Best Power Technology Sales Corporation, Inc.

FERRUPS
SERVICE MANUAL

for

FD10KVA	QFD10KVA
FD12.5KVA	QFD12.5KVA
FD18KVA	QFD18KVA

LTS 570

Best Power Technology Sales Corporation, Inc.

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Overview

To ensure ease of use, this manual has different types of information given in each section. Information in each section includes:

Section 100 General manual and Technical Suppon Center information;

Section 200 System description and theory of operation;

Section 300 System operation, communications, and software information;

Section 400 Maintenance and component replacement;

Section 500 Troubleshooting;

Section 600 Part lists;

Section 700 Technical Information Publications (TIP and QTIP);

Section 800 Pictorial layouts (parts identification) and system schematics.

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Support and Specifications

100 General Information

This Service Manual supplements the User Manual. You should be familiar with the User Manual before proceeding with any material in this Service Manual.

READ ME FIRST

This service manual contains operational, technical, maintenance and repair information for the Best Power Technology FERRUPS systems with the following model numbers:

60 Hertz	50 Hertz
FD10KVA	QFD10KVA
FD12.5KVA	QFD12.5KVA
FD18KVA	QFD18KVA

The information' presented herein is applicable to all 10KVA, 12.5 KVA and 18 KVA models, both 50 and 60 Hertz. All 50 Hertz models are prefixed with a ***Q (e.g. QFD10KVA)***. **Any references specifically applicable to 50 Hertz units will be designated *in italics*.**

The models covered by this manual have SERIAL NUMBERS in the following format:

FDsKnnnnn and QFDsKnnnnn where:

"s" refers to the size (e.g. 10, 12.5 or 18) and
"nnnnn" refers to the unique serial number

The information in this manual is accurate for all units with software versions of F6.10 as noted on the logic board EPROM. Changes may occur on other versions. Please contact Best Power Technology Customer Support Center for any questions.

101 Technical **Support**

Best Power Technology, Inc. has an outstanding Technical Support Center. Please write or call if you have a problem or a question about your FERRUPS. When contacting the Technical Support Center, it is important that you have your system serial number. The FERRUPS serial number is stamped on a specification plate located on the back of the unit, below the RS232 port. All service records and system modifications arc filed by serial number.

The Technical Support Center is open every business day from 7:00 a.m. to 11:00 p.m. Central Time. Customers outside the United States may wish to use the TELEX number. If you need to send drawings or diagrams, you may do so by calling our facsimile number. If you have a sales inquiry, you may call the sales department toll-free in the U.S. and Canada.

Technical Support	800-356-5737 (U.S. and Canada)
Technical Support Fax	(608) 565-2509
General Fax	(608) 565-2221
TELEX	701934
Sales	800-356-5794 (U.S. and Canada)
General Office	(608) 565-7200
BBS	(608) 565-7424

Mailing Address:

Best Power Technology, Inc.
P.O. Box 280
Necedah, WI 54646

Shipping Address:

Best Power Technology, Inc.
Route 1, Box 106
Necedah, WI 54646

A variety of technical services are available from BEST's Technical Support Center.

101-1 Telephone Support

If you have a question about a FERRUPS system, such as how to install or repair it, call the Technical Support Center hotline at 800-356-5737. BEST's staff of Field Service Technicians is available 24 hours a day to help customers with any type of problem relating to a FERRUPS system.

101-2 Field Support

In the unlikely event that your FERRUPS system should fail, you can make arrangements to have your system repaired by a BEST factory-trained technician. Call the Technical Support Center hotline for price and scheduling information,

101-3 Service Training

If you would like to arrange factory training for your in-house service technicians, call the technical support hotline for more information.

102 Warranty

As stated in the Warranty Section of the user's manual, the warranty period is one year from the

date of purchase. If within the one year period you return a FERRUPS system or component or circuit board to BEST's Technical Support Center, BEST will repair or replace it free of charge. The customer is responsible for all freight charges to and from BEST.

Customers who purchase the Customer Protection Plan (CPP) receive on-site service and extended warranty coverage. Contact the Technical Support Center for detailed information about the CPP.

103 Ordering Exchange Parts

BEST products are warranted for one year. If a product fails while under warranty, you may order replacement parts for exchange, or you may send in the failed part for repair.

After the warranty has expired, you may order exchange parts or send in the failed parts for repair, but in either case the failed part must be repairable to qualify for the Non-Warranty Parts pricing.

To send in a failed part for repair or exchange, contact the Technical Support Center, give the serial number of your system, and ask for a Return Material Authorization (RMA) number. Once you have been issued an RMA, ship the failed part back to BEST. Do not ship returned parts COD, as such shipments will be refused by BEST. Please be sure to mark the RMA number clearly and plainly on the outside of the shipping carton. When the failed parts are received by the service department, repaired and reconditioned replacement parts will be sent out within two days and you will be invoiced for shipping charges. If the failed parts are judged by BEST to be out of warranty, the replacement parts will be sent COD for the value of the parts plus shipping charges.

104 FERRUPS Specifications 50 Hertz Models

	MODEL		
	QFD10KVA	**QFD12.5KVA**	**QFD18KVA**
AC Input Voltage/Service Required (Amps)	220VAC/55 Amps 230VAC/55 Amps 240VAC/50 Amps	220VAC/70 Amps 230VAC/70 Amps 240VAC/65 Amps	220VAC/100 Amps 230VAC/100 Amps 240VAC/95 Amps
AC Output/Max. Amps	220VAC/45.5 Amp 230VAC/43.5 Amp 240VAC/41.7 Amp	220VAC/56.8 Amp 230VAC/54.3 Amp 240VAC/52.1 Amp	220VAC/81.8 Amp 230VACf18.3 Amp 240VAC/75.0 Amp
Audible Noise	55 dB	56 dB	57 dB

	MODEL		
	QFD10KVA	QFD12.5KVA	QFD18KVA
DC Amps Max. (Nom. Bat.)	71	95	146
DC Voltage	120	120	120
Efficiency (Line)	90%	91%	92%
Frequency-line (Inverter)	50 Hz +/-3Hz (0.5Hz)	50Hz+/-3Hz (0.5Hz)	50Hz+/-3Hz (0.5Hz)
Harmonic Distortion (THD) (Single)	5% THD 3% Single Harmonic	5% THD 3% Single Harmonic	5%THD 3% Single Harmonic
Heat Dissipation BTU/Hr	2844	3375	4452
Isolation	<2 pF	<2 pF	<2 pF
Noise Rejection (Common Mode (Transverse Mode)	>120 dB >60 dB	>120 dB >60 dB	>120 dB >60 dB
Operating Temp.	0 to 40 deg. C. 32 to 104 deg. F.	0 to 40 deg. C. 32 to 104 deg. F.	0 to 40 deg. C. 32 to 104 deg. F.
Relative Humidity	0 to 95% noncondensing	0 to 95% noncondensing	0 to 95% noncondensing
Output Power	10,000VA	12,500VA	18,000VA
Overload Capability	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)
Runtime Full Load (Half)	11 Min. (26)	11 Min. (27)	10 Min. (26)
Weight	500lbs (227kg)	565lbs (257kg)	750lbs (341kg)
Voltage Regulation (Nominal)	3%	3%	3%

105 FERRUPS Specifications 60 Hertz Models

	MODEL		
	FD10KVA	**FD12.5KVA**	**FD18KVA**
AC Input Voltage/Service Required (Amps)	208VAC/60 Amps 240VAC/50 Amps	208VAC/75 Amps 240VAC/65 Amps	208VAC/110 Amps 240VAC/95 Amps
AC Output/Max. Amps	120VAC/83.3 Amp 208VAC/48.1 Amp 240VAC/41.7 Amp	120VAC/104.2 Amp 208VAC/60.1 Amp 240VAC/52.1 Amp	120VAC/150.0 Amp 208VAC/86.5 Amp 240VACff5.0 Amp
Audible Noise	55 dB	56 dB	57 dB
DC Amps Max. (Nom. Bat.)	72	97	151
DC Voltage	120	120	120
Efficiency (Line)	90%	91%	92%
Frequency-line (Inverter)	60 Hz +/-3Hz (0.5Hz)	60Hz+/-3Hz (0.5Hz)	60Hz+/-3Hz (0.5Hz)
Harmonic Distortion (THD) (Single)	5% THD 3% Single Harmonic	5% THD 3% Single Harmonic	5%THD 3% Single Harmonic
Heat Dissipation BTU/Hr	2844	3375	4452
Isolation	<2 pF	<2 pF	<2 pF
Noise Rejection (Common Mode (Transverse Mode)	>120 dB >60 dB	>120 dB >60 dB	>120 dB >60 dB
Operating Temp.	0 to 40 deg. C. 32 to 104 deg. F.	0 to 40 deg. C. 32 to 104 deg. F.	0 to 40 deg. C. 32 to 104 deg. F.
Relative Humidity	0 to 95% noncondensing	0 to 95% noncondensing	0 to 95% noncondensing
Output Power	10,000VA	12,500VA	18,OOOVA

	MODEL		
	FD10KVA	**FD12.5KVA**	**FD18KVA**
Overload Capability	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)	150% Surge 125% 10 Min. (Line) 110% 10 Min. (Inv.)
Runtime Full Load (Half)	11 Min. (26)	11 Min. (27)	10 Min. (26)
Weight	440lbs (200kg)	4901bs (223kg)	650lbs (295kg)
Voltage Regulation (Nominal)	3%	3%	3%

System Description and Theory of Operation

200 FERRUPS System Description

FERRUPS protects sensitive electronic equipment against sags, surges, noise, lightning, spikes, brownouts, and glitches while providing continuous, computer-grade power. PERRUPS is a true no-break uninterruptible power supply. PERRUPS comes equipped with an onboard microprocessor-based control system that provides the operator with control, monitoring, metering and diagnostics. The serial data port allows connection to an external terminal, computer, or modem. Microprocessor sophistication provides easy change and calibration of system set points and functions from the front panel keyboard. It also makes the PERRUPS system extremely easy to install, operate and maintain.

Best Power Technology selected the FERRUPS name because of the unique ferroresonant transformer used to achieve uninterruptible power. In the normal operating mode the ferroresonsant 'transformer filters line power and protects the critical load. The ferroresonant transformer stores energy in its magnetic field and capacitor circuit, and when line power fails, it continues to provide power to the load. This "flywheel effect" can carry the full rated load from eight to sixteen milliseconds, much longer than the two milliseconds it takes to bring the inverter on line.

If AC line fails or drifts out of tolerance, the PERRUPS microprocessor detects the problem in as little as 260 microseconds. FERRUPS then switches off the line input and turns on the ***inverter,*** in phase. The inverter changes DC power from the batteries into pulsed DC and supplies it to the ferroresonant transformer. The ferroresonant transformer takes the pulsed DC and waveshapes it into computer grade AC. Because of the "flywheel effect" there is continuous, no-break output power.

When input power returns to normal, the microprocessor synchronizes the inverter to the phase of the incoming line. The microprocessor evaluates line voltage quality and stability. If acceptable, the inverter turns off and AC line is switched to the ferroresonant transformer. This transfer occurs almost instantly, and with help from the "flywheel effect" provides continuous, no-break AC output.

Figure 1 is an actual oscilloscope photo of what happens during a complete AC line loss. Notice that although the input failed, there was no AC output loss.

201 System Theory of Operation

The theory of operation for both the 10 KVA, 12.5 KVA and the 18 KVA units is the same. Two subassemblies are interchangeable: the power board and the logic board (only if it is programmed for the model in which it is installed).

The FERRUPS has four system modes. “System Mode Auto”, is used in normal operation; “System Mode Inverter" and “System Mode Line Condition”, which are used for testing, and “System Mode Off’, which is used to turn the FERRUPS off. These modes are covered in more detail in Section 300. During normal operation (System Mode Auto), both AC and DC are available. Refer to Figure 2 for the diagram of the FERRUPS during normal operation. AC line is applied to the #1 primary of the ferroresonant transformer and the loads are powered by the secondary. In this mode, AC line is powering the loads; commercial AC is being filtered and regulated by the transformer. The incoming AC line is continuously monitored by the control electronics under supervision of the control program. Monitored parameters are compared to preset parameters and the program makes real-time decisions based on these comparisons. Other operating parameters also being monitored are input current, output AC voltage and current, battery voltage and current, ambient temperature, heatsink temperature, and ambient humidity (optional).

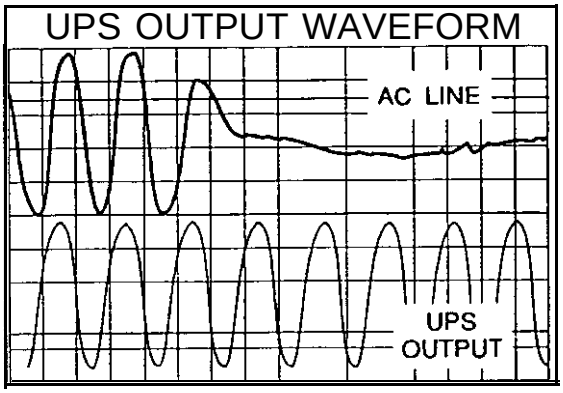
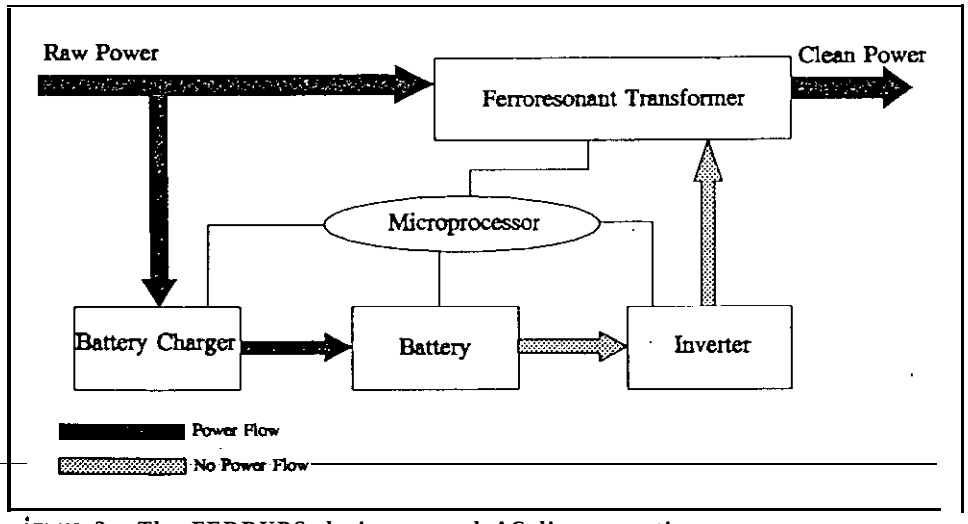


Figure 1 . Oscilloscope Trace of an AC Line Loss and the FERRUPS' Response

If any of these parameters exceed preset limits, the FERRUPS will emit an audible morse code alarm and enter the cause of the alarm condition into an internal log which is available for future reference. If certain values exceed preset limits, the FERRUPS may shutdown to protect the loads or the unit from damage.



igure 2 - The FERRUPS during normal AC line operation.

The battery voltage is also monitored by the battery charger circuitry and the batteries are automatically charged as necessary. Once fully charged, the batteries are “floated” to maintain full charge.

When the incoming line fails to meet minimum requirements, the control electronics turns off the static switch, removing the AC line from the #1 primary of the transformer. Refer to Figure 3 for the diagram of the FERRUPS during line failure. This begins a sequence of steps resulting in powering the #2 primary of the

transformer with pulsed DC from the inverter. The inverter provides output energy in phase before any significant decay in output voltage has occurred. The resonant reactance of the ferroresonant transformer smooths the pulsed DC input and yields a high quality sine-wave output. This sequence of events requires two milliseconds. During this time the energy stored in the ferroresonant tank circuit supplies the full rated output power to the load.

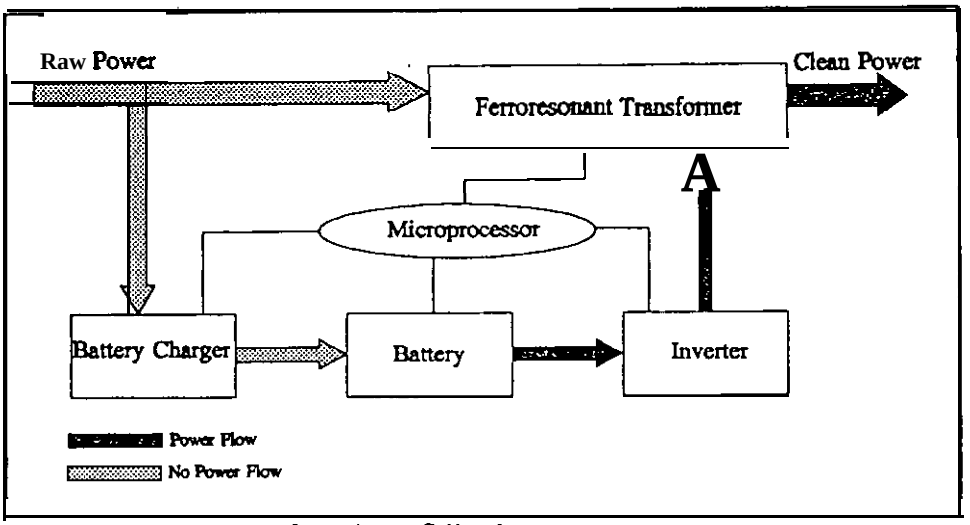


Figure 3 - The FERRUPS during AC line loss.

With the FERRUPS running on battery power, the control program continues to monitor all parameters and generates an audible beep every 20 seconds to let the user know the system is on battery power. Since the battery is now being discharged, the battery current and voltage are monitored. These measurements, along with the stored battery capacity parameter and calculated VA load value, are used to calculate a runtime remaining. This parameter, stored in minutes, is available for display as parameter #9 on the front panel or through the RS232 port. When this value reaches five minutes (the default value) a low runtime alarm sounds. If the battery continues to discharge, it will reach another programmable value called “near low battery” (the default is 119 volts), and the audible alarm changes. If the battery is discharged further, and reaches a preset low voltage value of 105 volts, the alarm will change to “low battery” and the FERRUPS will shut itself down to prevent deep discharge damage to the battery.

While running on battery power in the AUTO mode, the control program continues to monitor the incoming AC line. After determining that AC line is stable, the system will match the invener phase to the incoming AC phase and begin a transfer back to line. This is done by turning off the inverter and closing the AC static switch. The ferro tank once again powers the load during this brief transition and the loads are now back on AC line.

To better understand the System Theory of Operation it is necessary to break the system down into its major components and examine the function performed by each in detail.

202 Major System Components

The basic system is composed of four major assemblies and their respective subassemblies plus wiring and cabinetry. The four major assemblies are the logic board, the power board, the

heatsink and the ferroresonant transformer. Let us examine the functions of the logic board while the system is operating in the AUTO mode, the normal mode of operation for the FERRUPS.

202-l The Logic Board

The logic board controls all the functions in the FERRUPS with the exception of the battery charger. The heart of the board is an NEC 78C10 microprocessor running at 14.74 Mhz. The control program is software resident in EPROM (permanent memory) located on this board. In addition, there are many subsystems located on this board which make up the control and monitoring circuitry. In all modes of operation, the monitoring circuitry receives its conditioned and scaled signals from the power board, the current transformers, or the DC shunt.

-202-1.1 Logic Board Subsystem Functions

Multiplexer

The monitored signals, along with preset parameters and external commands, are used by the logic board to make decisions for control of the FERRUPS. There are a limited number of A/D (analog-to-digital) port connections on the microprocessor. In order to sample all of these signals, a multiplexer circuit is used. This makes it possible to monitor more signals than the processor could by itself.

AID Converter

Monitored voltages and currents are analog in nature; they do not have discrete or fixed values. In order for the monitored signals to be useful to the microprocessor they must be converted to digital values. This is the purpose of the analog-to-digital (A/D) converter. When the FERRUPS parameters have been properly calibrated, A/D calibration factors are stored in memory. Calibration factors are necessary because components used in manufacturing will normally have slightly different performance values. These factors are used to offset the actual reading and will change only when another calibration is performed. These values are available for readout on the display panel or RS232 port.

Phase-Locked-Loop

In order for the FERRUPS to switch from line to inverter and back to line smoothly and in phase, a circuit called the phase-locked-loop (PLL) is used. The PLL compares the external frequency (AC line) to the oscillator variable frequency and corrects the oscillator frequency to match the phase of the line. The rate of phase shift or “slew rate” can be accelerated by a hardwired jumper located on the logic board. This is usually done to accommodate an unstable AC source such as a generator.

Snubber SCR Drive

When the system goes to inverter operation, the static switch opens. Before the MOSFETs can begin switching DC, the logic board generates a gate signal for a series SCR located between the center tap bifilar inverter winding in the transformer and the positive battery. This gate signal sends DC to the MOSFETs, which can now turn on. This snubber SCR drive, originating on the logic board, is amplified and optoisolated on the power board

before. passing to the SCR on the heatsink assembly. This SCR is also allowed to shut off on zero crossover thereby snubbing ***any*** high voltage spikes and preventing damage to the MOSFETs. The SCR is turned on again before the next MOSFET drive signal occurs.

Interface

The logic board contains the interface circuitry for commands entered via the keypad or terminal. The keypad plugs in directly with a modular phone plug and the RS232 port is directly connected through a ribbon cable. The line drivers and UARTs are located on this board. In addition, the LEDs and the DIP switch are also part of the interface.

Power Supplies

The logic board operates on 12 volts supplied from the power board and derives other required voltages from the battery supply. It also contains a three-volt lithium battery to back up volatile RAM when the DC supply is off.

Miscellaneous

Additional components on the logic board include a pair of relays provided for external annunciation of inverter on or alarm conditions (available at the intelligent interface port), a DIP switch for allowing a hardware override of several software parameters, and adjustment potentiometers for peak current and PLL circuitry. The board also contains the jumper for changing the slew rate of the PLL and an audio beeper.

-202-1.2 Monitoring Functions

AC Line

This is a scaled value representative of the incoming line. This value originates at the input step-down monitor transformer (T4) located externally within the unit, passes through the power board (which provides spike protection) and enters the logic board for signal conditioning. This is the AC sensing signal for the line detect circuitry. This signal lights the LINE LED on the indicator panel and is available for true RMS readout on the display panel or RS232 port.

AC Output

The output voltage from the ferroresonant transformer is tapped and fed to the power board where it is scaled (stepped-down) through output monitor transformer (T1). This voltage enters the logic board and is used to determine proper output voltage. Low and high AC out alarms are based on this level. This parameter is **used** to calculate the VA out plus phase angle and is available for true RMS readout on the display panel or RS232 port.

AC Amps In

This signal is generated by the input current transformer (T2), a toroid located just below the DIN rail. AC input passes through this coil and is fed through the power board for spike protection, and on to the logic board. This parameter is calibrated and is available

for input AC current readings on the display panel and RS232 port

AC Amps Out

A second toroid (T3) also located below the DIN rail is used to sense output current. The AC output passes through this coil and generates the AC Amps output signal. This signal is passed through the power board for scaling and sent to the logic board. This signal is used to calculate the VA out plus the phase angle and is available for readout on the display panel and RS232 port.

Battery Current

This signal originates on the heatsink assembly from the DC current shunt. The shunt, a precision resistor, generates a voltage proportional to the current that passes through it. This voltage is passed through the power board and on to the logic board. In the AUTO mode, with the system on AC line, there is no battery current and no voltage across the shunt. When running on battery power, this DC current signal is used to calculate (with DC voltage, battery capacity, and VA load) the runtime remaining. It is available for readout on the display panel and the RS232 port.

DC Voltage

This battery reference voltage is a scaled proportional voltage which originates on the power board. It is used for calculating runtime while on battery power, for determining low and near low battery alarms and is available for readout on the display panel and the RS232 port.

Temperature and Humidity

Three additional monitored values include ambient temperature, heatsink temperature and (optionally) ambient humidity. Ambient temperature is monitored directly from a temperature-sensitive resistor connected to the logic board. Heatsink temperature, which originates from another temperature-sensitive resistor on the inverter heatsink, provides a signal which passes through the power board. An optional humidity sensor is connected directly to the logic board. These signals are monitored and compared to stored parameter settings to determine a possible alarm condition. These signals are also available for readout on the display panel and RS232 port.

-202-1.3 Control Signals

The logic board monitors signals to control system operation. These control signals originate on the logic board (except for the battery charger) but are conditioned-or-amplified-on the-power board. These signals consist of: --

Static Switch Drive

In the AUTO mode, AC line is applied to the #1 primary of the ferroresonant transformer. When the system is turned off or must switch to the inverter mode, AC line must be removed from the transformer to avoid damage. This drive signal controls the state of the static switch to turn AC line on or off. This switch is a single sealed module which

consists of two thyristors (SCRs) connected back-to-back. This module is located on the heatsink assembly. The logic board generates the drive signal that ultimately is applied to the gates of these SCRs. The static switch drive is conditioned by the power board and incorporates soft-start circuitry which is enabled whenever the system is initially turned on. The logic board must time the static switch drive to turn off before the invetter comes on when transferring to inverter. When switching back to line, it must turn on only after the invetter has turned off.

Inverter Gate Drive

In the AUTO mode, with the system operating normally and AC line applied, the invetter section of the system is not operating. When required to transfer to inverter, a gate drive signal is necessary to control the power MOSFET transistors. These are located on the heatsink assembly. This drive signal originates on the logic board and actually consists of two timed signals, A and B drive, corresponding to the two "sides" of the inverter. The basic frequency of these signals is 60 Hz (50 Hz) and is derived from the clock on the microprocessor. These A and B drive signals are amplified by the power board before being applied to the gates of the MOSFETs. This basic timing is controlled by the PLL circuit on the logic board.

202-2 The Power Board

The power board conditions and amplifies signals to and from the logic board. It supplies the main 12-volt source for the logic board, which originates from the battery supply. This is fused by F3, a one-amp fuse.

-202-2.1 Power Board Subsystem Functions

Fail Safe

If the FERRUPS is operating from AC line and loses the DC battery supply, a circuit on the power board continues to supply DC to the logic board by deriving a DC source from the AC input monitor transformer T4. This enables the system to perform an orderly shutdown in case of DC loss and also provides a DC source to operate the system in Line Condition Mode. With loss of DC in the AUTO mode, the system would shutdown on low battery and would continue to alarm as long as AC were present on the input.

Static Switch Drive and Soft-start

The static switch drive signal from the logic board is conditioned by the power board, which uses transformer T2 to provide gate pulses to the static switch. When. the FERRUPS is initially turned on, the inrush current to the ferroresonant transformer would exceed the input breaker requirements due to the large energy storage capacity of the tank circuit. To eliminate any problem with this inrush, the power board circuitry incorporates a soft-start. Instead of allowing the gate signal from the logic board to fully turn on the static switch, the power board alters the signal phase so the switch initially comes on very late in the half cycle. After a number of cycles the signal reverts back to the timing dictated by the logic board.

Inverter Gare Drive

These signals (A and B drive) from the logic board are amplified, pulse- height limited, and provided as test points before being passed to the MOSFETs. The power board also receives sensor signals from the MOSFET drains and can shutdown the drive signals in case of transistor damage.

Snubber SCR Drive

This drive signal from the logic board is conditioned and optoisolated by the power board. In addition, the current across the SCR is mdnitored by the power board and the drive signal can be shutdown by opening the 20 amp fuse F2. The snubber SCR located on the heatsink is in the current path of the MOSFETs and can shutdown inverter operation when required.

MOSFET Snubber

The power board contains active snubbing networks for both sections of the MOSFET transistors.

Battery Charger

The power board contains the battery charger control circuitry. The charger is a three-step, phase-controlled charger. Charger current is supplied by a 65 volt RMS winding in the main ferro. The first step of the charger occurs when the batteries are below the float level of 2.42 volts per cell; the charger puts out full rated current. The second step reduces current while maintaining a constant voltage, and the third step is a trickle charge. Charger output is applied to a full-wave bridge rectifier located on the heatsink assembly. The charger uses a soft-start circuit when turning on. Charger test points are TP3, 6, 7, 8, 10 and 11. Voltage is adjusted with potentiometer R113.

-202-2.2 Signal conditioning

The signals conditioned on the power board are:

AC Input

This signal comes from the input monitor transformer (T4) and is passed directly to the logic board with no change except for spike protection.

AC Output

This signal, coming from the DIN rail, is fused on the power board by F1, a five-amp fuse, and is stepped down by transformer T1 then passed to the logic board.

AC Amps In

This signal is generated by current transformer T2, located below the DIN rail, and is attenuated and spike-protected by the power board before passing to the logic board.

AC Amps Our

This signal is generated by current transformer T3 located below the DIN rail and is

attenuated by the power board before passing to the logic board.

I Battery

This signal, originating from the DC shunt on the heatsink, is passed through the power board unchanged except for providing test points.

DC Voltage

This signal, originating from the battery, is precision-scaled and provided to the logic board.

202-3 Heatsink

The heatsink assembly consists of power switching devices mounted on a large finned aluminum heatsink. These devices are the static switch, the power MOSFETs, the snubber SCR, the DC shunt and a temperature sensor. On the 10, 12.5 and 18 KVA models, the fan runs continuously. The functions of the individual devices on the heatsink are covered in the logic and power board descriptions.

202-4 Ferroresonant Transformer

The ferroresonant transformer consists of two bifilar wound primary windings, one for AC at 240/208 (*220/230/240*) volts input and a second for 120 volts pulsed DC. The output windings are 240/208 AC (*220/230/240*), a 65-volt charger winding and a tank winding for the tank capacitors.

202-S Battery Bank

The standard battery bank consists of ten, 12-volt batteries, connected in series for a nominal voltage of 120VAC. The batteries may be either gelled electrolyte or an absorbed glass mat (ACM) construction. These batteries are totally sealed, non-gassing, non-spillable batteries and are contained in a separate battery cabinet. The battery cabinet also contains the DC switch and main DC fuse. Additional series strings of ten batteries may be added in parallel to increase runtime.

Unit Size	Standard Battery (AH)	Type
10 KVA	31 A.H.	AGM
12.5 KVA	55 A.H.	Gel
18 KVA	57 A.H.	AGM

System Operation

300 System Operation, Communication, and Software Information

NOTE: The information in this chapter is provided to refresh and enhance material provided in the USER MANUAL. Basic information on startup and operation is covered **more thoroughly in the user manual. Some additional material is provided in more depth in this section.**

301 Startup

The startup procedure that follows will explain how to start the FERRUPS, use the keypad, and prepare the system for use with your loads. Once the FERRUPS has been installed and the AC wiring has been completed you are ready to proceed to startup and system operation.

302 DC Switch

Before the FERRUPS can be operated in Auto Mode (normal operating condition), the system must be powered up on DC. Locate the DC switch behind the lower front panel by unlocking and lowering the panel. Turn the DC switch on. Close panel and relock. If the system **is an Optional External Battery** system, the DC switch is located on the external battery cabinet.

303 Off/On/Keypad Disable

The FERRUPS can now be turned on by the front panel keylock switch. Inserting the key and turning it to the ON position will cause the unit to come on in five seconds (ten seconds if AC line is not yet applied). If AC line is not yet applied, the READY and BATTERY POWER indicator LEDs will be on. The FERRUPS will now be operating in Inverter Mode, and providing AC output from its battery supply. Turn on the AC line now. The AC LINE indicator will come on. The battery power indicator LED will turn off in 20 seconds. The FERRUPS is now in Auto Line Mode, the normal system operating condition. The READY indicator along with the AC LINE indicator should be on. The CHARGING LED may or may not come on depending on the condition of the batteries. If an alarm sounds and alarm indicator is on, go to the Alarm Conditions section of this chapter. The FERRUPS can be turned on and off as required by the front panel key. If the FERRUPS is to be left on, the key can be turned to the KEYPAD DISABLE position and removed. The system cannot be turned off or the operating conditions changed until the key is turned to the ON position. However, the FERRUPS will continue to run in Auto Mode and will go to battery power if required.

304 System Modes

The system modes control the operating state of the UPS. They are an indication to both the software and the operator how the unit should respond to a change in commercial power. The mode names (e.g. SMODE F) are the same commands entered from a terminal connected to the

RS232 port.

SMODE F (System MODE OfF) - [CONTROL][1]

The unit is off. There is no output from the unit.

SMODE A (System MODE Auto) - [CONTROL][2]

The unit is in automatic mode. This is the normal. operating state of the UPS. When line is present, the loads are powered by conditioned line power. If line fails, the inverter takes over to supply power to the ferro, provided the UPS is in a ready state (the READY LED is lit).

SMODE L (System MODE Line Condition) - [CONTROL][3]

The unit is in line condition mode. In this mode, conditioned power is only supplied to the load when AC line is present. If line fails, power to the load is lost. This mode is useful for several reasons. Some loads have a high start surge current that may cause the UPS to turn the inverter on. These loads can be started with the unit in this mode. If the battery fails, the loads can still receive conditioned power in this mode until the batteries are replaced. If the unit is on generator power, this mode will give the actual input line frequency from the generator on parameter #8. This helps in adjusting the "frequency window" on the UPS to accept generators that may be somewhat unstable in frequency.

SMODE I &stem MODE INVERTER Run) - [CONTROL][4]

This is a manual inverter start. The inverter will run in this mode until the battery is exhausted, the mode is changed, or a failure occurs. Power to the loads continues as if there had been an actual power failure.

In order for the system to respond to a mode change, certain conditions must exist that will allow it. Some of the reasons that modes cannot be changed are:

FROM:	TO:	Reason for Inability to Change
OFF	AUTO	Cannot lock the PLL
AUTO	AUTO	Cannot lock the PLL
AUTO	LINE COND	Line voltage below a minimum level or freauencv is out of tolerance
LINE COND	AUTO	Line voltage below a minimum level or frequency is out of tolerance

CHANGING		Reason for Inability to Change
FROM:	TO:	
LINE COND	INVERTER	Cannot lock the PLL
INVERTER	AUTO	Cannot lock the PLL

305 The Batten, Charging System

The 120-volt battery systems use a phase control charger. The charger is a float charger and is on whenever line is present and the unit is either in SMODE A or SMODE L. If the inverter is running, the charger will be off. Software controls the charger. It will shut off any time a high battery condition exists.

306 System Parameters

System parameters provide comparison set points that can be read by software to compare to values acquired in real-time. These values are either loaded at the factory or by qualified field service personnel and are calibration factors, operational limits or default parameters based on the model of the unit. Many parameters require a password to display or change. The password level is directly related to the sensitivity of the parameter. The lowest password is USER, followed **by** SERVICE and FACTORY.

NOTE: The parameter name is a mnemonic and is shown here as it actually appears on the front panel, handheld remote, or a terminal. In the explanation that follows the summary list, an expansion of the name is given.

P#	Name	Range	Default	PASSWORD REQUIRED
0	Time	0-2359 HRS	12:00:00am	SERVICE
1	V In	0-500 AC Volts	Approx	SERVICE
2	V out	0-300 AC Volts	Approx	SERVICE
3	I In	0-300 AC Amps	Approx	SERVICE
4	I out	0-300 AC Amps	Approx	SERVICE

P#	Name	Range	Default	PASSWORD REQUIRED
5	VA Out	Value calculated as factor of I Out and V Out	---	None
6	I Batt	0-300 DC Amps	Approx	SERVICE
7	V Batt	0-175 DC Volts	Approx	SERVICE
8	Freq	Output frequency; cannot be calibrated	---	NC
9	RnTm	Calculated from V Batt, Watts and BatCap and RnTm K	---	NC
10	Date	0101-1231 Mo Day	Jan-01	SERVICE
11	Amb Temp	Actual display of sensor temperature	---	NC
12	HS Temp	Actual display of sensor temperature	---	NC
13	%Humidity	Actual display of humidity from optional sensor	---	NC
14	ID Number:	FD10K012224	None	SERVICE
15	Model Number	FD4.3KVA	9	Param. #41
16	Full Load%	0-999	Actual	NC
17	Watts	0-99999 Watts	Actual	NC
18	PF 1.00----	0.00-1.00	Actual: Lead, Lag, Dist	NC

P#	Name	Range	Default	PASSWORD REQUIRED
19	VALimit	00000-99999 VA	Actual, at current PF	NC
20	#Pwr Out	0-9999 #	0	FACTORY
21	#Ovr Lds	0-9999	0	FACTORY
22	Sys Hrs	0-99999HRS	0	FACTORY
23	InvMin	0-9999.0MIN	0	FACTORY
24	Inverter Log NOTE: Records the last 16 inverter runs or resets. Cannot be changed, only cleared.			FACTORY
25	Alarm Log NOTE: Records the last 16 alarms Cannot be changed, only cleared.			FACTORY
26	Reserved			
27	Low Vout	90-300 AC Volts	108VAC or .90 * VoutNom	SERVICE
28	Hi Vout	100-300 AC Volts	130ACV or 1.08 # VoutNom	SERVICE
29	LowBat	0-175 DC Volts	105 VDC	FACTORY
30	NLBatt	0-175 DC Volts	110 VDC	SERVICE
31	HiBatt	0-200 DC Volts	149 VDC	FACTORY
32	L RnTm	0-99MIN	5min	SERVICE
33	A Otemp	25C-60C	60C	SERVICE
34	AT Shdn	25-80C	70C	SERVICE
35	S Otemp	---	95 C	NC
36	Low Humid	0-99	00	SERVICE
37	Hi Humid	0-99	99	SERVICE

P#	Name	Range	Default	PASSWORD REQUIRED
38	Off Cnt	0-9999	0	USER
39	EPO Dly	1-9999 Seconds	20 Seconds	SERVICE
40	NVVers		Actual	NC
41	Model Indx	1-8	9	FACTORY
42	ARst Time	0-255	001 min	SERVICE
43	XferDly	3-99 Seconds	5 sec	SERVICE
44	AutoRst	1)YES 2)NO	1)Yes	SERVICE
45	AC ShDn	1)YES 2)NO	1)Yes	FACTORY
46	ExBnOut	1)YES 2)NO	1)Yes	SERVICE
47	AltSetup	0-7	0	SERVICE
48	EPO Rst	0-2	0	SERVICE
49	VinNom	100-500 AC Volts	120	FACTORY
50	VoutNom	100-300 AC Volts	120	FACTORY
51	BrownoutV	75V-240 AC Volts	95VAC (120V in) or 0.79 * VinNom	SERVICE
52	Lo Freq	57-60Hz (*47-50Hz*)	59.50Hz (*49.50Hz*)	SERVICE
53	Hi Freq	60-63Hz (*50-53Hz*)	60.50HZ (*50.50Hz*)	SERVICE
54	Max ACVI	0-500		FACTORY
55	Min ACVI	0-500		FACTORY
56	Freq Delay	1-9	2	SERVICE
57	Glitch Cnt	1-5	2	SERVICE
58	RTL Mode	0-1	0	SERVICE

P#	Name	Range	Default	PASSWORD REQUIRED
59	Line Delt1	5-99	12	SERVICE
60	Line Delt2	5-99	16	SERVICE
61	V Reftbl	0-500 AC Volts	Actual	SERVICE
62	EBrownotV	75-400 AC Volts	Calculated	NC
63	Reserved			
64	Overlap	0-9	0	FACTORY
65	PhsDly	0-6142	0040	FACTORY
66	Reserved			
67	Reserved			
68	InvTest	1)YES 2)NO	1	SERVICE
69	TestRate	1-9999 MIN	1440	SERVICE
70	IPk	1-800 DC Amps	600	FACTORY
71	TestPhas	0-9999	0100	NC
72	I Batt Pk	0-999 DC Amps	000	NC
73	Peak 1	0-9999 DC Amps	0000	NC
74	Peak 2	0-9999 DC Amps	0000	NC
75	Alarm Enables		Enable	SERVICE
76	Relay Control	OPTION	OPTION	
77	Reserved			
78	Baud NOTE: 1=300 **baud,** 2=1200 **baud,** 3=4800 **baud and** 4=9600 baud	1-4	2)1200	SERVICE

P#	Name	Range	Default	PASSWORD REQUIRED
79	ConMde	l)Norm 2)NoAM 3)NoEB 4)SndF	l)Norm	SERVICE
80	Ctl Pswd	l)YES 2)NO	2)No	SERVICE
81	# Bad PW	o-9999.	oooo	FACTORY
82	Reserved			
83	RnTm K	1-99	57	FACTORY
84	BatCap	5-9999 AH	31	SERVICE
85	BTT	60-240 Seconds	60	FACTORY
86	BattTst	1)YES 2)NO	1)Yes	SERVICE
87	IntrvlDays	l-30 Days	30	SERVICE
88	RnTm Alm	5-9999 Minutes	0005 Changes with model	SERVICE
89	FctrAlm	o-99999 Minutes	00000	NC
90	BTRT	0-9999 Minutes	0000	NC
91	Reserved			
92	CFACVI	0-59999	6530	FACTORY
93	CFACVO	0-59999	3060	FACTORY
94	CFACAI	0-59999	4710	FACTORY
95	CFACAO	0-59999	8160	FACTORY
96	CFDCV	0-59999	11265	FACTORY
97	CFDCA	0-59999	8600	FACTORY
98	CFREF	o-59999	7460	FACTORY
99	Reserved			

306-l Explanation of Parameters

0 Time - This is the current time of day, using the 24-hour clock format. It is a real-time clock and can be set to any valid time. If the unit is shut off, the time it was shut off will be the time displayed when it is turned on again.

