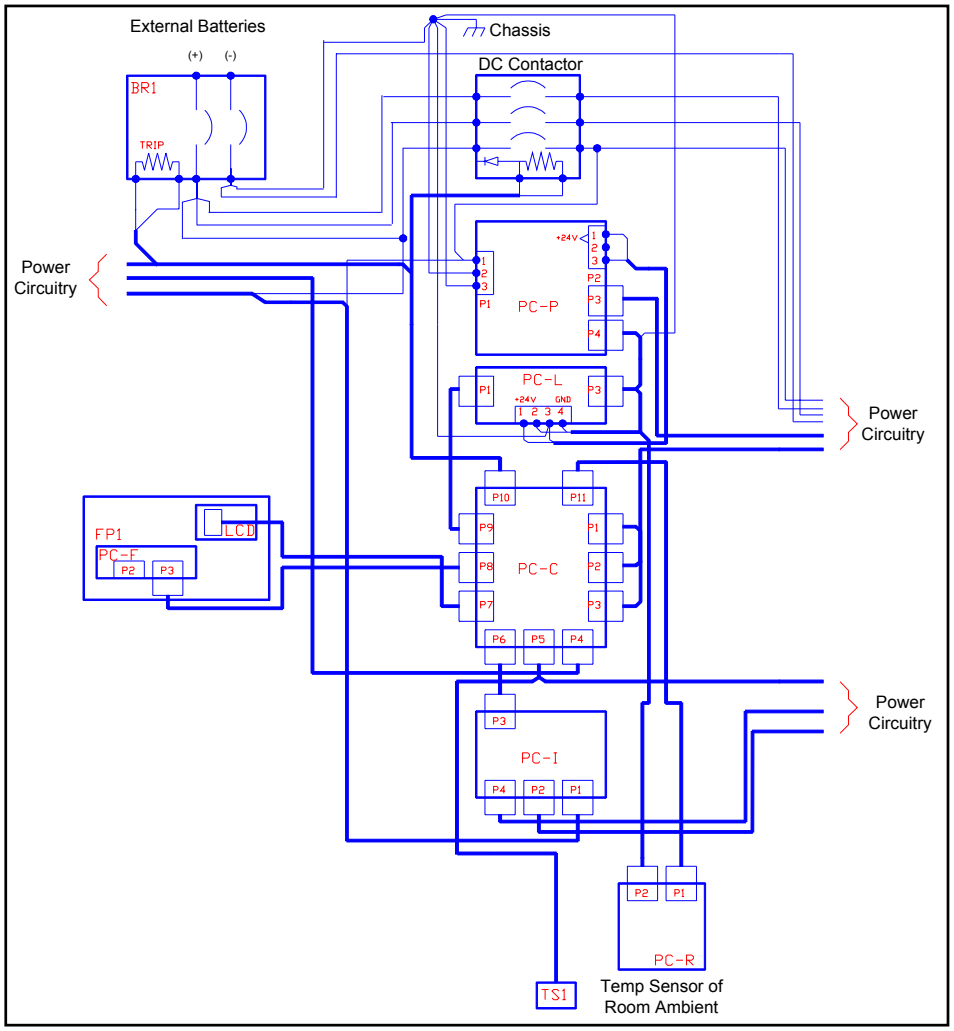


Figure 10b) System without Internal Batteries



4. OPERATING PROCEDURE

This section outlines the procedure to turn on and off your UPS and perform a transfer from UPS to Bypass and vice-versa. All of the power controls are conveniently located on the front of the UPS. The Main battery breaker controls the connection of the UPS to all batteries (internal or external). With this breaker off, no battery power will reach the electronics of the UPS. The External Battery Breaker (only present on systems with external battery cabinets) connects the external and internal batteries in parallel. This breaker, along with the breaker in the external battery cabinets, must be ON in order for the external batteries to be utilized by the UPS. The AC Input Breaker connects the UPS to the AC utility, and it must be on for the UPS to derive its output power from the utility. All of these breakers must be on for the system to operate correctly.

The large rotary switch, called the Transfer Switch, is used to control the operating mode of the UPS. This switch has four positions. When in the OFF position, the UPS will not provide any output voltage and the internal control circuits and power circuits are off. When in the OFF IDLE position, the UPS will still not provide any output voltage, but all of the internal controls will operate while the internal power circuits are energized but are not functioning. The ON UPS is the normal operating position for the UPS. The UPS is fully operational when the switch is in this position. The load is protected and powered by the UPS while in the ON UPS position. The ON BYPASS position is used to connect the load directly to the AC utility. While in this position, the load is **not** protected or powered by the UPS. In fact the breakers on the front of the UPS can all be turned off, including the AC Input breaker, without affecting the operation of the load. However, should the switch be in this position when a utility failure occurs, the load would crash. If the UPS breakers are left on while in this ON BYPASS position, the UPS would continue to operate, but its output is disconnected from the load. This ON BYPASS position is provided so that maintenance can be performed on the UPS without interrupting power to the load or to allow the load to be powered directly from the utility should a failure occur in the UPS that prevents the UPS from providing power to the load. When maintenance on the UPS is complete, the load can be switched back from the AC utility to the UPS without interruption of power to the load.

The front panel LCD display and keypad are very powerful diagnostic tools that can be used by the operator to detect problems both internal and external to the UPS. This 8 line by 40 character display, informs the operator in English of all normal and abnormal conditions seen by the UPS. Should a problem develop, the operator can quickly determine the cause using the information displayed. Many problems are caused by faults outside the UPS such as overloads due to the load being too large or not evenly distributed among the 3 output phases or due to a failure of a load. Also, AC line problems caused by other equipment connected to the same utility feed pulling large inrush currents can occur. The LCD display provides an abundant amount of information that allows the operator to detect and correct such external problems without the need of a more costly service call. Internal UPS problems are also more easily diagnosed and are, therefore, corrected much faster.

Besides providing the usual voltages, currents, etc., as well as very comprehensive diagnostic displays, your UPS has what is referred to as historical data storage. Historical data storage allows abnormal events such as AC line problems, overloads, and abnormal shutdowns to be saved in battery backed-up memory which keeps the data intact even when the UPS is shut off. The operator can look at this historical data either immediately, or at a later time, to determine exactly what problem the UPS encountered. This information can be invaluable in detecting one-time or sporadic problems with the load, AC line or UPS.

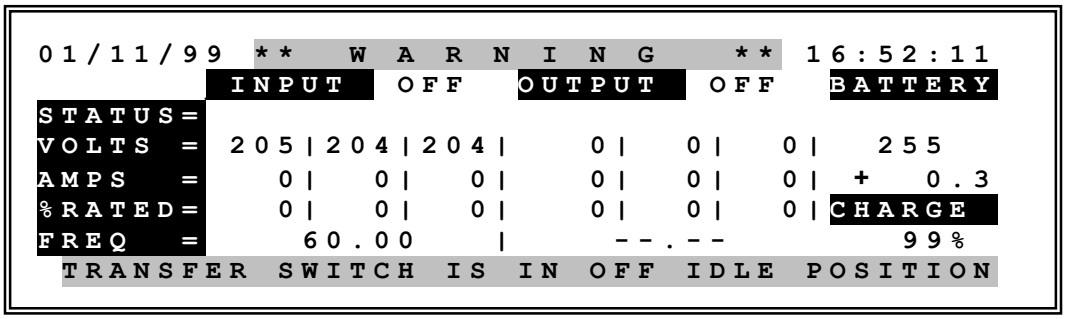
4.1 SYSTEM TURN-ON

Normally, the UPS can be switched on by simply turning on the main battery breaker and AC input breaker on the front of the UPS, and turning the rotary "transfer switch" clockwise from the OFF position to the OFF IDLE position and then to the ON UPS position (there is no need to stop at the OFF

IDLE position for any period of time). Make sure the breakers are not in the tripped position. If they are, turn the breakers all the way off, then turn them on. The breakers and transfer switch may be turned on in any order. Also, the loads may be either turned on or off when turning on the UPS -- the UPS doesn't care; however, the manufacturer of your load equipment may require a power-up sequence with your equipment. After turning on the UPS, an LCD display, similar to that shown in step 6 below, will appear. If this is the first time you are turning on the UPS following installation, you should follow the following turn-on procedure to become familiar with the operation of the UPS and to check your wiring and loads:

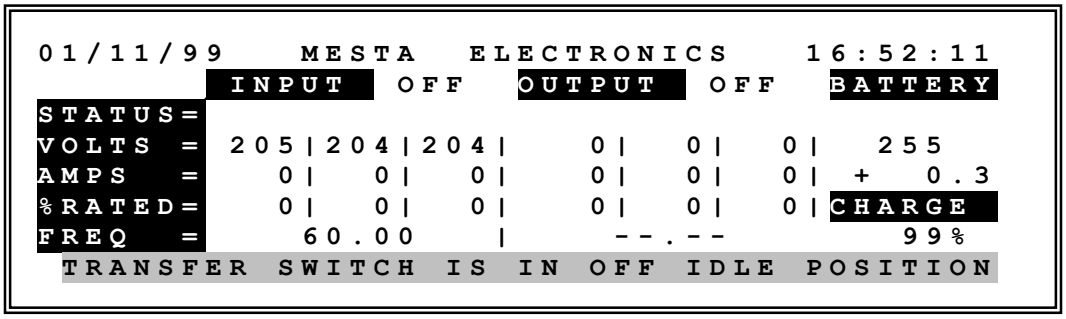
1. With the UPS' AC breaker off and all loads turned off, turn on the AC utility feed to the UPS, turn on the battery breaker(s) on the UPS and on all external battery cabinets. Turn the Transfer Switch clockwise one position to the OFF IDLE position. After a few seconds, the UPS system logic will turn on all three lights on the front panel, and the audible alarm will beep twice, then go silent. The three lights will stay lit for about 10 seconds. At the end of this 10 seconds, the audible alarm will emit a steady tone for about 3 seconds and the lights will start flashing in unison. During this startup, the LCD screen will indicate a "Warning" exists. The only warning that should exist at this time is one indicating that the AC breaker is open. If any other display than the Warning Alarm display appears, you probably have a problem, or the AC breaker is not off.

2. Press the Alarm Reset button on the front panel keypad to acknowledge that you've seen the warning. The main status display (display #1) should appear similar to the example that follows:



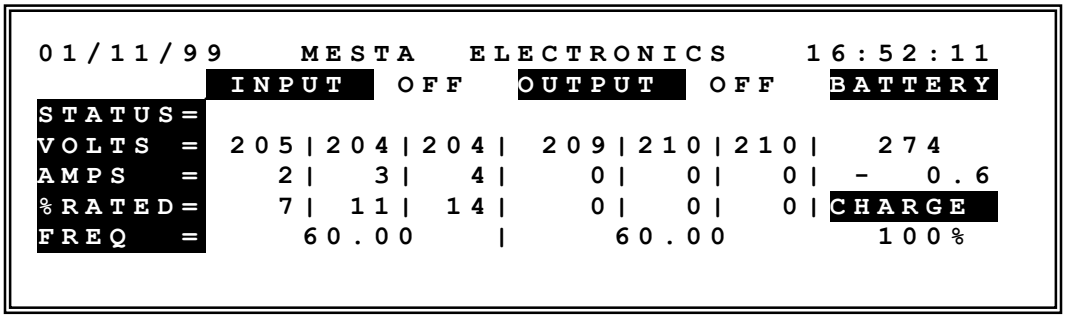
The message "** WARNING **" will be flashing at the top of the display in place of the "MESTA ELECTRONICS" that is normally displayed. This informs you that a warning still exists, which in this case is caused by the AC breaker being open. INPUT should display OFF indicating the AC line is not being utilized. INPUT STATUS will be blank unless there is a problem with the AC utility (such as low voltage because an external breaker feeding the AC to the UPS is open or a phase rotation problem exists). The UPS is able to display the AC line voltage and frequency even though the AC line breaker on the UPS is off because the UPS monitors the AC line both before and after this breaker. OUTPUT STATUS will display OFF (flashing) indicating that the UPS is not producing any output to the load. At the bottom of the display, the message TRANSFER SWITCH IS IN OFF IDLE POSITION will be flashing, indicating the reason why the UPS is not operating correctly.

3. If the AC line status is blank, indicating no problems with the AC utility, proceed to turn on the input AC breaker. This will cause the warning to disappear, but the UPS still won't run, because the transfer switch is still in the OFF IDLE position. All three lights are still flashing. The screen should now appear similar to the example that follows:



This screen shows that there is no input or output taking place yet, because the UPS logic has not allowed any connections to occur. The AC line voltages are being read, because they are available, but there is no current flowing.

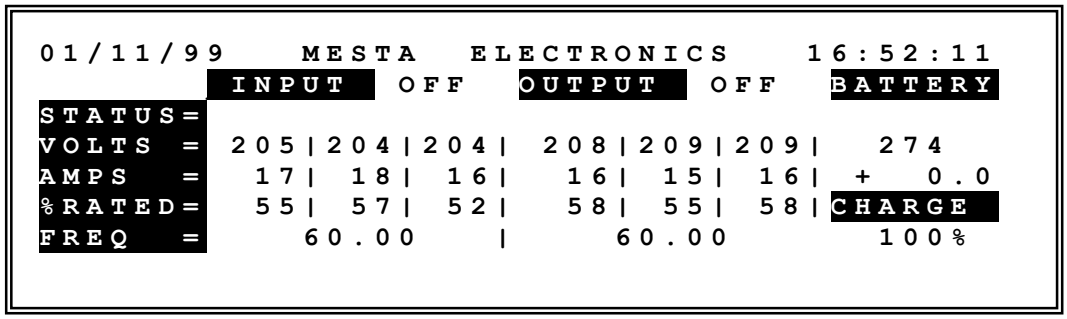
4. Rotate the Transfer Switch clockwise 1/4 of a turn to the "ON UPS" position. The AC line green light should come on steady, indicating that the UPS is able to derive power from the AC utility. The Battery discharging and Attention lights should go off. The main screen should show normal operation, although no load may be indicated, provided the external loads are not yet turned on. Normal operation is best indicated by the fact that no flashing messages are present on the display.



5. Before the load is turned "ON," consult the LCD screen to confirm that the proper voltages are present.

6. Assuming that normal operation was observed, you can now turn ON your load. If during this procedure the LCD screen displays an overload warning, your load is too large for the UPS, and some must be removed or the UPS will shut down. Short duration overloads that are a result of inrush currents in your load equipment being turned on could cause momentary overload conditions. Such a condition may not be a cause for alarm. The LCD screen will indicate any problems detected.

Once the loads are turned ON, a typical screen will appear as:



Fault Checking: Once the UPS is turned "ON", the system logic will normally indicate any faults affecting the operation of the equipment. Generally these would be:

1) If at any time the INPUT STATUS is flashing a message, regardless of whether the AC LINE breaker of the UPS is on or off, there is a problem with the voltage coming from the utility. If the flashing message is BAD ROTATION, you have incorrectly connected the utility to the INPUT VOLTAGE terminal block of the UPS. To obtain the correct phasing, you must swap two of the three phase wires (X, Y, and Z) at the block of the UPS or at the service breaker feeding the UPS. Refer to the Installation section of this manual to perform this change (note: you will have to completely power down the UPS and turn off all UPS breakers and the AC service feed breaker to perform this task).

2) If after turning the front rotary switch to the ON UPS position, the BATTERY DISCHARGING light does not go off, check the LCD display for reasons. If the bottom line flashes AC LINE PROBLEM, the INPUT STATUS line will flash reason for the AC line problem. If another message is displayed, refer to the Troubleshooting section of this manual for further information.

3) Any other problems encountered may either be caused by skipping a step, or a malfunction in the UPS. Please check your procedure before calling the factory for assistance.

4.2 TRANSFERING BETWEEN "ON UPS" AND "ON BYPASS" MODES OF OPERATION

Your UPS is equipped with a bypass feature that allows you to manually connect your critical load directly to the utility instead of powering your load from the UPS. This feature allows maintenance to be performed on the UPS without interrupting your load. You can switch to the ON BYPASS position, then turn off the UPS via its AC line and battery breakers. When maintenance on the UPS has been completed, the breakers on the UPS are turned back on, and the load is switched back to the UPS without interruption. These transfers are make-before-break, which means there is absolutely no interruption of power to the load. When changing from ON UPS to ON BYPASS or vice versa, a "Transfer Request" must be made by pressing the TRANSFER REQUEST button on the front panel. The UPS must know when a transfer is to take place in order to assure that a seamless transfer is performed. The transfer switch has an interlock that disables the switch from being turned between the ON UPS and ON BYPASS positions when such a transfer cannot be performed seamlessly. However, do not rely entirely on this interlock from stopping an unapproved transfer. Read the directions on the LCD transfer request screen to determine when the switch may be turned.

