

## Enhanced Vehicular Charger

M-RK <sup>™</sup> .....	BML 161 67/12
Prism HP <sup>™</sup> /LPE-200 <sup>™</sup> /LPE-50 .....	BML 161 67/32
JAGUAR <sup>™</sup> 700P/Pi, P7100 <sup>IP</sup> /P5100 .....	BML 161 67/72
JAGUAR 700P/Pi/P7100 <sup>IP</sup> /P7200/P5200 Dual Position .....	BML 161 67/172

### MANUAL REVISION HISTORY

REV	DATE	REASON FOR CHANGE
E	Jul/04	Added caution statement to the dual position vehicular charger (BML 161 67/172) and incorporated new batteries.
F	Mar/09	Added warning regarding proper charger use, added P7200 and P5200 radios, other minor corrections/updates.
G	May/09	Improved troubleshooting cross-references for fuse F1.

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# 1 SAFETY SYMBOL CONVENTIONS

The following conventions are used to alert the user to general safety precautions that must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere violates safety standards of design, manufacture, and intended use of the product. Harris Corporation assumes no liability for the customer's failure to comply with these standards.



**WARNING**

The **WARNING** symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** symbol until the conditions identified are fully understood or met.



**CAUTION**

The **CAUTION** symbol calls attention to an operating procedure, practice, or the like, which, if not performed correctly or adhered to, could result in a risk of danger, damage to the equipment, or severely degrade the equipment performance.



**NOTE**

The **NOTE** symbol calls attention to supplemental information, which may improve system performance or clarify a process or procedure.



The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of Electro-Static Discharge. Proper precautions must be taken to prevent ESD when handling circuit modules.



The electrical hazard symbol is a **WARNING** indicating there may be an electrical shock hazard present.

## 2 SPECIFICATIONS\*

### 2.1 GENERAL

Size (H x W x D)	194 mm x 180 mm x 58.5 mm (7.64" x 7.09" x 2.30")
Radio Latch	Push Button - Press-To-Latch
Radio Latch Release	Push Button - Press-To-Release
Indicator Lights	
Charging (high rate)	Amber LED
Ready	Green LED
Transmit	Red LED
Typical Recharge Times	
1200 mAh NiCd Battery Pack	1 Hour
1700 mAh NiCd Battery Pack	1 Hour, 30 Minutes
2400 mAh NiMH Battery Pack	2 Hours
Temperature Limits	
Charging	0°C to +45°C (+32°F to +113°F)
Operating	-30°C to +60°C (-22°F to +140°F)
Charge Fault Detection	
Battery pack voltage beyond limits	Low Battery Voltage
Battery pack temperature beyond limits	High/low temperature limits
Duty Cycle	50%

### 2.2 ELECTRICAL

Nominal Input Voltage	13.8 Vdc $\pm$ 20%
Maximum Current Drains	
Off	5 mA
On and Not Charging	100 mA
Fast Charge Currents	
Fast Charge	1.5 A
Trickle Charge	75 mA
External Speaker	
Rated Audio Power Output	10 Watts
Impedance	4 Ohm Load
Maximum Audio Distortion	Less Than 5.0%
Frequency Response	300 Hz to 3000 Hz

\* These specifications are intended primarily for the use of service personnel. See the appropriate Specification Sheet for complete specifications.



### 3 DESCRIPTION

Harris' Enhanced Vehicular Charger, BML 161 67/12, BML 161 67/32, BML 161 67/72, or BML 161 67/172 provides a mobile charging capability for either the M-RK™, Prism HP™/LPE-200™/LPE-50, JAGUAR™ 700P/Pi, P7100<sup>IP</sup>, P5100, P7200, and P5200 personal handheld radios as follows:

M-RK (BML 161 67/12):

- 19A149838P1 (1200 mAh) NiCd Battery Pack
- 344A3076 (1700 mAh) NiCd Battery Pack

Prism HP/LPE-200/LPE-50 (BML 161 67/32):

- BKB 191 202 (Extra High Capacity) NiCd Battery Pack
- BKB 191 203 (High Capacity) NiCd Battery Pack

JAGUAR 700P/Pi, P7100<sup>IP</sup>, P5100, P7200, and P5200 (BML 161 67/72):

- BKB 191 210/3 (High Capacity, Non-Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/33)
- BKB 191 210/5 (High Capacity, Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/35)
- BKB 191 210/23 (High Capacity, Non-Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/43)

The enhanced units listed above operate with battery packs as specified and will accommodate either standard or extra high capacity battery packs.

JAGUAR 700P/Pi, P7100<sup>IP</sup>, P5100, P7200, and P5200 Dual Contact (BML 161 67/172):



The dual contact version allows battery charging with a speaker/mic attached. This capability is only available when using speaker/mic P/N's KRY 101 1617/185, KRY 101 1617/186, or equivalent mics specifically identified as vehicular charger compatible.

- BKB 191 210/3 (High Capacity, Non-Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/33)
- BKB 191 210/23 (High Capacity, Non-Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/43)
- BKB 191 210/4 (Extra High Capacity, Non-Intrinsically Safe) NiMH Battery Pack (superceded by BKB 191 210/34)
- BKB 191 210/24 (Extra High Capacity, Non-Intrinsically Safe) NiMH Battery Pack (superceded by BKB 191 210/44)
- BKB 191 210/5 (High Capacity, Intrinsically Safe) NiCd Battery Pack (superceded by BKB 191 210/35)
- BKB 191 210/6 (Extra High Capacity, Intrinsically Safe) NiMH Battery Pack (superceded by BKB 191 210/36)



NOTE

Only BML 161 67/172 supports nickel-metal hydride battery packs.

The portable radio can be operated as a pseudo-mobile radio when fully inserted into the charging insert. Provision for this operation is designed into the charger with a vehicular antenna, a remote microphone, and a remote speaker connected at the back of the charger. The connections to the radio, required for this operation, are made through a Universal Devices Connector (UDC). The radio is inserted into the charging insert by pushing the large latch button on the front panel of the station into the locked position. In this position the portable radio is locked into the charging insert and the UDC contacts meet with mating contacts on personal radio. Pushing the small blue release button, located inside the large latch button on the front panel of the charger, releases the radio.

When a radio is inserted into the charging insert, charging contacts are automatically made at the back of the radio. A "radio detect" microswitch, located near the charging contacts, applies power and the fast charge begins, provided the battery is within the acceptable temperature range.

The high/low temperature limit detector circuit measures battery pack temperature by monitoring the resistance of the battery pack thermistor. It provides a signal to the charge controller if the battery is within acceptable temperature limits for fast charging.

### 3.1 LED INDICATORS

The front panel of this charger has three (3) indicator LEDs: **TX/BSY**, **RDY**, and **CHRG**.

1. **TX/BSY** (red) - This LED is on when the PTT switch is pressed and the transmitter is active.
2. **CHRG** (amber) - When the radio is inserted in the charger, this LED flashes for 3-5 seconds, then lights steady to indicate the battery is rapid charging. When the internal battery voltage and temperature is too high or too low, this LED will continue to flash after the 3-5 second period (refer to Section 6).
3. **RDY** (green) - This LED will light when the radio battery is 90 to 100 percent charged and the charger is in trickle charge mode.

### 3.2 LATCH BUTTON

The latch button secures the radio in place while the battery pack is charging. When the latch is activated, no other electrical connections are made to the radio. This latch should always be engaged when the radio is in the vehicular charger and the vehicle is moving.

### 3.3 RELEASE BUTTON

The release button disengages the latch so the radio can be removed from the charger.

### 3.4 ACCESSORY CONNECTOR

A DB-25 Accessory Connector (P1) provides connections for the power cable, speaker leads, repeater control, hookswitch and optional control head leads to the charger. DC Power from the vehicle battery is routed through the alternator noise filter.

### **3.5 ALTERNATOR NOISE/TRANSIENT FILTER**

This filter reduces the alternator noise on the incoming DC power to prevent noise from being heard from the receiver or appearing on the transmitted signal. The transient filter prevents damage due to short term reversed polarity DC voltages, or from high voltage, positive or negative voltage spikes, caused by automotive electronics.

### **3.6 HIGH RATE CONSTANT CURRENT SOURCE**

This is an active constant current source used to regulate charge current.

### **3.7 CHARGE CONTROLLER**

The charge controller (U2) enables or disables the high rate constant charge current. Functions performed by this controller are:

- Shorted cell detection
- Over/Under voltage detection
- Over/Under temperature detection
- Battery pack removal sensor
- $-\Delta V$  and  $\Delta T/\Delta t$  for charge control
- Charge indicator control and fault display

### **3.8 HI/LO TEMPERATURE LIMIT DETECTOR**

This circuit is part of the charge controller and measures battery pack temperature by monitoring the resistance of the battery pack thermistor. It provides a signal to the charge controller (0°C to +45°C) (+32°F to +113°F).

### **3.9 AUDIO AMPLIFIER**

Receiver audio at a fixed level from the radio UDC is amplified by this audio amplifier (U8) to 10 Watts of audio power output. The audio level is adjusted by audio taper volume control *R302* in the charger. This amplifier is enabled or disabled by the UDC **MUTE OUT** lead to prevent alternator noise or other transients from being heard while the radio is in the squelched condition.

### **3.10 5-VOLT REGULATOR**

This regulator circuit (U1) provides a regulated general circuit + 5 Vdc and is switched on by inserting a radio into the charging sleeve.

### **3.11 REMOTE CONTROL LOGIC INTERFACE**

The Remote Control Logic Interface takes serial data control signals from the radio UDC and translates these signals to IEE-485 logic levels. This complies with the Orion<sup>™</sup> Control Head data interface.

### 3.12 MICROPHONE CONNECTOR

The microphone connector provides connections for the external microphone, PTT switch and Channel Guard hook switch.

### 3.13 ANTENNA CONNECTOR

This is a TNC connector, located on the back of the housing, is connected to the radio UDC RF connector with low loss coax.

### 3.14 UNIVERSAL DEVICES CONNECTOR (UDC)

The Universal Devices Connector provides control and audio interface leads for the Enhanced Vehicular Charger. When the radio is operating, the configuration of the UDC jack is set by a programming resistor connected to the UDC sense on Pin 8. The vehicular charger has an internal DIP switch that can connect one of the three resistor values to the sense pin. The values of the three resistors are 3160, 5360, and 6490 ohms. The Prism Enhanced Vehicular Charger is shipped from the factory with the 5360 ohm resistor connected. This selects Mode 1 operation: **pseudo-mobile radio with external speaker and external microphone**. The radio display is normal.

### 3.15 RF BYPASSING

Because the Enhanced Vehicular Charger may be installed in vehicles containing other high-powered radio equipment, all leads connecting to the charger are bypassed to prevent malfunction caused by RF energy fed into the charger.

## 4 COMPATIBILITY

The table below indicates each radio and the supported Flash Code versions required for “Pseudo” Mobile and Remote Control Head operation.

RADIO TYPE	SUPPORTED FLASH CODE VERSIONS	
	"PSEUDO" MOBILE OPERATION	REMOTE CONTROL HEAD OPERATION
M-RK I <sup>2</sup>	G22 or higher	G22 or higher
M-RK II/Scan <sup>1</sup>	G13 or higher	G13 or higher
JAGUAR 700P/Pi (KRD 103 161 Models)	R2A or higher	R2A or higher
JAGUAR 700P/Pi (RU101219V1 and V2 Models)	R1A or higher	R1A or higher
P7100 <sup>IP</sup>	R1A or higher	R1A or higher
P5100	R1A or higher	R1A or higher
P7200	R1A or higher	R1A or higher
P5200	R1A or higher	R1A or higher

<sup>2</sup> M-RK I, II, Scan models 256k and 512k support only (128k is not supported).

## 5 OPERATION

When the Enhanced Vehicular Charger is operated as a vehicular charger, the operation is automatic when a radio is inserted into the charging sleeve. The radio is inserted into the charger when the battery pack needs recharging or when the radio is to be used as a pseudo-mobile radio. For complete operating instructions refer Operator's Manual AE/LZT 123 3257/1.



**CAUTION**

The following actions could trigger unusual Enhanced Vehicular Charger behavior and is not a proper use of the equipment as designed:

- Do not turn the portable radio on and put it into the EVC and then start the vehicle.
- Do not leave the portable radio on with the portable in the EVC and turn the vehicle off.

The charger allows the radio to operate as a pseudo-mobile radio while the battery pack is simultaneously being charged. The procedure is as follows:

1. Before attempting to insert the personal radio into the charging sleeve, verify that the LATCH is in the released position. If not, unlock if necessary and press down on the RELEASE BUTTON until the latch snaps to the released position.



**CAUTION**

The radio should never be inserted into the charger while the latch is engaged. Damage to the UDC and RF pin could result.

The radio unit should never be inserted or removed from the charger using the antenna as a handle, as this may damage the antenna or unit.

Prior to inserting the radio, it should be aligned with the charger sleeve. Damage may result if the radio is angled such that it impacts the UDC RF pin.



**CAUTION**

The UDC cover must be removed from the radio prior to placing the radio into the charger.

2. Insert the Personal Radio into the charger by sliding it down into the slot. The radio should be inserted so that the front of it faces the top of the charger unit. When fully inserted, the radio extends approximately 1/8" above the front of the charger. The fast charge begins immediately after a short charge evaluation period indicated by the flashing charge LED and the yellow charge indicator is illuminated.
3. Engage the interfacing UDC by engaging the LATCH, until it clicks into the latched position. This connects the radio to the charger audio circuits and to the external antenna. The radio cannot be removed from this position until the UDC is unlatched using the RELEASE BUTTON in the center of the LATCH.
4. Turn the power to the radio ON by rotating the power ON-OFF/Volume knob clockwise out of the detent (OFF) position.

**NOTE**

Portable radio display will read “Dual.” If the display does not read “Dual,” please check the portable radio code version. See table in Section 4.

