Service Manual **English**

APC Smart-UPS® RT

3,000VA – 10,000VA 200-240 Vac

Tower/Rack Mount

Uninterruptible Power Supply

Table of Contents

1 Safety Precautions

Read and adhere to the following warnings when installing or servicing a UPS and/or battery packs. Failure to observe these warnings may result in serious injury, death or damage to the equipment.

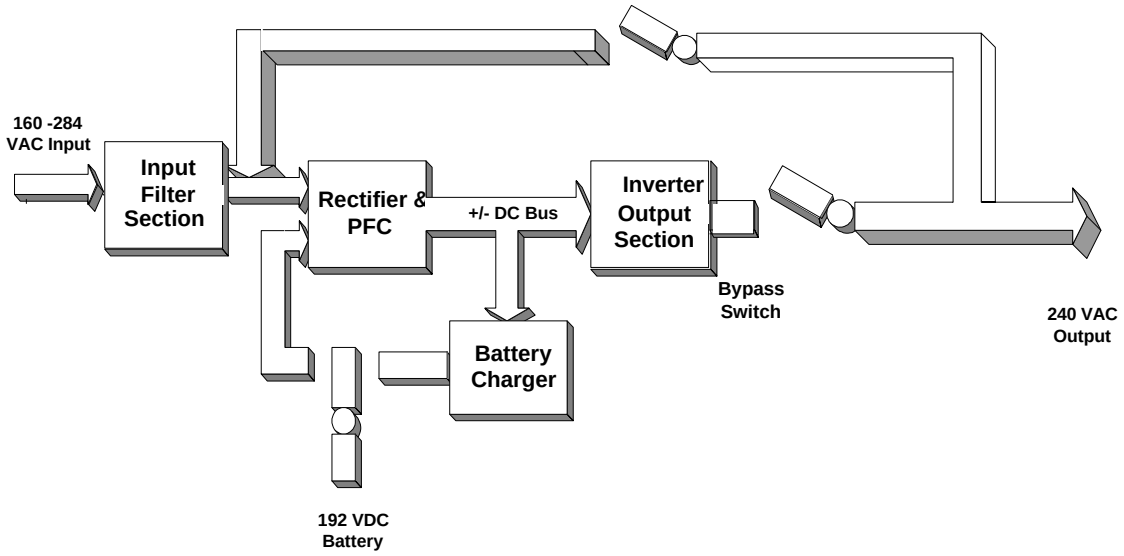
WARNINGS 	• Do not attempt to install or service external batteries alone. **A qualified electrician should perform the installation and servicing of external batteries.** • Disconnect charging source(s) **BEFORE** connecting or disconnecting battery terminals. • External batteries may retain lethal voltages after power has been disconnected and all switches are off. • Use extreme caution when making terminal connections. Do not allow cables to touch anything except the intended terminal.
PRACTICES	Always wear: • Goggles or face shields • Acid-resistant, insulated gloves • Protective aprons • Protective overshoes or rubber boots Always use: • Insulated tools • Rubber mats to cover batteries during servicing • Rubber mats or rubber stands on the floor • Adequate lifting devices Remove: • Watches, rings, and other metal objects from your body
PRECAUTIONS	• To avoid static build-up, service personnel should establish a grounding contact prior working on batteries. • Do not lay tools or metal parts on top of batteries. • Lead-acid batteries contain hazardous, toxic materials. ▪ Do not open, alter or mutilate batteries. Internal materials may be harmful to the skin and eyes. ▪ Do not dispose of batteries in a fire. There is danger of explosion. • Handle, transport and recycle batteries in accordance with local codes and regulations.

2 Introduction to SURT

2.1 Key Points

- Double-conversion online topology
- Inverter voltage is selectable through communication only: 200V, 208V, 220V, 230V, 240V.
- Bypass “acceptable voltage” window changes with Inverter voltage setting.
- Batteries must be connected to start UPS. After startup, batteries can be safely removed and replaced without interruption to the output.
- Lynx2 (3kVA – 6kVA) has single battery (192V nominal) referenced to output Neutral.
- Lynx3 (7.5kVA – 10kVA) has two battery strings (+192V and -192V nominal) managed independently and charged with separate chargers.
- Lynx3 (7.5kVA – 10kVA) can accept single-phase or three-phase input voltage. In both cases, Bypass is only single-phase (“L1” and “N” inputs) so the input wiring must be sized to handle full-load current as single-phase.

2.2 One-Line Diagram



2.3 Main Circuit Components

The primary sections of the UPS are:

- Input disconnect and filter stage
- Input Power Factor Correction (PFC) power stage
- Energy storage stage (dc bus capacitor bank)
- Output power stage (inverter)
- Bypass
- Battery charger
- Battery: 1 or 2 strings each connected to output Neutral

2.4 Functional Description

The control of power module and fault detection logic is uP based. The input filter stage contains input backfeed relays, input EMI filter, transient suppression, and battery select transfer relays. Input PFC power stage contains non-isolated power factor correcting AC/DC converters. PFC converter is split in two power sections – positive and negative boost stage – while operating on-line and in positive boost and buck boost power stage while operating on battery. This converter is capable of full power operation from 160 to 280 VAC line to neutral or from a nominal DC battery voltage of 192VDC. The output from this stage is a +/-395V center tapped dc bus. The energy storage stage is split DC bus capacitor handling seamless transitions from battery to line and vice versa as well as the low and high frequency power stages ripple. The inverter stage operates directly from +/- 395VDC bus and produces an AC output voltage of 200/208/220/230/240Vac (for NAM and EMEA) or 200Vac (for Japan). The output of the UPS is either connected through a pair of relays either to the inverter or to the input filtered line. The UPS contains 1 or 2 battery chargers, each rated 400W.

2.5 Power Train Operation

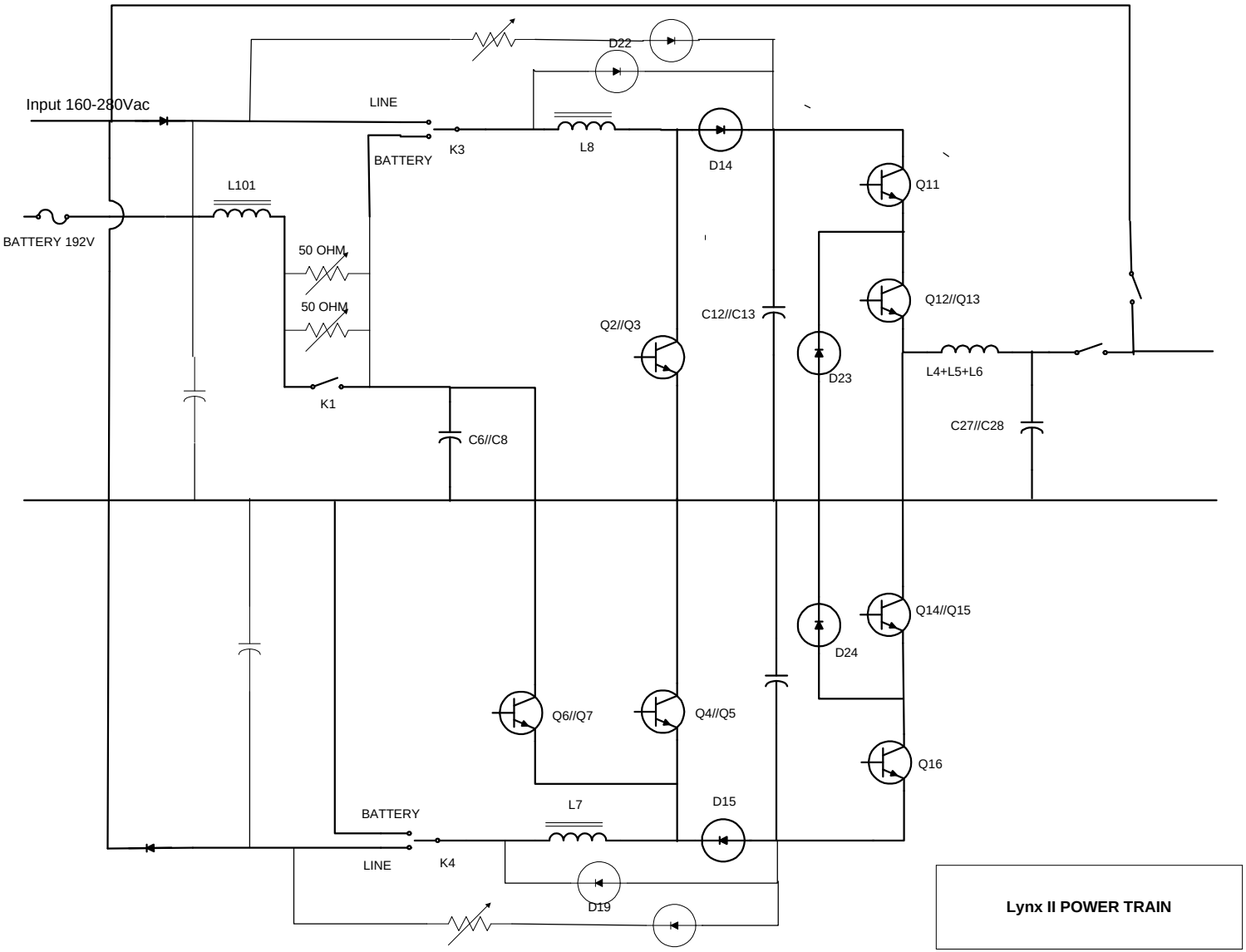
When operating **on line,** the input voltage is first rectified so two half wave rectified voltage waveforms are produced in reference to the Neutral. Positive line rectified signal is fed to positive boost PFC stage. This stage is a boost type converter which converts positive half rectified input signal into DC positive bus voltage of +395V, drawing the input current in phase with positive half cycle of the line current. The boost stage consists of an input choke, high frequency IGBT switch, high frequency soft recovery diode and the output electrolytic capacitor. The positive boost stage is bypassed by a low power diode which serves as the boost converter protection in the case of sudden line overshoots and overvoltages or any other condition which causes input line peak voltage to be higher than DC bus capacitor voltage. The negative line rectified signal is fed to negative PFC stage. This stage is also boost type converter and operates in the same manner as the positive PFC boost stage. This stage converts negative line half rectified voltage to negative DC bus voltage of -395V. The bottom line is that when operating on line both PFC stages are operating as boost converters each processing half of the total output power per phase.