When the TRANSFER REQUEST button is pressed, the LCD screen will inform you of the type of transfer from UPS to BYPASS or BYPASS to UPS that is being attempted and whether or not such a transfer can be performed. If the transfer cannot be performed, the display will indicate the reason. For example, if the rotary switch is in the ON UPS position and the TRANSFER REQUEST button is

pressed, the display will indicate a UPS to BYPASS transfer has been requested. If the AC utility is not present at the time, the UPS will not allow such a transfer to take place, as doing so would switch the critical load to a non-existent utility, which would crash the critical load. If all conditions are OK for a transfer to take place, the LCD display will indicate so and ask you to press the ❶ key to proceed. After a few seconds after pressing the ❶ key, the LCD will instruct you to turn the transfer switch. You have a limited time to turn the switch (the LCD display will tell you how much time). If you fail to turn the switch in the designated time, the operation will be aborted and you will have to start the procedure over. Note that it is normal for the Battery Discharging front panel light to come on after you press the ❶ key and for the audible alarm to start beeping after 10 seconds. If you decide to continue with the transfer to ON BYPASS, the switch should be promptly turned to the ON BYPASS position. Once you turn the transfer switch, the UPS will issue a warning to tell you that you are in the Bypass mode of operation, which means your load is not protected from power outages on the AC line.

When you wish to go back from the ON BYPASS position to the ON UPS position, use this same procedure. The only difference is that the UPS will display that you are attempting to transfer from BYPASS to UPS and that you will be turning the switch counter-clockwise to the ON UPS position.

When performing a transfer between UPS and BYPASS or vice-versa make sure that you do not accidentally turn the switch in the wrong direction or turn the switch too far so as to enter the OFF or OFF IDLE positions. Doing so will cause the output from the UPS to shut off and your load to crash. The UPS must disconnect itself from the AC line and operate from batteries during a transfer. To conserve battery energy, promptly turn the switch as soon as possible after the LCD screen instructs you to turn the switch. DO NOT attempt subsequent transfers if the LCD screen says that a transfer is not possible due to low or bad batteries. If the LCD screen indicates a transfer is not possible you may perform an interrupted transfer. Such a transfer will result in an interruption of voltage to the load; therefore, all critical loads should be shut down in an orderly manner before attempting an interrupted transfer. An interrupted transfer from ON UPS to ON BYPASS is accomplished by turning the transfer switch counter-clockwise to the OFF IDLE position, then to the OFF position, and then to the ON BYPASS position. An interrupted transfer from ON BYPASS to ON UPS is accomplished by turning the transfer switch clockwise from ON BYPASS to OFF to OFF IDLE and ON UPS positions. REMEMBER: DO NOT ATTEMPT AN **INTERRUPTED** TRANSFER UNLESS ALL CRITICAL LOADS ATTACHED TO THE UPS ARE ALREADY POWERED DOWN!

If the Transfer switch is in the ON UPS position, but the UPS is not producing an output to the load because of a fault condition, you will not be able to turn the switch clockwise to the ON BYPASS position. The only way to change to the ON BYPASS position when the UPS is not producing an output is to turn the switch counter-clockwise from ON UPS to OFF IDLE, to OFF, and finally to ON BYPASS.

4.3 SYSTEM TURN-OFF

Before you turn off your UPS, make sure that all critical loads are prepared for the loss of power. When you have confirmed this, turn the rotary transfer switch counter-clockwise to the OFF IDLE position and then to the OFF position. The UPS will immediately stop producing an output and a solid audible alarm will be produced to indicate the UPS has been shut down once the switch leaves the ON UPS position. Also, the LCD display will indicate a shutdown has occurred because of the transfer switch being switched to the OFF IDLE position. Once the transfer switch reaches the OFF position, the UPS controls will also shut down in about 5 to 10 seconds. You may also turn off the breakers on the front of the UPS, but this is unnecessary unless you plan to open the unit. If left in the OFF IDLE position, the controls of the UPS will continue to operate for about 2 hours (but the UPS power output will be off). At the end of this 2 hour period, the UPS will turn itself completely off by tripping the Main Battery and AC Input breakers automatically.

4.4 DIAGNOSING PROBLEMS

The three front panel lights along with the LCD display will indicate any problems that exist in the UPS. When the transfer switch is first turned from the OFF to the OFF IDLE position, the lights will all be lit as a lamp test. This lamp test will last for 10 seconds unless the transfer switch is rotated, prior to this time-out period, to the ON UPS position, in which case the lights will start operating normally. If you remain in the OFF IDLE position more than 10 seconds, the lights will change to flashing in unison, indicating the UPS output is off.

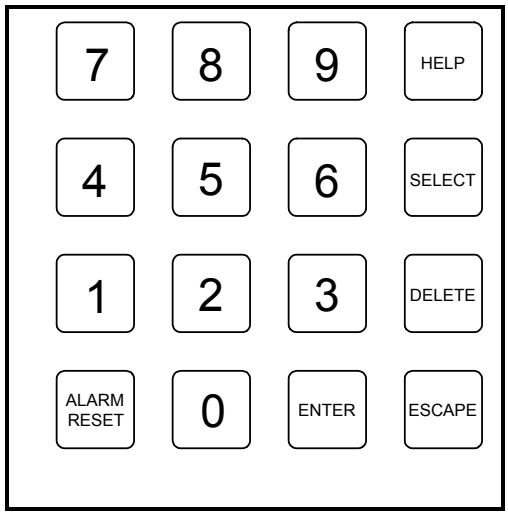
When the UPS is operating normally, the green AC LINE light will be lit and the other yellow and red lights will be off. If the utility is lost, the green AC LINE light will go off and the yellow BATTERY DISCHARGING light will come on indicating energy is being drawn from the batteries to supply the UPS electronics and the load. After this condition has existed for 10 seconds, the audible alarm will start to beep to warn the operator that the batteries are being discharged. The audible alarm can be silenced by pressing the ALARM RESET key on the keypad.

5. FRONT PANEL KEYPAD & LCD OPERATION

5.1 SYSTEM SOFTWARE COMMANDS (via the front panel)

The keypad on the front panel of the UPS can be used by the operator to select the information displayed on the LCD display, as well as to input various set-up parameters.

A. HELP key - Pressing this key will result in a "pop-up" display giving a short description of the functions of the buttons on this keypad. Pressing the ESCAPE key while in this display, will return you back to the display that you were on when you pressed the HELP key.



B. ALARM RESET key - Press this key to silence the audible alarm indicating either the battery is discharging or an alarm exists. If an alarm exists, the audible alarm will be accompanied by the LCD display indicating what the problem is. Pressing the ALARM RESET key will silence the audible alarm and the LCD display will revert back to its mode of operation prior to the alarm. There are four categories of alarms: Shutdown, Overload, Diagnostic, and Warning. It is possible for more than one of these categories to exist at a time. In such a case, pressing the ALARM RESET will display the second category of alarms, which will require a second pressing of the ALARM RESET button to silence the audible alarm and clear the alarm display. Note that pressing the ALARM RESET will not clear the problem, it will merely silence the audible alarm and clear the alarm display. You will notice if an alarm condition exists, display #1 and display #2 LCD displays will flash the category of alarm on the top line to remind you that an alarm exists. Also, the ATTENTION light on the front panel will remain lit.

C. DELETE key - If a wrong number key is pressed while entering numeric data using the keypad, the DELETE key may be pressed to delete the last number entered.

D. ENTER key - If satisfied with numeric data that has been entered, press the ENTER key for the UPS to accept your data and act upon it.

E. ESCAPE key - Press this key to navigate up from a sub-display or to cancel data entry. The ESCAPE key will continue stepping up the display structure until the top screen of the current level of operation is reached. To return to the main menu, the SELECT key can be pressed from any sub-display.

F. SELECT key - Press this key when you want to fully exit a particular display and enter a new display. The only types of display you can not exit by pressing this key is an ALARM display, which can only be exited by pressing the ALARM RESET key, and a HELP display which must be exited using the ESCAPE key. Pressing the SELECT key will result in the MAIN MENU being displayed, from which you can select a new display to observe.

5.2 LCD MAIN MENU DISPLAY

To change the type of information being currently displayed on the LCD display, you must get to the MAIN MENU display. To get to the MAIN MENU display, press the select key while in any display except a HELP or ALARM display. The following menu will appear on the LCD display:

```
01/11/99      MAIN MENU (1.16)      16:52:11
 1) DISPLAY #1            6) MAN BATTERY TEST
 2) DISPLAY #2            7) VIEW HISTORY
 3) DISPLAY ALARMS        8) SET DATE/TIME
 4) SYSTEM RESETS         9) SET PARAMETERS
 5) SYSTEM HELP

SELECTION:_
```

The number within brackets "(" and ")" on the first line is the version of software present in the UPS. The display example above indicates version 1.16 software is present. At the cursor next to SELECTION: enter the number corresponding to the new display that you desire to see, then hit the ENTER key. Below is a short description of what each of these display options have to offer. For more detailed information regarding specific displays, consult later sections of this manual.

1) DISPLAY #1 -- Displays important AC line, Output, and Battery real-time operating parameters including voltages, currents, percent loading on the UPS, frequencies, % battery charge and status messages. The following section goes into greater detail regarding this screen.

2) DISPLAY #2 -- Displays additional system real-time operating parameters such as temperatures of critical components; AC line, Output, and Battery KVA and KW levels; more detailed battery currents and Output Neutral current. The following section goes into greater detail regarding this screen.

3) DISPLAY ALARMS -- This display is used to view if any alarms currently exist. It displays a list of four categories of alarms: SHUTDOWN, OVERLOAD, DIAGNOSTIC, and WARNINGS. If the alarm category name is displayed in reverse video (light characters on a dark background), there is no alarm present in that category (this is the normal mode of operation). However, if an alarm category is displayed in normal video (dark characters on a light background), an alarm exists in that category. You may enter the number corresponding to such an alarm category at the bottom of the display followed by the ENTER key to display alarms that exist under that category. The following section goes into greater detail regarding this screen.

4) SYSTEM RESETS -- This display is used by the operator to reset the UPS following any system shutdown, or clear any major diagnostics/warnings, thus allowing the UPS to resume operating in normal mode. A Shutdown can be caused by a current overload, temperature overload, or sometimes when the battery is totally discharged (thus needing what is referred to as an AC BOOT-UP COUNT RESET). Diagnostics or warnings that may require a system reset include a tripped AC breaker. In this case, the unit is still running, but will run out of battery charge after some time, causing a shutdown. On the last line of DISPLAY #1 and DISPLAY #2, you will be informed if such a reset is needed. If you read that such a reset is needed, go to the SYSTEM RESETS display to perform the reset.

   Reset options that are enabled are displayed in normal video. Select the number corresponding to the reset needed and press the ENTER key. If the reset can be performed, the reset option in the menu will change to reverse video. If the reset can't be performed, the display will indicate the reason. In the case of a current overload, a short period of time (approximately 30 seconds) must elapse between a system shutdown and a reset. Existing high temperatures may also cause an inability to reset the UPS.

5) SYSTEM HELP -- Displays the same information that the HELP key displays. Use the SELECT key to return to the MAIN MENU display.

6) MAN BATTERY TEST -- Displays the manual battery test that can be performed by the operator on the UPS batteries. This test is used to determine the health of the batteries. Current needs to be drawn from the batteries in order to determine if they still have sufficient capacity to back up a critical load in the event of a power failure. The UPS must be operating from the AC line in order for this test to be performed. During this test, the UPS draws current from the batteries and monitors the voltage across the batteries. From this data, the UPS determines an approximate charge capacity of the batteries. In the case where there is no load on the UPS, the UPS will send the power drawn from the batteries back to the utility. Section 5.3.4 goes into greater detail concerning the Manual Battery Test LCD display.

7) VIEW HISTORY -- To display historically stored events, select this option. This function allows the operator to display the total hours of UPS operation, along with any events that have occurred. The UPS stores in battery backed up memory the last 20 times the UPS output has either powered on or powered off. The UPS also stores the last 20 times an abnormal shutdown occurred, the last 50 times the UPS detected a problem with the AC line causing it to remove itself from the AC line, the last 20 times an overload occurred, the results of the last 20 automatic quick battery tests, and the results of the last 20 automatic capacity battery tests. The operator may view these events on the LCD display by selecting one of these options. To scroll through the events, press ❶ to move up in the list, or ❷ to move down. The most recent event will appear at the top of the list as item 1, with the other events listed as they occurred in time. ESCAPE will return you to the VIEW HISTORY screen, while SELECT will return the LCD display to the MAIN MENU screen. Refer to the Troubleshooting section of this manual for additional details about the information displayed by this function.

8) SET DATE/TIME -- This function allows the date, time, or weekday kept by the UPS to be changed by the operator. The date and time are used by the UPS historical storage function to indicate when a particular event occurred. The weekday is used by the automatic battery test to determine which day of the week a test is to be performed. Selecting this display will result in a menu that asks if you want to change the date, the time, or the weekday. Press the number key corresponding to the parameter you wish to change (❶ for DATE, ❷ for TIME, or ❸ for WEEKDAY) followed by the ENTER key.

   A new date is entered by using the numeric keypad to input a 2 digit month (01 through 12, followed by a 2 digit day (01 through 31), followed by a 2 digit year (94 through 99 for 1994 through 1999, and 00 through 90 for 2000 through 2090). Note that after each 2 digit entry, the "/" delimiter is automatically displayed for you. Also note that you must enter two digits for each item. An example of entering the date February 4, 1998 would be to enter 02 (for the month), followed by 04 (for the day), followed by 98 (for the year), followed by the ENTER key. If entered correctly, no error message will be displayed and the date in the upper left corner of the display will change to the date that you entered. If you change the date, you may also need to change the weekday, as the system will not automatically update the weekday.

   A new time is entered as military time (12 midnight through 12 noon is entered as hours 00 through 12, respectively, and 12 noon through 11 PM is entered as hours 12 through 23). The time is entered by using the numeric keypad to input a 2 digit hour (00 through 23), followed by a 2 digit minute (00 through 59), and followed by a 2 digit second (00 through 59). Note that after each 2 digit entry, the ":" delimiter is automatically displayed for you. Also note that you must enter two digits for each item. An example of entering the time 2:34:06 PM would be to enter 14 (for the hour), followed by 34 (for the minute), followed by 06 (for the second), followed by the ENTER key. If

entered correctly, no error message will be displayed and the time in the upper right corner of the display will change to the time that you entered.

A new weekday is entered as a number 1 through 7, representing Sunday through Saturday. Enter 1 for Sunday, 2 for Monday, 3 for Tuesday, 4 for Wednesday, 5 for Thursday, 6 for Friday, or 7 for Saturday. This number should be followed by the ENTER key. If entered correctly, no error message will be displayed and the new weekday will be displayed in the center of the 2nd line on the display.

If you make a mistake while entering a new date, time, or weekday, the DELETE key may be used to delete numbers previously entered. If you change your mind about altering the DATE, TIME, or WEEKDAY after you've selected it, press either the ESCAPE key to go back to the DATE/TIME/WEEKDAY selection, or the SELECT key to go back to the MAIN MENU. If you press either of those keys prior to hitting the ENTER key, the change will be aborted.

Note that the system does not automatically account for Daylight Savings Time. If desired by the operator, such time changes can be made manually using the above procedure.

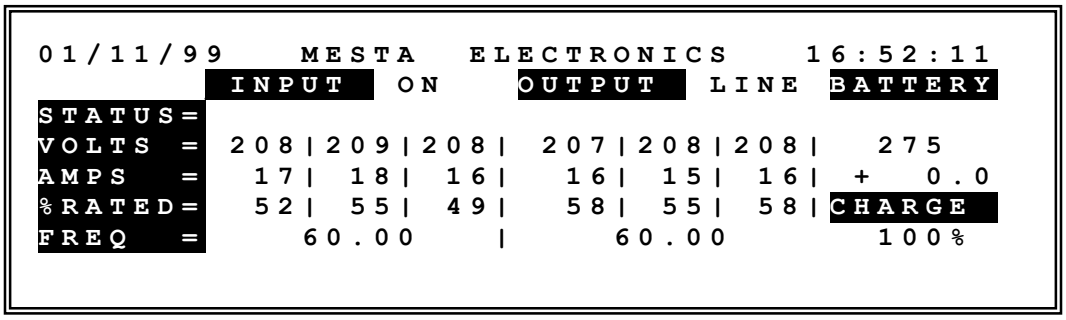
9) SET PARAMETERS – This display allows the operator to inspect and modify the configurable operating parameters of the UPS. Only a qualified operator should change these settings since an error could result in erroneous operation of the UPS.

   There are currently two options available from this screen. They include SELECTABLE PARAMETERS and AUTOMATIC BATTERY TEST SETUP. Section 5.3.5 goes into greater detail concerning the SELECTABLE PARAMETERS screen and section 5.3.6 goes into greater detail concerning the AUTOMATIC BATTERY TEST SETUP.

5.3 LCD SUB-MENU DISPLAYS

This section of the manual describes in greater detail some of the menu options introduced in the previous section.

5.3.1 DISPLAY #1 Screen



This display contains real-time UPS operational values that are vital to the operation of the UPS. Reverse video areas are titles whereas normal video areas contain status information. The top line contains the current date and time. If no alarms exist, MESTA ELECTRONICS will appear in the center of this line. If an alarm exists, this center portion will be replaced by a flashing message indicating what type of alarm exists.