5. The charger and radio are now set for mobile operation (if the DIP switches are in the correct position). Use the charger volume control knob to adjust the external speaker volume level and use the microphone PTT button to transmit. The red LED transmits indicator (**TX**) lights when the radio is transmitting.
6. When removal of the radio is necessary, disengage the UDC INTERFACE by pressing down on the **RELEASE BUTTON** until the **LATCH KNOB** snaps to the released position. Grip the radio on the top and bottom and pull it out of the charger.

**CAUTION**

When the battery is placed in the upper position (i.e., radio with speaker/mic attached) in the charger, it is designated for battery charging only. The radio may be on and receiving calls, but **TX** is not allowed. If an attempt is made to transmit during battery charging in the upper position, the charge cycle may be terminated early (battery incompletely charged). If this occurs removing and re-inserting the radio into the charger must restart the charge.

## 6 BATTERY CHARGER DETAILS



NOTE

1. To maximize battery life, the Vehicular Charger is designed with automatic controls which limit the rapid charging of the battery pack if the internal battery temperature is below 0°C (+32°F) or above +45°C (+113°F). The charger indicates this high or low internal temperature condition by a blinking amber LED.
2. If a blinking amber LED is observed, the operator must wait until the internal battery temperature stabilizes within the allowable range before restarting the charging procedure by removing and re-inserting the radio into the charger.
3. In a vehicular application, with either high ambient temperature inside or outside of the vehicle, the automatic charging control will prevent rapid charging or limit the time of rapid charging.
4. In other situations, where the operator inserts or removes the radio many times during a short period of time, the automatic control will sense a high internal battery temperature (due to start-up rapid charging of the battery) and will prevent further rapid charging of the battery until the internal temperature of the battery stabilizes within the acceptable range.

When the radio (with battery pack) is placed into the charging sleeve, the radio battery pack is charged. The fast or “rapid” charge feature normally is applied immediately and is controlled by the circuits within the charger. The following details apply to the battery charge feature:

- Normally, when initially placed in the charger, the battery pack is fast charged and the amber **CHRG** LED glows continuously until it is near a full charge (between 90% and 100% full charge). At this time, the charger switches to a slow or “trickle” charge and the green **RDY** LED is illuminated.
- The amber **CHRG** LED lights when the unit is fast charging.
- If the **CHRG** LED flashes, the battery is not being fast charged. Several factors may cause this to occur. These include dirty battery pack contacts, an extremely hot or cold battery pack, a deeply discharged battery pack, or a defective battery pack.
- The amber **CHRG** LED turns OFF and the green **RDY** LED turns on when the unit has completed the fast charge and the “trickle” charge starts.



## 7 CIRCUIT ANALYSIS

The Enhanced Vehicular Charger converts the portable radio into a “pseudo” mobile radio. This is accomplished by transferring the PTT and microphone functions on the portable to an external hand held microphone. The speaker in the portable is bypassed and speaker audio is sent through a 10-watt audio amplifier in the charger and fed to an externally mounted speaker. The antenna in the portable is bypassed and this function is transferred to an external antenna located on the outside of the vehicle.

The enhanced charger adds the functional blocks of a Dead Battery Power Supply, audio amplifier, RS-485 network, microphone, and antenna interface (Figure 7-1 and Figure 7-2). All signal inputs and outputs to/from the charger are through the following connectors:

- Female DB25 mounted externally on the charger
- External microphone connector
- External antenna connector
- Universal Device Connector (UDC)

### 7.1 DEAD BATTERY POWER SUPPLY

The Enhanced Vehicular Charger, as described earlier, converts a portable radio into a pseudo-mobile radio. If the battery pack voltage is below 6.5 volts, the transmitter is inhibited or locked out. This means the transmitter cannot use the battery pack as a power source. The purpose of the Dead Battery Power Supply is that, if a portable radio is initially inserted into the charger with a discharged battery pack, to place 7.5 volts across the portable radio battery terminals so the radio can transmit. This essentially overrides the TX Lockout.

The Dead Battery Power Supply is turned on by the PTT signal (-T/R) from the radio UDC and microphone. This means the Dead Battery Power Supply is activated every time the transmitter is keyed. However, the Dead Battery Power Supply is only effective until the battery pack voltage becomes greater than 7.5 volts (battery voltage during charge is typically 8 to 9 volts). While transmitting, the charge controller is inhibited.

In summary, the Dead Battery Power Supply is active under the following conditions:

- Battery voltage is <7.5V.
- -T/R output from the radio UDC is logic low (this line goes low when the radio goes into TX mode).

### 7.2 REMOTE CONTROL INTERFACE

When the portable radio is in the pseudo-mobile mode, the user has the option to remotely control the portable with an Orion™ control head. In this mode, all keypad controls and the portable display is transferred to the remote control head (except for Prism HP/LPE-200/LPE-50 portable).



Remote Control Head operation is not available with Prism HP/LPE-200/LPE-50.

The charger accepts serial data from the portables only and converts it to RS-485 levels in order to communicate with the remote control head.

### 7.3 MODES OF OPERATION

The mode of operation is controlled by sense resistors located inside the charger, which the portable radio reads on a power up cycle. These sense resistors are DIP switch selectable so the user can change the configuration of the charger.

### 7.4 INPUTS, FILTER, AND POWER SWITCH

Operating power for the charger is applied to connector P1, Pins 1 and 7(-), 2, 3 and 15(+). Diode D1 provides reverse polarity protection. RV1 suppresses excessive voltage. Capacitors C1, C4, C20, C26, C27, C35, C83, and C84 and inductor L25 form a pi-filter for the dc input power.

Inserting a battery pack into the charging sleeve closes "radio detect" microswitch SW100 (Prism HP/LPE-200/LPE-50, JAGUAR 700P/Pi, P7100<sup>IP</sup>, P5100, P7200, and P5200) or SW200 (M-RK) located near the bottom of the charging sleeve slot. With this switch closed, filtered 13.8 Vdc (nominal) power enables the charger.

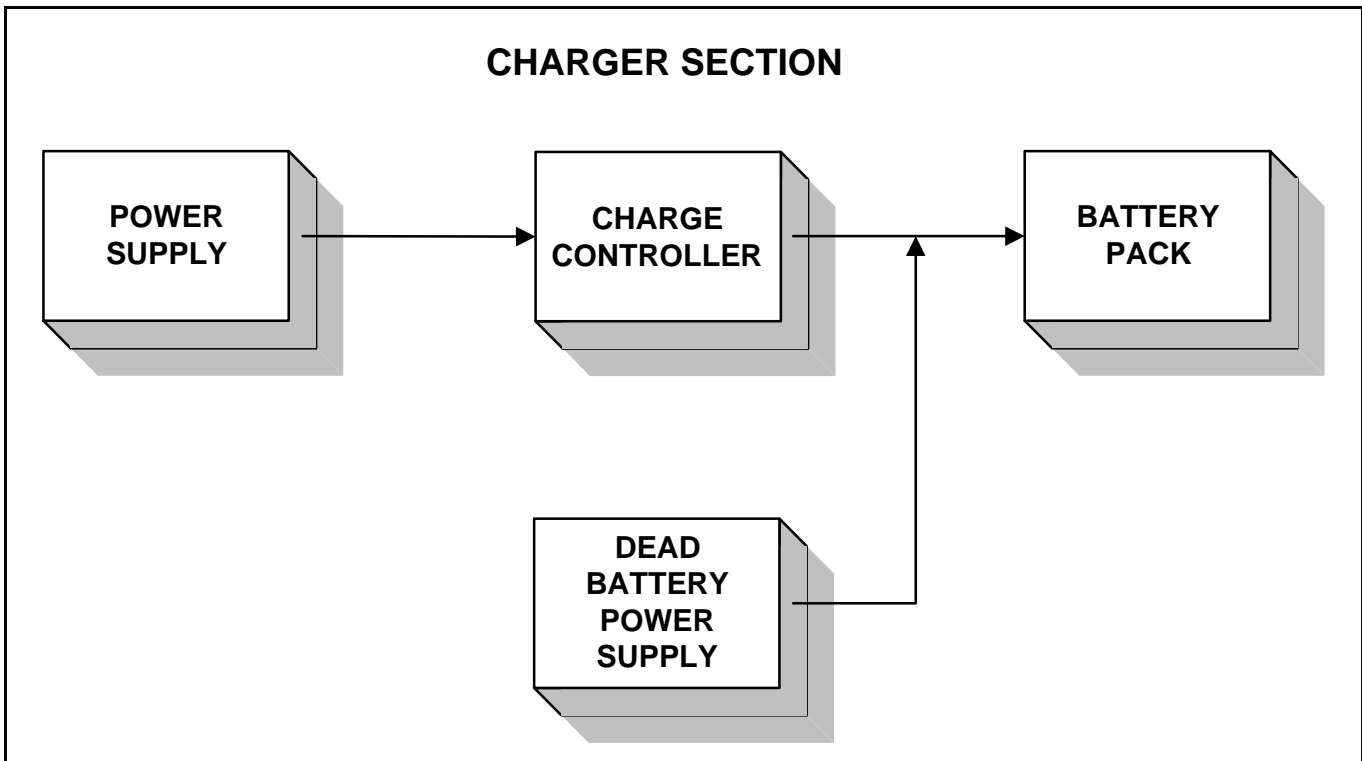
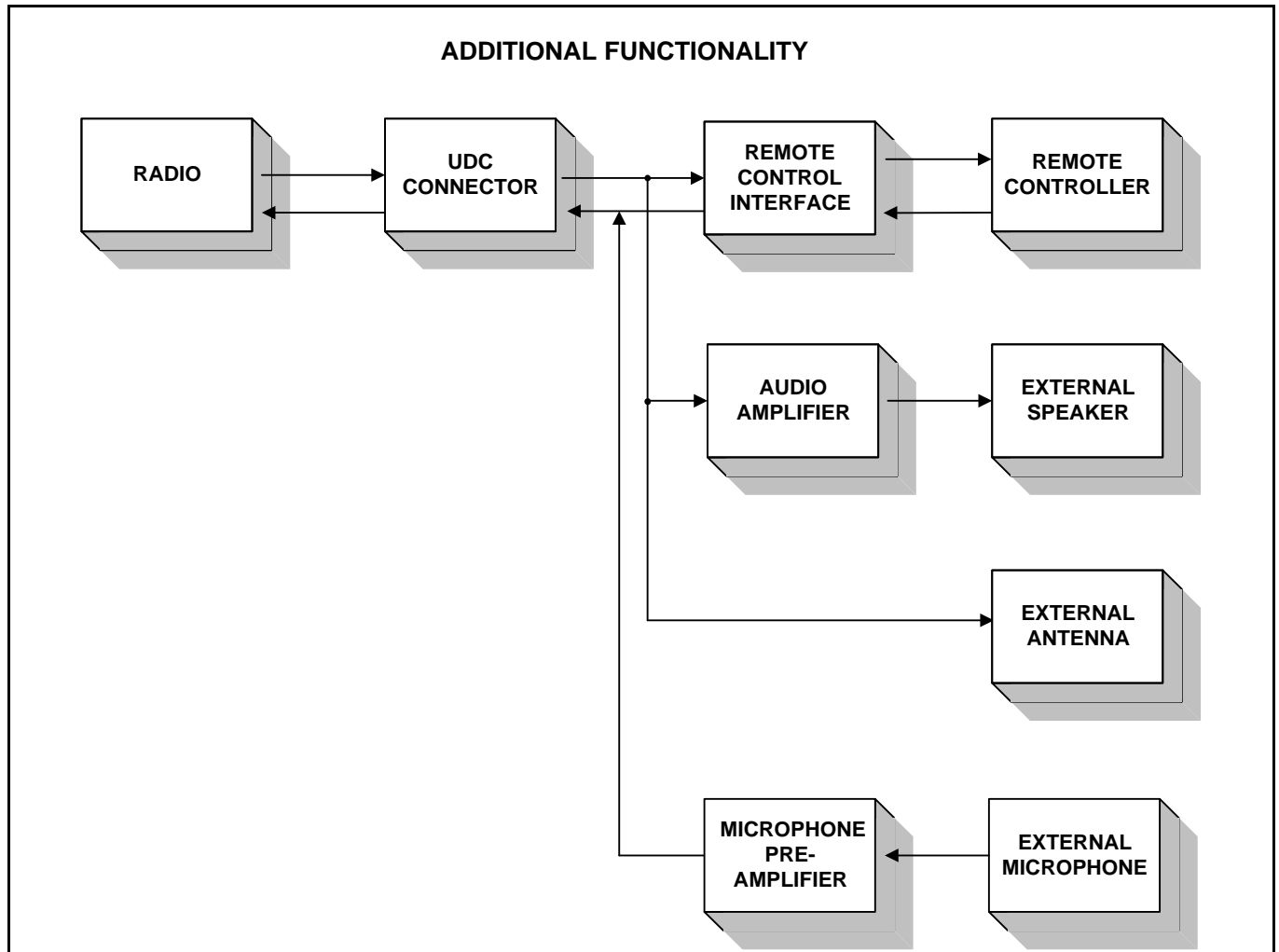


Figure 7-1: Block Diagram (Charging Circuit)



**Figure 7-2: Block Diagram (Additional Functions)**

**7.4.1 Switching Regulator Circuit**

The switching regulator is a low loss synchronous buck converter, which operates in several different modes. Converter controller U3 and the half-bridge MOSFET Q10 switch the filtered input power to inductor L27 and the output filter capacitors C90 and C37. Diode D15 blocks any reverse current from the battery pack. Diode D12 and resistor R63 provide trickle charge current to the battery pack. Quad Operational Amplifier (Op-Amp) U9, Quad Bilateral Switch U10 and Quad Two-Input NAND Gate U11 control the operating mode of the switching regulator. This is in response to battery pack voltage, output voltage, output current, charge controller output and the T/R signal from the UDC.

**7.5 EXTERNAL SPEAKER AMPLIFIER**

Integrated circuit U8 (TDA7240A) is the audio power amplifier that drives the external speaker. This IC is secured to the case to provide heat dissipation. Audio from the radio on the RX AF OUT line (UDC, Pin 9) passes through a mute switch in quad bilateral switch U4 and the volume control before it is applied to U8 for amplification.

Volume control R302 provides adjustment for the external speaker audio. This rotary control also has an On/Off switch.