When operating **on battery,** the transfer relays connect the PFC to a DC voltage from the battery. The battery voltage is fed through a filter and inrush stage to both positive and negative PFC stages. The battery filter consists of chokes and two electrolytic capacitors. The function of the filter is to prevent high frequency ripple from PFC stage going back to battery and to provide differential mode filter for high frequency noise emanating from battery buses or cables (in case of external battery packs). The inrush stage as its name says during startup limits the battery inrush current. When the battery is connected to the input of the PFC stage, the battery filter capacitor and positive DC bus capacitor charging current is limited through two 50 ohm PTC resistors. When capacitors are charged to battery voltage inrush relays are switched into closed position bypassing the PTC resistors. The positive PFC stage operates as a DC/DC boost converter and converts battery voltage to DC bus voltage. The operation in this mode is the same as operation on line as described above, except that current drawn from battery is now DC current. The negative PFC stage operates as buck boost stage and converts battery voltage to negative DC bus voltage.

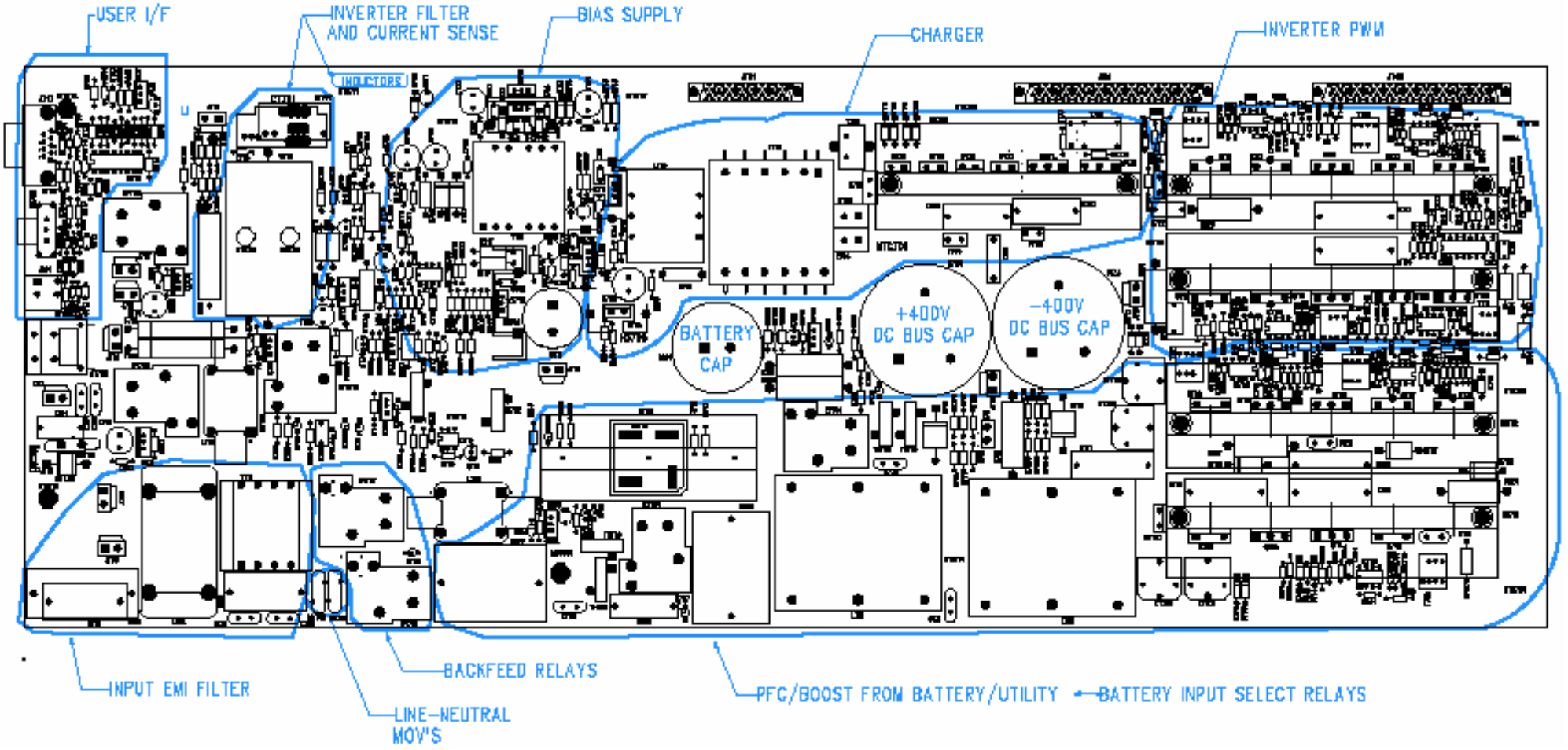
The output stage of the UPS consists of inverter with output filter and bypass relays. This stage is a DC/AC converter which function is to convert DC bus voltages into regulated output sine wave voltage. The inverter uses a neutral point clamp topology and consists of the top and bottom section. The top section converts positive DC bus voltage of 395V into positive half wave sine voltage and bottom portion converts negative DC bus voltage into negative half sinewave voltage. The PWM control of inverter regulates the frequency and amplitude of the output AC voltage. The output filter consists of a smoothing choke and a filter capacitor. The filtered voltage is fed through a NO relay contact to the UPS output.