1 V In - This is the input AC line voltage. This is initially calibrated at the factory to an actual value.

2 V Out - This is the output AC voltage. This is initially calibrated at the factory to an actual value.

3 I In - This is the AC input current, initially calibrated at the factory.

4 I Out - This is the value of the current applied IO the load, and is initially calibrated at the factory.

5 VA Out - This is an internally-calculated value and is a factor of V Out and I Out. This parameter cannot be changed.

6 I Batt - This is the battery current being supplied to the unit. This is initially calibrated at the factory.

7 V Batt This is the value of rhe battery voltage. This is initially calibrated at the factory.

8 Freq - This is the frequency of the input to the unit when the unit is in SMODE A and the inverter is off. If the inverter is on, this is the nominal design frequency of the unit. If the unit is in SMODE L, it is the frequency of the input to the unit. This parameter is a display of an actual value.

9 RnTm - This is the calculated runtime of the system on inverter for the current load. This value is a factor of V Batt, I Batt and BatCap. It is only valid after the unit has been running on the inverter for two to three minutes. The formula used to calculate runtime is

$$Constant \times Battery\ AH \times \frac{(VDC - LowBat)^2}{(FullChgV - VDC) \times (LoadWatts + WattsLoss)}$$

The above formula is valid when running on inverter. If calculating this parameter while the unit is on line, use the following formula to derive the VDC value for the above formula.

10 Date - This is the current date. It is a real-time calendar and can be set to any valid date. If the unit is shut off,the date it was shut off will be displayed when it is turned on again.

$$New\ VDC = VDC_{actual} - ResidualChg - \frac{(0.036 \times LoadWatts + Wattloss)}{20 + (\frac{Battery\ AH}{3})}$$

11 Amb Temp - This is the actual ambient temperature of the unit's environment in degrees Celsius. It is derived from a probe inside the unit and cannot be changed.

12 HS Temp - This is the actual temperature of the inverter heatsink in degrees Celsius. It is derived from a probe attached to the heatsink and cannot be changed.

13 %Humidity This is the actual relative humidity that is sensed by the optional humidity sensor.

14 ID Number The unit's serial number can be entered in this location. It is provided for installations with multiple units sharing a common terminal. If a mode change or alarm condition occurs, this ID number is also displayed.

15 Model Number - This value is set at the factory to identify the model number of the unit. Standard operating parameters, located in system ROM, are transferred to operational memory based on this value. This value is set at the factory but can be changed when the Model Index parameter (41) is entered.

16 FullLoad% - Percentage of actual rated load being provided by the unit. It is calculated using the formula:

$$FullLoad\% = \frac{VAOut}{VALimit}$$

17 Watts - The actual wattage being drawn from the unit.

18 PF - Power Factor is determined using the formula below. The power factor type (LEAD, LAG, or DIST) is determined by software and displayed with this parameter as well.

$$PF = \frac{wattage}{VA}$$

19 VALimit - The maximum VA that can be supplied to the load at the current power factor. This parameter is determined by the following formulas:

For lagging loads:
For 0.7 < PF c 1.0, leading or distortion:

$$VALimit = \frac{unit\ watt\ rating}{PF}$$

VALimit=unit watt rating

For PF < 0.7 leading or distortion:

VALimit=unit wattKatingxl.43

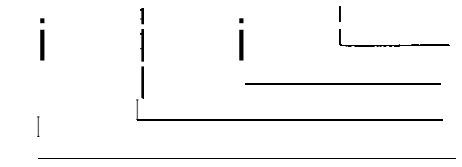
20 #Pwr Out - This is the cumulative number of power outages (actually, the number of times the inverter was run). This value can be manually set to zero and will be automatically cleared when a memory check alarm occurs.

21 #Ovr Lds - This is the total number of output overloads. If the VA Out exceeds the VALimit (Parameter 19) this value increments. It can be set to zero and is reset when a memory check alarm occurs.

22 Sys Hrs - This is the total number of hours the unit has been in operation, regardless of system mode. The only time this counter does not update is when the unit is manually shut off with the switch. It can be set to zero and is reset when a memory check alarm occurs.

23 InvMin - This is the cumulative total minutes the inverter has been run. It can be set to zero and is reset when a memory check alarm occurs.

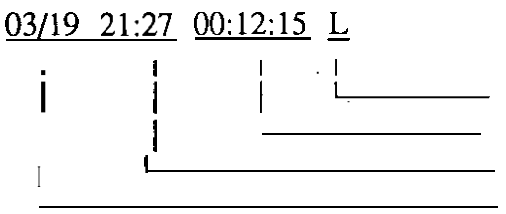
24 Inverter Log - The inverter log is a record of inverter activity. The log has room for the most recent 16 entries. It is cleared by a CLRLOG terminal command or a memory check alarm. On a terminal, the display also includes the number of seconds as well as an asterisk ("*") if the inverter is still active. Here is a description of a typical entry in the log:



Reason for inverter run:

L - Line loss has occurred. This is the normal SMODE A response to line failure.
M - Manual inverter run initiated by a [CONTROL][4] or SMODE I command.
F - Line frequency has exceeded tolerance.
R - A DC reset has occurred. (The DC breaker was turned OFF and then ON again.)
C - Battery test was activated.
B - Brownout has occurred.

25 Alarm Log - The alarm log is a record of alarm activity. The log has room for the most recent 16 entries. It is cleared by a CLRLOG terminal command, or a memory check alarm. On a terminal, the display also includes the number of seconds as well as an asterisk ("*") if the alarm is still active. Here is a description of a typical entry in the log:



Reason for Alarm:					
A	• -	Low Battery	I	• •	Heatsink Overtemp
B	- • • •	Near Low Battery	J	• - - -	User Test Alarm
C	- • - •	High Battery	K	- • -	Check Cooling
D	- • •	Low Run Time Left	L	• - • •	Reserved Alarm
E	•	Low AC Out	M	- -	Check Battery
F	• • - •	High AC Out	N	- •	Check Inverter
G	- - •	Output Overload	O	- - -	Memory Check
H	• • • •	High Ambient Temp	P	• - - •	Shutdown Activated

26 Reserved

27 Low Vout - This is the set point at which the low AC out alarm triggers. If the voltage falls to five volts below this number, the unit will shutdown. Calculated by software as 90% of Vout Nominal.

28 Hi Vout This is the set point at which the high AC out alarm triggers. Calculated by software as 108% of Vout Nominal.

29 LowBat - This is the set point for the low battery alarm. If the actual battery voltage falls below this point while the invener is running, it forces the inverter to turn off.

30 NLBatt - This is the set point when the near low battery alarm sounds. This value should always be higher than the low battery set point.

31 HiBatt - This is the set point for the high battery alarm

32 L RnTM - This is the set point at which the low runtime alarm activates. The value is entered in minutes.

33 A Otemp - This is the set point for the ambient overtemperature alarm. It is entered in degrees Celsius.

34 AT Shdn - This is the ambient temperature shutdown set point in degrees Celsius. This is the value at which the unit will actually shutdown. The unit will alarm first at the ambient overtemperature set point (A Otemp). This can be user-defined but is factory-set to a nominal value.

35 S OTemp - This is the set point for the inverter heatsink overtemperature alarm. It is entered in degrees Celsius. The alarm will sound 10 degrees before the inverter is forced off.

36 Reserved - If the humidity option is installed, this is the LowHumid set point for the low humidity alarm.

37 Reserved - If the humidity option is installed, this is the HiHumid set point for the high humidity alarm.

38 Off Cnt - This is a counter, loadable from a remote computer or terminal, that will shut off the unit when it reaches zero. If this parameter is manually reset to zero, the timer-is canceled. Used with CheckUPS software.

39 EPO Dly - Emergency Power Off Delay. This controls the length of time that pin 21 of the interface connector must be asserted before the system will shut down. This delay time is used only if parameter #48 (EPO Rst) is set to 1)YES.

40 NVVers - This is the software version number in the EPROM.

41 Model Indx - This is a factory-set parameter that establishes initial parameters for the software, depending on the unit size. Examples are:

[redacted]	[redacted]
11	10KVA
12	12.5KVA
13	18KVA

This parameter will always default to a 9 (4.3 KVA) when a NOVRAM rewrite is performed.

42 ARst Time - Number of minutes that the unit will remain in a "Not Ready" state after shutting down because of a low battery condition.

43 XferDly - This is the delay time, in seconds, that the UPS will wait before transfer back to line after a good line has been verified.

44 AutoRst - This is the automatic restart parameter. It determines how the unit will respond to a line loss. If it is set to 1)YES and the system shuts off due to a low battery condition, the UPS will indicate an AUTO and NOT READY state. If the line returns, the unit will continue to operate, but it will be in Line Condition Mode. When the battery voltage gets to 120% of low battery, and AC is good and no other shutdown alarms are in effect, the UPS will go back to the ready state. If it is set to 2)NO, the UPS will still indicate the same AUTO/NOT READY state, the inverter will not run, and the system will remain in a NOT READY condition.

45 AC ShDn - This parameter determines whether the unit will shutdown on a low AC out alarm. If this parameter is set to 2)N0 and you have a low AC out condition (such as a shorted output), the unit will keep on running. If it is set to l)YES the unit will shutdown.

46 ExBnOut - If extended brownout is set to 1)YES, it allows the brownout voltage to be lower than set point P51, when there is less than the full load on the UPS. The minimum voltage on a 120VAC unit is 72V, with no load on the unit. When set to 2)NO, then set point of P51 is used.

47 AltSetup - Alternate setup is a way to change eight parameters at once. This is associated with the DIP switch on the logic board, switches 1, 2 and 3. See the table below. Dip switches 1, 2 and 3 will always be used if they-are not equal to zero (all off). Each parameter can be changed normally, but will be forced to the value in the table when Altsetup is changed.

SWITCHES				PARAMETERS CHANGED							
	Sw1	Sw2	Sw3	P43	P51	P52	P53	P56	P57	P59	P60
0	OFF	OFF	OFF	20	79%	.50	.50	2	2	12	16
1	ON	OFF	OFF	20	79%	1.00	1.00	2	2	12	16
2	OFF	ON	OFF	20	79%	3.00	3.00	2	2	12	16
3	ON	ON	OFF	3	71%	1.50	1.50	3	2	13	18
4	OFF	OFF	ON	10	65%	3.00	3.00	2	2	14	19
5	ON	OFF	ON	10	75%	1.50	1.50	2	2	16	21

SWITCHES				PARAMETERS CHANGED							
6	OFF	ON	ON	5	75%	3.00	3.00	2	2	20	40
7	ON	ON	ON	3	63%	3.00	3.00	6	3	20	40

P51 BrownoutV - percentage of VinNom (e.g. 79% of 120VAC in)
P52 Lo Freq is nominal line frequency minus 0.5 Hz.
P53 Hi Freq is nominal line frequency plus 0.5 Hz.

48 EPO Rst - Emergency Power Off Restart. If set to the default value of 2)NO, the EPO function will shutdown the system immediately when pin 21 of the interface connector is asserted. If it is set to 1)YES, the restart feature is enabled. This means that pin 21 must be asserted for the length of time specified in parameter 39 (EPO Delay, default 20 seconds) before the system shuts down. In either case, once the shutdown has occurred, the FERRUPS will alarm "shutdown activated" (code P). If EPO Rst is set to 1)YES, the system will also emit a short beep once every five seconds for a period of one minute. The system will only turn on again when all of the following conditions have been met:

1) The EPO signal (pin 21) is not asserted.
2) Input line voltage is OK.
3) The system has been off for at least one minute.

49 VinNom - AC input voltage nominal. Change this parameter to the desired AC input voltage. This parameter will also change P51 BrownoutV, to 79% of the set voltage.

50 VoutNom - AC output voltage nominal. Change this parameter to the desired AC output voltage. This parameter will also change P27 Low Vout and P28 Hi Vout.

51 BrownoutV - This is the set point at which the inverter will start, if the RMS input voltage is less than this value at full load. It is entered in AC volts.

52 Lo Freq - This is the set point for the low input line frequency limit. It can be set in 0.01 Hertz increments.

53 Hi Freq - This is the set point for the high input line frequency limit. It can be set in 0.01 Hertz increments.

54 Max ACVI - Monitors and records the maximum AC volts in.
55 Min ACVI - Monitors and record the minimum AC volts in.

56 Freq Delay -The microprocessor measures frequency of the AC input line once every ten cycles (166ms or 200ms). Frequency delay is the number of samples, in a row, that must be out of the range of parameters 52 or 53 for the inverter to go on.

57 Glitch Cnt This is the number of consecutive glitches that must occur before the inverter is started. The glitch count evaluates the results of the reference table and counts the glitches as they occur. The glitch counter is an up/down counter. This means that missed compares will increment the counter while good compares will decrement it (down to zero only).

58 RTL Mode - If set to default value of 0, and running on Inverter and AC returns, Mode 0 requires to the phase lock loop to lock to line after the transfer delay counter finishes counting down. Mode 1 ignores the phase lock loop and transfers to line after the transfer delay has finishing counting.

59 Line Deltl Line Delta represents the maximum allowable absolute value difference (1=approximately .7 to 1.0 volt at 120VAC) between the present sample and the reference waveform. A line deviation in excess of this set point represents a glitch. Units are in A/D counts.

60 Line Delt2 - Same as Line Delta1 but used when transferring from inverter to AC line or changing to System Mode Auto.

61 V Reftbl - Voltage reference table is the true RMS value of the reference waveform. This should be calibrated with AC input at the desired brownout voltage. When AC input goes below rhe brownout, the inverter will be triggered.

62 EBrownotV - Extended brownout voltage. When the AC input voltage reaches this set point the inverter will come on. This is calculated with VinNom and VA out. If P46 ExBnOut is programmed to 2)NO, rhis function is not used.

63 Reserved

64 Overlap - The number of half cycles (8.3ms or *10ms*) before the inverter turns off on a return to line.

65 PhsDly - When the inverter is first turned on the gate pulse is delayed for this amount of time after the zero cross (falling edge of PLL 120Hz or *PLL 100Hz* signal). Each half cycle after the turn on, the delay time is reduced (Phase Step) until the delay is about *208 s.*

66 Reserved

67 Reserved

68 InvTest - Enables or disables the automatic inverter test.

69 TestRate - Inverter test frequency in minutes.

70 IPk - The minimum peak current for the inverter test. One current peak must be 50% and the other between 25% and 75% of this value.

71 TestPhas - Determines the phase at which the inverter test is performed. This parameter will automatically adjust to the proper test phase required to get the proper current peaks.

72 I Batt Pk - Displays the peak DC current, whether on inverter or AC line. Updated every 0.5 seconds. IBatt must be calibrated for this to work correctly. (During line operation, due to the small current levels, this may not be accurate.)

73 Peak 1 - Displays the first peak DC current captured at the instant the inverter test was activated. IBatt must be calibrated for proper operation of the inverter test.

74 Peak 2 - Displays the second peak DC current captured at the instant the inverter test was activated. IBatt must be calibrated for proper operation of the inverter test.

7 5 Alarm Enables - This feature allows the user to select which alarms will operate the alarm signal contacts available at the communications port (DB25). To determine how to program this parameter refer to TIP502 in Section 700.

76 Relay Control - This parameter is a option that has 7 relays and 35 functions. It can not be programmed if option board is not present.

77 Reserved

78 Baud - This is the baud rate at which the RS232 portion of the interface circuitry communicates with external devices. It is active only if DIP switch 4 on the logic board is off. If the switch is on, the baud rate is fixed at 1200.

79 ConMde When in 1)Norm, the unit automatically displays inverter and alarm messages on a CRT connected to the RS232 port. A setting of 2)NoAM, will suppress these messages. The 3)NoEB setting is designed to be used with custom power monitoring software (like CheckUPS). If this is changed to 4)SndF, the "F" string is sent automatically every 15 seconds. This is primarily used by customers who would like to log the command status string.

80 CtlPswd When this parameter is set to 1)YES, a USER password is needed to use the control functions. This is useful to prevent unauthorized tampering. When set to 2)NO, no password is needed.

81 # Bad PW - This is a counter that increments whenever an invalid password is entered. It is a record of possible tampering.

82 Reserved

83 RnTm K - This is the constant in the run time formula.

84 BatCap - Battery capacity factor used in calculation of runtime. This parameter is entered as the manufacturer's ampere-hour (AH) rating number. If there is more than one string of batteries, multiply the number of strings times the ampere-hour rating of the battery. Typical entries in this position for standard factory configurations are:

10 KVA = 31 AH
12.5 KVA = 55 AH
18 KVA = 57 AH

85 BTT - The amount of seconds the unit will run on inverter while doing the battery test.

86 BattTst Enables or disables the automatic battery test.

87 IntrvlDays - Number of days between automatic battery tests.

88 RnTm Alm Set point for the minimum full load runtime during a battery test.

89 FctrAlm - The full load runtime alarm factored by the current load. If this is greater than the Battery Test Runtime (Parameter #90), the battery test will fail.

90 BTRT - Battery test runtime. The actual runtime during the last battery test.

91 Reserved

92 CFACVI - This is a calibration factor for the line voltage. It is the multiplier used by the A/D converter in determining the value to be displayed in parameter #1.

93 CFACVO This is the calibration factor for the output voltage. It is the multiplier the A/D converter uses in determining the value to be displayed in parameter #2.

94 CFACAI This is the calibration factor for the input current. It is the multiplier the A/D converter uses in determining the value to be displayed in parameter #3.

95 CFACAO - This is the calibration factor for the output current to the load. It is the multiplier the A/D converter uses in determining the value to be displayed in parameter #4.

96 CFDCV - This is the calibration factor for the battery voltage. It is the multiplier the A/D

converter uses in determining the value to be displayed in parameter #7.

97 CFDCA - This is the calibration factor for the battery current. It is the multiplier the A/D converter uses in determining the value to be displayed in parameter #6.

98 CFREF - This is the calibration factor for the true RMS value of the reference waveform. it is the multiplier the A/D converter uses in determining the value to be displayed in parameter #6 1.

307 The Control Panel Keypad

The front panel keypad/display is attached to the FERRUPS by a six-foot-long (1.8 meter) cable. The keypad can be removed from the front panel and used as long as the cable is attached. When the unit is powered up the display should be scrolling through the following: FERRUPS by BEST, Sysmode: AUTO, Status: Ready. The READY and AC LINE LEDs should be on and the CHARGING indicator may or may not be on. Refer to the section on the Handheld Remote for operation. Refer to **Figure 1.**

307-1 The Remote Control Panel

This optional device is powered by the UPS. Once the remote is plugged in, press [ENTER] until the "=>" prompt appears in the display. This is an indication that the remote is ready to receive commands. Next, press [123] followed by [DISPLAY], [CONTROL], [PROGRAM] [ENTER]. This sequence is called 123DCP. After the 123DCP entry, the display will show a "scrolling" sequence of information about the status of the unit. On the remote, the LED indicators will also show the status of the unit. To enter a password, press [PROGRAM] at this point. The response will be "Password?". Enter the appropriate password for the action you will be performing and press [ENTER]. With the remote, be sure to clear it before **unplugging** it. This is done by pressing [CLEAR] until the-scrolling display appears, then **pressing** [CLEAR] and [.] simultaneously until the "=>" prompt appears. This clears the 123DCP mode and prepares the unit for subsequent communications.

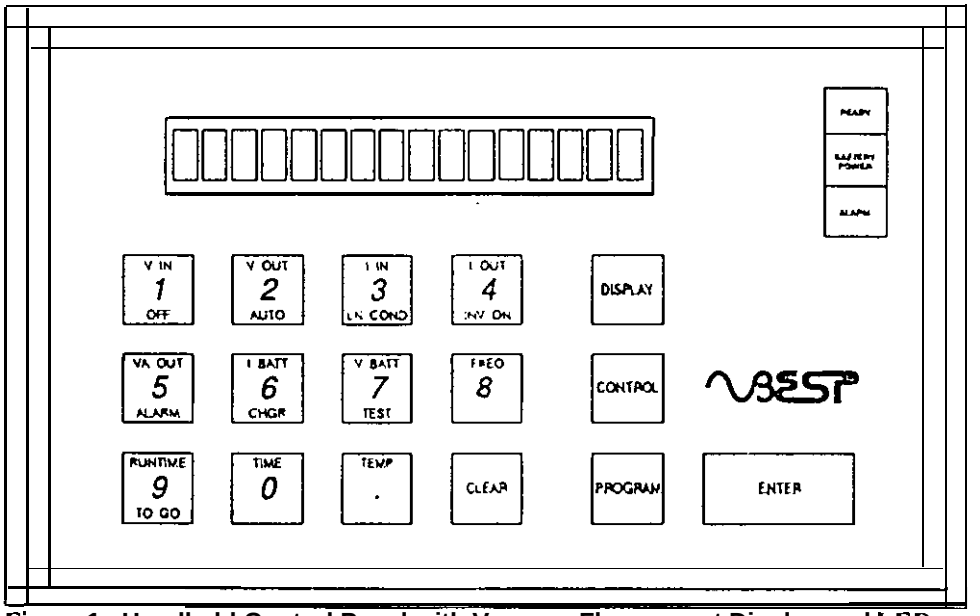


Figure 1 - Handheld Control Panel with Vacuum-Fluorescent Display and LEDs

307-Z Definition of the Buttons

DISPLAY (GREEN) - This is used before entering a parameter number you wish to display. Some passwords are required for certain parameters to allow you to either display or change them. These are:

Password Level	Parameters Accessed
None	O-63, 67-69, 71-82, 84-99
U S E R	O-63, 67-69, 71-82, 84-99
SERVICE	O-63, 67-69, 71-82, 84-99
FACTORY	0 - 99

NOTE: The USER password is 377. The origin of this password is from the date that the company was founded (March 1977). The SERVICE password is seven times the USER password (2639 = 377 x 7). The FACTORY password is seven times the SERVICE password (18473 = 2639 x 7).

NOTE: the improper use of the Factory password could cause unnecessary alarms, premature shutdown, or system damage.

The green lettering above each number (and decimal point) on the keypad indicates the first eleven (and most common) parameters displayed by pressing DISPLAY and the corresponding pad.

CONTROL (RED) - This button is used to change the operating modes of the unit. Notice that underneath each of the first seven digits on the keypad, there is lettering to designate the CONTROL functions performed by pressing the corresponding pad. Any time you enter a command using the CONTROL key, the system will respond with “Enter to Confirm”.

[CONTROL][1], [2], or [3] performs SMODE changes to OFF, AUTO and LN COND, respectively.

[CONTROL][4] manually starts the inverter. Turn it off by selecting an appropriate SMODE.

[CONTROL][5] toggles the audible alarm to either off or on

[CONTROL][6] is an invalid command.

[CONTROL][7] initiates an inverter test. [CONTROL][7][7] initiates the battery test. Once either of these tests are started, the display will show relevant parameters, to indicate how the test is doing. After the test is finished, the display will show whether or not the unit passed. If it does not pass, the unit will also alarm. To stop looking at the test parameters, press [CLEAR]. This requires a USER password,

[CONTROL][8] initiates an alarm test to verify that the audible alarm device(s) works. This requires a least a SERVICE password. Press this sequence again to clear the alarm test.

[CONTROL][9] clears both the inverter and alarm logs. This requires at least a FACTORY password.

[CONTROL][O] clears all alarms and resets all 16 alarm flags. If the alarm condition still exists, the alarms will reactivate, five seconds later. This requires at least a FACTORY password. If the alarm caused the unit to go into a NOT READY state, you must change system mode to get it back into READY..

[CONTROL][.] performs a system reset. This causes the unit to respond as if it *were* first turned on. *It is possible to drop the load with this command.* This requires at least a FACTORY password.

[CONTROL][DISPLAY] to display the status of the unit and the first 19 parameters. Press [CLEAR] to exit back to the normal scrolling display.

PROGRAM (ORANGE) - This pad is used to either initiate a password sequence, as explained above, or to enter a new value in a parameter.

ENTER (BLUE) This is used in conjunction with the [DISPLAY], [CONTROL] and [PROGRAM] buttons, as described above. If a parameter is being displayed, pressing [ENTER] consecutively will step through the remaining parameters. This is especially useful in displaying the inverter or alarm logs.

CLEAR (BLUE) This clears the last value or command entered. It is also used to return to the scrolling display after completion of a parameter inspection or change. Press this button twice to clear the password.

307-3 Additional Functions

There are three remote control panel commands that are used to affect the audible or visible response of the handheld ONLY. These are for the audible alarm, keyclick and display brightness. The sequence to affect these parameters is also printed on a sticker on the back of the handheld remote.

Simultaneously pressing [CONTROL] and [PROGRAM] will initiate the sequence. The first choice is "Audible 1>YES 2>NO". By choosing either [I] or [2], you can enable or disable the handheld alarm. If you press [ENTER], the previously set value is retained and the display goes to the next function.

This next function is "Key click 1>YES 2>NO". Again, select [1] or [2], or simply [ENTER] to retain the original setting. This brings up the last parameter, "Dim 1>YES 2>NO". The same choices are available. In this case, [1] dims the display and [2] brightens it.

At this point, there are two options. If [ENTER] is pressed, the above sequence is restarted. If You have made changes to any of the three parameters and want them to be permanent, press

[PROGRAM] [ENTER].

308 LED Indicator Lights

The AC LINE (green LED on front panel) LED is on only when AC line is present.

The READY (green) LED is lit to indicate the FERRUPS will support an outage.

The CHARGING (green LED on front panel) Lit whenever system is charging batteries. Off when batteries are charged.

The BATTERY POWER (yellow) LED is lit whenever the inverter is running and the unit is on battery power.

The ALARM (red) LED is lit whenever an alarm condition exists. See Alarms, this chapter.

309 Alarm Conditions

A red indicator LED lit on the front panel indicates an alarm condition. The red indicator on the display/keypad will also be on. The display will indicate the status of the FERRUPS and the alarm condition. A Morse coded letter will also indicate which alarm is active. The audible portion of the alarm can be silenced by pressing [CONTROL][5][ENTER][ENTER]. (If using a terminal, type [SHUTUP]). To restore the alarm do another [CONTROL][5][ENTER][ENTER] (On a terminal, type [UNSHUTUP]). Alarm conditions ‘vary in severity. Certain alarms are only warnings; others indicate a shutdown condition and some will force a System Mode change. Certain alarms clear when the offending condition abates. Other alarms “latch” and have to be manually cleared even though the offending condition no longer exists. All alarms require attention from site personnel because of the possibility of system failure. If a system has shutdown due to an alarm condition that no longer exists, [CONTROL][2][ENTER][ENTER] will bring the system back up. A latched alarm that has not shut the system down and no longer exists can be cleared with [CONTROL][2][ENTER][ENTER] or [CONTROL][0][ENTER][ENTER]. (If using a terminal type [SMODE A], return). The following table lists all alarms, their severity and action to be taken. If an alarm cannot be cleared or corrected, proceed to the troubleshooting section.

309-1 Table of Alarm Conditions

ALARM	Letter/Code	Latching	Mode-Change To	PROCEDURE
Low Battery	A/• -	YES	Auto Not Ready (Ln-Cond.)	Batteries have discharged to 41 volts or less. With AC restored, do a system reset ([CONTROL][2]). Display battery voltage, parameter #7.
Near Low Battery	B/- • • •	NO	No Change	Battery voltage has fallen to 44 volts or less. Will clear when voltage rises over 44.
High Battery	C/- • - •	YES	Not Ready	See troubleshooting procedures.
Low Runtime	D/- • •	NO	No Change	Inverter only-warning
Low AC Out	E/•	Both	Sys Mode Off	Output AC too low - See Troubleshooting
Hi AC Out	F/• • - •	NO	No Change	See troubleshooting procedures.
Output Overload	G/- - •	Both	Sys Mode Off	VA out (parameter #5) exceeds VALimit (#19). On AC Line FERRUPS will continue to run for 10 minutes with 101-125% overload. (Inverter, 101-110%). After this, the unit will shutdown. Small, short overloads will self-clear. Reduce load, do a system reset.
High Am. Temp.	H/• • • •	Both	Sys Mode Off	Temp. exceeds the A Otemp set point (#33). Non-latching until temp. exceeds ATShdn set point (#34). To restart do a system reset. If I. temp. does not decrease, go to troubleshooting.
Heatsink Overtemp	I/• •	YES	Sys Mode Off	Heatsink temperature probe rises to within 10 degrees of S Otemp set point (#35). (Alarm-only) If temperature exceeds #35, unit shuts down. To correct - See Troubleshooting.
User Test	J/• - - -	NO	No Change	User Test only ([CONTROL][8]). Clear ([CONTROL][8]).
Check Cooling	L/• - • •	YES	Sys Mode Off	Cabinet temperature exceeds 60C (Alarm). Cabinet temperature exceeds 65C (Shuts down) See Troubleshooting.
Check Battery	M/- -	YES	No Change	Automatic battery test has failed. Check calibrations and batteries. Clear with a reset or [CONTROL][0].
Check Inverter	N/- •	YES	No Change	Inverter has failed. Check calibrations and batteries. Clear with a reset or [CONTROL][0].
Memory Check	O/- - -	NO	Any Possible	Calibration factors in unit have changed. See Troubleshooting.
Shutdown Activated	P/• - - •	YES	Sys Mode Off	Pin 21 of RS232 (Panic Button) has been activated. Open pin 21 and manually restart.

310 Communication via RS232 Port

NOTE: This section describes communication with the FERRUPS by a computer or a terminal only.

310-l Hardware Connection

A DB25S (female) connector is provided on the back panel of the FERRUPS cabinet. Using this connector the user can communicate directly with the FERRUPS microprocessor to access information or control operation. To communicate directly, a terminal is required. A computer that can emulate a terminal can also be used. The FERRUPS DB25 is wired DCE (Data Communications Equipment) as opposed to most terminals which are wired DTE (Data Terminal Equipment). Therefore a DTE can plug directly into a DCE. If your computer has a DB25 style serial port, it is typically wired DTE like a terminal. However, if it uses a DB9-style service port, it is wired DCE. If this is the case, a null-modem cable or a cable that has transmit and receive (pins 2 and 3) reversed will have to be used. Refer to **Figure 2.**

CAUTION: Pin 1, chassis ground, should never be connected between **the FERRUPS and the terminal if there is the possibility of pin 1 and pin 7 (signal ground) being connected together in the terminal device. To do so might cause damage to the interface electronics.**

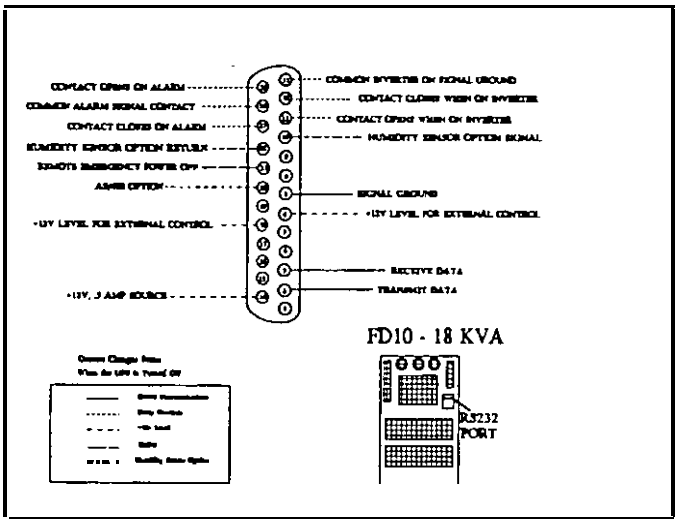


Figure 2 - The FERRUPS Intelligent Interface Connector

If the terminal device has no handshaking requirements, it may only be necessary to connect the TD, RD, and SG PINS between the communication line and the FERRUPS. (Consult your device's operations manual if handshaking is required.)

The connection between the FERRUPS and the console device should be through a high- quality shielded cable.

310-2 Communications Protocol

The data format is ASCII, 8 Data Bits, 1 Stop Bit. Baud Rate is 1200. Baud rate can be changed. (See Baud Rate end of this chapter;)--Parity is-set. to none and operation is full duplex.

With the FERRUPS powered up and the serial ports connected, the FERRUPS will echo all characters it **receives.** It will terminate all responses with a "**=>**" prompt indicating the FERRUPS is ready to accept command input from the console.

310-3 Using a Terminal Connected to the RS232 Port

All of the operations that can be performed from the remote can also be performed from a serial ASCII device connected to the RS232 port. In addition, a terminal (or a computer emulating a terminal) can perform functions the remote cannot. This is related to the limitations of the remote (limited alphabetic characters) and the display (limited display area).

The following is a menu of functions that can be performed from a terminal and the password level required.

	No password needed to do this command.
*	User password required. (377)
@	Service password required. (2639)
#	Factory password required. (18473)

A or ALARM - Lists the currently active alarm(s).

ATEST(C) @ Invokes (or cancels) the user test alarm (alarm code J). [ATEST C] cancels the user test alarm. [ATEST] invokes it. If optional CheckUPS software is in use, the UPS may shutdown after two minutes on this alarm when running on inverter. Check CheckUPS software documentation.

CLRLOG # Clears the invener and alarm logs.

CLRPW Removes any active password.

DATA _ Generic 64 point ASCII output for use with external plot programs.

NOTE: See the explanation of this command at the end of this section.

DATA X Outputs AC line and reference table at the time of last inverter turn on.
DATA R Output of present reference table.
DATA L Output of present AC line samples.

DATA _ _ _ - Generic 32 point ASCII output for use with external plot programs. Input voltage must be executed alone. Other plots can be executed individually or together. (Up to three plots can be specified.)

DATA 1 Output of present AC output voltage.
DATA 2 Output of present AC input voltage.
DATA 3 Output of present AC output current.
DATA 4 Output of present DC input current.

D or Display - Displays one or a range of parameters. The format is: D <start #>

		<end #>
DATE or TIME	-	Displays the system date or time.
F		Returns 80 characters of fixed-field status information for use with programs that monitor the UPS state.
H or HELP		Displays a list of console commands requiring a SERVICE p&sword or less.
ID [<idstr>]	@	Display (no parameter number needed) or change unit ID.
ILOG		Displays inverter log.
ITEST	*	Initiates an inverter test. Test will end automatically.
L or LOG		Displays both inverter log and alarm logs.
MEM		Displays a memory location in hex code.
OFF	*	Displays the off time.
OFF <time>	*	Timed shutdown facility (time in seconds). For a shutdown of 60 seconds, type [OFF 60].
OFF <time> A	*	Timed shutdown with automatic restart when power returns.
OFF C	*	Cancels timed shutdown.

NOTE: Although the commands SHUTDN and SHUTDN C do not appear in the HELP menu, they exist to allow compatibility with previous versions of **PowerWatch** software. These commands actually invoke or cancel the OFF command.

Por PARAM	*	Displays a list of parameters up through 99.
PLOT _	*	64 point ASCII plot for use with terminals.

NOTE: See the explanation of this command at the end of this section.

PLOT X Outputs AC line and reference table at time of last inverter turnon.
PLOT R Output of present reference table.
PLOT L Output of present AC line samples.

PLOT _ _	*	32 point ASCII plot for use with terminals. Two can be executed at the same time except #2.

PLOT 1 Output of present reference table.
PLOT 2 Output of present AC input voltage.
PLOT 3 Output of present AC output current.
PLOT 4 Output of present DC input current.

PORTS	#	Displays the values. at ports A,B,C,D and F of the processor. This is a programmer's diagnostic tool.
PROGRAM	#	Works the same as PR.
PW<#>	#	To enter a password, PW should be immediately followed (without a space) by the appropriate three to five digit number. If the number matches one of the internally stored passwords, that password level will be activated. It can be removed with the CLRPW command or by entering PW without a number.
RESET	%	Resets the unit as if it were initially powered up. Equivalent to a [CONTROL][.].
SHUTUP	*	Disables the audible alarm.
SMODE		Displays the system mode.
SMODE A		Changes the SMODE to AUTO.
SMODE F		Changes the SMODE to OFF.
SMODE I		Manually starts the inverter.
SMODE L		Changes the SMODE to LINE COND.
S or STATUS	-	Displays date, time, and system status. The system mode, alarm condition and inverter status are also shown, In addition, parameters 0 through 9 and 11 are then displayed.
TIME		Displays the system time and date.
UNSHUTUP	*	Enables the audible alarm. Here are some additional details on the available terminal commands:

AHELP - This command will print the list of alarms

Reason for Alarm:					
A	• -	Low Battery	I	• •	Heat Sink Overtemp
B	- • • •	Near Low Battery	J	• - - -	User Test Alarm
C	- • - •	High Battery	K	- • -	Reserved Alarm
D	- • •	Low Run Time Left	L	• - • •	Check Cooling
E	•	Low AC Out	M	- -	Check Battery
F	• • - •	High AC Out	N	- •	Check Inverter
G	- - •	Output Overload	O	- - -	Memory Check
H	• • • •	High Ambient Temp	P	• - - •	Shutdown Activated

ALOG - This command displays the entire alarm log. See the section on parameters for a description of the entries.

ILOG - This command displays the entire inverter log. See the section on parameters for a description of the entries.

CLRPW, or PW<> - Clears the current password in effect.

D <#> or DISPLAY <#> Displays the parameter requested at #. A range of parameters can be requested by separating starting and ending parameters with a space.

PR <parameter> <value> Allows a parameter to be changed, providing you have the proper password and the parameter can be changed.

ID <value> - Allows programming the unit's serial number into parameter #14. This could also be accomplished using the PR command. A service password is required.

I and IDENTIFY Responds with the unit model number, software version, address and phone number of BEST and a copyright notice. An example would be:

FERRUPS BY BEST
Model #-FD18K-VA--Unit-ID-"FD18K00000"
Software version F6.00 dated 05/12/90
Copyright (C) 1990
Best Power Technology, Inc.
Necedah, WI. 54646 USA
Tel. (608) 565-7200
Patents Pending

OFF - Displays the time before the unit will shut off.

OFF C - Cancels the OFF command and resets the counter back to 0. Changing the SMODE or setting parameter 38 to zero will also cancel the OFF command.

OFF <time> - Sets the parameter, in minutes, when the unit should shutdown.

OFF <time> A - A stands for auto restart. This means that after the off timer (parameter #38) has counted down to zero, another counter is started for one minute. After that minute is up, the unit will restart in AUTO Not Ready. The unit will go back to ready when criteria stated in the low battery routine are met. While the OFF command is active, the beeper will sound once every 5 seconds until the off command is in the Auto Not Ready state.

SHUTUP and UNSHUTUP - [SHUTUP] silences the audible alarm and [UNSHUTUP] will enables it. Any mode change or DC reset also enables the audible alarm.