The left half of the screen below the 1st line contains status pertaining to the AC line. Either an ON or OFF will exist next to the INPUT title, indicating whether or not the UPS is drawing power from the AC line. ON is the normal operating mode of the UPS. If OFF is displayed, the STATUS line and the bottom line of the display will indicate the reason why. VOLTS indicates the RMS line-to-line voltage (nominally 208 volts) of the utility (Vab, Vbc, and Vca for all three line-to-line voltages). AMPS indicates the current drawn from each line and %RATED is the percentage of rated current being drawn from each line. FREQ indicates the frequency of the utility voltage (nominally 60 Hz).

To the right of the AC line information is a similar block of information pertaining to the OUTPUT (powering the load). The STATUS line under the OUTPUT indicates from where the output is derived. This status normally indicates LINE (not flashing), indicating that the AC line utility is supplying the power. Abnormal conditions such as ON INVERTER (indicating the batteries are supplying the output power), ON LINE+INVERTER (indicating the AC line and the batteries are jointly supplying the output power), and OFF (indicating the OUTPUT is off) are flashed so as to gain the attention of the operator. VOLTS indicates the RMS line-to-line voltage (nominally 208 volts) of the output (Vab, Vbc, and Vca for all three line-to-line voltages). AMPS indicates the current supplied by each phase to the load. %RATED is the percentage of rated current being drawn from the UPS by the load. If any of these numbers exceeds 100%, the system is being overloaded. Unless this situation is temporary such as in inrush caused by powering up a load, adjustments should be made in the load to eliminate this condition. Normally, the steady state value of all three of these %RATED values should be less than 85% to assure some margin. If one or two of the output lines are heavily loaded while the others are not, it is probably wise to better distribute the load more evenly. FREQ in this portion of the display indicates the frequency of the OUTPUT voltage (nominally 60 Hz).

The far right side of the display contains battery related data. VOLTS indicates the voltage of the batteries. For a system containing twenty 12-volt batteries having a total nominal voltage of 240 volts, this number will be approximately 274 volts when the batteries are fully charged. 274 represents the float voltage applied to the batteries when they are fully charged. AMPS indicates the current coming from the batteries. A negative number indicates the batteries are being charged. Once the batteries are

charged, the normal condition, the AMPS should nominally be close to 0. CHARGE indicates an estimate of the amount of charge left in the batteries. Nominally this value will be 100% indicating the batteries are fully charged. If the utility fails and energy must be drawn from the batteries, this value will start to drop. If it reaches less than 2%, the batteries are considered to be drained of their usable energy, and the UPS output will shut down to protect the batteries from being damaged due to a deep discharge.

The very bottom line of this display is a status line. Normally it will be blank; however, if the UPS has detected an abnormal condition, this line will flash the cause of the abnormality.

5.3.2 DISPLAY #2 Screen

This screen shows additional real-time UPS parameters that could not be included on DISPLAY #1. An example of this screen is shown below:

```
01/11/99     MESTA  ELECTRONICS     16:52:11
TEMPERATURES|   KVA/POWER     |BATTERY AMPS
HSINKA=  27  C| IN_KVA=    0.9| INT_=    0.3
HSINKB=  29  C|OUT_KVA=    0.0| EXT =    0.6
HSINKC=  28  C|  IN_KW=    0.5|NEUTRAL OUT
  AMB  =  27  C| OUT_KW=    0.0| AMPS  =    0
 ROOM  =  23  C|BATT_KW=    0.1|%RATED=    0%
```

The first line and last line are identical to those described in DISPLAY #1. The first column of the screen contains temperatures of the 3 heat sinks, the inside ambient, and the room in centigrade. The heat sink and ambient sensors are used for thermal protection -- if these temperatures get too high, the system will first issue a WARNING alarm. If the temperature continues to increase, the system will shut down to protect itself from damage. Shutdowns of this nature are referred to as Temperature Overloads. The temperatures will normally stay well below these warning and shutdown thresholds, unless there is a problem with the cooling fans.

The middle column of this display contains kilo-volt-amperes and kilowatts drawn from the AC line and supplied to the load, and kilowatts drawn from the batteries.

The upper half of the last column of this display contains battery current data. Internal Battery Amps is a measure of the current drawn from the internal batteries. External Battery Amps is a measure of current drawn from external batteries, should your system have an external battery cabinet. If your system has external batteries, the UPS is configured to control them through the SET PARAMETERS function. If you disconnect the external batteries, or if the external battery breakers are turned off, or if your internal or external batteries are bad, the UPS uses these two currents to detect such problems. It then uses this information to modify its battery charging current and notify the operator of the problem via a WARNING alarm.

The bottom half of the last column of this display contains the current flowing in the output Neutral wire to the load. With a perfectly balanced 3-phase linear load, this current should ideally be 0. However, unbalanced loads and/or highly nonlinear loads may result in a large Neutral current. If left unchecked, such a high Neutral current could result in the overheating of the wire carrying the Neutral current. This parameter is monitored by the controls for such a condition. If this Neutral current exceeds 125% of the rated current for your UPS, an overload condition will occur and the UPS will shut down after approximately one minute.

5.3.3 DISPLAY ALARMS Screen

This screen provides access to any system alarm messages that may be active in the system. Refer to the TROUBLESHOOTING section of this manual for additional information concerning alarms.

SHUTDOWN Screen - Various messages identifying the situations that have been detected which caused a system shutdown. If such a shutdown occurs the screen will appear similar to the following example:

```
01/11/99      SHUTDOWN ALARM!      16:52:11

        UPS WAS SHUT DOWN BECAUSE:
      TRANSFER SWITCH WAS TURNED OFF

      PRESS <ALARM RESET> TO ESCAPE
```

Other messages that you may find are “BATTERY WAS DISCHARGED!”, “PROBLEM WITH DC LINK OR BATTERY”, etc. Press the ALARM RESET button to escape from this screen.

OVERLOAD Screen - Two types of overload situations can trigger this screen: current and temperature overloads. This screen will identify the type and the duration of the overload. If the cause of the overload is not removed, the UPS will shut down in the time displayed on the screen. The 5th line of this screen indicates the reason for the overload. This reason is flashed on and off to get the operators attention. Press the ALARM RESET button to escape from this screen. The following is a sample temperature overload screen:

```
01/11/99      OVERLOAD STATUS!      16:52:11
   0:54 DURATION / 0:06 UNTIL SHUTDOWN
 PERCENT      A       B       C     NEUTRAL
RATED LOAD    80 %    70%     70%     50 %
        OVER-TERMERATURE OVERLOAD
TEMPER-   HSA   HSB   HSC   AMB   ROOM
 ATURES   76 C  75 C  75 C  34 C  27 C
      PRESS <ALARM RESET> TO ESCAPE
```

NOTE

Text appearing with black letters and a gray background, as show below, indicate the message is flashing on the UPS’ front LCD display.

SAMPLE TEXT

Similarly, DIAGNOSTIC and WARNING alarm screens exist to display diagnostic and warning alarms that have been detected by the UPS. Press the ALARM RESET button to escape from these screens.

DIAGNOSTIC Screen - This screen will reveal various situations that have been detected and need to be corrected. See Troubleshooting, Section 7, for further information on diagnostic readouts.

```
01/11/99     DIAGNOSTIC ALARM!      16:52:11

          DC LINK/BATTERY PROBLEM




       PRESS <ALARM RESET> TO ESCAPE
```

WARNING Screen - Warnings consist of high temperatures, AC/DC breakers open, low battery charge, and UPS in BYPASS mode.

```
01/11/99       WARNING ALARM!       16:52:11

              AC BREAKER IS OPEN




       PRESS <ALARM RESET> TO ESCAPE
```

5.3.4 MANUAL BATTERY TEST Screen

This screen shows the results of the last manual battery test that was performed along with the option of performing a new manual battery test.

```
01/11/99  MANUAL BATTERY TEST   16:52:11
             LAST TEST RESULTS
DATE&TIME=01/10/99 15:30:00 LASTED= 1:00
RESULT=TEST PASSED
MAX BATT AMPS =  40 AVG BATT AMPS =  38
MIN BATT VOLTS= 248 START/MIN%= 100/ 92
0)STOP 1)START 2)CHANGE DURATION= 1 MIN.
SELECTION:
```

Items displayed include the date and time of when the last test was performed, how long the test lasted (in minutes and seconds), and the result of that test. The result will display one of several messages. If the test completed the desired time duration without encountering a problem, “TEST PASSED” will be displayed. If the test encountered a problem with the batteries, either “FAIL-WARNING” or “FAIL-DIAGNOST” will be displayed. The “FAIL-WARNING” message indicates that the charge percentage dropped below 20% during the test. This indicates that your battery capacity is greatly reduced and your batteries should be changed in the very near future, as the UPS is capable of only supporting your load for a short time should a power failure occur.

The “FAIL-DIAGNOST” message is the more serious of the two messages because it indicates that your batteries have very little or no capacity, probably not enough to support your load for even a very

short period of time. Should you receive a “FAIL-DIAGNOST” message, you should immediately call for service. If service can not be immediately obtained, power down your loads and turn the UPS transfer switch counter-clockwise to the “ON BYPASS” position via the “OFF IDLE” and “OFF” positions. When in the “ON BYPASS” position, you may turn your loads back on. When in the “ON BYPASS” position, your loads will not be protected from any outages on the utility; however, you are better off connected to the utility than to a UPS without batteries. Your loads may be able to ride through short blips in the utility whereas the UPS may attempt to go off line and use its batteries to support the load. Since such an attempted use of the batteries is not possible, this action will result in an immediate shutdown of your load. Service should be contacted as soon as possible.

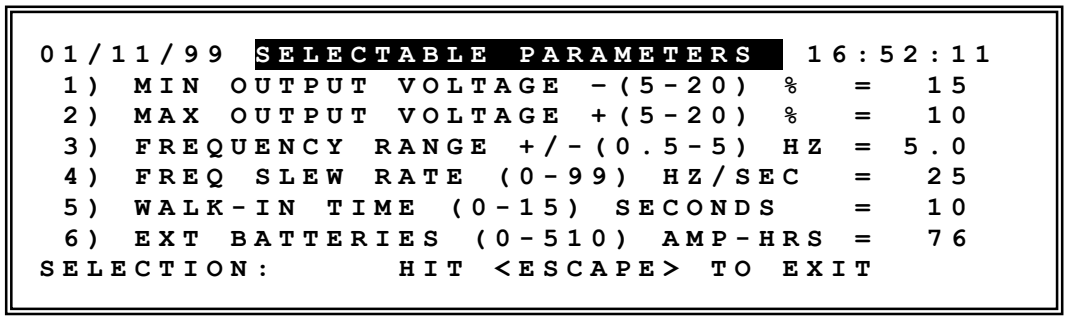
Any other message appearing after ”RESULT=” indicates that the test was aborted for some other reason. For example, if you should terminate the test early, the message “OPERATOR ABORT” will be displayed. These other messages only indicate that the test could not be completed and that the test results are inconclusive as to the status of the batteries.

Other information that appears on this display are maximum and average battery amps pulled from the battery during the test, the minimum battery voltage seen during the test, the battery charge percentage at the start of the test, and the minimum battery charge percentage seen during the test. Even if the charge percentage does not drop to below 20% to cause a test failure, a charge percentage dropping to below 60% may indicate that your batteries are in need of replacement. Should such a percentage be observed, service should be contacted to determine if your batteries should be replaced. Conclusive results may be obtained only if the battery charge percentage is above 90% prior to starting the test.

On the last line of this display, you may select one of three options. If a battery test is not already in progress, the “1)START” option will appear in normal video and the “0)STOP” option will appear in reverse video, indicating “1” is a valid selection while “0” is not. Press the “1” key followed by the <ENTER> key to start a battery test. If conditions are not right for performing a test, an error message will be displayed. If the test can be performed, the “1)START” option will change to reverse video and the “0)STOP” will change to normal video, indicating “0” is now a valid selection while “1” is not. If the “0” key is entered followed by the <ENTER> key, the battery test will stop, and the “OPERATOR ABORT” message will appear next to the “RESULT=” label on the display. While performing a battery test, the 4th line of the display will show the present battery voltage, current , and charge percentage instead of the “RESULT” message. All other data is dynamically updated as the test proceeds. Once the test concludes, the “RESULT” message will again appear. A third option “2) CHANGE DURATION =” indicates the duration that the manual battery will run. By selecting “2”, you may change the test duration to 1, 2, 3, 4, or 5 minutes. Refer to section 8.4 for additional information concerning battery testing.

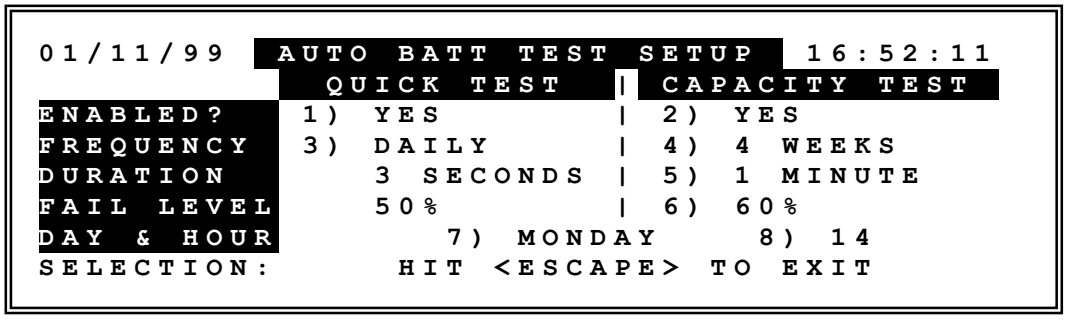
5.3.5 SELECTABLE PARAMETERS Screen

This screen has the programmable parameters by which the UPS is to be operated. ONLY A QUALIFIED OPERATOR SHOULD MAKE ANY CHANGES IN THIS SCREEN! The setting is displayed with a selection number and the current value. To change a setting, enter the number of the setting following by the ENTER key. A prompt will appear at the bottom of the screen that will allow you to enter a new value. The range for each setting is displayed in parenthesis in the setting’s description. To abort changing a value, press the ESCAPE key any time during the data entry prompt. Once all of the necessary changes have been entered, press the <ESCAPE> key to save all of the changes made. To exit the screen without saving any of the changes, press the <SELECT> key to return to the main menu screen. To make sure parameters were entered correctly, go back to the display and verify their correctness.



5.3.6 AUTOMATIC BATTERY TEST SETUP Screen

In addition to being able to run manual battery tests, your UPS has the capability of performing regularly scheduled automated battery tests. This display allows you to program various parameters that control when and how these tests are to be performed. Below is a sample display of this screen:



Refer to section 8.4 for suggested settings for these parameters. There are some restraints on how various values can be programmed. Quick tests must be enabled if Capacity tests are to be enabled. Capacity tests can not be performed more often than Quick tests. The unit will automatically correct any discrepancy should you attempt to violate these constraints. After changing one or more of these parameters, press the <ESCAPE> key on the keypad to save the new parameters and leave the display. If you press the <SELECT> key while in this display, you will leave the display, but none of the changes you made will be saved.

6. SYSTEM SOFTWARE COMMANDS (via the rear panel RS232 interface)

For sophisticated applications, the Mesta UPS system provides an RS232 communications interface which can link the microcontroller with a remote computer or terminal. This two-way link allows users to 1) collect detailed information on power usage and other characteristics of the load to which the UPS is connected and 2) remotely control the UPS or the load. (For example: a software package can be developed to alert the computer to automatically save data and shut itself down when the UPS battery power is dwindling and no emergency generator is available.)

Any computer or terminal equipped with an RS232 serial port capable of a 1200 baud rate can be used to communicate with the UPS. If a terminal is being used, one can begin sending commands to the UPS as soon as a 3-wire hardware interface is in place. Once communication has been established with the UPS, the UPS will provide a ">" prompt, which signals the operator to enter a command.

By typing **S <enter>** to obtain the UPS' operating status, the following typical screen appears:

```
                    *** MESTA UPS STATUS ***

LINE_VOLT AB/BC/CA= 210.8/210.6/210.9     LINE_AMPS   A/B/C =  11.4/ 10.1/ 11.4
LOAD_VOLT AB/BC/CA= 212.8/212.1/211.8     LOAD_AMPS   A/B/C =   0.0/  0.0/  0.0
FREQ_HZ  LINE/LOAD=    60.01/60.04        LOAD_PERCENT A/B/C=     0%/  0%/  0%
BATT VOLT/AMPS/CHG= 274.5/   0.4/100%     LOAD_PWR KW/KVA/PF=    0.0/  0.0/ .00
TEMP  HSA/HSB/HSC =  24.8/ 26.3/ 26.7     TEMP  ROOM/AMBIENT=     23.1/ 25.4
UPS= * ON AC LINE*   NORMAL OPERATION     AC_LINE_STATUS=            GOOD
```

Software Commands: UPS information may be examined using the following commands:

Sn Status command displays the present status of a parameter. To display the status of a particular parameter, type **Sn<enter>.** "**S**" indicates the status command, "**n**" represents a letter from A to Q designating the parameter you desire to observe, and **<enter>** indicates an enter key, which is used to terminate the command. Table 4 contains the list of available parameters that may be examined. As an example, if the present AC line voltage is to be examined, one would type **SA** followed by striking the **<enter>** key. One can also just enter **S<enter>** with no parameter letter and obtain a status update of 12 of the most useful parameters all at once.