2.6 Transistor-Level Diagrams

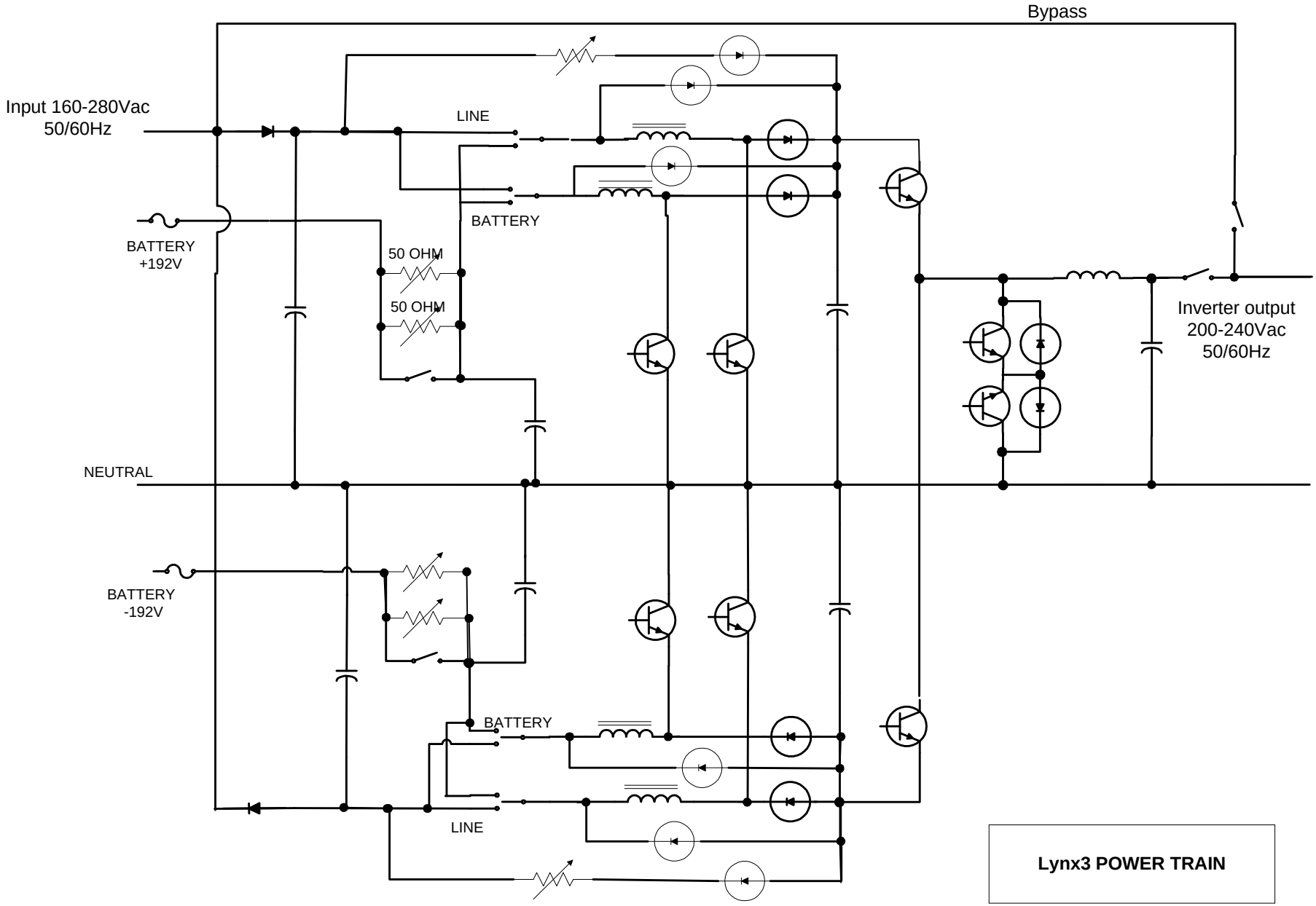
Lynx2: 3kVA – 6kVA



Lynx II POWER TRAIN

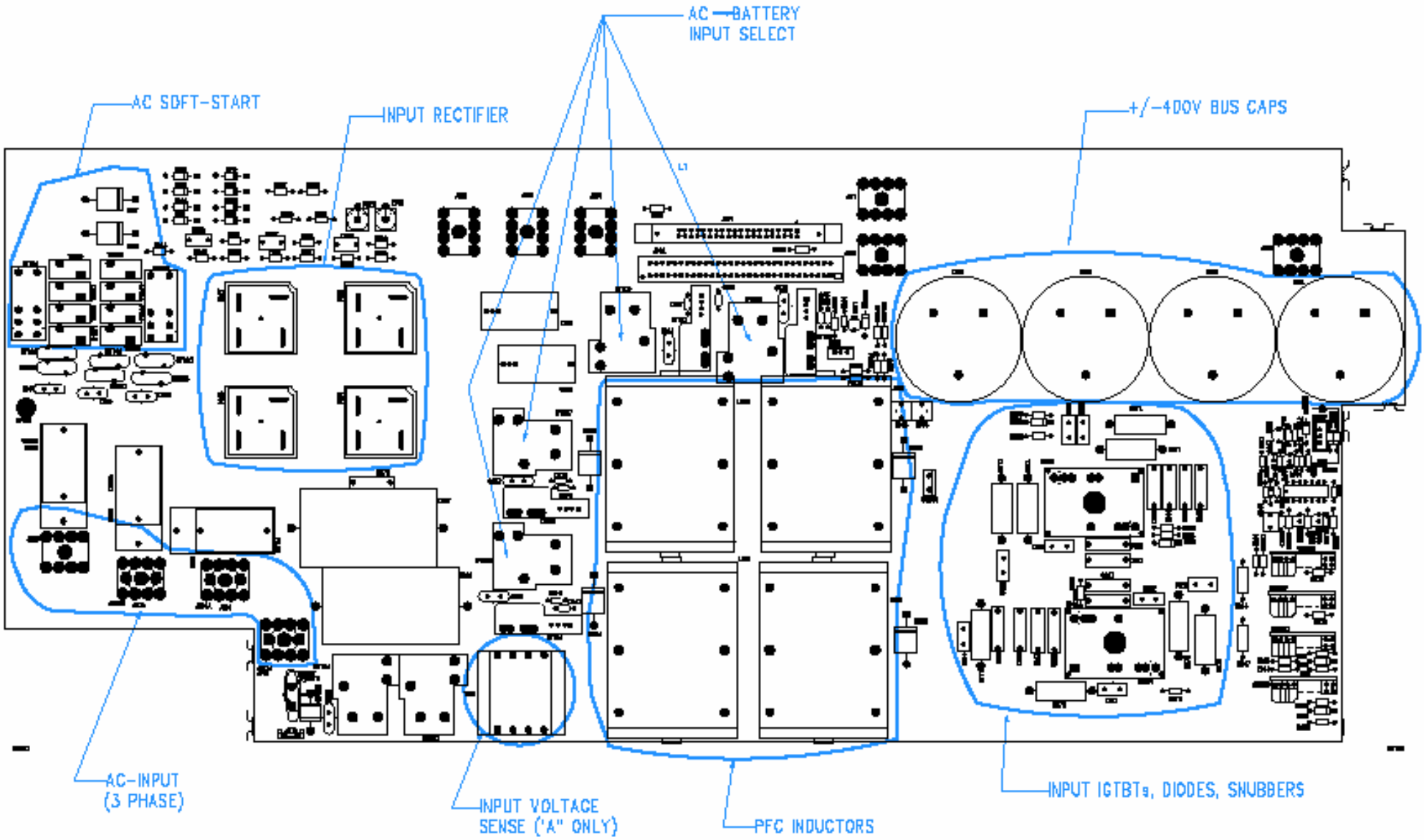


Lynx3: 7.5kVA – 10kVA (interleaved PFC)

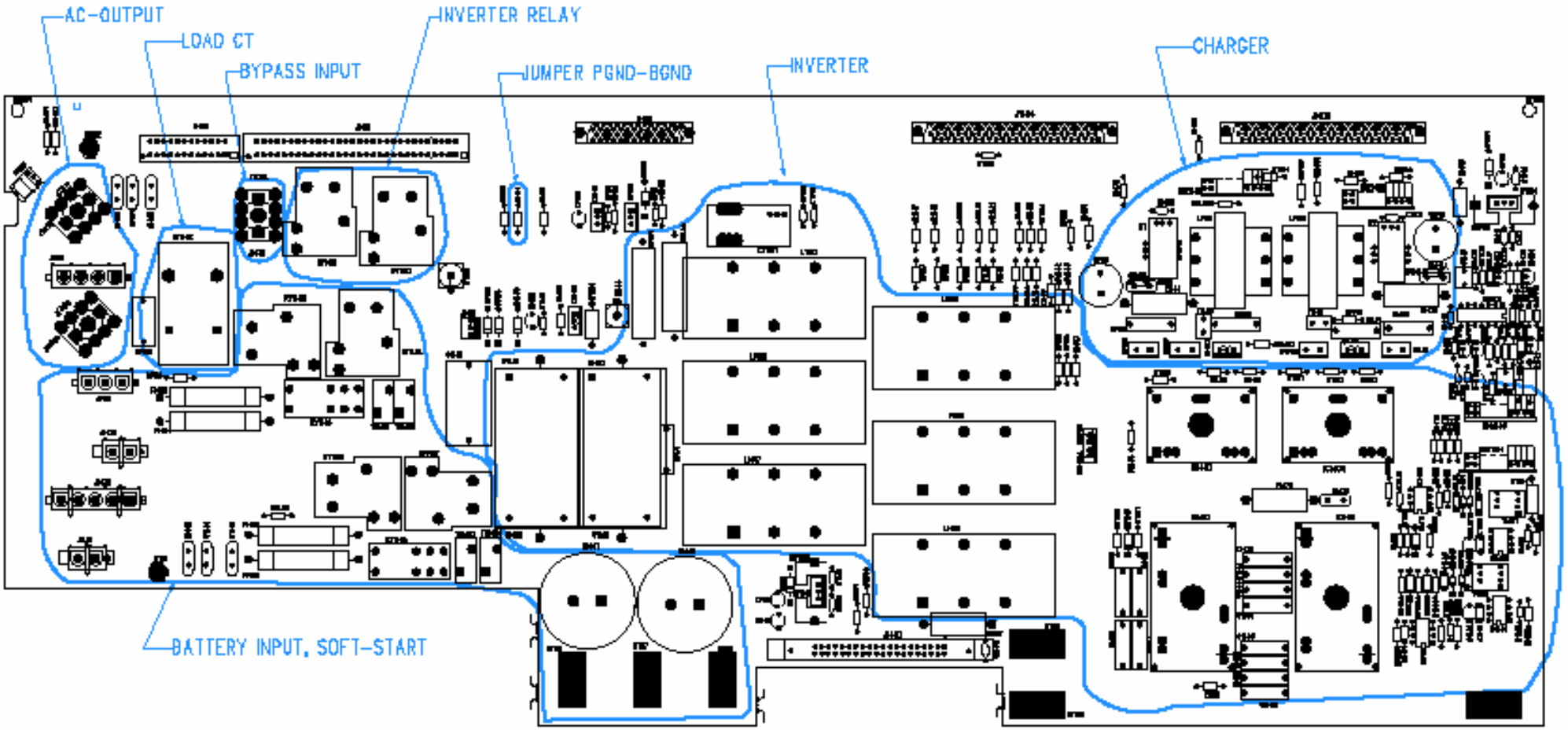


Lynx3 POWER TRAIN

Lynx3 PFC power board, 640-0761 – Circuit locations



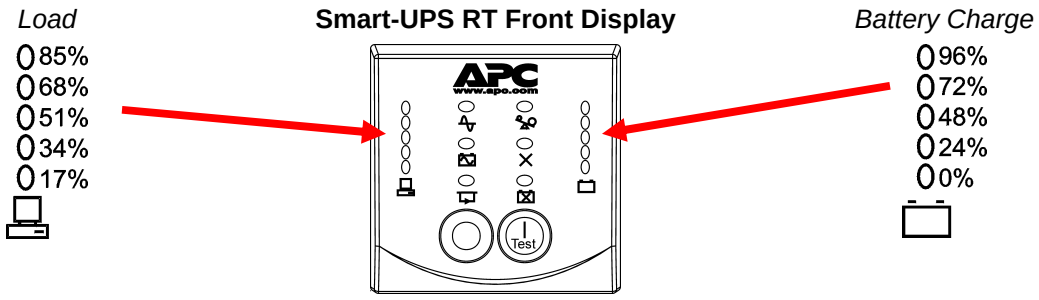
Lynx3 INVERTER power board, 640-0762



3 User Interface

3.1 Front Panel Display and Control Buttons

The front panel contains status and diagnostic LEDs and two control buttons. Several of the LEDs comprise bar graphs that display status and diagnostic information according to the table below.



Indicator	Description
Online	The Online LED illuminates when the UPS is drawing utility power and performing double conversion to supply power to connected equipment.
On Battery	The UPS is supplying battery power to the connected equipment.
Bypass	The Bypass LED illuminates indicating that the UPS is in bypass mode. Utility power is sent directly to connected equipment during bypass mode operation. Bypass mode operation is the result of an internal UPS fault, an overload condition or a user initiated command either through an accessory or the manual bypass switch. Battery operation is not available while the UPS is in bypass mode. Refer to *Troubleshooting* in this manual.
Fault	The UPS detects an internal fault. Refer to *Troubleshooting* in this manual.
Overload	An overload condition exists. See *Troubleshooting.*
Replace Battery	The battery is disconnected or must be replaced. See *Troubleshooting.*

Table 1. Front Panel LEDs.

Feature	Function
Power On 	Press this button to turn on the UPS. (See below for additional capabilities.)
Power Off 	Press this button to turn off the UPS.
Cold Start 	When there is no utility power and the UPS is off, press and hold the  button to power up the UPS and connected equipment. The UPS will emit two beeps. During the second beep, release the button.
Self-Test	Automatic: The UPS performs a self-test automatically when turned on, and every two weeks thereafter (by default). During the self-test, the UPS briefly operates the connected equipment on battery. Manual: Press and hold the  button for a few seconds to initiate the self-test.

Table 2. Front Panel Control Pushbuttons.

Diagnostic Utility Voltage	The UPS has a diagnostic feature that displays the utility voltage applied to the UPS. The UPS starts a self-test as part of this procedure. The self-test does not affect the voltage display. Press and hold the  button to view the utility voltage bar graph display. After a few seconds the five-LED, *Battery Charge*  display on the right of the front panel shows the utility input voltage. Refer to the figure at left for the voltage reading (values are not listed on the UPS). The display indicates the voltage is between the displayed value on the list and the next higher value.

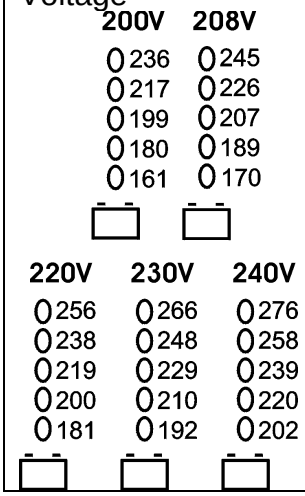


Table 3. Front Panel Bar Graphs.