The volume control on the top of the radio is disabled when the radio is placed in the charger and latched in. Attenuated audio from the wiper of R302 is applied to the input of U8, Pin 3. Typical signal level at Pin 3, is 60→110 mVrms when R302 is fully clockwise and the radio is receiving a 1 kHz tone.

Audio power amplifier U8 provides approximately 15 dB of power gain. This IC has differential outputs that drive the speaker with up to 10 watts of audio power. The outputs are routed to pins on the DB-25 connector on the bottom of the unit (P1, Pins 18 and 19). Switched dc operating power for U8 is applied to U8, Pin 6 from transistor Q3.

## **7.6 EXTERNAL MICROPHONE AMPLIFIER**

The external microphone amplifier circuit consists of operational amplifier U7B. The input to the amplifier is through microphone connector CN6, Pin 1 and connects through dc blocking capacitor C60 to the negative input terminal of U7, Pin 6. The amplifier circuit provides -15 dB of gain for the microphone input. The output of the amplifier is from U7, Pin 7 through blocking capacitors C63 and C62 to the UDC, Pin 4, EXT. MIC IN.

## 8 MAINTENANCE

This maintenance section contains Adjustment Procedures and Disassembly Procedures.

### 8.1 ADJUSTMENT PROCEDURE

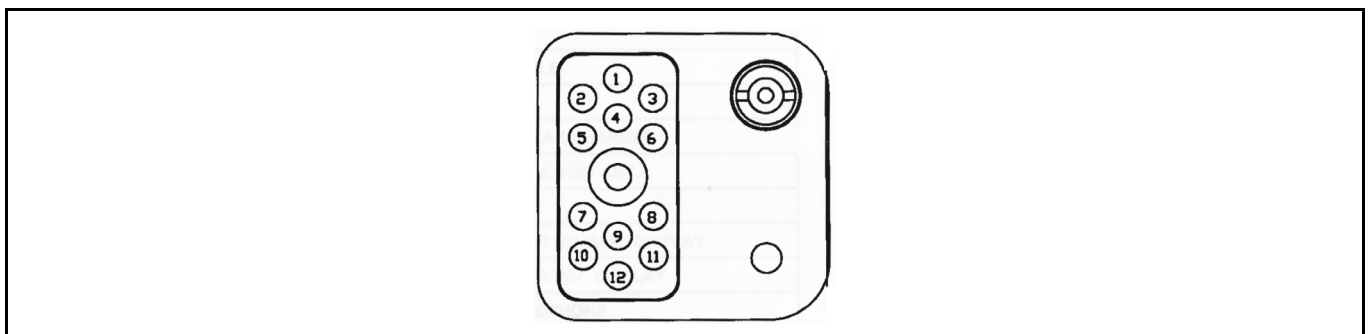
The only adjustment to the charger is the setting of DIP switch S9. The factory DIP switch settings are as shown in Table 8-1.

**Table 8-1: DIP Switch Factory Settings**

S9-1	S9-2	S9-3	S9-4	S9-5	S9-6	S9-7	S9-8
OFF	ON	ON	ON	OFF	OFF	ON	ON

### 8.2 DISASSEMBLY PROCEDURE

1. Remove the radio from the charger (UDC in released position).
2. Remove the charger from the vehicle.
3. Remove the charging sleeve:
  - Remove the two 3.5 mm TORX® screws located on the back of the charger.
  - Remove the charging sleeve by pulling straight forward toward the front of the charger. When rear bosses of the sleeve reach the UDC, lift the sleeve straight up. This allows the sleeve to clear the capture in the charger.
4. Remove the charger top cover.
  - Remove four TORX screws from the bottom of the charger.
  - The cover can now be tilted up from the back edge, rotating around the front lower edge of the charger, until it is approximately 45 degrees from horizontal, then slipped forward and off. The front panel, with all switches and indicators, remains attached to the base casting.



**Figure 8-1: Universal Device Connector (UDC)**



The UDC/latch mechanism alignment has been set at the factory. Loosening or otherwise adjusting this assembly may cause UDC-radio interface problems.

## 9 TROUBLESHOOTING

The first step in troubleshooting the *Enhanced Vehicular Charger* is to make a careful visual inspection of the unit for signs of burning or overheating of components. Also check for loose connections and cracked components. If there is no visible evidence to indicate the location of the failure, the next step is to troubleshoot by voltage measurements and/or signal tracing. For this purpose, functional diagrams are provided.

### 9.1 QUICK CHECKS

- Check fuse F1. This 5 amp fuse is typically located within the fuse holder near the battery end of the power cable between the positive battery post (or positive power source) and the DB25 connector on the charger. Refer to Operator/Installation Manual AE/LZT 123 3257/1 shipped with the charger and available online at [www.harrispublicsafety.com](http://www.harrispublicsafety.com).
- Check all power cable connections to charger.
- Check using a known good battery pack.
- Check battery sleeve charging contacts.
- Check battery sleeve connections to connector PCB.
- Check inside connections between connector PCB and control PCB.
- Inspect for cold solder joints, solder bridges, or pattern cuts.

### 9.2 CHECKING PROCEDURES

The following procedures aid in isolating failures to field/shop replaceable assemblies. The procedures do not attempt to isolate failures to the component level.

#### 9.2.1 Fault Condition 1

Charger does not charge, as indicated by **CHRG** (amber) LED not lighting.

1. With a known good battery as a load, check the output voltage of the Charge Control assembly. Voltage at J8A, Pins 1-3 should be 6.15 Vdc to 11.8 Vdc. If the voltage is greater than 10.5 Vdc, there is the possibility that the battery load is not properly connected to the charge control assembly. Check charge path connections between +BAT terminal of the charger sleeve, as well as continuity to the battery charging contact. Check for continuity between the ground return -BAT and the "-" terminal of the sleeve/battery terminal. Check for dirt on both charger and battery contacts.
2. Check the supply voltage to the CPU. Voltage at U2 (between Pins 12 and 13) should be +5 Vdc  $\pm 0.25$  Vdc.

This voltage is the output of regulator circuit U1 contained on the main circuit board assembly.

#### 9.2.2 Fault Condition 2

Charger does not charge, as indicated by the **CHRG** (amber) LED flashing.

1. If the battery voltage is below 6.15 Vdc, the battery may be either excessively discharged or contains one or more shorted cells. Under these conditions, the charge control circuit normally enters a pre-charge mode or trickle charge. If this condition persists with a known good battery and there is continuity in the path between the battery and U2, then a failure in the charge control circuitry is indicated and the main circuit board must be replaced.

If the battery is excessively discharged, the vehicular charger supplies the pre-charge trickle charge to the battery. Under this condition, if the battery is good, the trickle charge raises the battery voltage above 6.15 Vdc in less than 10 minutes. Once the voltage reaches 6.15 Vdc, the charger automatically switches to the normal rapid charge rate, which is indicated by the constant **CHRG** (amber) LED.

If the battery pack is too cold, the amber LED flashes once the battery pack warms up to 0°C (+32°F) and the rapid rate of charge starts.

With a hot battery pack, the amber LED flashes until the battery pack cools down to +45°C (+113°F).

2. The flashing **CHRG** (amber) LED indicates battery temperature outside the acceptable range for rapid charging. This indication results from the following sequence: After the excessively hot or cold battery is inserted into the sleeve, the **CHRG** (amber) LED remains ON for approximately 10 seconds, which indicates normal battery voltage, and then goes into the flashing mode.

Upon insertion of the battery into the charger, the charge control circuitry measures the resistance of the internal battery thermistor, via the connection from connector J8B, Pin 4 through inter-connecting cables/PCB to the thermistor contact on the sleeve. With a known good battery at room temperature +25°C (+77°F), the thermistor resistance is approximately 50 k Ohms. If the **CHRG** (amber) LED is flashing with a room temperature battery in the sleeve, check for continuity or shorts from the battery thermistor contact to charger controls path.

If the **CHRG** (amber) LED blinks continuously for more than 10 minutes and the battery temperature is within the operating range 0°C to +45°C (+32°F to +113°F) measure the battery voltage at J8B, Pins 1-3 and J8B, Pins 5-7. Below 6.0V indicates a defective battery.

### **9.2.3 Fault Condition 3**

Premature termination of rapid charge prior to full charge (LED is flashing **RDY** [green]).

1. This failure mode is the result of the charge control circuit detecting a minus delta ( $\Delta$ ) V condition early in the charging cycle. This condition is the result of a marginal battery or a battery that has limited capacity and is close to the end of its life. The battery should be discarded and replaced with a known good battery.
2. If the temperature of the battery pack goes above +45°C (+113°F) after the rapid charge rate has begun, the rapid rate will terminate and the **RDY** (green) LED indicator will come on. Battery over voltage (11.8V), battery over temperature +45°C (+113°F), and battery time out (90 minutes) will result in termination of charging. The normal method of charge termination is when there is a  $-\Delta V$  of 60 mV or when:

$$\Delta T/\Delta t > 1^\circ\text{C}/\text{minute}$$

( $\Delta$ Temperature/ $\Delta$ time)

3. If the battery pack voltage goes above 11.8V after rapid charge has begun, rapid charge will terminate.

## 10 PARTS LISTS

### 10.1 ENHANCED VEHICULAR CHARGER ASSEMBLY (REVS THROUGH R5A)

ITEM	PART NUMBER	DESCRIPTION
1		Base Assembly
2	M39/7028230200	Cover Assembly
3	M39/7028011500	Main PCB
4	M39/9203680000	Latch Assembly
5	N/A	N/A
6	N/A	N/A
7	M39/7028020500	Volume Flex
8		Switch Cap
9		Switch Membrane
10		Label Assembly
11 thru 19	M39/9203500000	---HARDWARE KIT---
11	M39/3023250000	Door
12		U-Clip
13		M3 Hex Nut
14		M3 Lock Washer
15		M3 5x12 Flat
16	M39/5051320000	M3 5x.6x10 Flat
17	M39/5051440000	M3 5x.6x32 Round
18		ME 5x.6x10 Round
19	M39/4035130000	D-Sub Socket Screw

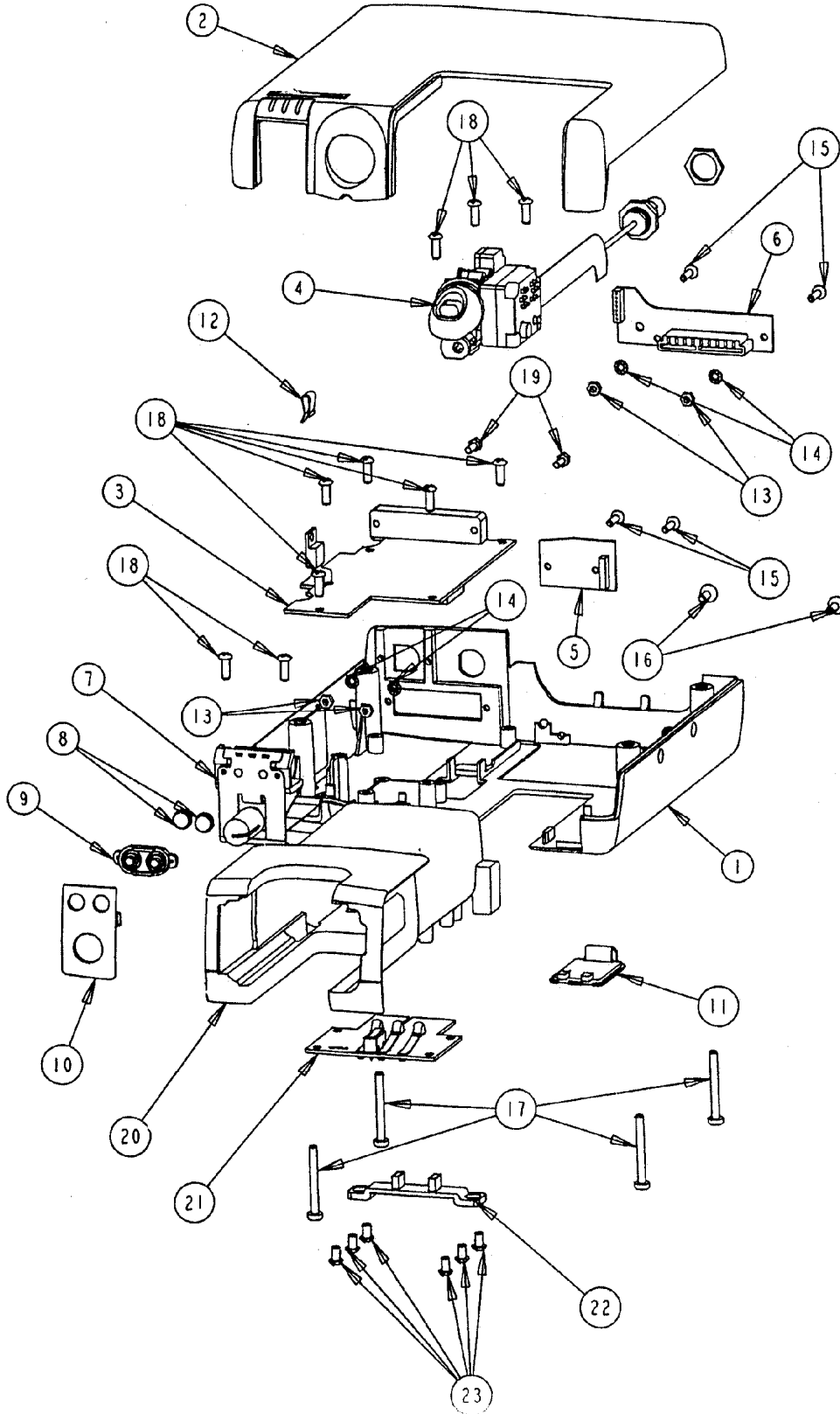
#### M-RK SLEEVE ASSEMBLY (Revs through R5A)

ITEM	PART NUMBER	DESCRIPTION
20	M39/3900870000	M-RK Sleeve
21	M39/7027950000	M-RK PCB Assembly
22	N/A	N/A
23	M39/5051310600	M3 5x.6x6 Round