MEM <location> - Displays the value at memory locations FF00-FFFF in hex.

ITEST - Performs the inverter test. The inverter will be turned on for a half cycle on each side. It will adjust the test phase, to try to get the proper DC peak current for the unit. If the proper values are not reached, the unit will alarm "Check Inverter". Before doing this test, the unit must be calibrated and the battery charged continuously for at least eight hours.

BTEST - Performs the battery test. When entered the inverter test will start first. After the inverter test is passed, the battery test will turn on the inverter for one minute and check the calculated runtime. If the runtime goes below 80% of the unit's expected runtime with three year old batteries, the unit will alarm "Check Battery". Before doing this test the unit should be calibrated and the battery charged continuously for 24 hours.

310-4 Explanation of DATA and PLOT Commands

The DATA and the PLOT commands differ only in what is actually displayed on the terminal's screen. The DATA command will return a table of data points. This is useful if these data are captured on a **disk tile** and later manipulated and displayed using some form of plotting software.

The PLOT command will return an actual plot to the terminal's screen. Since the typical terminal only has 80 fixed horizontal and 25 fixed vertical locations, the plot has been slightly modified to provide maximum horizontal resolution to the viewer. Each plot is "folded", i.e. the negative half cycle is displayed as going in the same direction as the positive half cycle. This way each half cycle is given the full screen width for better resolution.

There are two forms of the DATA command: DATA _ and DATA _ _ _. The first form takes "X", "R" or "L" as a single argument, "X" will return both the AC line and the reference table **at the time of** last transfer to inverter. This is useful to give some indication of what the last

cycle of commercial AC power looked like before the system transferred to inverter. "R" will return the current reference table data. "L" will return the current line sample table.

The responses to all DATA commands will return the sample number in the left column (from 00 to 64) and one or more numbers next to these, depending on the form of the command.

The second form of the DATA command (DATA _ _ _) can have one, two, or three arguments. The are four choices for the arguments. These are:

1	Present AC output voltage
2	Present AC input voltage
3	Present AC output current
4	Present AC input current

There are some restrictions on which combinations are valid. For a two-argument command, only 1-3, 1-4, and 3-4 are valid as DATA arguments. For a three-argument command, only l-3-4 is valid.

There are two forms of the PLOT command: PLOT _ and PLOT _ _. The first form, like its associated DATA command, takes "X", "R" or "L" as its single argument. The meanings are the same as in the DATA command.

The plot will list the sample number in the left column (from 00 to 63) and the x-axis at the end of the plot.

The second form of the PLOT command is analogous to the second form of the DATA command except that no more than two arguments are allowed. These are the same DATA command.

310-S Examples of Responses to The Status and Parameter Commands

(Note that some parameters are model-dependent.)

The STATUS Command

```
Fact =>s
Status - Model # FDlOKVA - Jun 12,
16:45:43

SysMode: A u t o
Status: Ready
Aud Alm: Enabled
Inverter: Off

Alarm(s) - None

1 V In 240
2 v out 120
3 I In 003.1
4 I out 000.0
5 VA Out 00010
6 I Batt 000
7 V Batt 053.3
8 Freq 59.95 Hz
9 RnTm 0242 Min
Amb Temp 020C
```

The Parameters

```
Fact =>p
Parameters -Apr 26, 16:45:46

12 HS Temp 023C
13 %Humidity 00
14 ID Number:
  FD10K001991
15 Model Number
  FDlOKVA
16 FullLoad% 000
17 Watts 00015
18 PF 1.00 ----
19 VALimit 10000
20 #Pwr Out 0065
21 #Ovr Lds 0009
22 Sys Hrs 00027
23 InvMin 0092.0
24 Inverter Log
25 Alarm Log
26 Reserved
27 Low Vout 108
28 Hi Vout 130
29 LowBat 105.0
30 NLBatt 110.0
31 HiBatt 149.0
32 L RnTm 05 Min
33 A Otemp 060C
34 AT Shdn 070C
35 S Otemp 095C
36 Low Humid 00
37 Hi Humid 99
38 Off Cnt 0000
39 Reserved
40 NVVers 06.10
41 Model Indx 12
42 ARst Time 001
43 XferDly 05Sec
44 AutoRst 1)Yes
45 AC ShDn 2)No
46 ExBnOut 1)Yes
47 AltSetup 0
48 Reserved
49 VinNom 2 4 0
50 VoutNom 1 2 0
51 BrownoutV 195
52 Lo Freq 59.50
53 Hi Freq 60.50
54 Max ACVI 278
55 Min ACVI 005
56 Freq Delay 2
57 Glitch Cnt 2
58 RTL Mode 0
59 Line Deltl 12
60 Line Delt2 16
61 V Reftbl 200
62 EBrownotV 125
```

63 Reserved
64 Overlap 0
65 PhsDly 0040
66 Reserved
67 Reserved
68 InvTest l)Yes
69 TestRate 1440
70 IPk 600
71 TestPhas 0100
72 I Batt Pk 000
73 Peak 1 0000
74 Peak 2 0000
75 Alarm Enables
76 Relay Control
77 Reserved
78 Baud 2)1200
79 ConMde 1)Norm
80 CtlPswd 2)No
81 # Bad PW 0002
82 Reserved
83 RnTmK 19
84 BatCap 0031
85 BTT 060
86 BattTst l)Yes
87 IntrvlDays 30
88 RnTm Alm 0005
89 FctrAlm 00000
90 BTRT 0000 Min
91 Reserved
92 CFACVI 06534
93 CFACVO 03437
94 CFACAI 15872
95 CFACAO 13797
96 CFDCV 11258
97 CFDCA 00001
98 CFREF 07460
99 Reserved

Maintenance and Component Replacement

400 Maintenance

In order to obtain years of built-in reliability from your FERRUPS, proper maintenance procedures must be followed. Scheduled maintenance is the only way to insure continued reliability. Unscheduled maintenance procedures may have to be followed when batteries, parts or components have to be replaced.

401 Scheduled Maintenance

In order to insure satisfactory operation of your FERRUPS, regularly-scheduled preventive maintenance procedures must be followed. The most basic of these procedures consists of an outage test to see that the unit is functional, This augments the internal operational tests that are automatically performed on a regular basis by the FERRUPS. Any irregular results are logged by the system and generate an alarm condition to alert the operator of a possible malfunction. An outage test should be performed monthly.

A system load test is more comprehensive than a simple outage test. This test should be performed biannually and should also include an inspection of the system and battery bank. It should be performed if the outage test is failed.

401-l Outage Test

This test should be performed when operations are not critical. Usually scheduled for after-hours or weekends, it may have to *be* conducted "off line" when critical operations are conducted on a 24-hour basis. When conducted "off line" the load equipment would be operating on "bypass mode" and the results of this test would only indicate whether the FERRUPS will or will not come on in case of an outage. It will not indicate whether it will successfully carry the required load equipment. The same procedure is used for both models covered in this manual and for all operating voltages.

Step 1. The FERRUPS should be running on AC line in the Auto Mode. Loads that are normally supported by the UPS should be up and running, if at all possible.

Step 2. Do a battery test first. ([CONTROL][7][7][ENTER][ENTER]) This will assure you of properly charged batteries, and also to assure you that the inverter is working properly. The battery test could take up to 30 minutes to perform.

Step 3. Find the AC breaker or AC disconnect for the FERRUPS and turn it off.

Step 4. Verify the FERRUPS has switched to battery power and the loads are running normally. There should be no alarms; a short beep will sound every 20 seconds.

Step 5. Using the keypad, press [DISPLAY][9][ENTER]. The number displayed will be the calculated runtime remaining. After about two minutes on batteries, record this number to compare with results from future tests. At some point this number will decrease, indicating a failing or weakening battery string. This will require a complete system performance check and battery load test. If the **number obtained** is acceptable, continue running the FERRUPS on battery power until a significant portion of the DC has **been** run off.

Step 6. Restore AC line or AC disconnect; in 20 seconds the FERRUPS will switch back to Auto Mode. Check to see that the CHARGING LED comes on.

401-Z System Load **Test**

This test is performed as part of a six-month routine or in response to questionable numbers obtained during the **outage** test. When performed as part of a six month routine, the system and battery physical inspections are also performed. When performing this test, fill out the Scheduled Maintenance Checklist to keep a record of the test results.

Caution: Portions of the following procedure are conducted with the system AC and DC powered up, the side panels removed and internal components exposed. The following procedure should be attempted by BEST factory authorized technicians only. Dangerous AC and DC voltages are present.

Step 1. With the system operating in Auto Mode and load equipment powered by the FERRUPS, fill out steps #3 through #10 in TIP 605(TIP 605 is located in Section 700). Using the keypad, display and record the first 20 parameters in step #12 column A. Then display and record the most recent five entries in the inverter log (parameter #24) and the alarm log (parameter #25) in step #8 of TIP 605.

Step 2. Enter the factory password by pressing [PROGRAM]; the display should read Password?. Press [18473][ENTER]. The display should read Factory Password.

Step 3. Disable the battery charger. Press [DISPLAY][31]. The display should read "Hi Batt 149.0". Push [PROGRAM] on the keypad; the display will change to New Value?. Push [48][ENTER] on the keypad and the display will confirm Hi Batt 120. The Hi Batt Alarm will now come on. Silence it by pushing [CONTROL][5] [ENTER][ENTER]. The remaining steps will be performed with the red alarm light on.

Step 4. Using a calibrated DC voltmeter, measure the individual **battery voltage readings** (read each individual battery plus to minus). Record these readings under battery information, "No Load Voltage". If any battery in the string is under 11 volts, and after a recharge continues to read under 11 volts, it should be replaced. See the battery replacement procedure at the end of this chapter.

step 5. Perform a system test by switching off the AC breaker to the FERRUPS. After two minutes of battery power operation, display and record the first 23 parameters in step #13, INV. on with LOAD column in TIP 605. Using the DC voltmeter, measure the individual battery voltage readings again and record under battery information, "With Load Voltage". Any battery more than .4 volts lower than others in the string should be replaced, If all batteries are nearly equal and the system runtime is still insufficient, the entire string should be replaced.

Step 6. Reset Hi Batt Alarm (parameter 31) to 59.6 and push [CONTROL][2][ENTER] [ENTER]. The alarm light should go out.

Step 7. Restore AC Line and wait 20 seconds. Verify the battery charging light comes on. After a 24-hour charge all batteries should read at least 13 volts and the system should have a string voltage of at least 52 volts. Clear the password by pressing [CLEAR][CLEAR] twice.

401-3 **Final System Check** and **Inspection**

To complete the biannual routine, a final system check and inspection should be performed. The first step is performed with the system powered down and the covers off. The second three steps are performed with the covers off, but with the system operating in Auto Mode.

Tools and Material Required:

Hand vacuum cleaner or compressed air outlet.
Wire Brush, Petroleum jelly
7/16" insulated open end wrench

Step 1. With system AC and DC powered down, covers off, and front panel open, inspect the interior of unit. If excessive dust and din have accumulated inside **use** a vacuum cleaner to remove or use compressed air to **blow** it out. Locate the Spike Suppression circuit board (located extreme rear upper left). This small board has four fuses and two MOV's mounted on it; inspect for any damage. Replace if necessary.

Step 2. Locate the fan. It is mounted directly behind the. front panel. Using a pen or pencil, spin the rotor of the fan to see if it spins freely. Check all connectors and cables, looking for loose or bad connections. Look for any unusual discolorations on circuit boards for evidence of hot spots or leaking capacitors.

Note: Before proceeding, follow battery safety precautions. Remove rings, watches, bracelets and wear safety glasses.

Step 3. Inspect the battery compartment. Look for leaking, swollen or cracked batteries.

Check battery cables for tight connections and corrosion on terminals. Use an insulated wrench to tighten terminals and a wire brush to remove corrosion. Coat terminals and connections lightly with petroleum jelly. If leaking electrolyte is found, neutralize with a baking soda solution and replace the battery. If external batteries are being used, follow the same procedures for additional strings.

Step 4. Power the unit up on DC and set the time and date. Apply AC and verify the system is running in the Auto mode. Check operarion of fan. Apply rhe load and if a load test has not been performed previously, perform it now. Close the cabinet and return the system to service.

402 Unscheduled Maintenance

402-l **10,** 12.5 and 18 KVA Battery Replacement

Preparation: Make sure unit has no power applied. Ensure battery cabinet switch is turned off.

NOTE: Before replacing batteries, observe all safety precautions. Remove rings, watches, bracelets and wear safety glasses. Use insulated tools.

Tools and Material Required:

(2) 7/16" open end wrenches (Tape length of wrench to avoid shorting battery)
Wire brush, Electrical tape
Baking soda, Petroleum jelly
Small brush
DC Voltmeter

NOTE: When replacing the batteries, the batteries should all be the same type to ensure proper charging.

Removal Procedure:

Step 1. Remove the cover on the battery cabinet as outlined in the procedure at the end of this chapter.

Step 2. Locate the positive battery cable (attached to fuse on battery) and remove and tape the connector end to prevent accidental contact.

Step 3. If replacing the entire string of batteries, remove the most positive battery and replace it first. Continue replacing batteries on a one-for-one basis until the entire string is replaced. If replacing only one or two batteries, remove only those and replace on a one-for-one basis. Before installing a new battery, wire brush

terminals to remove any corrosion. After tightening terminals, brush on a light coating of petroleum jelly. If any of the replaced batteries have leaked electrolyte, use baking soda and water to neutralize before wiping it up. Reinstall the fuse on the most positive terminal.

Step 4. After the entire string has been replaced, measure across the string (from the negative cable to the positive terminal with fuse attached) with a DC voltmeter. Voltage should read at least 48 volts. Make certain the polarity is correct before turning on the unit. After batteries have been replaced, a system load test should be done to verify the integrity of the new batteries.

Step 5. Close the covers as describe at the end of this section.

Step 6. Do a load test as described in Section 400, Scheduled Maintenance.

402-2 Fan Removal and Replacement

Preparation: Make certain that there are no external voltages applied to the unit. Power the unit down (turn key switch to OFF.) Turn off the input AC by turning off the supply circuit breaker or removing the input line cord from the outlet. Turn off the DC circuit breaker behind the from panel.

Tools and Material Required:

#2 Phillips Screwdriver
5/16" open end wrench
1/4" nutdriver
1/4" open end wrench

Reference Drawings: Refer to the diagram in Section 800 to locate fan

Removal Procedure:

Step 1. Open the cabinet sides

Step 2. Locate the heatsink assembly under the power board. Remove four 1/4" screws holding the heatsink brackets to the upper and lower plates. Move the heatsink with attached wires and cables toward the rear of the unit to allow clearance for removal of the fan and shroud.

Step 3. Using the key, open the unit front panel. With a Phillips screwdriver from the front, and a 5/16" open end wrench from the rear, remove the four screws holding the fan and shroud. Remove the fan and shroud.

Replacement Procedure:

Step 1. Replace the fan and shroud from the front of the panel.

Step 2. Reconnect the heatsink assembly.

Step 3. Replace the side panels using the procedure at the end of this section.

402-3 Logic Board Removal and Replacement

Preparation: Make certain that there are no external voltages applied to the unit. Power the unit down (turn key switch to OFF.) Turn off the input AC by turning off the supply circuit breaker or removing the input line cord from the outlet. Turn off the DC circuit breaker behind the front panel.

Tools and Material Required:

1/4" Screwdriver
1/8" Screwdriver
#2 Phillips Screwdriver
1/4" Nut Driver
7/16" Nut Driver

Reference Drawings: Refer to the diagram in Section 800 to locate the logic board.

Removal Procedure:

Step 1. Open the cabinet sides. Use the procedure at the end of this section.

Step 2. Locate the logic board. This is the circuit board behind the front panel at the top of the unit.

Step 3. Disconnect the four ribbon cables from the circuit board. Note that each cable has a red stripe on one edge. This is the side of the connector that will be mated with pin 1 when reconnecting the cable.

Step 4. Disconnect the ambient temperature probe plug from the connector marked TR.

Step 5. Disconnect the keyboard modular jack from J2.

Step 6. Remove three Phillips screws from the top and right sides of the board (as viewed from the component side). Remove the fourth screw nearest the on-board transformer with the short screwdriver.

Replacement Procedure:

Step 1. Mount the new board with the four Phillips screws.

Step 2. Reconnect the modular jack to J2.

Step 3. Reconnect the temperature sensor to connector TR

Step 4. Reconnect the ribbon cables. Be sure to align the edge with the red stripe with pin 1 on the board.

Step 5. Close the cabinet sides. Use the procedure at the end of this section.

Required System Calibration:

Recalibrate the system using the procedure at the end of this section,

402-4 Power Board Removal and Replacement

Preparation: Make certain that there are no external voltages applied to the unit. Power 'the unit down (turn key switch to OFF.) Turn off the input AC by turning off the supply circuit breaker or removing the input line cord from the outlet. Turn off the DC circuit breaker behind the front panel.

Tools and Material Required:

1/4" Screwdriver
1/8" Screwdriver
#2 Phillips Screwdriver
1/4" Nut Driver
7/16" Nut Driver

Reference Drawings: Refer to the diagram in Section 800 to locate the power board.

Removal Procedure:

Step 1. Open the cabinet sides. Use the procedure at the end of this section.

Step 2. Disconnect the eight orange connectors.

Note: J5 is composed of three connectors. Correct arrangement is with the four black wires in a row on connectors two and three of J5.

step 3. Disconnect the two ribbon cables from J6 and J4.

Step 4. Disconnect, left to right, black El, white E2 and red E3 charger wires using the 1/8"screwdriver.

Step 5. Remove the cables from E7, E8 and E9 using a 7/16" nutdriver. The E8 cable comes from the u-shaped bar on the left side with transformer wire #1; E9 cable comes from the common bar on the. DC shunt, and E7 comes from u-shaped bar on the right side with transformer wire #4.

Step 6. Remove the five Phillips/hex head mounting screws holding'the board; remove the board.

Replacement Procedure:

Step 1. Replace the five Phillips/hex head mounting screws.

Step 2. Attach cables from E7, E8 and E9 using 7/16" nutdriver.

Step 3. Reconnect, left to right, black El, white E2 and red E7 charger wires using a 1/8"screwdriver.

Step 4. Reconnect the two ribbon cables from J6 and J4. The red stripe should be on the same side as pin 1.

Step 5. Reconnect the eight orange connectors. J5 is composed of three connectors; the correct arrangement is with the two orange wires in a row on connector one goes to Pin 1.

Step 6. Close the cabinet sides. Use the procedure at the end of this section.

Required System Calibration:

Recalibrate system using the procedure at the end of this section.

402-S **Heatsink** Assembly Removal and Replacement

Preparation: Make certain that there are no external voltages applied to the unit. Power the unit down (turn key switch to OFF.) Turn off the input AC by turning off the supply circuit breaker or removing the input line cord from the outlet. Turn off the DC circuit breaker behind the front panel.

Tools and Material Required:

1/4" Screwdriver.

#2 Phillips Screwdriver
1/4" Nutdriver
5/16" or 8 mm socket wrench
7/16" socket or open end wrench

Reference Drawings: Refer to the pictorial of the 10 thtu 18 KVA units in Section 800 to locate the power board.

Removal Procedure:

Step 1. Remove the cabinet sides. Use the procedure at the end of this section.

Step 2. Locate the heatsink assembly under the power board. It is in a vertical position.

Step 3. Disconnect the orange connectors P8, P9, P10, P11, P12 and P13 from the power board.

Step 4. Disconnect the temperature probe from the center of the heatsink by unscrewing the Phillips head screw.

Step 5. Looking from the rear of the unit, disconnect transformer wire #1 and the cable coming from E8 of power board on left u-shaped bar.

Step 6. Remove the DC shunt with its attached cables in the center of the heatsink by locating the two mounting Phillips head screws on either side of the shunt. Let the shunt hang free with the horizontal bar after removing the two left and two right 5/16" bolts.

Step 7. Disconnect positive-switched battery cable from the left side of the SCR pack (on the lower left of the heatsink) along with the red wire going to El on the power board. Replace the 7/16" bolt back in the pack with the small white wire.

Step 8. Remove transformer cable #2 from the center of the SCR pack.

Step 9. Remove transformer cable #4 and the cable coming from E7 on the power board from the right MOSFET pack (a u-shaped bar).

Step 10. Locate the static switch on the lower right of the heatsink. Remove the left cable going to the rear of the DIN rail connector and the right cable going to the front of the DIN rail on connector marked ST SW.

Step 11. Remove the two Phillips head screws holding the heatsink to the bracket on the right side and the two screws holding the bracket on the left side to the upper and lower plates. Slide the heatsink out to the left with the left bracket and its

associated wires attached

Replacement Procedure:

Step 1. Slide the heatsink in from the left side. Attach the four screws that hold both the right and left brackets in place.

Step 2. Reconnect the wire going to the static switch coming from the DIN rail.

Step 3. Reconnect transformer cable #2 from the center of the SCR pack. Reconnect transformer cable #4 and the cable coming from E7 on the power board from right MOSFET pack (u-shaped bar).

Step 4. Reconnect the positive-switched battery cable from the left side of the SCR pack (on the lower left of the hearsink) along with the red wire going to El on the power board. Attach the 7/16" bolt to the pack with the small white wire.

Step 5. Replace the DC shunt with its attached cables in the center of the heatsink with two mounting Phillips head screws on either side of the shunt.

Step 6. Reconnect the temperature probe to the center of the heatsink with the Phillips head screw.

Step 7. Reconnect the orange connectors P8, P9, P10, P11, P12 and P13 to the power board.

Step 8. Close the sides using the procedure at the end of this section.

Required System Calibration:

Recalibrate system using the procedure at the end of this section.

403 Calibration Check

The logic board and or pans you receive should be calibrated. After installation, a check to insure the calibrations are correct must be performed. To do this you will need a true RMS meter and a clamp- on current probe. We recommend the Fluke 87 true RMS multimeter and the Fluke 80i-400 AC current probe.

Step 1. Open the cabinet sides. Use the procedure at the end of this section.

Step 2. Power up the unit by applying DC and AC. Turn the key switch to on.

Step 3. Apply the load to the UPS.

Step 4. With your digital multimeter (DMM) measure AC volts in and program this into parameter #1

Step 5. With your DMM measure AC volts out and program this into parameter #2.

Step 6. With your clamp-on current probe measure current in and program this into parameter #3.

Step 7. With your clamp-on current probe measure current out and program this into parameter #4.

Step 8. With your DMM measure battery voltage and program this into parameter #7.

Step 9. Drop AC line to the unit so that it is running on inverter. The next two measurements will be done while running on inverter. Allow the unit to run for 'I minute before taking measurements.

step 10 With your DMM set to Mv, measure across the shunt. Multiply this value by 2 for a 4.3K and 10K, 3 for a 12.5K, and 4 for a 7K and 18K. One Mv = one amp.

404 Cover Removal and Replacement Procedure

Tools and Material Required:

Phillips Screwdriver
Standard Screwdriver

Removal Procedure:

Step 1. Using a Phillips screwdriver, loosen the three screws on top of the UPS

Step 2. Using a standard screwdriver, remove both covers by loosening the spring-loaded screws or remove the six phillips screws on each side of the FERRUPS.

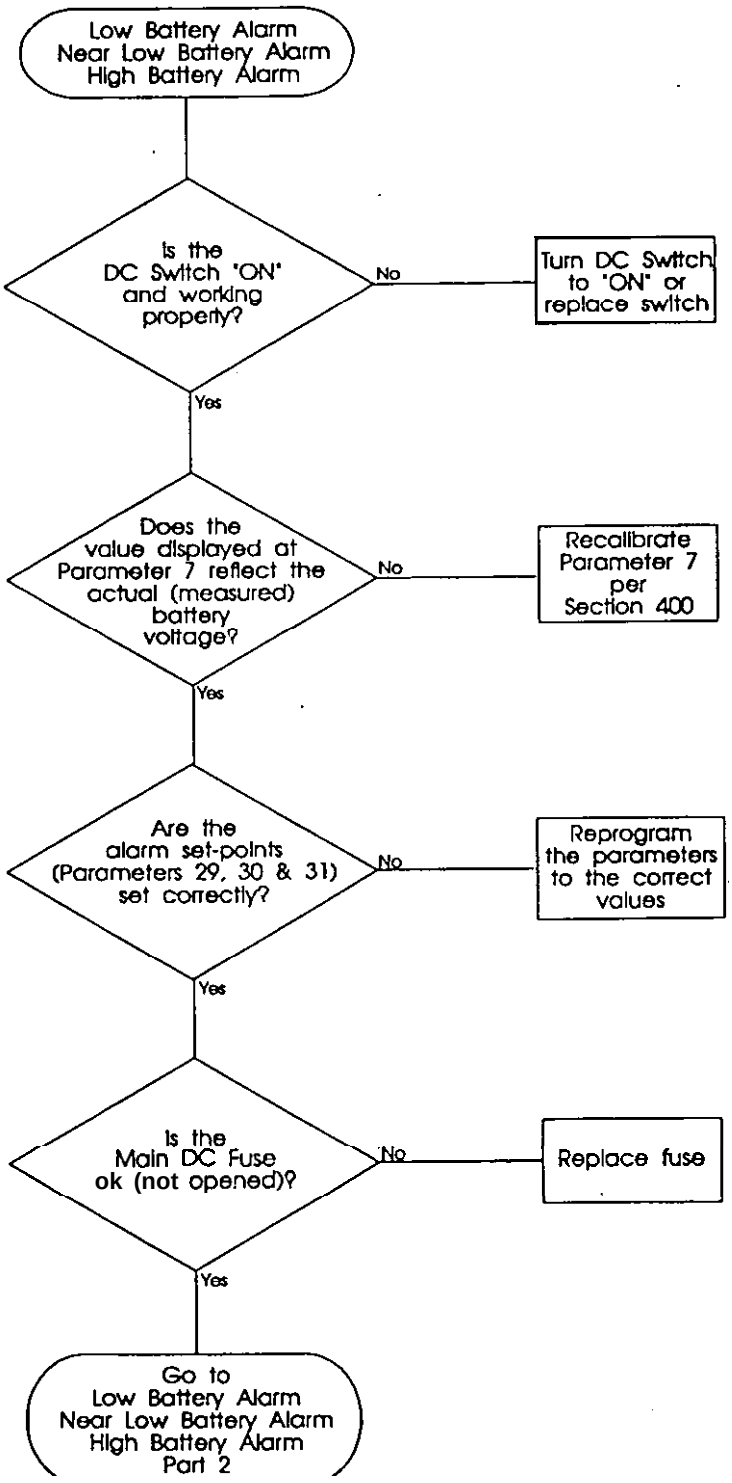
Replacement Procedure:

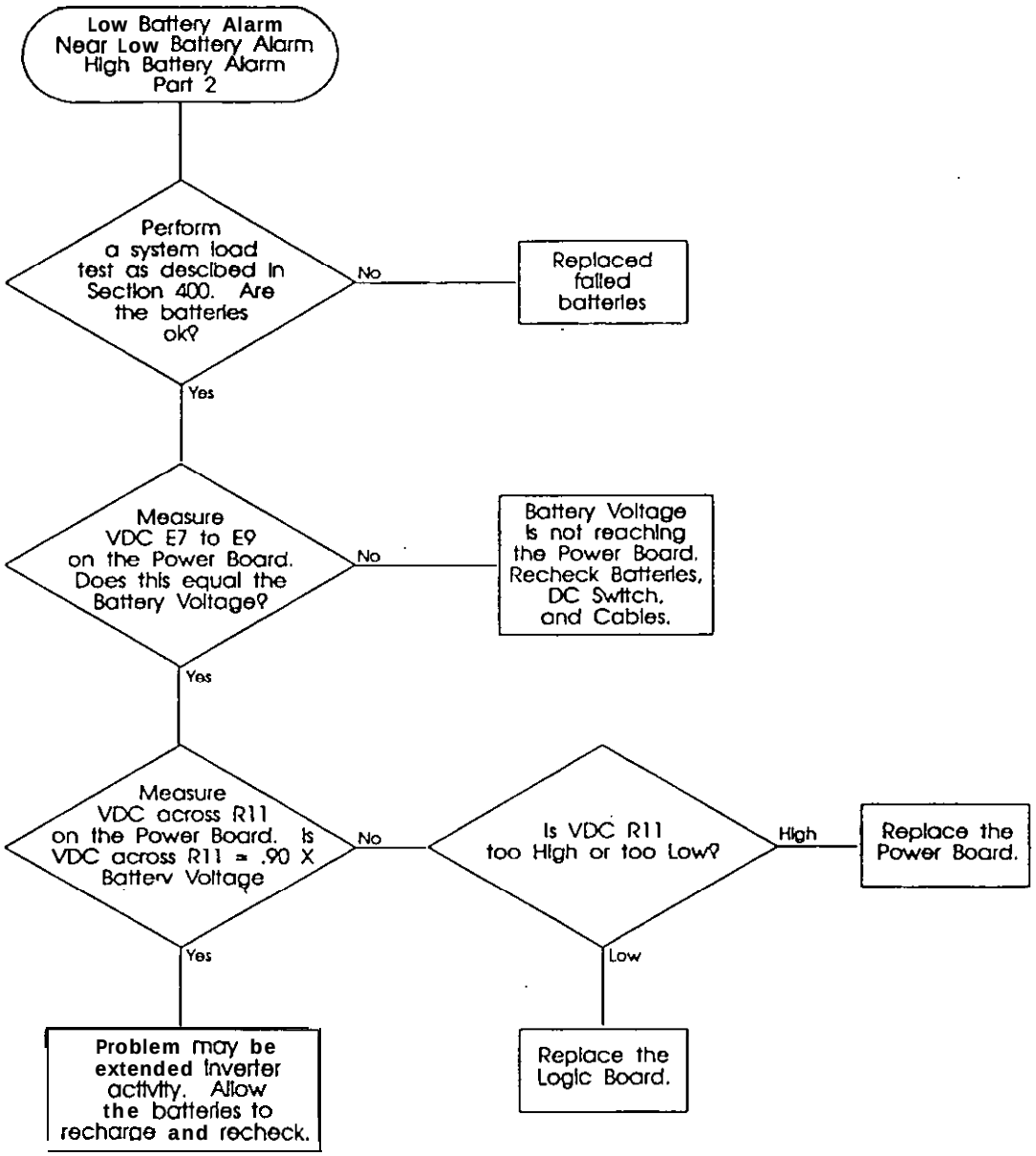
Step I. Using a standard screwdriver attach both covers by tightening the spring-loaded screws on each side or replace the six phillips screws on each side.

Step 2. Using a Phillips screwdriver, attach the bar across the top of the UPS and tighten the screws.

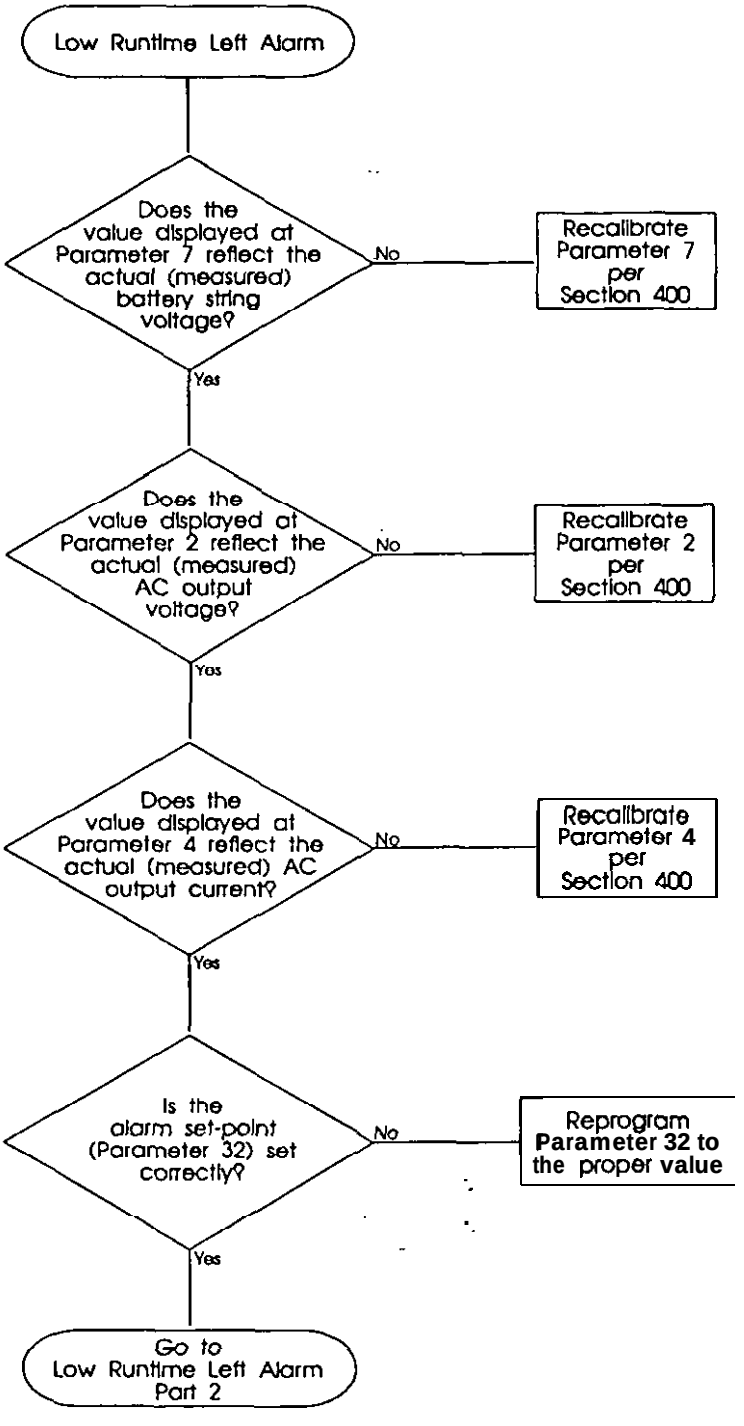
501-1 Diagnostic Flowcharts

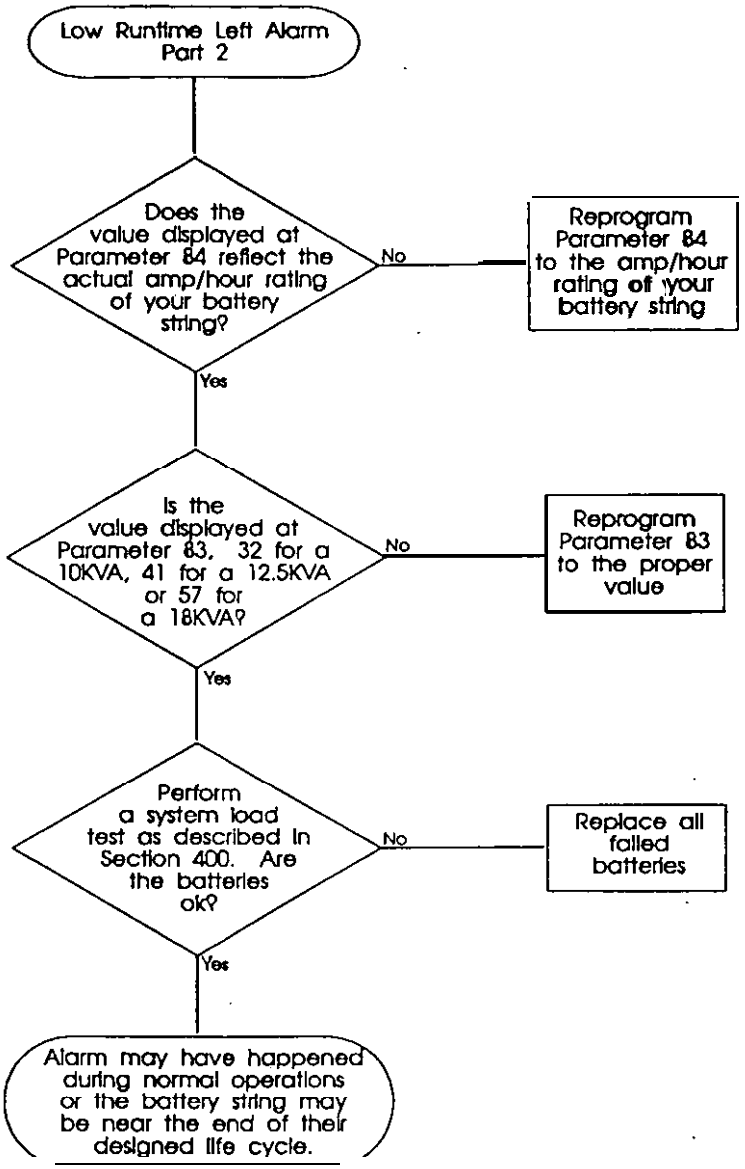
-Low/Near Low/High Batten, Alarms



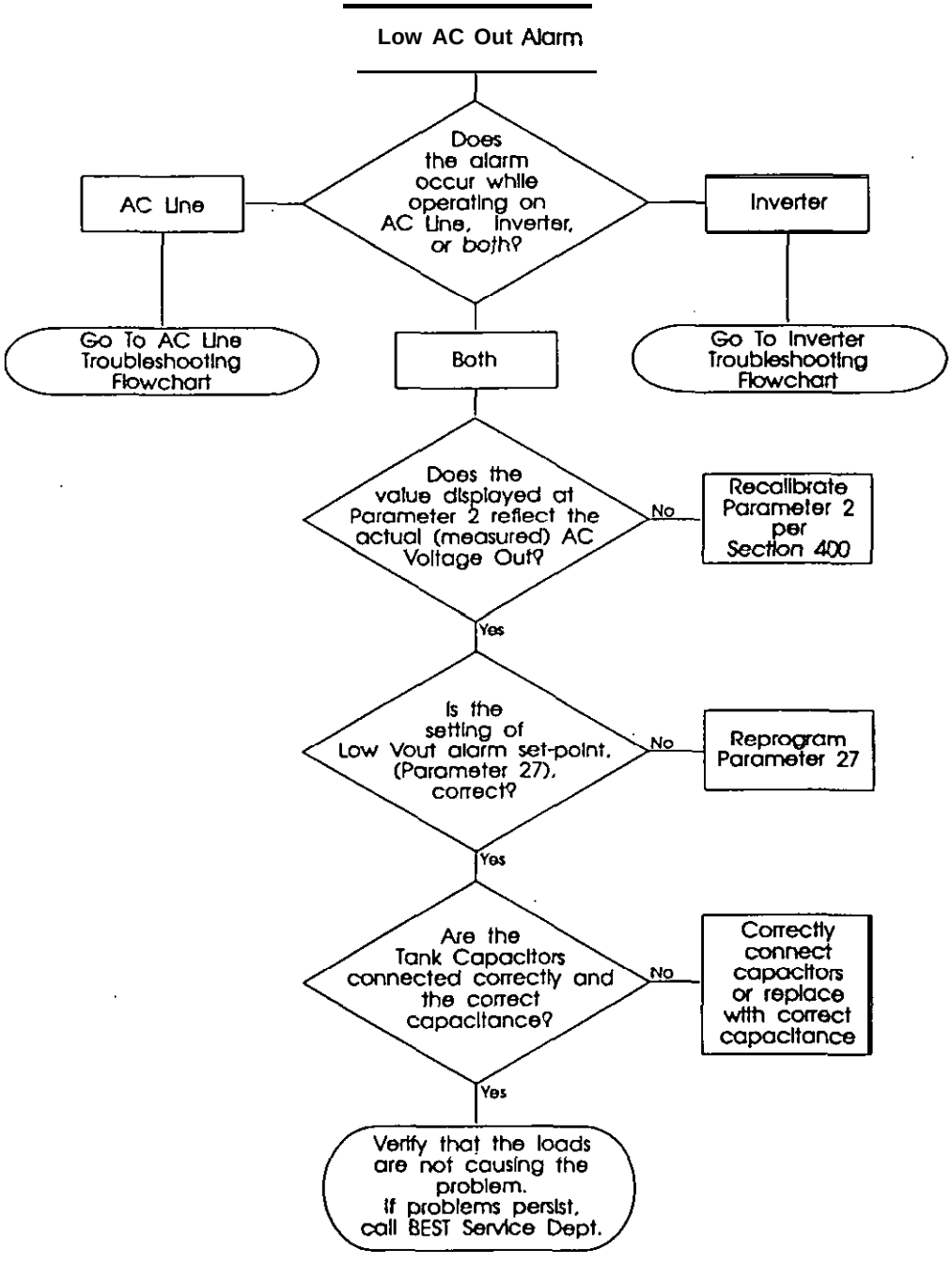

Low Battery Alarm
Near Low Battery Alarm
High Battery Alarm
Part 2
Perform a system load test as described in Section 400. Are the batteries ok?
No
Replaced failed batteries
Yes
Measure VDC E7 to E9 on the Power Board. Does this equal the Battery Voltage?
No
Battery Voltage is not reaching the Power Board. Recheck Batteries, DC Switch, and Cables.
Yes
Measure VDC across R11 on the Power Board. Is VDC across R11 = .90 X Battery Voltage
No
Is VDC R11 too High or too Low?
High
Replace the Power Board.
Yes
Low
Problem may be extended inverter activity. Allow the batteries to recharge and recheck.
Replace the Logic Board.