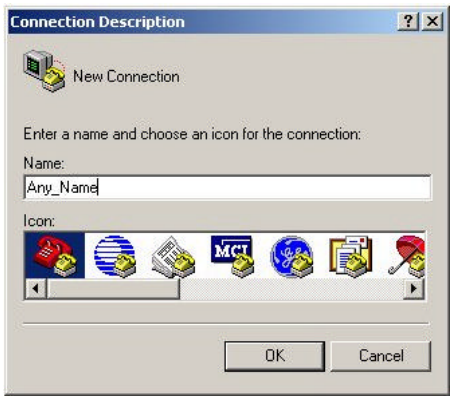
3.2 Terminal Mode

SURT can be configured in a number of ways: Network Management Card web interface, PowerChute ® Software, Terminal Mode, or UPS-Link commands.
To access Terminal Mode, you will need:

- A computer with an RS-232 serial port
- A terminal application such as Hyperterminal
- An APC black cable 940-0024C (included with the UPS)

Make sure that no SmartSlot accessory is installed in the SmartSlot bay of the UPS. The SmartSlot prevents access to certain UPS communication features such as the Terminal Mode.

<table>
<tr><td colspan="2">Using a standard APC serial cable (APC part number 940-0024C), connect the computer serial port to the back of the UPS.</td></tr>
<tr><td colspan="2">Open a terminal program. Hyperterminal example:
From the Desktop, go to Start => Programs => Accessories => Communication =>HyperTerminal.</td></tr>
<tr><td>The “Connection Description” dialog box appears. Enter a name for this connection and select any icon for it.

Click [OK]</td><td> 
</td></tr>
<tr><td>The “Connect To” dialog box appears. In the “Connect using” drop-down list select the COM port you’re going to use to communicate with the UPS.

If you get a message that this port is used by another application then either use a different COM port or close the application using the intended port.

Click [OK]</td><td> 
</td></tr>
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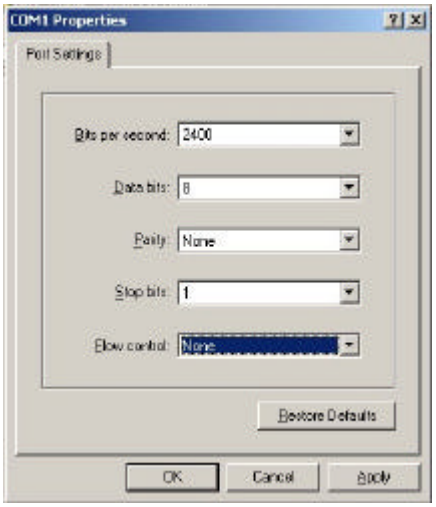
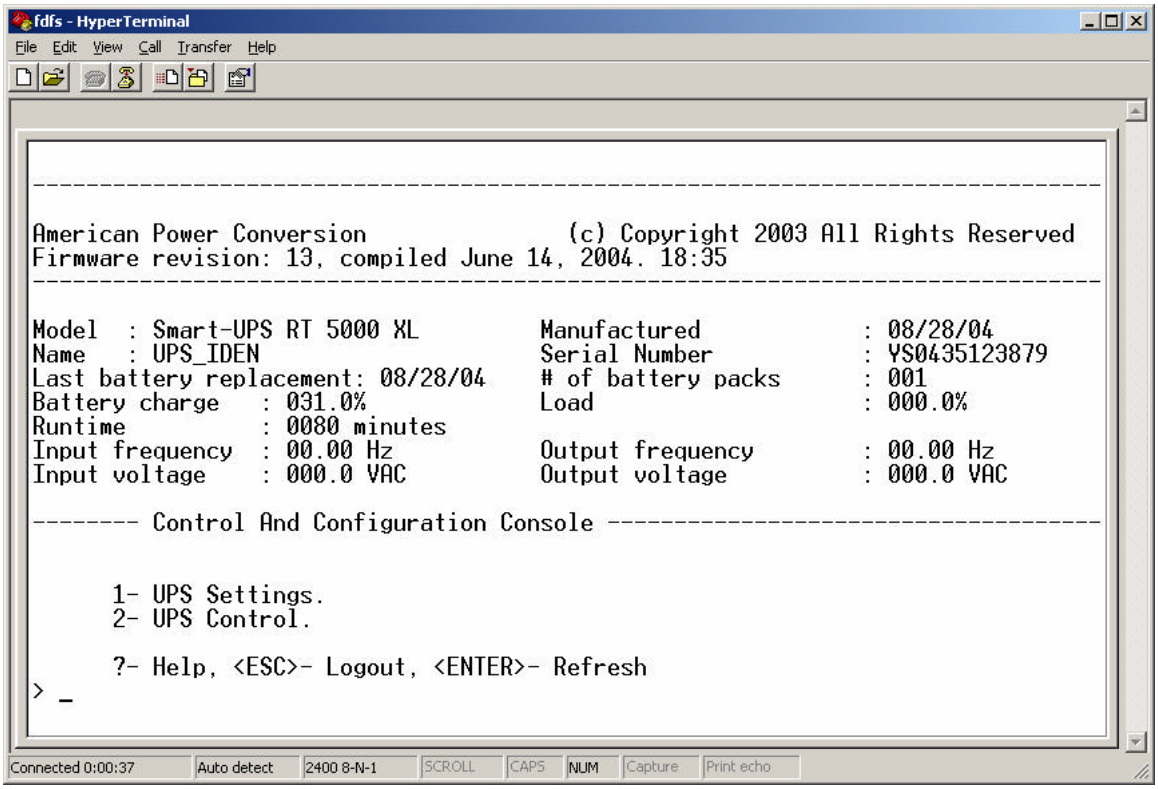
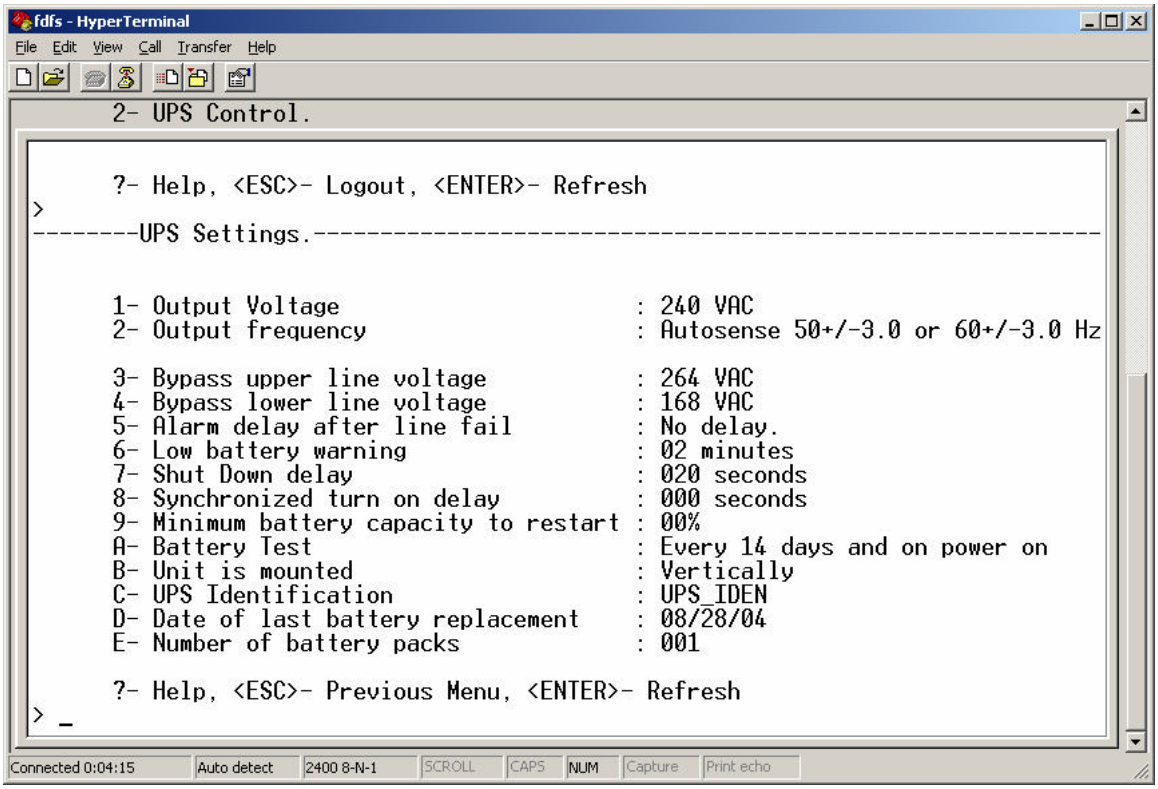
In the communication settings dialog box, select the following settings: Bits per second: 2400 Data bits: 8 Parity: Note Stop bits: 1 Flow control: None Click [OK]	

Press the **Enter** key. The root terminal mode menu will appear, similar to the following:



To configure the UPS, press the **1** key. The UPS will chirp and the “UPS Settings” menu will appear.



To change a setting, press the corresponding key (not case-sensitive) and follow the instructions.

Please note that if no key is pressed for approximately 5 minutes, the Terminal Mode session will time out and you'll have to press **Enter** and start from the root menu again.

3.3 SmartSlot Accessories (Webcard)

SURT models include a standard SmartSlot that is compatible with accessories used in other APC products.

Notes on "event log" entries in the AP9619 (NMC or "webcard"):

- Almost all internal UPS faults are recorded as "Bad output voltage" regardless of whether or not the detected fault is related to the Inverter or Bypass. The NMC is not able to differentiate between the different UPS failure codes.
- "Battery charger failure" could be a momentary battery overvoltage condition -- see if this alarm is cleared within 2 seconds in the log.

4 Installation

See User Manual included with the UPS for installation precautions and instructions.

Installation troubleshooting: Make sure:

- each battery string is above 175V (there are two battery modules per string)
- all battery modules are securely connected
- input AC is connected correctly, input phase_select switch set correctly to 1 or 3 (if exists)
- input breaker closed (if exists)
- output breakers on (if exist)

5 Component Replacements

Replacement boards:

SKU	Power Board	Control Board
SURT3000	0P7510	0P7603
SURT5000	0P7510	0P7600
SURT6000	0P7516	0P7606

SKU	PFC power	Inverter power	Main Control	Aux Control	Bias & I/O
SURT7500	0P7611	0P7621	0P7507	0P7631	0P7641
SURT8000	0P7611	0P7621	0P7608	0P7631	0P7641
SURT10000	0P7611	0P7621	0P7501	0P7631	0P7641

Battery modules (RBC44?) – one for Lynx2, two for Lynx3?