Vn **View** command is similar to the Status command except the View command will <u>continually</u> display the status of the selected parameter until one presses the escape key on the computer or terminal keyboard. To continually view the status of a particular parameter, type **Vn<enter>**. "**V**" indicates the View command, **"n"** represents a letter from A to Q designating the parameter to be viewed, and **<enter>** indicates a carriage return (or Enter key) which is used to terminate the command. Again, Table 4 contains the list of available parameters that may be examined. As an example, if the AC line voltage is to be viewed continuously, one would type **VA** followed by striking the **<enter>** key. One can also just enter **V<enter>** with no parameter letter and continually view the status of 12 of the most useful parameters all at once.

<Esc> The escape key can be pressed at any time to abort any command. After pressing the escape key, the UPS will display **<Esc>** to indicate such a key was pressed followed by a new ">" prompt. At such a time a new command can be entered.

RQ3 This command is used to run an in-service battery check test for 60 seconds. The LCD screen on the cabinet will show that this test is being run. RQ0 will terminate this test early. After the battery test is initiated, type **VG<enter>** to view the battery status during the test. If your batteries are in very poor condition, the test may abort prematurely and immediately display a very low charge percentage on DISPLAY #1 for about 1 minute. If this happens, have the unit serviced immediately as you have insufficient battery capability to survive **any** type of utility outage, and if such an event occurs, your load will crash! If the test completes its full minute and your battery charge does not drop below 75%, your batteries are still good. A result below 75% will require further investigation.

RES This command is a RESET command and can be used to silence the "battery discharging" audible alarm when triggered. "Overloads" and "warning" alarms must be reset via the front panel.

OPT This command reveals the various options specific to this particular UPS: configuration version x.xx, the output/input kVA ratings, power transformer step-up ratio, internal battery amp-hr rating, and 100 mv shunt current (100 mv = _ amps).

Table 4 UPS Software Parameters

S/V option	UPS Parameter	Notes
A	AC line voltages (in RMS volts)	
B	AC line currents (in RMS amperes)	
C	UPS output voltages (in RMS volts)	
D	UPS output currents (in RMS amperes)	
E	AC line frequency and UPS output frequency (in Hertz)	
F	UPS output currents (in percentage of rated output)	
G	Battery (DC voltage/ DC current /percentage charge remaining)	1, 2
H	Load power (KW/KVA/power factor)	
I	Temperature of heat sink A/B/C (in °C)	
J	Room/Control PC board ambient temperature (in °C)	
K	Fault status (Indicates operational problems, should they exist)	
L	AC line status (Indicates problems with the AC line)	
M	Battery Voltage (Batteries/Bus, should be approx. equal)	
N	Battery Amps (Total/From Internal batteries)	
O	AC Line Power (KW/KVA/power factor)	
P	Power (AC Utility + Battery/Load/Efficiency)	
Q	Neutral Amps/Percentage of Rated Load	
None	Parameters A through L displayed all at once	

Notes on the MESTA UPS Parameters:

1. Current draw from the batteries is "+" if batteries are being discharged and "-" if batteries are being charged. A small positive or negative value of .1 or .2 amps may not necessarily reflect that the batteries are being charged or discharged.

2. The accuracy of the percentage of battery charge remaining depends on operating conditions and the present loading of the UPS. The accuracy will be much more precise at the lower percentages than it is at the higher percentages (where the performance curve flattens and a perfectly correct interpolation is more difficult - in the 92-100% range).

7. TROUBLESHOOTING

WARNING

Risk of ***Electric Shock***. Do not open a UPS and attempt to repair it yourself. Personnel entering the cabinet may be exposed to an electrical shock hazard that could result in death or injury or further damage to the UPS or its electrical loads

Your UPS is equipped with extensive diagnostic capabilities. It will convey problems detected via messages displayed on the LCD display. The bottom line of Display #1 or Display #2 will normally be blank; however, if an abnormal condition exists, a message will be flashed indicating the problem. See section 7.1 for detailed information concerning these messages.

The more serious problems will result in an alarm condition being annunciated. There are four levels of alarms that the UPS will annunciate: Shutdown, Overload, Diagnostic, and Warning, with Shutdown being the most serious and Warning being the least serious. If an alarm condition occurs, the LCD display will automatically switch to a special screen displaying the type of alarm and the reason for the alarm. See section 7.2 for detailed information concerning alarm annunciations.

If a problem exists long enough, the UPS may eventually have to shut down its output. If this occurs, the controls of the UPS will remain on, but in a state of inactivity for up to 2 hours. At the end of this 2 hour period, the UPS will trip off its INPUT AC BREAKER and MAIN BATTERY BREAKER. These actions will totally shut down the UPS and protect the batteries from being deep discharged. If you find your UPS in this condition, with both breakers in the tripped position, it most likely tripped the breakers off in this manner. A breaker that is in the tripped position is one whose handle is in an intermediate position between ON and OFF. An attempt to push the handle up to the ON position will fail, as the handle will not stay in the ON position. To reset the breaker, the handle must be pulled down to the OFF position, then pushed up to the ON position.

In such situations where the UPS has totally shut itself down, the information causing the shutdown is saved in a battery-backed-up historical data base within the UPS. This information along with Overload and AC line problem conditions are stored in this database, and can be retrieved and viewed on the LCD display at anytime. Even if the UPS is totally shut down, this information is not lost as it is preserved by a small lithium battery located within the storage element on the control board. See section 7.3 for detailed information concerning the historical database.

To restart a UPS that has shut down abnormally, some precautions should be taken to protect the load from powering up and then shutting back down due to the same problem reoccurring. The reason for the shutdown should be viewed on the shutdown alarm display if the UPS has not totally shut down; or the History display if the UPS has totally shut down. Before resetting tripped breakers, rotate the Transfer Switch counter-clockwise from the ON UPS to the OFF IDLE position so the UPS will not immediately attempt to start producing an output that it may not be able to maintain. If the shutdown reason appears to be due to a problem external to the UPS, such as an overload on one or more of the load phases or a utility failure, repair the external problem and restart the UPS. It may be advisable to turn off all loads connected to the UPS in the event that the UPS' batteries are depleted, and wait a short period of time (several minutes) until the batteries reach some level of charge, before turning on the loads.

If the UPS shutdown appears to have been caused by an internal problem, call for service. Do not attempt to turn the Transfer Switch to the ON UPS position with loads attached. Doing so may result in the load being powered for a short time, then being shut down. This may cause damage to your load equipment. If you turn off all loads connected to the UPS, you may try the ON UPS position to see if the problem reoccurs. If not, you may then start turning on your loads. If you need to start your loads

immediately, you may run them from the AC utility directly by turning the Transfer Switch counter-clockwise to the ON BYPASS position. While in the ON BYPASS position, your loads are not protected by the UPS and are subject to any outages or disturbances that may occur on the AC utility. You may remain in the ON BYPASS position until the problem with the UPS is resolved.

7.1 FAULT MESSAGES ON THE BOTTOM LINE OF DISPLAY #1 or #2 SCREENS

If the UPS detects a problem that results in the UPS being unable to operate in a totally normal mode of operation, a message will be flashed on and off at the bottom of the LCD display when displaying either DISPLAY#1 or DISPLAY#2 screens. If multiple problems exist, the highest priority problem will be displayed. This bottom line of the LCD display will be blank if no problems are detected. Table 5 lists messages that may be observed and recommended action to be taken.

Table 5 Screen Messages flashed at bottom of Display #1 or #2

LCD Screen Message	Comments	Remedy
INVALID TABLE OF CONSTANTS	Internal Problem	Call for service
INVALID CONFIGURATION DATA	Internal Problem	Call for service
UPS NOT INITIALIZED PROPERLY	Internal Problem	Call for service
DIAGNOSTIC ERROR EXISTS	Internal Problem	Call for service
UPS OFF DUE TO OVERLOAD – TRY RESET	Your load pulled current that exceeded the capabilities of the UPS	Look at History Display for overloads to find the cause of the overload. Correct the load that caused the problem. Go to Reset Display and reset the overload
UPS OFF DUE TO OVERTEMP – TRY RESET	Heat sink temperature exceeded 75°C or Ambient exceeded 65°C.	Look at History Display for overloads to find the cause of the overload. Check current status of temperatures on Display #2. If temperatures are OK, go to reset display and reset the overtemperature. When UPS starts, determine if all 3 fans are producing airflow. Call for service.
DC VOLTAGE IS TOO LOW TO START UPS	DC voltage from batteries is too low to operate.	Occurs normally when UPS is being shutdown.
DC VOLTAGE IS TOO HIGH TO START UPS	Internal Problem	Call for service.
BATTERY AND DC VOLTAGE DIFF IS TOO HIGH	Internal Inverter Capacitors are not precharged yet	Occurs normally when UPS is turned on.
OFF DUE TO AC BOOTUP COUNT – TRY RESET	UPS shut down due to battery being exhausted.	Go to Reset Display and reset the AC Bootup count.
AC LINE OK BUT CANT PHASELOCK TO IT	Internal Problem	Call for service.
AC LINE OK BUT CANT RESET AC TRIP	Internal Problem	Call for service.
TRANSFER SWITCH IS IN 0FF-IDLE POSITION	Transfer switch has not yet been moved to the ON UPS position.	Turn switch clockwise to ON UPS position to start UPS.
INVALID SETUP DATA	Internal Problem	Call for service
UPS IS IN BATTERY TEST MODE	Battery test is in progress	Normal display when a battery test has been requested via the System Test Display.
AC LINE PROBLEM	Appears if a problem exists with the AC line that prevents the UPS from using it.	Input status on Display #1 will show reason why AC line is not useable. The problem is most likely due to a problem in the utility feeding the UPS (e.g. power failure, open feeder breaker, low or high line voltage).
AC LINE BACKFEED DIAGNOSTIC	Internal Problem. In such a case, the UPS will also trip the AC breaker to prevent backfeed to the utility.	Call for service.
INVERTER TRIP DIAGNOSTIC	Internal Problem	Call for service

AC BREAKER OPEN	AC breaker on unit has been turned off.	Turn on the AC breaker if you want the UPS to run from the utility, otherwise it will stay on battery until energy is exhausted at which time it will shut down.
AC LINE DISABLED BY OPERATOR	An ACDIS command was received via the serial interface. This instructs UPS not to use the AC line.	Type ACEN command over serial interface to re-enable use of the utility, otherwise UPS will stay on battery.
AC LINE HAS BEEN SWITCHED TOO OFTEN	UPS is having difficulty connecting to utility.	If this continues for more than a few seconds, call for service.
CANT GO TO AC LINE DURING OVERLOAD	During an overload greater than 125%, UPS is disconnected from utility	Determine equipment causing overload and remove it before UPS shuts down.
AC LINE OPEN DIAGNOSTIC	Internal Problem	Call for service
POWER IMBALANCE DIAGNOSTIC	Internal Problem	Call for service
POWER IMBALANCE TIMER IS ACTIVE	Internal Problem	Call for service

7.2 SHUTDOWN, OVERLOAD, DIAGNOSTIC, AND WARNING ALARM MESSAGES

Table 6 contains a list of Alarms that may occur and be displayed by the UPS. If they occur, the UPS will automatically display the alarm. It will remain displayed until either the condition goes away or the operator presses the “ALARM RESET” button. If multiple alarms occur, they will be displayed using the following priority (arranged from highest to lowest): SHUTDOWN, OVERLOAD, DIAGNOSTIC, and WARNING. For example if the AC breaker is turned off, an “AC BREAKER IS OPEN” warning alarm will be displayed and will remain displayed until the breaker is turned on or the alarm is acknowledged by pressing the “ALARM RESET” button. If the alarm is not acknowledged before the UPS exhausts its batteries and shuts down, a “BATTERY WAS DISCHARGED” shutdown alarm will be displayed. Acknowledging this shutdown alarm will result in the “AC BREAKER IS OPEN” warning being displayed. Acknowledging this warning alarm will result in the LCD display that was being displayed prior to the alarms to be displayed. Once acknowledged, the highest priority type of existing alarm will continue to be flashed on the 1st line of DISPLAY#1 and DISPLAY#2. In addition, the red ATTENTION light on the front panel will remain lit as long as the alarm exists. The reason for the alarm may be viewed by pressing the “SELECT” key, selecting the “DISPLAY ALARMS” display, and selecting any of the alarm types that are not presently displayed in reverse video.

A SHUTDOWN alarm occurs when the UPS output is shut down for any reason. Abnormal shutdowns, those occurring due to any reason other than the Transfer Switch being rotated to the OFF IDLE or OFF position, are saved in the UPS’ “shutdown” historical database. Every time the UPS’ output is turned on or off is stored in the UPS’ “on/off” historical database. If the UPS shuts down due to an overload or over-temperature condition, the UPS will not restart until the operator resets the condition. To reset the condition, press the “SELECT” key, go to the “SYSTEM RESETS” display, and select the reset needed, (it will be displayed in normal video as opposed to reverse video)

An OVERLOAD alarm occurs while either the load is drawing more current than the UPS is rated for or an over-temperature problem exists. If the UPS shuts down due to the overload or over-temperature, or the condition disappears, the OVERLOAD alarm will disappear. Details of the overload or over-temperature are saved in the UPS’ “overload” historical database.

A DIAGNOSTIC alarm occurs if the UPS’ control detects an abnormal internal problem within the UPS. In most cases, the UPS will continue to produce an output while a DIAGNOSTIC alarm exists; however, it may not be able to draw power from the utility. The DIAGNOSTIC alarm will continue to exist until it is either reset via the “SYSTEM RESETS” display or the Transfer Switch is rotated to the OFF position for a long enough period to totally shut down the controls. It is important that if a DIAGNOSTIC alarm exists and the UPS is still producing an output, that an attempt to reset the diagnostic via the “SYSTEM RESETS” display be made. If that effort fails, attempt a Transfer Request to Bypass to run the load

directly from the utility (see section 4.2). If not able to transfer to bypass, shut down all of your loads in an orderly manner, then perform an interrupted transfer to Bypass by turning the Transfer Switch counter-clockwise through the OFF IDLE and OFF positions to the ON BYPASS position. You may now power up your loads to operate from the utility directly. Note that in the ON BYPASS position, any utility power outage will shut down your critical load. Once transferred to ON BYPASS, call for service.

A WARNING alarm is not as critical as a DIAGNOSTIC alarm. The UPS will continue to operate while a WARNING alarm exists; however, the problem should be corrected as the UPS may eventually shut down due to the problem either continuing or worsening. If the condition causing the WARNING alarm disappears, the WARNING alarm will also disappear, unlike a DIAGNOSTIC alarm.

Table 6 Shutdown, Overload, Diagnostic, and Warning Alarms

LCD SHUTDOWN Alarm Message	Comments	Remedy
PROBLEM WITH DC LINK OR BATTERY	DC voltage to inverter dropped dramatically when current was drawn from batteries. Most probable cause is bad batteries. May also be displayed if DC breaker on UPS is shut off prior to Transfer Switch being turned off.	If UPS was turned off by shutting off DC breaker before turning Transfer Switch to the off position, ignore. If this is not the case, turn off the DC breaker and call for service. If the load needs to be powered while waiting for service, rotate the TRANSFER SWITCH counter-clockwise to the ON BYPASS position to power the load directly from the utility.
CURRENT TRIP OCCURRED DURING STARTUP	Internal Problem	Call for service
PHASELOCK PROBLEM DURING LOW BATT START	Internal Problem	Call for service
TRANSFER SWITCH WAS TURNED OFF	Transfer Switch was turned to the OFF IDLE or OFF position.	This is a normal power-down message.
BATTERY WAS DISCHARGED	UPS ran without utility until batteries were exhausted.	Wait for utility to return. Once the utility returns, an “AC boot-up count” reset on the “System Resets” screen may be needed.
EXTERNAL SHUTDOWN REQUEST	An external piece of equipment commanded the UPS to shut down (and turn off its breakers) by shorting pins 1&2 of the “Custom I/O” connector.	This is a normal UPS operation.
AC SHORT FOUND DURING STARTUP	Internal Problem	Call for service
CURRENT OVERLOAD	One or more of the output phases was overloaded.	Review overload history information to determine the cause, then remove the load causing the overload. Perform an overload reset on the “System Resets” LCD screen to restart UPS.
OVER-TEMPERATURE	Either the heat sink temperature exceeded 75°C or the control board temperature exceeded 65°C for more than 1 minute..	Review overload history information to determine the cause. Check Display#2 for present temperatures to see if they have declined. Check to make sure exhaust air is not blocked at top of unit. If all is OK, perform an over-temperature reset on the “System Resets” LCD screen to restart UPS. Check to make sure all 3 fans are exhausting air at top of UPS. Call for service.
LOW OUTPUT VOLTAGE WITHOUT AN OVERLOAD	Internal Problem	Call for service
POWER IMBALANCE	Internal Problem	Call for service

LCD OVERLOAD Alarm Message	Comments	Remedy
LOAD CURRENT OVERLOAD	One or more of the 3 output phases or the neutral is presently being overloaded.	Remove the load causing the problem.
UNDER VOLTAGE OVERLOAD	Internal Problem	Call for service
INVERTER CURRENT TRIP OVERLOAD	Internal Problem	Call for service
OVER-TEMPERATURE OVERLOAD	Either the heat sink temperature exceeded 75°C or the control board temperature exceeded 65°C.	Check to make sure all 3 fans at top of UPS are exhausting air.
POWER IMBALANCE OVERLOAD	Internal Problem	Call for service.