#### PRISM HP/LPE-200/LPE-50 SLEEVE ASSEMBLY (Revs through R5A)

ITEM	PART NUMBER	DESCRIPTION
20	M39/3900880000	Prism HP/LPE-200/LPE-50 Sleeve
21	N/A	N/A
22	N/A	N/A
23	M39/5051310600	M3 5x.6x6 Round





**Enhanced Vehicular Charger (Revs through R5A)**

## 10.2 VEHICULAR CHARGER ASSEMBLY (REVS R6A AND HIGHER)

ITEM	PART NUMBER	DESCRIPTION
1	M39/1018940500	Base Assembly
2	N/A	N/A
3	M39/7028010500	Main PCB Assembly
4	M39/9203680000	Latch Assembly (see chart below)
5	M39/7028210000	Mic Board Assembly (For Dual Contact Charger only)
7	M39/7028020500 M39/7028021500	VOL/Flex LED PCB For Dual Contact Charger only
10	M39/7037990200	Label Assembly
11	M39/3900980000	Door
12		U-Clip
15	M39/5051320000	M3.5x.6x10 Flat
16	M39/5051440000	M3.5x.6x32 Round
17		M3.5x.6x10 Round
18	M39/4035130000	D-Sub Socket Screw

### LATCH SUB-ASSEMBLIES

ITEM	PART NUMBER	DESCRIPTION
4A	M39/920362000	UDC Flex Sub-Assembly
4B	M39/9203660000	RF Housing Kit
4C	M39/4034300000	RF Center Pin

### M-RK SLEEVE ASSEMBLY (Revs R6A and Higher)

ITEM	PART NUMBER	DESCRIPTION
16	M39/5051310600	M3 5x.6x6 Round
20	M39/3900870000	M-RK Sleeve
21	M39/7027950500	M-RK PCB Assembly

### PRISM HP/LPE-200/LPE-50 SLEEVE ASSEMBLY (Revs R6A and Higher)

ITEM	PART NUMBER	DESCRIPTION
15	N/A	N/A
16	M39/5051310600	M3 5x.6x6 Round
20	M39/3900880000	Prism HP/LPE-200/LPE-50 Sleeve
21	M39/7027960500	Prism HP/LPE-200/LPE-50 PCB Assembly

### JAGUAR 700P/Pi and P7100<sup>IP</sup> SLEEVE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
16	M39/5051310600	M3 5x.6x6 Round
20	M39/3902320000	JAGUAR 700P/Pi and P7100 <sup>IP</sup> Sleeve (single and dual position) - sleeve only
21		Dual Position Charger – sleeve PCB only
		Limit Switch PCB Assembly (For Dual Position Charger only)
		Cable Assembly (Dual position Charger only)

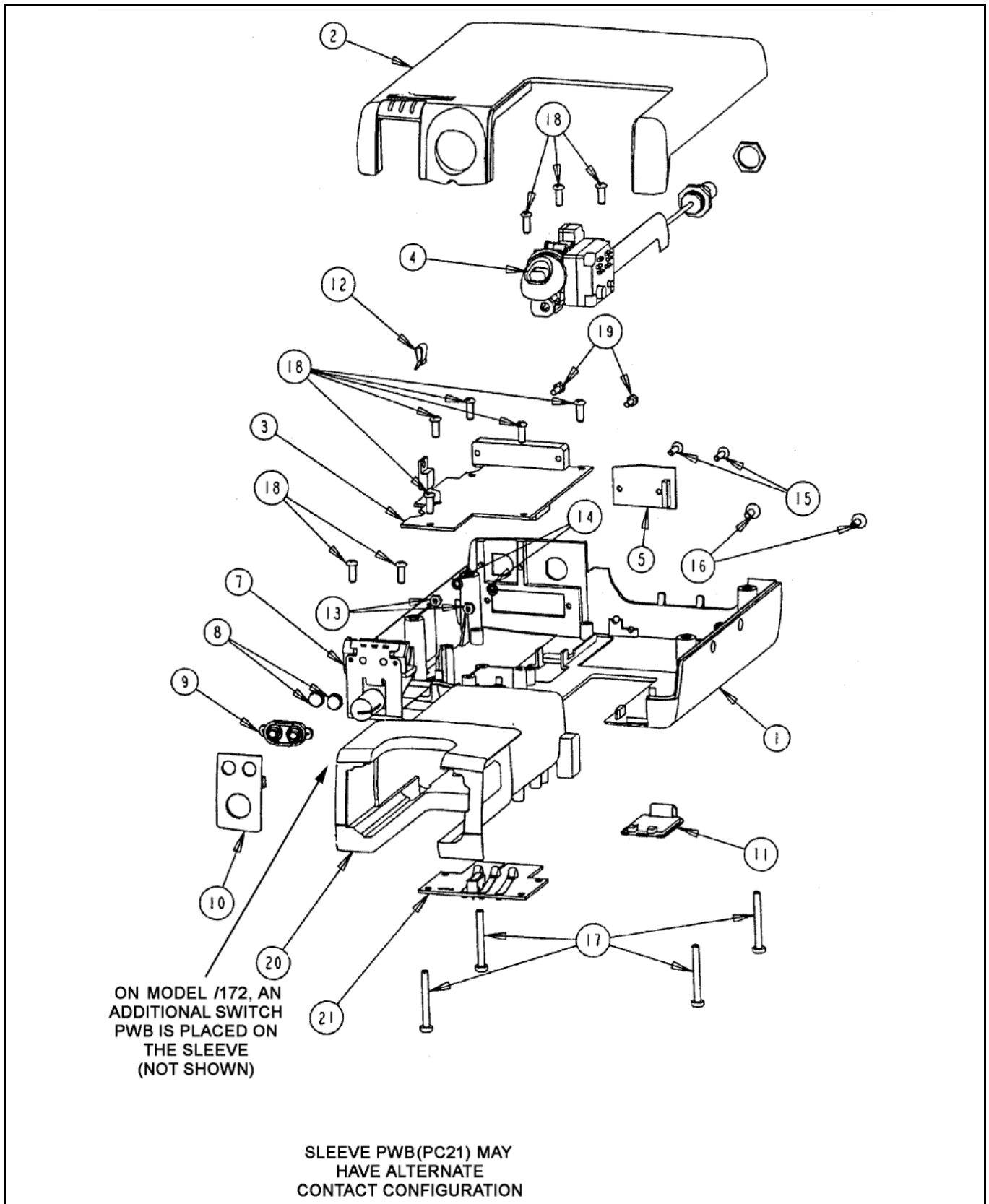


Figure 10-1: Enhanced Vehicular Charger (Revs R5A and Higher)

### 10.3 ENHANCED VEHICULAR CHARGER (REVS R5A OR EARLIER)

BML 161 67/12 - M-RK Battery Packs  
BML 161 67/32 - Prism HP/LPE-200 Battery Packs

SYMBOL	PART NUMBER	DESCRIPTION
3		<b>MAIN BOARD</b>
		--- CAPACITORS---
C1, C4, C17 and C21		100pF, 50 V
C22 and C23		.1μF, 50V
C24		100 pF, 50 V
C25 and C26		.1 μF, 50 V
C27		
C28		100pF, 50 V
C29 and C30		1 μF, 25V,TE-SERIES-Y
C31		.01 μF, 50V
C32		0.1μF, 50V
C33		.01 μF, 50V
C34		0.1μF, 50V
C35		POL, 220μF 25V, VA-G
C36		1nF, 50V
C37		POL, 220μF 25V, VA-G
C38		220pF, 50V
C39		5.6nF, 50V
C40		47nF, 50V
C41		47 pF, 50V
C42		0.1μF, 50V
C43		1μF, 25V,TE-SERIES-Y
C44 thru C54		100 pF, 50V
C55		.01μF, 50V
C56		1.0 μF, 25V
C60		0.1 μF, 50V
C61		100 pF, 50V
C62 thru C74		0.1 μF, 50V
C79 and C82		1μF, 25V,TE-SERIES-Y
C85 thru C90		0.01μF, 50V
C91		100pF, 50V
C92 and C94		.01μF, 50V
C95		100pF, 50V
C96 and C97		1.0, 25V.
C98		100pF, 50V
C99		0.1μF, 50V

**NOTE:** ADDED, DELETED, OR CHANGED COMPONENTS ARE DESCRIBED IN THE PRODUCTION CHANGES.

SYMBOL	PART NUMBER	DESCRIPTION
		---DIODES---
D1		1 A RECTIFIER, 100V
D2, D3 and D5		1N4148, 500 Mw, DL-35
D12		1 A RECTIFIER, 100V
D13		Zener <sup>®</sup> 3A, SHOTTKY, 30V
D14		1N4148, 500 Mw, DL-35
D15		Zener 3A, SHOTTKY, 30V
D16		Zener, 4.7V
D17		Zener, 15V, SOT-23-D
		---CONNECTORS---
J1 and J4		MTE Header, 7 Pin
J5AA		FFC/FPC, 1MM, ZIF
		---INDUCTORS---
L02		0 Ohms
L03, L05, L07, L10 thru L14, L16 thru L18, L21		FERITE, 1000 Ohms, 200mA
L24		0 Ohms
L25		128 $\mu$ H, 4A
L27		47 $\mu$ H, 2.8 A
L28 thru L38		FERITE, 1000 Ohms.
		----CONECTOR---- (Female)
P1	M39/40342500	DB-25
		---TRANSISTORS---
Q1 and Q2		NPN, 2N2222, 330 Mw
Q3		Sim to S14431DY
Q4		NPN, 2N2222, 330 Mw
Q5 and Q6		MOSFET, 60V, NMOS, 150 mA, SOT-23
Q10	M39/47110011	Half Bridge, 5.8 A/4.9 A
Q11 thru Q16		NPN, 2N2222, 330 Mw
Q17 and Q18	M39/4730001	MOSFET, 60V
		---RESISTORS---
R1		10k Ohms, 5%, 1/8 Watt
R2 and R3		3.6k Ohms, 1/8 Watt
R5		10k Ohms, 5%, 1/8 Watt
R6		3.6k Ohms, 5%, 1/8 Watt
R7		1k Ohms, 5%, 1/8 Watt
R8		100 Ohms, 5%, 1/8 Watt
R9		10K Ohms, 5%, 1/8 Watt
R10		1k Ohms, 5%, 1/8 Watt

SYMBOL	PART NUMBER	DESCRIPTION
R11		10k Ohms, 5%, 1/8 Watt
R12		150k Ohms, 1%, 1/8 Watt
R13		82.5k Ohms, 1%, 1/8 Watt
R14		61.9k Ohms, 1%, 1/8 Watt
R15		19.1k Ohms, 1%, 1/8 Watt
R16 and R17		300k Ohms, 5%, 1/8 Watt
R18		27.4k Ohms, 1%, 1/8 Watt
R19		24.9k Ohms, 1%, 1/8 Watt
R20		10k Ohms, 5%, 1/8 Watt
R21		100 Ohms, 5%, 1/8 Watt
R22		3.6k Ohms, 5%, 1/8 Watt
R23		2k Ohms, 5%, 1/8 Watt
R24		1k Ohms, 5%, 1/8 Watt
R25		3.3k Ohms, 5%, 1/8 Watt
R26		150k Ohms, 1%, 1/8 Watt
R27		73.2k Ohms, 1%, 1/8 Watt
R28		14.7k Ohms, 1%, 1/8 Watt
R29		45.3k Ohms, 1%, 1/8 Watt
R30		10k Ohms, 5%, 1/8 Watt
R31		3.6k Ohms, 5%, 1/8 Watt
R32		100k Ohms, 5%, 1/8 Watt
R33 thru R37		10k Ohms, 1%, 1/8 Watt
R38 and R39		3k Ohms, 5%, 1/8 Watt
R40		620 Ohms, 5%, 1/8 Watt
R41 and R42		3k Ohms, 5%, 1/8 Watt
R43 and R44		33k, 5%, 1/8 Watt
R45		10k Ohms, 5%, 1/8 Watt
R46, R48		1k Ohms, 5%, 1/8 Watt
R50 and R51		2.2 Ohms, 5%, 1/8 Watt
R52 and R53		10k Ohms, 5%, 1/8 Watt
R54		10k Ohms, 0.1%, 1/8 Watt
R55		2k Ohms, 0.1%, 1/8 Watt
R56		10k Ohms, 0.1%, 1/8 Watt
R57		1k Ohms, 5%, 1/8 Watt
R58		59k Ohms, 1%, 1/8 Watt
R59		1Meg Ohms, 5%, 1/8 Watt
R60		100k Ohms, 5%, 1/8 Watt
R61		0.1Ohm, 2%, 1.5 Watt
R62		2k Ohms, 0.1%, 1/8 Watt
R63		120 Ohms, 5%, 3 Watt
R64 and R65		20 Ohms, 5%, 1/8 Watt
R66		14.7k Ohms, 1%, 1/8 Watt
R67		25.5k Ohms, 1%, 1/8 Watt
R68		100k Ohms, 1%, 1/8 Watt
R69		26.1k Ohms, 1%, 1/8 Watt
R70		59k Ohms, 1%, 1/8 Watt

