
HA3000
11KVA

HA3000 11 kVA Uninterruptible Power System User's Guide

Order Number EK-11KVA-UG-001

Digital Equipment Corporation

1st Edition, December 1990

The postpaid Reader's Comment Card included in this document requests the user's critical evaluation to assist in preparing future documentation.

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SECTION I

INTRODUCTION

1.0 Scope

This manual provides technical information required for the installation, operation, and maintenance of the HA3000 Uninterruptible Power System (UPS). Please read this manual thoroughly before installing or operating the HA3000 equipment. The manual is divided into four sections:

Section I — INTRODUCTION

This section serves as an introduction to the manual and the HA3000 series of UPS products. The UPS is described, followed by specifications for standard models, and an introduction to controls and indicators.

Section II — INSTALLATION

This section explains procedures for receiving, handling, and storing the equipment, prerequisites to the installation procedure, and equipment start-up procedures.

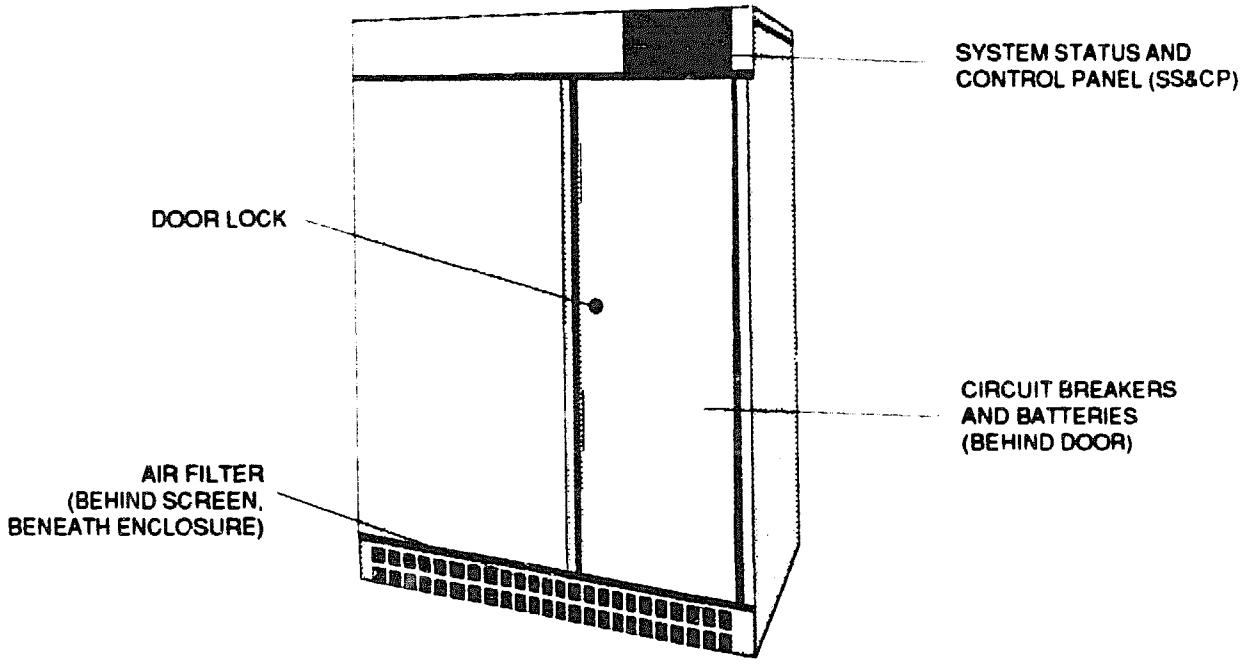
Section III — OPERATION

This section describes the HA3000 System Status and Control Panel (SS&CP), including programmable controls and indicators, electro-mechanical controls, UPS operating modes, and system alarm conditions.

Section IV — MAINTENANCE

This section describes preventive maintenance procedures, and the diagnostic capabilities of the UPS.

FIGURE 1: HA3000 11 kVA PICTORIAL



1.1 System Description

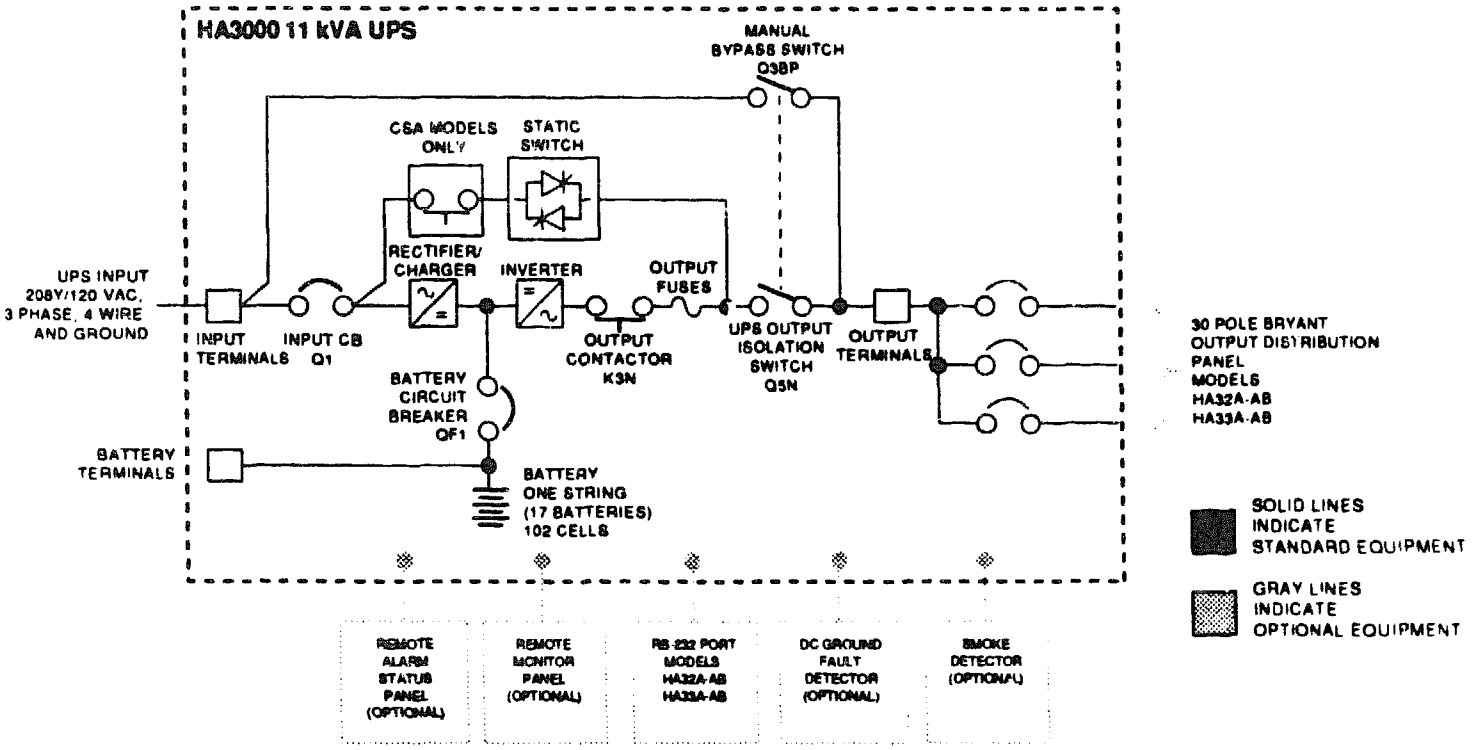
The HA3000 is an on-line static uninterruptible power system (UPS), designed to protect critical loads from anomalies encountered on a building's power distribution system. The HA3000 UPS can be installed in a computer room, or an equipment room. Figure 1 shows a pictorial of the HA3000 11 kVA UPS.

The HA3000 UPS is Listed for safety by Underwriter's Laboratories, Inc. (UL), under UL Standard 1778 — Uninterruptible Power Supply Equipment.

Major components of the HA3000 11 kVA UPS include a Rectifier/Battery Charger, a transistorized pulse-width-modulated (PWM) static Inverter, a continuous-duty rated Static Switch that automatically transfers the load to and from the bypass AC input source and the UPS Inverter output, an internal Manual Bypass function that allows the critical load to be operated from the utility source while the UPS output is isolated for service, and a battery system housed inside the UPS enclosure.

A System Status and Control Panel (SS&CP) provides controls to select system operation, and indicators that allow system performance to be monitored. A liquid-crystal display (LCD) is used to display system operating parameters, provide step-by-step operating instructions to the system operator, and provide a diagnostic capability to assist in troubleshooting the UPS. The built-in UPS Monitor software is programmed to display messages in five languages: English, French, German, Spanish, and Italian.

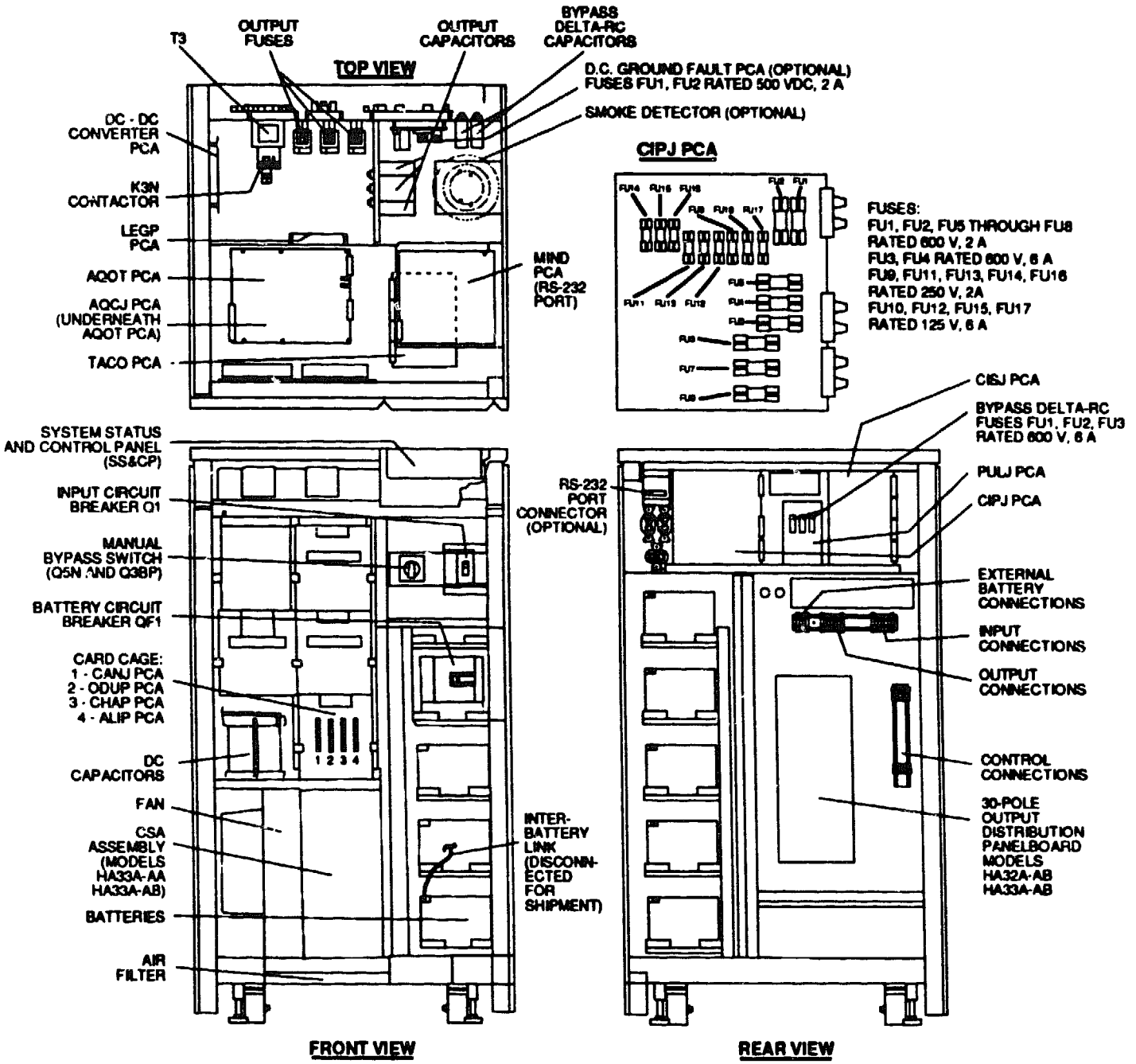
FIGURE 2: SINGLE-LINE DIAGRAM



The HA3000 UPS uses microprocessors to precisely control operation of the Rectifier/Battery Charger, transistorized pulse-width-modulated (PWM) static Inverter, and Static Switch, to insure optimum performance for all line, load, and operating conditions. In addition, a microprocessor-based diagnostic system assists in troubleshooting faulty assemblies for replacement, to minimize service time. Modular construction throughout the HA3000 UPS facilitates maintenance of the system.

A single-line diagram of the HA3000 11 kVA UPS is shown in Figure 2. The location of the HA3000 11 kVA UPS major internal components is shown in Figure 3.

FIGURE 3: LOCATION OF MAJOR INTERNAL COMPONENTS



1.1.1 Rectifier/Battery Charger

The Rectifier/Battery Charger consists of:

- **AC Input Circuit Breaker (Q1)**: The AC Input Circuit Breaker provides mechanical isolation and electrical protection for the input of the UPS
- **Battery Bank**: A string of sealed, maintenance-free batteries of lead-calcium, recombination-type, that provide power to the Inverter during power outage conditions
- **Battery Circuit Breaker (QF1)**: This circuit breaker provides mechanical isolation and electrical protection for the battery bank
- **Power Module**: The Power Module is a plug-in unit that converts incoming ac power to a regulated dc output voltage. The regulation is carried out by controlling the silicon-controlled rectifier (SCR) conduction angles, allowing the Rectifier/Battery Charger to supply a stable dc voltage (± 1%). The dc voltage is filtered by a capacitor bank
- **DC Shunt**: The DC Shunt is used to monitor the battery charge current and provide data for regulating the dc voltage at the desired level

1.1.2 Static Inverter

The Static Inverter consists of:

- **Power Module**: The Power Module is a plug-in unit, used to chop the dc voltage to obtain a PWM waveform at the primary of the output transformer
- **Inverter Transformer**: The Inverter Transformer is a full-isolation transformer that provides input/output electrical isolation for the UPS, provides the required output voltage, and provides the required inductance for the AC Output Filter
- **AC Output Filter**: The AC Output Filter is used to achieve a computer-grade sine wave output voltage waveform, with a total harmonic distortion (THD) of 4% maximum (3% typical)

1.1.3 Static Switch

The Static Switch transfers the load from the UPS Inverter output to the Bypass AC Input source, or from the Bypass AC Input source to the UPS Inverter output, without any interruption to the load (provided that the UPS Inverter output is synchronized to the Bypass AC Input source). These transfers take place automatically upon Inverter start-up or shut-down. The Static Switch is rated for continuous-duty, and is of plug-in construction for ease of maintenance.

The ΔRC (delta-RC) circuit network protects the Static Switch against high voltage spikes and surges by absorbing the excess energy. The ΔRC circuit network is protected by fuses, and any failure of these fuses will be displayed on the SS&CP LCD.

1.1.4 Manual Bypass

The internal Manual Bypass switch, when operated as specified, provides a make-before-break transfer of the load from the UPS Inverter output to the Bypass AC Input source, or from the Bypass AC Input source to the UPS Inverter output. This feature allows the critical load to be operated from the utility power source.

Proper operation of the Manual Bypass switch is shown on the SS&CP LCD as part of the procedure for start-up or shut-down of the equipment.

1.2 Programmable Controls and Indicators

All HA3000 UPS programmable controls (excluding circuit breakers and non-automatic switches) and indicators are located on the System Status and Control Panel (SS&CP), on the front upper right portion of the UPS enclosure.

1.2.1 System Status and Control Panel (SS&CP)

The SS&CP is shown in Figure 4. The SS&CP contains these elements:

- Liquid-Crystal Display (LCD)
- Audible Alarm Silence key
- Alarm Indication LED
- Scroll Up key
- Scroll Down key
- Ten Digit (0 to 9) keys
- Rectifier/Battery Charger Status Indicator LED
- Inverter Status Indicator LED
- Load On Bypass Indicator LED
- Voltage Measurement key
- Current Measurement key
- Main Menu Call key
- Entry Validation or Return To Menu key
- Emergency Power Off (EPO) keys

Detailed descriptions of the SS&CP indicators and the use of the SS&CP keys are provided in Section III — OPERATION, ¶ 3.1.

1.3 Specifications

Specifications for the HA3000 11 kVA UPS are provided in Table 1.