-Low Runtime Left Alarm

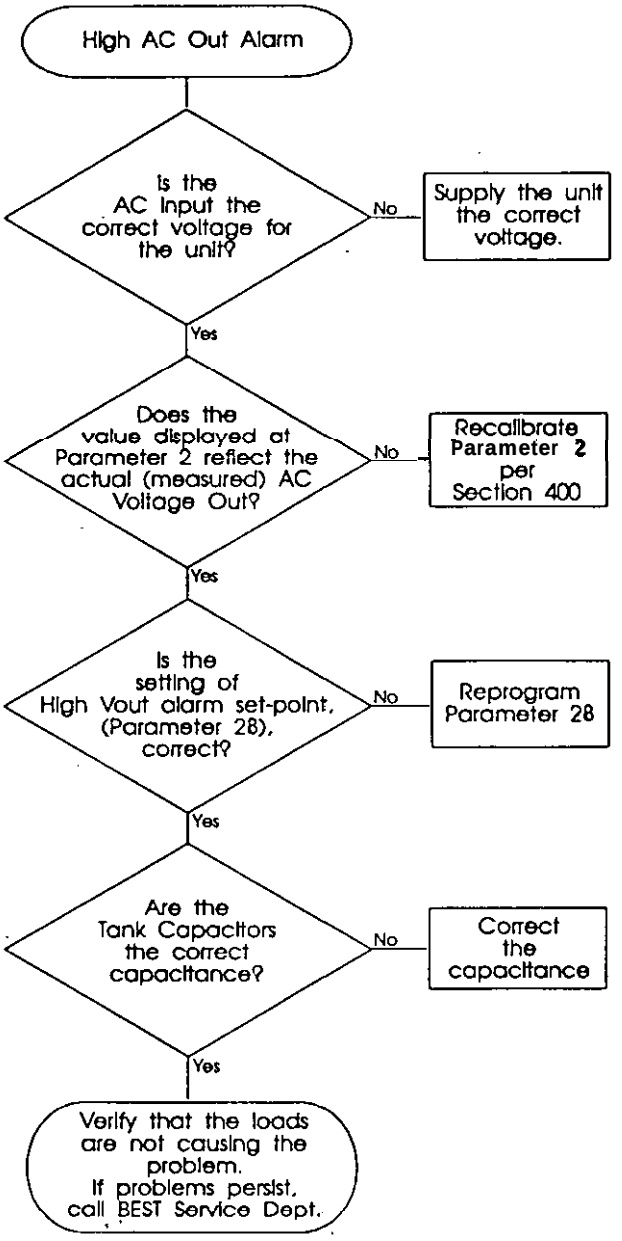



Low Runtime Left Alarm Part 2
Does the value displayed at Parameter 84 reflect the actual amp/hour rating of your battery string?
No
Reprogram Parameter 84 to the amp/hour rating of your battery string
Yes
Is the value displayed at Parameter 83, 32 for a 10KVA, 41 for a 12.5KVA or 57 for a 18KVA?
No
Reprogram Parameter 83 to the proper value
Yes
Perform a system load test as described in Section 400. Are the batteries ok?
No
Replace all failed batteries
Yes
Alarm may have happened during normal operations or the battery string may be near the end of their designed life cycle.

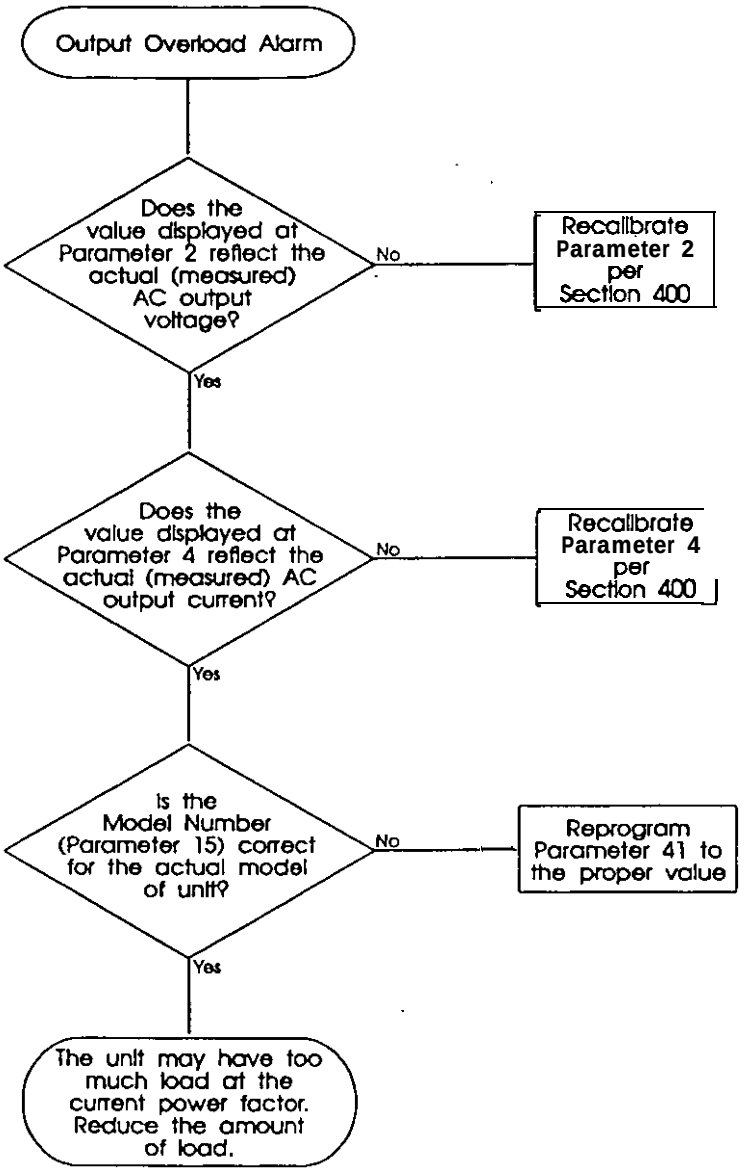
-Low AC Out Alarm



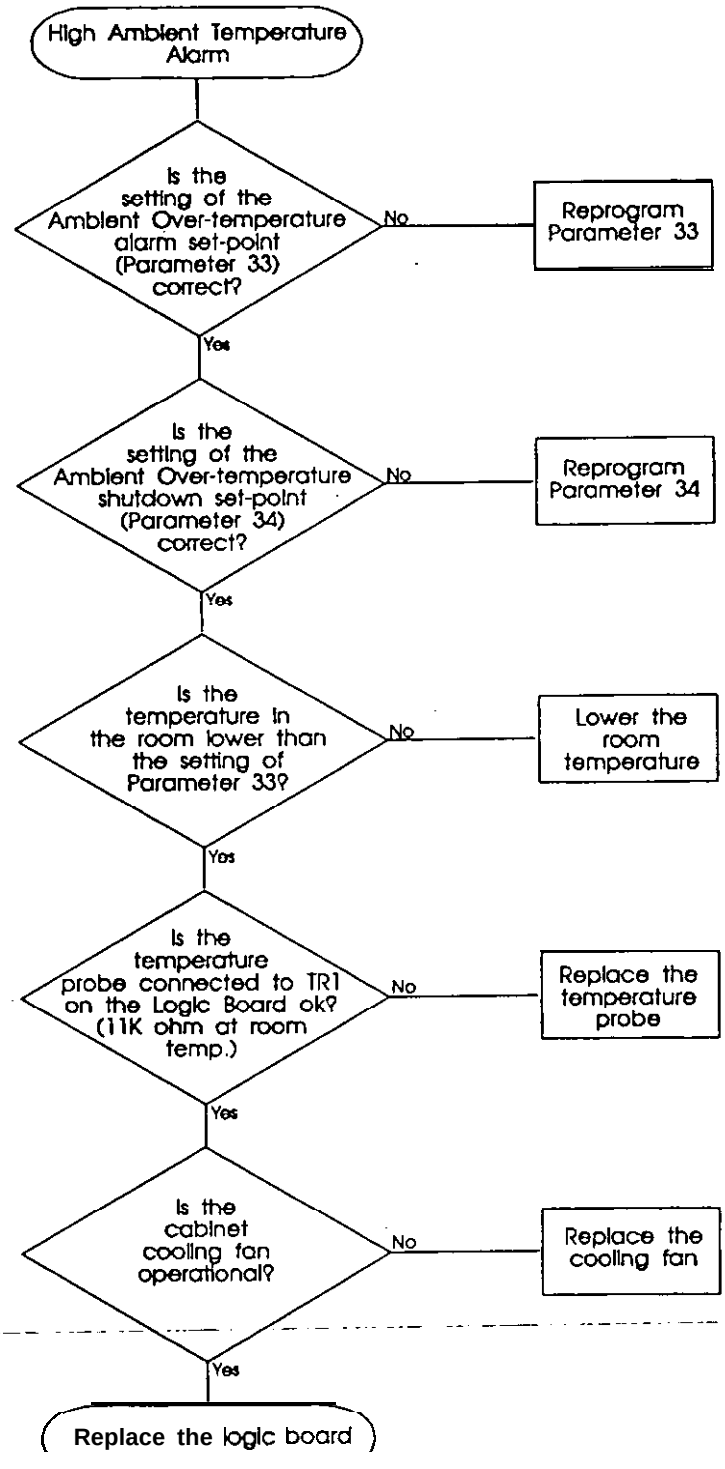
-High AC Out Alarm



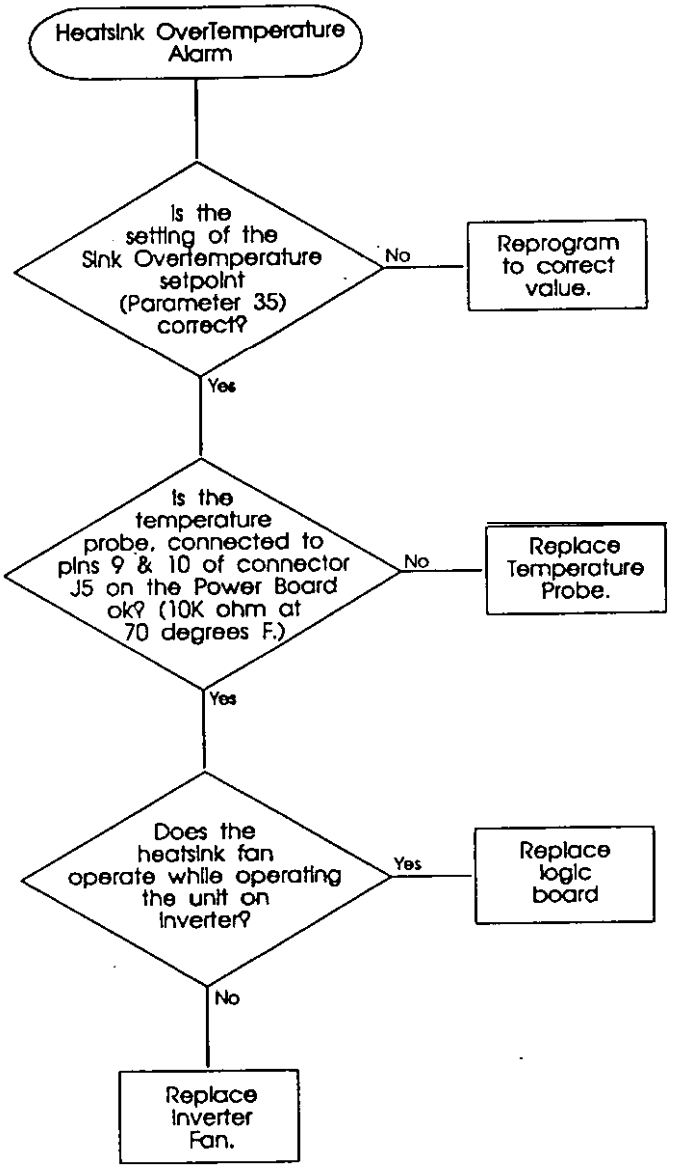
—Output Overload Alarm



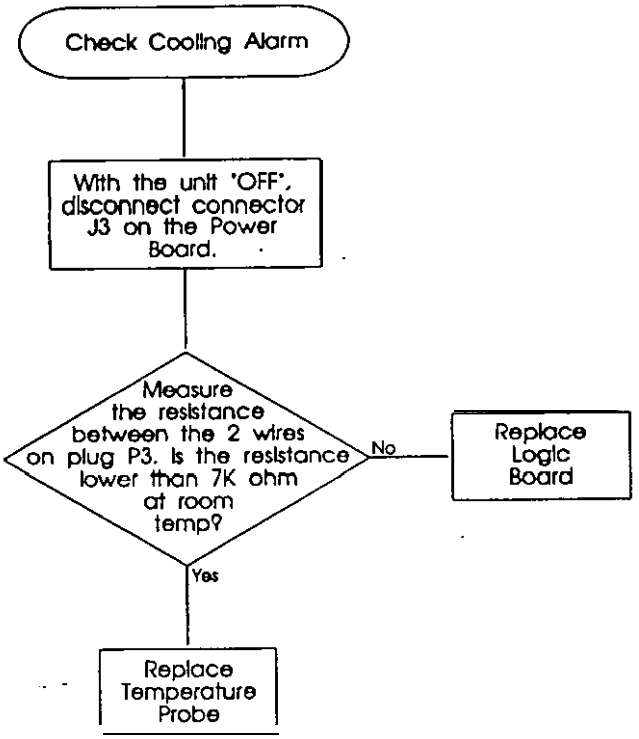
—High Ambient Temperature Alarm



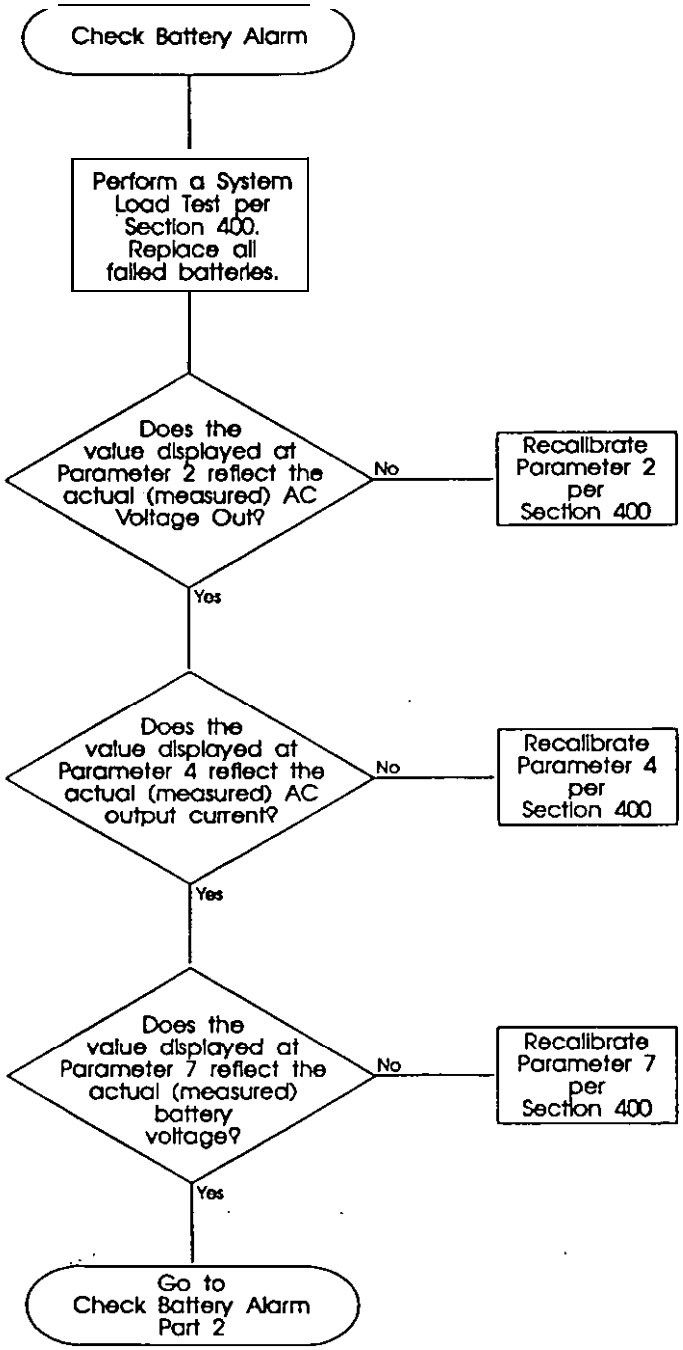
—Heatsink Overtemperature Alarm

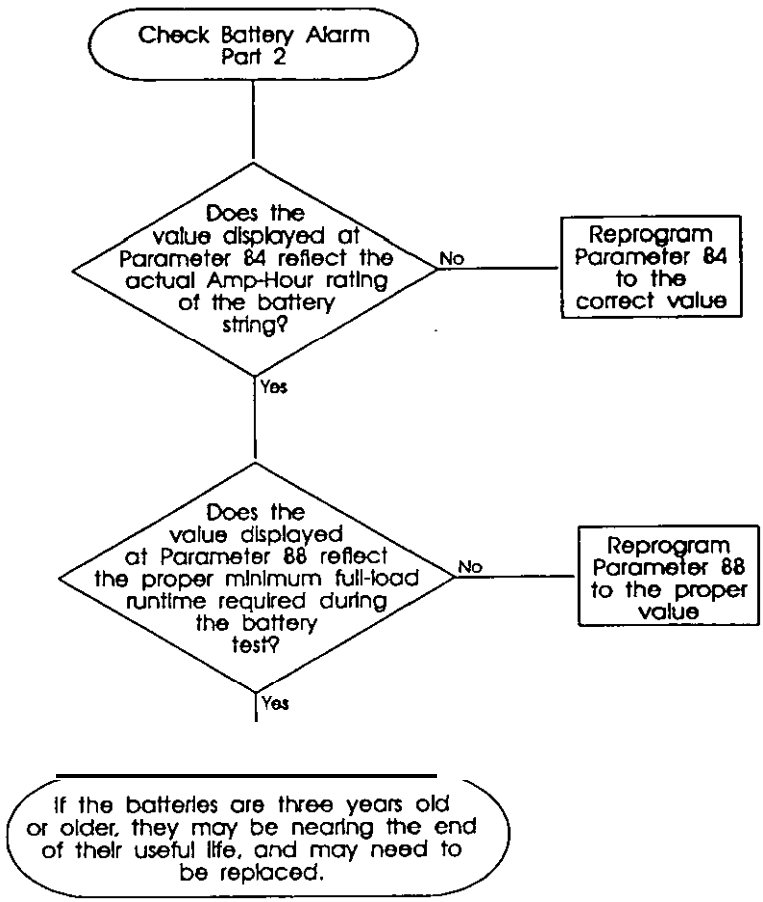


-Check Cooling Alarm

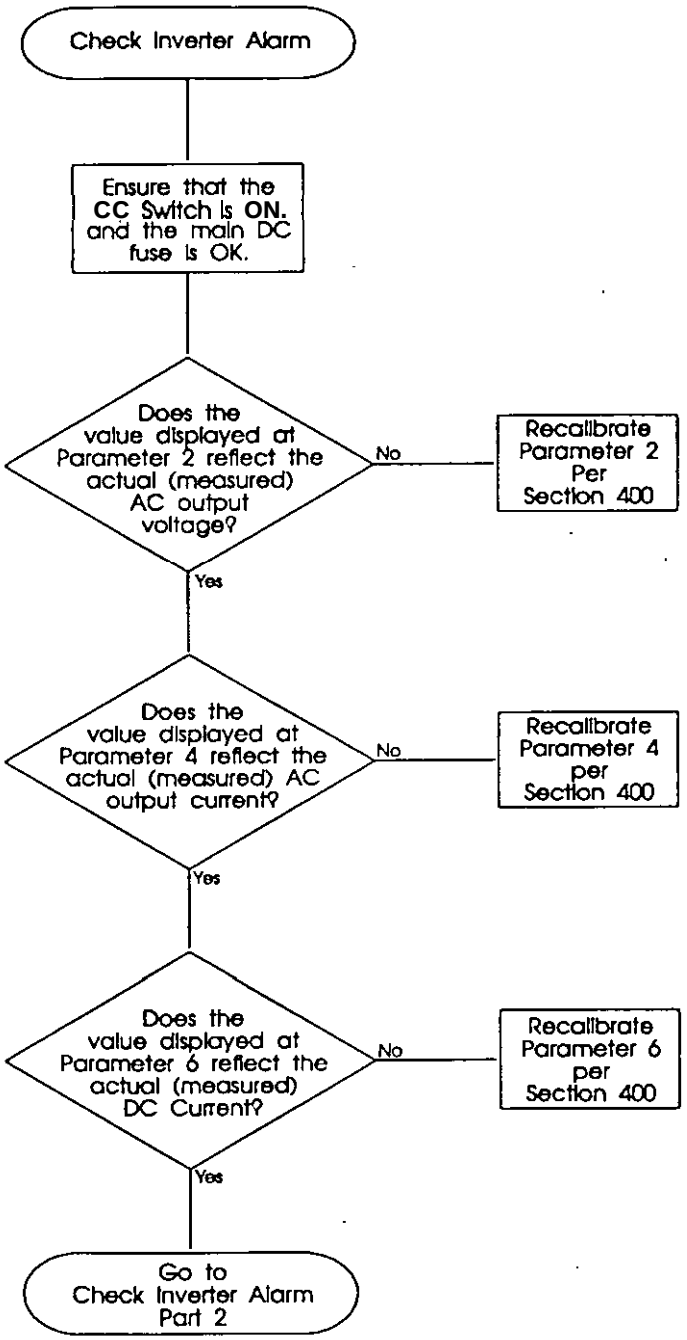


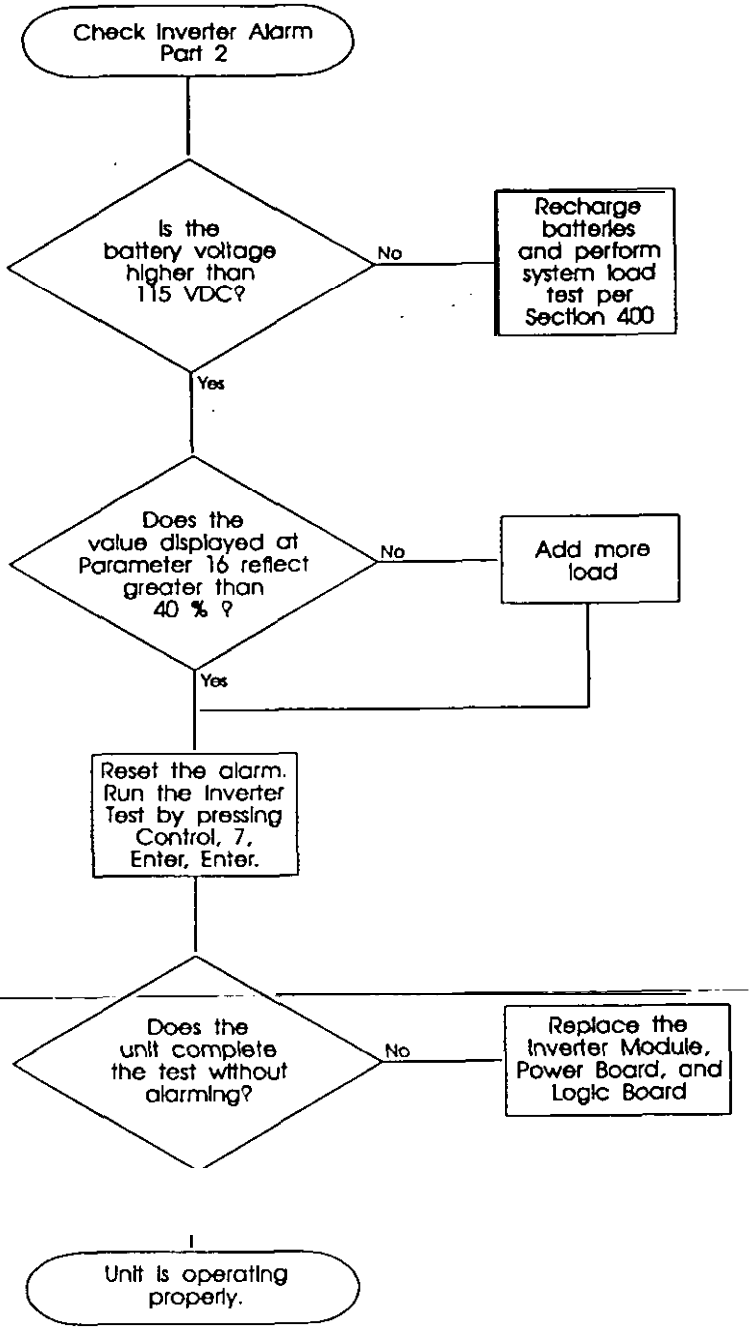
-Check Batten, Alarm



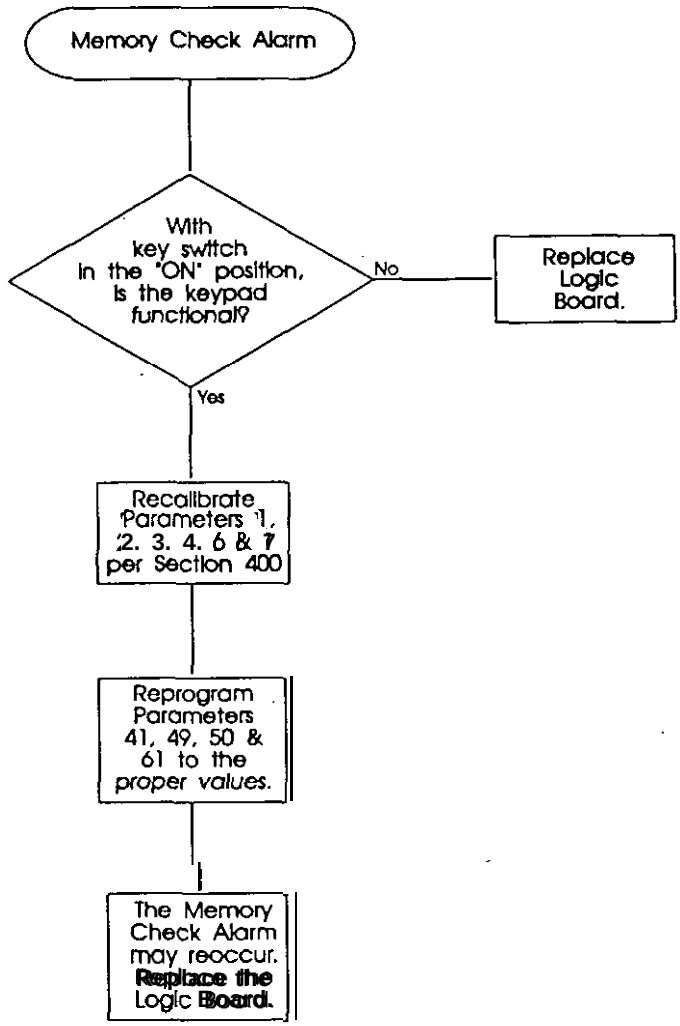

Check Battery Alarm Part 2
Does the value displayed at Parameter 84 reflect the actual Amp-Hour rating of the battery string?
No
Reprogram Parameter 84 to the correct value
Yes
Does the value displayed at Parameter 88 reflect the proper minimum full-load runtime required during the battery test?
No
Reprogram Parameter 88 to the proper value
Yes
If the batteries are three years old or older, they may be nearing the end of their useful life, and may need to be replaced.

-Check Inverter Alarm

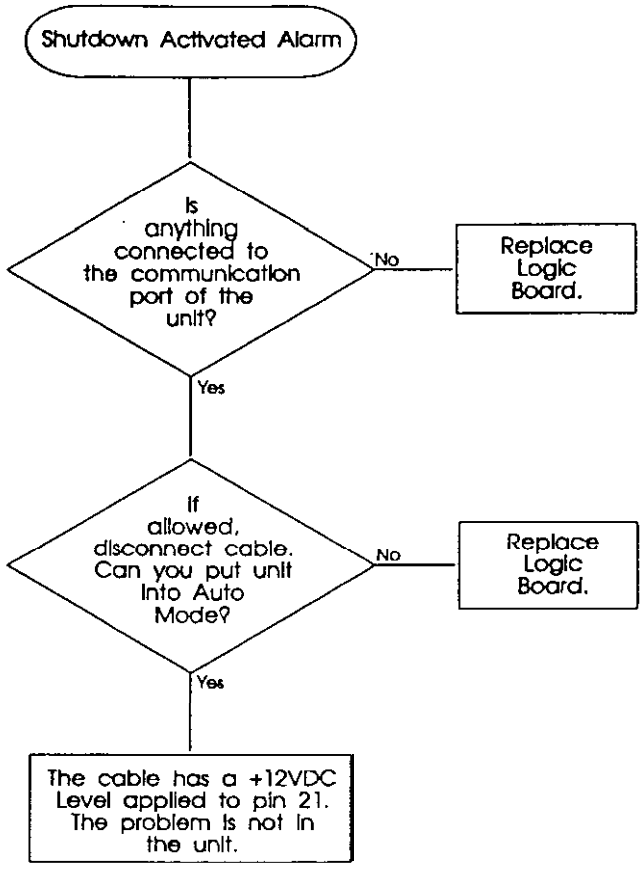



Check Inverter Alarm Part 2
Is the battery voltage higher than 115 VDC?
No
Recharge batteries and perform system load test per Section 400
Yes
Does the value displayed at Parameter 16 reflect greater than 40 % ?
No
Add more load
Yes
Reset the alarm. Run the Inverter Test by pressing Control, 7, Enter, Enter.
Does the unit complete the test without alarming?
No
Replace the Inverter Module, Power Board, and Logic Board
Unit is operating properly.