SYMBOL	PART NUMBER	DESCRIPTION
R71		100k Ohms, 1%, 1/8 Watt
R72		31.6k Ohms, 1%, 1/8 Watt
R73		100k Ohms, 1%, 1/8 Watt
R74		6.8k Ohms, 5%, 1/8 Watt
R75 thru R77		10k Ohms, 5%, 1/8 Watt
R78		6.8k Ohms, 5%, 1/8 Watt
R79 and R80		10k Ohms, 5%, 1/8 Watt
R81		2.2 Meg Ohms, 5%, 1/8 Watt
R82		73.2k Ohms, 1%, 1/8 Watt
R83		118k Ohms, 1%, 1/8 Watt.
R84		33k Ohms, 5%, 1/8 Watt
R85		5.36k Ohms, 1%, 1/8 Watt
R86		6.49k Ohms, 1%, 1/8 Watt
R87		3.1k Ohms, 1%, 1/8 Watt
R88 thru R90		10k Ohms, 5%, 1/8 Watt
R91		6.8k Ohms, 5%, 1/8 Watt
R92		3.6k Ohms, 5%, 1/8 Watt
R93		8.2k Ohms, 5%, 1/8 Watt
R94		100 Ohms, 5%, 1/8 Watt
R95		8.2k Ohms, 5%, 1/8 Watt
R96 and R97		10k Ohms, 5%, 1/8 Watt
R98		100 Ohms, 5%, 1/8 Watt
R99		2k Ohms, 5%, 1/8 Watt
		---VARISTOR---
RV1	M39/45034001	22V, 0.9J, CF/SF
		--- SWITCHES ---
S9		DIP: 8 Banks
		-INTEGRATED CIRCUITS-
U1	M39/47300101	Regulator: 5 V, 100 Ma
U2	M39/47300111	Fast Charge Controller: Sim to Benchmark™ BQ2004
U3	M39/47300121	Synchronizer Buck Converter Controller: Sim To S19150DY
U4	M39/47300131	Quad Bilateral Switch
U5		RS485/433 XLATER
U6	M39/47300151	Sim To 74HC244
U7		Dual Operational Amplifier: Sim To 1458
U8		Audio Power Amplifier: Sim to TDA7240A.
U9		Quad Op-Amp, CMOS
U10	M39/47300131	Quad Bilateral Switch
U11	M39/47300191	Quad 2-Input NAND Gate
U13	M39/47300131	Quad Bilateral Switch
		<b>CONNECTOR BOARD</b>
		---CONNECTORS---
J7B		7-Pin Header Cable, To Main PCB
J8A		9-Pin Edge Connector, Molex® 09-04-1092

SYMBOL	PART NUMBER	DESCRIPTION
	M39/7027950000	<b>M-RK SLEEVE BOARD</b>
		---CAPACITOR---
C200		0.1 $\mu$ F, 50V
		---CONNECTOR---
J8B	M39/4034520000	EDGEBOARD Connector, part of PCB
		---RESISTOR---
R200		100 Ohms, 5%, 1/8 Watt
		---SWITCH---
S200		SPDT, C&K LMGGF5WOS
	M39/7027960500	<b>PRISM HP/LPE-200/LPE-50 SLEEVE BOARD</b>
		---CAPACITOR---
C100		0.1 $\mu$ F, 50V
		---CONNECTOR---
J8B	M39/4034520000	EDGEBOARD Connector, part of PCB
		---RESISTOR---
R100		100 Ohms, 5%, 1/8 Watt
		---SWITCH---
S100		SPDT, C&K LMGGF5WOS
		<b>LED/VOLUME FLEX BOARD</b>
		---CAPACITOR---
C300		100 pF, 50 V
		---INDICATORS---
D300		LED, Red, Panasonic <sup>®</sup> LN1371SR
D301		LED, Amber, Panasonic LN1471SY
D302		LED, Green, Panasonic LN1371SG
		---CONNECTOR---
P5A		EDGEBOARD Connector, Part of Flex PCB
		---RESISTORS---
R300 and R301		100 Ohms, 5%, 1/8 Watt
R302		Pot/Switch Combination



## 10.4 ENHANCED VEHICULAR CHARGER (REVS R6A OR LATER)

BML 161 67/12 - M-RK Battery Packs  
 BML 161 67/32 - Prism HP/LPE-200 Battery Packs  
 BML 161 67/72 BML 161 67/172- JAGUAR 700P and P7100<sup>IP</sup> Battery Packs

SYMBOL	PART NUMBER	DESCRIPTION
3		<b>MAIN BOARD</b>
		---- CAPACITORS----
C1 - C5		100 pF, 50 V
C6		1 $\mu$ F, 25 V
C7 - 9, C11-14 C16-18 and C20-21		100 pF, 50 V
C22 and C23		.1 $\mu$ F, 50 V
C24		100 pF, 50 V
C25 and C26		.1 $\mu$ F, 50 V
C27		220 $\mu$ F, 25 V
C28		100 pF, 50 V
C29 and C30		1 $\mu$ F, 25 V
C31		.01 $\mu$ F, 50 V
C32		0.1 $\mu$ F, 50 V
C33		.01 $\mu$ F, 50 V
C34		.1 $\mu$ F, 50 V
C35		220 $\mu$ F, 25 V
C36		1 nF, 50 V
C37		POL, 220 $\mu$ F 25 V, VA-G
C38		150 pF, 50 V
C39		5.6 nF, 50 V
C40		47 nF, 50 V
C41		47 pF, 50 V
C42		0.1 $\mu$ F, 50 V
C43		1 $\mu$ F, 25 V,TE-SERIES-Y
C44 thru C54		100 pF, 50 V
C55		.01 $\mu$ F, 50 V
C56		1.0 $\mu$ F, 25 V
C60		0.1 $\mu$ F, 50 V
C61		100 pF, 50 V
C62 thru C65		0.1 $\mu$ F, 50 V
C66		10 $\mu$ F, 35 V.
C67 and C68		22 $\mu$ F, 35 V.
C69		0.1 $\mu$ F, 50 V
C70		POL, 220 $\mu$ F 25 V, VA-G
C71 and C72		0.1 $\mu$ F, 50 V
C74		TANT, 3.3 $\mu$ F 10 V, 20%
C79 and C82		1 $\mu$ F, 25V,TE-SERIES-Y

SYMBOL	PART NUMBER	DESCRIPTION
C83 and C84		POL, 220 $\mu$ F 25 V, VA-G
C85 thru C90		.01 $\mu$ F, 50 V
C91		100 pF, 50 V
C92		.01 $\mu$ F, 50 V
C93		100 $\mu$ F, 25 V, 20%
C94		.01 $\mu$ F, 50 V
C95		100 pF, 50 V
C96 and C97		1.0 $\mu$ F, 25 V
C98		100 pF, 50 V
C99		0.1 $\mu$ F, 50 V
		---DIODES---
D1		1 A RECTIFIER, 100V.
D2 – D6		1N4148, 500 mw, DL-35
D12		1 A RECTIFIER, 100V
D13		Zener 1 A, SHOTTKY, 30V
D14		1N4148, 500 mw, DL-35
D15		Zener 3A ,SHOTTKY, 30V
D16		Zener, 4.7V
D17		Zener, 15V, SOT-23-D
		---CONNECTORS---
J1 and J4A		MTE Header, 7 Pin
J5A and J6A		FFC/FPC, 1mm, ZIF
		---INDUCTORS---
L02		Resistor 1/10 w, 5%
L03, L05, L07, L10 thru L14, L16 thru L18, L21		FERITE, 1000 Ohms, 200mA
L24		Resistor 1/10 w, 5%
L25		128 $\mu$ H, 4A
L27		47 $\mu$ H, 2.8 A
L28 thru L38		FERITE, 1000 Ohms, 200mA
		---CONECTOR--- (Female)
P1	M39/40342500	DB-25
		---TRANSISTORS---
Q1 and Q2		NPN, 2N2222, 330 mw
Q3		Sim to S14431DY, 5.8
Q4		NPN, 2N2222, 330 mw
Q5, Q6 and Q9		MOSFET, 60 V, 350 mw
Q10	M39/47110011	Diode/HB S14539
Q11 thru Q16		NPN, 2N2222, 330 mw

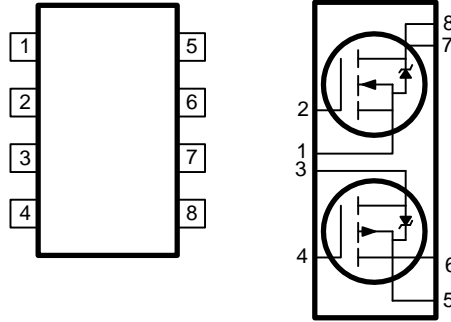
SYMBOL	PART NUMBER	DESCRIPTION
Q17 thru Q28	M39/4730001	MOSFET, 60 V, 350 mw
		--- -RESISTORS- ---
R1		10k Ohms, 1/8 Watt, 50 V
R2 and R3		3.6k Ohms, 5%, 1/8 Watt
R5		10k Ohms, 1/8 Watt, 50 V
R6		3.6k Ohms, 5%, 1/8 Watt
R7		1k Ohms, 5%, 1/8 Watt
R8		100 Ohms, 5%, 1/8 Watt
R9		10k Ohms, 1/8 Watt, 50 V
R10		1k Ohms, 5%, 1/8 Watt
R11		10k Ohms, 1/8 Watt, 50 V
R12		150k Ohms, 1%, 1/8 Watt
R13		82.5k Ohms, 1%, 1/8 Watt
R14		61.9k Ohms, 1%, 1/8 Watt
R15		19.1k Ohms, 1%, 1/8 Watt
R16 and R17		300k Ohms, 5%, 1/8 Watt
R18		27.4k Ohms, 1%, 1/8 Watt
R19		24.9k Ohms, 1%, 1/8 Watt
R20		10k Ohms, 1/8 Watt, 50 V
R21		100 Ohms, 5%, 1/8 Watt
R22		3.6k Ohms, 5%, 1/8 Watt
R23		2k Ohms, 5%, 1/8 Watt
R24		1k Ohms, 5%, 1/8 Watt
R25		3.3k Ohms, 5%, 1/8 Watt
R26		150k Ohms, 1%, 1/8 Watt
R27		73.2k Ohms, 1%, 1/8 Watt
R28		14.7k Ohms, 1%, 1/8 Watt
R29		66.5k Ohms, 1%, 1/8 Watt
R30		10k Ohms, 1/8 Watt, 50 V
R31		3.6k Ohms, 5%, 1/8 Watt
R32		100k Ohms, 5%, 1/8 Watt
R34 thru R37		10k Ohms, 1/8 Watt, 50 V
R38 and R39		3k Ohms, 5%, 1/8 Watt
R40		620 Ohms, 5%, 1/8 Watt
R41 and R42		3k Ohms, 5%, 1/8 Watt
R43		33k, 1%, 1/8 Watt
R44		26.1k, 1%, 1/8 Watt
R45		6.98k Ohms, 1%, 1/4 Watt
R46		1k Ohms, 5%, 1/8 Watt
R47		10k Ohms, 1/8 Watt, 50 V
R48		1K Ohms, 5%, 1/8 Watt
R49		10k Ohms, 1/8 Watt, 50 V
R50 and R51		2.2 Ohms, 5%, 1/4 Watt
R52 and R53		10k Ohms, 1/8 Watt, 50 V
R54		10k Ohms, 0.1%, 1/8 Watt
R55		2k Ohms, 0.1%, 1/8 Watt
R56		10k Ohms, 0.1%, 1/8 Watt
R57		1k Ohms, 5%, 1/8 Watt
R58		64.9k Ohms, 1%, 1/8 Watt
R59		1Meg Ohms, 5%, 1/8 Watt

SYMBOL	PART NUMBER	DESCRIPTION
R60		100k Ohms, 5%, 1/8 Watt
R61		0.1 Ohm, 2%, 1.5 Watt
R62		2k Ohms, 0.1%, 1/8 Watt
R63		100 Ohms, 5%, 3 Watt
R64 and R65		20 Ohms, 5%, 1/8 Watt
R66		15.8k Ohms, 1%, 1/8 Watt
R67		25.5k Ohms, 1%, 1/8 Watt
R68		100k Ohms, 1%, 1/8 Watt
R69		26.1k Ohms, 1%, 1/8 Watt
R70		59k Ohms, 1%, 1/8 Watt
R71		100k Ohms, 1%, 1/8 Watt
R72		31.6k Ohms, 1%, 1/8 Watt
R73		100k Ohms, 1%, 1/8 Watt
R74		6.8k Ohms, 5%, 1/8 Watt
R75 thru R77		10k Ohms, 1/8 Watt, 50 V
R78		6.8k Ohms, 5%, 1/8 Watt
R79 and R80		10k Ohms, 1/8 Watt, 50 V
R81		2.2 Meg Ohms, 5%, 1/8 Watt
R82		73.2k Ohms, 1%, 1/8 Watt
R83		118k Ohms, 1%, 1/8 Watt
R84		33k Ohms, 1%, 1/8 Watt
R85		5.36k Ohms, 1%, 1/8 Watt
R86		6.49k Ohms, 1%, 1/8 Watt
R87		3.1k Ohms, 1%, 1/8 Watt
R88 thru R90		10k Ohms, 1/8 Watt, 50 V
R91		6.8k Ohms, 5%, 1/8 Watt
R92		3.6k Ohms, 5%, 1/8 Watt
R93		8.2k Ohms, 5%, 1/8 Watt
R94		100 Ohms, 5%, 1/8 Watt
R95		8.2k Ohms, 5%, 1/8 Watt
R96 and R97		10k Ohms, 1/8 Watt, 50 V
R98		100 Ohms, 5%, 1/8 Watt
R99		2k Ohms, 5%, 1/8 Watt
R100 thru R102		10k Ohms, 1/8 Watt, 50 V
R103		100 Ohms, 2%, 3 Watt
R104		10k Ohms, 1/8 Watt, 50 V
		---VARISTOR---
RV1	M39/45034001	22V, 0.95, CF/SF
		---- SWITCHES ----
S9		DIP: 8 Banks
		-INTEGRATED CIRCUITS-
U1	M39/47300101	Regulator: 5 V, 7805
U2		Fast Charger control BQ2004
U3	M39/47300121	Synchronizer Buck Converter Controller: Sim To SI9150DY
U4	M39/47300131	Quad Bilateral Switch
U5		Transistor
U6	M39/47300151	OCTAL TRIST

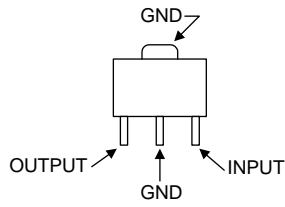
SYMBOL	PART NUMBER	DESCRIPTION
U7		Dual Operational Amplifier: Sim To 1458
U8		Audio Power Amplifier: Sim to TDA7240A.
U9		Quad Op-Amp, CMOS
U10	M39/47300131	Quad Bilateral Switch
U11	M39/47300191	Quad 2-Input NAND Gate
U13	M39/47300131	Quad Bilateral Switch
		<b>SLEEVES</b>
		---CONNECTORS---
	M39/7027960500	PRISM HP/LPE-200/LPE-50 Sleeve Board
	M39/702795000	M-RK Sleeve Board
	M39/7027962500	JAGUAR 700P/Pi and P7100 <sup>IP</sup> Sleeve Board