FIGURE 4: SYSTEM STATUS AND CONTROL PANEL (SS&CP)

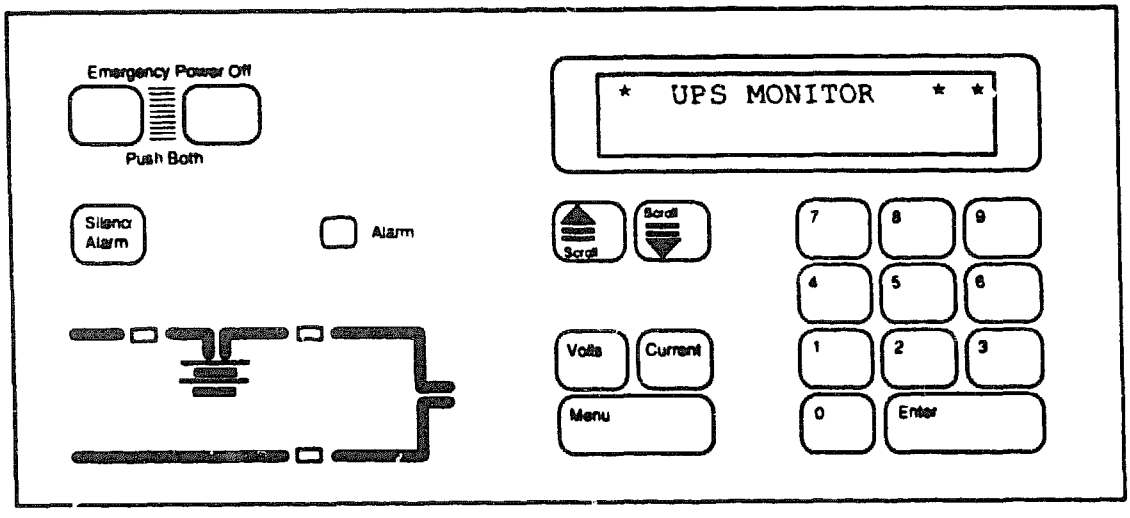
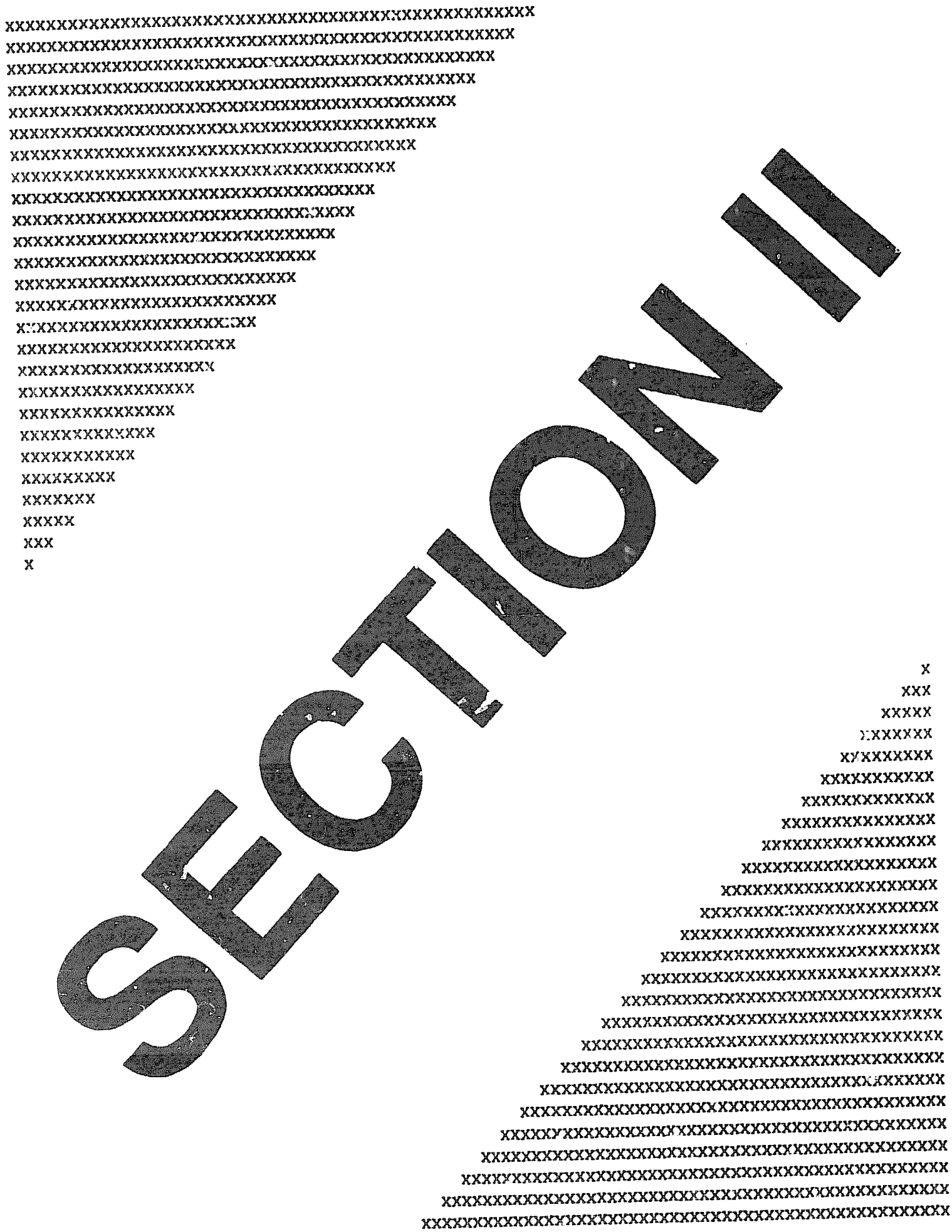


TABLE 1: HA3000 11 kVA UPS SPECIFICATIONS

AC Input Requirements:	**Voltage:**	208Y/120 VAC; ± 15%; 3 phase, 4 wires plus ground
	Frequency:	60 Hz ± 5%
	Current:	34 Amperes/Phase nominal
	Power Factor:	0.83 lagging minimum
	Main AC Input Circuit Breaker (Q1) Rating:	480 VAC, 50 Amperes
AC Output Characteristics:	**Voltage:**	208Y/120 VAC; 3 phase, 4 wires plus ground. Output voltage is adjustable within a range of ± 5% by software selection (see Section III — OPERATION)
	Voltage Regulation:	± 1% for balanced load and up to 30% unbalanced load ± 2% for 50% unbalanced load ± 5% for 100% unbalanced load
	Voltage Transient Response:	± 3% for 50% step load change ± 5% for 100% step load change ± 1% for loss or return of ac input power ± 1% for manual transfer at full load
	Voltage Recovery Time:	Return to within 1% of nominal value within 16.67 milliseconds (one cycle)
	Maximum Output Current:	30.5 Amperes @ nominal output voltage
	Phase Angle Displacement:	120 degrees ± 1 degree for balanced load 120 degrees ± 3 degrees for 50% unbalanced load
	Voltage Distortion:	Maximum 4% total (THD) and 3% for any single harmonic when the UPS is connected to 100% linear loads, or non-linear loads with a crest factor not to exceed 3
	Frequency:	60 Hz ± (0.25, 0.5, 0.75, or 1.0 Hz, software selectable) 60 Hz ± 0.1% when free-running (UPS on internal oscillator)
	Slew Rate:	1 Hz/second maximum
	Power Factor:	0.8 at rated load
	Overload Capability:	125% of rated load for 10 minutes 150% of rated load for 1 minute

(Table 1 continues . . .)

Battery and DC Bus Requirements:	**Voltage:**	Float = 232 Vdc Cut-Off = 163 Vdc
	Current:	Charge = 3 Amperes per string (field adjustable) Discharge = 60 Amperes maximum @ cut-off voltage
	Battery String:	One string (17 batteries) of 102 cells
	Battery Protection Time:	10.0 minutes @ 11 kVA/8.8 kW load [Battery protection time is determined at an ambient temperature of 25° C. (77° F.)]
	Battery Circuit Breaker (QF1) Rating:	250 Vdc, 60 Amperes
Environmental Characteristics:		
Ambient Temperature:		
	Operating:	0° C. to 40° C. (32° F. to 104° F.) (Excluding battery)
	Non-Operating and Storage:	-25° C. to +70° C. (-13° F. to 158° F.) (Excluding battery)
	Maximum Operating Temperature for Optimal Battery Performance:	25° C. (77° F.)
	Efficiency:	The system efficiency at nominal input voltage and with battery fully charged: 89% at full load 88% at 75% load 88% at 50% load
	Heat Generation:	3,715 Bth/Hr at full load
	Air Exhaust:	600 CFM
	Relative Humidity (Operating and Storage):	0 to 95%, non-condensing
Altitude:		
	Operating:	Up to 2,134 meters (7,000 feet) above sea level
	Non-Operating:	Up to 12, 192 meters (40,000 feet) above sea level
	Acoustical Noise:	58 dB at 0.9 meters (3 feet) (ANSI "A" scale weighting)
Dimensions:		
	Height:	22.46 cm (57 inches)
	Width:	12.41 cm (31.5 inches)
	Depth:	12.66 cm (32.12 inches)
	Weight:	499 kg (1,100 pounds)


SECTION II

INSTALLATION

2.0 Scope

This section contains the procedures for receiving, handling, and storing the equipment; prerequisites to the installation procedure; the installation process; and equipment start-up procedures.

2.1 Receiving

Inspect the exterior of all shipping containers and the equipment for damage that may have occurred during transit. If the shipping containers or equipment show evidence of damage, note the damage on the receiving document before signing for receipt of equipment.

The equipment should be unpacked immediately after receipt, and inspected again to determine of any internal shipping damage has occurred. Verify that the equipment nameplates correspond to the equipment ordered.

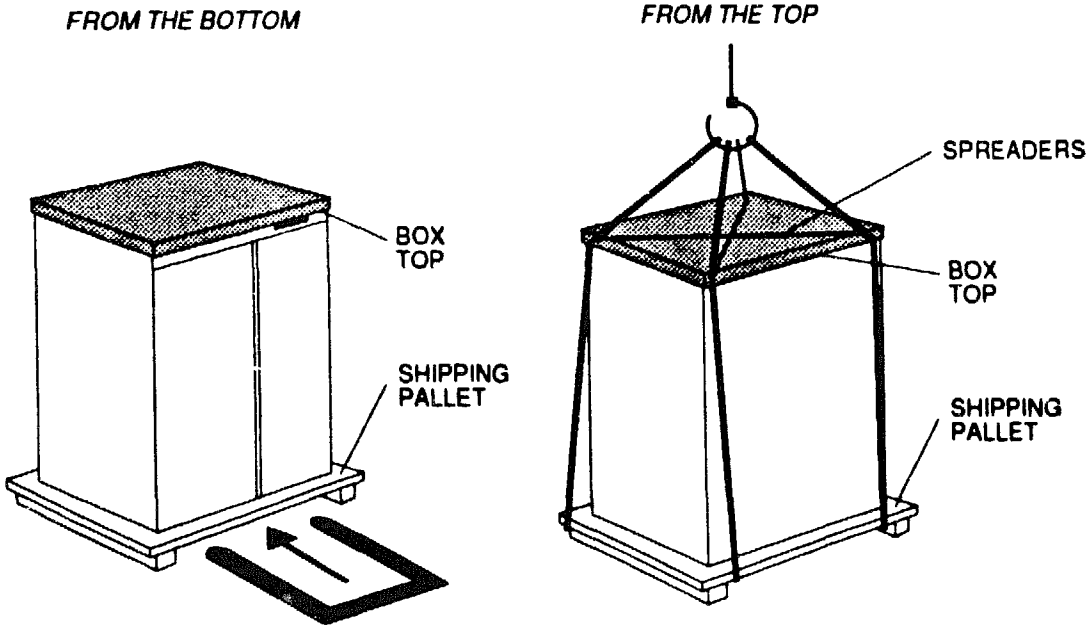
Damage claims should be filed directly with the carrier. Replacements for damaged components should be ordered through DIGITAL Customer Service.

2.2 Handling

The HA3000 UPS is designed for handling from the bottom (see Figure 5) For dimensions and weight, refer to Table 1.

The HA3000 UPS enclosure is mounted on a shipping pallet, covered by plastic wrapper, and topped with a box top. It is designed to be moved by a pallet mover, a rolla-lift (Models M-4, M-4-6, or CD-6), or a fork lift type truck. The front and rear lower cover plates of the enclosure are removed for shipment. The HA3000 UPS has a draw-out input air filter located under the enclosure, which is also removed for handling or transit. The air filter can be pulled out from beneath the enclosure once the front lower cover plate is removed.

FIGURE 5: HANDLING



The HA3000 UPS enclosure can be handled or moved by overhead equipment after it has been fitted with the necessary slings and spreaders (see Figure 5).

Follow the procedure below to move the HA3000 UPS from the shipping truck to the final installation position. This procedure is a general guideline; all safety precautions should be followed.

Removing Unit From Truck

Use a pallet mover or a fork lift to move the HA3000 UPS shipping pallet from the shipping truck to the loading dock.

Removing Shipping Carton

1. Cut the two plastic bands that secure the shipping carton to the pallet.

2. Remove the box top protecting the HA3000 UPS.

Removing Unit From Pallet

1. Remove the two corner boards from each vertical edge of the UPS.

2. Remove the four mounting brackets that secure the UPS to the shipping pallet:

    a. Use a 9/16-inch wrench to remove the bolts that secure the mounting brackets to the pallet.

    b. Use a Phillips screwdriver to remove the screws that secure the mounting brackets to the UPS.

3. Use a rolla-lift pair to remove the UPS from the shipping pallet. This requires at least two people:

    a. Place four corner boards across the top of each rolla-lift half to prevent damaging the front and rear panels of the UPS.

    b. Place one half of the rolla-lift on the front side, and the other half of the rolla-lift on the rear side of the UPS.

    c. Gradually tighten the strapping between the rolla-lift halves until they are resting securely against the UPS.

    d. Raise both rolla-lift halves simultaneously until the four caster are above the top surface of the pallet.

    e. Pull the pallet out from under the UPS, or roll the UPS to the side, until it is clear of the pallet.

Moving Unit To Final Position

1. Ensure that the four caster lifting legs are raised enough to allow the UPS to rest on the four casters.
2. Slowly lower both rolla-lift halves simultaneously until the UPS is resting on the four casters.
3. Use a sufficient number of people to roll the UPS to the installation area.
4. Slide the plastic shipping bag off of the UPS.
5. Roll the UPS to the final installation position.

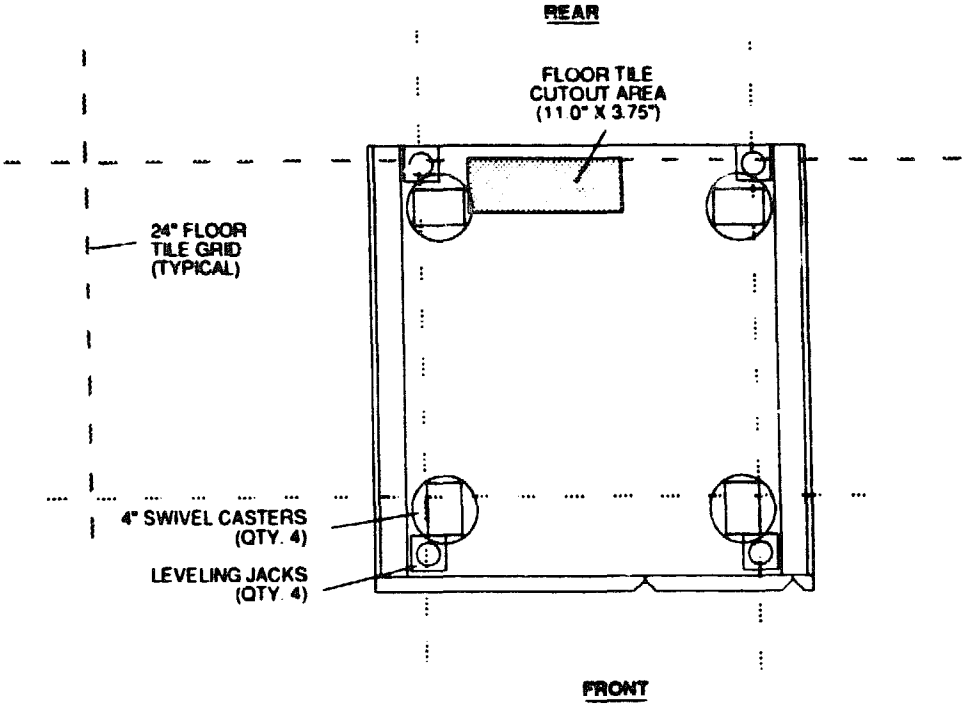
2.3 Storage

If the equipment is to be stored prior to installation, it should be stored in a cool, dry, well-ventilated location which is protected against rain, splashing water, chemical agents, etc. The equipment should be covered with a tarpaulin or plastic wrapper to protect it against dust, dirt, or other foreign materials.

IMPORTANT

The battery can only be stored for three (3) months maximum at 25° C. (77° F.) prior to recharging. Exceeding the recommended ambient storage temperature will reduce battery back-up time and may adversely effect battery life.

FIGURE 6: PLACEMENT, SHOWING FLOOR TILE CUT-OUTS



2.4 Prerequisites to the Installation

The UPS is intended for use in a computer room environment (controlled temperature and humidity), and can be installed on a raised computer room floor or on a solid surface. Wiring for power and control cables enters through the bottom rear of the enclosure.

The HA3000 11 kVA UPS requires a minimum of one (1) meter (three feet) of front and rear clearance for normal maintenance.

The UPS dissipates heat and exhausts warm air through the top portion of its enclosure. See Table 1 for heat dissipated (Btu/hr). Air exhaust is 600 cubic feet per minute (CFM).

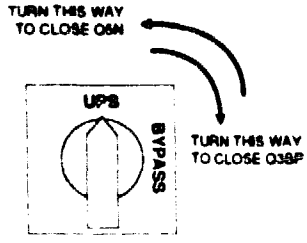
2.5 Installation Procedure

NOTE

The installation procedure detailed below is to be followed by the customer's licensed electrician.

After determining the final location for the UPS, lower the leveling jacks on all four corners of the enclosure (see Figure 6) to insure proper stability. The casters must be at least 8 mm (5/16") off of the floor for the final installation.

Before making any electrical connections, check to see that all upstream ac input circuit breakers or fused switches that will interface with the UPS are in the OFF position. Make certain that the HA3000 UPS AC Input Circuit Breaker (Q1) and Battery Circuit Breaker (QF1) are in the OFF position. Make certain that the Manual Bypass Switch (Q5N/Q3BP) is in the Q5N position (see the Figure opposite).



MANUAL BYPASS SWITCH

All field wiring connections for the HA3000 11 kVA UPS are made in the rear portion of the UPS enclosure (see Figure 7). To gain access to this area, the rear panel of the UPS must be removed.