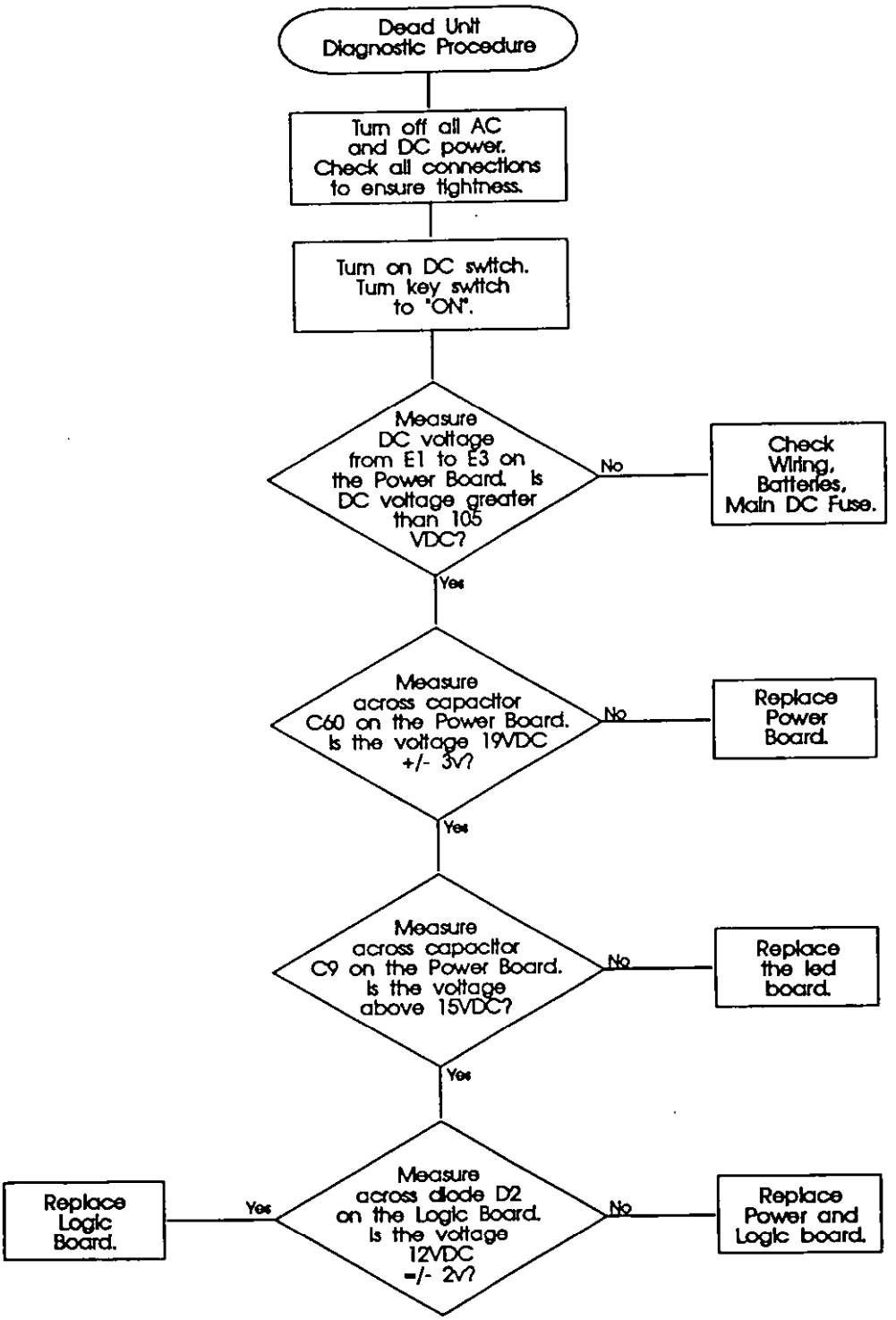
-Memory Check Alarm



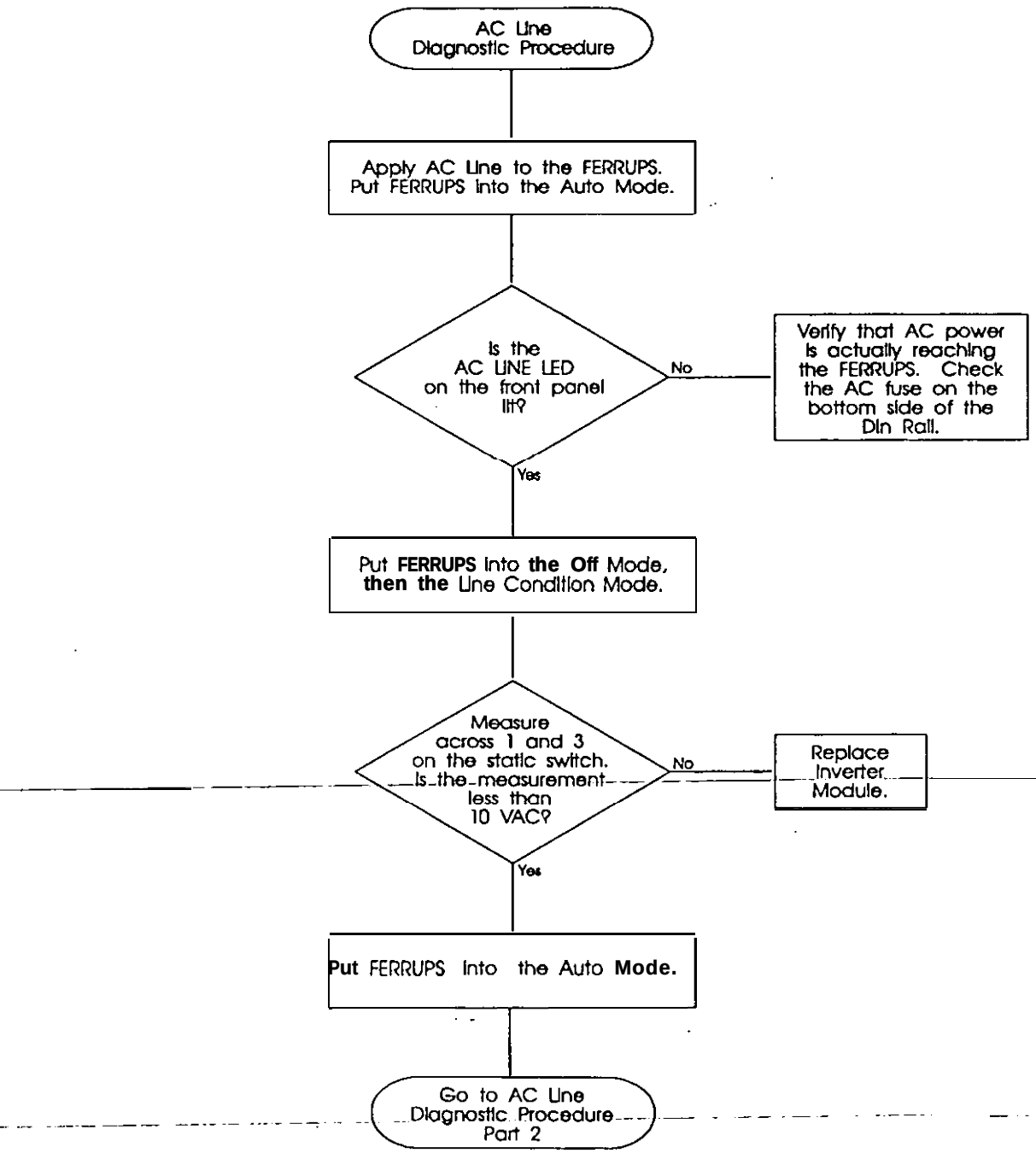
--Shutdown Activated Alarm

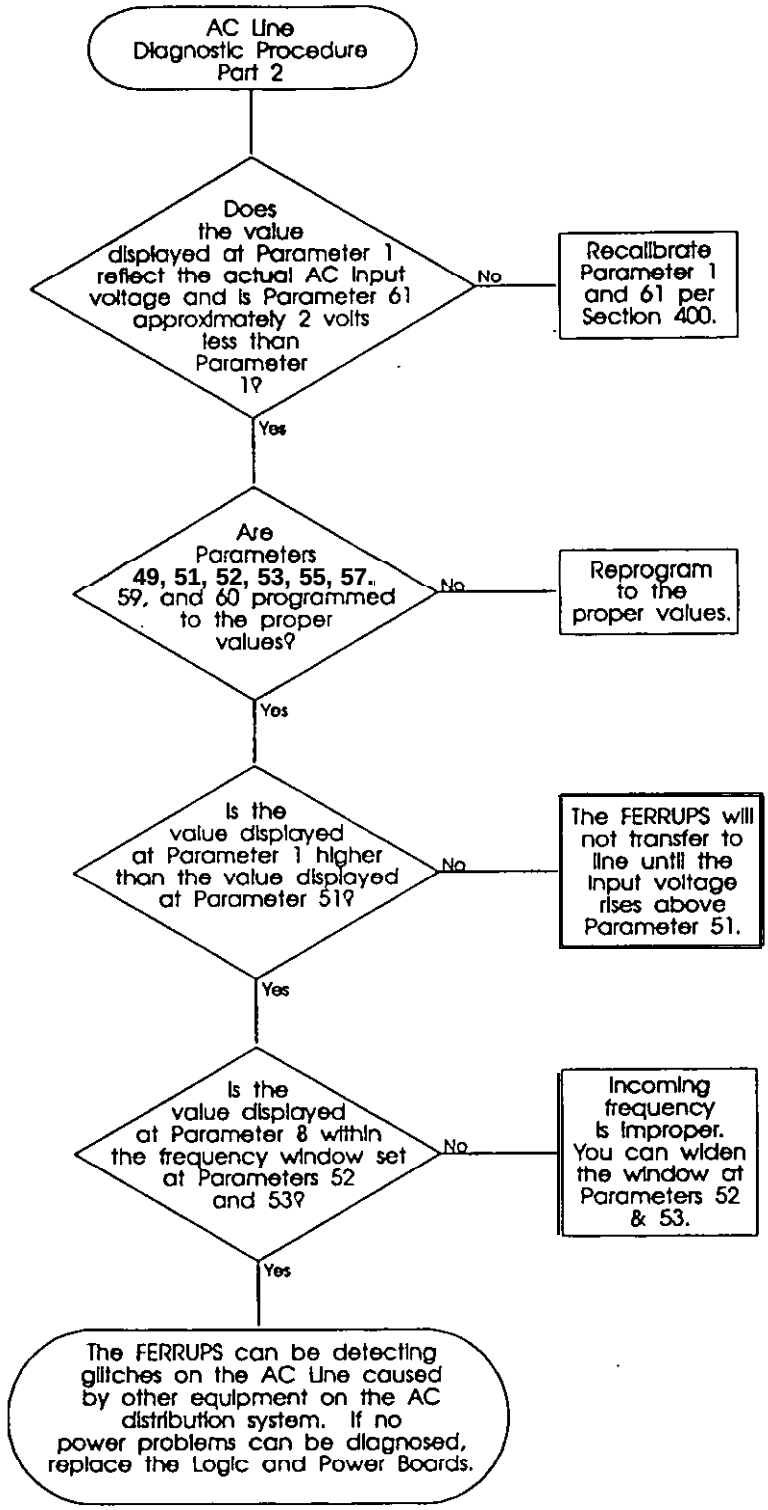


-Dead Unit Diagnostic Procedure

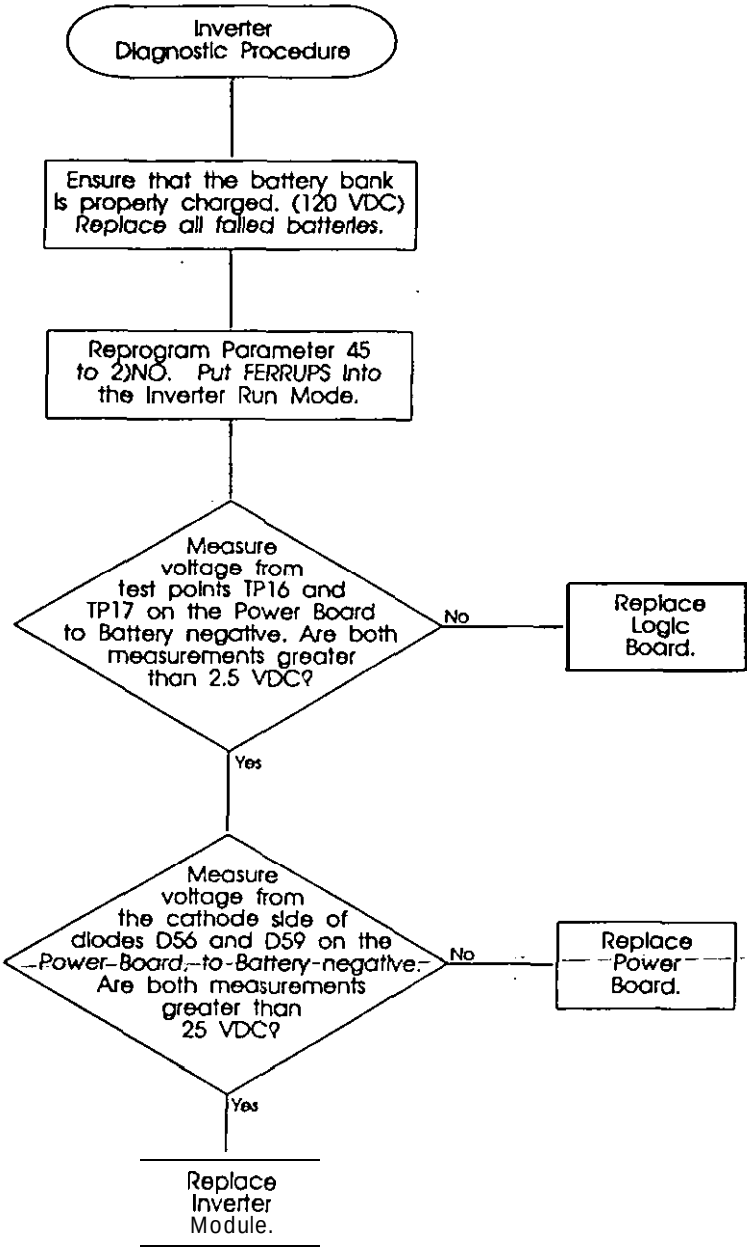


-AC Line Diagnostic Procedure




AC Line
Diagnostic Procedure
Part 2
Does the value displayed at Parameter 1 reflect the actual AC input voltage and is Parameter 61 approximately 2 volts less than Parameter 1?
No
Recalibrate Parameter 1 and 61 per Section 400.
Yes
Are Parameters 49, 51, 52, 53, 55, 57, 59, and 60 programmed to the proper values?
No
Reprogram to the proper values.
Yes
Is the value displayed at Parameter 1 higher than the value displayed at Parameter 51?
No
The FERRUPS will not transfer to line until the input voltage rises above Parameter 51.
Yes
Is the value displayed at Parameter 8 within the frequency window set at Parameters 52 and 53?
No
Incoming frequency is improper. You can widen the window at Parameters 52 & 53.
Yes
The FERRUPS can be detecting glitches on the AC Line caused by other equipment on the AC distribution system. If no power problems can be diagnosed, replace the Logic and Power Boards.

—Inverter Diagnostic Procedure



501-2 Fuses and Locations

The fuses and locations charts are set up to aid in the identification of the fuses in the FERRUPS system. The charts are separated into five columns. The first column lists what the fuse is used for. The second column lists the BEST part number for ordering replacement fuses. The third column lists the voltage and current rating of the fuse, and the type of fuse. The fourth column lists the location of the fuse in reference to the schematics in section 800. The fifth column lists the physical location of the fuse within the actual unit

FUSES and LOCATIONS **(10 - 18KVA)**

Fuse Use	BEST Part Number	Fuse Size	Location (Schematic)	Location (Physical)
Main DC Fuse	FUSA-155 (10KVA Only)	125 Amp XL25X125	F3 DRWG #D2003 2 of 3	On Battery Bank
	FUSA-010 (12.5KVA ONLY)	175 Amp XL25X175	F3 DRWG #D2003 2 of 3	On Battery Bank
	FUSA-111	250 Amp XL25X250	F3 DRWG #D2003 2 of 3	On Battery Bank
Input Monitor Fuse	FUSA-168	2 Amp MDA 2 Amp 250 VAC	Not Shown	F1 on Vertical Din Rail
Standard Charger AC Fuse	FUSA-088	MSL 15 Amp, 250V	F2 DRWG #D2003 2 of 3	Right of Heatsink below Power Board
IEEE 587 Board Fuses	FUSA-154	5 Amp MSL 5 Amp 250 VAC	IEEE 587 DRWG #D2003 2 of 3	Left side of DIN Rail upside down
AC Output Monitor Fuse	FUSA-154	5 Amp MSL 5 Amp 250 VAC	Not Listed	F1 on Power Board
DC Protection Fuse	FUSA-I 53	1.5 Amp 250 VAC	Not Listed	F2 on Power Board
Battery Positive Logic DC Power		1 Amp MDL I Amp 250 VAC	Not Listed	F3 on Power Board

502 Troubleshooting External Problems

Once you have completed the tests indicated above, you may still find that the FERRUPS system does not perform properly. If you are able to turn-on and test the FERRUPS when it is not connected to the line or load, but have problems once you reconnect it to the “real world”, then the problem is almost certainly external in nature.

FERRUPS is a separately-derived power system, and as such must be installed differently than a simple step-up transformer. The role that grounding plays in the proper installation of this system is of critical importance. Improperly installed FERRUPS grounding can contribute to what are colloquially referred to as “back door” problems.

“Back door” problems are generally intermittent in nature, and include such things as CPU halts, data errors, and parity errors. In the worst case; peripherals that are not powered by the UPS will allow transient or lightning energy to reach the CPU via the “back door”, or I/O ports, hence the moniker.

Although 100% absolute lightning and transient protection is not reasonable to attain, using the proper installation methods can certainly afford you a very high degree of protection from these kinds of problems. Refer to the previous section entitled “Installation Wiring and Grounding” for general information.

502-l Installation Wiring and Grounding

As stated at the beginning of this chapter, statistical analysis performed by Best’s Service Department reveals that about 80% of all problems with FERRUPS systems are installation related. Most of these problems result from simply NOT using the correct wiring diagram provided by BEST. The National Electrical Code requires that listed equipment be installed in accordance with the instructions furnished by the manufacture. Failure to comply with this is a violation of NEC Article 110-3(b).

If you suspect that FERRUPS system faults are caused by external problems, begin to troubleshoot by reviewing the entire installation, from the service entrance panel, through the FERRUPS connection panel, through the bypass switch, and out to the receptacle outlets that the load equipment plugs into. Compare the installation to the wiring diagram in the Installation Manual shipped with the unit and make note of any discrepancies.

The following chart describes some of the most common installation errors. what should be done IO correct the error, and the National Electrical Code Articles that apply

Error	Correction	NEC Article
Switchgear, disconnects, and load-breakers not labeled	Label all disconnects, bypass switches, load breakers, etc.	110-22
FERRUPS located in cramped or inaccessible area. Unable to fully open doors and inspect system components.	Locate and position the FERRUPS so that clearance conforms to the specifications in the users manual.	110-16

FERRUPS neutral not grounded, not used, or not switched at external bypass.	FERRUPS is a separately derived power source, and must be installed as such.	250-S(d) 250-26 250-23
FERRUPS neutral is fused at the bypass switch.	Use a bypass switch that is not fused.	230-90(b) 240-22
Local ground to FERRUPS is missing or supplied by conduit only.	Supply an unbroken conductor from the nearest available effectively grounded electrode, which is usually building structural steel if the building has steel or rebar in the concrete.	250-26(c) 250-91(a) 250-92(a) 250-92(b)
FERRUPS 208 VAC output is fed to loads with a neutral. As a result the loads are fed 208/120/88 VAC and loads on the 88 VAC leg are damaged or malfunction.	Never use the 88 VAC leg on the FERRUPS output. Use the 240/120/120 configuration instead.	110-3(b)

Parts Listing

600 50 Hertz Models

600-I QFDlOKVA

QFDlOKVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery		BAT-041	(S) 31 A.H. AGM Type, 10 Required
Batterv		BAT-048	(O) 100 A.H. AGM Tvoe. 10 Reauired
Battery Charger	I -	I BCA-050	(S) 5 Amp Standard Kit
Battery Charger 10A		BCA-055	(O) 10 Amp Charger Kit
Batterv Charger 20A		BCA-060	(O) 20 Amp Charger Kit
Capacitor, Tank		I CPR- 144	(S) 30uf. 660VAC, 7 Required,
Door, Front		CAB-209	(S) Includes Lock and Key
	Lock & Kev	HWR-010	(S)
Fan		FAN-005	(S) 240 VAC
Fuse, AC Input Mon.'	F1 DIN Rail	FUS-159	(S) Buss MDA 1/2 Amp
Fuse, AC Input Mon.	F1 DIN Rail	FUS-167	(O)
Fuse. Main DC	F2	Fus-155	(S) 125 Amp, Brush Tvoe SF13X125
Heatsink	--	I HSA-016	(S) 220/230/240 VAC Input
	Fuse F1,2,3,4	I Pus-154	(S) Buss MSL-5, 250 Volt

QFD10KVA			
ASSEMBLY	**SUB-ASSY**	**BEST PART #**	**COMMENT (S)=Standard Model (O)=Option**
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)
Logic Board		PCL-113	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 220/230/240 VAC Input
Power Board		PCP-043	(O) 220/230/240 VAC Input, 10/20 Amp Charger
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T3	MTN-005	(S) Toroid, AC Output Amps
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main	T1	TRN-424	(S) 220/230/240
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(O) AS-400 Plug-In Board
	Receptacle	RCP-069	(O) 3 Pos. DIN Female
CSA (Opt)		BFK-008	(O) 220 VAC Backfeed Relay Kit

QFD10KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
	Backfeed Relay	RLY-073	(0) 220 VAC
CSA (Opt)		BFK-009	(0) 230 VAC Backfeed Relay Kit
	Backfeed Relay	RLY -074	(0) 230 VAC
CSA (Opt)		BKF-010	(0) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-075	(O) 240 VAC

600-2 QFD12.5KVA

QFD12.5KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery		BAT-007	(S) 55 A.H. AGM Type, 10 Required
Battery		BAT-048	(O) 100 A.H. AGM Type, 10 Required
Battery Charger		BCA-050	(S) 5 Amp Standard Kit
Battery Charger 10A		BCA-053	(0) 10 Amp Charger Kit
Battery Charger 20A		BCA-052	(0) 20 Amp Charger Kit
Capacitor, Tank		CPR-144	(S) 30uf. 660VAC, 9Required
Door, Front		CAB-209	(S) Includes Lock and Key

QFD12.5KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
	Lock & Key	HWR-010	(S)
Fan		FAN-005	(S) 240 VAC
Fuse, AC Input Mon.	F1 DIN Rail	FUS-159	(S) Buss MDA 1/2 Amp
Fuse, AC Input Mon.	F1 DIN Rail	FUS-167	(O) Buss 3AG 1 Amp (120 VAC Unit)
Fuse, Main DC	F2	FUS-010	(S) 175 Amp, Brush Type SF13X175
Heatsink		HSA-017	(S) 220/230/240 VAC Input
	Fuse F1,2,3,4	FUS-154	(S) Buss MSL-5, 250 Volt
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)
Logic Board		PCL-113	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 220/230/240 VAC Input
Power Board		PCP-043	(O) 220/230/240 VAC Input, 10/20 Amp Charger
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T1	MTN-005	(S) Toroid, AC Output Amps

QFD12.5KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main	T1	TRN-425	(S) 220/230/240
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(0) AS-400 Plug-In Board
	Receptacle	RCP-069	(0) 3 Pos. DIN Female
CSA (Opt)		BFK-008	(0) 220, VAC Backfeed Relay Kit
	Backfeed Relay	RLY-073	(0) 220 VAC
CSA (Opt)		BFK-009	(0) 230 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-Q74	(0) 230 VAC
CSA (Opt)		BKF-010	(0) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-075	(0) 240 VAC

QFD18KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Batten,		BAT-046	(S) 55 A.H. AGM Type. 10 Reauired
Battery		BAT-048	(0) 100 A.H. AGM Type, 10 Required
Battery Charger		BCA-050	(S) 5 Amp Standard Kit
Batterv Charger 10A		BCA-053	(O) 10 Amp Charger Kit
Battery Charger 20A		BCA-052	(0) 20 Amp Charger Kit
Capacitor, Tank		CPR-144	(S) 30uf. 660VAC, 13 Required
Door, Front		CAB-209	(S) Includes Lock and Kev
	Lock & Key	HWR-010	(S)
Fan		FAN-005	(S) 240 VAC
Fuse, AC Input Mon.	F1 DIN Rail	FUS- 159	(S) Buss MDA 1/2 Amp
Fuse, AC Input Mon.	F1 DIN Rail	FUS-167	(0) Buss 3AG 1 Amp (120 VAC Unit)
Fuse. Main DC	F2	FUS-Ill	(S) 250 Amp. Brush Type SF13X250
Heatsink		HSA-018	(S) 220/230/240 VAC Input
	Fuse F1,2,3,4	FUS-154	(S) Buss MSL-5, 250 Volt
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)

QFD18KVA

ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Logic Board		PCL-113	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 220/230/240 VAC Input
Power Board		PCP-043	(O) 220/230/240 VAC Input, 10/20 Amp Charger
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T3	MTN-005	(S) Toroid, AC Output Amps
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main	T1	TRN-426	(S) 220/230/240
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(O) AS-400 Plug-In Board
	Receptacle	RCP-069	(O) 3 Pos. DIN Female
CSA (Opt)		BFK-008	(O) 220 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-073	(O) 220 VAC
CSA (Opt)		BFK-009	(O) 230 VAC Backfeed Relay Kit

QFD18KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT **(S)=Standard** Model **(O)=Option**
	Backfeed Relay	RLY-074	(O) 230 VAC
CSA (Opt)		BKF-010	(0) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-075	(0) 240 VAC

601 60 Hertz Models

601-l FDlOKVA

FDlOKVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery		BAT-04 1	(S) 31 A.H. AGM Type, 10 Required
Battery		BAT-048	(0) 100 A.H. AGM Type, 10 Required
Battery Charger		BCA-050	(S) 5 Amp Standard Kit
Battery Charger 10A		BCA-053	(0) 10 Amp Charger Kit
Battery Charger 20A		BCA-052	(0) 20 Amp Charger Kit
Capacitor, Tank		CPR-144	(S) 3Ouf. 660VAC, 6 Required
Door, Front		CAB-209	(S) Includes Lock and Key
[redacted]	Lock & Key	HWR-010	(S)
Fan		FAN-005	(S) 208/240 VAC
Fuse, AC Input Mon.	F1 DIN Rail	FUS-159	(S) Buss MDA 1/2 Amp
Fuse, Main DC	F2	FUS-155	(S) 125 Amp, Brush Type SF13X125
Heatsink		HSA-016	(S) 2081240 VAC In
IEEE-587	Fuse F1,2,3,4	FUS-154	(S) Buss MSL-5, 250 Volt
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)

FD10KVA			
ASSEMBLY	**SUB-ASSY**	**BEST PART #**	**COMMENT (S)=Standard Model (O)=Option**
Logic Board		PCL-112	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 208/240 VAC Input
	Fuse F1	FUS-154	(S) Buss MSL-5
	Fuse F2	FUS-153	(S) Buss AGC-10
	Fuse F3	FUS-101	(S) Buss MDL-1
Power Board		PCP-032	(O) 208/240 VAC Input, 10/20 Amp Charger
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T3	MTN-005	(S) Toroid, AC Output Amps
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main F.	T1	TRN-418	(S) 208/240 VAC
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(O) AS-400 Plug-In Board
	Receptacle	RCP-069	(O) 3 Pos. DIN Female

FD10KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
CSA (Opt)		BFK-021	(0) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-059	(0) 240 VAC
CSA (Opt)		BKF-024	(0) 208 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-058	(0) 208 VAC

601-2 FD12.5KVA

FD12.5KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery		BAT-007	(S) 55 A.H. AGM Type, 10 Required
Battery		BAT-048	(O) 100 A.H. AGM Type, 10 Required
Battery Charger		BCA-050	(S) 5 Amp Standard Kit
Battery Charger 10A		BCA-053	(O) 10 Amp Charger Kit
Battery Charger 20A		BCA-052	(O) 20 Amp Charger Kit
Capacitor, Tank		CPR-144	(S) 30uf. 660VAC, 8 Required
Door, Front		CAB-209	(S) Includes Lock and Key
	Lock & Key	HWR-010	(S)
Fan		FAN-005	(S) 208/240 VAC

FD12.5KVA

ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Fuse, AC Input Mon.	F1 DIN Rail	FUS-159	(S) Buss MDA 1/2 Amp
Fuse, Main DC	F2	FUS-010	(S) 175 Amp, Brush Type SF13X175
Heatsink		HSA-017	(S) 208/240 VAC In
IEEE-587	Fuse F1,2,3,4	FUS-154	(S) Buss MSL-5, 250 Volt
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)
Logic Board		PCL-112	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 208/240 VAC Input
	Fuse F1	FUS-154	(S) Buss MSL-5
	Fuse F2	FUS-153	(S) Buss AGC-10
	Fuse F3	FUS-101	(S) Buss MDL-1
Power Board		PCP-032	(O) 208/240 VAC Input, 10/20 Amp Charger
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T3	MTN-005	(S) Toroid, AC Output Amps

FD12.5KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main F.	T1	TRN-419	(S) 208/240 VAC
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(O) AS-400 Plug-In Board
	Receptacle	RCP-069	(O) 3 Pos. DIN Female
CSA (Opt)		BFK-021	(O) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-059	(O) 240 VAC
CSA (Opt)		BKF-024	(O) 208 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-058	(O) 208 VAC

601-3 FD18KVA

FD18KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery		BAT-046	(S) 57 A.H. AGM Type, 4 Required
Battery		BAT-048	(0) 100 A.H. AGM Type, 4 Required
Battery Charger		BCA-050	(S) 5 Amp Standard Kit
Battery Charger 10A		BCA-053	(0) 10 Amp Charger Kit

FD18KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Battery Charger 20A		BCA-052	(O) 20 Amp Charger Kit
Capacitor, Tank		CPR-144	(S) 30uf. 660VAC, 11 Required
Door, Front		CAB-209	(S) Includes Lock and Key
	Lock & Key	HWR-010	(S)
Fan		FAN-005	(S) 208/240 VAC
Fuse, AC Input Mon.	F1 DIN Rail	FUS-159	(S) Buss MDA 1/2 Amp
Fuse, Main DC	F2	FUS-111	(S) 250 Amp, Brush Type SF13X250
Heatsink		HSA-018	(S) 208/240 VAC In
IEEE-587	Fuse F1,2,3,4	FUS-154	(S) Buss MSL-5, 250 Volt
Keypad/Display		RCA-001	(S)
LED Board		PCX-001	(S)
Logic Board		PCL-112	(S) Specify Model, Input, Output Voltage
Power Board		PCP-033	(S) 208/240 VAC Input
	Fuse F1	FUS-154	(S) Buss MSL-5
	Fuse F2	FUS-153	(S) Buss AGC-10
	Fuse F3	FUS-101	(S) Buss MDL-1
Power Board		PCP-032	(O) 208/240 VAC Input, 10/20 Amp Charger

FD18KVA			
ASSEMBLY	SUB-ASSY	BEST PART #	COMMENT (S)=Standard Model (O)=Option
Switch, Keylock		SWI-139	(S) On, Off, Lock
Switch, Main DC		SWI-035	(S) 100 Amp, 65 Volt, 2 Pole
Terminal Block	DIN Rail	TRB-332	(S)
Transformer, AC (I)	T2	MTN-005	(S) Toroid, AC Input Amps
Transformer, AC (I)	T3	MTN-005	(S) Toroid, AC Output Amps
Transformer, AC Input	T4	TRN-502	(S) Signal/Failsafe
Transformer, Main F.	T1	TRN-406	(S) 208/240 VAC
AS-400 Option		ASK-002	AS-400 Kit
	AS-400 Harness	HRS-155	(O)
	Interface Bd	PCI-005	(O) AS-400 Plug-In Board
	Receptacle	RCP-069	(O) 3 Pos. DIN Female
CSA (Opt)		BFK-021	(O) 240 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-059	(O) 240 VAC
CSA (Opt)		BKF-024	(O) 208 VAC Backfeed Relay Kit
	Backfeed Relay	RLY-058	(O) 208 VAC

Technical Information Publications

This section of your service manual contains the following Technical Information Publications:

700 TIP's

TIP 604	Written Schedule Maintenance Procedure for ME and FD Models
TIP 605	Schedule Maintenance and Service Call Report Form for ME and FD Models
TIP 611	Changing AC Input Voltage In FD 10, 12.5, and 18 KVA
TIP 613	FD and QFD Battery Charger Control

701 QTIP's

QTIP 611	50 Hz Voltage Change

Best Power
UNINTERRUPTIBLE POWER SYSTEMS

TIP 604
2345
June 1, 1994

FERRUPS® Written Scheduled Maintenance Procedure

Use TIP 605 with this TIP to record the responses to the steps below.

1. ***Name and signature of the contact person who authorized the maintenance and UPS test.*** Does the customer understand that during this procedure the load equipment must be powered down if the bypass is "break before make" or if the UPS is a line cord model?

2. *Comments or problems* ***regarding the*** UPS. Record any comments or problems the UPS has had since its last scheduled-maintenance .

3. ***Is the UPS environment clean and free from dust and dirt?*** If the UPS is not in a safe, clean, dry area, stop and call BEST's Technical Support at 800-356-5737.

YOU MUST EITHER BYPASS THE UPS OR SHUT DOWN THE LOAD EQUIPMENT FOR STEPS 4, 5, AND 6.

Note: If you have a BEST "make before break" bypass, switch it to Line. If you have a BEST "break before make" bypass, a non-BEST bypass or a line cord UPS unit, protect your load equipment by shutting it down.

4. *FloorSaver models only.* **Follow this step only if your FERRUPS is a FloorSaver FD or FE model.** See if the battery extension cable (BAA-0024) is installed on the back of the FloorSaver unit. If not, you must bypass or turn off the load equipment and then turn off the FERRUPS unit. Turn off the DC switch and install the battery extension cable.

⚠ WARNING!

These procedures must be performed by a qualified technician ONLY!
UPS units are designed to provide power under a variety of operating conditions.
Dangerous voltages may be present even if AC line or DC voltage is removed.
TEST BEFORE TOUCHING!
Turn off the UPS' power switch (500 VA - 3.1 KVA models) or key switch (4.3 - 18 KVA models) and then remove AC line and DC input power before continuing.
UPS batteries are high current sources. Shorting battery terminals can cause severe arcing, equipment damage, and injury. A short circuit can cause a battery to explode.
Always wear protective clothing and eye protection and use insulated tools when working near batteries.

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1-608-565-7200 / 18003565794 (U.S.A. and Canada) / Fax: 1-608-565-2221
service: 1-800-356-5737, Fax: 1-608-565-2509 / Fax-On-Demand: 1-800-487-6813

TURN OFF THE UPS AND REMOVE AC LINE AND DC INPUT POWER TO THE UPS BEFORE REMOVING THE COVER AND CONTINUING WITH STEPS 5 AND 6. TEST BEFORE TOUCHING!

Cover Removal:

For ME ***or*** FE 500 VA - 3.1 KVA models- Remove the #1 Phillips screw on the top of the unit and loosen the #2 Phillips screw on the front of the unit behind the sticker. Then, slide the cover forward until it is completely off the UPS.
For FD or FE 4.3 KVA - 18 KVA models- Loosen the screws on the top center strip and then loosen and/or remove the side screws to remove the side covers.

5. ***Perform a visual inspection of the UPS.*** With the covers off, look for any damage on the boards or any marks inside the unit. Check all terminal connections, including battery AC Input, and AC Output, to make sure each is in good working order and free of corrosion. Tighten the connection if a wire is loose. Check each battery connection to ensure each one is tight. We recommend each connection be torqued to 55 inch/lbs (7.2 newton-meters). If any damage is evident, stop and call BEST's Technical Support. If not, continue.

6. ***FD and FE 4.3 KVA - 18 KVA models*** only. Check the 587 Spike Suppression Board for any damage. This board is located in the back of the unit by the DIN rail. If any damage is evident or fuses are open, stop and call BEST's Technical Support. If not, continue.

THE UPS MUST BE OPERATING AND AT LEAST 50% OF FULL LOAD SHOULD BE APPLIED FOR THE FOLLOWING TESTS.

Note: To start the UPS you must take the unit off of bypass. The load applied should be as close to 50% of full load as possible.

7. List the five most recent inverter and alarm log ***events.*** In this order, turn on DC power, AC power, and the UPS power switch or key switch. Apply the load to the UPS. The load applied should be at least 50% of full load. Then, to view the inverter log activity, display parameter 24 (Inverter Log) on the control panel by pressing [DISPLAY] [24] [ENTER]. To view the alarm log activity, display parameter 25 (Alarm Log) on the control panel by pressing [DISPLAY] [25] [ENTER].

Note: On FE models, pressing [0] immediately after [ENTER] will halt the scrolling of the logs. Pressing [1] will display the next recorded event in the logs.

On ME or FD models, pressing [ENTER] will display the next recorded event in the logs.

The first entry listed after the parameter wording display is always the most recent. Refer to TIP 406 (ME or FD) or TIP 407 (FE) if you need more information on using the hand-held remote control panel.

8. *Is there anything in the logs that implies the UPS will not sustain the equipment daring an outage?* Look at step 7 and determine if any batteiy alarms have occurred since the last scheduled maintenance was performed, such as Alarm A (LOW BATTERY), Alarm B (NEAR LOW BATTERY), or Alarm C (HIGH BATTERY). If so, stop and call BEST's Technical Support. If not, continue.

9. *Is customer using UPS contacts for a communications link?* If the customer is using a communications link with UPS monitoring software (for example, AS/400) or BEST CheckUPS software, you must disable the'software prior to doing the battery and alarm tests.

For ME or FD models: Perform a battery test by pressing [CONTROL] [77] [ENTER] [ENTER].

Note: Although the unit will actually run on battery power for only one minute, the full rest cycle may take up to 30 minutes.

For FE models: Perform a system test by pressing [CONTROL] [7] [ENTER] [ENTER].

Note: If the unit fails, repair accordingly.

10. *Perform an alarm test.* Press [CONTROL] [8] [ENTER] [ENTER] to test the alarm. While the unit is sending an alarm, check to make sure that the alarm LED is on. Press [CONTROL] [8] [ENTER] [ENTER] to cancel the alarm test. If the alarm did not work, stop and call BEST's Technical Support. If the alarm did work, continue.

Note: The ME and FD alarm LED on the front of the unit will not light if the unit is set up to operate with an AS/400 or if the User Test Alarm is disabled (masked).

11. *Check the LED status indicators to make sure they work when they should.* The LED status indicators are located on the front panel. You may want to press [CONTROL] [4] [ENTER] [ENTER] to have the inverter come on and make sure the battery power LED is lit. Next, press [CONTROL] [2] [ENTER] [ENTER] to verify that the AC LINE and READY LEDs are lit. If so, continue. If not, stop and call BEST's Technical Support. (The CHARGING LED may or may not be lit.)

Note: On ME and FD units, Alarm J must be enabled.

12. *Battery load test.* Remove AC line from the UPS. With a load applied, run the UPS on inverter for 10 minutes per battery string or until each battery is 11.5 volts DC. Record these figures in the "Inverter On With Load" row and record the date code in the "Date Code" row.

Note: On BEST batteries, the date code is the three digit number printed near the positive (+) battery post: 'Example: 3 11 would represent November of 1993 as the date of manufacture.

On Panasonic batteries, the date code is a six digit number printed on the side of the battery. Example: 93 1120 would represent November 20, 1993 as the date of manufacture.

On Gates batteries, the date code is the last 4 numbers of a 12 digit number printed on the top of the battery. Example: 0765-0001-3295W would represent the 295th day of 1993 as the date of manufacture.

Ifadditional space for battery information is needed, use another TIP 605 and attach it to the back of the form on which you're working.

On 12VDC batteries, watch for any battery that deviates by more than 0.5 VDC from the average of all batteries. On 6VDC batteries, watch for any battery that deviates by more than 0.25 VDC from the average of all batteries. If a battery that deviates from these averages is found, reapply AC line so that the customer's protected loads will not be dropped. If you find one or more bad batteries, circle the date code(s). If you replace one or more bad batteries, note this in step 15. If all of the batteries are in tolerance, continue. If not, stop and call BEST's Technical Support (after applying AC line to protect the load equipment).

13. *Fill in the parameters in the list that apply to the model being tested.* This is a two step process:

a. While the UPS is running on inverter (from the battery load test in step 12), display the parameters listed and record these values in the "On Inverter" column. After the inverter test has been completed, fill in the information for "Length of load test" (record how many minutes the test ran) and "Battery Type" (write down the BATA number located on the top of the batteries).

b. Reapply AC line to the UPS. After the UPS has transferred back to AC line, display the parameters listed and record the values in the "On Line" column. Reset the time and date.

14. *Record any repairs or changes that you made.* Did you change anything? If yes, you must completely describe what you found and what you did to correct the problem.

15. *List all parts, including batteries, used to repair the system.*

16. *For BEST IFSCs:* Fill out the information on the bottom of page two (travel time, time on site, was the unit operational, is a return trip required, and whether BEST must contact the customer). If a billable battery replacement is necessary, fill out the P.O. section and have an authorized site contact sign the form under "Authorized by". If proper authorization cannot be obtained for a PO#, do not replace any battery. Have the form signed by the required individuals and return it to BEST.

SERVICE ORDERTERMS & CONDITIONS

BEST POWER, a division of General Signal Power Systems, Inc (hereinafter called BEST POWER) and Customer agree that Start-Up, Repair, Exchange, Preventive Maintenance, Training and other services or repair parts sales ("Service") provided by BEST POWER to Customer shall be performed exclusively pursuant to the charges, terms and conditions stated below in the absence of an applicable Service Agreement between BEST POWER and Customer. Charges are based on BEST POWER'S then [redacted] charges for Service, including labor, parts, travel (portal to portal) and other expenses.

1. [redacted]RS. The charge for any repairs not covered by a Service Agreement (a "Non-covered Repair") and any repairs made in the absence of a Service Agreement will be invoiced to the Customer at BEST POWER's standard rates. A Non-Covered Repair includes, but is not limited to, repairs or replacements including all parts and labor) due to damage, unreasonable use or other cause and include, without limitation, all damage from road hazards, accident, fire or other casualty, misuse or misapplication, negligence, premises wiring, load equipment, high temperature, dirty or dusty environments, and any use or installation not in conformity with instructions furnished, as well as any repairs or replacements needed due to unauthorized modifications to the equipment or related software or the use of parts not authorized or supplied by BEST POWER, or multiple trips including trips due to denied access to the equipment.

2. REPAIR COMPONENTS. Under a Service Agreement or Standard Limited Warranty, parts required *to repair a unit will be provided by BEST POWER and replaced on an exchange basis. In the absence of* coverage under a Service Agreement or Warranty, parts are provided at the current non-warranty exchange prices, if returned parts are repairable and remarketable. If the parts returned are not repairable or remarketable *then the customer will be invoiced for the full list price of the parts. All parts removed or* unused become the property of BEST POWER and must be returned to the factory within 30 days of receipt of replacement. Any unused parts returned to BEST POWER may be subject to the current restocking fee. In the absence of an applicable Service Agreement or Standard Limited Warranty, Batteries will be provided at BEST POWER's then applicable charges.

3. PAYMENT TERMS. All invoices are payable to BEST POWER within thirty (30) days of the date of the invoice. Customer shall make such arrangements for payment as BEST POWER may require, and BEST POWER may suspend service until such arrangements are made. Past due amounts shall be subject to an interest charge of one percent (1%) per month or the highest rate permitted by law plus all costs of collection, including attorneys fees. All sales, property, excise and other federal, state and other local taxes (other than those based upon BEST POWER's net income) shall be paid by Customer.

4. SUPERSEDING EFFECT. Any terms and provisions of Customer's order or other document which are inconsistent with any of the terms and conditions hereof are rejected, will not be binding on BEST POWER nor considered applicable to the Services ordered. Acceptance of these terms and conditions shall be conclusively indicated by issuance by Customer of any written or oral order or request for Service ("Service Order"). Except as set forth in an applicable Service Agreement, these terms and conditions constitute the entire Agreement between the parties and replace any prior understandings, proposals or other communication with respect to this subject matter.

5. LIMITED WARRANTY. This Limited Warranty applies to all Services rendered by BEST POWER or its authorized representatives. (The standard Limited Warranty applicable to a Product shall apply to any sale *of new Products.) BEST POWER warrants that the Services* that the Customer has received or w[redacted] from BEST POWER or its authorized representative pursuant to the terms of a Service Order sh[redacted]erformed properly and/or any parts supplied by BEST POWER under this Service Order shall be free from *defects in materials and workmanship under normal use for a period of thirty* (30) days. This warranty, however, extends only to the Customer. It cannot be transferred to anyone who subsequently purchases the product from the Customer.

EXCEPT AS EXPRESSLY SET FORTH IN THIS WARRANTY BEST POWER MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED *WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.* BEST POWER EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED IN THIS LIMITED WARRANTY. WITH RESPECT TO INTERMITTENT PROBLEMS, COMPLEX PROBLEMS THAT *INVOLVE SITE SPECIFIC ISSUES OR ANY NON-COVERED REPAIR,* BEST POWER MAKES NO WARRANTY, EXPRESS OR IMPLIED, THAT THE SERVICES SHALL FULLY RESOLVE ALL PROBLEMS OR ISSUES.

BEST POWER IS NOT LIABLE FOR ANY DAMAGES CAUSED BY (I) THE PRODUCT OR PARTS USED BY IT OR THE SERVICES RENDERED BY IT OR (II) THE FAILURE OF THE PRODUCT OR PARTS TO PERFORM OR (III) THE FAILURE OF ANY SERVICES RENDERED TO HAVE BEEN PROPERLY RENDERED, INCLUDING, BUT NOT LIMITED TO, ANY LOST PROFITS, LOST SAVINGS, INCIDENTAL DAMAGES, OR CONSEQUENTIAL DAMAGES. THIS LIMITATION OF LIABILITY WILL BE EFFECTIVE EVEN IF THE CUSTOMER HAS ADVISED BEST POWER, OR AN AUTHORIZED REPRESENTATIVE OF BEST POWER, OF THE POSSIBILITY OF SUCH DAMAGES. THE LIMITATIONS CONTAINED HEREIN MAY NOT BE WAIVED OR ALTERED BY ANY PERSON.

FURTHERMORE, THE CUSTOMER'S ONLY REMEDY IS TO HAVE BEST POWER REPLACE ANY PARTS OR REDO THE SERVICES RENDERED. IF BEST POWER IS UNABLE TO REPAIR OR REPLACE THE PRODUCT OR PARTS OR CORRECT THE SERVICES TO CONFORM TO THIS WARRANTY AFTER A REASONABLE NUMBER OF ATTEMPTS, THEN BEST POWER WILL REFUND THE CHARGE FOR THE DEFICIENT SERVICE. REMEDIES UNDER THIS WARRANTY ARE EXPRESSLY LIMITED TO THOSE SPECIFIED ABOVE.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages for consumer products. In such states, if the Service should be deemed a consumer product, the exclusions or limitations of this Limited Warranty may not apply to the Customer. This Limited Warranty gives the Customer specific legal rights. However, the Customer may also have other rights that may vary from state to state. The Customer is advised to consult applicable state laws to ascertain the full extent of his rights.

6. GOVERNING LAW. The terms of this Agreement shall be governed by the laws of the State of Wisconsin exclusive of conflict of laws rules.

7. LIABILITY AND CLAIMS. Liability of BEST POWER on any claim of any kind, including claims for negligence or other torts, or for any loss or damage, arising out of, or connection with, *or resulting* from, any Service, or from the manufacture, sale, delivery, resale, repair or use of any products covered by, or furnished under, such an order, shall in no case exceed the price allocable to the product, service or part thereof which gives rise to the claim. In no event shall BEST POWER be liable for any special, incidental, consequential or exemplary damages. Any claims against BEST POWER for shortages by it in making shipments shall be made in writing to BEST POWER within fifteen (15) days after receipt of shipment.

The fulfillment of any Service Order is subject to strikes, labor disputes, lockouts, accidents, fires, delays in manufacture or in transportation or delivery of material, floods, severe weather or other acts of God, embargoes, governmental actions, or any other cause beyond the reasonable control of BEST POWER, whether similar to, or different from, the causes above enumerated, whether affecting BEST POWER or BEST POWER's supplier or subcontractor, and any such causes shall absolve BEST POWER from any liability to Customer.