# 11 IC DATA

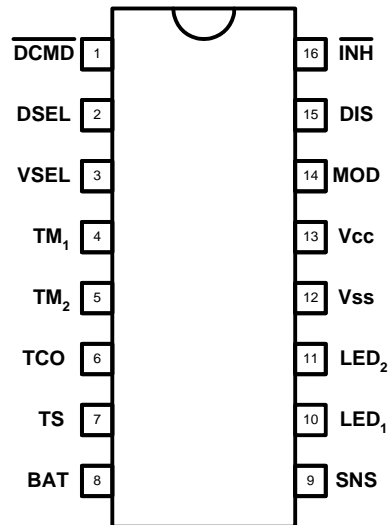
**Q10**  
Half Bridge 5.8A/4.9A  
47110011 (S14539)



**U1**  
5 Volt Regulator  
47300101 (7805)



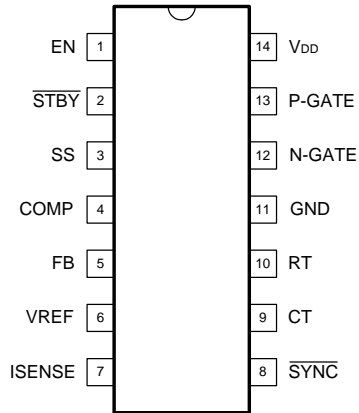
**U2**  
**Fast Charge Controller**  
 47300111 (BQ2004)



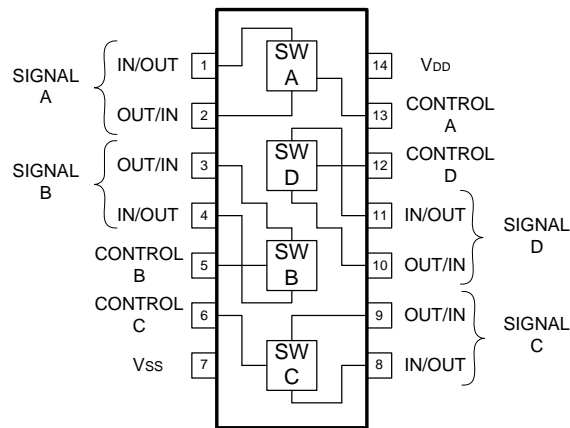
**PIN NAMES**

<b>DCMD</b>	Discharge Command
<b>DSEL</b>	Display Select
<b>VSEL</b>	Voltage Termination Select
<b>TM1</b>	Timer Mode Select 1
<b>TM2</b>	Timer Mode Select 2
<b>TCO</b>	Temperature Cutoff
<b>TS</b>	Temperature Sense
<b>BAT</b>	Battery Voltage
<b>SNS</b>	Sense Resistor Input
<b>LED<sub>1</sub></b>	Charge Status Output 1
<b>LED<sub>2</sub></b>	Charge Status Output 2
<b>Vss</b>	System Ground
<b>Vcc</b>	5.0 V ±10% Power
<b>MOD</b>	Charge Current Control
<b>DIS</b>	Discharge Control Output
<b>INH</b>	Charge Inhibit Input

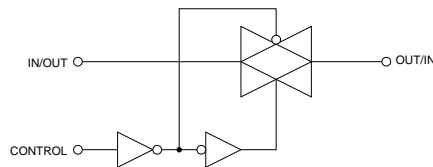
**U3**  
**Synchronizer Buck Converter Controller**  
 47300121 (S19150DY)



**U4, U10, U13**  
**Quad Bilateral Switch**  
 47300131 (MC14066B)



**LOGIC DIAGRAM (1/4)**



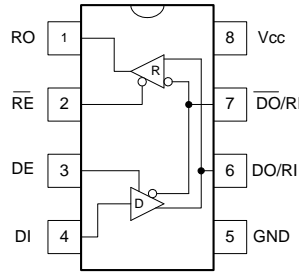
**FUNCTION TABLE**

CONTROL	SWITCH
L	OFF
H	ON

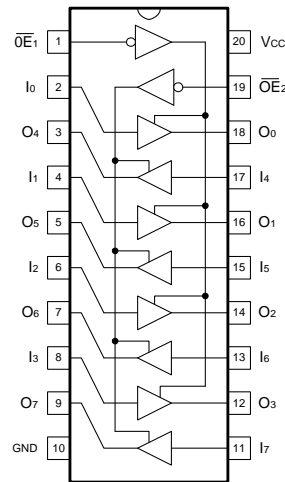
GND < or = Vin < or = Vcc  
 GND < or = Vout < or = Vcc



**U5**  
**RS485/433 XLATER**  
**47300141 (DS75176B/DS75176BT)**



**U6**  
**Low-Voltage Buffer/Line Driver**  
**47300151 (74HC244)**



PIN NAMES	DESCRIPTION
OE <sub>1</sub> , OE <sub>2</sub> ( <i>barred</i> )	TRI-STATE Output Enable Inputs
I <sub>0</sub> -I <sub>7</sub> - Inputs	
O <sub>0</sub> -O <sub>7</sub> Outputs	

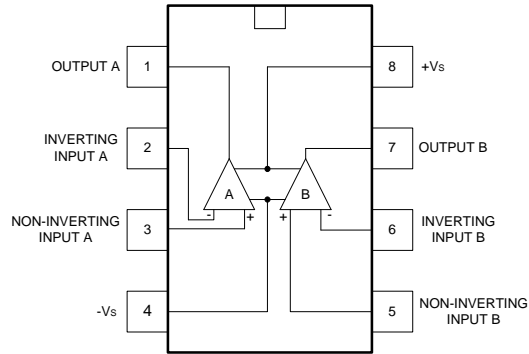
**Truth Tables**

INPUT		OUTPUTS
OE <sub>1</sub> ( <i>barred</i> ) In		(Pins 12, 14, 16, 18)
L	L	L
L	H	H
H	X	Z

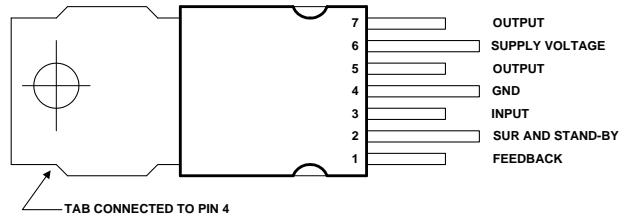
INPUTS		OUTPUTS
OE <sub>2</sub> ( <i>barred</i> )	In	(Pins 3, 5, 7, 9)
L	L	L
L	H	H
H	X	Z

H=HIGH Voltage Level, X=immaterial, L=LOW Voltage Level, Z=High Impedance

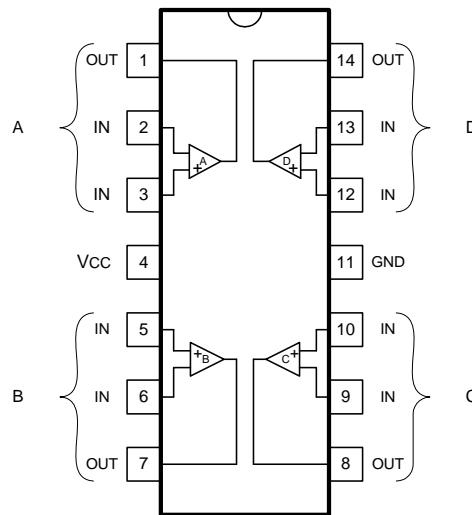
**U7**  
**Dual Operational Amplifier**  
 47300161 (1458)



**U8**  
**Audio Power Amplifier**  
 (TDA7240A)

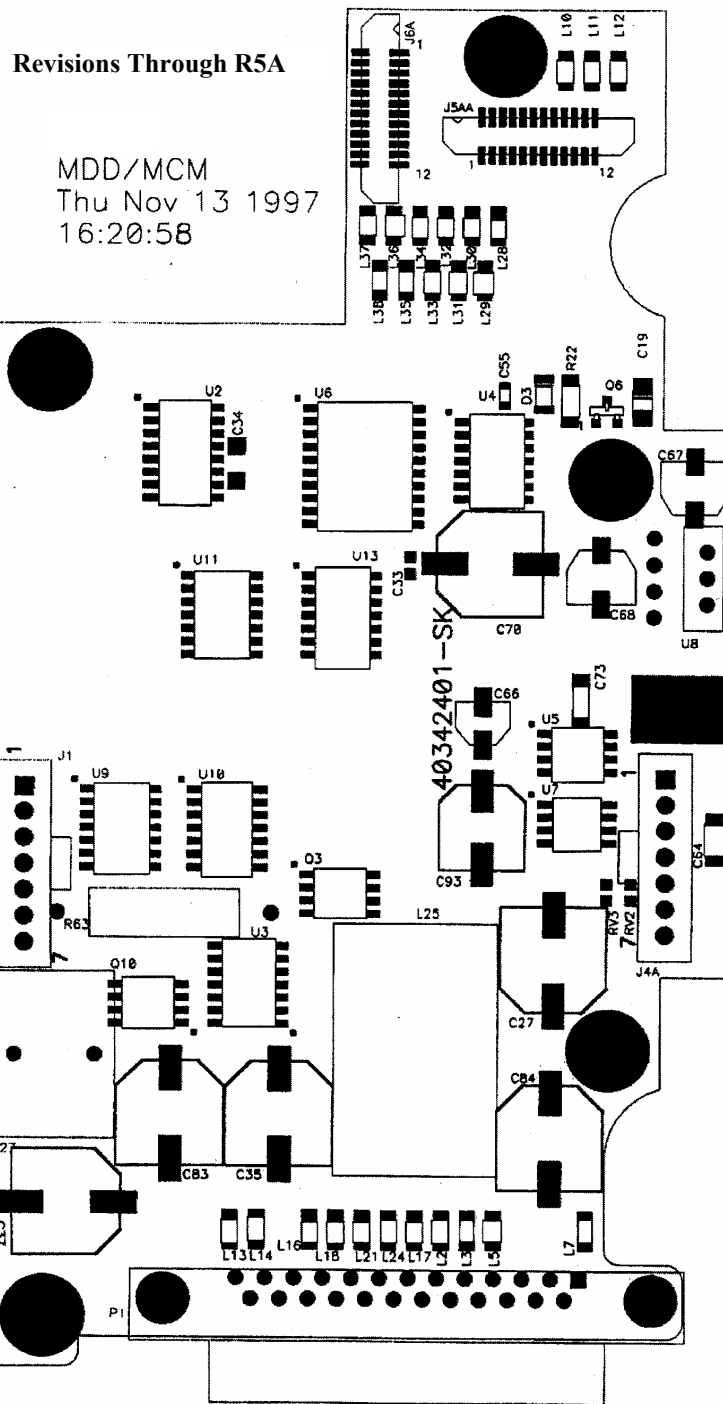


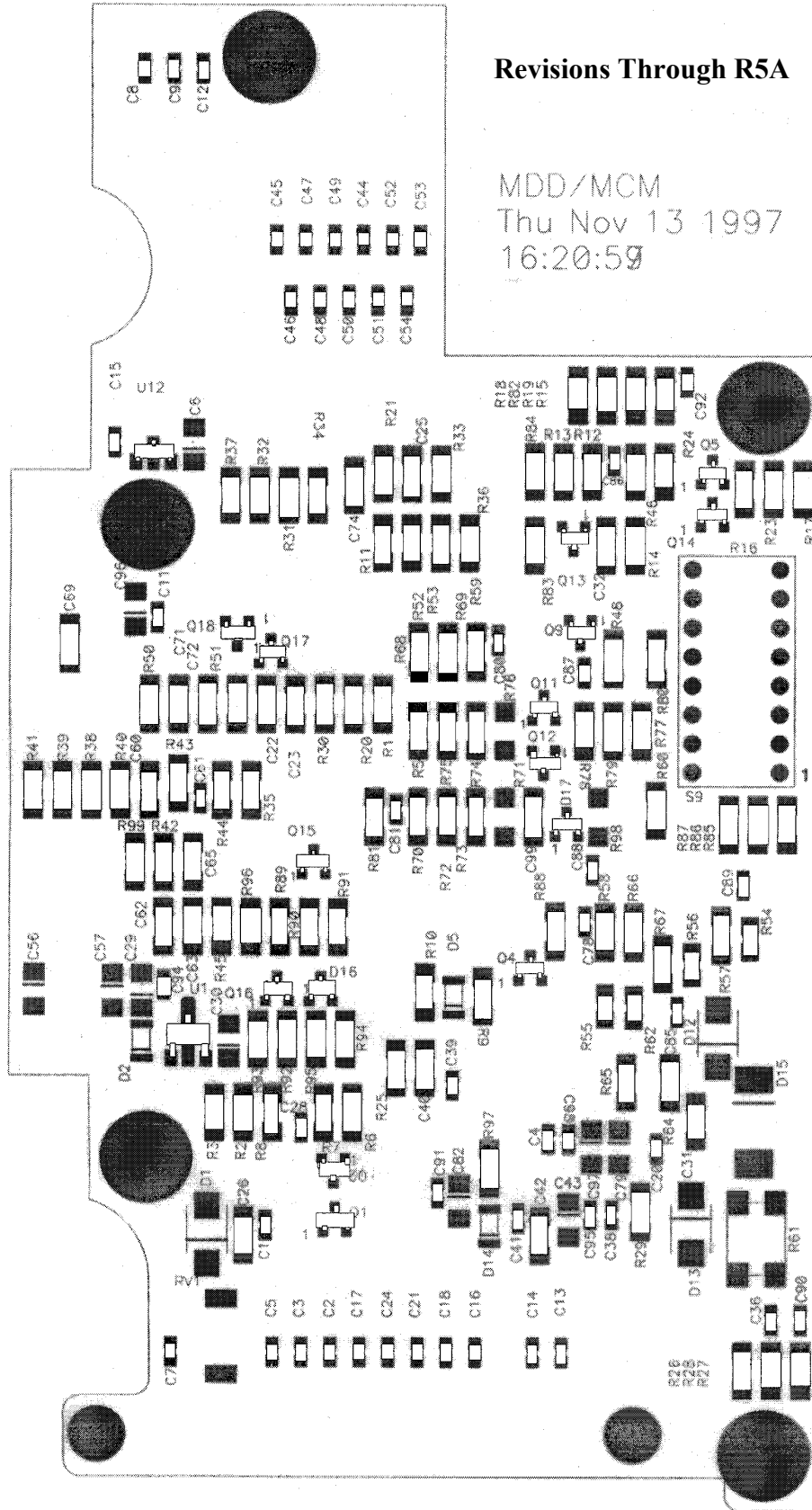
**U9**  
**Quad Operational Amplifier**  
 47300381 (324)