2.5.1 AC Input Connections

See Figures 7 and 8 for the location of the ac input connections. The power connections are three phase, four wire Wye plus equipment ground: the phase rotation must be A, B, C. The input circuit breaker (Q1) rating is 50 Amperes. The nominal ac input current at nominal input voltage is 34 Amperes. Size the main input cables and upstream protective devices accordingly.

FIGURE 7: HA3000 11 kVA UPS REAR VIEW, COVERS REMOVED

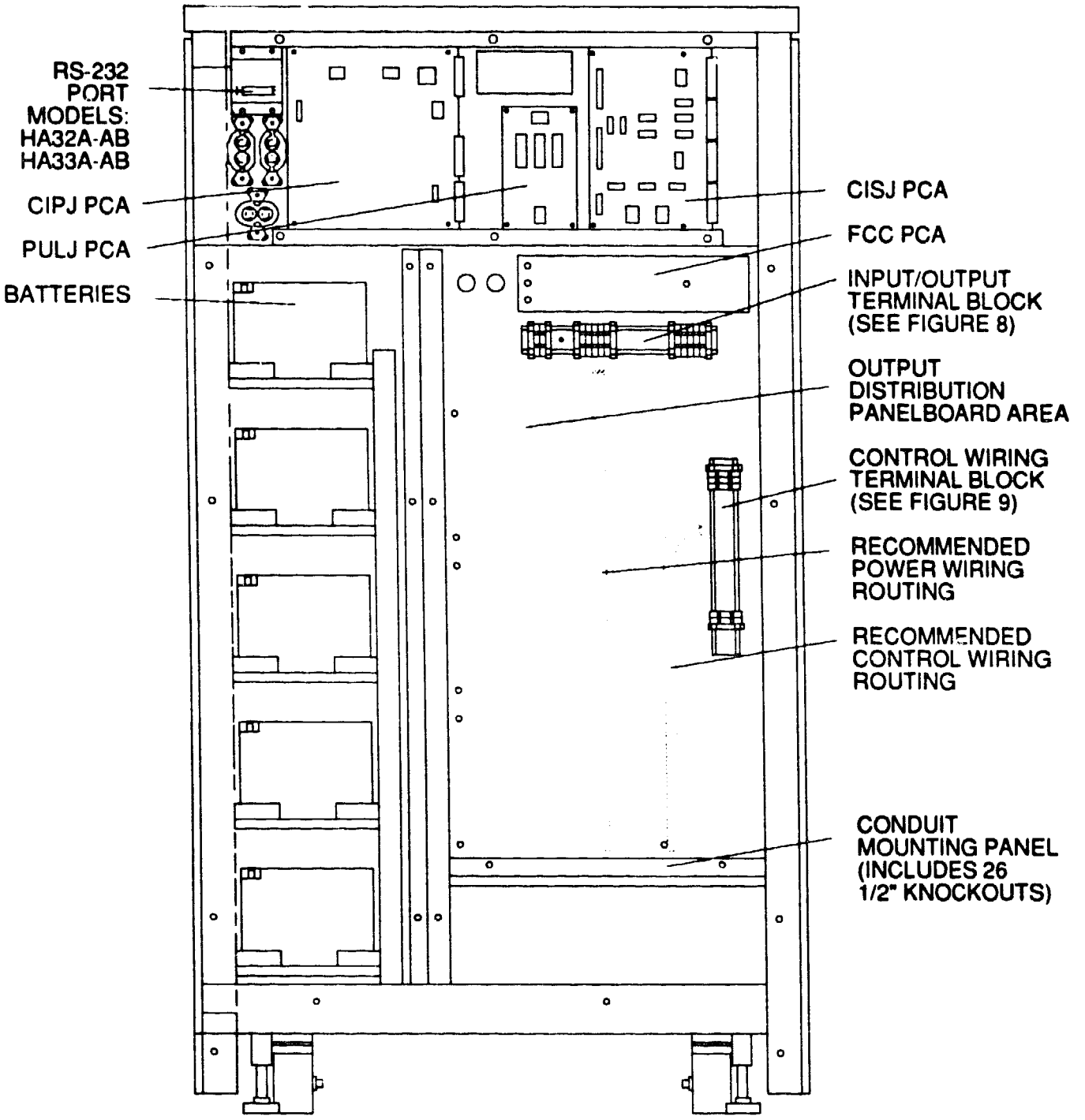
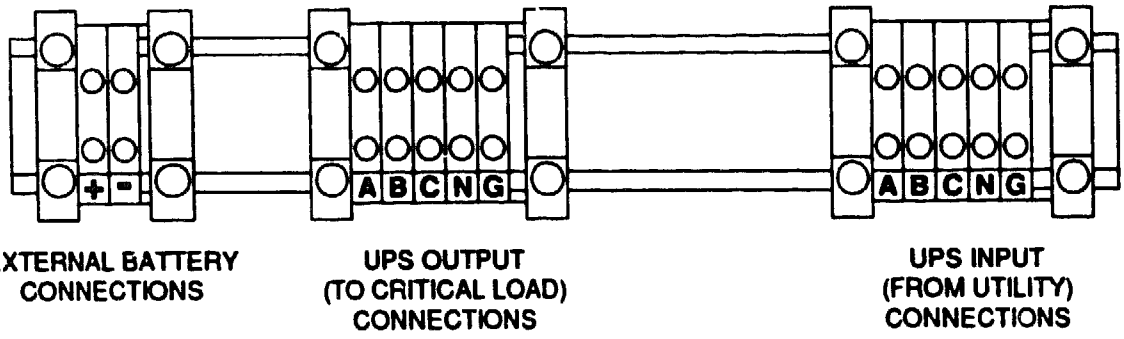


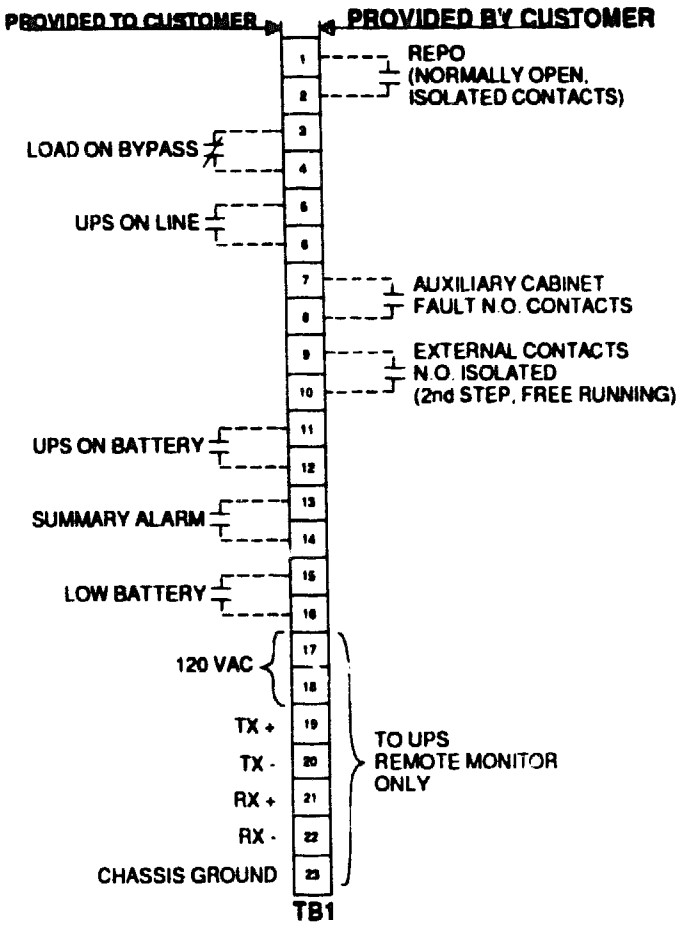
FIGURE 8: INPUT AND OUTPUT TERMINAL BLOCK

INPUT AND OUTPUT CONNECTIONS



NOTE: MAXIMUM CABLE SIZE = #6 AWG

FIGURE 9: CONTROL WIRING TERMINAL BLOCK TB1



NOTE: MAXIMUM CABLE SIZE = #10 AWG

NOTE: DRY CONTACTS RATED 1 AMPERE AT 24 VDC OR 120 VAC

2.5.2 UPS Output Load Connection

See Figure 8 for the location of the UPS output load connections (for Models HA32A-AB and HA33A-AB, refer to Appendix A, ¶ A.6). The output connections are three phase, four wire Wye plus equipment ground. The phase rotation must be A, B, C. The UPS ac output current rating at nominal output voltage is 30.5 amperes. Size your output cables and downstream protective devices accordingly.

NOTE

A three wire Delta load can be connected to the UPS output, but the phase connection cannot be grounded.

2.5.3 Control/Interface Wiring

See Figure 7 for the location of the control wiring interface, and Figure 9 for the detailed connection information.

2.5.4 Battery Connection

The HA3000 11 kVA UPS is shipped from the factory with all batteries firmly secured in place. The batteries comprise a single string, fully wired together except for a single link or inter-battery connector that is removed for safety during shipment. This inter-battery link must be installed before attempting to use the UPS.

The battery link is located in the front of the unit (see Figure 3). Use the nut and washer that are attached to the battery terminal. The connection must be torqued to 25 in-lbs.

NOTE

One inter-battery link is removed for safety during shipment. This link must be reinstalled before using the HA3000 UPS.

2.6 Start-Up Procedure

Prior to beginning the start-up procedure, read thoroughly Section III — OPERATION. Be sure that you fully understand the operation of the LCD Display (¶ 3.1), use of the SS&CP keys (¶ 3.1), and the UPS Monitor (¶ 3.3).

2.6.1 Checks Prior to UPS Start-Up

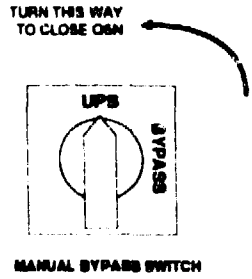
a. Check to insure that all power and control wires have been properly connected and tightened securely.

b. Check the rating of the upstream and downstream protective devices, and make certain that they are compatible with the UPS and the load requirements.

c. Verify that the voltage of the main ac input source is indeed that shown on the UPS nameplate, located inside the right door of the HA3000 UPS enclosure.

d. Verify that the air filter located under the UPS enclosure is properly installed and is free of dust and dirt. Make certain that no objects block the air intake at the front bottom of the enclosure, or the air exhaust at the top rear of the enclosure.

e. Install the front and rear kick plates.



MANUAL BYPASS SWITCH

f. Verify that both Q1 and QF1 in the UPS enclosure are in the OFF position.

g. Verify that the Manual Bypass Switch (Q5N/Q3BP) is in the Q5N position (see the Figure opposite).

2.6.2 Initial Start-Up Procedure

NOTE

If the LCD Display on your HA3000 UPS differs from that presented in this manual, a problem is indicated. Stop immediately and contact DIGITAL Customer Service.

a. Close the upstream circuit breaker providing power to the UPS main ac input.

b. Measure the upstream supply voltages at the UPS input connections (see Figure 8 for location) to insure that the voltage is that required by the UPS (see the UPS nameplate located inside the right door of the enclosure). Make certain that the phase rotation of the main ac input is A, B, C.

c. Close the UPS Input Circuit Breaker (Q1). When Q1 is closed, the HA3000 UPS power supply will turn on, and the UPS Monitor will be active. The UPS Monitor will provide instructions for the start-up procedure.

NOTE

Closing Q1 will energize the output connections. Work Carefully!

When the UPS is first energized, the LCD will display the Language Selection:

```
1 ENGLISH
2 FRANCAIS
```

```
2 FRANCIAS
3 DEUTSCH
```

```
3 DEUTSCH
4 ESPANOL
```

```
4 ESPANOL
5 ITALIANO
```

The display will continue to vertically scroll through the above messages until one language is selected. The red Alarm LED on the SS&CP will be flashing.

To select English as the display language, press the 1 key on the SS&CP firmly to insure contact. The Audible Alarm will "chirp" indicating that a key has been pressed.

Press:	Display Reads:	Comment:
1	* * CHECKING * * * * * * *	

After a few seconds, the Test Position display will appear:

TEST POSITION

The UPS Monitor displays the Test Position when the Manual Bypass Switch is in the Bypass (Q3BP) position, or if circuit breaker QF1 is open.

To view the current status of the UPS, press the Scroll Down key:

Scroll	QF1 IS OPEN MIN BAT VOLTAGE	The Battery Circuit Breaker (QF1) is open.
Scroll TWICE	INVERTER OV OR UV K3N IS OPEN	The Inverter is OFF (no output voltage). The Output Contactor (K3N) is open.
Scroll TWICE	CHARGER OFF INV. PHASE OUT OF TOL	The Rectifier/Battery Charger is OFF.

These alarm conditions, as displayed after Test Position, are the normal alarm conditions that should appear for the present status (initial start-up) of the UPS.

If other alarm conditions are displayed, refer to the DIAGNOS!S menu to resolve these conditions (see ¶ 3.3.2.7).

Press:	Display Reads:	Comment:
Menu	1 START-UP 2 INVERTER ON/OFF	
1	START THE CHARGER 1 = START ___	The UPS Monitor is waiting for your command to start the Rectifier/Battery Charger.
1 Enter	RESET FAULTS	
	* * CHECKING * * * * * * *	
	COMMAND ACCEPTED	The Rectifier/Battery Charger is ON. The dc bus voltage is at its preset value. The green Rectifier/Battery Charger LED on the SS&CP is ON.
	CLOSE BAT. BREAKER ITEM: QF1	Close the Battery Disconnect circuit breaker QF1. The Audible Alarm will sound once every three seconds. To silence the Audible Alarm, press: Silence Alarm
	START THE INVERTER 1 = START ___	The UPS Monitor is waiting for your command to start the Inverter.

Press:		Display Reads:	Comment:
1	Enter	RESET FAULTS	
		* * CHECKING * * * * * * *	
		COMMAND ACCEPTED	
		END OF PROCEDURE	The Inverter will start. The Audible Alarm will silence, and the flashing red Alarm LED will turn off. The green Inverter LED will turn ON, and the green Bypass LED will turn OFF.
		1 START-UP 2 INVERTER ON/OFF	
		NORMAL OPERATION LOAD ON UPS	The UPS Monitor has assumed its normal operating condition.

The HA3000 UPS is now in its normal operating condition. Voltage and Current measurements are performed continuously and can be displayed by pressing the Volts and Current keys on the SS&CP. See ¶ 2.8 for instructions.

The UPS can be adjusted for the requirements of your installation if you desire settings other than the standard factory settings. Contact DIGITAL Customer Service for further information.

2.6.3 Anomalies

During the start-up procedure, the LCD on your HA3000 UPS may indicate:

```
WRONG M1 PH SEQ
SWAP 2 PHASES
```

The main ac input (M1) source phases are out of sequence. Corrective action is requested by the UPS Monitor during start-up; in this case, swap any two phases of the main ac input source. To perform this correction, the UPS must be isolated and completely shut down by switching off the upstream circuit breakers supplying power to the UPS.

2.7 Tests After Initial Start-Up

After performing the initial start-up procedure, the following tests should be performed to insure proper operation of the HA3000 UPS.

2.7.1 Start/Stop Tests

For the location of the keys and LEDs, see Figure 2, on page 3 - 1.

2.7.1.1 Rectifier/Battery Charger

To execute the Rectifier/Battery Charger start/stop test, first press the MENU key to return to the Main Menu.

Press:	Display Reads:	Comment:
Menu, Scroll (FOUR TIMES), 6	CHARGER 0=STOP 1=START	Press the 0 key to stop the Rectifier/Battery Charger. Validate the command by pressing the ENTER key. The green Rectifier/Battery Charger LED on the SS&CP will be OFF, and the green Inverter LED will be ON, indicating that the Inverter is supplying power to the load from the battery.
0, Enter	* * CHECKING * * * * * * * COMMAND ACCEPTED CHARGER 0=STOP 1=START	Press the 1 key followed by the ENTER key to restart the Rectifier/Battery Charger. The green Rectifier/Battery Charger LED should be ON again.
1, Enter	* * CHECKING * * * * * * * COMMAND ACCEPTED CHARGER 0=STOP 1=START	

2.7.1.2 Inverter

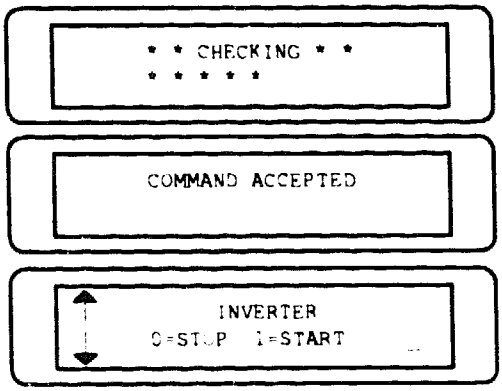
To execute the Inverter start/stop test, first press the Scroll Down key to display the next two lines of the Command sub-menu.

Press: **Display Reads:** **Comment:**

Scroll

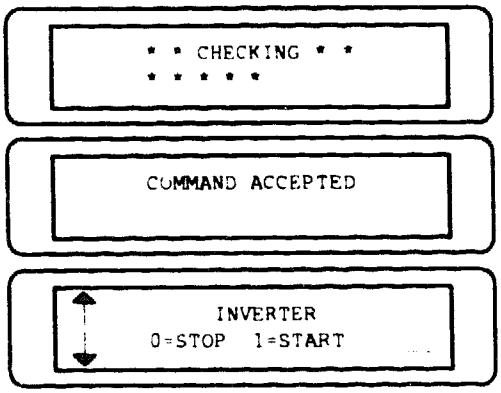
Press the 0 key and then the ENTER key to stop the Inverter. The green Inverter LED will be OFF and the green Bypass LED will be ON, indicating that the load has been transferred from the UPS Inverter Output to the Bypass AC Input source.

0 Enter



Press the 1 key and then the ENTER key to restart the Inverter and return the UPS to normal operation. The green Bypass LED will be OFF and the green Inverter LED will be ON.