LCD DIAGNOSTIC Alarm Message	Comments	Remedy
DC LINK/BATTERY PROBLEM	See “PROBLEM WITH DC LINK OR BATTERY” SHUTDOWN	
SHORTED AC SWITCH	UPS detected a possible backfeed problem to the utility. As a precaution, UPS tripped its AC breaker.	Perform a Diagnostic/Warning reset on the “System Resets” LCD screen to clear diagnostic. Reset AC breaker by pulling it all the way to the off position then turning it on. If diagnostic reappears (and AC breaker trips again), an internal problem exists that requires service. In such a case, the UPS will not be able to use the AC line and will only run until the batteries are exhausted. You must either perform an uninterrupted transfer to ON BYPASS so that your load can continue to run from the raw utility or shut off your loads in an orderly manner before the battery energy is exhausted. If resetting the diagnostic works, monitor system closely and call for service.
LOW LOAD VOLTAGE, NO HIGH LOAD CURRENTS	Internal Problem	Call for service
POWER IMBALANCE	UPS detected a problem with one or more of its internal current sensors.	Perform a Diagnostic/Warning reset on the “System Resets” LCD screen to clear diagnostic. If diagnostic reappears, an internal problem exists that requires service. In such a case, the UPS will not be able to use the AC line and will only run until the batteries are exhausted. You must either perform an uninterrupted transfer to ON BYPASS so that your load can continue to run from the raw utility or shut off your loads in an orderly manner before the battery energy is exhausted. If resetting the diagnostic works, monitor system closely and call for service.
OPEN AC SWITCH	UPS did not detect enough current coming in from one of the utility lines, so it has determined that it can no longer use the utility.	Perform a Diagnostic/Warning reset on the “System Resets” LCD screen to clear diagnostic. If diagnostic reappears, an internal problem exists that requires service. In such a case, the UPS will not be able to use the AC line and will only run until the batteries are exhausted. You must either perform an uninterrupted transfer to ON BYPASS so that your load can continue to run from the raw utility or shut off your loads in an orderly manner before the battery energy is exhausted. If resetting the diagnostic works, monitor system closely and call for service.
INV CURRENT TRIPS, NO HIGH LOAD CURRENTS	Internal Problem	Call for service
CURRENT TRIP OCCURRED DURING STARTUP	Internal Problem	Call for service
EPROM CHECKSUM ERROR	Internal Problem	Call for service

LCD WARNING Alarm Message	Comments	Remedy
NOVRAM PROBLEM ENCOUNTERED	Control had a problem retrieving setup information from its non-volatile memory.	Unit will continue to run with default values. Call for service.
INT/EXT BATTERY AMP-HR MISMATCH	A mismatch is detected between the current drawn from internal batteries and current drawn from external batteries.	Make sure External Battery Breaker on UPS and breakers on all external battery cabinets are in the on position. Make sure the correct number of amp-hrs are recorded in the Selectable Parameters screen (see Set Parameters in section 5.2 for details). If you have removed or installed battery cabinets, the external battery amp-hrs value on this screen must be altered to reflect the change. If the external battery amp-hrs on this display match your configuration, you may need new batteries in either the UPS or external battery cabinets, so call for service.
BATTERY CHARGE IS LOW	Battery charge has dropped below 20%.	Start turning off your loads in an orderly fashion as the battery energy in the UPS is nearly exhausted. If utility is present, but UPS cannot go to it because of some internal problem, an uninterruptible transfer to ON BYPASS can be attempted to continue operating the load from the utility.
HIGH TEMPERATURE DETECTED	A heat sink temperature higher than 65°C or a control board temperature higher than 55°C was detected.	Check to make sure all 3 fans are exhausting air at the top of the UPS. The warning will continue to exist until heat sink temperature drops below 60°C and control board is below 50°C. The UPS will continue to operate unless temperatures rise further, to 75°C on the heat sink or 65°C on the control board, at which time the unit will revert to an over-temperature condition and shut down in 1 minute. If temperature does not drop, call for service. Shedding less critical loads may reduce the temperature problem until service on unit can be performed.
AC BREAKER IS OPEN	AC breaker is in the OFF position.	Turn on AC breaker. If breaker is in the tripped position, you must first push the breaker handle all the way off, then push it to the on position. Note: if a “Shorted AC switch” diagnostic exists, the control will trip the AC breaker as soon as you attempt to turn it on.
DC BREAKER IS OPEN	DC breaker is in the OFF position	Turn on DC breaker. If breaker is in the tripped position, you must first push the breaker handle all the way off, then push it to the on position.
UPS IS IN BYPASS MODE	Transfer Switch is in the ON BYPASS position	Perform repairs or maintenance on UPS quickly and transfer back to ON UPS mode, as the load is not protected by the UPS while in this mode.
BATTERY PROBLEM FOUND DURING LAST TEST	Last completed battery test found a problem with the batteries	Check the manual battery test LCD display along with the Quick and Capacity automatic battery test history displays to determine which test registered the problem. Read the test “RESULT” to determine if it issued a “FAIL-WARNING” or a “FAIL-DIAGNOST”. Call for service if either FAIL message is observed; however, the “FAIL-DIAGNOST” requires much more immediate response. Once the battery charge returns to above 90%, you may also run a manual battery test to make sure the problem still exists.

7.3 HISTORICAL DATABASE DISPLAY INFORMATION

The “Power On/Off”, “Shutdown”, “AC Line Fault”, “Overload”, “Batt Test Q”, and “Batt Test C” historical databases are stored in battery-backed-up memory. This information is preserved even when the UPS is totally shut down. The information in the database may be viewed by selecting the “View History” option from the MAIN MENU LCD. Refer to the FRONT PANEL KEYPAD & LCD OPERATION section of this manual for additional information on accessing the history information.

The Power On/Off database contains information as to each time the UPS output is powered on or powered off. Information recorded includes date & time when the event occurred. “Powered off” recordings will also include a reference to shutdown if the UPS output was powered off in any way other than the transfer switch being rotated to the OFF IDLE or OFF positions. In such cases additional information about the shutdown can be obtained from the “Shutdown” historical database.

The Shutdown database contains information about each time the UPS output is powered off in any way other than the transfer switch being rotated to the OFF IDLE or OFF positions. Information recorded includes date & time when the shutdown occurred and the reason for the shutdown.

The AC Line Fault database contains information about each time the UPS produces an output when energy from the AC utility is not able to be used. Information recorded includes date & time when the UPS left the utility, the reason the UPS had to leave the utility, and the length of time that the UPS continued to produce an output without the help of the AC utility. Note that every time the UPS is powered up, an event is stored in the “AC fault” database. This is because the UPS powers up using its battery, then synchronizes to the utility, and then switches over to using the utility. If a utility power failure occurs, one of several reasons may be recorded. This is because several parameters are monitored to detect a utility power failure. Depending on which of these is detected first determines the reason that is recorded. “Hard Current Trip”, phase loss, low rms voltage, or low peak voltage may be recorded reasons for utility power failures.

The Overload database contains information about each time the UPS is overloaded or experiences an over-temperature condition. Information recorded includes date & time that the condition started and duration of the event. Also recorded is the maximum rms current observed during the overload period on each of the three output phases. If the neutral current remained below 125% rated load during the overload period, “IN= OK” will be displayed. “IN>125%” will be displayed if it too was overloaded. If an over-temperature condition did not occur, “OVERTEMP = NONE” will be displayed. If an over-temperature did occur, “A”, “B”, “C”, an/or “AMB” will be displayed in place of the “NONE” message if heat sink A, B, C, and/or Control board ambient temperature sensor registered an over-temperature condition. A “PI” (power imbalance), “CT” (current trips), or “UV=” (undervoltage, followed by AB, BC, and/or CA referring to which phases were undervoltage) will be displayed if an internal problem occurred during the overload duration. Call for service if one of these internal problems is detected.

The “Batt Test Q” and “Batt Test C” databases contain results of the last 20 Automatic Quick Battery Tests and Capacity Battery Tests, respectively. Information recorded includes the date & time that the test was performed, how long the test lasted, % battery charge at the start of the test and minimum % charge observed during the test, maximum & average current drawn from the battery during the test, minimum battery voltage observed during the test, and results of the test. In addition, at the end of the first line of each record, two numbers appear enclosed in parentheses. The first is the weekday that the test was programmed to occur on (1 = Sunday, 2 = Monday … 7 = Saturday) and the second is the hour of the day that the test was programmed to occur. Note that Quick tests done on a daily basis ignore the weekday information when determining when to perform a test. Refer to section 8.4 for further information regarding battery testing.

8. MAINTENANCE

8.1 SYSTEM STORAGE

Battery Life: The MESTA UPS should be stored with the batteries fully charged and all breakers in the off position. MESTA Battery Cabinets should also be stored with the batteries fully charged. Storage temperature should be maintained between -20°C and 40°C. The life of the batteries may be greatly reduced if stored at temperatures exceeding 30°C for extended periods of time. Optimal storage temperature for maximum battery life is 20°C or lower. Also, batteries may be permanently damaged if not removed from storage periodically and fully recharged at least once every 6 months. To recharge batteries inside UPS, simply remove the UPS from storage and connect the unit to an AC power source for a minimum of 4 hours (make sure batteries are being charged by monitoring the charge current and battery charge percentage on Display#1 of the LCD screen. Then you may turn the unit off again and return it to storage for up to another 6 months. To recharge batteries in a battery cabinet purchased from Mesta, follow the directions to connect the battery cabinet to a Mesta UPS in Section 2 of this manual. Allow a minimum of 4 hours charging per battery cabinet.

8.2 OPENING THE UPS CABINET

WARNING

Only qualified technicians or supervised personnel should open the UPS and only after ALL of the following WARNINGS and instructions are read and fully understood. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

WARNING

Risk of ***Electric Shock*** exists inside the UPS. The UPS receives power from the AC source (via external wiring to the INPUT VOLTAGE terminal block) and a DC source (via the internal and/or external batteries). Maintenance personnel must be aware of this hazard, or they may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads.

WARNING

The UPS internally contains capacitive components, which remain energized even after power to the UPS has been turned off. After the UPS is turned off, the front panel LEDs and LCD display will go off within 20 seconds. Under these circumstances the voltage across these capacitive components will be minimized to safe levels within 1 minute of turning the UPS off. If, however, the LEDs never come on when the UPS is turned on or never go off when the UPS is turned off, a problem exists with the unit. Under such conditions it is possible for hazardous voltages to remain for longer periods of time. If such a malfunction exists, it is advisable not to open the unit. Instead, contact the manufacturer or nearest repair center. A qualified technician will need to check the DC voltage across the buss bars that connect the large capacitors attached to the heat sink before proceeding with any internal maintenance. This voltage could be as high as 250 volts DC. One should wait until voltage is below 30 volts DC before proceeding. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury.

WARNING

The UPS should only be entered after all breakers on the unit and breakers on all external battery cabinets connected to the unit have been turned off. For maximum safety, the AC source feeding the UPS should also be turned off.

If the load connected to the UPS must remain powered while maintenance is performed, the UPS may be entered while the AC source feeding the UPS remains energized and the Bypass Switch is in the ON BYPASS position. Under such circumstances, all breakers on the UPS should still be turned off, but the AC source feeding the UPS will remain on. The upper part of the cabinet, specifically the Transfer Switch, the INPUT VOLTAGE and OUTPUT VOLTAGE terminal blocks, the upper terminals of the AC breaker, the small relay located to the right of the AC breaker, and all wiring interconnecting these components, remains energized with hazardous voltage. Contact with this hazardous voltage will result in an electrical shock that could result in death or injury; therefore, this area must be avoided.

Instructions for Opening and Closing the UPS: The only internal components that are intended to be serviced by the end-user are the batteries. The end-user should contact the distributor or manufacturer for repairs needed to any other components within the UPS. Even though the batteries may be serviced by the end-user, he/she is encouraged to contact the distributor or manufacturer prior to attempting replacement of batteries. Before opening the unit, make sure you read and understand all of the warnings in this section. Either turn the Transfer Switch clockwise to the ON BYPASS position (if the load is to remain energized) or counter-clockwise to the OFF position. Turn off all breakers on the UPS and all external battery cabinets connected to the UPS. If, and only if, Transfer Switch was moved to the OFF position, turn off AC feeder breaker to the UPS, for additional safety. After all front panel LEDs go off, unlock the front panel. Push each latch in and turn 1/4 turn to open the front door. **DO NOT** try to enter the unit any other way (such as from the side or back panels of the unit) as such an action may result in risk of ***Electric Shock.*** After completing servicing inside the unit, close the door, and lock unit by turning latches and keys 1/4 turn back to their original position. Remove keys from lock and put away in a safe place. Turn on breakers that were turned off prior to opening the unit. If Transfer Switch is in the ON BYPASS position, turn it counter-clockwise to the ON UPS position. If Transfer Switch is in the OFF position, turn it clockwise two positions to the ON UPS position.

8.3 REMOVING AND REPLACING BATTERIES

UPS Batteries: The batteries are the only component within the UPS that should ever need service. Batteries have a finite life of approximately 3 to 5 years. Since your UPS has a design life in excess of 20 years, your batteries will probably need to be replaced several times during the life of your system. Your unit is equipped with either 18 or 20 sealed lead-acid maintenance-free batteries, each having a nominal voltage of 12 volts and a capacity of either 38 or 65 amp-hours. These batteries are wired in series to form a battery bank that has a total nominal voltage of 216 volts (18 batteries) or 240 volts (20 batteries). The part number of your UPS determines the battery configuration for your system. The part number has the format UPSnnnnn/3-xx-y, where nnnnn is the volt-ampere/watt rating of your system (10000, 15000, 20000, 25000, or 30000), xx is the number of batteries wired in series (18 or 20), and y is the cabinet size (1 or 2). Size 1 cabinets have 6 trays of batteries with 3 batteries per tray. Size 1 cabinets with 20 batteries have an additional tray of 2 batteries. Refer to figure 11A for a diagram indicating the wiring of a size 1 cabinet with 20 batteries. Size 2 cabinets have 9 (18 battery systems) or 10 (20 battery systems) trays of 2 batteries each. Refer to figure 11B for a diagram indicating the wiring of a size 2 cabinet with 20 batteries.

WARNING

Risk of ***Electric Shock*** – Batteries are energy storage devices, and even though all breakers are off, there still exists the potential of high current flow. For this reason extreme caution should be exercised at all times during operation or maintenance of the UPS and its external battery cabinets. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

WARNING

Only qualified technicians or supervised personnel should remove and/or replace the batteries. Batteries have a high short-circuit capacity: MISTAKES IN CONNECTING OR DISCONNECTING CAN CAUSE CONNECTIONS TO ARC OR WELD AND COULD RESULT IN SEVERE BURNS. DO NOT TOUCH UNINSULATED BATTERY TERMINALS. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury or damage to the UPS or its electrical loads.

Removing UPS Batteries: Removing the batteries necessitates opening the front door of the unit. MAKE SURE THE BATTERY BREAKERS ON THE UPS ARE IN THE OFF POSITION. When the breakers are in the off position, the batteries have no connection to earth ground, more specifically the cabinet chassis. This means that accidentally touching a battery terminal to the chassis will not result in high current flow, as the chassis is no longer connected to the battery circuit. Follow the procedure for opening the UPS outlined in the previous section. The following precautions should be observed while working on batteries:

1) Remove watches, rings, or other metal objects.
2) Use tools with insulated handles.
3) Do not lay tools or metal parts on top of batteries.
4) Do not touch battery terminals to any other battery terminals than those terminals intended to be connected to (watch for inadvertent contact that can occur if not being careful when removing lead wires to battery terminals).

After opening the front door of the UPS, the battery trays may be unfastened by unscrewing the screw directly in the front of the tray.

Note: Remove trays starting from the bottom shelf and with the tray on the right.

Refer to figure 11A for the wiring configuration of a size 1 UPS cabinet and figure 11B for the wiring configuration of a size 2 UPS cabinet. Remove the black wire from the frontmost terminal, on the front battery of the rightmost tray, on the bottom shelf of batteries. This is the wire that goes to the rightmost terminal of the battery breaker. Place this wire so that the removed terminal cannot come in contact with any of the terminals of any of the batteries. Pull the tray out, resting it on a platform, until the rearmost terminal of the back battery is exposed. Remove the wire from this terminal along with the other end which connects to the frontmost terminal on the front battery on the tray to the left, being careful not to let either end of the wire come in contact with any battery terminals. Once this wire is removed, the battery tray may be removed from the UPS.