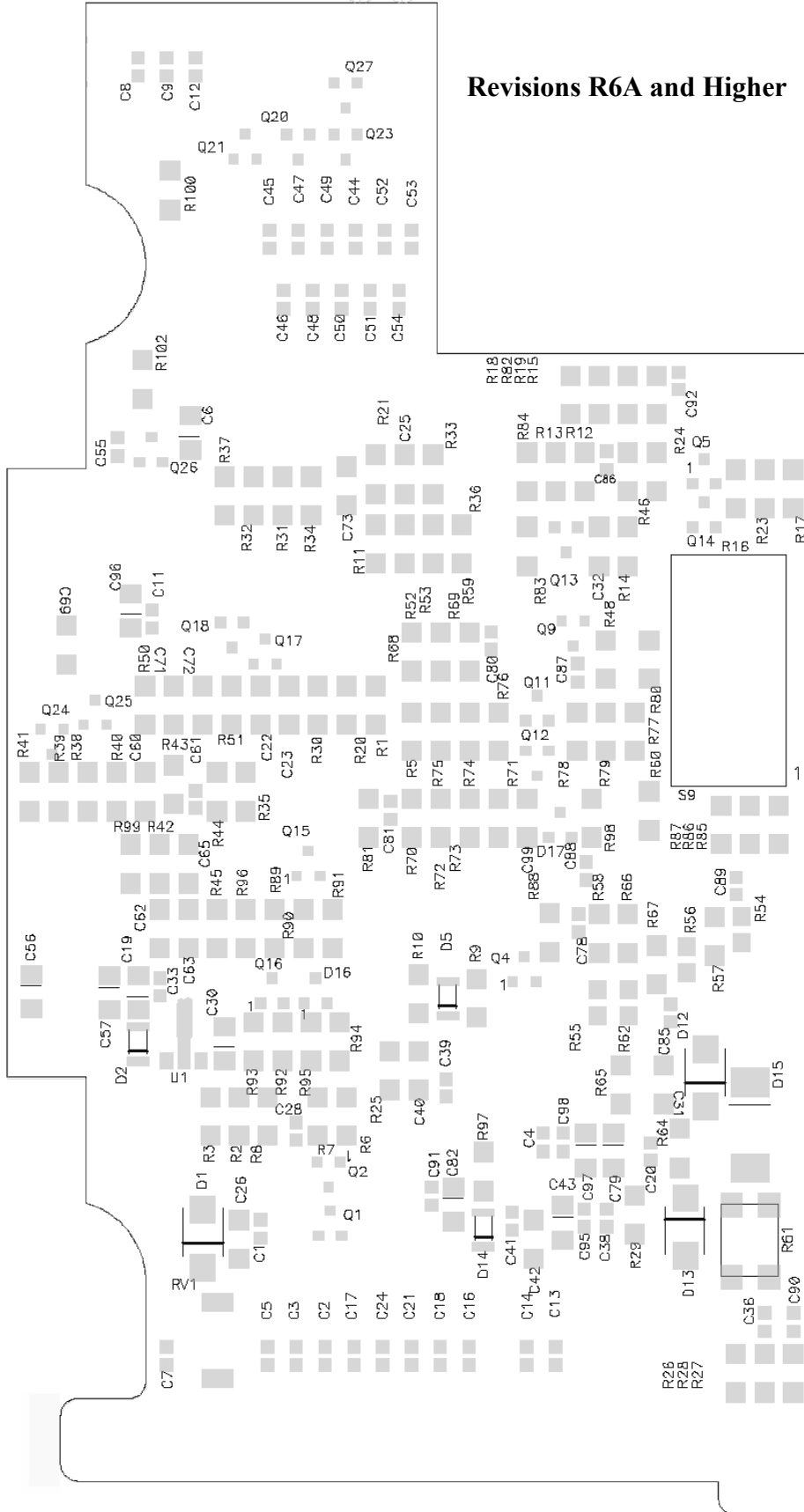
# 12 BOARD DIAGRAMS





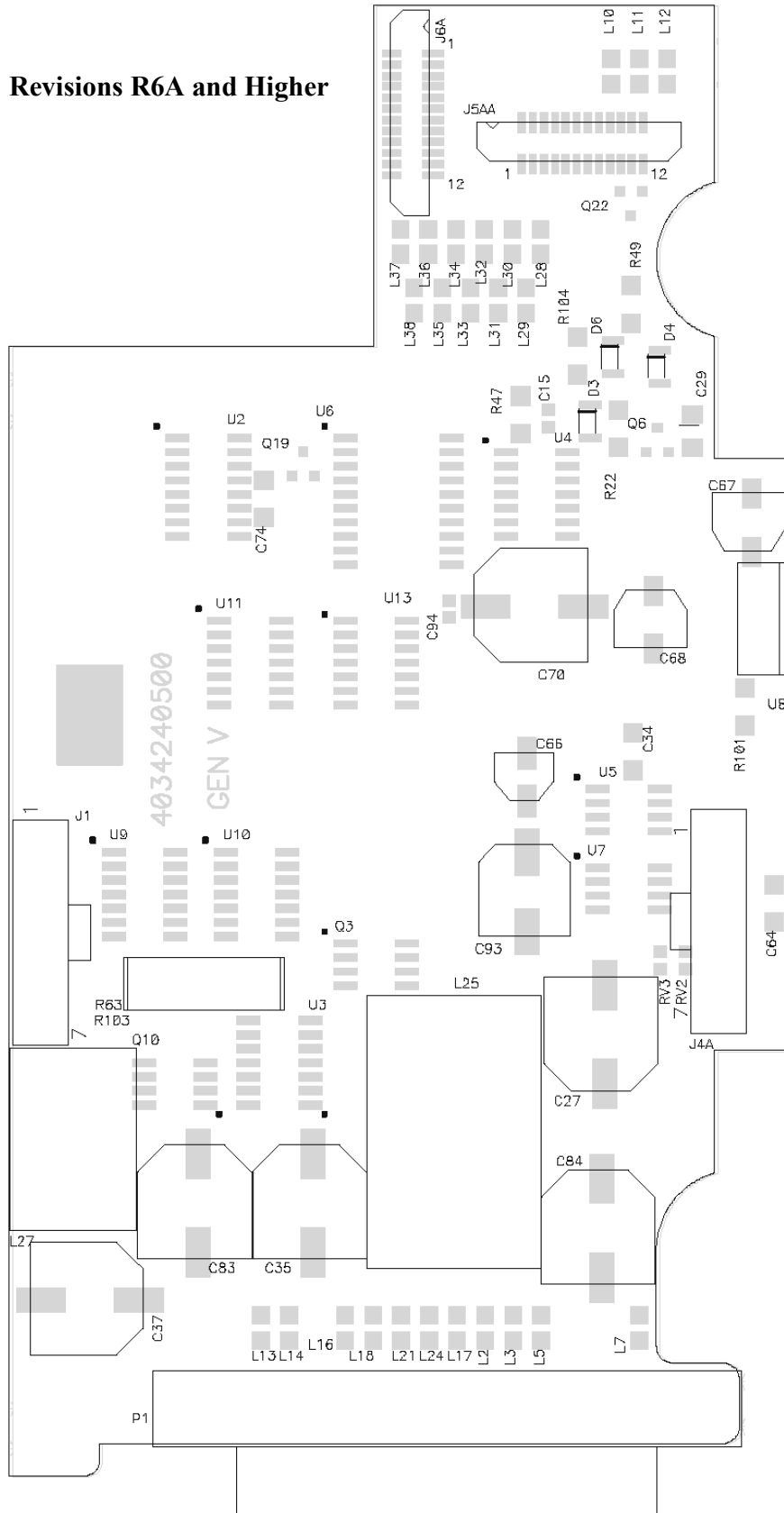
Revisions Through R5A

MDD/MCM  
Thu Nov 13 1997  
16:20:59



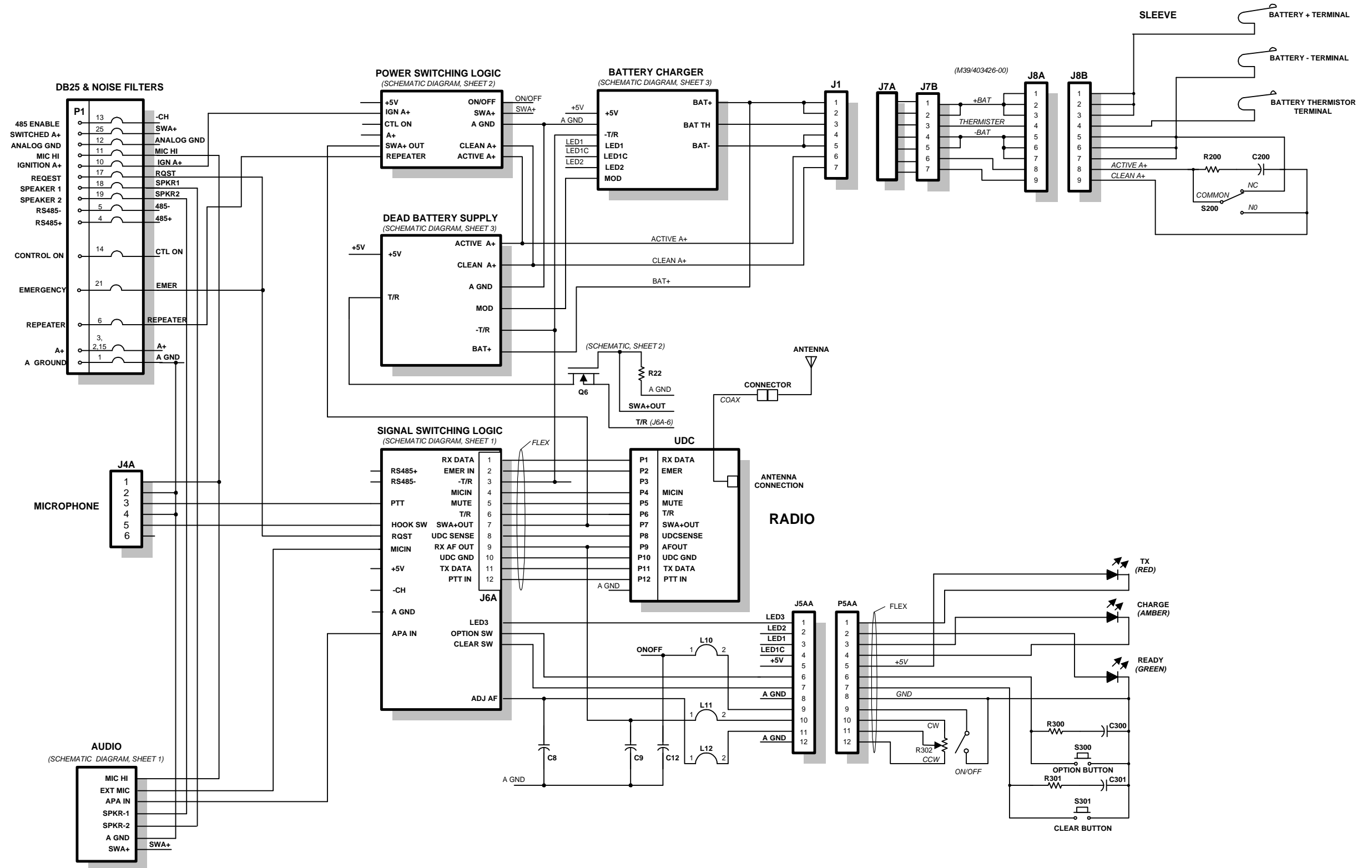
Revisions R6A and Higher

**Revisions R6A and Higher**

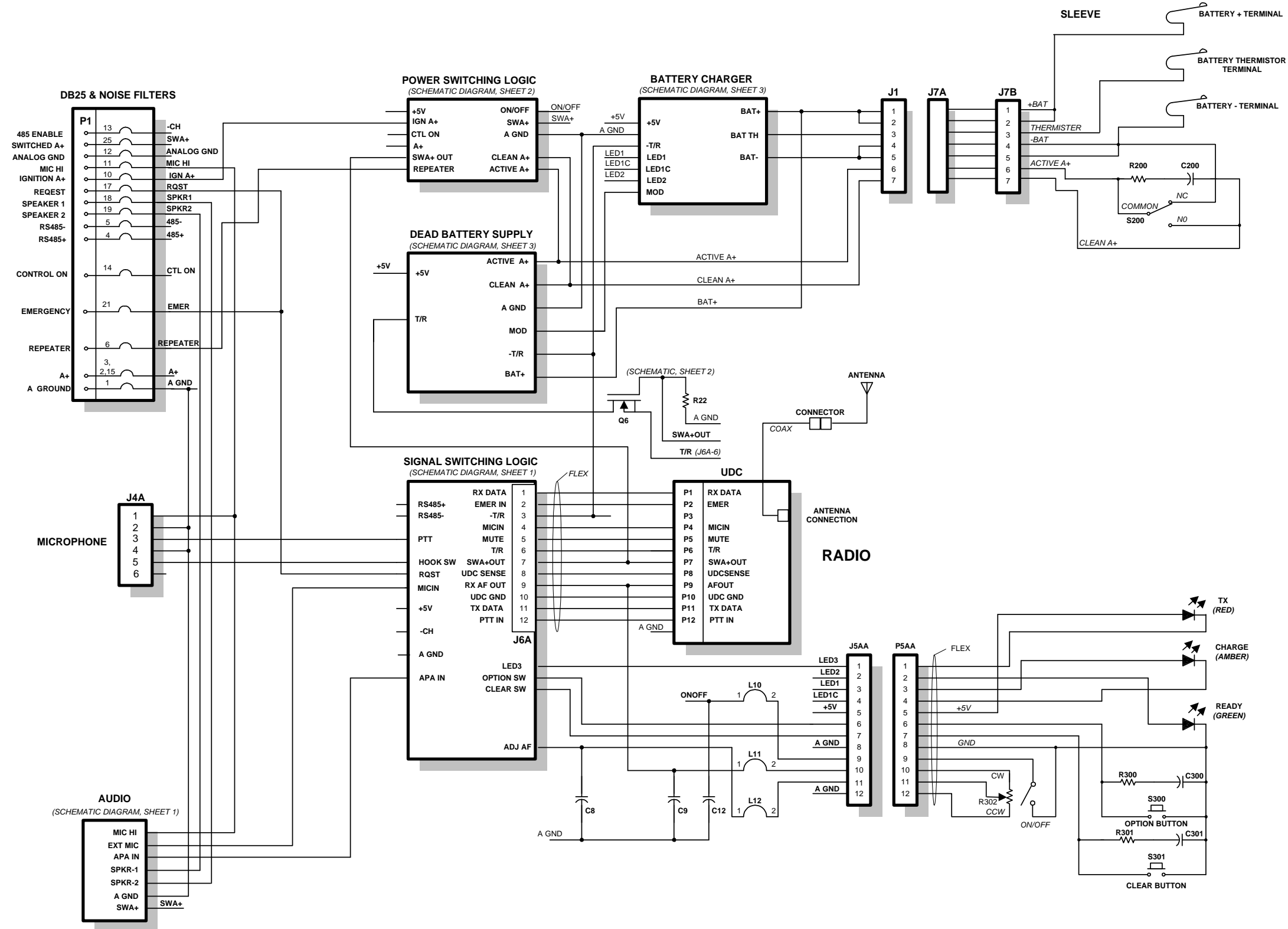


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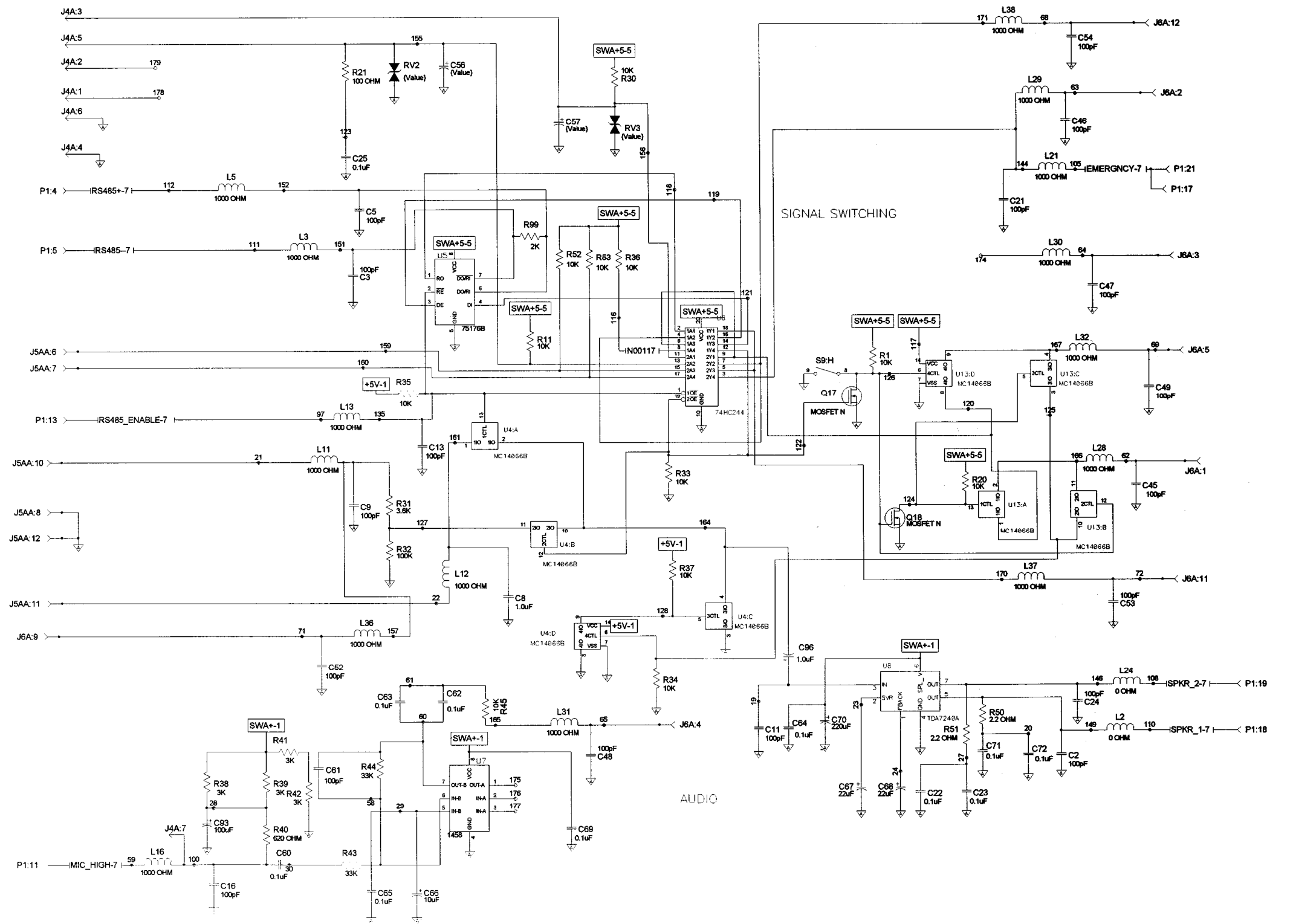