1 Enter



2.7.2 On Battery Operation Test

To execute the On Battery Operation test, first insure that the UPS is operating in a normal manner, with a load connected to the UPS Inverter output.

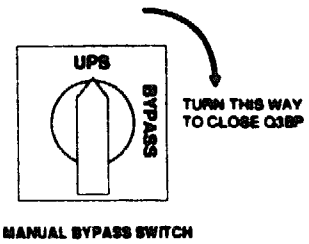
Press:	Display Reads:	Comment:
Menu, Enter	NORMAL OPERATION LOAD ON UPS	Turn off the upstream ac input circuit breaker (supplying the UPS) to simulate a utility power failure. The UPS Inverter will operate on battery power. The green Rectifier/Battery Charger LED will be OFF. The green Inverter LED will be ON. The display will indicate:
	INV. ON BATTERY MINI AUTO = xxx mn	Check the UPS output voltage (see Voltage Measurements, ¶ 2.8.1). Press the Volts key, then the 2 key, to monitor the Inverter output voltage and frequency:
Volts, 2	INV. F=xx.x U12=xxx V U23=xxx V U31=xxx V	Monitor the decrease in battery voltage (see Voltage Measurements, ¶ 2.8.1). Press the ENTER, Scroll Down, and 3 keys to display Battery Voltage and Time.
Enter, Scroll, 3	BATTERY U=xxx V	Turn on the upstream ac input circuit breaker supplying the UPS. The Rectifier/Battery Charger will start automatically. The green Rectifier/Battery Charger LED will be ON. The Rectifier/Battery Charger is recharging the batteries and supplying power to the UPS Inverter. The Battery Charger Current can be displayed by using the current measurement key (see Current Measurements, ¶ 2.8.2).
Enter TWICE	NORMAL OPERATION LOAD ON UPS	Normal operation has resumed.

2.7.3 Manual Bypass Operation Test

a. Transfer To Manual Bypass

To transfer the UPS output from the Inverter to the Bypass AC Input source, the UPS should be operating in a normal manner, with a load connected to the UPS Inverter output. The UPS Inverter output must be synchronized to the Bypass AC Input source.

Press:	Display Reads:	Comment:
Menu, Scroll (FOUR TIMES), 5	1 SW TO MAN BY-PASS 2 RETURN TO UPS	
1	STOP THE INVERTER 0 = STOP ___	
0, Enter	* * CHECKING * * * * * * *	
	COMMAND ACCEPTED	The Inverter turns OFF. The load is transferred to the Bypass AC Input source. The green Inverter LED is OF' The green Bypass LED is ON. The Audible Alarm is activated. The red Alarm LED is flashing.
	CLOSE BY-PASS SW ITEM: Q3BP	Close the Manual Bypass Switch (Q3BP) by turning the switch to the right (see the Figure opposite). The Audible Alarm turns off.
	END OF PROCEDURE	



MANUAL BYPASS SWITCH

WARNING

When Q1 and QF1 are in the OFF position, high voltage may still exist at the line and load terminals of these circuit breakers.

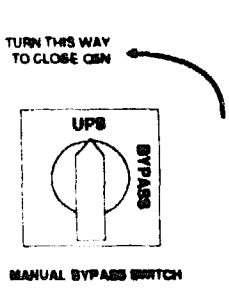
NOTE

To completely isolate the UPS from all power sources, the UPS Input Circuit Breaker Q1 and the Battery Circuit Breaker QF1 must be turned off.

b. Return To Inverter

To return the UPS to normal operation (Inverter output supplying load), follow this procedure:

Press:	Display Reads:	Comment:
	1 SW TO MAN BY-PASS 2 RETURN TO UPS	
2	CLOSE OUTPUT SWITCH ITEM: Q5N	Close the UPS Output Isolation switch Q5N by turning the switch to the left (see the Figure). The Audible Alarm is active.
	START THE INVERTER 1 = START	
1 Enter	RESET FAULTS	
	* * CHECKING * * * * * * *	
	COMMAND ACCEPTED	The UPS Inverter provides load power. The green Inverter LED turns ON. The red Alarm LED is OFF. The Audible Alarm is off. The green Bypass LED turns OFF.
	E D OF PROCEDURE	
	1 SW TO MAN BY-PASS 2 RETURN TO UPS	
Enter	4 BATT TRANS. TEST 5 BYPASS PROCEDURE	
Enter	NORMAL OPERATION LOAD ON UPS	The UPS has resumed normal operation.



MANUAL BYPASS SWITCH

2.7.4 Emergency Power Off (EPO) Test

Two Emergency Power Off (EPO) keys are provided on the upper left portion of the SS&CP.

When these keys are pressed simultaneously, the HA3000 UPS will shut down. The Rectifier/Battery Charger, the Inverter, and the Static Switch will all turn off. The Main AC Input circuit breaker Q1 will trip off. Power to the load will cease. The Battery Disconnect circuit breaker QF1 will trip off.

To restart the UPS, follow the procedure as indicated in ¶ 2.6.2.

NOTE

The Emergency Power Off (EPO) feature is to be used in emergency situations only, and should not be used as an on-off switch for the UPS. To turn the UPS on or off, follow the start-up and shut-down instructions provided in this manual.

2.7.5 Remote Emergency Power Off (REPO) Test

An external dry contact closure can be used to cause a complete shut-down of the UPS. This action is the same as indicated in ¶ 2.7.4, except that it is initiated from a remote location.

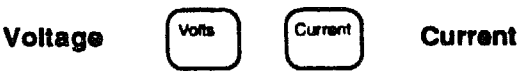
To restart the UPS, follow the procedure indicted in ¶ 2.6.2 after the external dry contact REPO has been reset.

NOTE

The Remote Emergency Power Off (REPO) feature is to be used in emergency situations only, and should not be used as an on-off switch for the UPS. To turn the UPS on or off, follow the start-up and shut-down instructions provided in this manual.

2.8 Voltage and Current Measurements

Voltage and current measurements can be obtained instantly by pressing the Voltage and Current keys on the SS&CP.



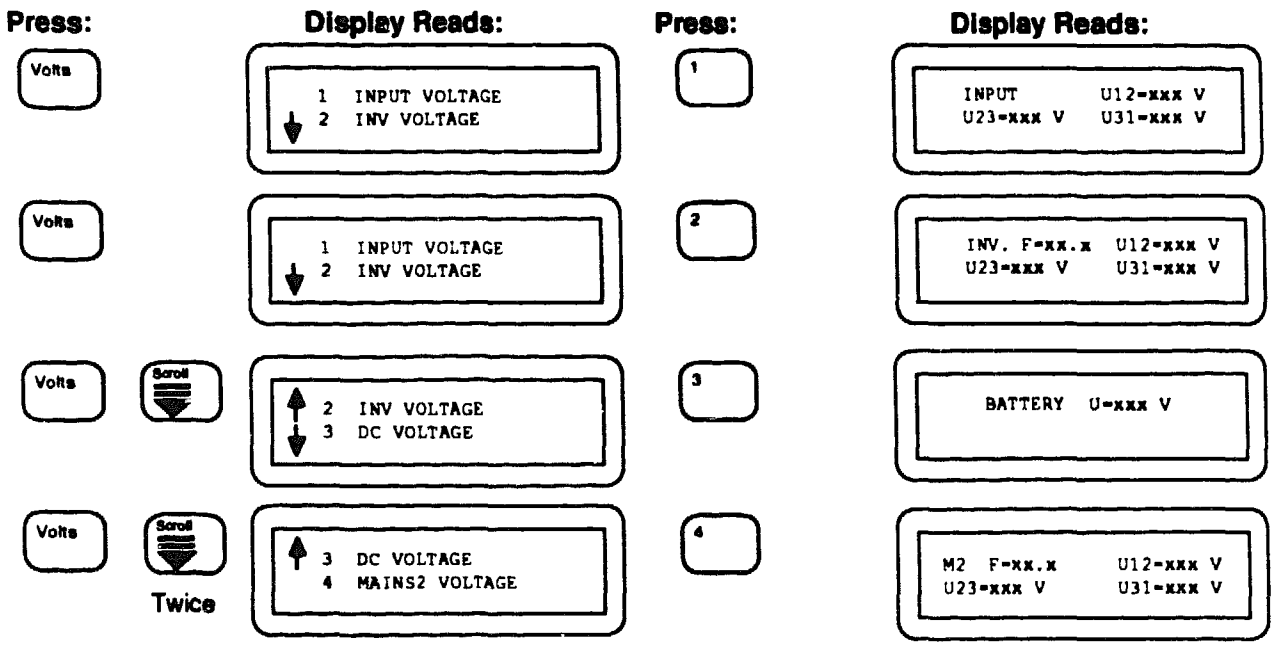
2.8.1 Voltage Measurement

The following voltage parameters (L-L) are continuously monitored, and displayed on the LCD when selected:

- UPS Input Voltage
- DC Bus Voltage (battery)
- Inverter Voltage (UPS Output) and Frequency
- Bypass AC Input Voltage and Frequency

Press the [Volts] key to display.

FIGURE 10: VOLTAGE MEASUREMENT



NOTES:

(1) The desired menu must appear on the LCD before it can be selected for access.

(2) Use the [▲] and [▼] keypads for menu review.

(3) By pressing the [Enter] keypad once, you will return to the next higher menu where you exited it.

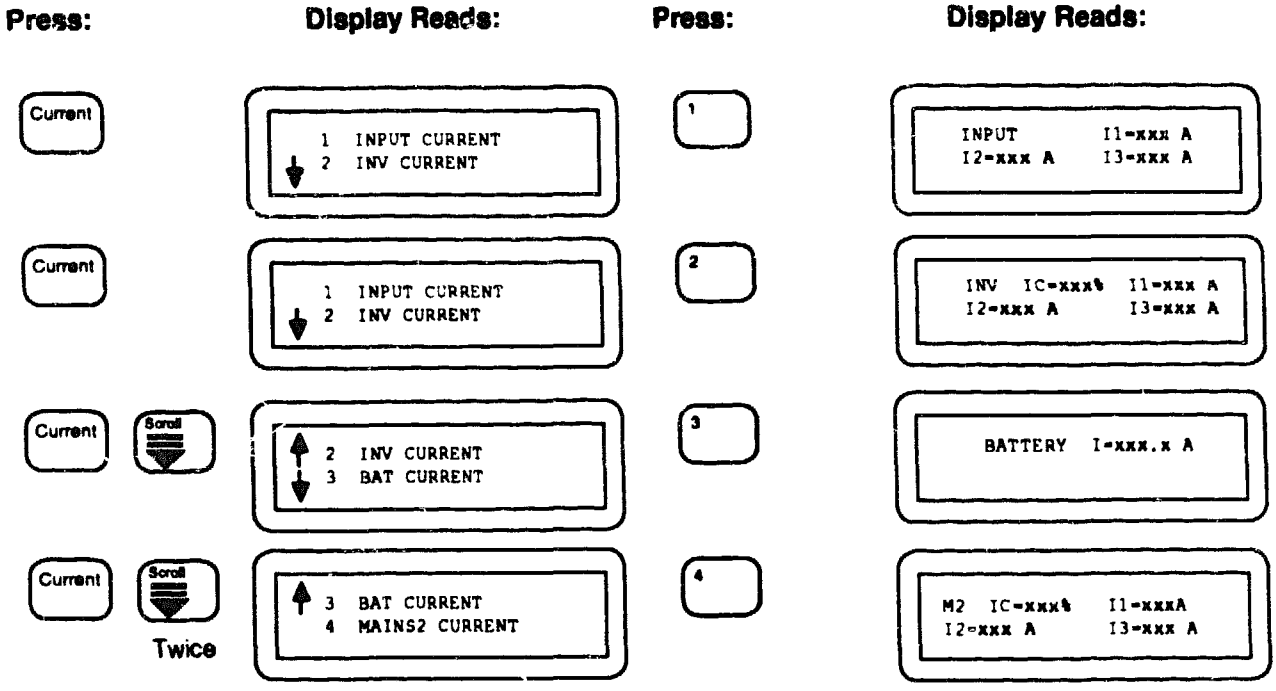
2.8.2 Current Measurement

The following current parameters are continuously monitored, and displayed on the LCD when selected:

- UPS Input Current, All Three Phases
- Battery Current [if positive (+) indicates battery charging current; if negative (-) indicates battery discharging current]
- UPS Output Current
- UPS Output Current in Percent Load for the most Heavily Loaded Phase
- Bypass AC Input Current
- Bypass AC Input Current in Percent Load for the most Heavily Loaded Phase

Press the Current key to display.

FIGURE 11: CURRENT MEASUREMENT



NOTES:

(1) The desired menu must appear on the LCD before it can be selected for access.

(2) Use the ▲ and ▼ keypads for menu review.

(3) By pressing the Enter keypad once, you will return to the next higher menu where you exited it.


SECTION IIII

OPERATION

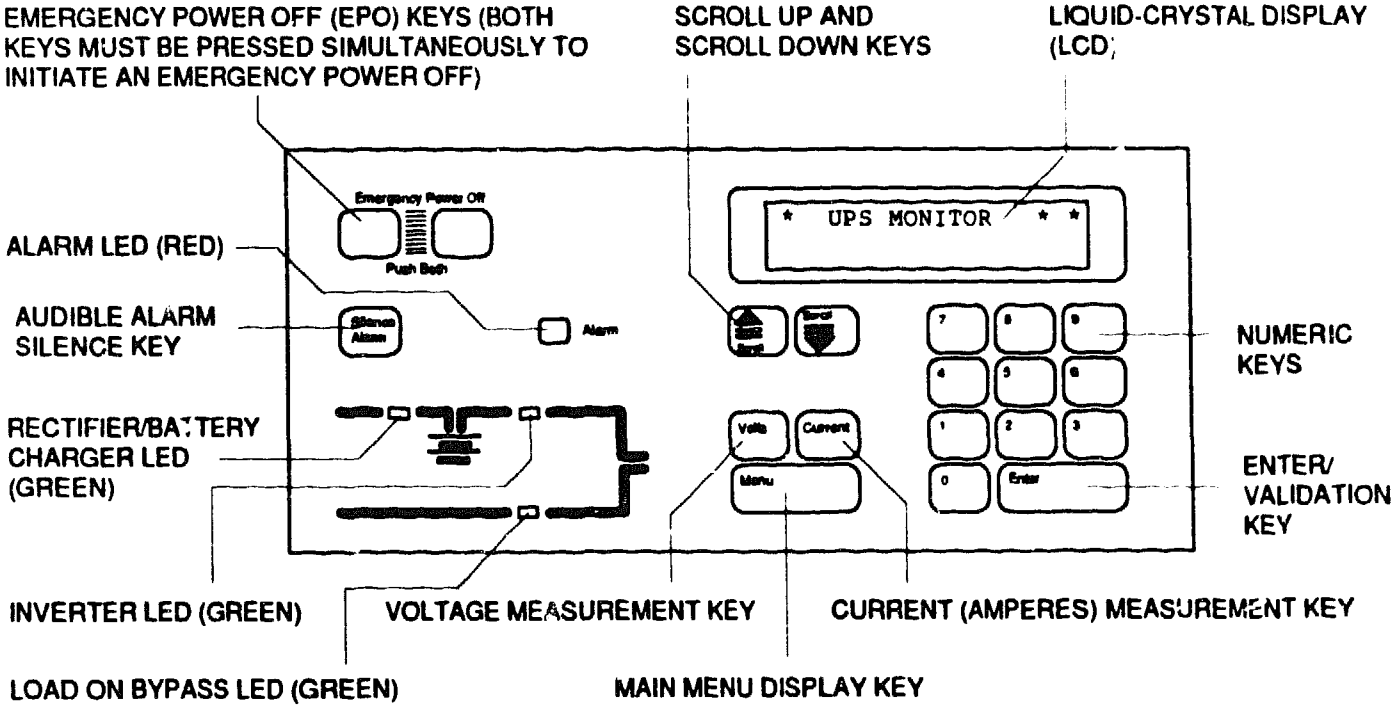
3.0 Scope

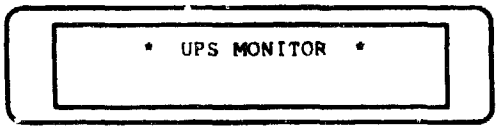
This section describes the HA3000 UPS System Status and Control Panel (SS&CP), including programmable controls and indicators, UPS Monitor software operation, electro-mechanical controls, operating modes, and alarm conditions.

3.1 System Status and Control Panel (SS&CP)

The SS&CP, shown in Figure 12, is located on the upper right portion of the HA3000 UPS enclosure. The SS&CP contains the elements listed on the following pages.

FIGURE 12: SYSTEM STATUS AND CONTROL PANEL (SS&CP)





- **LCD**

The Liquid-Crystal Display (LCD) contains two line, of 20 characters each. It is used to display measurements, start-up and operating procedures, diagnostics, and alarm messages. Contrast of the LCD can be adjusted to suit the viewing environment; see ¶ 3.3.2.3.

NOTE

Each key on the SS&CP, when pressed, emits a short tone to indicate that a key has been pressed.

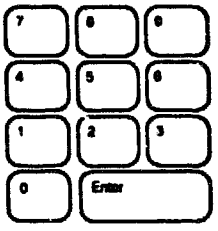
- **Audible Alarm Silence key**

This key is used to silence the Audible Alarm.

- **Scroll Up key**

- **Scroll Down key**

The Scroll keys allow the operator to scroll up or down menus on the LCD display. When arrows appear on the left side of the LCD, additional text is available which can be brought into view by pressing either the Scroll Up or Scroll Down keys.



- **Ten Digit (0 to 9) keys**

These keys are used to select menus, to select items from menus, and to enter or change system settings. When the LCD prompt indicates that a number is to be entered, press the appropriate numbered key. The number you have pressed will appear on the right portion of the LCD. All entries can be modified by re-entering, as long as they have not been validated by pressing the Enter key. If the number has been validated, then the operational sequence needs to be repeated to change the number.