The remaining trays on the bottom shelf are removed in a similar manner. When the last tray on the bottom shelf is reached, disconnect the wire connected to the rearmost terminal of the rear battery. Disconnect the other end of this wire, which connects to the frontmost terminal on the front battery in the rightmost tray of the top battery shelf. Remove this last tray on the bottom shelf.

The battery trays on the top shelf are disconnected and removed in a similar way to those on the bottom shelf. When the last tray is reached, the wire connected to the rearmost terminal of the back battery, marked with white tape, can be disconnected from the battery and placed aside. The last battery tray can be removed.

Replacing UPS Batteries: After the battery trays are removed from the cabinet, individual batteries may be disconnected and replaced. **Exercise extreme caution** to insure that batteries are replaced correctly, insuring proper battery polarities (See figure 11A or 11B for correct wiring). Batteries must be secured back onto the tray using the fasteners originally supplied.

To reinsert the battery trays back into the cabinet, reverse the order that the trays were removed. This means that the leftmost tray on the top shelf will be inserted first. The rearmost terminal on the back battery (it should be a positive battery terminal) should be connected to the white taped wire whose other end connects to the resistive shunt on the left side of the UPS. The tray may then be slid into place. The 2nd tray may then be readied. A wire should be installed between the frontmost terminal of the front battery on the 1st tray and the rearmost terminal of the rear battery on the 2nd tray. This procedure is repeated for the remaining trays on the top shelf.

After the last tray is placed on the top shelf, the leftmost tray on the bottom shelf is readied. The rearmost terminal of the rear battery on this bottom shelf is wired to the frontmost terminal of the front battery on the leftmost tray on the top shelf using the longest of the wires. The remaining trays on the bottom shelf are added to the system. After the last tray (the rightmost bottom tray) is moved into place, the frontmost terminal of the front battery should be connected to the black wire that connects to the right bottom terminal of the battery breaker.

Figure 11 Size 1 & 2 UPS Internal Battery Tray Configuration

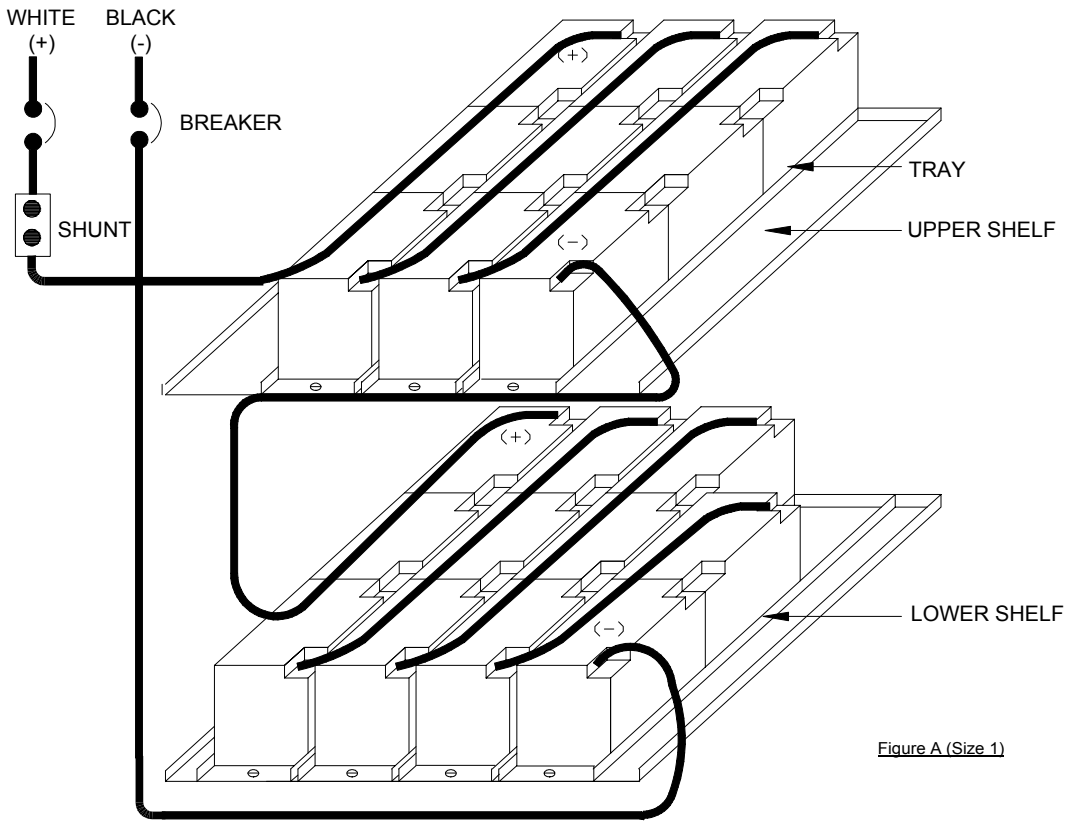


Figure A (Size 1)

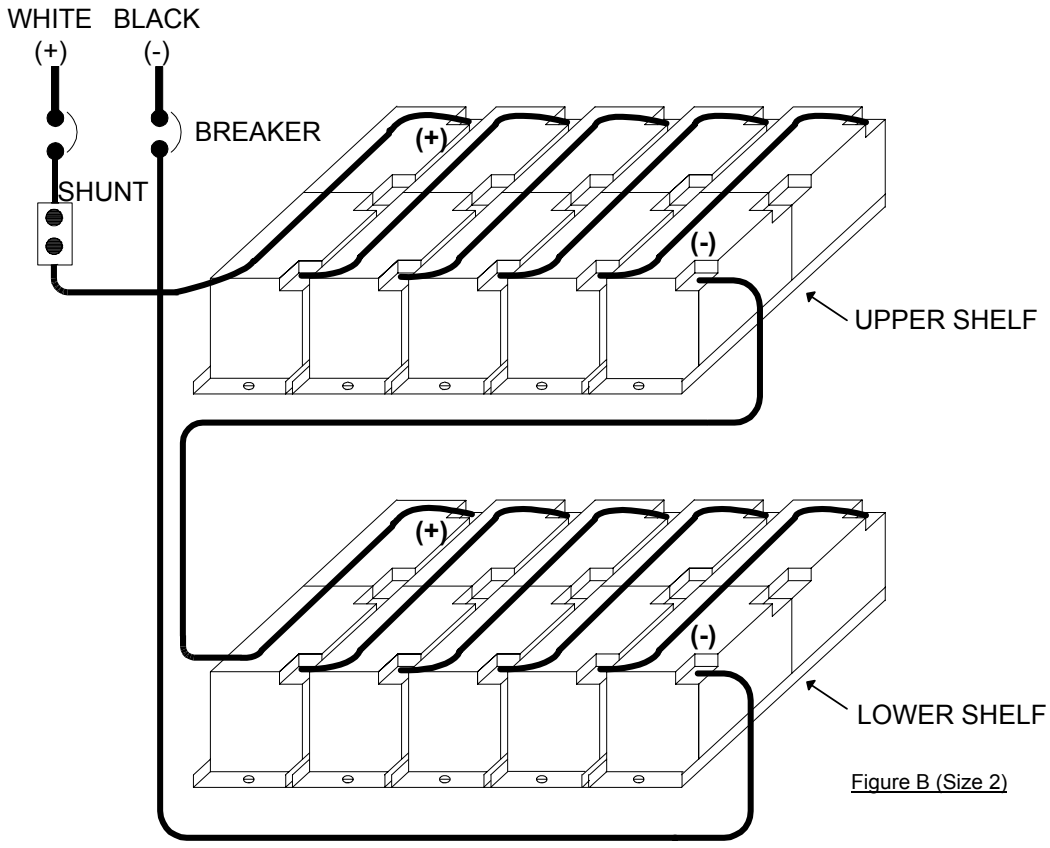


Figure B (Size 2)

8.4 BATTERY TESTING

The batteries are by far the most likely component in any UPS to fail. Loss of the batteries results in a power outage to your load as soon as the next power failure occurs. With most UPS's you don't know you have bad batteries until such a power outage occurs, which is too late. Mesta incorporates one of the most advanced battery diagnostic tools available in the market to detect battery problems before a power outage occurs. This allows the faulty batteries to be replaced before they cause your critical loads to crash! To test any battery, one must draw current from the battery while measuring the voltage output of the battery. A battery that has reduced capacity will exhibit a reduced voltage compared to a good battery. Even worse than a reduced capacity battery is a battery that has very high impedance. Such a battery may not be able to deliver any sizable amount of current. A UPS having such a battery in its bank will result in the bank being unable to support the critical load for even a fraction of a second. It is important to detect such problems as soon as possible; otherwise, the critical load is at risk of crashing at the next aberration in the utility voltage.

The Mesta UPS includes comprehensive battery tests that allow early detection of such battery problems. During these battery tests, current is drawn from the batteries without having to turn off the utility. Should a problem be observed during the test, the UPS immediately stops drawing current from the batteries and resumes recharging. The UPS will draw current from the batteries up to the amount needed to support the load. If a load does not exist or is very small, the Mesta UPS is capable of drawing current from the batteries and delivering the power back to the utility, thus using the utility as a load.

Such tests may be performed either manually, using the Manual Battery Test (refer to section 5.3.4 for details) or regularly scheduled Automatic Battery Tests (refer to section 5.3.6 for details). Generally, you should set up your system to perform Automatic Battery Tests at regularly scheduled intervals. Should the automatic tests find a problem, the UPS will issue a "Warning" annunciation. This will consist of a "BATTERY PROBLEM FOUND DURING LAST TEST" Warning message displayed on the LCD, the Red ATTENTION light on the front panel being lit, and an audible alarm being generated. In addition, if your unit is equipped with an optional remote annunciation feature, an indication of a pending problem will occur. This "Warning" annunciation will continue to exist until either a Manual or Automatic Capacity test is re-run with favorable results, the warning is reset via the DIAGNOSTIC/WARNINGS reset on the SYSTEM RESETS LCD screen (refer to section 5.2), or the UPS is shut off.

The results of the last manual battery test are stored in battery backed-up memory and can be observed by pressing the <SELECT> key on the front panel keypad and selecting item 6, "MAN BATTERY TEST". Once a new manual battery test is started, this display will show the active test results. The results of the "Quick" and "Capacity" automatic battery tests are archived in battery backed-up memory. The last 20 tests of each type are saved and can be viewed by pressing the <SELECT> key on the front panel keypad, selecting item 7, "VIEW HISTORY", and selecting item 5, "BATT TEST Q", or item 6, "BATT TEST C", to display the results of the last 20 "Quick" or "Capacity" tests, respectively. Both the Manual and Automatic battery test result displays have a "RESULT=" display. Following is a list of possible messages for this display:

RESULT message	Description
TEST PASSED	Test reached its desired duration finding no problems with the batteries
FAIL-WARNING	% charge fell below the failure level, indicating batteries have reduced capacity capability. Batteries may need to be replaced. Call for service.
FAIL-DIAGNOST	Battery voltage dropped dramatically to levels indicating that the batteries are in very bad shape and should be serviced immediately. Verify this failure by running a manual battery test
OPERATOR ABORT	Operator ended the manual test (by either selecting STOP from the manual

	battery test LCD page or by typing RQ0 over the serial port.
BAD AC LINE	Test had to be terminated because AC utility went bad.
TRANS REQUEST	Test was terminated because operator asked to perform a transfer request during the test.
SYS TURNED OFF	Test was terminated because operator turned the transfer switch to either the “OFF IDLE” or “OFF” position.
SYS SHUTDOWN	Test was terminated because system shut down for some other reason.
DC LINK DIAG	Test was terminated because of a diagnostic problem with the DC voltage. This should not normally occur. Call for service.
HIGH DC VOLTS	Test was terminated because the DC voltage went abnormally high. This should not normally occur. Call for service.
DURATION ERROR	Test was terminated because of an erroneous desired test duration. This should not normally occur. Call for service.
UNKNOWN	This message is displayed when observing a Quick or Capacity history record that is active because that test is presently being performed. This message should not normally occur otherwise. If it is observed at other times, call for service.

Should you receive a “BATTERY PROBLEM FOUND DURING LAST TEST” Warning, look at the Manual Battery Test display and the “Batt Test Q” and “Batt Test C” automatic battery test historical displays for “FAIL” results to determine the severity of the problem.

To set up your UPS for automatic battery testing, press the <SELECT> key to get the main menu. Select item 9, “SET PARAMETERS”, then select item 2, “AUTOMATIC BATTERY TEST SETUP”. Refer to section 5.3.6 for details about this display. Make sure that both the Quick and Capacity tests are enabled. At this time the factory is advising you to select “DAILY” Quick tests and 1 minute Capacity tests performed every 2 weeks. Doing testing too often or for too long could cause reduced battery life which would be counter-productive. Not testing often enough reduces the likelihood of detecting and correcting a problem before it is too late. This is why both a Quick and Capacity test exists. The Quick test lasts only 3 seconds and is primarily checking the integrity of the batteries to make sure they can support a load for at least a brief time. Such battery failures often occur without warning, so the test must be performed often to be effective. The Capacity test lasts much longer and is checking the capacity of the batteries to determine their effectiveness at supporting a load for extended periods of time. Capacity problems generally occur slowly, so testing capacity does not need to be performed as often. Running the Capacity test on a daily basis could reduce the life of the batteries; however, running the Quick test on a daily basis does not reduce the life of the batteries. If you have extensive batteries to achieve extended runtimes of an hour or so, you might want to increase the length of Capacity tests to 3 minutes.

The best battery tests occur when enough current is drawn from the batteries to support the nominal load. This is only achieved if the battery tests are performed while the UPS is supporting the nominal load. Therefore, it is important to pick a weekday and hour for when the automatic testing is to be performed that corresponds to a time when the UPS is supporting its normal load. Do not pick the 3rd hour (3 AM) Sunday if over the weekend most of the UPS load is shut off because the office is closed. Battery testing will not interrupt the normal operation of the UPS, so it is all right to select a weekday and hour during the day if that is when the UPS is protecting its normal load. It is also important to verify that the current weekday is correctly programmed into the UPS as viewed on the “Set Date/Time LCD display.

Personnel responsible for monitoring the UPS, either at the UPS or by viewing a remote display, should be notified of when battery tests will be performed. When a manual or automatic capacity battery test is

performed, current is drawn from the batteries. This action results in the unit annunciating that the batteries are being discharged. At the unit, this is accompanied by the yellow “BATTERY DISCHARGING” light turning on and an audible alarm sounding. Remote annunciation panels will also indicate that the battery is discharging.

One other parameter that needs to be set is the percent charge level that is used to indicate a capacity test failure. This value should normally be set at 60%; however, if your batteries are older and starting to fail at this level, but 60% is still able to get you the backup time you need, you may want to reduce this level to a lower value. This way you know that you will need new batteries soon so you can begin to budget for such an expense. In the mean time, you can continue to operate without receiving a continuous warning message. Should the batteries degrade further, the lower level will begin to be exceeded, telling you that you might want to step up the timeframe for replacing the batteries.

Capacity tests can not be performed unless a Quick test is performed first, as it is necessary to check the integrity of the battery prior to checking its capacity. Therefore, it is not possible to perform automatic Capacity tests more often than automatic Quick tests; however, it is possible to perform Quick tests without performing a Capacity test. If daily Quick tests are performed, such tests will be performed each day during the hour indicated on the automatic battery test setup LCD display. If the unit can not perform a test anytime during that hour because the batteries are not charged sufficiently due to a recent power failure, no AC line present during that hour, or the unit being off, no test will occur again until the following day during that hour. Quick tests and/or Capacity tests performed on a weekly basis will only be performed on the programmed weekday during the programmed hour. If unable to perform the test at that time, the UPS will attempt again the following week. Quick tests and/or Capacity tests performed less than weekly will only be performed on the programmed weekday during the programmed hour if the prescribed number of weeks have passed since the last test. If unable to perform the test at that time, the UPS will attempt again the following week. If a test is started but can not be completed due to an AC line or other problem, the test will not be repeated until the next programmed interval has passed.

Manual battery tests actually consist of a Quick test followed by a Capacity test. Manual tests will not result in a failed capacity result unless the charge percentage drops below 20% (not programmable). However, manual battery tests may be terminated early by the operator.

8.5 OTHER PREVENTIVE MAINTENANCE

The Mesta UPS has been designed for long, fault-free operation. However, to detect possible developing problems, it is advisable to perform the following list of preventive maintenance on a monthly or other regular basis interval. The parameter monitoring can be performed using either the front panel keypad and LCD display, or using a computer/terminal connected to the serial port of the UPS.

- Check all input and output voltages and currents. Make sure voltages are close to the nominal values and are not approaching either the minimum or maximum levels that can be tolerated by the UPS. If input voltages are too low or too high, it may be necessary to change a tap on the distribution transformer feeding the UPS. Check the %RATED output currents to insure that no phase is pulling more than 85 to 90%. Consider redistributing single phase loads so as to better balance the load currents, or dropping less critical loads from the UPS if at or above this level. The UPS will have no problem operating at up to 100% loading; however, any fluctuations in the line or load could cause the output current to exceed 100%, which could result in an overload shutdown. You, therefore, want to make sure you have at least a 10 – 15% margin to prevent an overload condition from occurring.