Bezels w/ stickers

Display PCB/bezel assemblies

Fan for Lynx2
Fan for Lynx3

Battery fuses: (515-1030A)

See ??? for optional PDU's including H/W kit for Lynx2 output

6 Troubleshooting

Safety: Remove jewelry, pendants and wrist watches.

6.1 Unit Setup

Unpack the UPS and put it on a flat even surface (mind OSHA regulations). Check the packaging for any signs of damage.

Lynx2

Net Weight	120.00 lbs. (54.55 kg)
Shipping Weight	140.00 lbs. (63.64 kg)

Note: *Follow all environmental regulations. Discard old batteries in an environmentally friendly way. Be sure to deliver spent batteries to a recycling facility or ship to the manufacturer in the replacement battery packing material.*

6.2 Required Tools

- Digital multimeter (for example, Fluke 87)
- Power resistor to discharge capacitors
- Serial communication cable (RS-232)
- Communication software (for example, laptop and “Hyperterminal” software in Windows)
- Phillips screwdriver
- AC power supply
- Load

6.3 Visual Inspections

Visual inspection is often overlooked but is one of the most important steps in diagnosing a problem. It can also save a lot of time.

Exterior

Check the packaging and exterior of the UPS for any physical damage

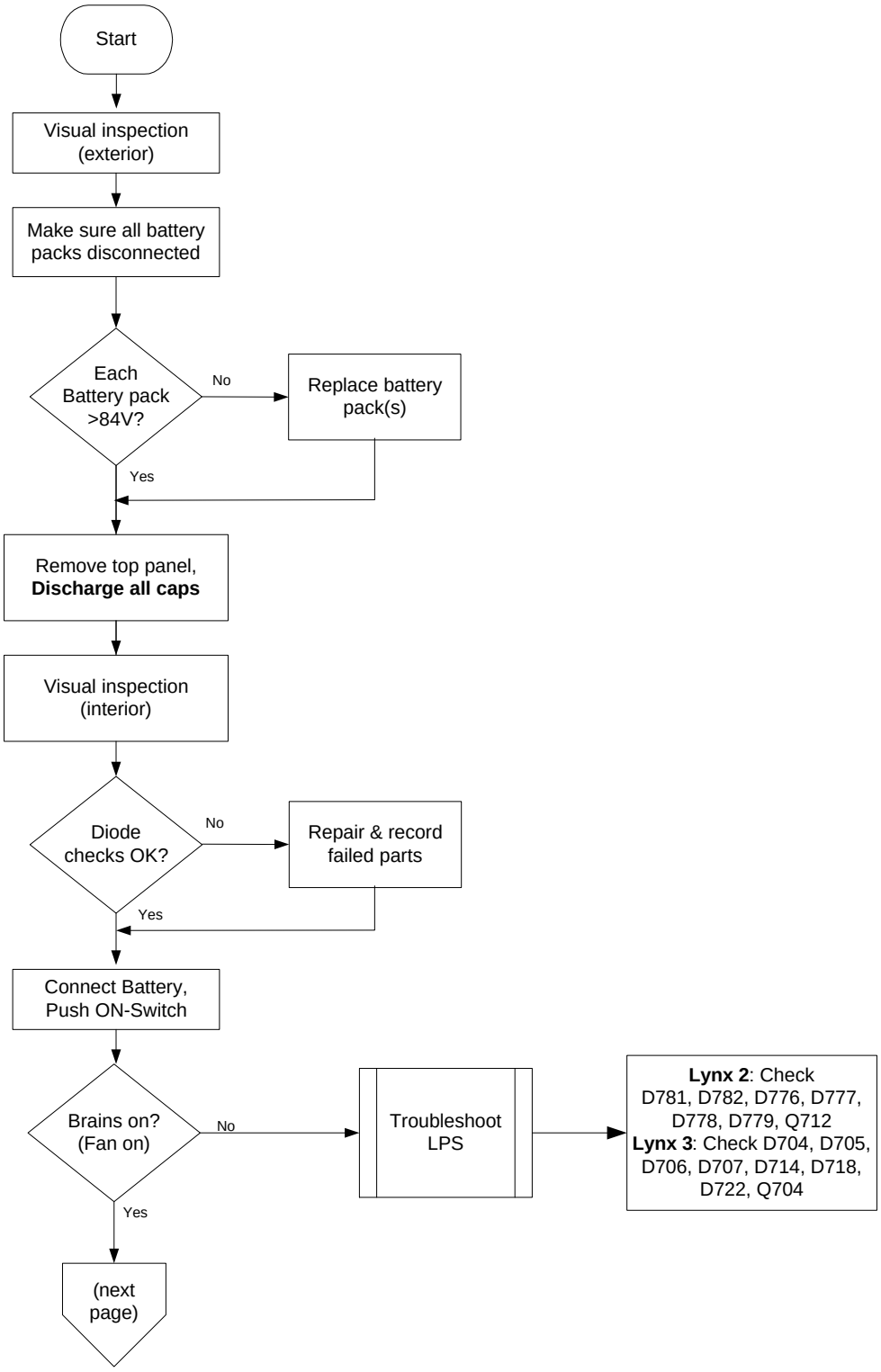
1. Plastic bezels
2. Fan guard & blades
3. Bent sheet metal
4. PDU breakers

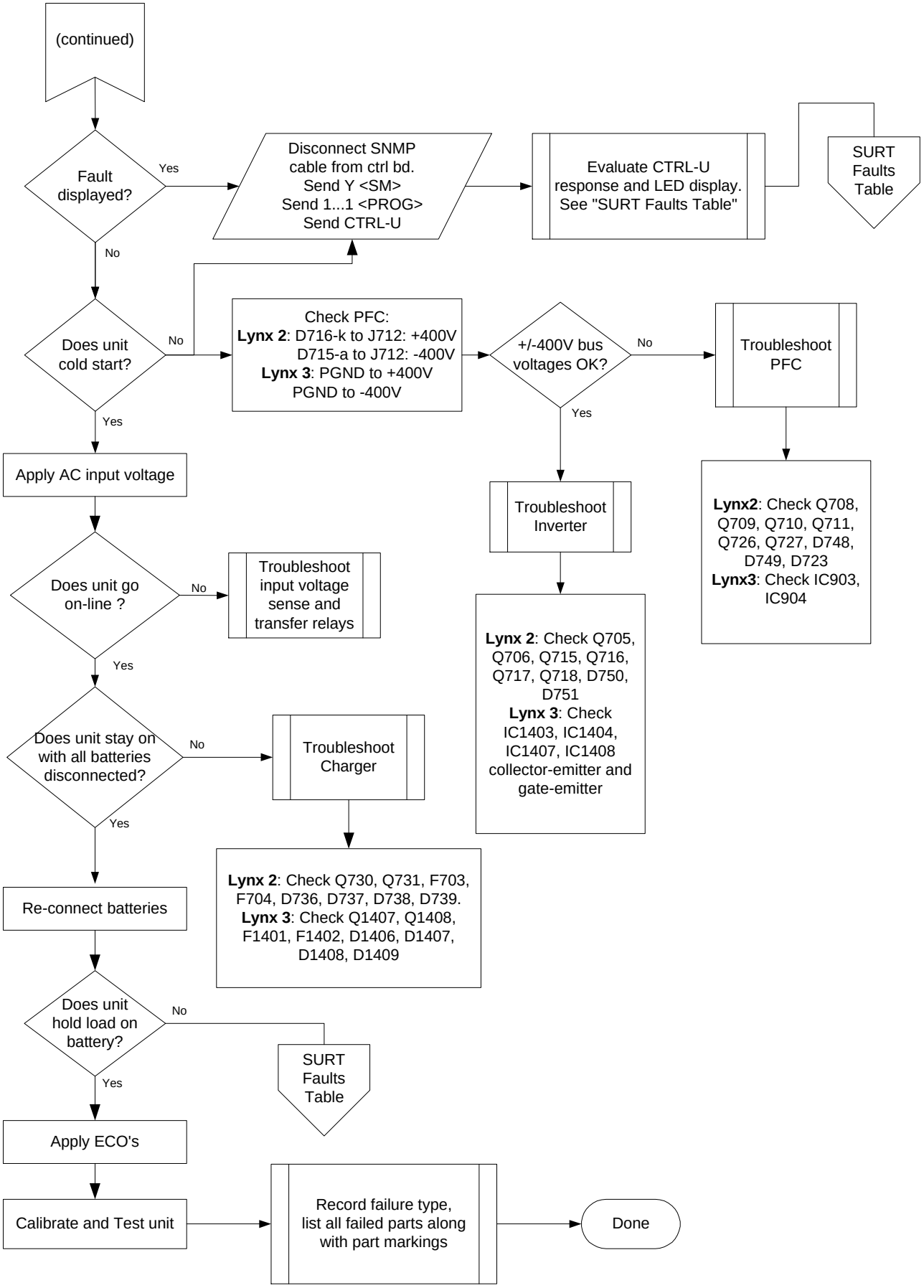
Interior

Check all wiring, connections, and PCB components

1. Wire insulation broken
2. Burned components and/or burned marks on PCB
3. Daughter PCBs not tight in sockets
4. Components touching chassis or other components (esp. small heatsinks, power resistor leads)
5. Leads not clipped properly, solder-bridges (solder-side of PCB)