- **Voltage Measurement key**

This key, when pressed, causes the LCD to display submenus which can be used to monitor:

UPS Input Voltage
Inverter Voltage (UPS Output)
DC Bus Voltage (battery)
Bypass AC Input Voltage

Refer to ¶ 2.8.1 for instructions on the use of the Voltage Measurement key.

- **Current Measurement key**

This key, when pressed, causes the LCD to display submenus which can be used to monitor:

UPS Input Current
Inverter Current (UPS Output)
Battery Current [if positive (+) indicates battery charging; if negative (-) indicates battery discharging]
Bypass AC Output Current

Refer to ¶ 2.8.2 for instructions on the use of the Current Measurement key.

- **Main Menu Call key**

This key, when pressed, returns the operator to the main menu display. Should you make an error while working with the HA3000 UPS, pressing the Menu key twice will always return you to the main menu.

- **Entry Validation or Return To Menu key**

This key is used to validate an entry, or to return to the last menu from the point that you exited from it.

- **Emergency Power Off (EPO) keys**

The two EPO keys must be pressed simultaneously to initiate an EPO shut-down. When an EPO shut-down is initiated, the UPS is turned off (the Main AC Input circuit breaker trips off), the battery is turned off (the Battery Disconnect circuit breaker QF1 trips off), and the load is disconnected from the ac power sources.

NOTE

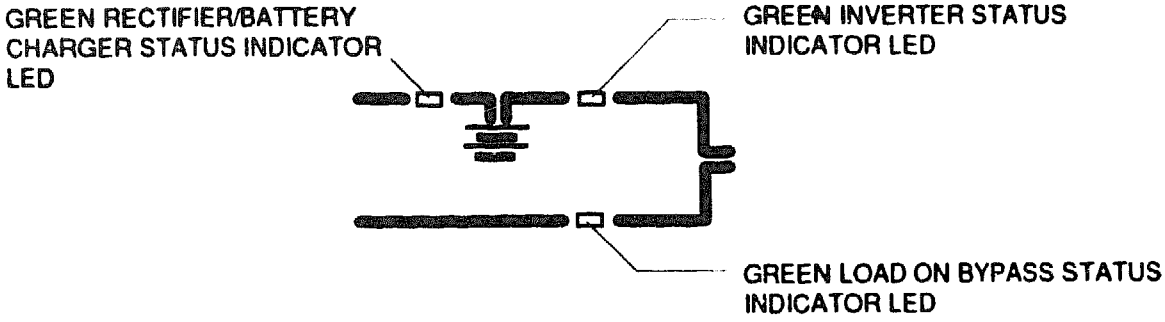
The Emergency Power Off (EPO) feature is to be used in emergency situations only, and should not be used as an on-off switch for the UPS. To turn the UPS on or off, follow the start-up and shut-down instructions provided in this manual.

INDICATORS

- **Alarm Indicator**

This red LED flashes to indicate a major or minor alarm condition has occurred. The actual alarm(s) causing the alarm condition is shown on the LCD.

Use the  and  keys to review all alarm conditions.



- **Rectifier/Battery Charger Status Indicator LED**

This green LED, when on, indicates that the Rectifier/Battery Charger is operational.

- **Inverter Status Indicator LED**

This green LED, when on, indicates that the Inverter is supplying power to the load.

- **Load On Bypass Indicator LED**

This green LED, when on, indicates that load power is being supplied by the Bypass AC Input source.

3.2 Controls

Controls for the HA3000 11 kVA UPS are of two types; programmable controls and electro-mechanical controls.

3.2.1 Electro-Mechanical Controls

The HA3000 11 kVA UPS has the following compliment of electro-mechanical switching devices. See Figure 3 for the location of these devices.

Circuit Reference Designator	Function
Q1	Main AC Input circuit breaker. Used to apply input voltage to the Rectifier/Battery Charger, and provides input current protection
QF1	Battery Disconnect circuit breaker. Used to connect and disconnect the UPS from its battery. QF1 provides isolation and protection between the UPS and its battery system
Q3BP/Q5N	Manual Bypass switch. Used to bypass the UPS and isolate the UPS output
K3N	Inverter Output contactor. Used to mechanically isolate the UPS Inverter from the Static Switch. When the Static Switch is ON, K3N is open; when the Static Switch is OFF, K3N is closed

3.2.2 Programmable Controls

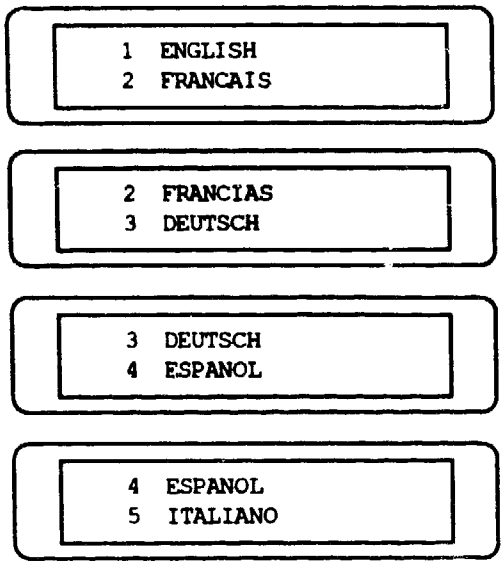
The programmable controls are covered under the UPS Monitor main menu headings, ¶3.3.2, and include such control functions as:

- Rectifier/Battery Charger Start and Stop
- Inverter Start and Stop
- Clearing of Faults
- Synchronized/Non-Synchronized UPS Inverter Operation
- Output AC Voltage Adjustment
- DC Voltage and Battery Charger Current Limit Adjustment
- Boost or Equalize Charging of the Battery
- Selection of Display Language
- Diagnostic and Test Routines
- Adjusting Display Contrast

3.3 UPS Monitor

The UPS Monitor is a software package through which the operator interacts with the HA3000 UPS. The UPS Monitor is menu-driven; to perform a function (such as Start-Up), the appropriate menu is selected, from which the operator selects the desired function.

When the HA3000 UPS is first energized, the Language Selection menu is displayed:

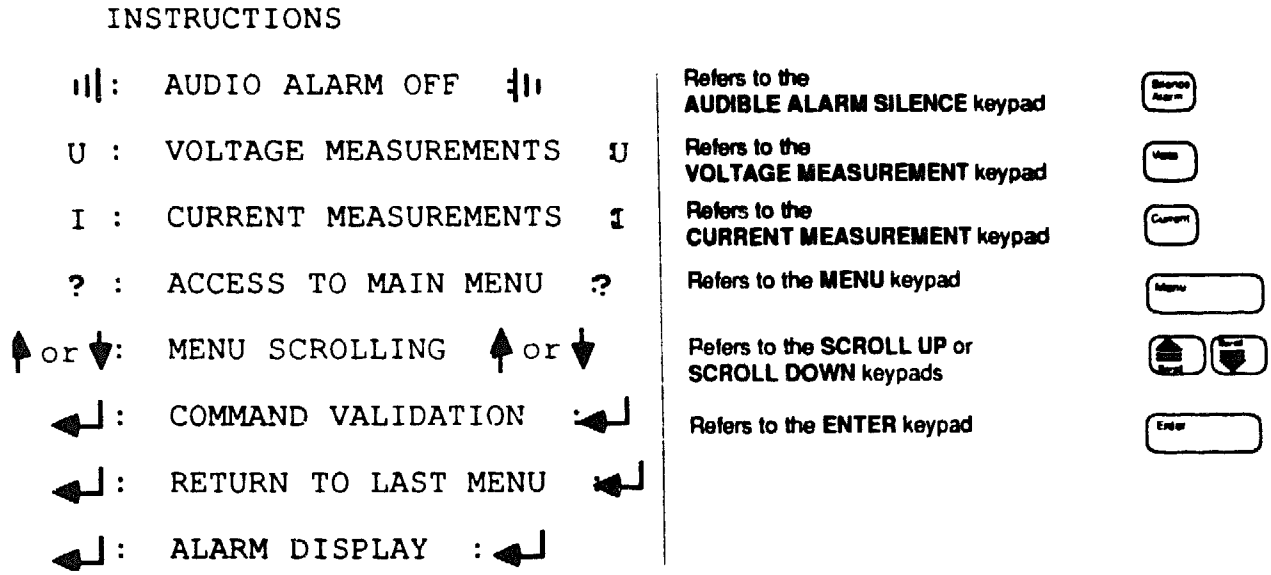


The LCD will continue to scroll vertically through the above displays until a language is selected. To select a language, simply press the numbered key corresponding to the desired language (for example, press 1 for English). The desired selection need not be shown on the LCD to make the selection, nor does it require validation.

3.3.1 UPS Monitor Instructions

Figure 13 shows the various characters that may appear on the LCD, and how they correspond to the SS&CP keys.

FIGURE 13: UPS MONITOR INSTRUCTIONS



3.3.2 Menus

Operation of the UPS Monitor is divided into nine menus:

Menu 1 — START-UP
Menu 2 — INVERTER ON/OFF
Menu 3 — DISPLAY CONTRAST
Menu 4 — BATTERY TRANSFER TEST
Menu 5 — BYPASS PROCEDURE
Menu 6 — COMMANDS
Menu 7 — DIAGNOSTICS
Menu 8 — PERSONALIZATION
Menu 9 — COMMUNICATION

When the Menu key is pressed, the menu listing will be displayed on the LCD:

Press:	Display Reads:	Comment:
Menu	1 START-UP 2 INVERTER ON/OFF	For the START-UP menu, see ¶ 3.3.2.1. For the INVERTER ON/OFF menu, see ¶ 3.3.2.2.
Scroll TWICE	3 DISPLAY CONTRAST 4 BATT. TRANS. TEST	For the DISPLAY CONTRAST menu, see ¶ 3.3.2.3. For the BATTERY TRANSFER TEST menu, see ¶ 3.3.2.4.
Scroll TWICE	5 BYPASS PROCEDURE 6 COMMANDS	For the BYPASS PROCEDURE menu, see ¶ 3.3.2.5. For the COMMANDS menu, see ¶ 3.3.2 6.
Scroll TWICE	7 DIAGNOSIS 8 PERSONALIZATION	For the DIAGNOSTICS menu, see ¶ 3.3.2.7. For the PERSONALIZATION menu, see ¶ 3.3.2.8.
Scroll	8 PERSONALIZATION 9 COMMUNICATION	For the COMMUNICATION menu, see ¶ 3.3.2.9.

You can manually scroll through the available menus by pressing the Scroll Up or Scroll Down keys, until the menu that you wish to select appears on the LCD. To select a menu, press the numbered key that corresponds to the desired menu (for example, press 1 for Start-Up); however the menu must appear on the LCD to be selected.

If you selected the wrong menu, or have made an error, press the Menu key again to return to the menu listing. By pressing the Enter key once, you can return to the next higher menu from where you exited.

3.3.2.1 Start-Up

A step-by-step start-up procedure is furnished in ¶ 2.6.2.

To access the Start-Up menu:

Press:	Display Reads:	Comment:
Menu, 1	START CHARGER 1 = START	Follow the instructions presented on the LCD.

3.3.2.2 Inverter On/Off

This menu is used to turn the UPS Inverter on and off.

To access the Inverter On/Off menu:

Menu, 2

```
INVERTER
0 = STOP  1 = START
```

To start the Inverter, press:

1, Enter

```
* * CHECKING * *
* * * * *
```

```
COMMAND ACCEPTED
```

```
END OF PROCEDURE
```

If the Inverter was commanded to start with the Rectifier/Battery Charger OFF, the display will indicate:

```
COMMAND REJECTED
CHARGER OFF
```

System Start-Up is required; refer to ¶ 2.6.2.

To stop the Inverter, press:

Press:	Display Reads:	Comment:
0 Enter	* * CHECKING * * * * * * * COMMAND ACCEPTED	

If the Inverter is commanded to stop during non-synchronous operation, the display will indicate:

```
MAINS2 OUT OF SPEC
INV STOP INHIBITED

INV FORCED STOP
0=NO  1=YES
```

Refer to ¶ 3.3.2.6, Synchronous/Non-Synchronous Operation

3.3.2.3 Display Contrast

This command allows you to adjust the contrast of the LCD to suit your viewing environment.

Menu Scroll 3

```
- CONTRAST
+
```

To decrease contrast (lightens the LCD), press:

Scroll

To increase contrast (darkens the LCD), press:

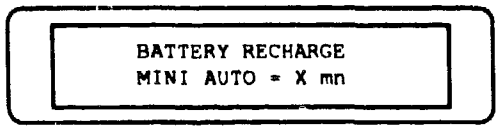
Scroll

3.3.2.4 Battery Transfer Test

The Battery Transfer Test is used to simulate an input power failure by turning off the Rectifier/Battery Charger, and allowing the Inverter to operate from battery power for two minutes, then returning the UPS to normal operation.

This test is only possible if the battery has been charged for at least ten (10) hours. Also, the Bypass AC Input source frequency and voltage must be within the prescribed limits for a no-break transfer to the Bypass AC Input source in the event of a battery problem.

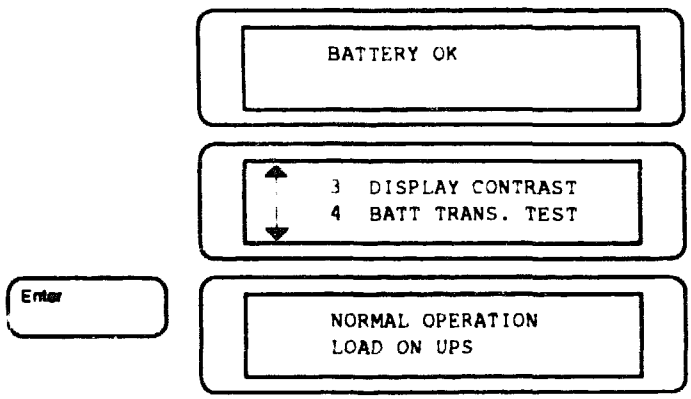
If the battery has been discharged within the last ten hours, this message is displayed immediately:



To execute the Battery Transfer Test:

Press:	Display Reads:	Comment:
Menu, Scroll TWICE, 4	STOP THE CHARGER 0 = STOP	
0, Enter	* * CHECKING * * * * * * *	
	COMMAND ACCEPTED	
	BATTERY TEST AUTO=XX mn Ub = XXX V	

The battery voltage is displayed during discharge, along with the time remaining on battery operation. The test ends with the display of:



3.3.2.5 Bypass Procedure

The Bypass Procedure is presented in detail in ¶ 2.7.3. The procedure is intended for manual transfer of the load to the Bypass AC Input source without interruption to the load, for maintenance purposes (Bypass); or to return the load to the UPS Inverter output (Return To Inverter).

If the Bypass AC Input source is out of tolerance, these operations will result in a 0.8 second load interruption, and can only be performed with a FORCED OFF or FORCED ON command (see ¶ 3.3.2.6). The FORCED OFF and FORCED ON commands can only be issued after entering the two-digit password.

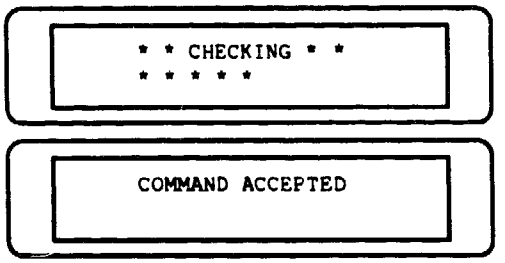
This procedure assumes that the UPS is operating in a normal manner, with the Inverter providing load power. The Inverter output must be synchronized to the Bypass AC Input power source.

3.3.2.6 Commands

The Commands menu can be reached by pressing the Menu key, pressing the Scroll Down key four times, then pressing the 6 key. The Commands menu is used to initiate the following operations:

- Rectifier/Battery Charger Start and Stop
- Inverter Start and Stop
- Clearing Memorized Faults
- Synchronized/Non-Synchronized UPS Inverter Operation
- Boost or Equalize Charging of the Battery
- Selection of Display Language

While a function is being executed, the LCD will display:



Rectifier/Battery Charger Start and Stop

The Scroll Up and Scroll Down keys are used to select from the available commands. Procedures for each command are listed below:

Press:	Display Reads:	Comment:
Menu, Scroll (FOUR TIMES), 6	CHARGER 0=STOP 1=START	Brings up the Command menu. The Rectifier/Battery Charger Start/Stop is the first command on the menu

To START the Rectifier/Battery Charger, press:

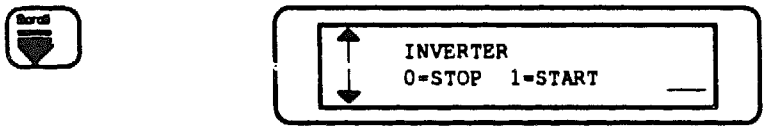
1, Enter

To STOP the Rectifier/Battery Charger, press:

0, Enter

Inverter Start and Stop

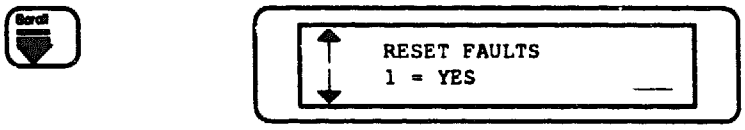
Press: **Display Reads:** **Comment:**



To START the Inverter, press:

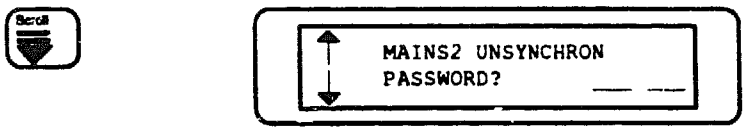
To STOP the Inverter, press:

Reset Memorized Faults



To reset memorized faults, press:

Synchronous/Non-Synchronous Operation



Synchronizing and de-synchronizing the Inverter requires entry of the two-digit password supplied with this manual. Enter the password:

NOTE

The two-digit password will NOT appear on the LCD.