- Check Heat sink, ambient, and room temperatures. Room temperature should be below 30°C for optimum battery life. Heat sink temperatures should be below 50°C (may be slightly higher if the UPS, within the last few minutes, ran off batteries with a fairly high load for several minutes). Ambient temperature on the control PC board should be below 40°C. If higher temperatures are observed, and the room temperature is below 30°C, check for proper fan operation and possible air blockage.
- If you use a generator for a backup system to the utility, make sure the frequency tolerance of the voltage generated by the generator is well within the limits set on the SELECT PARAMETERS LCD display of the UPS (normally set to +/- 5 Hz at the factory).
- Check to make sure all three fans, exhausting air at top of unit, are functioning (this is accomplished by simply moving hand over exhaust area to check airflow. Also, note any noise coming from the fans. If your UPS is equipped with air filters, check and replace if necessary.
- Make sure the automatic battery test feature is enabled on your UPS (see section 5.3.6 for details).
- Check the historical storage information for problems. Check AC Faults for an abnormally high number of problems. Check Overloads for problems. Check Shutdowns for abnormal shutdowns. Check Automatic battery quick and capacity test data for problems with the batteries.
- Make sure the date, time, and weekday are correct on the SET DATE/TIME LCD display.

9. EXTERNAL BATTERY CABINETS

This section describes all of Mesta's available battery cabinets that are designed to work with a Mesta UPS covered by this manual. Make sure to read and understand all warnings and instructions in this section of the manual before any work is begun.

WARNING

Only qualified technicians or supervised personnel should attempt to connect/disconnect external battery cabinets to/from the UPS models covered by this manual. **ALL** of the following **WARNINGS** and **INSTRUCTIONS** should be read and fully understood prior to undertaking this task. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

If your system is configured with internal batteries, additional battery cabinets may be added to your UPS to extend the backup time of your UPS. If the UPS cabinet does not have internal batteries, than at least one battery cabinet must be incorporated into the UPS system to provide backup energy. It is recommended that only battery cabinets supplied by Mesta Electronics be added so that complete compatibility with your UPS can be guaranteed. Different manufacturers' battery cabinets may possibly be used, but their use should be cleared with Mesta before doing so. **CAUTION** - not checking other battery cabinets with Mesta Electronics may result in serious damage to the UPS and will nullify warranty and UL compliance.

WARNING

Risk of ***Electric Shock***. Do not attempt to connect/disconnect external battery cabinets to/from the UPS unless the UPS external battery breaker and all external battery cabinet breakers are OFF. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

WARNING

Risk of ***Electric Shock*** and ***Fire***. The battery circuit is grounded at the UPS. Do not attempt to additionally ground the battery circuit. Otherwise, maintenance personnel may be exposed to an electrical shock hazard that could result in death or injury, or damage to the UPS or its electrical loads may occur.

Available Models: The Mesta battery cabinet model numbers are listed in Table 7. All of the battery cabinets are designed to mate with all UPS models covered by this manual. The "nn" in the model numbers to the right indicates the size of the UPS that the battery cabinet is to be mated with. The "nn" value **must** match the UPS rating to which it is being connected.

Table 7 Battery Cabinet Specifications

Cabinet Model No.	No. of Batteries	Amp-hour Rating
BC20-38-nn	20	38
BC20-65-nn	20	65
BC40-38-nn	40	76
BC40-65-nn	40	130
BC60-38-nn	60	114
BC80-38-nn	80	152
BC100-38-nn	100	190

Location: The auxiliary battery cabinet is designed to be located on the left side of the UPS cabinet. This arrangement will present the shortest distance between the two battery breakers, and it will also provide optimum access to the UPS if any of its cabinet panels need to be removed.

Procedure: To connect one or more external battery cabinets to a UPS, perform the following steps:

1) Verify that the breaker inside each battery cabinet is turned off. Verify that the UPS is off, and verify that all battery breakers, as well as the AC breaker, on the front of the UPS are off. No power must be present during the installation procedure. The qualified electrician should select wire and conduit sized to meet the battery currents shown in Table 7 and meeting the wire range shown in Table 8.

Table 8 External Battery Wire Size and Torque Requirements

UPS Size	Tool	Allowable wire size (Cu)	Torque (in-lbs.)	Torque (N-m)
10-15 KVA	Flat Blade Screwdriver	6 AWG –4 AWG	45	5.0
		3 AWG	50	5.6
		2 AWG -1/0 AWG	60	6.8
20-30 KVA	5/16” Allen wrench	6 AWG –1 AWG	120	14
		1/0 AWG – 350 kcmil	275	31
50 KVA	3/8” Allen wrench	3/0 AWG –500 kcmil	300	34

2) The qualified electrician will find pilot holes above the External Battery Breaker on the top of the UPS cabinet and above the breaker on the top of the External Battery Cabinet, unless the customer requests otherwise. The electrician can use the appropriate punch to prepare both cabinets for the type of conduit and connector that are going to be used on-site. Drilling or filing is not recommended, as the metal particles could interfere with the internal electrical/electronic equipment.

3) The wires should be cut to the appropriate length, and one wire should be marked at both ends with **white tape** to indicate this is the (+) wire. The other wire can be left black.

4) Once the wires are marked, they can be fed through the conduit from one cabinet to the other.

5) The wire marked **white** should be inserted on the left side of the breaker (from the top) which is indicated to be "+". The **unmarked** wire should be inserted on the right side of the breaker (from the top) which is indicated to be "-". According to Mesta convention the left side of the breaker will be (+) and the right side (-).

6) Make sure that the wire is stripped properly and that sufficient wire is inserted in the breaker lug for a solid mechanical and electrical connection. Refer to Table 8 for tightening torque and required tool. A copper lug marked “GND” is supplied on the upper right side of the UPS for the purpose of grounding the cabinet to earth ground. This lug will accommodate wiring between 8 and 2 AWG for units up to and including 30 KVA, and wiring between 8 and 1/0 AWG for systems above 30 KVA. A wire size that meets local electrical codes must be selected and may be routed with the AC supply wiring to the service distribution panel earth ground. Alternatively, a hole can be drilled and tapped on the backside of the cabinet frame (not the panel), near the bottom to provide an external chassis ground. Care should be taken so that metal particles produced by such operation are not allowed to come in contact with any internal electrical components.

7) Copper lugs marked “GND” are supplied on the upper right side of the Battery cabinet and the upper left side of the UPS cabinet for the purpose of grounding the Battery cabinet to earth ground via the UPS. This lug will accommodate wiring between 8 and 2 AWG for units up to and including 30 KVA, and wiring between 8 and 1/0 AWG for systems above 30 KVA. A wire size that meets local electrical codes must be selected and may be routed with the Battery wiring to the UPS. Alternatively, a hole can be drilled and tapped on the backside of the Battery cabinet frame (not the panel), near the bottom to provide an external chassis ground. Care should be taken so that metal particles produced by such operation are not allowed to come in contact with any internal electrical components.

8) Once the above steps are accomplished, turn on the external battery cabinet breaker, and then turn on the External Battery Breaker as well as the Main Battery Breaker on the UPS. Should the breakers trip a) check wiring for wiring errors, b) check breakers for possible defective breaker.

9) Turn on the UPS Input AC Breaker and start UPS by rotating main power switch clockwise to the ON UPS position.

Note: If more than one battery cabinet is to be used, the battery cabinets will be cascaded according to special instructions included with the battery cabinets.

Dimensions: Mesta Electronics offers three sizes of battery cabinets, size 1, 2, and 3. The size 1 and 2 battery cabinets are identical in size to the size 1 and size 2 UPS cabinets, measuring 32" (size 1) or 38" (size 2) wide X 28" (size 1) or 32" (size 2) deep X 75" high. The size 3 battery cabinets measure 38" wide X 36" deep X 75" high. Size 1 and size 3 cabinets contain 38 amp-hour batteries while size 2 cabinets contain 65 amp-hr batteries.

Backup Times: The auxiliary battery cabinets will increase the backup times for the UPS according to the magnitude and the power factor of the load. For the sake of comparison, Table 9 below demonstrates the amount of time (in minutes) that the UPS internal batteries will power the UPS inverter based upon the load (in kilowatts) expressed as a percentage of the rated load of the UPS model. Several examples of model numbers are included in Table 9:

Table 9 UPS Internal Battery Time at Various Loads

UPS MODEL NUMBER	100% Load	70% Load	50% Load
10000/3-20-1	22	36	56
15000/3-20-1	13	21	33
20000/3-20-1	9	14	22
25000/3-20-1	6	10	16
25000/3-20-2	13	21	34
30000/3-20-2	10	17	26
50000/3/20-2	N/A	N/A	N/A

Table 10 lists the total backup time when a battery cabinet is added to a UPS. The additional battery capacity adds to the internal capacity to yield much longer runtimes. All of the times indicated are in minutes and represent systems loaded to 100% and to 50% of their rated load. Actual times you receive with your system will vary depending upon your actual load.

Table 10 Total System Backup Time with Single External Battery Cabinet

MODEL #	BC20-38		BC40-38		BC20-65		BC40-65		BC60-38		BC80-38		BC100-38	
	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%
10000/3-20-1	56	139	95	238	83	208	159	360	139	330	187	420	238	540
15000/3-20-1	33	81	56	139	49	122	93	233	81	204	109	274	139	330
20000/3-20-1	22	56	38	95	33	83	63	159	56	139	75	187	95	238
25000/3-20-1	16	41	28	71	25	62	47	118	41	104	56	139	71	177
25000/3-20-2	25	62	37	94	34	84	58	144	51	129	66	166	82	206
30000/3-20-2	19	49	29	74	26	66	45	113	40	101	52	130	65	162
50000/3-20-2							13	34	11	28	17	41	22	56

Specifications: The maximum amperage that each cabinet will allow is dependent upon the UPS to which it is attached. A cabinet, therefore, will utilize different sizes of breakers according to the

cabinet's intended use. The breaker current ratings and maximum current that the UPS will pull from the batteries while supporting the rated UPS load are shown in Table 11:

Table 11 Battery Cabinet Amp Ratings vs. UPS KVA Rating

UPS KVA Rating	Breaker current trip rating on UPS and Battery Cabinet	Max Current from batteries while supporting rated UPS load
10KVA	80	50
15KVA	100	70
20KVA	150	100
25KVA	200	120
30KVA	225	140
50KVA	350	240

The breaker trip rating is approximately 50% higher than the maximum current drawn from the batteries while supporting the rated UPS load. This over-rating is necessary to avoid nuisance trips in the breakers should the UPS be overloaded periodically up to as much as 300% for very short periods of time or up to 150% for 1 minute.

Wiring Diagrams: Before beginning any work inside a Mesta Battery Cabinet, review the configuration of the batteries in the cabinet to prevent any personal injury. Figure 12 shows the three wiring configurations of Mesta battery cabinets. Figure 12a details a BC40-38, which contains two strings of batteries, each string taking two shelves. A BC20-38 is similar to a BC40-38, except there is only one string of batteries residing on the lower two shelves. Figure 12b shows a BC100-38 Mesta Battery cabinet which contains five strings of batteries with one string of batteries per shelf. The BC60-38 and BC80-38 cabinets have three and four strings/shelves of batteries, respectively, always placed from the bottom up. Figure 12c shows a BC40-65 Mesta Battery Cabinet. The BC20-38 and BC40-38 are similar to the BC20-38 and BC40-38 battery cabinets, except for the number of batteries in each string.