6.4 Troubleshooting Flowchart



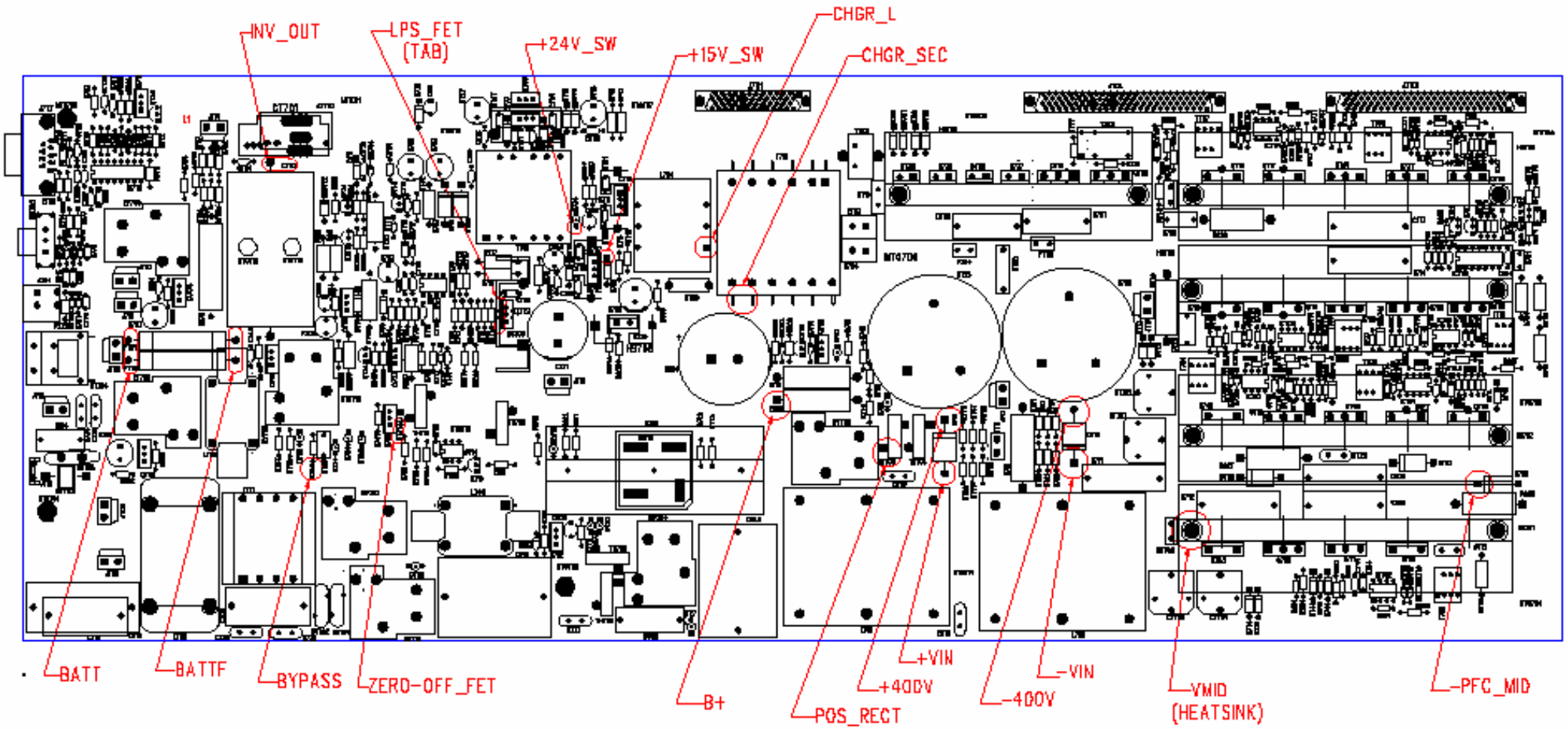


6.5 Diode Checks

The following "good value" measurements were made with a functional board and a Fluke 87 DMM. These measurements are approximate and will vary depending on the meter used. See the power board diagram on the next page for Test Point locations.

Lynx2: 3kVA - 6kVA

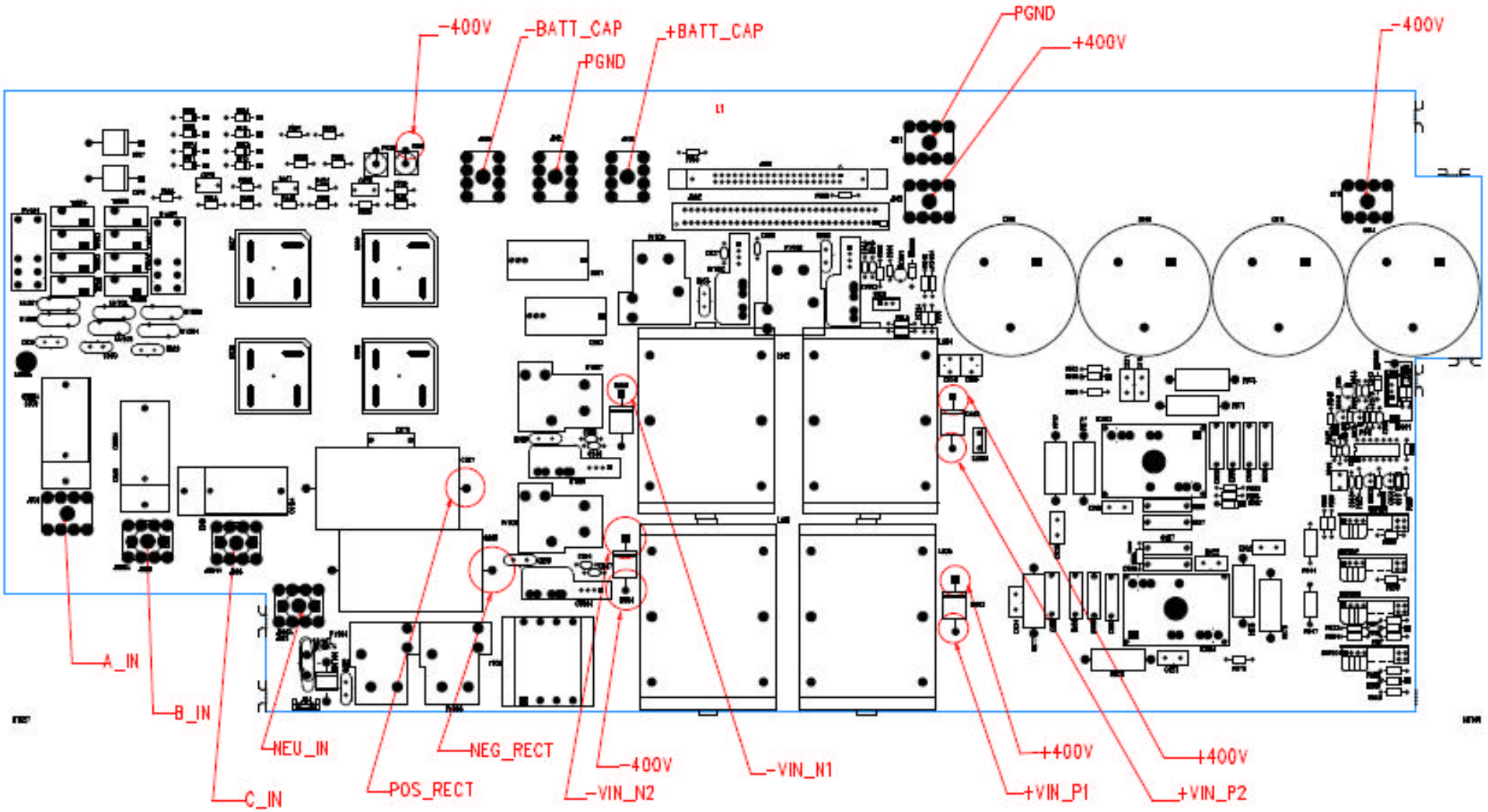
	+ Probe	- Probe	Good Value	Components checked	If open	If short
Fuse	**BATT**	**BATTF**	zero	F701, F702 (battery fuses)	Both fuses bad, PFC probably has problem	OK
PFC	**+VIN**	**+400V**	0.4V	D716, D748		at least 1 part bad
	VMID	**+VIN**	0.45V	Q709, Q710, D706	all parts bad	at least 1 part bad
	-400V	**-VIN**	0.4V	D715, D723	all parts bad	at least 1 part bad
	-VIN	**B+**	0.45V	Q726, Q727, D707	all parts bad	at least 1 part bad
	-VIN	**VMID**	zero	RY704-normally closed	RY704 bad	OK
Inverter	**INV_OUT**	**+400V**	0.8V	Q706, Q715, Q716	at least 1 part bad	Q706 and Q715/Q716 bad
	INV_OUT	**VMID**	charges > 2V	D751, Q718, Q717	if < 2V, Q718 or Q717 bad	At least D751 and 1 IGBT bad
	VMID	**INV_OUT**	charges > 2V	D750, Q715, Q716	if < 2V, Q715 or Q716 bad	At least D750 and 1 IGBT bad
	-400V	**INV_OUT**	0.8V	Q705, Q718, Q717	at least 1 part bad	Q705 and Q718/Q717 bad
Charger output	**VMID**	**CHGR_SEC**	0.45V	D738, D739	at least 1 part bad	
	CHGR_SEC	**CHGR_L**	0.45V	D736, D737	at least 1 part bad	
	CHGR_L	**BATTF**	0.45V	D735	D735 bad	
Bias Supply	**VMID**	**LPS_FET**	0.55V	Q712	Q712 bad, check F705, Q729, D714, and output diodes	
	VMID	**+24V_SW**	0.5V	D782	D782 bad, check Q712, F705, Q729, D715	
	VMID	**+15V_SW**	0.5V	D781	D781 bad, check Q712, F705, Q729, D714	
Zero off	**ZERO-OFF_FET**	**B+**	0.6V	D731, TH701, TH702	D731 bad, check TH701, TH702	
	ZERO-OFF_FET	**BATTF**	0.85V	Q728	Q728 bad, check MV703, GDT701	