NOTE

When the UPS Inverter is operated in a non-synchronous mode in relation to the Bypass AC input source, operation of the Static Switch is inhibited for 800 milliseconds.

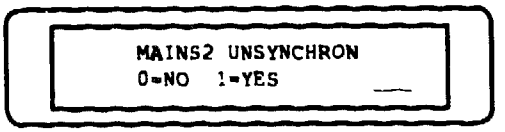
NOTE

The MAINS2 UNSYNCHRON message indicates that the load will be interrupted for a minimum of 800 milliseconds. Be certain that the load can tolerate this interruption.

Should you make an error, the UPS Monitor will allow you to re-enter the password number.

After the password is entered, the Inverter Forced Stop screen will appear:

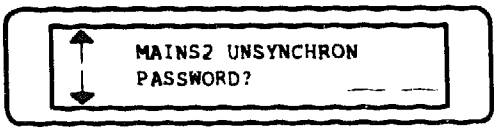
Press: **Display Reads:** **Comment:**



For Synchronous operation, press:

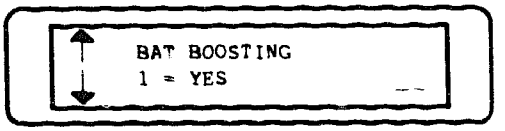
For Non-Synchronous (free-running) operation, press:

After the Unsynch Decision screen has been presented, the LCD will display:



Battery Boost Charge

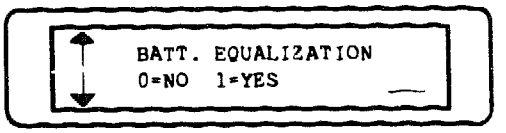
This command applies charge voltage to the battery.



To apply boost charge, press:

Battery Equalization Charge

This command applies an equalization charge to the battery.

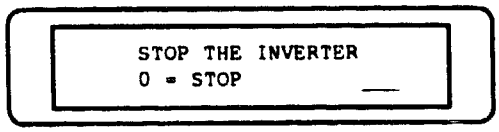


To continue without applying equalization charge, press:

To apply equalization charge, press:

Press:	Display Reads:	Comment:
1 Enter		

The Inverter must be shut down to apply the equalization charge. The LCD will display:



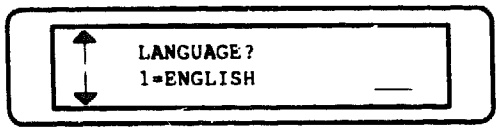
Press 0 and Enter to stop the Inverter.

0 Enter

The Inverter stops and Battery Equalization begins.

Language Selection

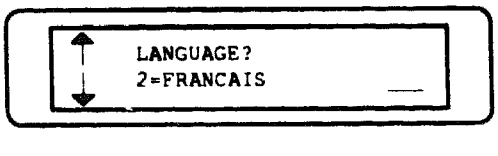
Scroll



To select English as the display language, press:

1 Enter

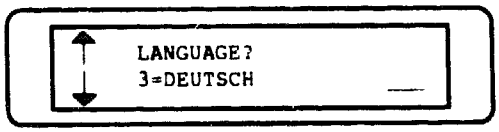
Scroll



To select French as the display language, press:

2 Enter

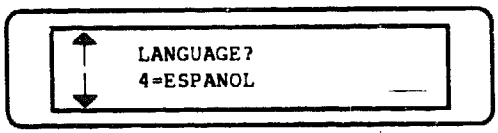
Scroll



To select German as the display language, press:

3 Enter

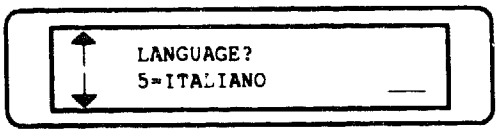
Scroll



To select Spanish as the display language, press:

4 Enter

Scroll

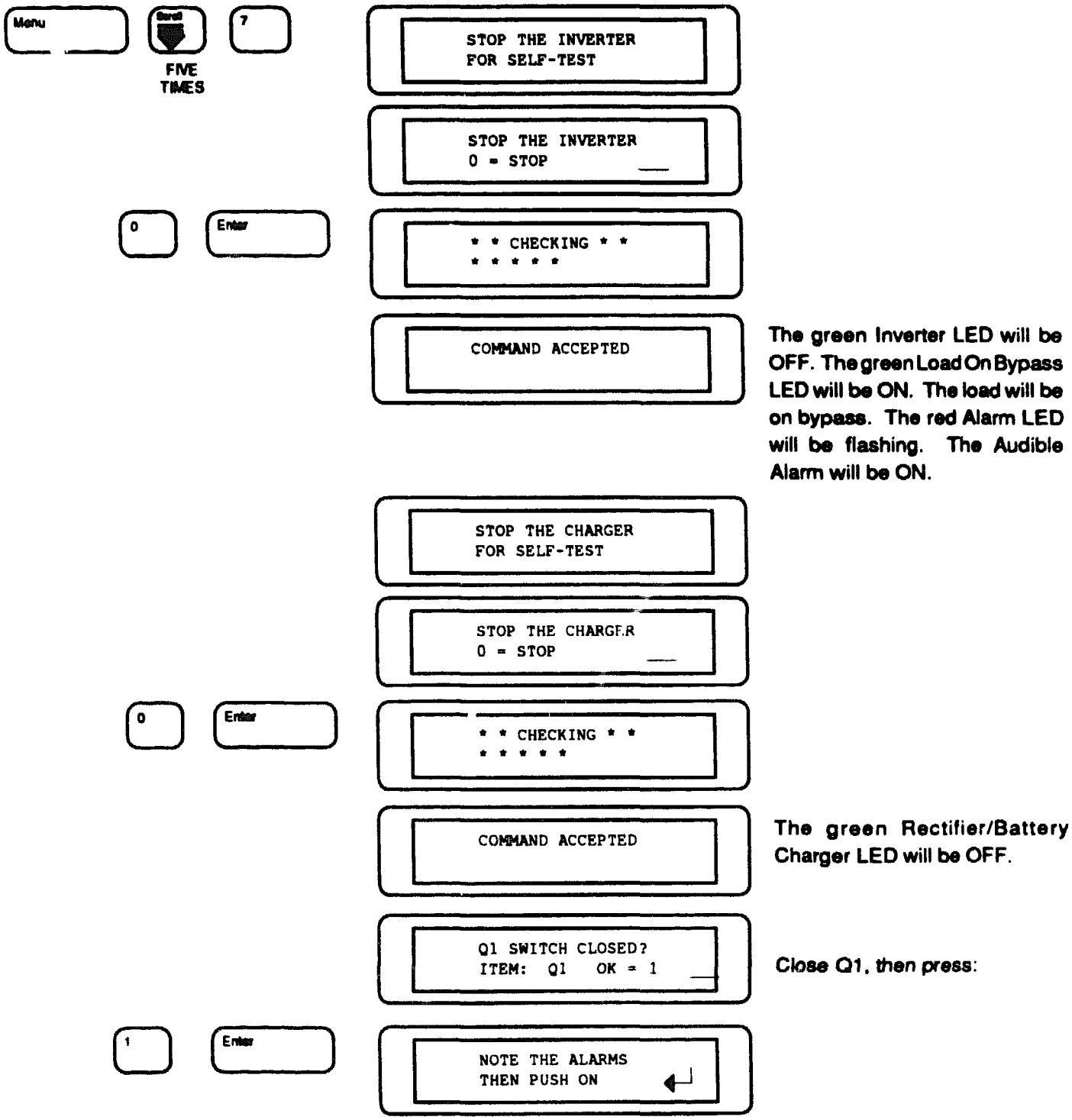


To select Italian as the display language, press:

5 Enter

3.3.2.7 Diagnostics

Follow this procedure to implement the Standard Diagnostic Routine:



Press:	Display Reads:	Comment:
	ALARMS INVERTER OFF	These five alarms are the normal alarm conditions that should appear for the present status of the UPS (both the Inverter and the Rectifier/Battery Charger are OFF).
Scroll TWICE	INVERTER OV OR UV K3N IS OPEN	
Scroll TWICE	CHARGER OFF INV PHASE OUT TOL.	If other alarm conditions are displayed (see ¶ 3.4 for all alarm conditions), immediate action should be taken. Write down all of the alarms and contact your DIGITAL Field Service account representative for assistance.

After viewing all of the alarm conditions, continue the diagnostics by pressing:

1 Enter	* * SELF-TESTING * * * * * * *
	SELF-TEST RESULT: LOGIC OK ↵
Enter	ANALOG TEST PCB AQCX
	ANALOG TEST PCB AQOX
	START THE CHARGER 1 = START ___
1 Enter	RESET FAULTS
	* * CHECKING * * * * * * *
	COMMAND ACCEPTED

The green Rectifier/Battery Charger LED will be ON.

Press:	Display Reads:	Comment:
	START THE INVERTER 1 = START	
1 Enter	RESET FAULTS	
	* * CHECKING * * * * * * *	
	COMMAND ACCEPTED	The green Inverter LED will be ON. The green Load On Bypass LED will be OFF. The load is supplied by the UPS Inverter Output. The red Alarm LED will be OFF. The Audible Alarm will be OFF.
	END OF PROCEDURE	
	↑ 6 COMMANDS ↓ 7 DIAGNOSIS	
Enter	NORMAL OPERATION LOAD ON UPS	The UPS has resumed normal operation.

3.3.2.8 Personalization

The Personalization menu allows access to routines that tailor the operation of the UPS to your installation. This menu should be accessed only by authorized DIGITAL Customer Services representatives.

3.3.2.9 Communication

The Communication menu is used to enter to communication interface parameters for models and installation where such interface is required, and should only be accessed by authorized DIGITAL Customer Services representatives.

3.4 Alarm Conditions

Alarms fall into two categories: Minor or Major alarms.

3.4.1 Minor Alarms

Minor alarms are those abnormalities or anomalies that occur during normal operation, and that do not interfere with the normal function of the UPS, but should be corrected in the near future. These are indicated on the LCD like this:

Display Reads:	Comment:
ALARM LOAD ON UPS	Alarms which could appear under this category include those listed below, and would appear on the LCD after pressing the Scroll Down key.
MAINS 2 RC FU BLOWN	Bypass AC Input spike protection RC network fuse has blown.
UPS FAN FAILURE	The internal fan has failed.
OUTPUT OVERLOAD	One or more of the three output phases is providing more than 100% of the full load current rating of the UPS.
CHARGER CT FAULT	Input current sensing circuit is not operating correctly.
CHARG MODULE FAULT	A fault has occurred in the Rectifier/Battery Charger power module.
MAINS2 OV OR UV	The UPS Inverter is not synchronized to the Bypass AC Input source because the Bypass voltage is outside the ± 10% tolerance. Operation of the Static Switch is inhibited.

Display Reads:	Comment:
MAINS2 OF OR UF	The UPS Inverter is not synchronized to the Bypass AC Input source because the Bypass frequency is outside the set Frequency Window (see ¶ 1.3). Operation of the Static Switch is inhibited.
MAINS 2 UNSYNCHRON	The UPS Inverter is not synchronized to the Bypass AC Input source because the phase differential between the two is greater than ± 3 degrees. Operation of the Static Switch is inhibited.

3.4.2 Major Alarms

Major alarms are listed separately for the Rectifier/Battery Charger and the UPS Inverter.

3.4.2.1 Rectifier/Battery Charger Major Alarms

Rectifier/Battery Charger major alarms result when the Rectifier/Battery Charger is not operating, and the UPS is providing the load power from the batteries. This On Battery condition is indicates on the UPS LCD with this display:

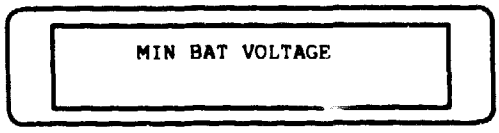
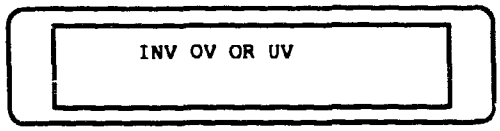
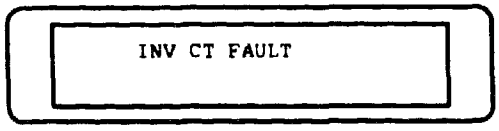
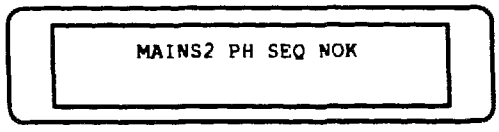
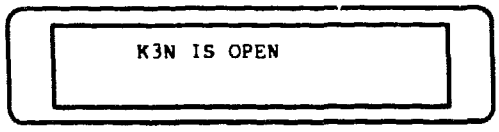
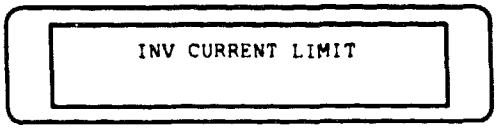
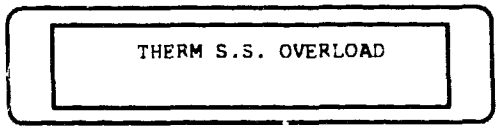
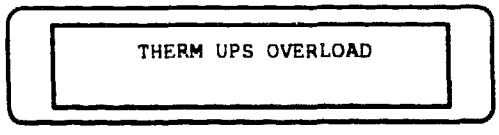
INV ON BATTERY MINI AUTO. = XXX mn	The alarms that could appear under this category include those listed below and would appear on the LCD after pressing the Scroll Down key.
END OF AUTONOMY	Battery has reached its end point of discharge and the UPS Inverter has been turned off.
CHARG OV OR UV	Rectifier/Battery Charger has turned off due to a dc over- or under-voltage condition.
ENVIRONMENTAL FAULT	Only used when either or both the DC Ground Fault Indication or Smoke Detector options have been installed.
MAX BAT VOLTAGE	Rectifier/Battery Charger has turned off due to a high dc voltage condition.

Display Reads:	Comment:
MAINS1 PH SEQ NOK	This indicates that the Rectifier/ Battery Charger will not start due to an incorrect phase rotation sequence on the input.
CHARGER OFF	Indicates that the Rectifier/Battery Charger has been programmed OFF.

3.4.2.2 UPS Inverter Major Alarms

UPS Inverter major alarms result when the UPS Inverter is not operating and the load is being supplied power from the Bypass AC Input source after a successful static transfer. This condition is indicated on the UPS LCD with this display:

ALARM INVERTER OFF	The alarms that could appear under this category include those listed below, and will appear on the LCD after pressing the Scroll Down key:
INV FUSE BLOWN	One or more output fuses have blown.
TRANSFO OVERTEMP	Inverter transformer over-temperature.
INV LEG1 OVERTEMP	Inverter LEG1 Power Module over-temperature.
S.S. OVERTEMP	Static Switch over-temperature.
LEG1 POW SUP FAULT	Inverter LEG1 Power Module supply fault.
LEG1 DESATURATION	Inverter LEG1 Power Module not operating in saturation.
PCB POW SUP FAULT	Logic card power supply fault.

Display Reads:	Comment:
	UPS Inverter turned off due to low battery voltage.
	UPS shut down due to an output voltage out-of-tolerance condition.
	Inverter output current sensing circuits not operating correctly.
	UPS Inverter turned off and prevented a Static Switch transfer due to an incorrect phase sequence on the Bypass AC Input source.
	Inverter output contactor fault.
	UPS Inverter turned off due to an overload condition on the UPS Inverter output.
	Static Switch thermal overload.
	UPS thermal overl


SECTION IV

MAINTENANCE

4.0 Scope

This section describes preventive maintenance procedures and the UPS diagnostic capabilities.

4.1 Preventive Maintenance

The following preventive maintenance routines should be considered as the minimum requirements; your installation and site may require additional preventive maintenance to insure optimal performance from you UPS. These routines should be performed twice a year (more often if required).

a. Isolate and de-energize the UPS equipment for all maintenance operations (see ¶ 2.7.3).

b. Insure that the equipment is clean, and free of loose dust, dirt, and debris.

c. Inspect the air intake and outlet grates (see Figure 6) and clean as required. Verify that the air flows freely through the equipment. Clean the grates and the enclosure interior with a vacuum cleaner if required.

d. The HA3000 UPS is equipped with a dust filter that should be changed at regular intervals. Inspect the filter regularly to determine how long the filter will last in your installation.

e. Initiate the Start-Up Procedure, as described in ¶ 2.6.2.

f. Test the main operating sequences as described in ¶ 2.7. through 2.7.5.3 (as applicable to your equipment).

4.2 General Diagnostic Capability

The UPS Monitor provides full UPS diagnostics for:

- Carrying out adequate remedial action in the event of an anomaly or abnormality
- Locating a faulty PC Assembly or subassembly
- Replacement of faulty components (following the indicated procedure)

When the required action is highly involved, or when the fault cannot be located by the UPS Monitor software, the UPS Monitor will recommend calling a maintenance specialist. Contact Digital Customer Services.

Diagnostic routines are available under Menu 7 (DIAGNOSTICS) from the main menu (see ¶ 3.3.2.7).

The terms displayed on the LCD are explained in the glossary at the rear of this manual.

In the event of a failure, a general electronics self-test can be executed. To execute the self-test, the Inverter and Rectifier/Battery Charger must be turned off. Refer to ¶ 3.3.2.7 for the self-test procedure.

4.3 Battery Safety Instructions

IMPORTANT SAFETY INSTRUCTIONS FOR SERVICING BATTERIES

A. Servicing of batteries should be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

B. When replacing batteries, use the same model number and manufacturer of batteries.

C. CAUTION — Do not dispose of battery or batteries in a fire. The battery may explode.

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

E. CAUTION — A battery can present a risk of electrical shock and high short circuit current. The following precautions should be observed when working on batteries:

1. Remove watches, rings, or other metal objects.

2. Use tools with insulated handles.

3. Wear rubber gloves and boots.

4. Do not lay tools or metal parts on top of batteries.

5. Disconnect charging source prior to connecting or disconnecting battery terminals.

6. Determine if the battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock will be reduced if such grounds are removed during installation and maintenance.