Figure 12 Battery Cabinet Wiring Diagrams

Figure 12a) BC20-38 and BC40-38 Wiring Diagram

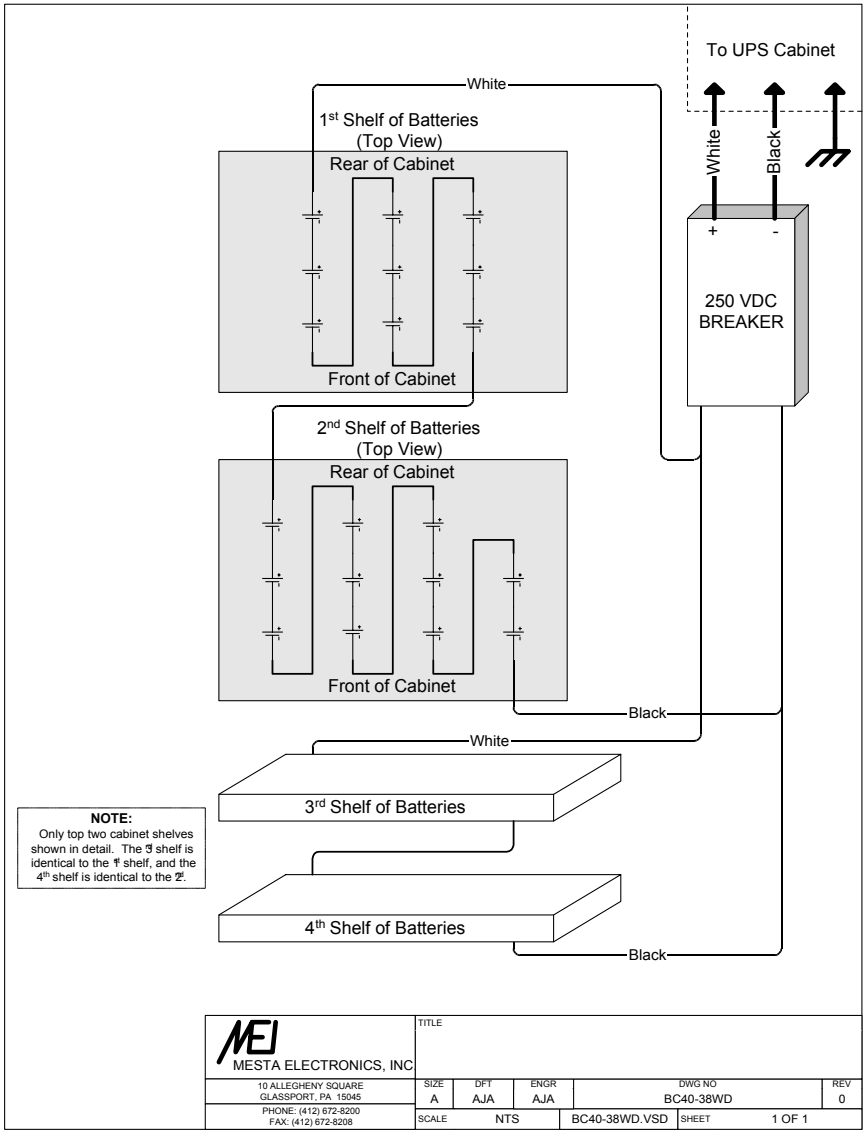


Figure 12b) BC60-38, BC80-38, and BC100-38 Wiring Diagram

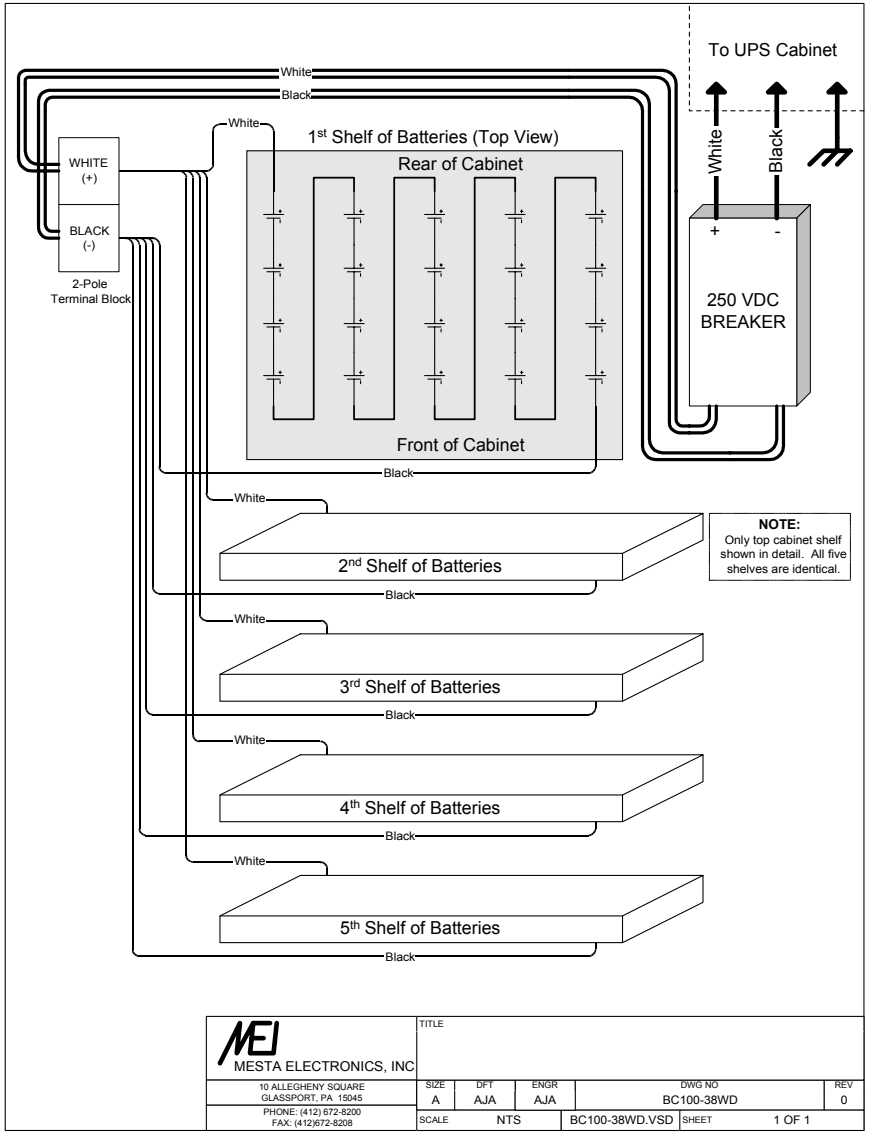
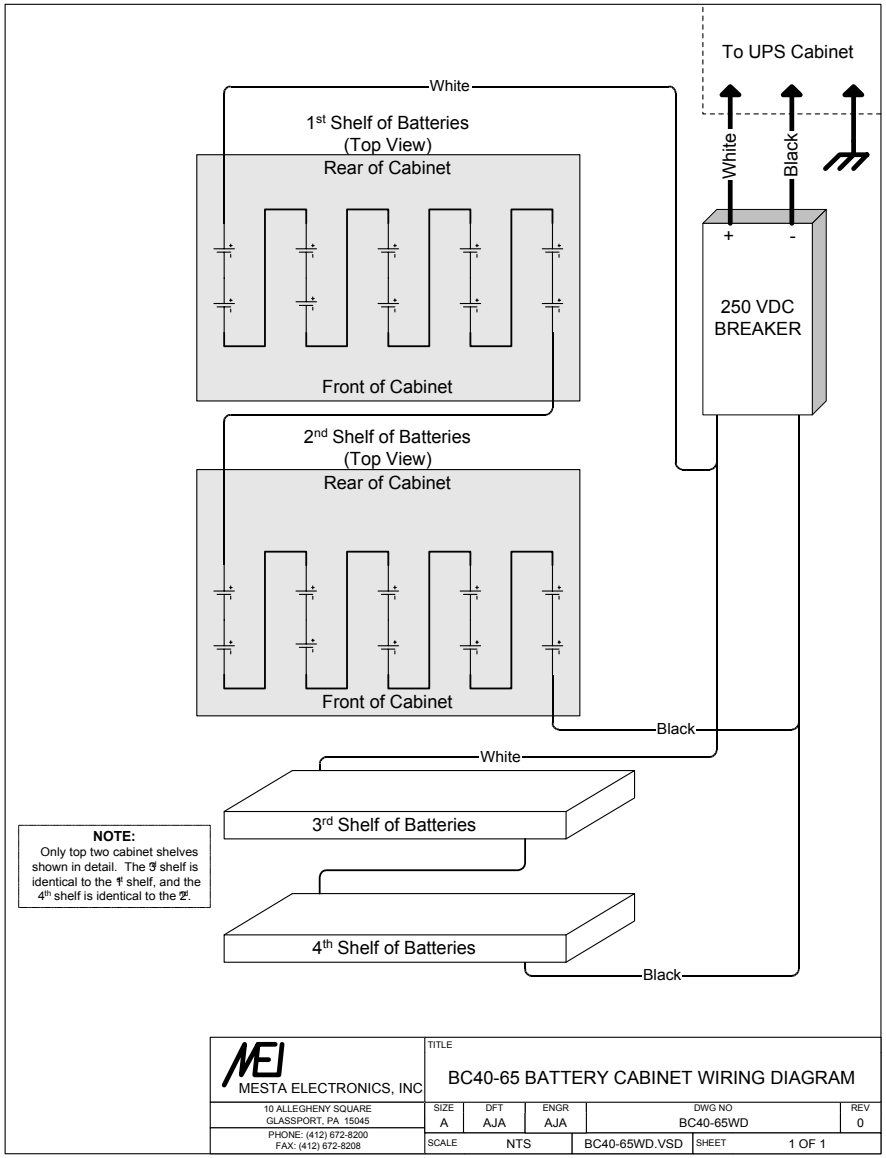


Figure 12c BC20-65 and BC40-65 Wiring Diagram



APPENDIX A. UPS SPECIFICATIONS BY MODEL

This section of the Mesta Electronics Owner's Manual contains the full set of operating specifications for the models covered herein.

⋖Standard UPS Models⋗

UPS10000/3-20-1 • 10KVA/KW 3Φ
UPS15000/3-20-1 • 15KVA/KW 3Φ
UPS20000/3-20-1 • 20KVA/KW 3Φ
UPS25000/3-20-1 • 25KVA/KW 3Φ
UPS25000/3-20-2 • 25KVA/KW 3Φ
UPS30000/3-20-2 • 30KVA/KW 3Φ
UPS50000/3-20-2 • 50KVA/KW 3Φ

⋖UPS10000/3-20-1 - 10KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⋗

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 35 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency ranges are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 28 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via front panel)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .34 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY

Sealed maintenance-free 3-5 year expected life
Battery voltage • 240VDC nominal
Battery current • 50 amps max
Backup time on internal batteries:
• 22 min. (full load - P.F.=1)
• 36 min. (full load - P.F.=.7)

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A operation.

PHYSICAL

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions
• Height 75"• Depth 28"• Width 32"
Weight with internal batteries • 1,400 lbs.
Color • PC Bone

OPTIONS

Larger size 2 cabinet (75” x 32” x 38”) with 65 amp-hr internal batteries
External Battery Cabinets • For extended backup times Models BC20-38, BC40-38, BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC20-65, BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.

NOTE: For any of the above options, consult factory.

⩤UPS15000/3-20-1 - 15KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⩥

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 50 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency range are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 42 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via front panel)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .34 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY

Sealed maintenance-free 3-5 year expected life
Battery voltage • 240VDC nominal
Battery current • 70 amps max
Backup time on internal batteries:
• 13 min. (full load - P.F.=1)
• 21 min. (full load - P.F.=.7)

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A operation.

PHYSICAL

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions:
• Height 75"• Depth 28"• Width 32"
Weight with internal batteries • 1,500 lbs.
Color • PC Bone

OPTIONS

Larger size 2 (75” x 32” x 38”) cabinet with 65 amp-hr internal batteries
External Battery Cabinets • For extended backup times Models BC20-38, BC40-38, BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC20-65, BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.

NOTE: For any of the above options, consult factory.

⩤UPS20000/3-20-1 - 20KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⩥

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 67 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency ranges are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 56 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via RS232 port)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .17 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY

Sealed maintenance-free 3-5 year expected life
Battery voltage • 240VDC nominal
Battery current • 100 amps max
Backup time on internal batteries:
• 9 min. (full load - P.F.=1)
• 14 min. (full load - P.F.=.7)

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line, or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A) operation.

PHYSICAL

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions
• Height 75"• Depth 28"• Width 32"
Weight with internal batteries • 1,600 lbs.
Color • PC Bone

OPTIONS

Larger size 2 (75” x 32” x 38”) cabinet with 65 amp-hr internal batteries
External Battery Cabinets • For extended backup times Models BC20-38, BC40-38, BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC20-65, BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.
NOTE: For any of the above options, consult factory.

⋖UPS25000/3-20-1(or 2) - 25KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⋗

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 85 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency ranges are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 70 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via RS232 port)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .17 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY

Sealed maintenance-free 3-5 year expected life
Battery voltage • 240VDC nominal
Battery current • 120 amps max
Backup time on int. batteries (-1 model)
• 6 min. (full load - P.F.=1)
• 10 min. (full load - P.F.=.7)
Backup time on int. batteries (-2 model)
• 13 min. (full load - P.F.=1)
• 21 min. (full load - P.F.=.7)

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line, or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A operation.

PHYSICAL

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions (-1 model)
• Height 75"• Depth 28"• Width 32")
Dimensions (-2 model)
• Height 75"• Depth 32"• Width 38")
Weight with internal batteries • 1,700 lbs.
(-2 model: larger cabinet = 2,000 lbs)
Color • PC Bone

OPTIONS

External Battery Cabinets • For extended backup times Models BC20-38, BC40-38, BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC20-65, BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.

NOTE: For any of the above options, consult factory.

⋖UPS30000/3-20-2 – 30KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⋗

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 100 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency ranges are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 83 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via RS232 port)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .17 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY

Sealed maintenance-free 3-5 year expected life
Battery voltage • 240VDC nominal
Battery current • 140 amps max
Backup time on internal batteries:
• 10 min. (full load - P.F.=1)
• 17 min. (full load - P.F.=.7)

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A operation.

PHYSICAL (30KVA)

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions
• Height 75"• Depth 32"• Width 38"
Weight with internal batteries • 2,100 lbs.
Color • PC Bone

OPTIONS

External Battery Cabinets • For extended backup times Models BC20-38, BC40-38, BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC20-65, BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.

NOTE: For any of the above options, consult factory.

⋖UPS50000/3-20-2 – 50KVA/KW 3Φ ON LINE UPS SPECIFICATIONS⋗

INPUT

Voltage • 208/120VAC 3Φ Nominal
Current • 160 amps max at rated load.
Frequency • 60Hz ±5Hz (Input voltage and frequency ranges are programmable via front panel)

OUTPUT

Voltage (AC line) • 208/120VAC 3Φ Nominal
Voltage (on inverter) • 208/120VAC ±1%
Current (rated load) • 139 amps
Crest Factor Capability • 3.0
Output Power Factor Limitations • None
Frequency (AC line) • follows input
Frequency (on inverter) • 60Hz ±.01Hz
Frequency Slew Rate • 1-255Hz/sec (programmable via RS232 port)
Efficiency >94% overall at full load
Overload Rating • 150% for 1 min.
• 300% for .17 sec.

OVERLOAD PROTECTION

Output is electronically current limited to 300% full load rating
Circuit breakers provide backup protection to electronic current limit
Over temperature protection

BATTERY CABINET

Sealed maintenance-free 3-5 year expected life
External Battery voltage • 240VDC nominal
External Battery current • 240 Amps max

INDICATORS AND CONTROLS

Keypad • to address several data screens, command UPS control, set parameters
LCD Screen • to provide full system operating data/warnings/messages
Rotating Transfer Switch to select modes: OFF/ OFF IDLE/ ON UPS/ ON BYPASS
Transfer Request button • to allow UPS to switch between normal operation and maintenance bypass without power interruption to load.
LEDs • indicate AC line presence, Battery discharging, and presence of an alarm condition.
Audible alarm • indicates loss of AC line or presence of an alarm condition.
Reset Switch • silences audible alarm
RS232 Interface for remote communications of status and diagnostics (Voltage or Current Loop interface configuration)
Custom I/O and Relay Contacts • provides status contacts capable of 120V/10A or 24V/0.1A operation.

PHYSICAL (50KVA)

Operating Temp • 0°C to 40°C ambient without derating.
Storage Temp • -20°C to 40°C
Thermal • Internal forced air
Audible Noise • 60 dBA
Input/Output • hardwired to distribution panels.
Dimensions
• Height 75"• Depth 36"• Width 38"
Weight • 2,200 lbs.
Color • PC Bone

OPTIONS

Additional External Battery Cabinets • Models BC60-38, BC80-38, BC100-38 (38 amp-hour) or BC40-65 (65 amp-hour)
50 Hz Models, Other voltages, External step up/down transformers, Remote status displays.

NOTE: For any of the above options, consult factory.

APPENDIX B: REAR PANEL RELAY CONTACT FUNCTIONAL OPERATION

The UPS has status relay contacts accessible from the rear of the unit. The status of these contacts (open or closed) is controlled by the internal microcontroller to reflect operational conditions of the UPS. Section 2.2 of this manual defines the electrical operation of these relay contacts. This Appendix defines the functional operation of these relays. Presently, these relay contacts can be set up to function in one of three different modes of operation. The mode used by a particular UPS can be determined by connecting a computer or terminal to the serial communications port (see section 2.2) and typing **OPT** followed by the **<enter>** key. Following is a description of the modes presently in existence. Note that if the UPS' controls are receiving no power because either the Transfer Switch is in the OFF position, the DC breaker is in the off position, or an internal UPS failure exists that prevents the controls from receiving power, all contacts will be open.

MODE 0:

Relay	Normally Open Contacts Closed if These Conditions Exist
1	Battery is being discharged (UPS may or may not be producing output power).
2	UPS is producing output power BUT needs attention. UPS needs attention if one or more of the following is true: an overload exists, an over-temperature condition exists, a diagnostic condition exists, or a warning condition exists.
3	Transfer Switch is in the ON BYPASS position.
4	UPS is producing output power AND Transfer Switch is in the ON UPS position.

MODE 1:

Relay	Normally Open Contacts Closed if These Conditions Exist
1	UPS is producing output power AND either battery has been discharging for at least 10 seconds OR a new alarm condition exists. A new alarm (overload, over-temperature, diagnostic, or warning) is an alarm that has occurred since the last time this status has been acknowledged. (Can be connected to control an audible alarm. Alarm may be acknowledged, and thus silenced, by shorting pins 3 & 4 of the "Custom I/O" connector on the UPS after the alarm has occurred.)
2	UPS is producing output AND battery is charging AND Transfer Switch is in the ON UPS position (UPS is operating normally).
3	UPS is producing output BUT battery is discharging AND Transfer Switch is in the ON UPS position (UPS is operating normally except battery is discharging).
4	UPS has either shut down due to an abnormal condition, is in an overload or over-temperature condition, or has detected a diagnostic or warning condition (UPS needs attention).

MODE 2:

Relay	Normally Open Contacts Closed if These Conditions Exist
1	UPS is producing output power AND battery has been discharging for at least 10 seconds.
2	UPS has either shut down due to an abnormal condition, is in overload or over-temperature condition, or has detected a diagnostic or warning condition (UPS needs attention).
3	Same as Relay 1
4	Same as Relay 2

MODE 3:

Relay	Normally Open Contacts Closed if These Conditions Exist
1	UPS is producing output power AND battery has been discharging for at least 10 seconds.
2	UPS has either shut down due to an abnormal condition, is in overload or over-temperature condition, or has detected a diagnostic or warning condition (UPS needs attention).
3	UPS is running from battery and battery charge has fallen below 20%. Relay is then not opened again until battery charge has risen above 80% AND 2 hours have passed. This relay output can be used to signal an external transfer switch to switch to an alternative source in the event that the original source is outside of the UPS's operating range. This relay output should be OR'd with the external transfer switch's command to switch to an alternate source.
4	UPS is producing output power AND Transfer Switch is in the ON UPS position.

Note: A remote status panel manufactured by Mesta is available that works with Mode 1 to provide an audible alarm controlled by relay 1, a green light by relay 2, a yellow light by relay 3, and a red light by relay 4. A pushbutton switch silences the audible alarm. A remote status indicator can provide important status information to personnel in situations where the UPS is placed in an area that is normally unattended. Other arrangements are also available from the factory.

APPENDIX C. WARRANTY/SERVICE AND REPAIR

⋖LIMITED WARRANTY POLICY⋗

Mesta Electronics, Inc. warrants its UPS to be free from defects in materials and workmanship for a period of 1 year from the date of original shipment from the factory, provided the UPS has not been abused, misused, or used outside of the specified conditions. Mesta Electronics, Inc. will be the sole determiner as to whether the UPS has been abused or misused. If found to be defective, the UPS will be repaired or replaced at the discretion of Mesta Electronics, Inc. An extended warranty may be purchased. The battery manufacturer's warranties are passed through by Mesta Electronics, Inc. to the customer. Before returning any UPS, in or out of warranty, to Mesta Electronics, purchaser must contact Mesta's Customer Service Department. Any UNAUTHORIZED return of a UPS to Mesta Electronics for in-warranty or out-of-warranty repairs will be subject to an inspection and handling charge, in addition to all associated repair and transportation costs. Mesta Electronics, Inc. will be in no way responsible for any consequential damages of any kind or nature whatsoever resulting from the use of its UPS in any manner whatsoever and/or from the breach of any warranty, express or implied.

Mesta Electronics, Inc.

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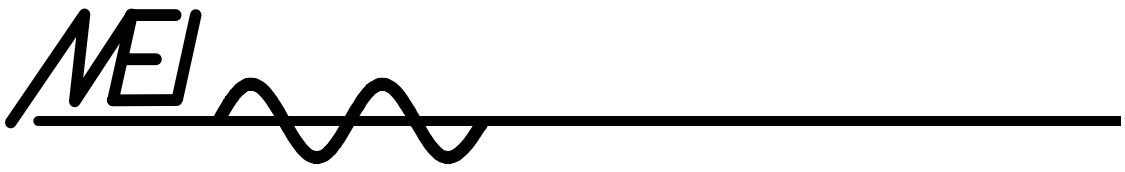

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