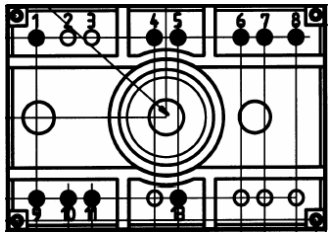


Lynx3: 7.5kVA through 10kVA

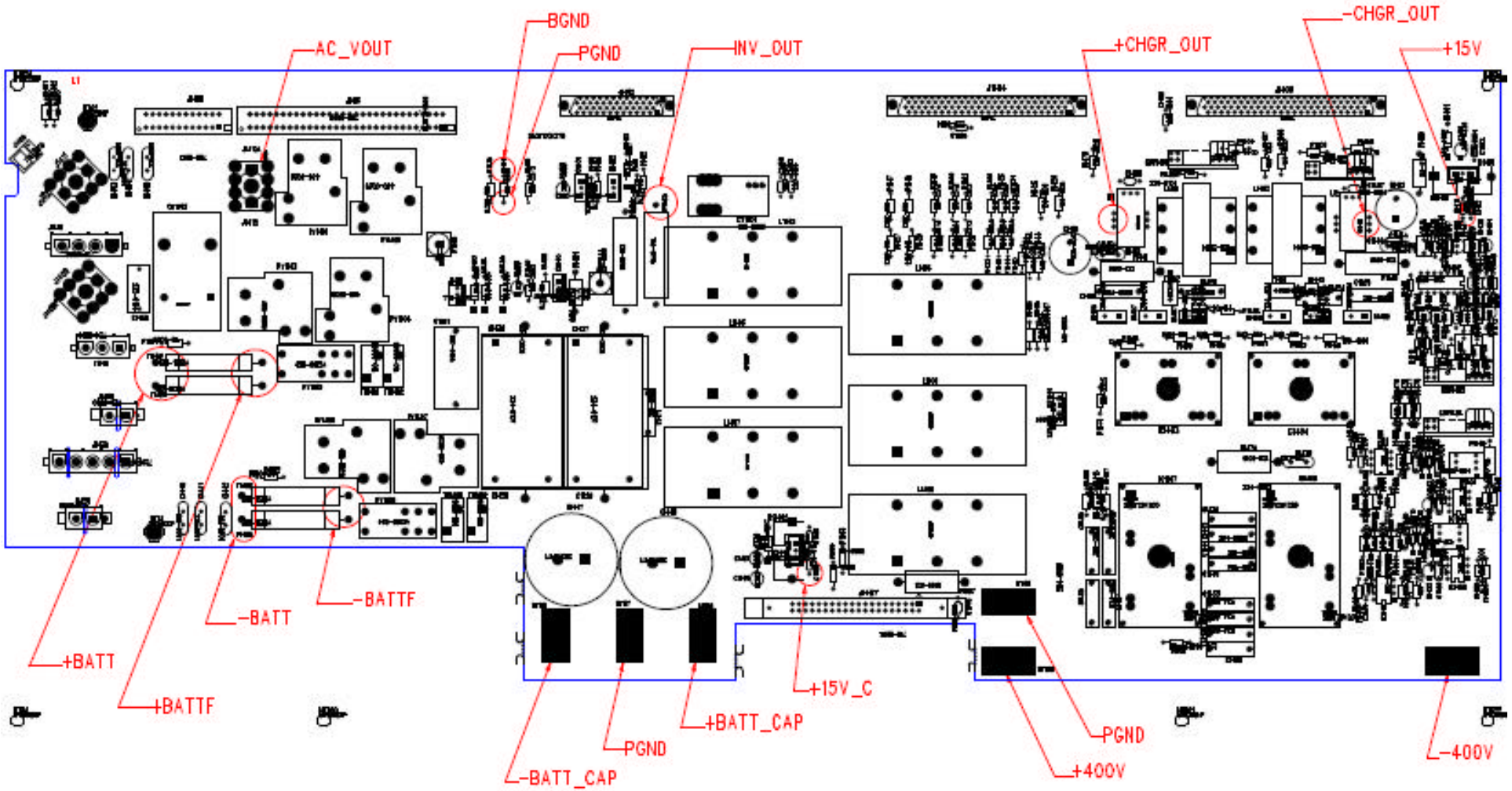
	+ Probe	- Probe	Good Value	Components checked	If open	If short
Fuses	**+BATT**	**+BATTF**	zero	F1403, F1404,	Fuses bad, +PFC probably has problem	OK
	-BATT	**-BATTF**	zero	F1405, F1406	Fuses bad, -PFC probably has problem	OK
PFC	**+VIN_P1**	**+400V**	0.35V	D903, IC903 (at least)	D903, D905, IC903, and/or IC904 bad	
	+VIN_P2	**+400V**	0.35V	D905, IC904 (at least)		
	-400V	**-VIN_N1**	0.35V	D902, IC903 (at least)	D902, D904, IC903, and/or IC904 bad	
	-400V	**-VIN_N2**	0.35V	D904, IC904 (at least)		
	PGND	**+VIN_P1**	0.4V	IC903 (at least)	IC903 and/or IC904 bad	
	PGND	**+VIN_P2**	0.4V	IC904 (at least)		
	-VIN_N1	**PGND**	0.4V	IC903 (at least)		
	-VIN_N2	**PGND**	0.4V	IC904 (at least)		
Inverter	**-400V**	**INV_OUT**	0.35V	IC1407, IC1408	IC1407 and/or IC1408	
	INV_OUT	**+400V**	0.35V			
	INV_OUT	**PGND**	Open	IC1403, IC1404	IC1403 and/or IC1404 bad	
Charger	**+Charger Out**	**+400V**	0.55V	Q1407, F1402	F1402 open, Q1407 probably bad	Q1407 bad
	-400V	**-Charger Out**	0.55V	Q1408, F1401	F1401 open, Q1408 probably bad	Q1408 bad

Lynx3 PFC power board, 640-0761

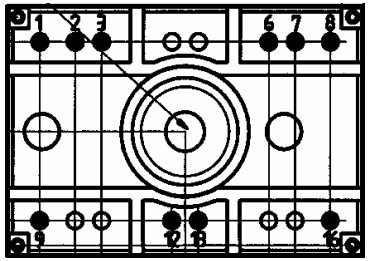


IC903, IC904 = 

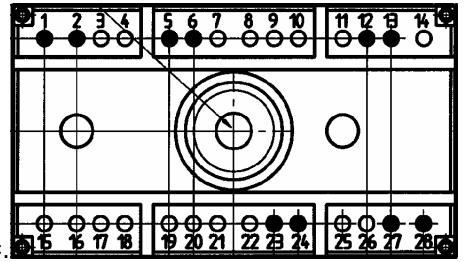
Lynx3 INVERTER power board, 640-0762



IC1403, IC1404 =



IC1407, IC408 =.



Notes:

Cold boot the unit and get the diagnostic information from the serial port before it gets cleared out. If the unit fails right away, read the display LED pattern and the failure code.

Initial power up (brains up) with batteries only
- Check calibration of batteries (both strings), DC buses, firmware version, model #, serial number, etc.
- Check fault history (^U command)

Cold-boot
- check calibration of DC buses, output AC voltage, etc.

AC-input
- check calibration of AC input voltage
- disconnect batteries to see if unit shuts down (indicates charger failure)

ON & OFF buttons, BYPASS switch, etc.
Startup with AC-input
Load: add/remove/calibration of watts & VA
AC input: add/remove with load
HF-OFF check

- Bypass switch
- 3phase input switch selection
- Lynx3 Battery voltage commands: ^J for +battery, ^K for -battery in PROG mode
- Once failed part is identified, try to determine if there were any manufacturing defects that might have caused the part to fail: Insufficient torque on mounting screw, leads not clipped, solder-bridge, parts touching other components, etc.
- In Terminal Mode, if Model = "??", the EEPROM has probably become cleared or corrupted.
- "Overload" fault (ctrl-u = 02) is stored during factory testing (during production). Seeing this fault stored in a field unit does not necessarily mean the overload timeout happened at the customer's site.
- "EQ charge" is normal in later versions of Lynx2 & Lynx3 firmware. If the battery voltage ever drops below 200V, the charger will go up to 235V for at least 5 minutes before settling back down to 218V. EQ charge is also performed about once every 4 weeks.l

6.6 Documenting Failures

Int'l Stars, SIEBEL, or local spreadsheets. Make sure to record all relevant information about the diagnosis:
- Reference designators of failed parts with date codes and vendor marks
- PCB revisions, firmware revisions, accessories added, etc.
- Recommend Corrective Actions and/or PCB revisions as needed.

7 ECO's

See ECO RMA database. For list as of this revision, see *Appendix B*.
- Need table showing which PCB revision combinations can be used together (examples: 762x requires 763x or later, 1kVA change)
- Need list of PCB revisions that are ok to ECO and send back to customers
- Need table showing which PCB revisions need which ECO's

8 Test After ECO's

(Final test fixture)
All calibration
Cold-boot
AC input: add/remove
Add load, check calibration of Voutput, Wout, VAout, DC buses, Vbatt, ...
AC input: add/remove
With AC input, disconnect batteries
HF-OFF check

Failure Analysis Report
& Corrective Action Plan

Customer		RMA number		
Customer location		RMA date		
Report date		PCB1 s/n	Rev	
Model		PCB2 s/n	Rev	
Unit s/n		Accessory1 s/n	Rev	

Initial Assessment

	Yes	No	Additional Information
Does the unit cold boot?	___	___	
Does the unit indicate a fault?	___	___	
Does unit operate online with no faults?	___	___	
Is there any output?	___	___	
Does unit switch to bypass?	___	___	
Do all display leds work? ("A" in SM)	___	___	
Does unit operate under 100% load?	___	___	
Unit shut off after 9 min on battery standby?	___	___	

Physical damage (deformed metal or plastic, loose connections, cut insulation, poor crimps, etc.)

Voltages:	Pos Bus	Neg Bus	Vin	Vout	Charger (no batt)	f/w rev	Fault History
Command:	Ctrl G*	Ctrl H*	Shift L	Shift O	Shift B or ^J / ^K*	b	Ctrl U*
Displays							
Measured						n/a	n/a

Voltages	5V	12V	-12V	-15V	15V	24V	Vbat (list packs separately)
Measured							

Action Taken to Repair

Repaired Unit - Measured and Calibrated Voltages

Voltages	Pos Bus	Neg Bus	Vin	Vout	Charger (batteries disconnected)	Fault History
Command	Ctrl G*	Ctrl H*	Shift L	Shift O	Shift B or Shift J / K* (Lynx 3)	Ctrl U*
Displays						
Measured						n/a

Corrective Actions to be Taken

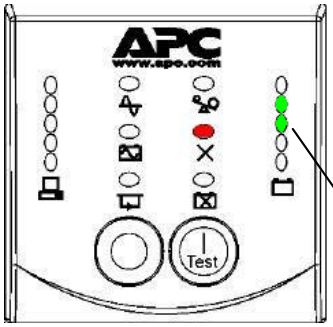
Additional Notes

*in programming mode

2/14/2005

Appendix A. Fault codes on LED display & stored in EEPROM

Display LEDs show "1" for LED ON and "0" for LED OFF in the Battery capacity bar graph. For example, the following display indicates "Battery Capacitor Soft Start Fault".



Notes
All values provided in UPS-Link terms. Overload test uses % power (watts) or % VA, whichever is greater.
The last fault(s) detected can be retrieved by sending the "Ctrl-U" command in Programming mode.