SECTION A

STANDARD FEATURES

A.0 Scope

This section describes standard features on the HA3000 11 kVA UPS. For each feature, a description is provided, followed by installation instructions, operating instructions, and maintenance information (if any).

A.1 Dry Contacts Interface

Description

Five (5) sets of isolated dry contacts are provided for external connections. They are located on control terminal block TB1 (see Figure A-1). These contacts indicate:

- UPS On Line
- Load On Bypass
- UPS On Battery
- Low Battery Shutdown
- Summary Alarm

Each of the contacts are normally open, and change state to indicate the status or operating condition. The contacts are rated 1 Ampere at 120 Vac, or 24 Vdc. The signals are identified below:

TB1-3	When closed, will indicate Load On Bypass
TB1-4	This signal also indicates that the Inverter is shut down. The display on the UPS LCD will indicate the alarm and the cause of the shut-down.
TB1-5	When closed, will indicate UPS On Line
TB1-6	This signal indicates that the Inverter is supplying the load
TB1-11	When closed, will indicate UPS On Battery
TB1-12	This signal indicates that the input utility power is no longer available or it is not within allowed tolerance, which will cause the Rectifier/Battery Charger to shut down, and the UPS Inverter to operate from the battery power source
TB1-13	When closed, will indicate Summary Alarm
TB1-14	This signal indicates that some operating parameter of the UPS is not within the allowed tolerance. Refer to the display on the UPS LCD to indicate the cause of the alarm
TB1-15	When closed, will indicate Low Battery
TB1-16	During UPS On Battery operation, the battery voltage reaches a set level that triggers this signal, to indicate the approach of Inverter shut-down due to a low dc voltage condition. Time remaining is dependent on the load level, battery operating temperature, and the age of the battery

Installation

This feature is factory installed.

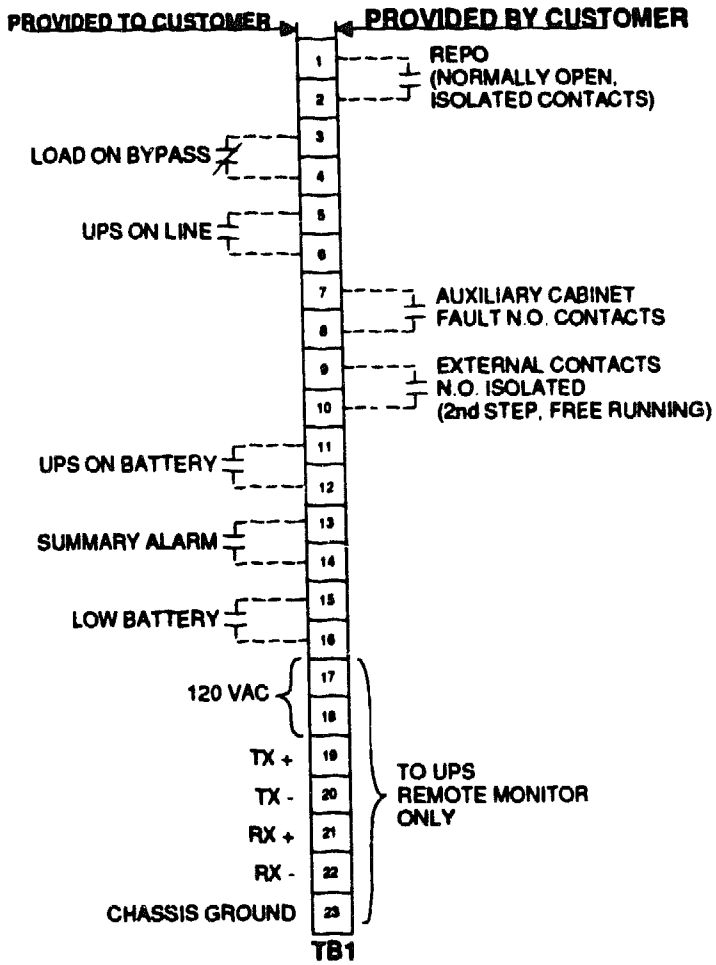
Operation

Refer to the Description above, which identifies how the external contacts generate signals, and how the alarms are displayed.

Maintenance

There is no maintenance associated with this feature.

FIGURE A-1: TERMINAL BLOCK TB-1



NOTE: MAXIMUM CABLE SIZE = #10 AWG

NOTE: DRY CONTACTS RATED AT 1 AMPERE, 24 VDC OR 120 VAC

A.2 Remote Alarm Status Panel (optional)

Description

The Remote Alarm Status Panel consists of a wall-mounted panel with four (4) indicating LEDs:

- green UPS On Line LED
- yellow Load On Bypass LED
- yellow UPS On Battery LED
- red Summary Alarm LED

The Remote Alarm Status Panel also includes:

- Alarm Reset pushbutton, to reset the latching alarm
- Audible Alarm (horn), for alarm annunciation
- Audio Reset pushbutton, to reset the Audible Alarm

Installation

An external 120 Vac power source is required. Refer to the Installation Drawing provided with this feature for installation and connection instructions.

Operation

When an alarm occurs, the appropriate LED will stay on (latch) even if the alarm is corrected. This feature enables the operator to verify the occurrence of the alarm. Once the alarm has been corrected, the operator can silence the Audible Alarm by pressing the Audio Reset pushbutton, and can reset the latching LEDs by pressing the Alarm Reset pushbutton.

Maintenance

There is no maintenance associated with this feature.

A.3 Remote Monitor Panel (optional)

Description

The Remote Monitor Panel is a wall-mount or desktop version of the UPS System Status and Control Panel, and includes:

- Three Indicating LEDs:
  - — Charger On
  - — Inverter On (UPS On Line)
  - — Static Switch On (Load On Bypass)
- Audible Alarm Silence key
- Scroll Up and Scroll Down keys
- Voltage and Current Measurement keys
- Menu and Enter command keys
- Ten Digit (0 to 9) keys
- Two Line, 20 Character LCD Display

The Remote Monitor Panel allows remote viewing of operating data and parameters including:

- Input, Output, Bypass, and Battery Parameters:
  - — Voltage
  - — Current
  - — Frequency
  - — Percentage of Output Power
  - — Time On Battery
- UPS Status:
  - — Normal Operation
  - — Low Battery Shutdown
  - — UPS On Battery
  - — Bypass Power Out of Tolerance

Other operating conditions indicated include:

- Indication of Exact Alarm Condition:
  - — Inverter Off
  - — Inverter Fuse Blown
  - — Output Transformer Overtemperature
  - — Inverter LEG1 Power Supply Fault
  - — Fan Failure

Up to 60 alarms are indicated.

Installation

Refer to the Installation Drawing provided with this feature for installation and connection instructions.

Operation

The Remote Monitor Panel has the same features and operates in the same manner as the HA3000 11 kVA UPS System Status and Control Panel (SS&CP); refer to Section III — OPERATION for detailed information.

Maintenance

There is no maintenance associated with this feature.

A.4 DC Ground Fault Detector (optional)

Description

The DC Ground Fault Detector is used to detect current flowing from the battery terminals to ground. When detected, this option causes the UPS Main AC Input circuit breaker (Q1) to trip, preventing any cascading failures. This fault is also indicated on the UPS LCD display.

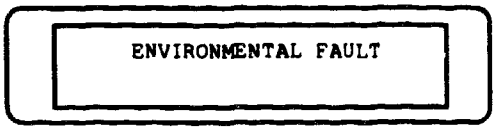
The DC Ground Fault Detector is mounted inside the UPS enclosure.

Installation

Refer to the Installation Drawing provided with this feature for installation and connection instructions.

Operation

When a dc ground fault is detected, the UPS Main AC Input circuit breaker (Q1) trips, shutting off the Rectifier/ Battery Charger, and initiates UPS On Battery operation, which will prevent any cascading failures. The LCD on the UPS SS&CP will display:



Maintenance

There is no maintenance associated with this feature.

A.5 Smoke Detector (optional)

Description

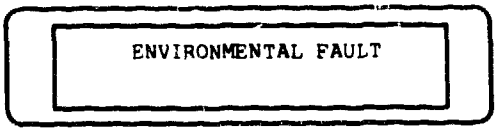
The Smoke Detector displays a warning signal on the UPS SS&CP when smoke is detected in the UPS battery compartment. The Smoke Detector is mounted inside the UPS enclosure.

Installation

Refer to the Installation Drawings provided with this feature for installation and connection instructions.

Operation

When the Smoke Detector senses the presence of smoke, a warning is displayed on the UPS SS&CP:



Maintenance

There is no maintenance associated with this feature.

A.6 Output Distribution Panel

Description

Models HA32A-AB and HA33A-AB are equipped with a 30-pole Bryan. distribution panelboard. The panelboard accepts one, two, or three-pole circuit breakers in any combination up to the maximum of 30 poles. The distribution panel is located in the rear of the UPS enclosure.

Installation

WARNING

Potentially hazardous voltages exist within this equipment when energized. Disconnect power to the equipment, including main input power and battery power, before removing panels or covers and before touching any internal elements.

The output cables and the output circuit breakers are shipped separately from the UPS. To gain access to the connection area, the rear panel of the UPS must be removed. Be sure there is sufficient clearance to provide a working area in the rear of the UPS (a minimum of 48" is recommended).

Output Circuit Breaker Installation

Installation of the output circuit breakers must be performed by a licensed electrician.

a. Remove the rear panel.

b. Install the appropriate circuit breaker(s) using the screws supplied with it.

Figure A-2 shows the location of the conduit mounting panel. Figure A-3 shows the distribution panel.

Output Cable Installation

a. Remove the appropriate sized knockout plug from the conduit panel.

b. Remove the locknut and bushing from the fitting at the end of the cable, and install the cable in the knockout hole with them, feeding the cable conductors through the hole.

c. Strip the insulation from the end of each cable wire, leaving 5/8" exposed copper wire.

d. Connect the cable wires to their respective terminations as shown in the following table:

Color	Signal	Termination
White	Neutral	Neutral Bus
Black	Phase A	Top CB Terminal
Red	Phase B	Middle CB Terminal
Blue	Phase C	Bottom CB Terminal
Green	Ground	Ground Bus

NOTE

Consult local electrical codes for color code variation.

FIGURE A-2: CONDUIT MOUNTING PANEL

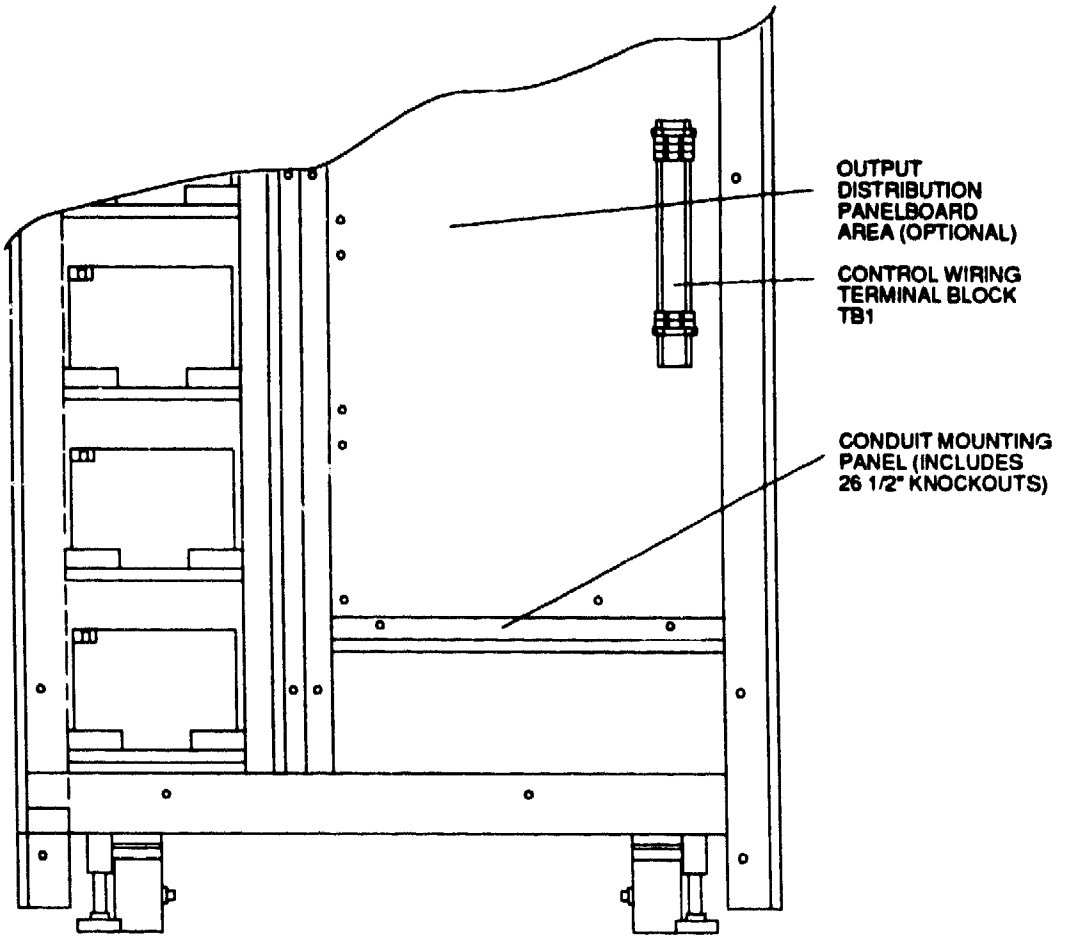
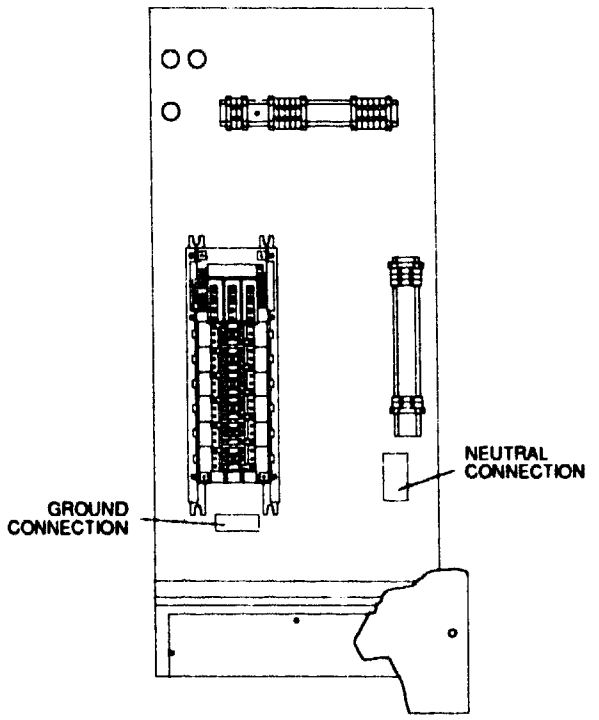


FIGURE A-3: 30-POLE BRYANT PANELBOARD



e. Check all connections for proper tightness.

f. Install all covers previously removed using the original hardware.

g. Identify the output circuit breaker(s) on the distribution cover panel nameplate.

h. Have a qualified technician check the output cable receptacle for proper voltage and phase sequence before connecting it to its respective equipment.

Maintenance

Condition of the output circuit breakers should be inspected as part of the normal UPS preventive maintenance routine. Refer to Section IV — MAINTENANCE for further information.

A.7 CSA Assembly

Description

The CSA Assembly is only applicable to Models HA33A-AA and HA33-AB. The CSA Assembly provides static bypass feedback protection during utility power outage.

Installation

The CSA Assembly is factory installed.

Operation

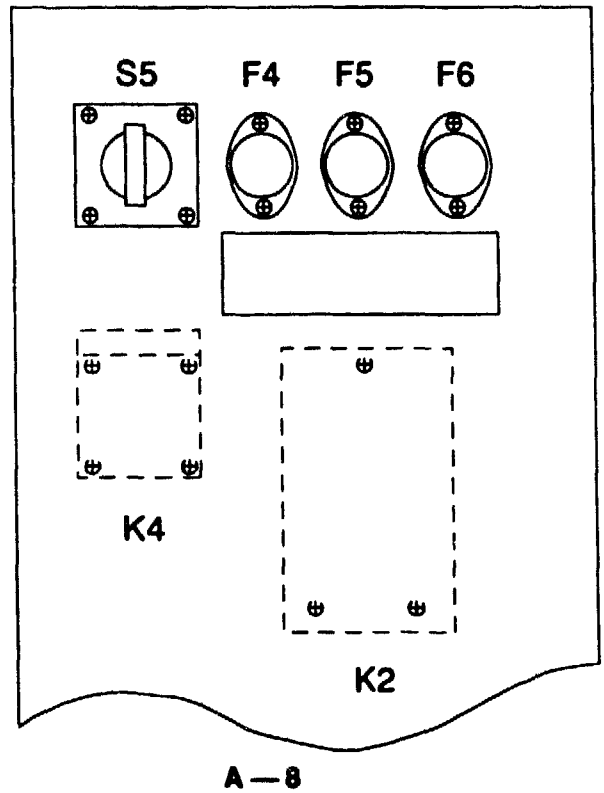
Switch S5 to the ON position. This in turn will energize control contactor K4, which in turn energizes the power contactor K2.