8. CHANGES. BEST POWER *may, at any time, without notice, make changes (whether in design,* materials, the addition of improvements, or otherwise) in any product, and may discontinue the manufacture of any product, all in its sole discretion, without incurring any obligations of any kind as a *result thereof, whether for failure to fill an order accepted by BEST POWER or otherwise. In performing* Services, BEST POWER may use factory reconditioned parts or product. BEST POWER may subcontract with others to perform Services without Customer's prior consent, but BEST POWER shall remain responsible for performing the Service.

9. EXCLUSIONS. In no event shall BEST POWER have any obligation to identify, correct, abate, cleanup, control or remove any defective premises electrical equipment or wiring or any code violation or any toxic or hazardous material in Customer's premises.

10. LIMITATION OF ACTIONS. No action, regardless of form or basis, arising out of transactions related to a Service Order or the Services performed or to be performed may be brought by either party more than two (2) years after the cause of action has accrued.

Best Power!
UNINTERRUPTIBLE POWER SYSTEMS

TIP 605
2345
June24.1995

FERRUPS® Scheduled Maintenance and Service Call Report Form
For ME, QME, FD, QFD, FE and QFE Models

Please check one: ☐ Maintenance ☐ Service Service Order Number _____
Technician _____ Technician ID Number- _____
LOCATION OF SYSTEM: Model Number _____ Serial Number _____
Company Name, Address and Phone Number _____

Work Instructions _____
Bypass Type: ☐ BBM ☐ MBB Date and Time of service _____

1. Name and signature of contact person who authorized the maintenance and UPS test. _____
2. Comments or problems regarding the UPS _____
3. Is the UPS environment clean and free from dust and dirt? Yes☐ No ☐ **If not, correct the problem at this time.**

YOU MUST EITHER BYPASS THE UPS OR SHUT DOWN THE LOAD EQUIPMENT FOR STEPS 4, 5, AND 6.

4. **FloorSaver models only:** Is your battery extension cable (BAA-0024) installed at this time? Yes☐ No☐ _____ If not, you must install it now. To do this you must turn off the FERRUPS. **Before installing the cable, make sure the DC switch is in the "Off' position.**

CAUTION! ⚠ **Turn off the UPS and then remove AC line and DC input power before removing the cover and continuing with steps 5 and 6. TEST BEFORE TOUCHING!**

5. Perform a visual inspection of the UPS. Check all terminal connections (battery, AC Input, and AC Output). Are connections tight, free of corrosion and in good condition? Yes☐ No☐ **If not, correct the problem at this time.**
6. FD **and FE** 4.3 **WA - 18 KVA models only** - Are there open fuses or physical damage on the Spike Suppression Board? Yes☐ No ☐ **If yes, correct the problem at this time.**
7. List the five most recent inverter and alarm log events:

	Inverter Log	Alarm Log
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	S - m - -

8. Is there anything in the logs that implies the UPS will **not** sustain the equipment during an outage? Notify the site that you are going to perform a battery load test and that in the unlikely event of a problem, all equipment should be prepared for a power outage.

FOR BEST RESULTS APPLY AT LEAST 50% OF FULL LOAD FOR THE FOLLOWING TESTS

9. Is customer using UPS contacts for a communications link? Take the necessary precautions so that this contact closure will not cause a premature shutdown. **For ME** or FD **models:** Perform a battery test by pressing [CONTROL] [77] [ENTER] [ENTER]. **For FE models:** Perform a system test by pressing [CONTROL] [7] [ENTER] ENTER].

LPT-0605K RESTRICTED

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Service: 1-800-356-5737 / Fax: 1-608-565-2509 / Fax-On-Demand: 1-800-487-6813

10. Perform an alarm test. Check the LED status indicators to make sure they work when they should.

11. Battery load test. Remove AC line from the UPS. With a load applied, run inverter for 10 minutes per battery string or until each battery measures Il.5 volts. Record voltages below in the "Inverter On With Load" column. Circle the date code for any bad batteries.

Battery Number	1	2	3	4	5	6	1	8	9	10
Inverter On With Load										
Date Code										

12. Fill in the parameters in the following list that apply to the model being tested.

Parameter Number	On Inverter	On Line	Parameter Number	On Inverter	On Line
0 Time	x x x		16 Full Ld %		
1 Volts In			17 watts		
2 Volts out			18 PF		
3 Reserved (I In FD/QFD only)			19 VALimit		
4 I Out			20 #Pwr out		
5 VA Out			21 #OvrLds		
6 I Batt			22 sys Hrs		
7 V Batt			23 Inv Min		
8 Freq			26 Test Results (FE only)		
9 Rn Tm			Time/Date	x x x	
10 Date	x x x		Logic RA/RD	x x x	
11 Amb Temp			Invgate L/R	x x x	
12 HS Temp			Batt RT/DC	XXX	
13 Reserved (% Hum FD/QFD only)	X X X		67 Hi Batt	XXX	
14 Xfmr Temp (certain FE models)			73 Pkl (FD only)		
14 Unit ID (ME or FD only)	XXX		74 Pk2 (FD only)		
15 unit ID (FE only)	XXX				

Length of load test_____ minutes. Battery Type_____

13. Record any repairs or changes that you made. Document any wiring problems and any corrective action that was taken.

14. List all parts, including batteries, used to repair the system.

15. Travel time_____ Time on Site_____ unit Operational7 Yes/No_____ Return Trip required7 Yes/No_____

Battery type _____ Quoted price_____ (Quoted price does not include shipping or tax, if applicable.)

P.O. # _____ Authorized by _____ Verified by (BEST employee)_____

Site Representative's signature_____
I have read and understood the terms and conditions listed on the reverse side of this form.

Service Representative's signature_____

SERVICE ORDER TERMS & CONDITIONS

ST POWER, a division of General Signal Power Systems, Inc (hereinafter called BEST POWER) and stomer agree that Start-Up, Repair, Exchange, Preventive Maintenance, Training and other services or ir parts sales ("Service") provided by BEST POWER to Customer shall be performed exclusively uant to the charges, terms and conditions stated below in the absence of an applicable Service ement between BEST POWER and Customer. Charges are based on BEST POWER'S then pli rges for Service, including labor, parts, travel (portal to portal) and other expenses.

RE . The charge for any repairs not covered by a Service Agreement (a "Non-covered Repair") ny repairs made in the absence of a Service Agreement will be invoiced to the Customer at BEST ER's standard rates. A Non-Covered Repair includes, but is not limited to, repairs or replacements uding all parts and labor) due to damage, unreasonable use or other cause and include, without itation, all damage from road hazards, accident, fire or other casualty, misuse or misapplication, ligence, premises wiring, load equipment, high temperature, dirty or dusty environments, and any use allation not in conformity with instructions furnished, as well as any repairs or replacements needed unauthorized modifications to the equipment or related software or the use of parts not authorized pplied by BEST POWER, or multiple trips including trips due to denied access to the equipment.

EPAIR COMPONENTS. Under a Service Agreement or Standard Limited Warranty, parts required air a unit will be provided by BEST POWER and replaced on an exchange basis. In the absence of ge under a Service Agreement or Warranty, parts are provided at the current non-warranty exchange ices, if returned parts are repairable and remarketable. If the parts returned are not repairable or rketable then the customer will be invoiced for the full list price of the parts. All parts removed or ed become the property of BEST POWER and must be returned to the factory within 30 days of pt of replacement. Any unused parts returned to BEST POWER may be subject to the current king fee. In the absence of an applicable Service Agreement or Standard Limited Warranty, Batteries be provided at BEST POWER's then applicable charges.

PAYMENT TERMS. All invoices are payable to BEST POWER within thirty (30) days of the date invoice. Customer shall make such arrangements for payment as BEST POWER may require, and POWER may suspend service until such arrangements are made. Past due amounts shall be subject terest charge of one percent (1%) per month or the highest rate permitted by law plus all costs of llection, including attorneys fees. All sales, property, excise and other federal, state and other local xes (other than those based upon BEST POWER's net income) shall be paid by Customer.

PERSEDING EFFECT. Any terms and provisions of Customer's order or other document which consistent with any of the terms and conditions hereof are rejected, will not be binding on BEST OWER nor considered applicable to the Services ordered. Acceptance of these terms and conditions all be conclusively indicated by issuance by Customer of any written or oral order or request for Service vice Order"). Except as set forth in an applicable Service Agreement, these terms and conditions itute the entire Agreement between the parties and replace any prior understandings, proposals or communication with respect to this subject matter.

LIMITED WARRANTY. This Limited Warranty applies to all Services rendered by BEST POWER its authorized representatives. (The standard Limited Warranty applicable to a Product shall apply to le Products.) BEST POWER warrants that the Services that the Customer has received or BEST POWER or its authorized representative pursuant to the terms of a Service Order be ned properly and/or any parts supplied by BEST POWER under this Service Order shall free from defects in materials and workmanship under normal use for a period of thirty (30) days. This anty, however, extends only to the Customer. It cannot be transferred to anyone who subsequently ases the product from the Customer.

EPT AS EXPRESSLY SET FORTH IN THIS WARRANTY BEST POWER MAKES NO OTHER ARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED ARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BEST WER EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED IN THIS LIMITED RANTY. WITH RESPECT TO INTERMITTENT PROBLEMS, COMPLEX PROBLEMS THAT LVE SITE SPECIFIC ISSUES OR ANY NON-COVERED REPAIR, BEST POWER MAKES NO RRANTY, EXPRESS OR IMPLIED, THAT THE SERVICES SHALL FULLY RESOLVE ALL ROBLEMS OR ISSUES.

POWER IS NOT LIABLE FOR ANY DAMAGES CAUSED BY (I) THE PRODUCT OR PARTS BY IT OR THE SERVICES RENDERED BY IT OR (II) THE FAILURE OF THE PRODUCT OR TS TO PERFORM OR (III) THE FAILURE OF ANY SERVICES RENDERED TO HAVE BEEN OPERLY RENDERED, INCLUDING, BUT NOT LIMITED TO, ANY LOST PROFITS, LOST AVINGS, INCIDENTAL DAMAGES, OR CONSEQUENTIAL DAMAGES. THIS LIMITATION OF ABILITY WILL BE EFFECTIVE EVEN IF THE CUSTOMER HAS ADVISED BEST POWER, OR AN ORIZED REPRESENTATIVE OF BEST POWER, OF THE POSSIBILITY OF SUCH DAMAGES. IMITATIONS CONTAINED HEREIN MAY NOT BE WAIVED OR ALTERED BY ANY PERSON.

RTHERMORE, THE CUSTOMER'S ONLY REMEDY IS TO HAVE BEST POWER REPLACE ANY RTS OR REDO THE SERVICES RENDERED. IF BEST POWER IS UNABLE TO REPAIR OR LACE THE PRODUCT OR PARTS OR CORRECT THE SERVICES TO CONFORM TO THIS RANTY AFTER A REASONABLE NUMBER OF ATTEMPTS, THEN BEST POWER WILL ND THE CHARGE FOR THE DEFICIENT SERVICE. REMEDIES UNDER THIS WARRANTY EXPRESSLY LIMITED TO THOSE SPECIFIED ABOVE.

me states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation idental or consequential damages for consumer products. In such states, if the Service should be l a consumer product, the exclusions or limitations of this Limited Warranty may not apply to the ner. This Limited Warranty gives the Customer specific legal rights. However, the Customer may o have other rights that may vary from state to state. The Customer is advised to consult applicable te laws to ascertain the full extent of his rights.

6. **GOVERNING LAW.** The terms of this Agreement shall be governed by the laws of the State of Wisconsin exclusive of conflict of laws rules.

7. **LIABILITY AND CLAIMS.** Liability of BEST POWER on any claim of any kind, including claims for negligence or other torts, or for any loss or damage, arising out of, or connection with, or resulting from, any Service, or from the manufacture, sale, delivery, resale, repair or use of any products covered by, or furnished under, such an order, shall in no case exceed the price allocable to the product, service or part thereof which gives rise to the claim. In no event shall BEST POWER be liable for any special, incidental, consequential or exemplary damages. Any claims against BEST POWER for shortages by it in making shipments shall be made in writing to BEST POWER within fifteen (15) days after receipt of shipment.

The fulfillment of any Service Order is subject to strikes, labor disputes, lockouts, accidents, fires, delays in manufacture or in transportation or delivery of material, floods, severe weather or other acts of God, embargoes, governmental actions, or any other cause beyond the reasonable control of BEST POWER, whether similar to, or different from, the causes above enumerated, whether effecting BEST POWER or BEST POWER's supplier or subcontractor, and any such causes shall absolve BEST POWER from any liability to Customer.

8. **CHANGES.** BEST POWER may, at any time, without notice, make changes (whether in design, materials, the addition of improvements, or otherwise) in any product, and may discontinue the manufacture of any product, all in its sole discretion, without incurring any obligations of any kind as a result thereof, whether for failure to fill an order accepted by BEST POWER or otherwise. In performing Services, BEST POWER may use factory reconditioned parts or product. BEST POWER may subcontract with others to perform Services without Customer's prior consent, but BEST POWER shall remain responsible for performing the Service.

9. **EXCLUSIONS.** In no event shall BEST POWER have any obligation to identify, correct, abate, cleanup, control or remove any defective premises electrical equipment or wiring or any code violation or any toxic or hazardous material in Customer's premises.

10. **LIMITATION OF ACTIONS.** No action, regardless of form or basis, arising out of transactions related to a Service Order or the Services performed or to be performed may be brought by either party more than two (2) years after the cause of action has accrued.

Changing AC Input Voltages in FERRUPS® FD 7, 10, 12.5 and 18 KVA

This Technical Information Publication describes bow to change the AC input operating voltage on FD 7, 10, 12.5 and 18 KVA models. Call BEST's Technical Support Center at 800-356-5737 if you have any questions during this procedure.

Tools Needed:

Standard Screwdriver
Phillips Screwdriver
True RMS AC Voltmeter
True RMS AC Ammeter
5/16" Open-end Wrench
Side Cutter
Torque Driver 8mm Blade

⚠ WARNING!

UPS units are designed to provide power under a variety of operating conditions, Dangerous voltages may be present even if input AC line voltage is removed. AC and DC voltages are present at the terminal strip terminals.

UPS batteries are high current sources. Shorting battery terminals or DC terminals can cause severe arcing, equipment damage and injury. A short circuit can cause a battery to explode. Always wear protective clothing and eye protection and use insulated tools when working near batteries. **Turn off the UPS according to the procedure describing "How and When to Shutdown Your UPS" in the FERRUPS User's Manual. Ensure that the UPS batteries and input AC are turned off or disconnected before starting the voltage change procedure.**

Make certain the UPS will comply with all applicable electrical codes when the voltage change has been completed.

Over the course of the FD production, Underwriters Laboratory established new requirements for the FERRUPS products. With these new requirements, design changes had to be made to the product; some of these changes affect the voltage change procedure.

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FAX 608-565-2221. Service FAX: 608-565-2509

Section 100

Using Table 100 and the serial number from the FERRUPS product, determine what sections **need** to be completed to perform an AC input voltage change.

100-l Remove all power from the UPS before beginning any procedure.

100-2 Under "SERIAL **NUMBER" find** the correct FERRUPS model.

100-3 Under "PROCEDURE" find the voltage change procedure needed to complete.

100-4 Under "HARDWARE CHANGES", "WIRING CHANGES" and "SOFTWARE CHANGES" **find** the sections to complete.

To complete any of the Hardware Changes in Section 200, call the BEST Technical Support Center to order parts.

SERIAL **NUMBER**	PROCEDURE	HARDWARE CHANGES	WIRING CHANGES	SOFTWARE **CHANGES**
FD7K08388	120 to **208/240**	Section 201, 202	Section 301	Section 400
or Higher	**208/240** to120	Section 201, 202	Section 302	Section 400
	208 to 240	**N/A**	Section 303	Section 400
	240 to 208	N/A	Section 303	Section, 400
FD7K08387	120 to 2081240	Section 202	Section 301	Section 400
to **FD7.0K07371**	**208/240** to 120	Section 202	Section 302	Section 400
	208 to 240	NIA	Section 303	Section 400
	240 to 208	NIA	Section 303	Section 400
FD12K005153 and **above with 5 AMP** Charger	240 to 208	Section 201	Section 303	Section 400
All other FD 10, 12.5 and 18 KVA units	208 to 240	N/A	Section 303	Section 400
	240 **to 208**	N/A	Section 303	Section 400

Table 100

Section 200 Hardware Changes

Section 201 Backfeed Relay replacement

This section involves replacing the backfeed relay along with the correct wiring terminations

201-I Remove the sides from the UPS by loosening the screws located on each side and loosening the thiee screws located across the top of the UPS.

201-2 Locate the backfeed relay, Loosen the screws for the wire terminations and remove the wires. Remove the mounting screws then remove the backfeed relay.

201-3 Install the new backfeed relay provided. See Figure 1 for wire terminations.

208 or 240 to 120 (FD 7 KVA only) - replace the static switch wire labeled WIA-0665 with the wire provided labeled BAA-0399.
240 to 208 (FD12.5K005153 and above with 5 AMP charger) - replace the static switch wire labeled BAA-0339 with the wire provided labeled BAA-0404.

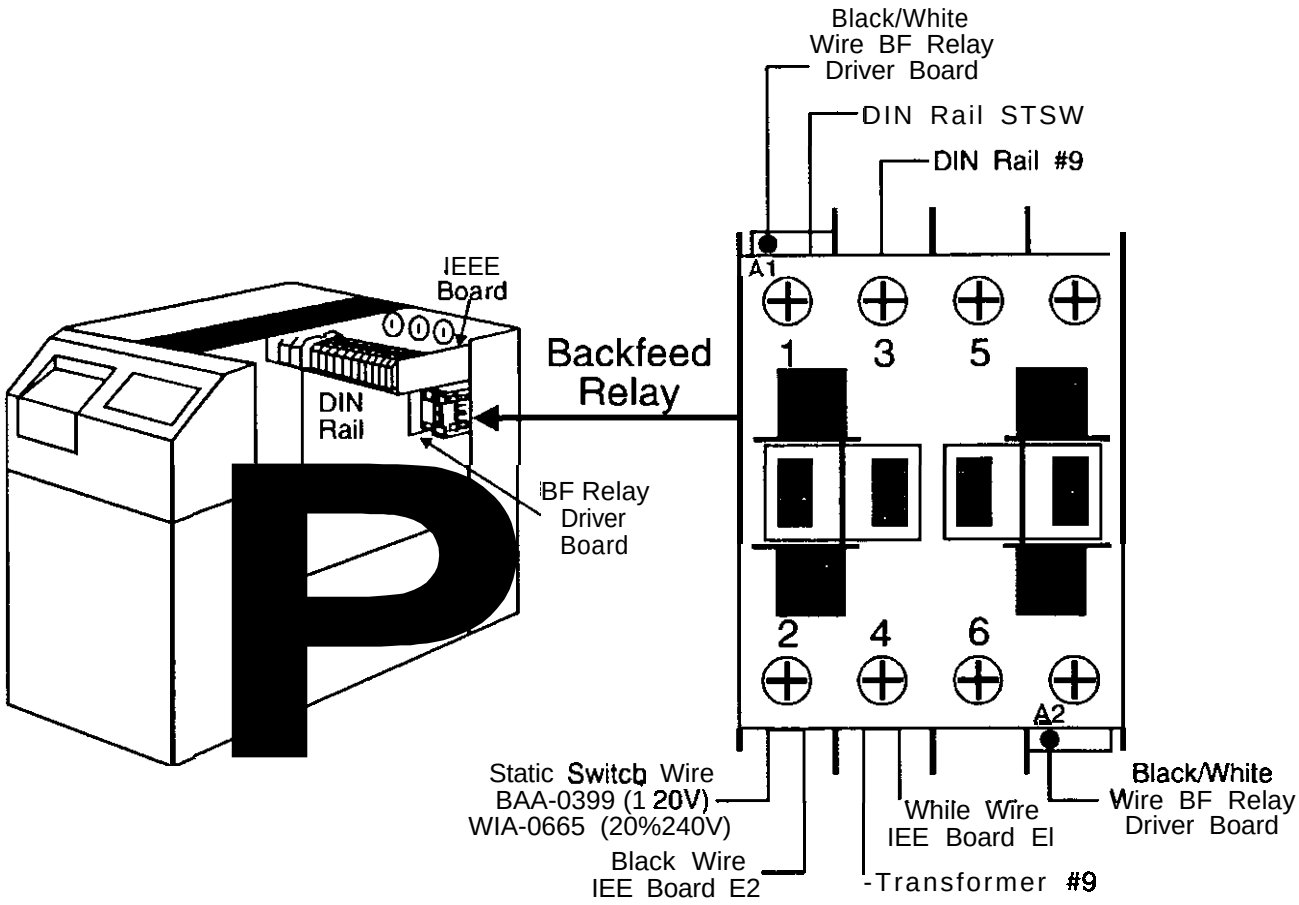


Figure 1

Section 202 Static Switch and Static Switch Driver Board replacement

This section involves replacing the static switch and static switch driver **board.** When changing from 208 or 240 to 120, a higher ampacity static switch and low voltage driver board must be installed. When changing from 120 to 208 or 240, a high voltage driver board must be installed.

202-l **Changing from** 208 **or** 240 **to 120** only. Locate the static switch on the **heatsink** assembly. See Figure 2. There are two types of **heatsink** assemblies depending on the serial number. Determine which is correct for your unit and replace the static switch with the higher ampacity switch provided.

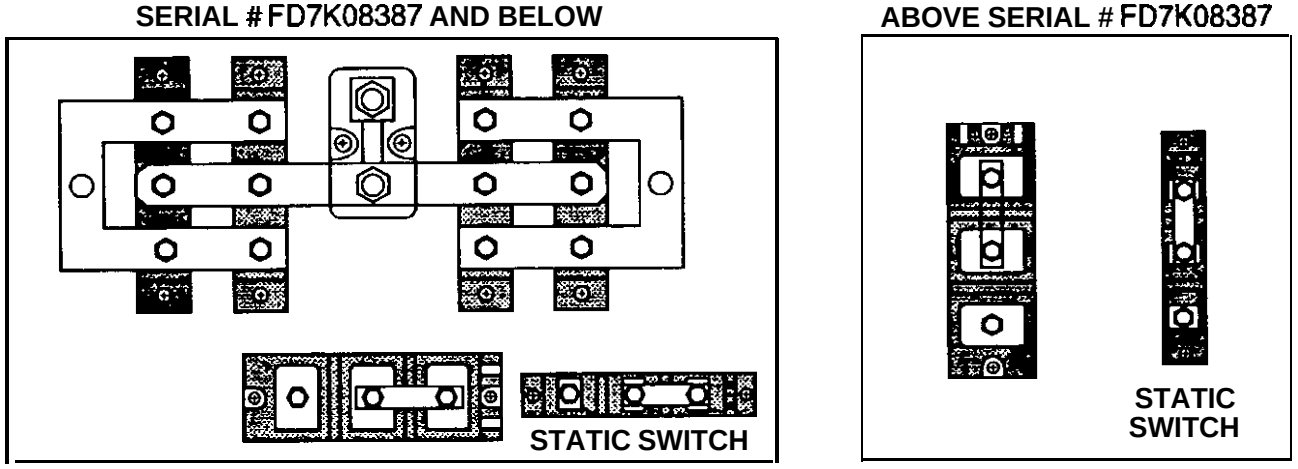


Figure 2

202-2 Locate the static switch driver board. **Note:** Units with serial numbers prior to FD7.0K07371 do not have a static switch driver board. If your unit has a static switch driver board, the board location will depend upon the serial number of **your** unit. Serial numbers after FD7K08387 have the driver board mounted on the left side of the unit next to the **heatsink** on the shelf. For serial numbers from FD7K08388, to FD7.0K07371, it is mounted on a bracket hanging above the heatsink assembly. Remove the static switch driver board and replace it with the one provided.

202-3 Refer to Figure 3. Locate **your backfeed** relay driver **board** mounted behind the **backfeed** relay under the DIN rail. Determine if your board has the jumper labeled J2. If changing to 120 VAC **input,** move the **jumper** to the ≤120V position, If changing to 208 or 240 VAC, move the **Jumper to** the ≥ 200 V position. I

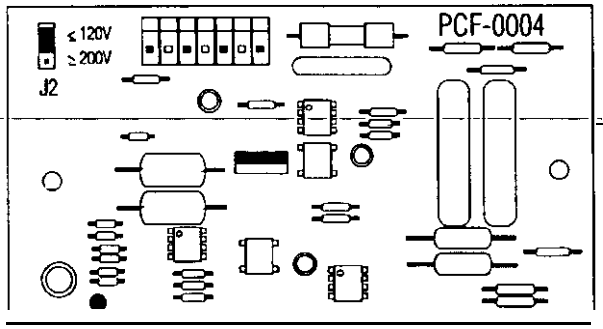


Figure 3

Section 300 Wiring Changes

This section covers the rewiring of the monitor transformer and DIN rail.

Section 301 Wiring Changes 120 to 208 or 240 (FD 7 KVA Only)

301-I Locate the monitor transformer near the DIN rail in the unit. See Figure 4.

301-2 Remove the gray jumper between pins 2 and 5 (2 and 6 Signal Transformer).

301-3 Move the jumper between pins 1 and 3 (1 and 4 Signal Transformer) and connect between pins 2 and 3 (2 and 4 Signal Transformer).

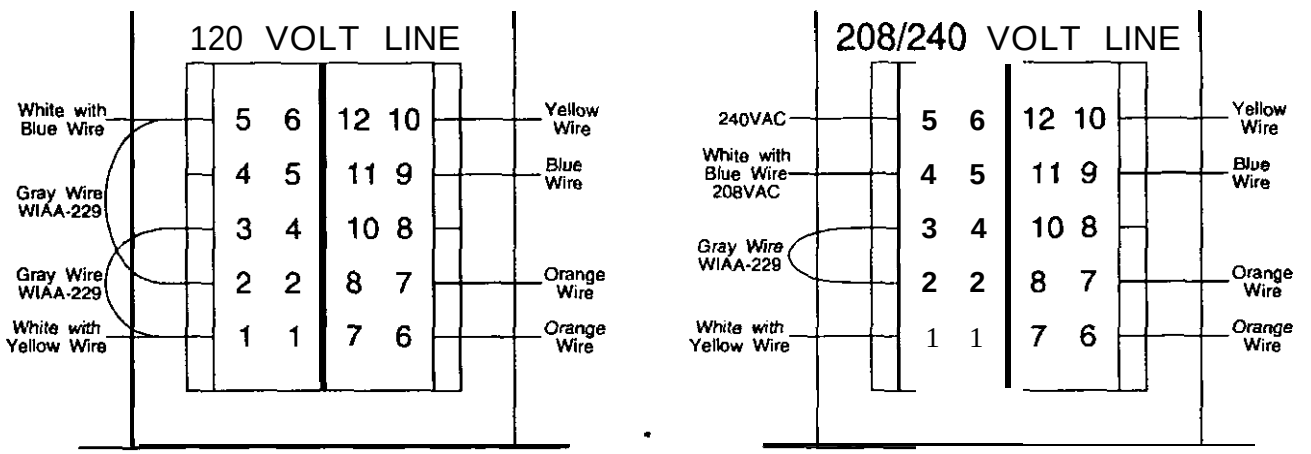
301-4 **240 Volt Input** - Connect the white wire with blue tracer to pin 5 (pin 6 on Signal Transformer).
208 **Volt** Input - Connect the white wire with blue tracer to pin 4 (pin 5 on Signal Transformer).

301-5 Locate the DIN rail. Remove Jumper A (see note) and Jumper B shown in Figure 5-1. Install **Jumper** C between terminal blocks 7 and 8 shown in Figure 5-2 or Figure 5-3.

Note: Starting at serial number FD7K10738, Jumper A *is* replaced by a longer jumper that connects from terminal 4 on the **backfeed** relay to DIN rail block 7.

301-6 **208 Volt Input** - Move the static switch wire labeled HRS-104 (or BAA-0339 with small orange wire) to terminal block #6. See Figure 5-2.
240 Volt Input - Move the static switch wire labeled HRS-104 (or BAA-0339 with small orange wire) to terminal block #5. See Figure 5-3. ,

301-7 Torque the DIN Rail screws to 26 inch lbs. and go to Section 400 Calibration.



Transformers manufactured by Cramer are numbered l-10.
Transformers manufactured by Signal are numbered l-12:

Figure 4

Section 302 Wiring Changes 208 or 240 to 120 (FD 7 KVA Only)

302-1 Locate the monitor transformer near the DIN rail in the unit. See Figure 4.

302-2 Move the jumper between pins 2 and 3 (2 and 4 Signal Transformer) and connect between pins 1 and 3 (1 and 4 Signal Transformer).

302-3 Install a jumper between pins 2 and 5 (2 and 6 Signal Transformer).

302-4 Connect the white wire with blue tracer to pin 5 (pin 6 on Signal Transformer).

302-5 Locate the DIN rail. Make one of the following DIN rail changes

A) If your unit has Jumper C or the bus bar shown in Figure 5-2 or 4-3 remove it. Install Jumper A between terminals blocks 5 and 8 and Jumper B between terminal blocks 7 and 9 shown in Figure 5-1.

B) If your unit has the two transformer leads labeled 7 and 8 terminated in DIN block 7, remove transformer lead 8. Insert transformer lead 8 in DIN rail block 5 along with transformer lead 5. Find the white wire labeled WIA-0866 (provided), and install one end in terminal 4 of the backfeed relay along with transformer lead #9. Place the other end of the white wire in DIN rail block #7 along with transformer lead #7.

302-6 Connect the static switch wire labeled HRS-104 (or BAA-0339 with small orange wire) to terminal block #5 shown in Figure 5-1.

302-7 Torque the DIN rail screws to 26 inch lbs. and go to Section 400 Calibration.

Section 303 Wiring Changes 208 to 240 or 240 to 208

303-1 Locate the monitor transformer near the DIN rail in the unit. See Figure 4.

303-2 240 Volt Input - Connect the white wire with blue tracer to pin 5 (pin 6 on Signal Transformer).
208 Volt Input - Connect the white wire with blue tracer to pin 4 (pin 5 on Signal Transformer).

303-3 FD 7 KVA FERRUPS DIN RAIL
208 Volt Input - Move the static switch wire labeled HRS-104 (or BAA-0339 with small orange wire) to terminal block #6. See Figure 5-2.
240 Volt Input - Move the static switch wire labeled HRS-104 (or BAA-0339 with small orange wire) to terminal block #5. See Figure 5-3.

FD 10, 12.5 and 18 KVA FERRUPS DIN RAIL
DIN rail terminal blocks for AC Input will be rearranged in Figure 5-4 and Figure 5-5 for older FERRUPS; however, the connections are still the same.

208 Volt Input - Move the static switch wire labeled BAA-0191 (or BAA-0403 with small orange wire) to terminal block #6. See Figure 5-4.
240 Volt Input - Move the static switch wire labeled BAA-0191 (or BAA-0403 with small orange wire) to terminal block #5. See Figure 5-5.

303-4 Torque the DIN Rail screws to 26 inch lbs. and go to Section 400 Calibration.

FD 7 KVA DIN Rail Diagrams

Figure 5-l 120 Volt Input FD 7 KVA DIN Rail Diagram

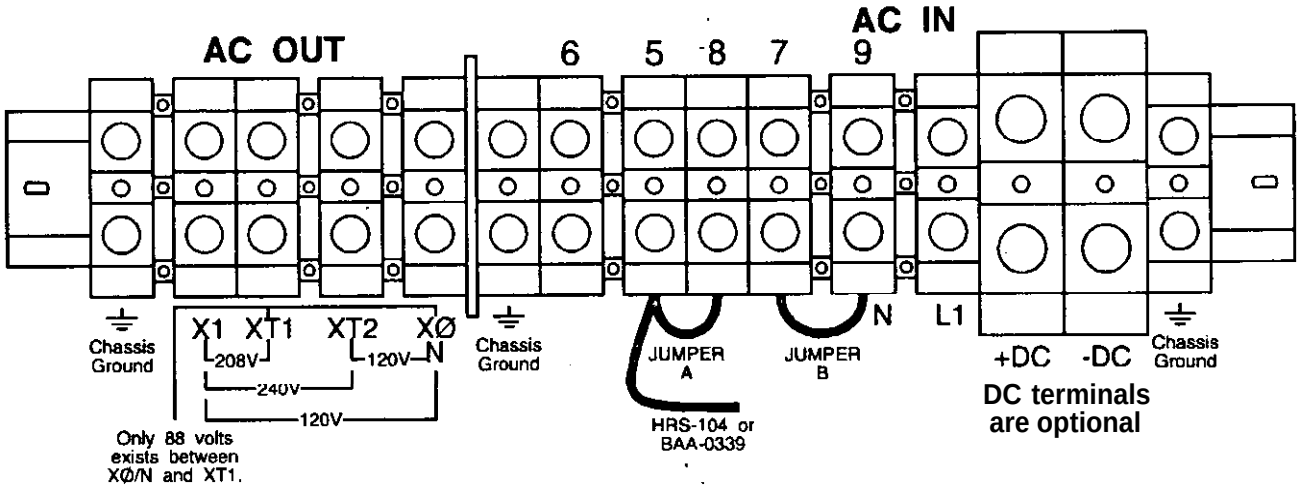


Figure 5-2 208 Volt Input FD 7 KVA DIN Rail Diagram

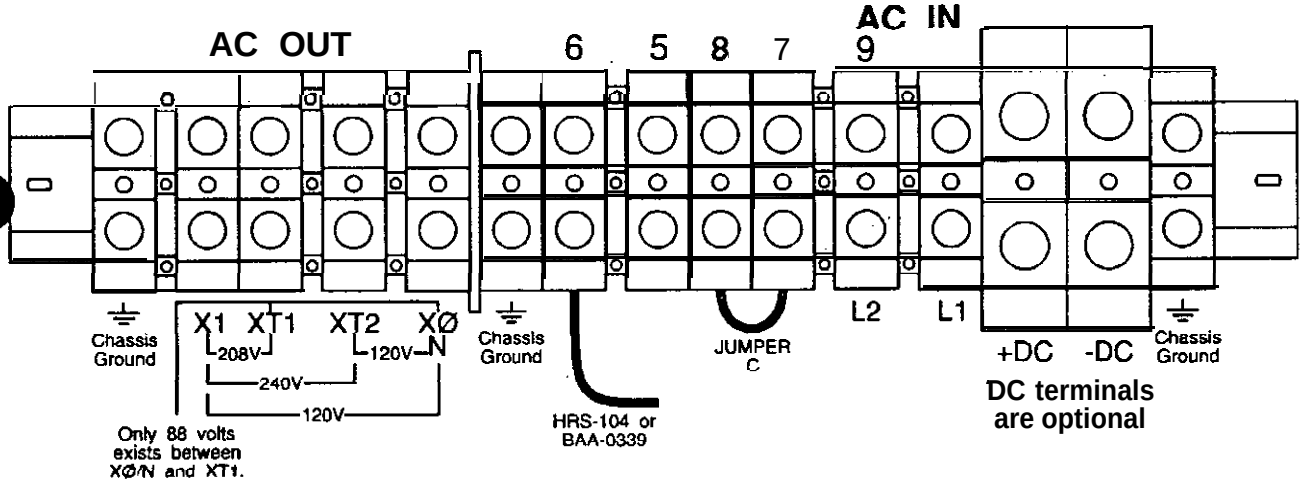
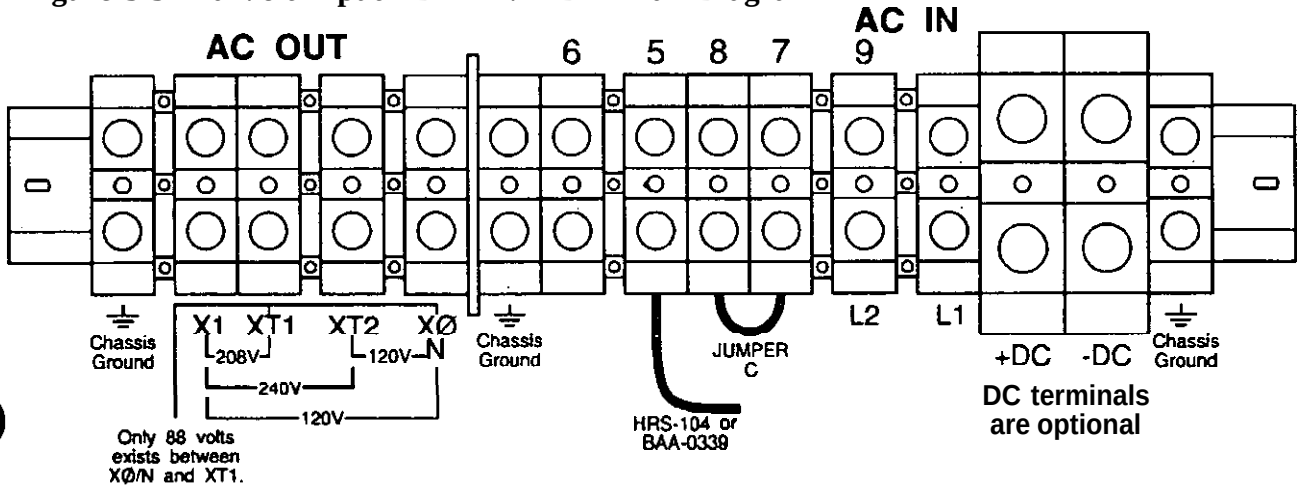


Figure 5-3 240 Volt Input FD 7 KVA DIN Rail Diagram



FD 10, 12.5 and 18 KVA DIN Rail Diagrams

Figure 5-4 208 Volt Input FD 10, 12.5 and 18 KVA DIN Rail Diagram

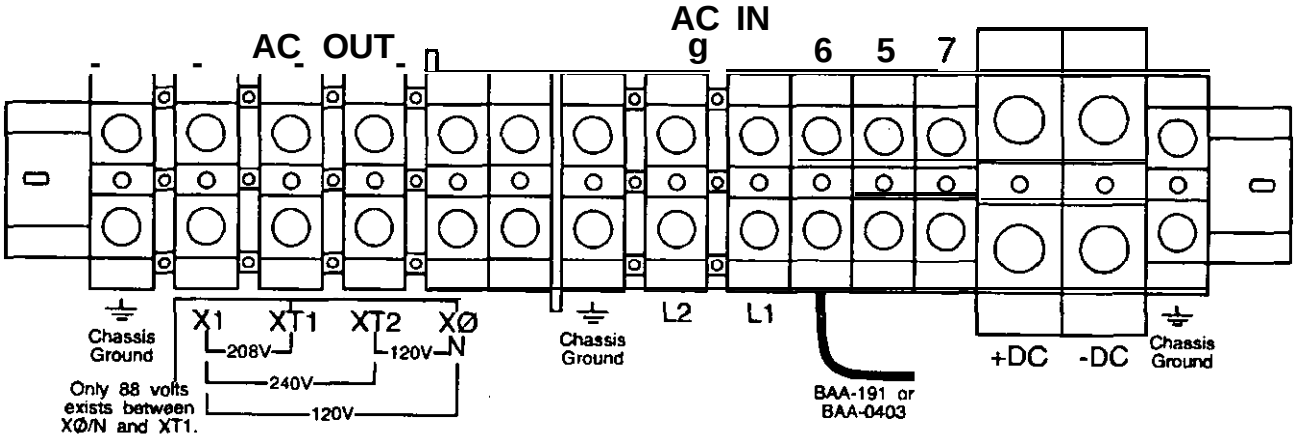
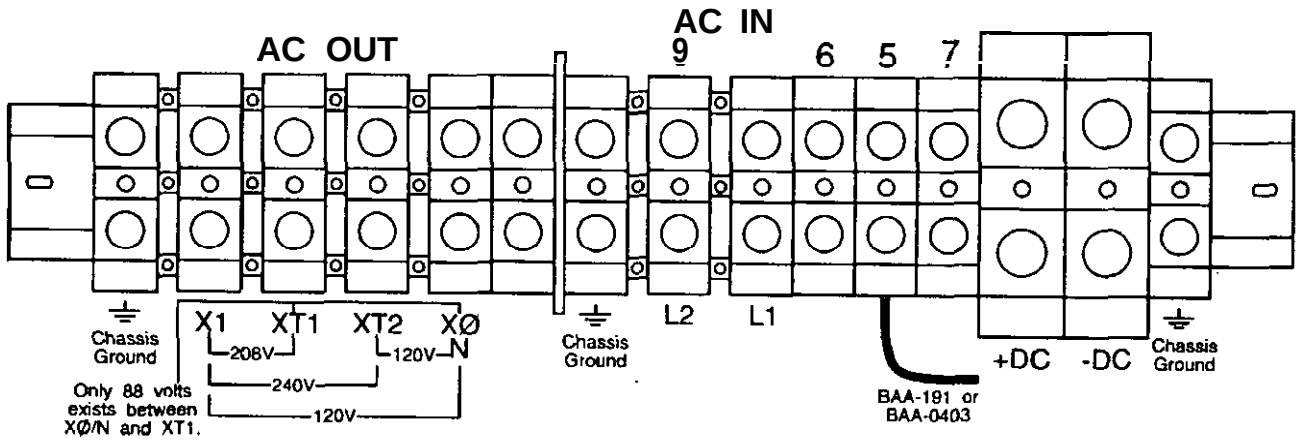


Figure 5-5 240 Volt Input FD 10, 12.5 and 18 KVA DIN Rail Diagram



Section 400 Perform a Software calibration

400-1 Refer to the User's Manual for startup procedure. You must be familiar with the UPS keypad operation to calibrate the software parameters. Enter the Factory password before attempting to change the parameter values. I

400-2 Program the new AC input voltage into parameter #49 (VinNom). I

400-3 Measure the actual input voltage. Program the measured value into parameter #1 (VIn). I

400-4 Subtract 2 volts from the value programmed into parameter 1. Program this reduced value into parameter #61 (V Reftbl).