Fault	Action Taken	Display LEDs	Ctrl-U	Auto-Recover from FAILURE_BYPASS?	Repair suggestion	Related ECOs
Battery Capacitor Soft Start Fault	The unit immediately changes state to UPS_FAILURE (less than 1ms)	0 1 1 0 0	*11*	Can't be in FAILURE_BYPASS	Confirm battery voltage(s) above 165V and that +/-400V buses rise to within 15V(9V) of the battery bus(es) within 12 seconds and. If they don't, check voltage after soft-start PTCs, relay and relay drives. Lynx2: TH701. TH702, RY702, Q701, Q728, F701, F702. Lynx 3: TH1401, TH1402, TH1403, TH1404, RY1403, RY1404, RY1405, RY1406, RY1407, RY1408, Q1402, F1403, F1404, F1405, F1406	BM934

Battery <-> Line (PFC Input) Relay Weld fault	No immediate action taken. State change will take place in the next AC line cycle (9ms @50Hz or 7ms @60Hz) The UPS will transfer to FAILURE_BYPASS or UPS_FAILURE state (See State Diagram.)	1 0 0 0 1	*0D*	NO		
Bypass Relay Fault (Bypass relay is closed)	No immediate action is taken. Unit will change the state to UPS_FAILURE a half of an AC cycle later (10ms @ 50Hz or 8ms @ 60Hz)	0 1 0 0 1	*0F*	Can't be in FAILURE_BYPASS	**Lynx3:** **Confirm customer wiring to input terminal block (hardwired). Input wires might be connected to Output terminal block by mistake.** Check Bypass contactor and drive	
Bypass Relay Fault (Output is off)						
Battery Charger Fault(descent method)	No immediate action taken. State change will take place in the next AC line cycle (13.3ms @50Hz or 11.1ms @60Hz) The UPS will transfer to FAILURE_BYPASS or UPS_FAILURE state (See State Diagram.)	0 1 0 1 0	*12*	NO	Lynx 2: Check Q727, Q728, F703, F704, D736, D737, D738, D739, Q730, Q731 Lynx 3: Check Q1407, Q1408, F1401, F1402, D1406, D1407, D1408, D1409	
Battery Charger Fault (hard limit)						
DC Bus Overvoltage Fault	DC Bus Overvoltage Fault will immediately turn-off the Inverter in hardware. The PFC will be turned off upon detection of this fault. **Case 1 (Inverter relay is closed):** The Inverter will be commanded off and new state will be set: UPS_FAILURE or FAILURE_BYPASS. Should UPS transfer to FAILURE_BYPASS, output Relay will be commanded to open and Bypass Relay will be commanded to close immediately. **Case 2 (Inverter relay is open)**: UPS will transfer to UPS_FAILURE state at the closest AC line phase angle of 67.5 degrees (or in less than 18msec @50Hz or 15msec @60Hz.)	0 1 0 0 0	*08*	YES		

Fan Fault	State transitions in the next AC line cycle (4ms @50Hz 3ms @60Hz) **Note:** The UPS still tries to control the high/low speed mode selection for the fan.	0 0 1 1 0	*10*	YES	Check: Fan connections to control board (Lynx2 uses J5 only), fan guard is not pushed in, no foreign objects stuck in fan blades, fan frame not broken	
Inverter Fault (Hardware fault)	The UPS commands an immediate turn off of the Inverter, the PFC and the Charger. Next, the unit will enter either a FAILURE_BYPASS or UPS_FAILURE state (See State Diagram.) Upon setting the FAILURE_BYPASS state the UPS will command the Bypass and the Backfeed relays to close. Upon setting UPS_FAILURE state the UPS will command the Bypass and Backfeed relays to open. For either state the unit commands the Output Relay to open.**Note:** Normal UPS_FAILURE/ FAILURE_BYPASS procedure timings can not be applied in this case. The rest of hardware control operations (e.g. PFC input relay control) will take place in the next AC line cycle. So, the timings specified will start from phase angle 0.	0 0 0 0 1	*06*	NO	Lynx 2: Check Q705, Q706, Q715, Q716, Q717, Q718, D750, D751 Lynx 3: Check IC1403, IC1404, IC1407, IC1408 collector-emitter and gate-emitter	
Inverter Fault (Output voltage test)	No immediate action is taken. All state transitions are taking place in the next AC cycle. (20msec @50Hz, 17msec @60Hz)		*0B*		Same as above	
Logic Power Supply Fault	Immediately switches in UPS_FAILURE state. (See Normal Behavior for UPS_FAILURE State.)	1 1 0 0 0	*01*	Can't be in FAILURE_BYPASS	R544, R545 should be 10k	TA107

High Output Voltage	No immediate action is taken. The UPS will transfer to UPS_FAILURE or FAILURE_BYPASS state (see State Diagram) in the next AC line cycle. (19msec @50Hz or 16ms @60Hz)	0 0 0 1 1	*09*	NO		
High Output Voltage (Extreme Overvoltage)						
Output Relay Fault (bypass relay is closed)	No immediate action is taken. The UPS will transfer into UPS_FAILURE state in the next AC cycle (8ms @50Hz or 6ms @60Hz.)	0 0 1 0 1	*0E*	Can't be in FAILURE_BYPASS		
Output Relay Fault (Transferring to inverter-on state)						
Output Relay Fault (Inverter is on)						
Overload (Percent LoadInverter is on)	No immediate action is taken. All state transitions are taking place in the next AC cycle (19msec @ 50Hz or 16msec @60Hz.)The UPS will sound the beeper as long as the fault conditions are present.	Overload LED	*02*	YES	This fault is stored in 'Ctrl-U' during factory testing. It is not cleared before shipment.	
Overload (Low output voltage)			*05*			
Overload (Percent Load Bypass Relay is closed)			*03*			
Overtemperature	No immediate action is taken. All state transitions are taking place in the next AC cycle (4msec @50Hz or 3msec @60Hz.) The UPS will transfer to FAILURE_BYPASS or UPS_FAILURE (see State Diagram.)	1 0 0 0 0	*07*	YES		

PFC Failure (Inverter on, hard limit detection)	No immediate action is taken. The UPS will transfer to FAILURE_BYPASS or UPS_FAILURE state (see State Diagram.) State transitions will take place at the closest phase angle of 67.5 degrees of AC line cycle.	0 0 1 0 0	*0A*	YES	Lynx2: Q708, Q709, Q710, Q711, Q726, Q727, D748, D749, D723, DC bus and battery voltage feedback resistors, esp. R856, R857 Lynx3: IC903, IC904, DC bus and battery voltage feedback resistors	
PFC Failure (Inverter on, delta detection)						
PFC Failure (Inverter off)						
PFC Failure (Charging up DC Buses)	Upon detection of this fault, the PFC is turned off immediately, state transitions are taking place in the next AC cycle (8msec @50Hz or 6msec @60Hz.) The UPS will transfer into FAILURE_BYPASS or UPS_FAILURE state (see State Diagram.)					
PFC Failure (cold-boot)	Upon detection of this fault, the UPS will immediately enter UPS_FAILURE state.					
Short Circuit	Same as overload above.	Overload LED	*04*	Can't be in FAILURE_BYPASS		
Backfeed Relay Weld	No immediate action is taken. All state transitions are taking place in the next AC cycle. (8msec @50Hz or 6msec @60Hz) The UPS will transfer to FAILURE_BYPASS or UPS_FAILURE (see State Diagram.)	0 0 0 1 0	*0C*	NO		

Appendix B. ECO list as of October, 2005

Lynx2 modifications (Control board) – mirrored 180 degrees

Models:
SURT3000XLI
SURT3000UXI
SURT5000XLI
SURT5000UXI

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3kVA (0P7503 or 0P7603)
R544: from 100k to 173-1002 [#TA107]
R545 from 100k to 173-1002 [#TA107]
R44: from 2.37k to 173-4991 [#BM1128]

R167: from 4.12k to 173-2261 [#BM1090]
R237: from 4.12k to 173-2261 [#BM1090]

5kVA (0P7500 or 0P7600)
R544: from 100k to 173-1002 [#TA107]
R545 from 100k to 173-1002 [#TA107]
R44: from 2.37k to 173-4991 [#BM1128]

R167: from 4.99k to 173-3481 [#BM1090]
R237: from 4.99k to 173-3481 [#BM1090]

Lynx3 modifications (Control board, top side)

Models:
SURT7500XLI
SURT7500UXI
SURT10000XLI
SURT10000UXI

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All 7.5k - 10kVA
C17 from 0.47uF to 225-1105 [#BM879]

* More on other side of PCB

Lynx3 modifications continued (Control board, bottom side) – mirrored 180 degrees

Models:
SURT7500XLI
SURT7500UXI
SURT10000XLI
SURT10000UXI

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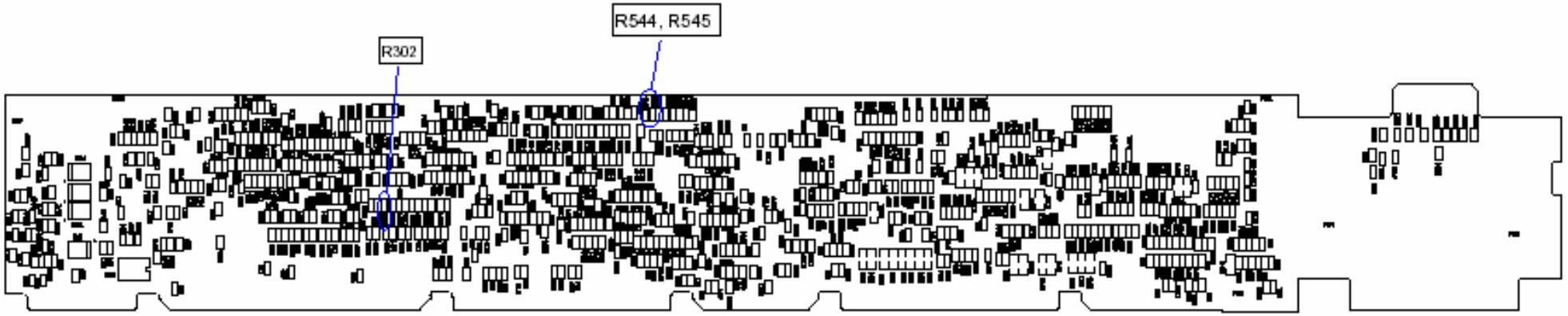

All 7.5k - 10kVA
R302 from 15k to 173-1001 [#BM879]
R544 from 100k to 173-1002 [#TA107]
R545 from 100k to 173-1002 [#TA107]

* More on other side of PCB