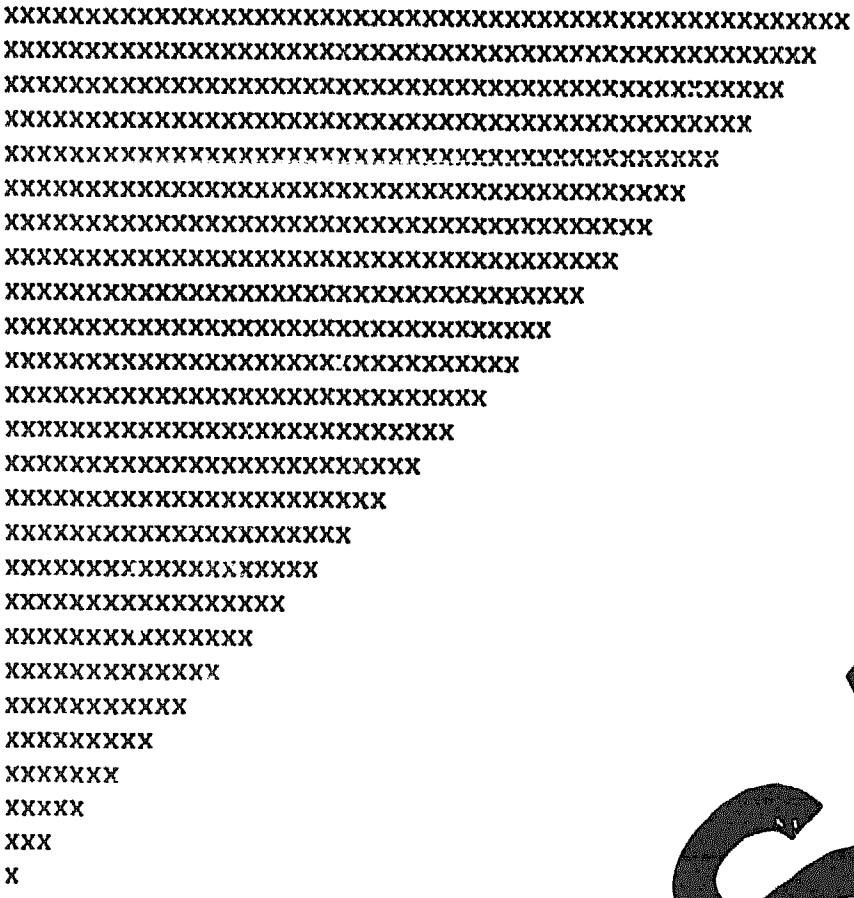
Switch S5 must remain in the ON position during normal operation.

Maintenance

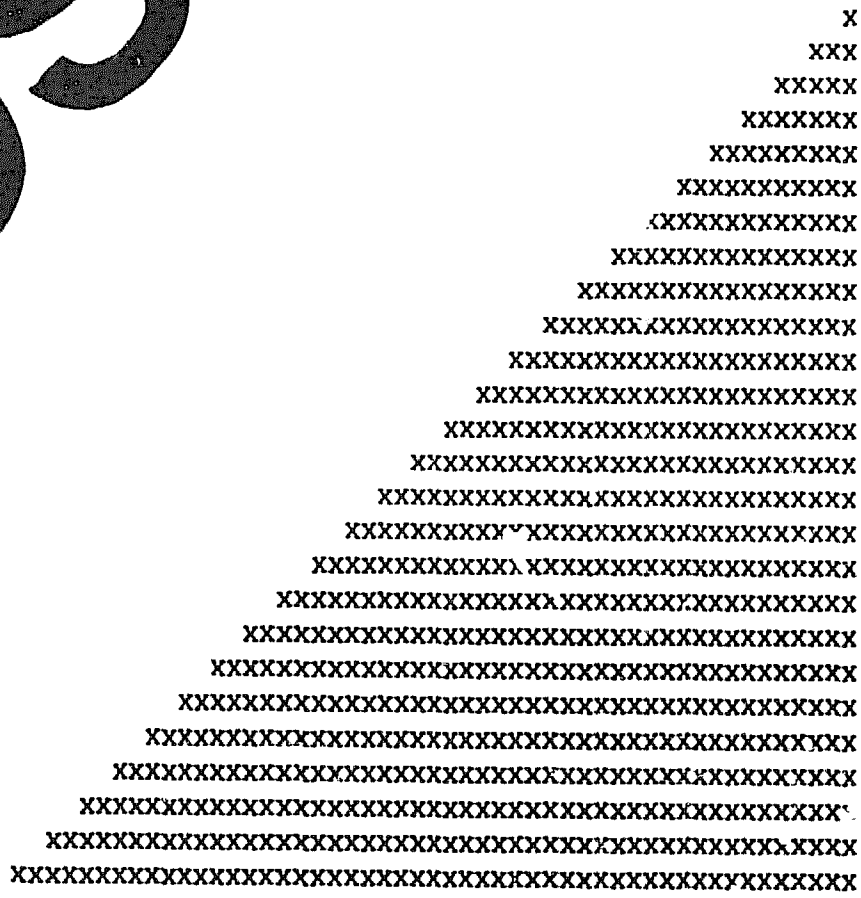
There is no maintenance associated with this feature.

FIGURE A-4: CSA ASSEMBLY





GLOSSARY



GLOSSARY

SYMBOLS

¶	Used to reference paragraph headings which are listed in the table of contents.
/	Used to represent "and/or".
%	Percent; of each hundred.
°F	Degrees Fahrenheit.
°C	Degrees Centigrade.
@	At.
±	Plus or minus.
#	Number.
Ø	Phase.
Ω	Ohms.
2nd	Second.

A

ABC	Normal sequence of phases in three phase power.
AC	Alternating current.
Ambient air temperature	The temperature of the surrounding air.
AWG	American Wire Gauge, formerly Brown & Sharp gauge.

B

B or BAT or BATT.	Battery.
BAT TRANS. TEST	Battery Transfer Test; simulates a Main Input power failure and tests Inverter operation on the battery for two minutes.
BATTERY OV	Battery Over-Voltage.
BATTERY UV	Battery Under-Voltage.
BREAKER	Circuit Breaker.

British Thermal Unit	A unit of heat equal to 252 calories. (Definition below.)
BTU	British Thermal Unit. Defined as the amount of energy required to raise the temperature of 1 pound of water by 1° F.
BYP	Bypass.
BYPASS	Manual Bypass; manual bypass without interruption to the load using the Manual Bypass switch Q3BP in conjunction with Q5N.
BYPASS AC INPUT	MAINS2.
BYPASS PROCEDURE	Main Menu selection for access to the procedure for transferring the load to the bypass source for isolation of the UPS equipment and returning the load to the Inverter output.

C

Calorie	A unit of heat. 1 calorie is the amount of energy required to raise the temperature of one gram of water by one degree Celsius.
Carrier	The company or individual responsible for delivering goods from one area to another.
CAPAC DISCHARGING	Capacitors Discharging; indicates that the capacitors are discharging. The voltage across the capacitor terminals is indicated on the next LCD line. When this indication appears on the LCD, wait until the capacitor voltage reaches zero before carrying out any operations on the equipment.
CB	Circuit Breaker.
CH	Rectifier/Battery Charger.
CHANGE OK=1	Prompt requesting replacement of subassembly indicated on the preceding LCD line. By entering 1, you indicate to the UPS MONITOR that the change has been made.
CHARG.	Rectifier/Battery Charger.
CHARGE I MAX	Prompt for entry of the maximum battery charge current value.
CHARGER ACQUISITION FAULT	The Rectifier/Battery Charger is not receiving information required for operation.

CHARGER CT FAULT — Indicates a fault on Current Transformer T1 or T2, installed on the Rectifier/Battery Charger input lines.

CHECK LOAD — Transfer the load to the bypass source, and check to see that the currents of the three phases do not exceed the Inverter current rating (In=Pn/3Un where In = Inverter nominal current rating in kVA, Pn = Inverter current rating in kVA, and Un = Inverter line-to-neutral voltage).

CHECK MAINS — Measure the Main AC Input (+10/-15%) voltages to insure that they are within tolerance.

CHGR. — Rectifier/Battery Charger.

COMMUNICATION — Main Menu selection providing access to parameter programming for communication.

Conduit — A flexible or rigid tube surrounding electrical conductors.

CT — Current Transformer.

C.T.M. — Centralized Technical Management; a system providing overall supervision of the various installations.

Curr. — Current.

Current Rating — The maximum current which a piece of electrical equipment was designed to carry.

D

DC — Direct Current.

DC FAULT — Indicates an internal fault at the dc voltage level (between the Rectifier/Battery Charger, the Inverter, and the battery).

DESIG. — Designation.

DIAGNOSIS — Main Menu heading providing access to UPS diagnostic routines for troubleshooting the HA3000 UPS system.

E

Earth ground — A ground circuit which has contact with the earth.

Electrician — Refers to an installation electrician qualified to install heavy-duty electrical components in accordance with local codes and regulations. Not qualified to maintain or repair electrical or electronic equipment; compare to Technician.

ENVIRONMENTAL FAULT	Indicates a dc ground fault has occurred in the battery, or the optional Smoke Detector has sensed smoke, or a failure has occurred in the optional Auxiliary Cabinet.
EPO	Emergency Power Off.

F

FAN FAILURE	Failure of the internal UPS enclosure cooling fan.
FAULT CLEAR	Clearing of memorized faults after the condition(s) causing the fault(s) has been corrected.
FORCED OFF	Inverter shut-down, with an 0.8 second load interruption caused by incorrect bypass source characteristics.
FORCE ON	Load transferred to Inverter with an 0.8 second interruption.
FORCE TRANSFER	Prompt requesting password entry to obtain load transfer to Inverter after an interruption of 0.8 seconds.
FREE RUNNING	Indicates that the Inverter frequency is stable and independent of the bypass source frequency.
FREQ	Frequency.
Fusible	Capable of being melted with heat.

G

GEN SET DESYNCHRO	Inverter frequency de-synchronization action with respect to the bypass source upon transfer to a motor-generator set.
GEN SET POW LIMIT	Motor-Generator Set Power Limit; reducing the power consumed by the Rectifier/Battery Charger during operation of the UPS on a motor-generator set.
GND	Ground.
GRAD CH STOP	Gradual Rectifier/Battery Charger Shut-Down; a gradual shut-down of the Rectifier/Battery Charger initiated by the closure of an external contact.

H

Hz	Hertz; one cycle per second equals one Hertz.

I

I	Current.
I SENSOR FAULT	Indicates a fault on the Inverter output current sensor.
Input Branch Circuit	The Input Circuit from the building Power Panel circuit breaker to the UPS module.
INV.	Inverter.
INV FUSE BLOWN	Inverter Fuse Blown; indicates that fuse F1, F2, or F3 has blown on the Inverter output.
INV LEG THERMO	Indicates over-temperature on the transistors of the Inverter leg.
INV NON SYNC	Indicates that the phase shift between the Inverter and the bypass source is outside of tolerance (±3°). Transfer of the load without interruption is not possible.
INV STOP DISABLED	Indicates that the Inverter cannot be stopped using the INVERTER STOP command, since the bypass source characteristics are incorrect, which would lead to an 0.8 second interruption to the load if the Inverter were stopped.
INVERT 2 PHASES	The Main AC Input or bypass source connections are incorrect. Swap any 2 phases to correct the phase sequence.
INVERTER ACQUISITION FAULT	Indicates that the Inverter is not receiving information required for operation.
INVERTER FORCED	Load supplied by the Inverter regardless of circumstances (transfer to the bypass source is locked out).
INVERTER RETURN	Prompt requesting the entry of the number 2 for access to the LOAD RETURN TO INVERTER procedure from maintenance bypass status.
I/P	Input.

J

K

kVA	Kilovolt Ampere; a measure of apparent power.
kW	Kilowatt; a measure of real power.

L

LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
LEG	Inverter phase.
LEG DESATURATION	Indicates that the power transistors are not operating in saturation.
LEG POWER SUP FAULT	Inverter Leg Power Supply Fault; indicates a power supply fault on the PC Board controlling the transistors of the Inverter leg.
LOAD INTERRUPT...!	Warning that impending action will cause an 0.8 second load interruption.

M

MAINS1	Main AC Input source.
MAINS2	Bypass AC Input source.
MAINS2 FU RC BLOWN	Indicates blown fuses on the voltage surge suppression circuit connected to the bypass source.
MAINS2 NOT OK	Indicates that the bypass source voltage or frequency is outside tolerance limits (±10% and ±0.5% of nominal respectively).
MAINS2 PHASING	Indicates zero volts on one phase of the bypass source.
MAINS PH SEQ NOK	MAINS Phase Sequence Not Okay; indicates that the phase rotation is incorrect; swap any two phases to correct this condition.
MAX	Maximum.
MCM	Thousand Circular Mil; wire size for multiple stranded conductors over 4/0 AWG in diameter. M is from the Roman Numeral system symbol for 1,000.
MG	Motor Generator.
MOV	Metal Oxide Varistor.

N

NEC	National Electric Code.
NFPA	National Fire Protection Association.
NO. or No.	Part Number.
NOK	Not Okay.

O

OSHA	Occupational Safety and Health Act.
OF	Over-Frequency.
OF/UF	Over- or Under-Frequency.
O.T.	Out of Tolerance.
OUTPUT OVERLOAD	Indicates that an overload (110%) has occurred.
OUTSIDE CONTACT	An external contact supplied by the user and initiating either independent Inverter frequency, or a reduction in the power consumed on the MAINS1/Main AC Input line, or force load supply by the Inverter, or a gradual Rectifier/Battery Charger shut down.
OV	Over-Voltage.
OV/UV	Over- or Under Voltage.

P

Packing List	The list of articles included in a given shipment.
PCA	Printed Circuit Assembly, refers to the electronic cards used in the UPS.
PERSONALIZATION	Main Menu heading for access to the programming of non-standard equipment characteristics.
P.F.	Power Factor.
PH	Phase.
PIA	Plug-In Assembly.

POWER SUPPLY FAULT	Indicates a fault on the control electronics power supply board ALIP.
Q	
Q1	UPS Main AC Input/MAINS1 circuit breaker designation.
Q3BP	Manual Bypass switch designation.
Q5N	UPS Output Isolation switch designation.
QF1	Battery Disconnect circuit L aaker designation.
R	
Remote Emergency Power Off	A switch used for shutting down electrical equipment.
REPO	See Remote Emergency Power Off.
REP.	Replacement.
RMTE CNTRL ENABLE	Remote Control Enable, indicating that the Inverter and Rectifier/Battery Charger can be stopped and started from the control module unit telemonitor.
S	
SCR	Silicon-Controlled Rectifier.
SEQ	Sequence.
S.G.	Specific Gravity (see below).
Shipping damage	Any damage done to an article while it is in transit.
Shipping pallet	A platform on which articles are fixed for shipping. Not used when equipment is shipped by air ride padded van.
Specific Gravity	The ratio of the weight of a given volume of substance (such as electrolyte) to that of an equal volume of another substance (such as water) used as a reference.
SPEED = BAUDS	Programming of the transmission speed in bits per second (baud rate).
S.S. or STATIC SW	Static Switch, used to transfer the load to the Bypass AC Input/MAINS2 source without interruption to the load.

S.S. PROTECTIVE DEVICE FAULT — Indicates a fault on the voltage surge protection circuit connected to the Bypass AC Input/MAINS2 source.

S.S. THERMO — Indicates an over-temperature condition on the SCRs of the Static Switch assembly.

SS&CP — System Status And Control Panel.

SYNC. or SYNCHRO — Synchronization.

SW or SWITCH — Switch.

SW TO MAN BY-PASS — Switch To Manual Bypass; should be used prior to performing maintenance on the UPS.

T

Technician — Refers to an electronic technician qualified to maintain and repair electronic equipment. Not qualified to install electrical wiring. Compare with Electrician.

Temp. — Temperature.

TEST POSITION — Indicates that the Inverter has been stopped for maintenance and is not available. The load is on maintenance bypass (Q5N is open and Q3BP is closed).

THERMAL OVERLOAD — Indicates that an overload (between 120% and 150%) has occurred.

THERMO — Abbreviation for Over-Temperature.

TRANSF. — Transfer.

TRANSFO — Transformer.

TRANSFO THERMO — Indicates an over-temperature condition on the Inverter output transformer T2.

U

U — Voltage.

UF — Under Frequency.

UL — Underwriters Laboratories, Inc.

UPS — Uninterruptible Power System.

UV	Under Voltage.
V	
VAC	Volts of Alternating Current.
Vb	Battery Voltage (in Volts).
Vdc	Volts of Direct Current.
Via	By way of.
Volt.	Voltage.
VPC	Volts Per Cell, the measure of the electrical potential of a storage cell, such as a battery.
W	
W/O	Without.
X	
XFMR	Transformer.
Y	
Z	


INSTALLATION
LOG

HA3000 UPS SYSTEM — INSTALLATION LOG

Customer Name: _____

DIGITAL Field Service
Account Manager: _____

DIGITAL Support Phone: _____

Installation Date: _____

UPS Serial Number: _____

Output kVA Rating: _____ I/O Voltages: _____ / _____

Battery Minutes: _____ _____

Installation Notes: _____

_____

_____

_____

_____

Problems at Installation? (Y/N): _____ Describe: _____

_____

_____

Described Solution to Problem: _____

_____

_____

Time to Install (hours:min): _____

Materials Used: _____

The above is filled out at successful completion of the Startup Procedure and is inserted in the Service Log.


SERVICE
LOG

HA3000 UPS SYSTEM — SERVICE LOG

Date: ________________ Engineer Name: ______________________________

Describe Symptoms: ____

____

____

Trouble Found: ____

____

____

Materials Used (Include Name and Serial # of new FRU): ________________

____

____

Total Time to Repair: ____

• •

Date: ________________ Engineer Name: ______________________________

Describe Symptoms: ____

____

____

Trouble Found: ____

____

____

Materials Used (Include Name and Serial # of new FRU): ________________

____

____

Total Time to Repair: ____

At least one section (two sections are found on each page as above) is completed at each service call. Copies of this page should be inserted in the Service Log for future use.