400-5 Measure the AC amperes in with the ammeter. Program the measured AC amperes value into parameter #3 (I In). I

400-6 Call BEST's Technical Support Center if you have any problems or questions. I

FD and QFD Battery Charger Control

This Technical Information Publication describes how to set the dip switches for charger control. The switches should be set if batteries am added to extended runtime.

A Warning

UPS units are designed to provide power under a variety of operating conditions. Dangerous voltages may be present even if AC line voltage is removed.

UPS batteries are high current sources. Shorting battery terminals can cause severe arcing, equipment damage and injury. A short circuit can cause a battery to explode. Always wear protective clothing and eye protection and use insulated tools when working near batteries.

The tables on page 2 are the recommendations for each charger size and battery string according to the Amp Hour Rating. A battery string is the number of batteries connected in series to equal the correct voltage DC. For example, four 12VDC batteries connected in series is equal to 48VDC in one string.

To use the tables, mad the steps below:

1. Find the correct charger that is being used. (5, 10, or 20 Amp)
2. Look at column 2 for the total Amp/Hour Range of the battery bank or string.
3. The next four columns will tell you what dip switches need to be on or off. These four dip switches are located on the Power Board.

BEST does not recommend a charger with a string of batteries that is not listed in the tables. For example; any string above 400 Amp/Hours is not recommended for a 5 Amp Charger.

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5 AMP CHARGER					
Battery Size (Amp/Hour)	Amp/Hour Range	Switch 1 On/Off	Switch 2 On/Off	Switch 3 On/Off	Switch 4 On/Off
24	20-30	On	On	On	On
31	30-50	On	On	On	Off
55	50-75	On	On	Off	On
80	75-100	On	Off	Off	On
100	100-150	Off	Off	Off	On
150	150-200	On	On	Off	Off
200	200-300	off	On	off	off
300	300-400	off	off	Off	off

10 AMP CHARGER					
Battery Size (Amp/Hour)	Amp/Hour Range	Switch 1 On/Off	Switch 2 On/Off	Switch 3 On/Off	Switch 4 On/Off
55	50-75	Off	Off	Off	On
80	75-100	On	On	On	Off
100	100-150	On	Off	On	Off
150	150-200	Off	Off	On	Off
200	200-300	On	On	Off	Off
300	300-400	On	Off	Off	Off
400	400-500	Off	Off	Off	Off

20 AMP CHARGER					
Battery Size (Amp/Hour)	Amp/Hour Range	Switch 1 On/Off	Switch 2 On/Off	Switch 3 On/Off	Switch 4 On/Off
80	75-100	On	On	On	On
100	100-150	Off	Off	On	On
150	150-200	Off	Off	Off	On
200	200-300	On	On	On	Off
300	300-400	On	Off	On	Off
400	400-600	Off	Off	On	Off
600	600-800	Off	On	Off	Off
800	800-1000	On	Off	Off	Off

(Q)TIP611
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February 20, 1991

Changing AC Input Voltages in FERRUPS®
Models QFD 10, 12.5 & 18 KVA

This Technical Information Publication describes how to change the AC input operating voltage on QFD10, 12.5, and 18KVA models.

Tools Needed:

Standard screwdriver True RMS AC Voltmeter True RMS AC Amp meter

!!! ---------- **Warning** ---------- !!!

UPS units are designed to provide power under a variety of operating conditions. Dangerous voltages may be present, even, if input AC line voltage IS removed. AC and DC voltages are present at the DIN rail terminals.

UPS batteries are high current sources. Shorting battery terminals or DC DIN rail terminals can cause severe arcing, equipment damage and injury. A short circuit can cause a battery to explode. Always wear protective clothing and eye protection and use insulated tools when working near batteries.

Make certain the UPS will comply with all applicable electric codes when the voltage change has been completed.

100: There are two procedures that must be completed to change the AC input voltage.

A. Change DIN rail connections.

B. Perform a software calibration.

NOTE: For 50 Hz applications, the monitor transformer does not change.

Complete only the Sections indicated in Table 200 on the following page.

RESTRICTED

P.O. Box 280 • Necedah, Wisconsin 54646 U.S.A.. 608-565-7200
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FAX: 608-565-2221 • Service FAX: 608-565-2509

Best Power

Section 200 For 220,230 or 240 VAC voltage change.

Converting from:	To:	Move BAA-l 91 from --- to		Go to Section #
220 VAC	230 VAC	#7	#6	300
220 VAC	240 VAC	#7	#5	300
230 VAC	240 VAC	#6	#5	300
230 VAC	220 VAC	#6	#7	300
240 VAC	220 VAC	#5	#7	300
240 VAC	230 VAC	#5	#6	300

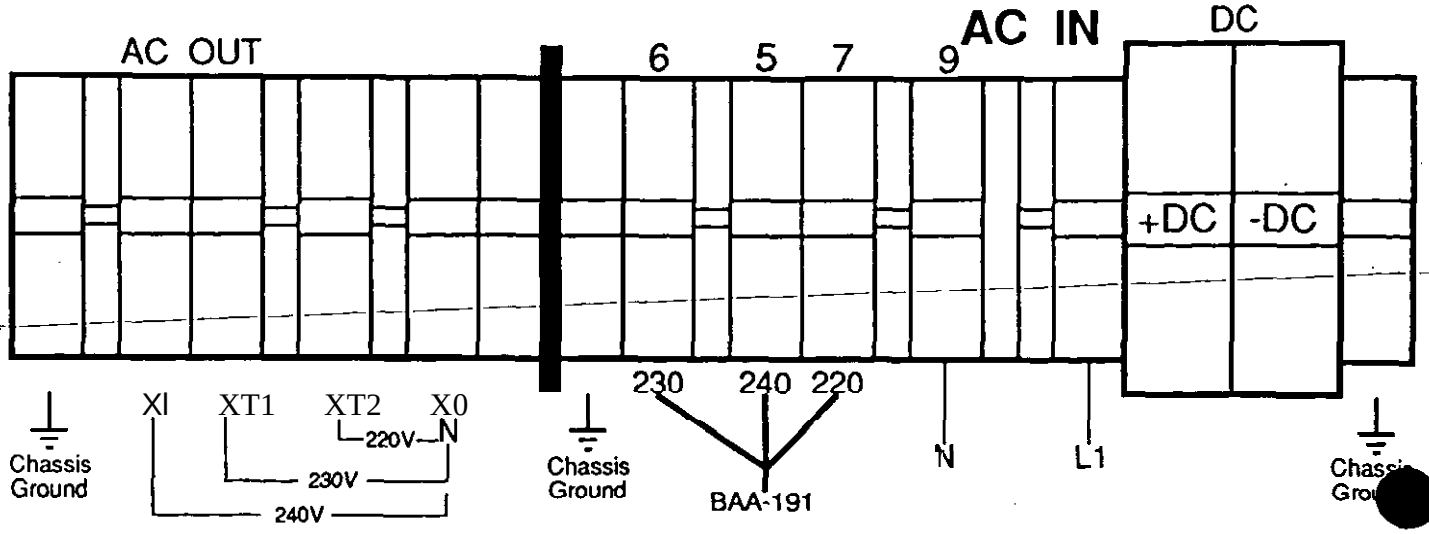
Table 200

If the FERRUPS is in operation, follow the TURNOFF and SHUTDOWN procedure in the User's Manual.

201 DIN rail change

201-l Find the DIN rail at the back of the UPS.
201-2 Move BAA-191 as indicated in Table 200.
201-3 Refer to Figure 201-l for QFD 10, 12.5, & 18 KVA

Figure 201-l for **QFD10,** 12.5, **& 18KVA** UPS DIN RAILS - 220,230, & 240 VAC



Section 300 Perform a Software calibration.

301 Refer to User's Manual for startup procedure. You must be familiar with the UPS keypad operation to calibrate the software parameters. Enter the Factory password before attempting to change the parameter values.

301-1 Program the new AC input voltage into parameter #49 (VinNom).

301-2 Measure the actual input voltage and program the measured value into parameter #1 (V In).

301-3 Subtract 2 volts from the value programmed into parameter 1. Program this reduced value into parameter #61 (V Reftbl).

301-4 Measure the AC amperes in with the amp meter. Program the measured AC amperes value into parameter #3 (I In).

301-5 Call the Service Department if you have any problems or questions.

Pictorial Layouts and System Schematics

800 Module Pictorials

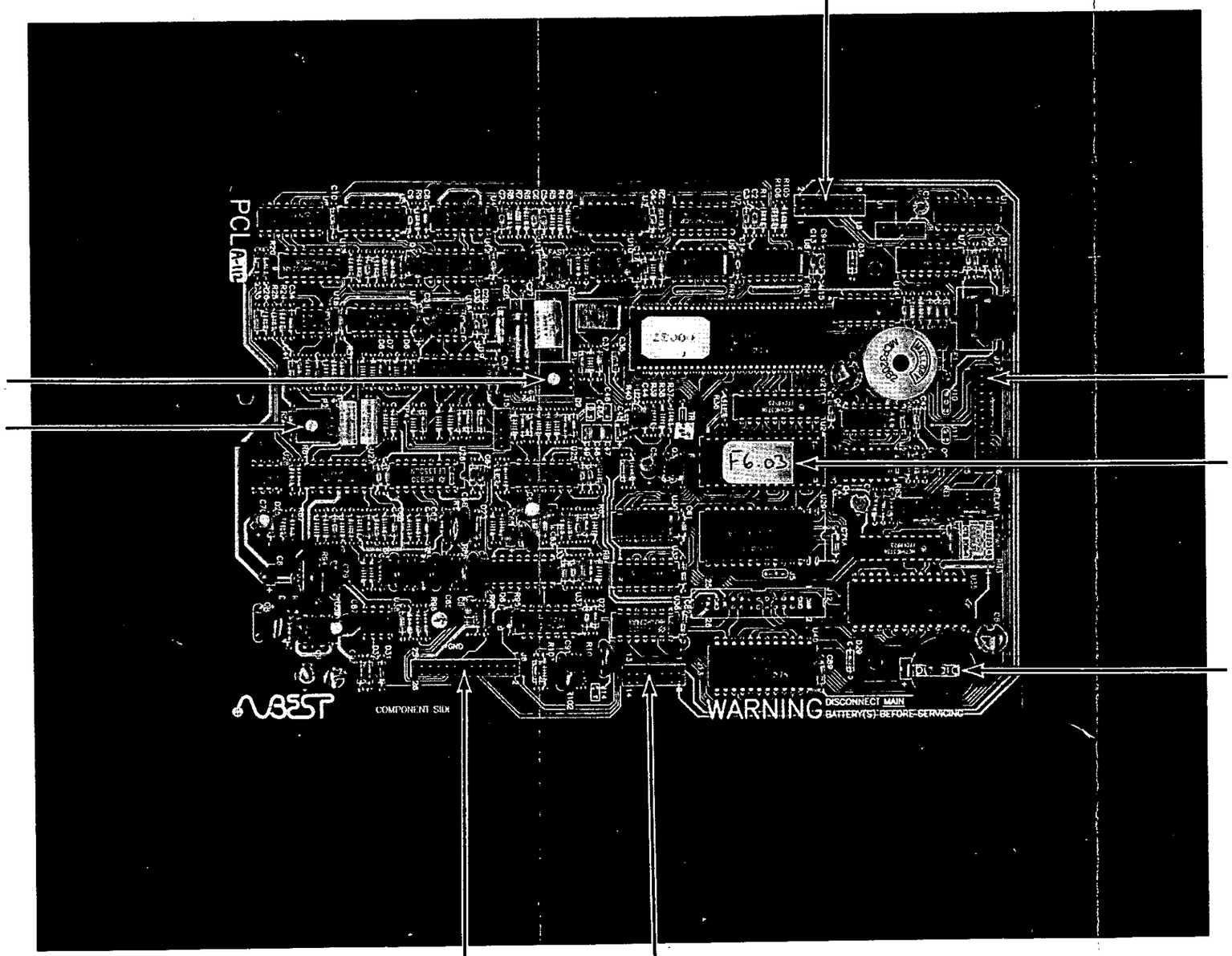
800-l	Logic Board
800-2	Power Board
800-3	IEEE-587
800-4	10 KVA Heatsink
800-5	12.5 KVA Heatsink
800-6	18 KVA Heatsink

801 Unit Pictorials

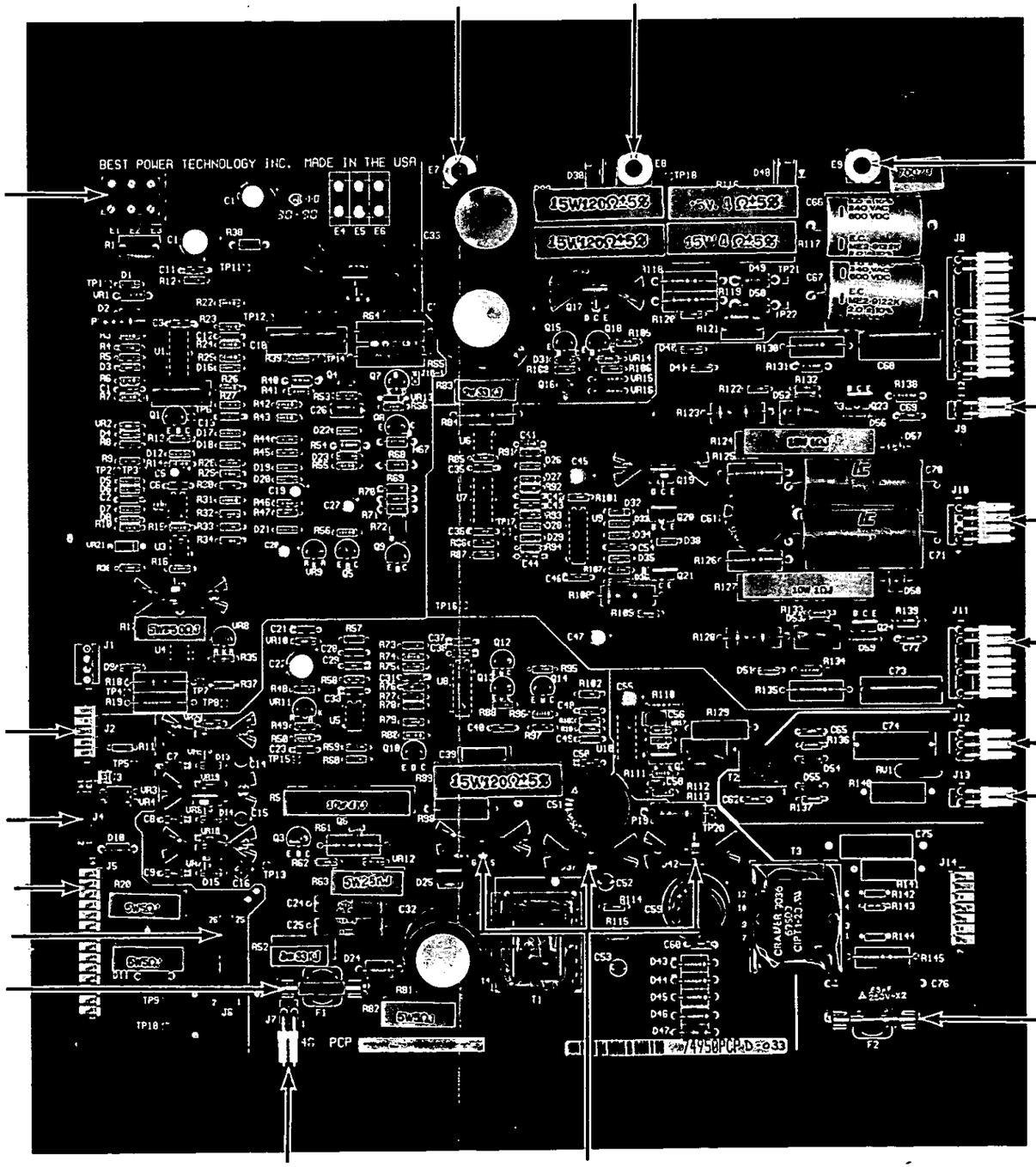
801-l	10 - 18 KVA Top View
801-2	10 - 18 KVA Left Side
801-3	10 - 18 KVA Right Side
801-4	Battery Cabinet Left Side
801-5	Battery Cabinet Right Side

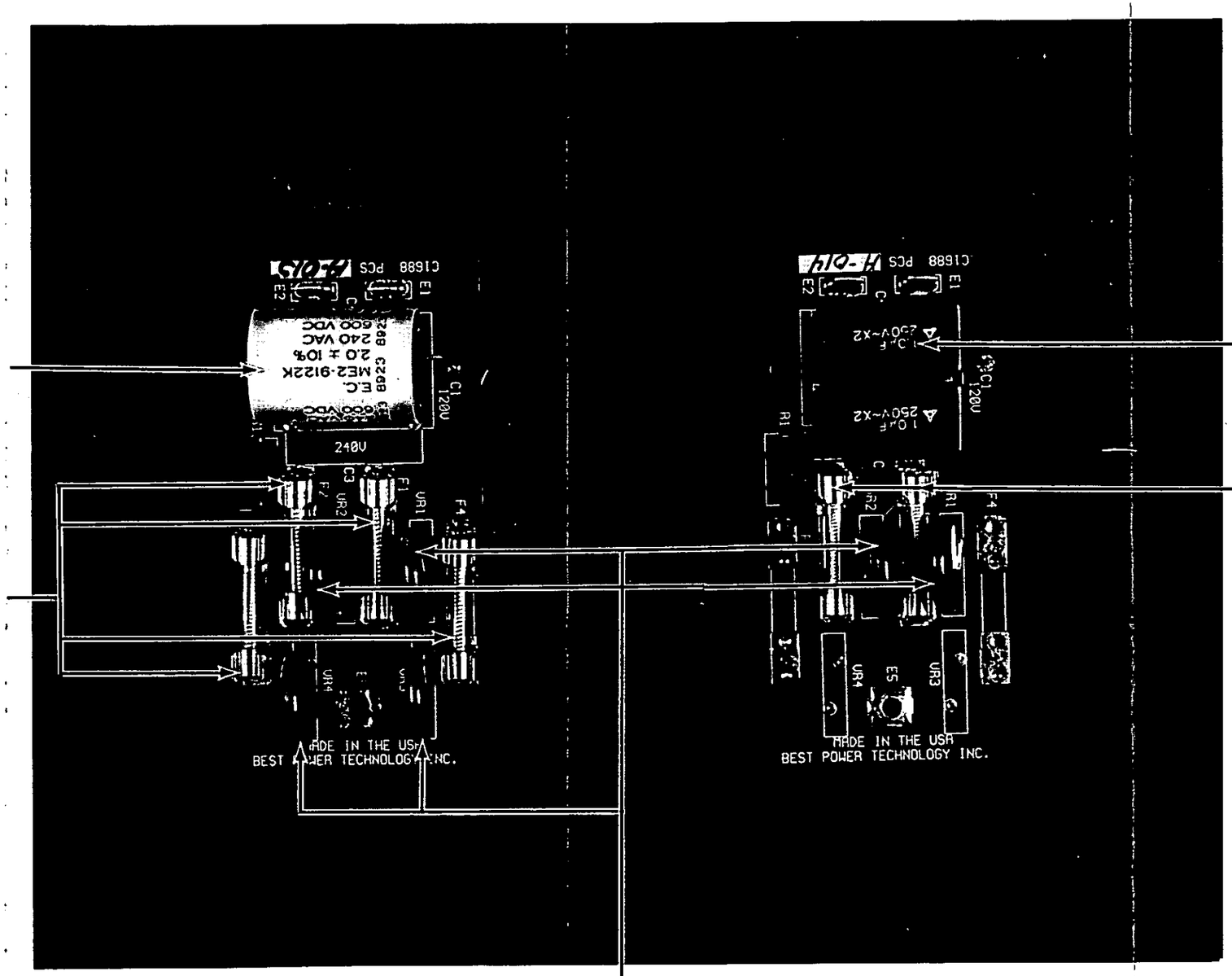
802 Schematics

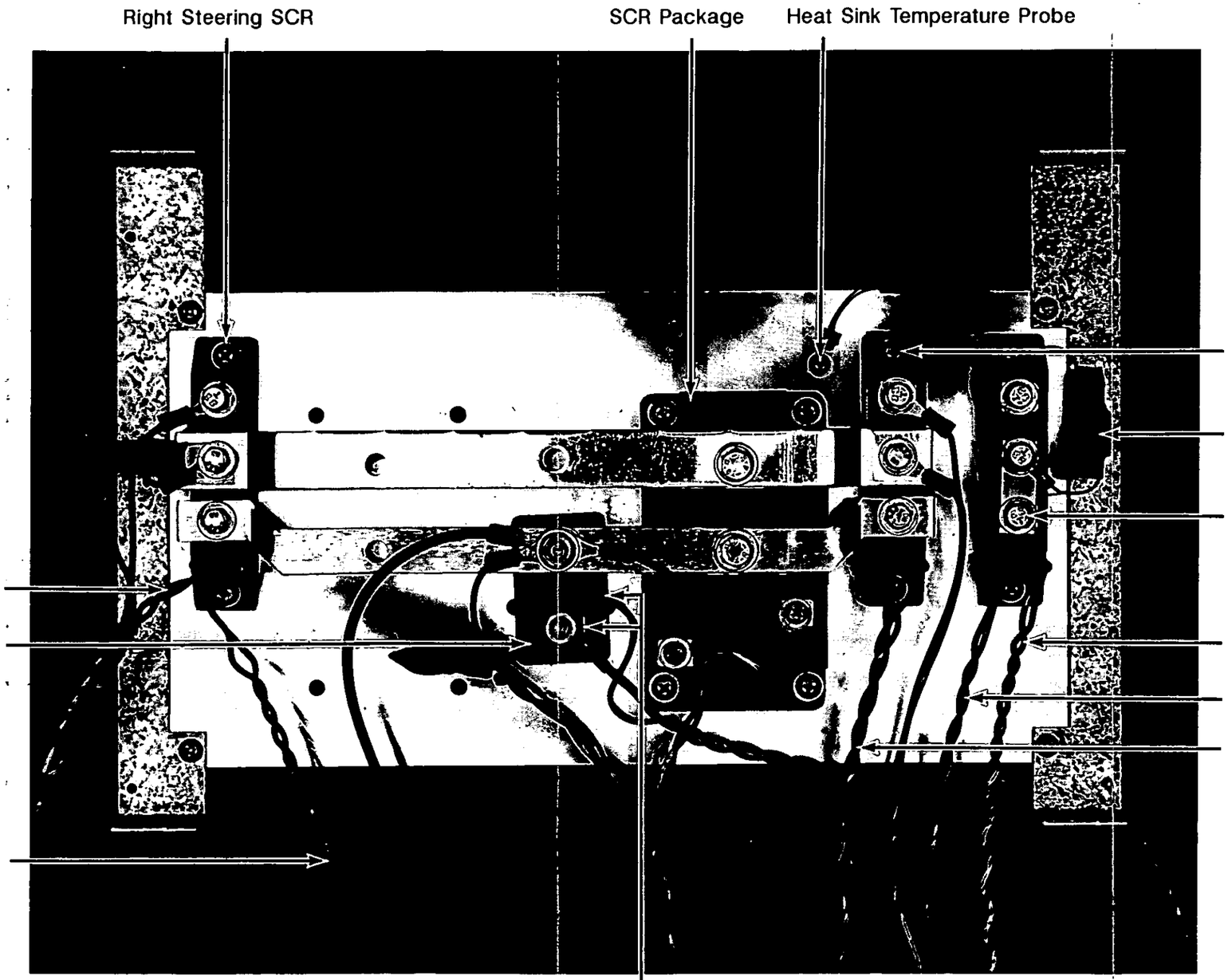
802-l	10 - 18 KVA System Schematics Page 1 of 3
802-2	10 - 18 KVA System Schematics Page 2 of 3
802-3	10 - 18 KVA System Schematics Page 3 of 3



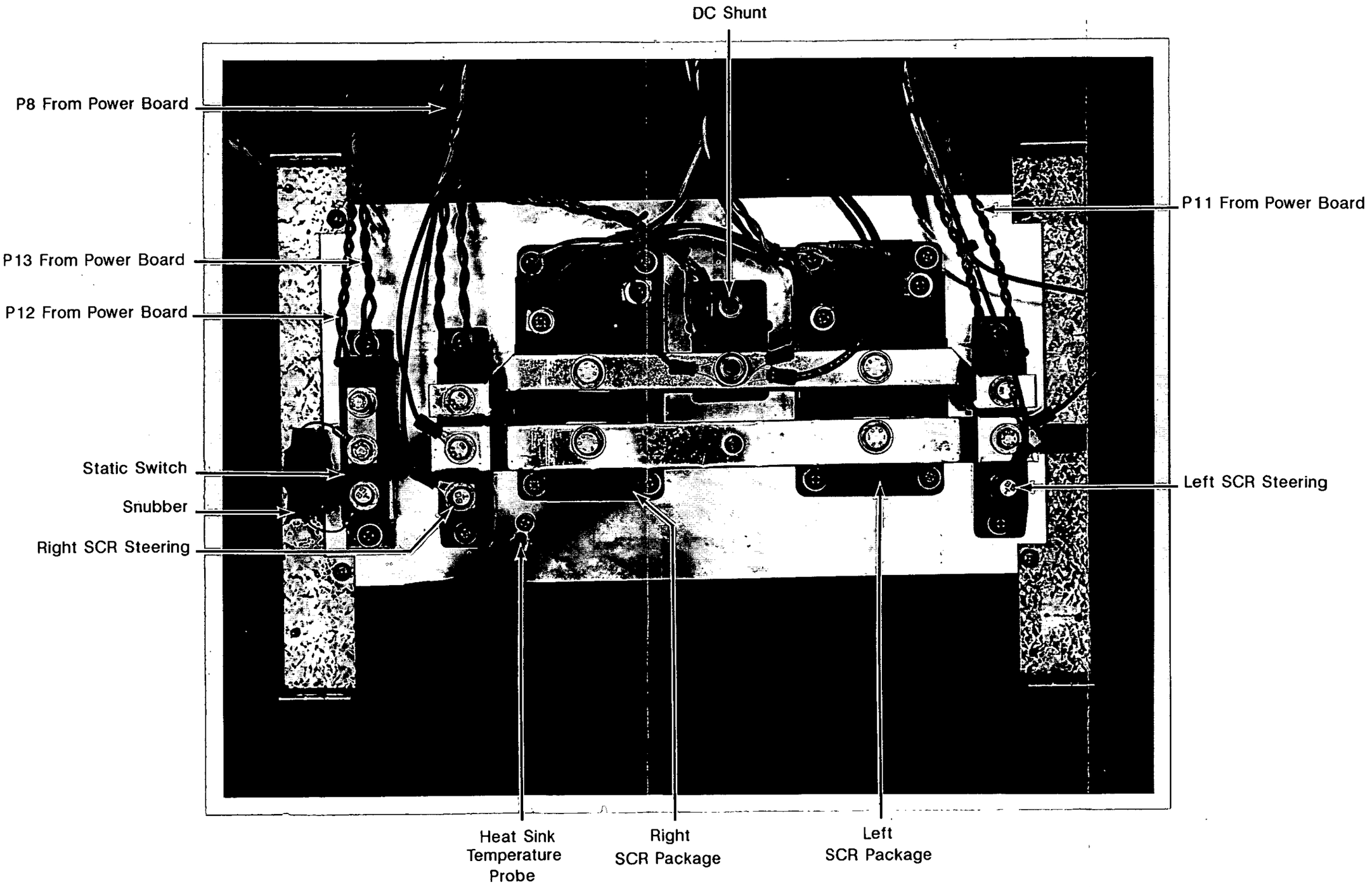
800-1 Logic Board


Positive Battery (E7)
Positive Lead From Right SCR
Negative Battery (E9)
Leads To AC To DC Rectifier
SCR Leads To Heat Sink Assembly (J8)
Right SCR Lead To Heat Sink Assembly (J9)
Logic Ground (J10)
Left SCR Gate Leads To Heat Sink Assembly (J11)
OEM Option
SCR Gate 1 To Static Switch (J12)
SCR Gate 2 To Static Switch (J13)
Ribbon Cable To Logic Board (J4)
Monitoring Wires (J5)
Ribbon Cable To Logic Board (J6)
AC Output Monitor Fuse 250 Volt 5 Amp (F1)
DC Protection Fuse (250 Volt 1.5 Amp (F2)
Positive DC Connector (J7)
Voltage Regulators

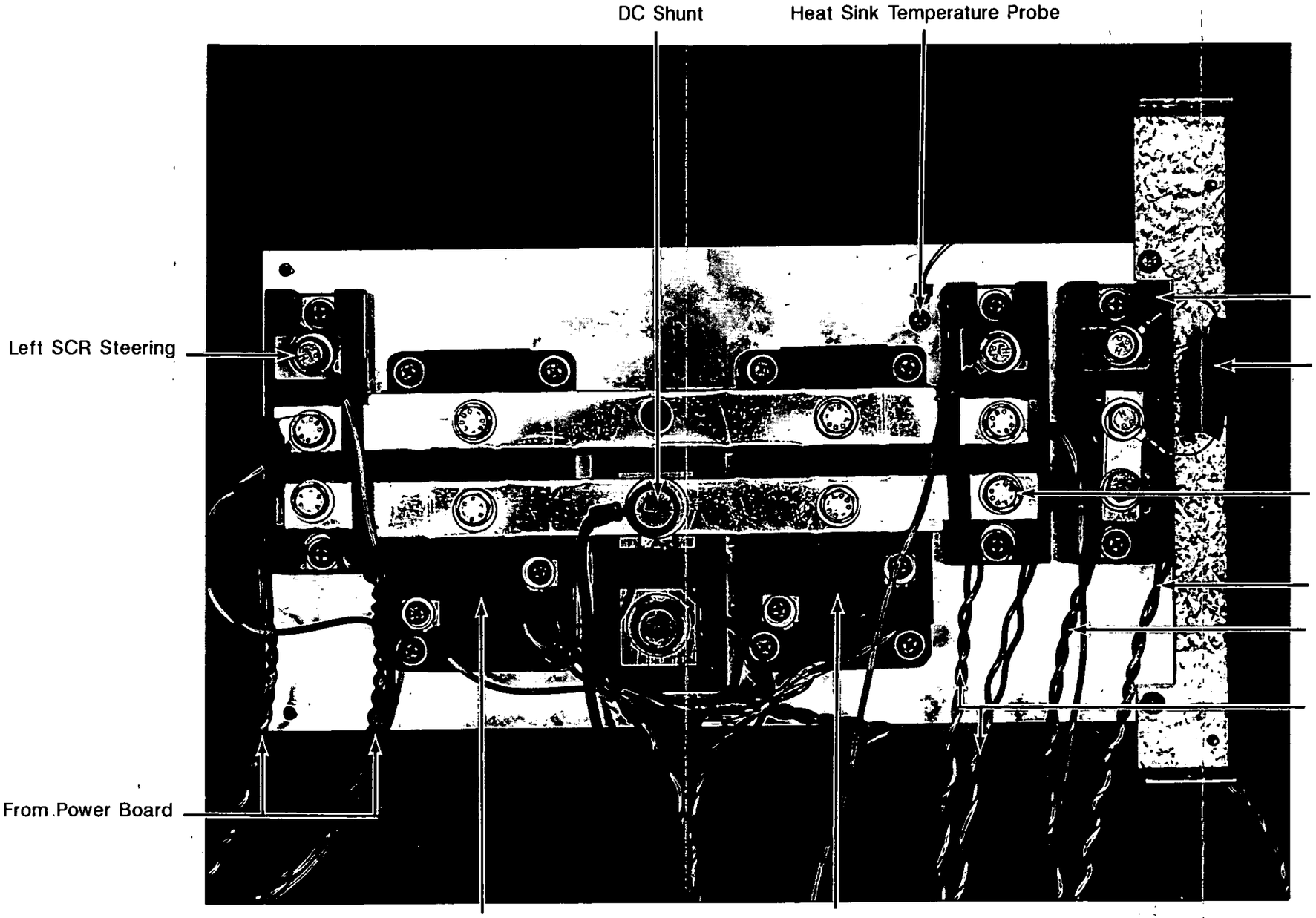

AC Input Suppressor Cap
Despiker Fuse (5 Amp 250 Volt)
AC Input Suppressor Cap
Despiker Fuses (5 Amp 250 Volt)
MOV's (Metal Oxide Varistor)
MADE IN THE USA
BEST POWER TECHNOLOGY INC.
MADE IN THE USA
BEST POWER TECHNOLOGY INC.



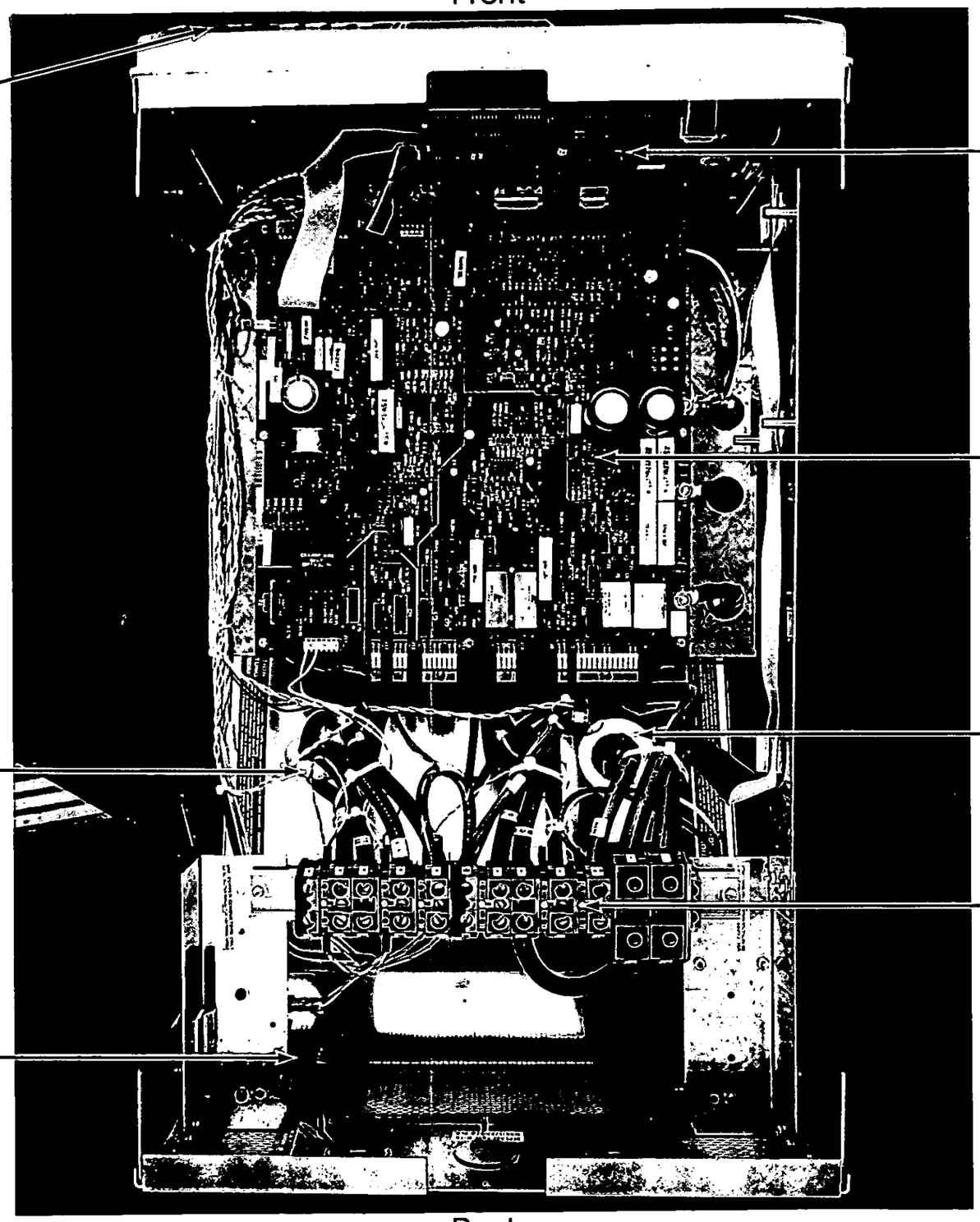
800-4 10KVA Heat Sink Assembly



800-5 12.5KVA Heatsink Assembly


DC Shunt
Heat Sink Temperature Probe
Left SCR Steering
Static Switch
Snubber
Right SCR Steering
P12 From Power Board
P13 From Power Board
P8 From Power Board
P11 From Power Board
Left SCR Package
Right SCR Package

Front



Hand-held Remote Control Panel

Logic Board

Power Board

AC Input Current Torroid

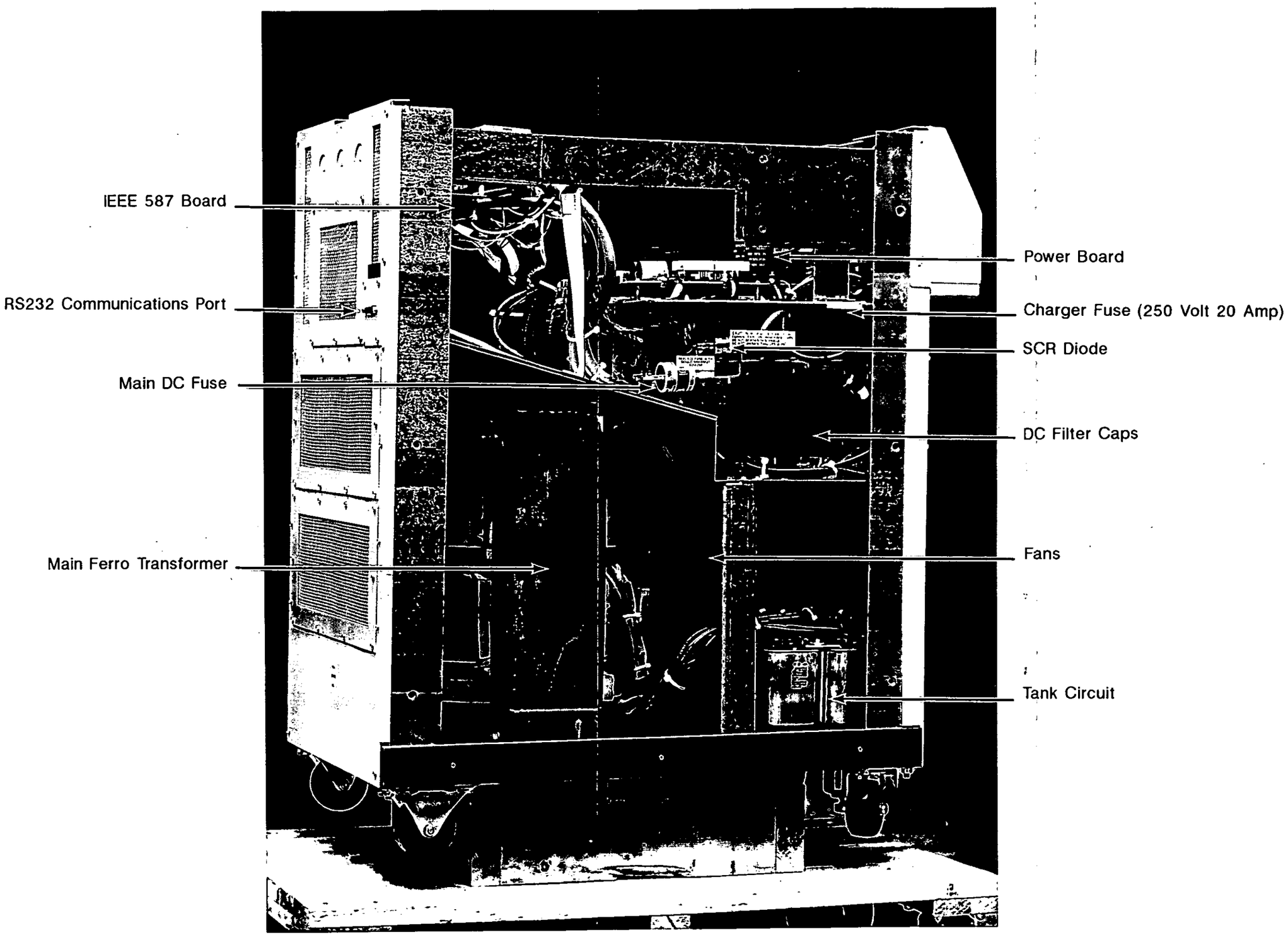
AC Output Current Torroid

DIN Rail

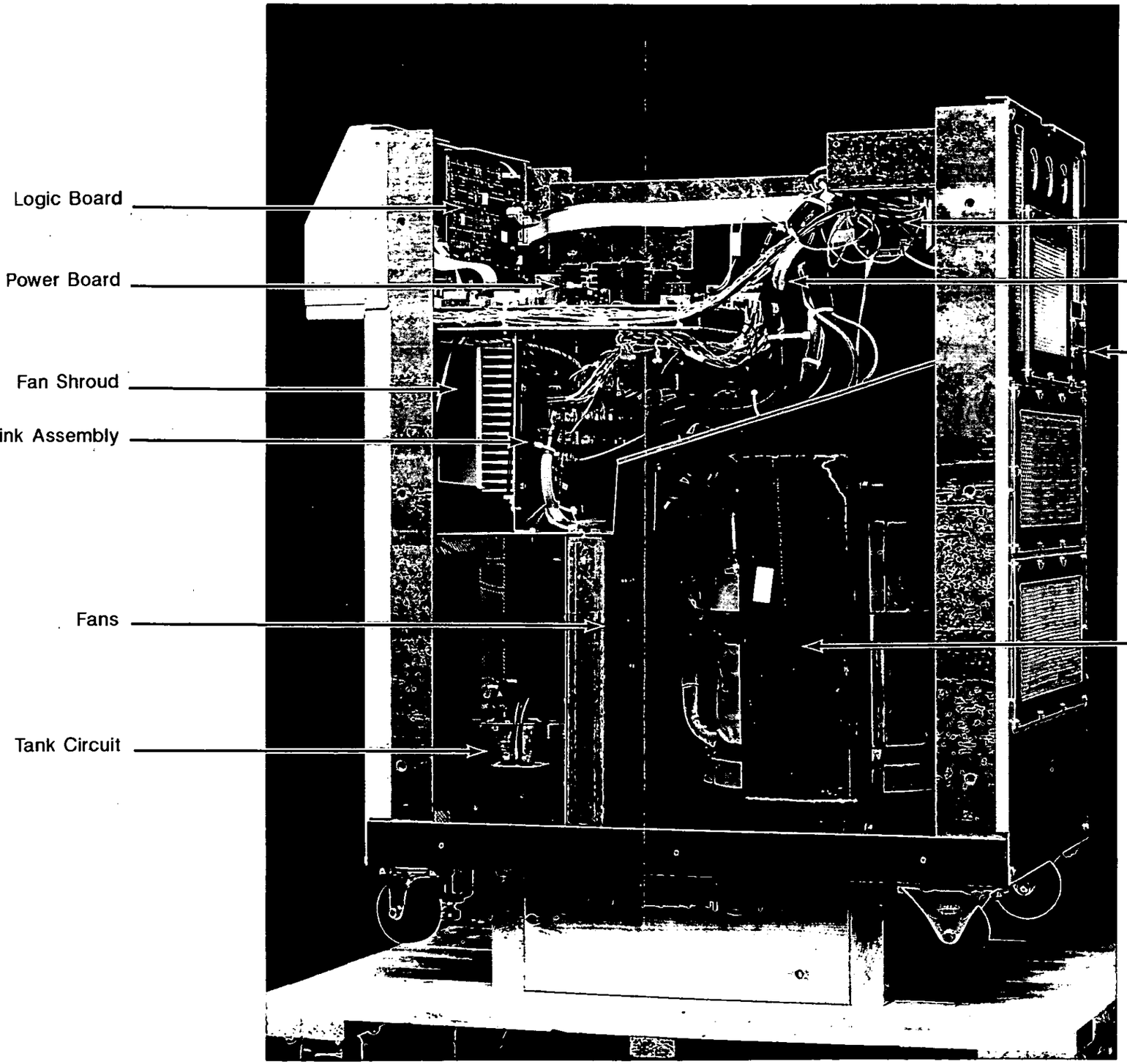
AC Input Monitor Transformer

Back

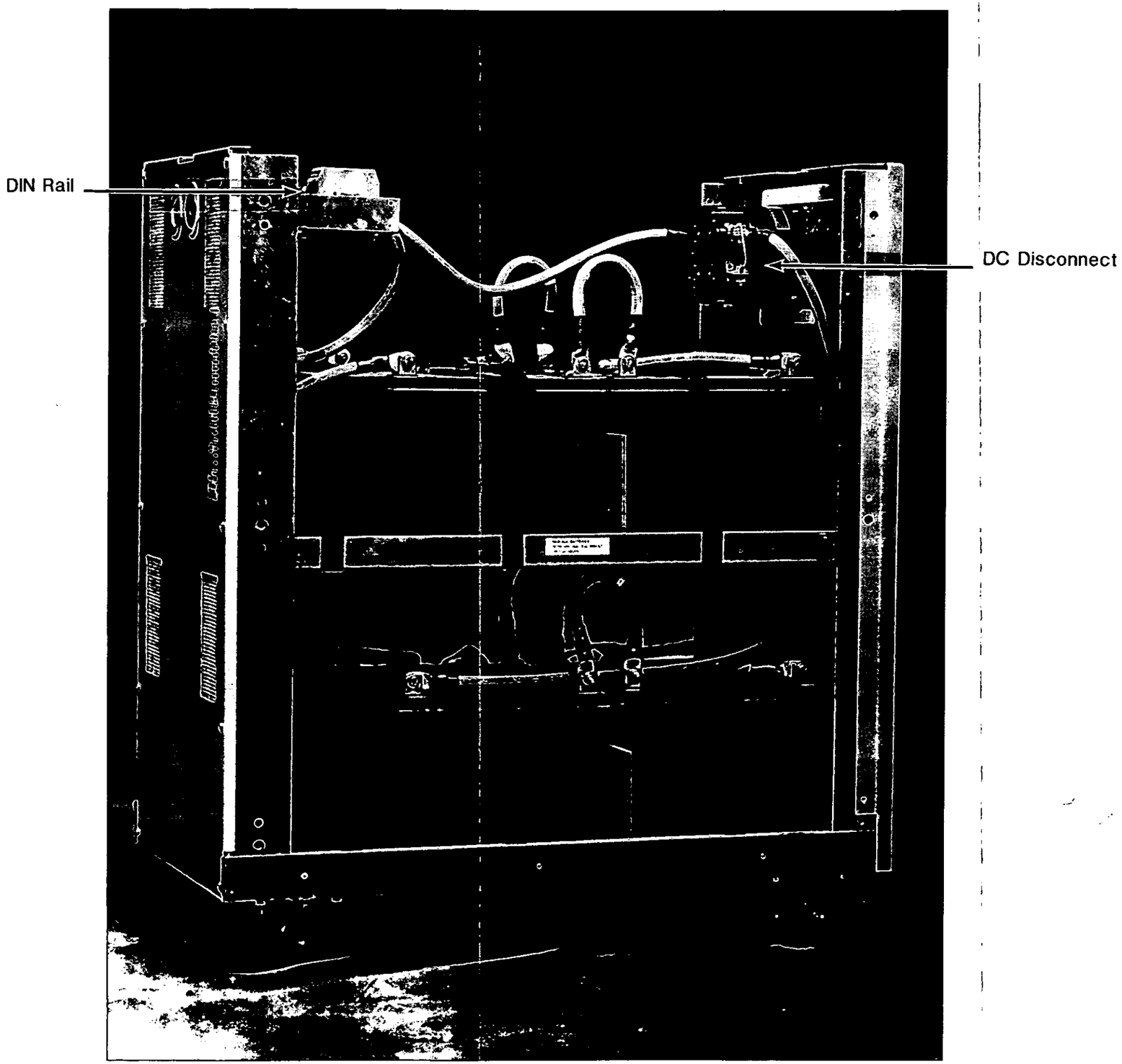
801-1 10-18KVA Top View



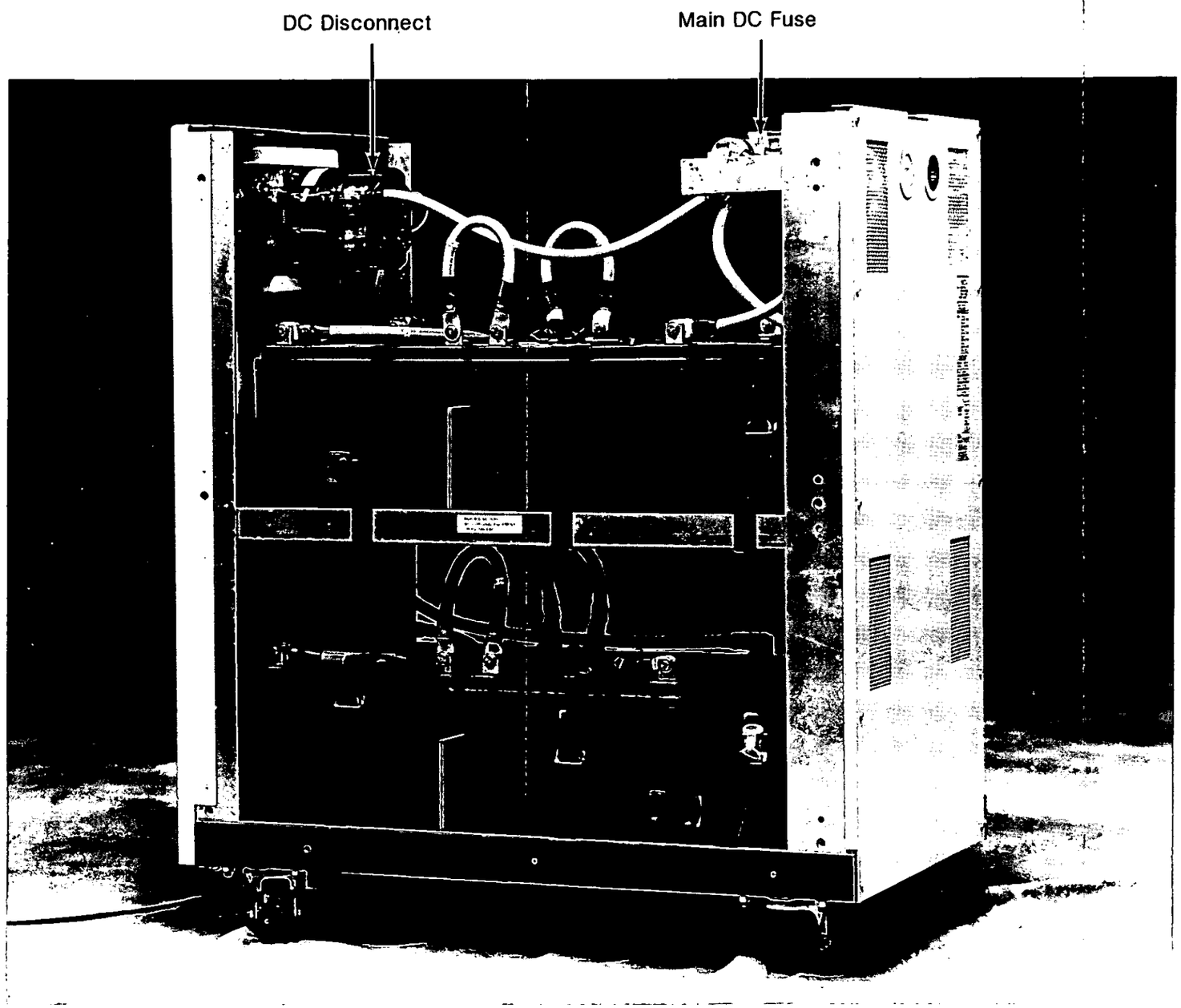
801-2 10-18KVA Left Side View



801-3 10-18KVA Right Side View



801-4 Battery Cabinet Left Side



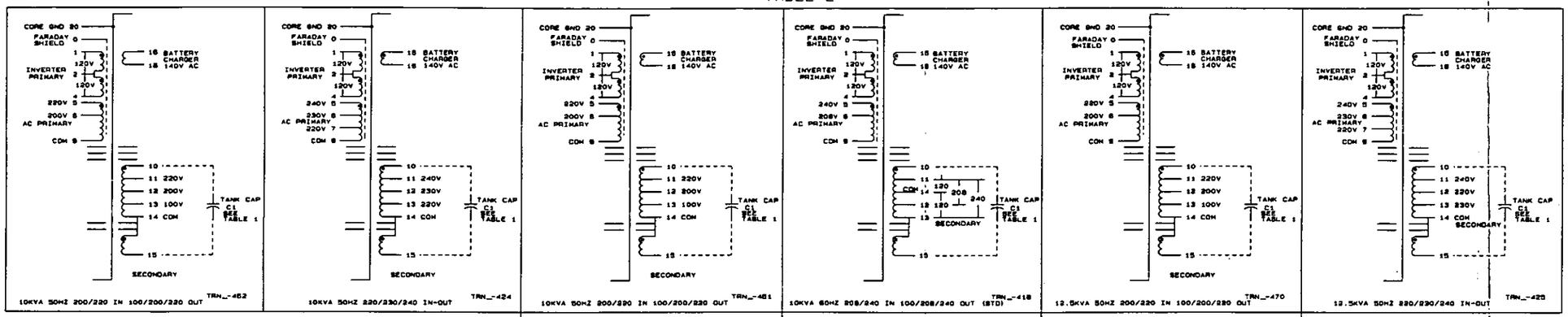
801-5 Battery Cabinet Right View

REV	DATE	DESCRIPTION
A	3/05/90	CLASS A RELEASE
B	6/28/90	ECN# 935
C	7/26/90	ECN# 947
D	9/11/90	ECN# 981 AND 985
E	12/6/90	CHANGE PER ECN# 1057
F	1/23/91	CHANGE PER ECN# 1080
G	3/29/91	CHANGE PER ECN# 1215

TABLE 1

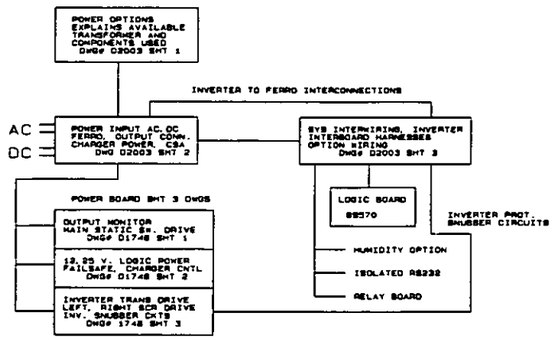
UNIT	VOLTAGE	FREQ	T1 TRANSFORMER	C1 TANK CAPS						LOGIC BOARD	HEATSINK ASSY P	CSA OPTION	AS400 OPTION
				VALUE	PART #	QTY	VALUE	PART #	QTY				
10KVA	200/220 IN 100/200/220 OUT	50Hz	TRN_-452	30uF	CPR_-144	7	N/A	N/A	N/A	PCL_-113	H5AA-015	STANDARD	STANDARD
	220/230/240	50Hz	TRN_-424	30uF	CPR_-144	7	N/A	N/A	N/A	PCL_-113	H5AA-015	STANDARD	STANDARD
	200/220 IN 100/200/220 OUT	60Hz	TRN_-461	30uF	CPR_-144	5	20uF	CPR_-256	1	PCL_-112	H5AA-015	OPTIONAL	OPTIONAL
	208/240 IN 100/208/240 OUT	60Hz	TRN_-418	30uF	CPR_-144	5	N/A	N/A	N/A	PCL_-112	H5AA-015	OPTIONAL	OPTIONAL
12.5KVA	200/220 IN 100/200/220 OUT	50Hz	TRN_-470	30uF	CPR_-144	9	20uF	CPR_-256	1	PCL_-113	H5AA-017	STANDARD	STANDARD
	220/230/240	50Hz	TRN_-425	30uF	CPR_-144	9	20uF	CPR_-256	1	PCL_-113	H5AA-017	STANDARD	STANDARD
	200/220 IN 100/200/220 OUT	60Hz	TRN_-469	30uF	CPR_-144	8	N/A	N/A	N/A	PCL_-112	H5AA-017	OPTIONAL	OPTIONAL
	208/240 IN 100/208/240 OUT	60Hz	TRN_-419	30uF	CPR_-144	8	N/A	N/A	N/A	PCL_-112	H5AA-017	OPTIONAL	OPTIONAL
18KVA	200/220 IN 100/200/220 OUT	50Hz	TRN_-463	30uF	CPR_-144	14	N/A	N/A	N/A	PCL_-113	H5AA-018	STANDARD	STANDARD
	220/230/240	50Hz	TRN_-426	30uF	CPR_-144	13	10uF	CPR_-114	1	PCL_-113	H5AA-018	STANDARD	STANDARD
	200/220 IN 100/200/220 OUT	60Hz	TRN_-464	20uF	CPR_-144	11	N/A	N/A	N/A	PCL_-112	H5AA-018	OPTIONAL	OPTIONAL
	208/240 IN 100/208/240 OUT	60Hz	TRN_-408	30uF	CPR_-144	11	N/A	N/A	N/A	PCL_-112	H5AA-018	OPTIONAL	OPTIONAL

TABLE 2



NOTES: UNLESS OTHERWISE SPECIFIED
1. SYMBOL FOR DIN RAIL CONNECTOR [ ], GND ▽, LOGIC GND. ▼.
2. ALL WIRES ARE 18 AWG.
3. THIS SYMBOL EXAMPLE: (101) IS USED TO RELAY INFORMATION FROM SHEET TO SHEET.

SCHEMATIC BLOCK FLOW DIAGRAM



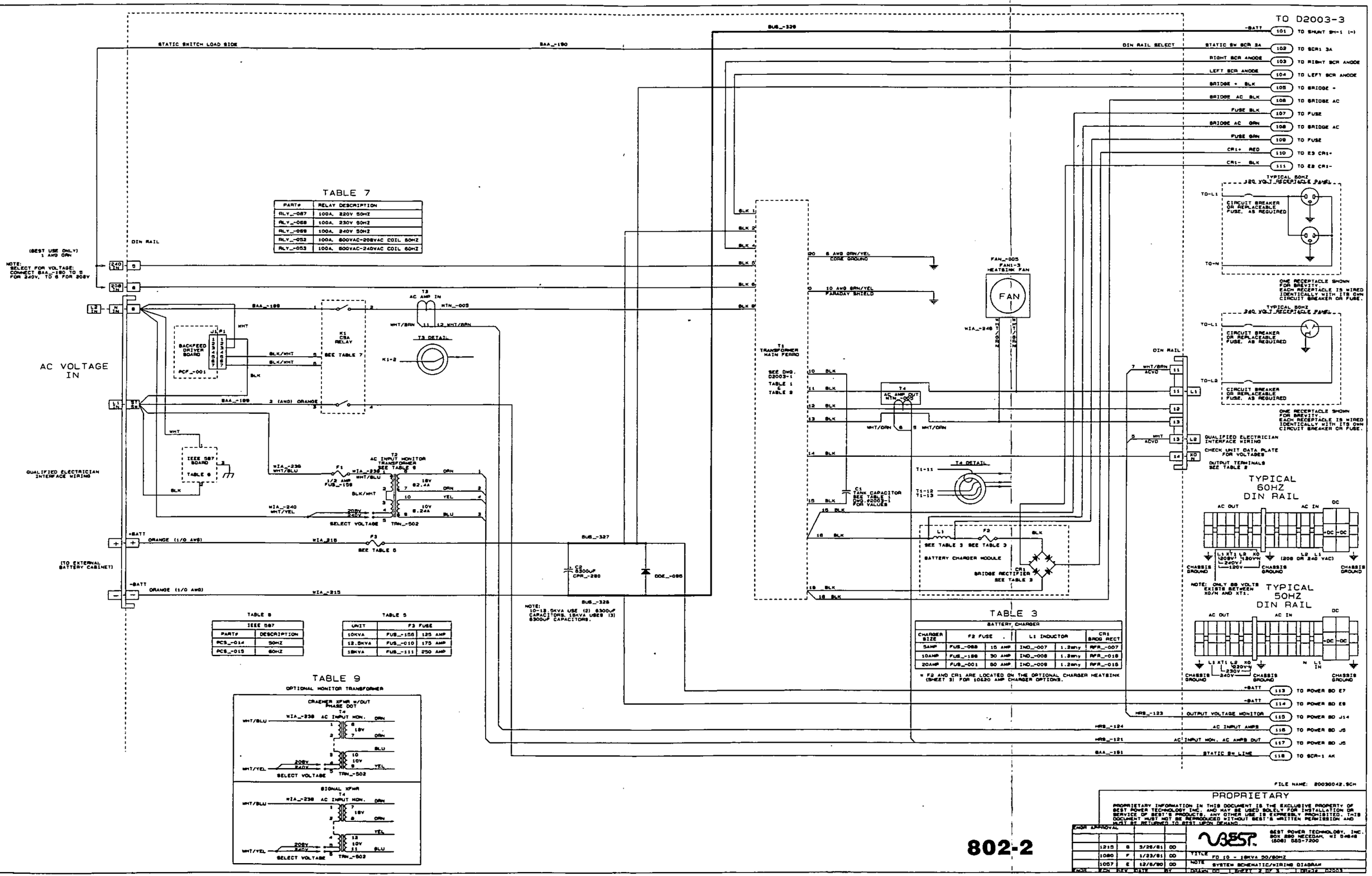
802-1

FILE NAME: 20030041.SCH

ENGR APPROVAL				
	1215	G	3/29/91	DD
	1080	F	1/23/91	DD
	1057	E	12/6/90	DD
ENGR	ECN	REV	DATE	BY

BEST POWER TECHNOLOGY, INC.
BOX 280 NECEDAH, WI 54646
(608) 565-7200

TITLE: PD 10 - 18KVA 50/60HZ
NOTE: SYSTEM SCHEMATIC/WIRING DIAGRAM
DRAWN BY _ SHEET 1 OF 3 _ DRAWING D2003


TO D2003-3
STATIC SWITCH LOAD SIDE
BAA_-190
BUS_-339
DIN RAIL SELECT
-BATT 101 TO SHUNT SH-1 (-)
STATIC SW SCR 3A 102 TO SCR1 3A
RIGHT SCR ANODE 103 TO RIGHT SCR ANODE
LEFT SCR ANODE 104 TO LEFT SCR ANODE
BRIDGE + BLK 105 TO BRIDGE +
BRIDGE AC BLK 106 TO BRIDGE AC
FUSE BLK 107 TO FUSE
BRIDGE AC GRN 108 TO BRIDGE AC
FUSE GRN 109 TO FUSE
CR1+ RED 110 TO E3 CR1+
CR1- BLK 111 TO E2 CR1-
TABLE 7
PART# | RELAY DESCRIPTION
RLY_-087 | 100A, 220V 50HZ
RLY_-088 | 100A, 230V 50HZ
RLY_-089 | 100A, 240V 50HZ
RLY_-052 | 100A, 600VAC-208VAC COIL 50HZ
RLY_-053 | 100A, 600VAC-240VAC COIL 50HZ
(BEST USE ONLY) 1 AWG GRN
NOTE: SELECT FOR VOLTAGE: CONNECT BAA_-180 TO 8 FOR 240V, TO 6 FOR 208V
DIN RAIL
240 IN
208 IN
L2 IN
N IN
L1 IN
ST BY
AC VOLTAGE IN
BAA_-188
BAA_-189
2 (AWG) ORANGE
BLK/WHT
WHT
BLK
BACKFEED DRIVER BOARD
PCF_-001
J1 P1
K1 CSA RELAY
SEE TABLE 7
K1-2
T3 AC AMP IN
RTN_-003
WHT/BRN
12 WHT/BRN
T3 DETAIL
IEEE 587 BOARD
TABLE 6
QUALIFIED ELECTRICIAN INTERFACE WIRING
WIA_-238 WHT/BLU
F1 1/2 AMP FUS_-158
WIA_-240 WHT/YEL
T2 AC INPUT MONITOR TRANSFORMER SEE TABLE 6
18V 82.4A
10V 8.24A
208V 240V
SELECT VOLTAGE
TRN_-502
+BATT
-BATT
ORANGE (1/0 AWG)
WIA_218
WIA_215
F3 SEE TABLE 5
(TO EXTERNAL BATTERY CABINET)
BLK 1
BLK 2
BLK 4
BLK 5
BLK 6
T1 TRANSFORMER MAIN FERRO
SEE DWG. D2003-1 TABLE 1 & TABLE 2
20 6 AWG GRN/YEL CORE GROUND
9 10 AWG GRN/YEL FARADAY SHIELD
10 BLK
11 BLK
12 BLK
13 BLK
T4 AC AMP OUT RTN_-003
WHT/ORN
5 WHT/ORN
14 BLK
15 BLK
16 BLK
18 BLK
C1 TANK CAPACITOR SEE TABLE 1 DWG #2003-1 FOR VALUES
T4 DETAIL
T1-11
T1-12
T1-13
L1
F2 SEE TABLE 3
BLK
SEE TABLE 3
BATTERY CHARGER MODULE
CR1 BRIDGE RECTIFIER SEE TABLE 3
FAN_-005 FAN1-3 HEATSINK FAN
FAN
WIA_-246
C3 13300uF CPR_-280
DDE_-095
BUS_-327
BUS_-328
NOTE: 10-18.5KVA USE (2) 6900uF CAPACITORS. 18KVA USES (3) 6900uF CAPACITORS.
TABLE 3
BATTERY CHARGER
CHARGER SIZE | F2 FUSE | | L1 INDUCTOR | | CR1 BRDG RECT
5AMP | FUS_-088 | 15 AMP | IND_-007 | 1.2mhy | RFR_-007
10AMP | FUS_-156 | 30 AMP | IND_-008 | 1.8mhy | RFR_-018
20AMP | FUS_-001 | 60 AMP | IND_-009 | 1.2mhy | RFR_-018
* F2 AND CR1 ARE LOCATED ON THE OPTIONAL CHARGER HEATSINK (SHEET 3) FOR 10&20 AMP CHARGER OPTIONS.
TABLE 8
IEEE 587
PART# | DESCRIPTION
PCS_-014 | 50HZ
PCS_-015 | 60HZ
TABLE 5
UNIT | F3 FUSE
10KVA | FUS_-156 | 125 AMP
12.5KVA | FUS_-010 | 175 AMP
18KVA | FUS_-111 | 250 AMP
TABLE 9
OPTIONAL MONITOR TRANSFORMER
CRAEMER XFMR w/OUT PHASE DOT
T4
WIA_-238 AC INPUT MON.
WHT/BLU
WHT/YEL
18V
10V
208V
240V
SELECT VOLTAGE
TRN_-502
SIGNAL XFMR
T4
WIA_-238 AC INPUT MON.
WHT/BLU
WHT/YEL
18V
10V
208V
240V
SELECT VOLTAGE
TRN_-502
TYPICAL 50HZ 380 VOLT RECEPTACLE PANEL
TO-L1
TO-N
CIRCUIT BREAKER OR REPLACEABLE FUSE, AS REQUIRED
ONE RECEPTACLE SHOWN FOR BREVITY. EACH RECEPTACLE IS WIRED IDENTICALLY WITH ITS OWN CIRCUIT BREAKER OR FUSE.
TYPICAL 60HZ 240 VOLT RECEPTACLE PANEL
TO-L1
TO-L2
CIRCUIT BREAKER OR REPLACEABLE FUSE, AS REQUIRED
ONE RECEPTACLE SHOWN FOR BREVITY. EACH RECEPTACLE IS WIRED IDENTICALLY WITH ITS OWN CIRCUIT BREAKER OR FUSE.
DIN RAIL
7 WHT/BRN ACVO
5 WHT ACVO
L1
L2
XO
QUALIFIED ELECTRICIAN INTERFACE WIRING
CHECK UNIT DATA PLATE FOR VOLTAGES
OUTPUT TERMINALS SEE TABLE 2
TYPICAL 60HZ DIN RAIL
AC OUT
AC IN
DC
+DC -DC
L1 XT1 L2 XO (208V) (480Y/N) (240V) (120V)
L2 L1 (208 OR 240 VAC)
CHASSIS GROUND
NOTE: ONLY 65 VOLTS EXISTS BETWEEN XO/N AND XT1.
TYPICAL 50HZ DIN RAIL
AC OUT
AC IN
DC
+DC -DC
L1 XT1 L2 XO (400Y/N) (230V) (240V)
N L1 IN
CHASSIS GROUND
+BATT 113 TO POWER BD E7
-BATT 114 TO POWER BD E8
HRS_-123 OUTPUT VOLTAGE MONITOR 115 TO POWER BD J14
HRS_-124 AC INPUT AMPS 116 TO POWER BD J6
HRS_-121 AC INPUT MON. AC AMPS OUT 117 TO POWER BD J6
BAA_-191 STATIC SW LINE 118 TO SCR-1 AK
FILE NAME: 2003G042.SCH
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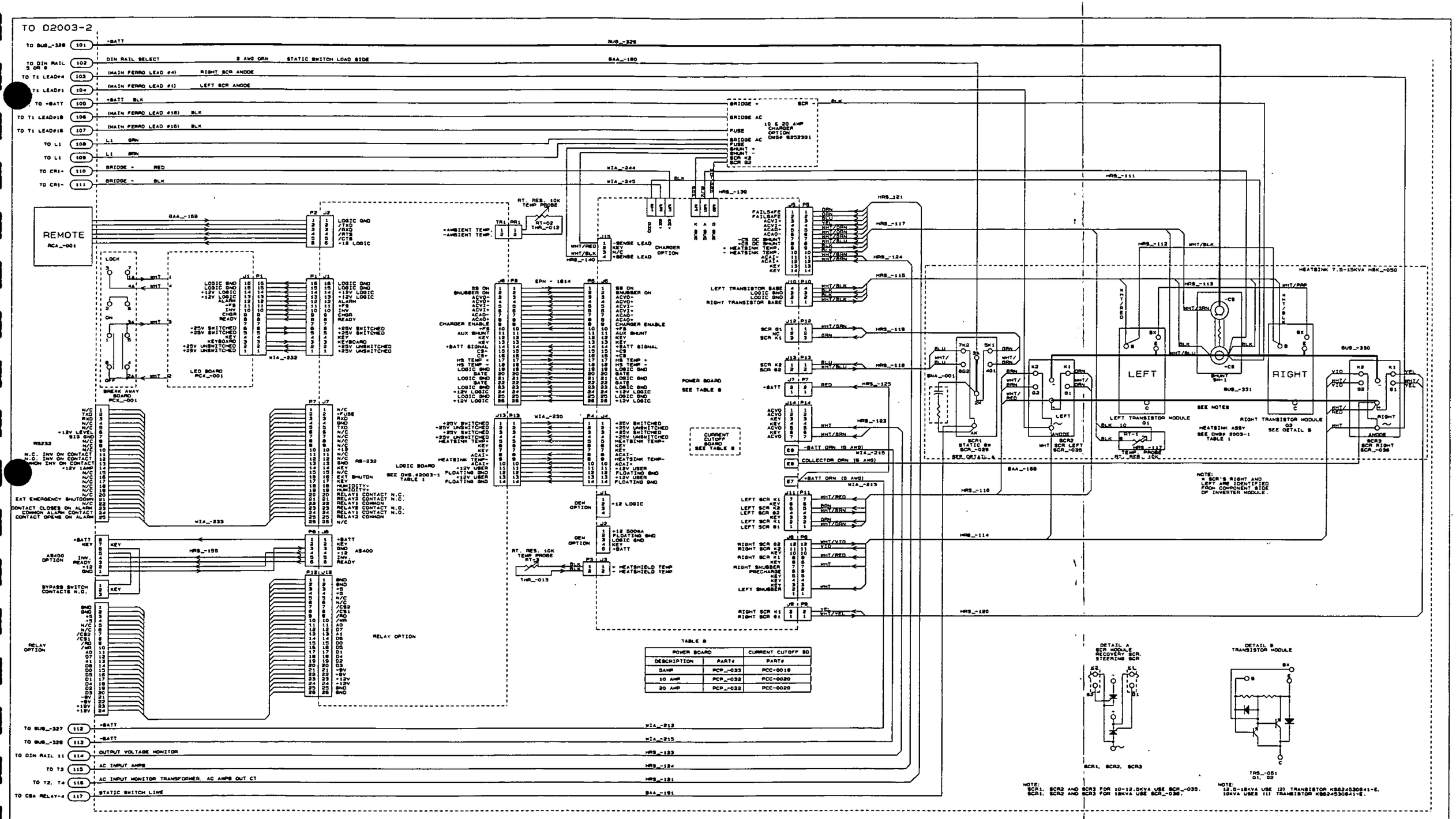
FOR APPROVAL
1215 B 3/26/91 DD
1080 F 1/23/91 DD
1057 E 12/5/90 DD
BEST POWER TECHNOLOGY, INC. BOX 280 NECEDAH, WI 54646 (608) 565-7200
TITLE FD 10 - 18KVA 50/60HZ
NOTE SYSTEM SCHEMATIC/WIRING DIAGRAM
DRAWN DH SHEET 2 OF 3 DRAWING 2003
802-2


TO D2003-2
REMOTE
RCA_-001
BAA_-189
LOCK
BREAK AWAY BOARD PCK_-001
LED BOARD PCK_-001
WIA_-232
LOGIC BOARD SEE DWG #2003-1 TABLE 1
WIA_-233
RS232
RS-232
EXT EMERGENCY SHUTDOWN
CONTACT CLOSES ON ALARM
COMMON ALARM CONTACT
CONTACT OPENS ON ALARM
RELAY OPTION
AS400 OPTION
BYPASS SWITCH CONTACTS N.O.
HRS_-135
AS400
RT. RES. 10K TEMP PROBE RT-2
THR_-012
THR_-013
+AMBIENT TEMP.
-AMBIENT TEMP.
WHT/RED
WHT/BLK
HRS_-140
CHARGER OPTION
BRIDGE +
BRIDGE AC
FUSE
SHUNT +
SHUNT -
SCR K2
SCR G2
SCR -
10 & 20 AMP CHARGER OPTION DWG# 8253301
WIA_-244
WIA_-245
HRS_-130
HRS_-131
HRS_-121
HRS_-117
HRS_-124
HRS_-115
HRS_-116
HRS_-118
HRS_-125
HRS_-123
HRS_-114
HRS_-120
EPN - 1814
POWER BOARD SEE TABLE B
CURRENT CUTOFF BOARD SEE TABLE B
OEM OPTION
+12 LOGIC
+12 500mA FLOATING GND
LOGIC GND
+BATT
+ HEATSHIELD TEMP
- HEATSHIELD TEMP
WIA_-235
WIA_-213
WIA_-215
HRS_-129
HRS_-124
HRS_-121
BAA_-191
BAA_-188
HEATSINK 7.5-15KVA HSK_-050
HRS_-112
HRS_-113
WHT/BLK
WHT/BRN
WHT/PNK
WHT/BLU
LEFT
RIGHT
SHUNT SH=1
BUS_-331
BUS_-330
SEE NOTES
LEFT TRANSISTOR MODULE Q1
RIGHT TRANSISTOR MODULE Q2 SEE DETAIL B
HEATSINK ASSY SEE DWG# 2003-1 TABLE 1
RT-1 TEMP. PROBE RT. RES. 10K
LEFT ANODE SCR2 SCR_-035
RIGHT ANODE SCR3 SCR_-036
SCR1 STATIC SW SCR_-029
SCR_-029 x1, 4
7K2
5K1
2K
BNA_-001
NOTE: * SCR'S RIGHT AND LEFT ARE IDENTIFIED FROM COMPONENT SIDE OF INVERTER MODULE.
DETAIL A SCR MODULE RECOVERY SCR. STEERING SCR
SCR1, SCR2, SCR3
DETAIL B TRANSISTOR MODULE
TRS_-051 Q1, Q2
NOTE: 12.5-15KVA USE (2) TRANSISTOR KSE24530841-E. 10KVA USES (1) TRANSISTOR KSE24530841-E.
NOTE: SCR1, SCR2 AND SCR3 FOR 10-12.5KVA USE SCR_-035. SCR1, SCR2 AND SCR3 FOR 15KVA USE SCR_-036.
TABLE B
POWER BOARD
DESCRIPTION
PART#
CURRENT CUTOFF BD
PART#
5AMP
PCP_-033
PCC-0018
10 AMP
PCP_-032
PCC-0020
20 AMP
PCP_-032
PCC-0020
TO BUS_-326 101 -BATT
TO DIN RAIL 5 OR 6 102 DIN RAIL SELECT 8 AWG ORN STATIC SWITCH LOAD SIDE
TO T1 LEAD#4 103 (MAIN FERRO LEAD #4) RIGHT SCR ANODE
TO T1 LEAD#1 104 (MAIN FERRO LEAD #1) LEFT SCR ANODE
TO -BATT 105 +BATT BLK
TO T1 LEAD#18 106 (MAIN FERRO LEAD #18) BLK
TO T1 LEAD#16 107 (MAIN FERRO LEAD #16) BLK
TO L1 108 L1 GRN
TO L1 109 L1 BRN
TO CR1+ 110 BRIDGE + RED
TO CR1- 111 BRIDGE - BLK
TO BUS_-327 112 +BATT
TO BUS_-328 113 -BATT
TO DIN RAIL 11 114 OUTPUT VOLTAGE MONITOR
TO T3 115 AC INPUT AMPS
TO T2, T4 116 AC INPUT MONITOR TRANSFORMER, AC AMPS OUT CT
TO CBA RELAY-4 117 STATIC SWITCH LINE
NOTES: UNLESS OTHERWISE SPECIFIED
4. SHUNT USED FOR 10KVA SHT_-010, 12.5KVA SHT_-009, 15KVA SHT_-011.
5. USE BUS_-330 AND BUS_-331 FOR 10KVA AND 12.5KVA, USE BUS_-332 FOR 15KVA.
FILE NAME: 20030043.SCH
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802-3