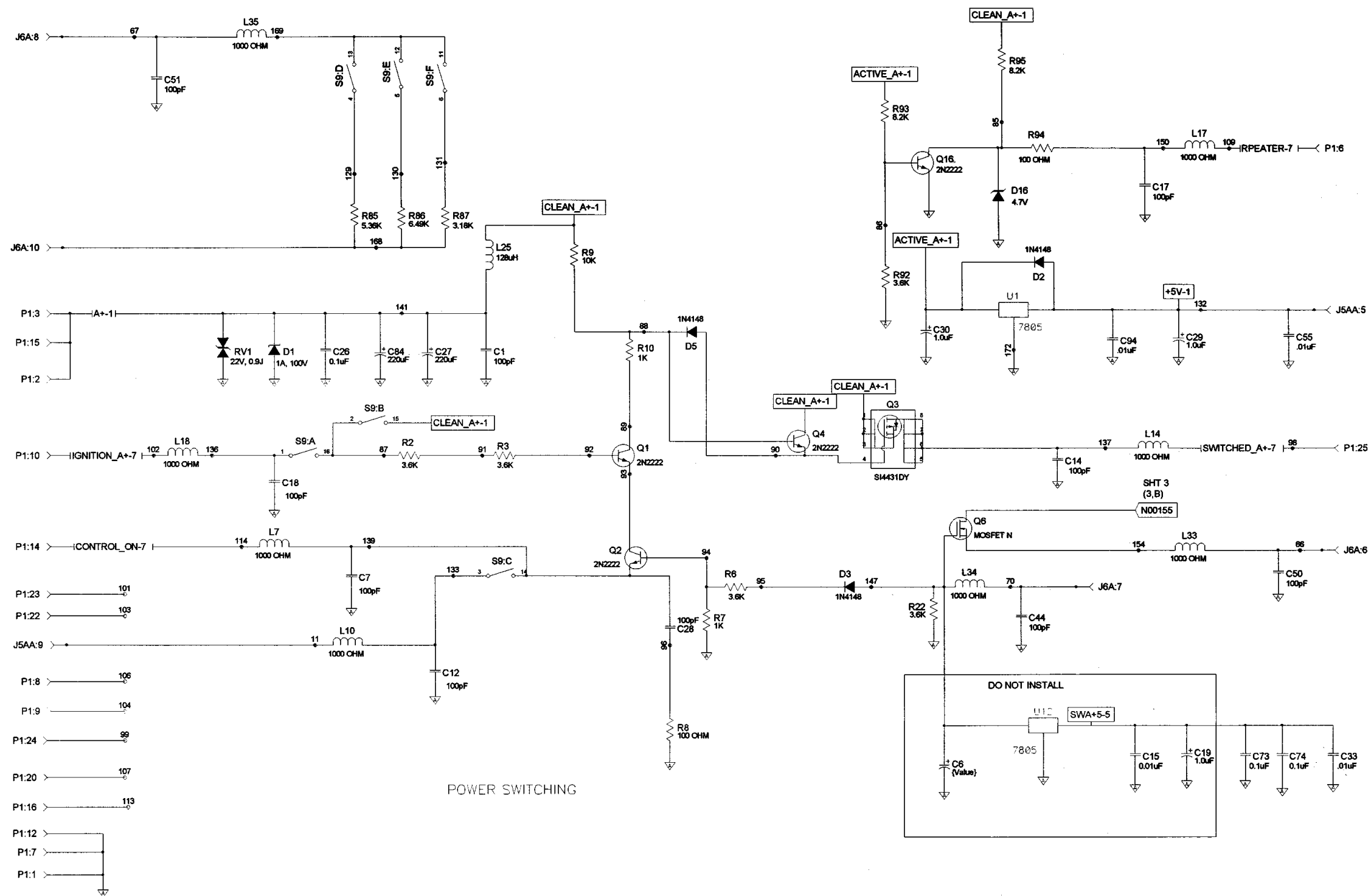
Enhanced Vehicular Charger Interconnection Diagram  
(Revisions Through R5A)



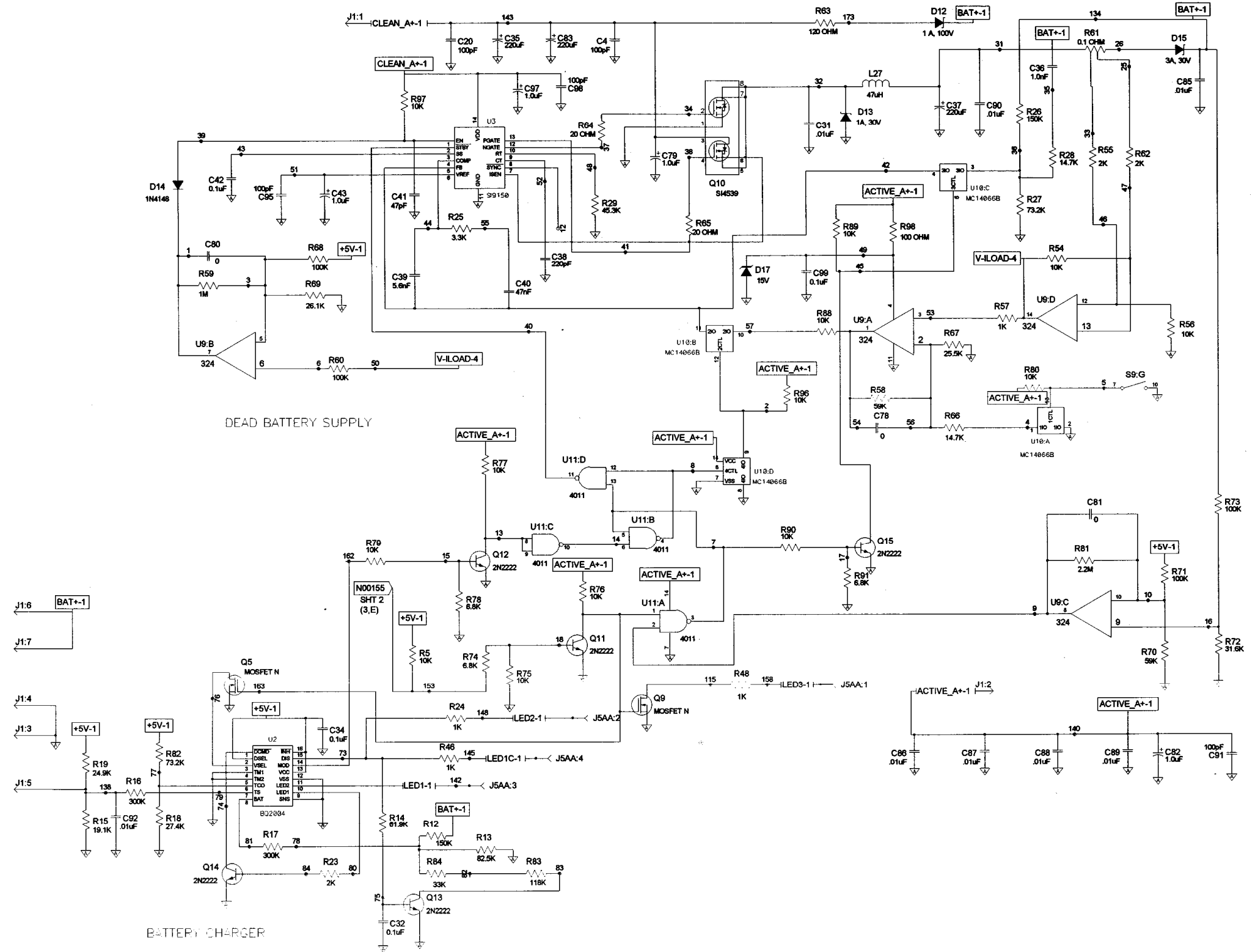
Enhanced Vehicular Charger Interconnection Diagram  
(Revisions R6A and Higher)



Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger  
(Revisions Through R5A)  
(Sheet 1 of 3)

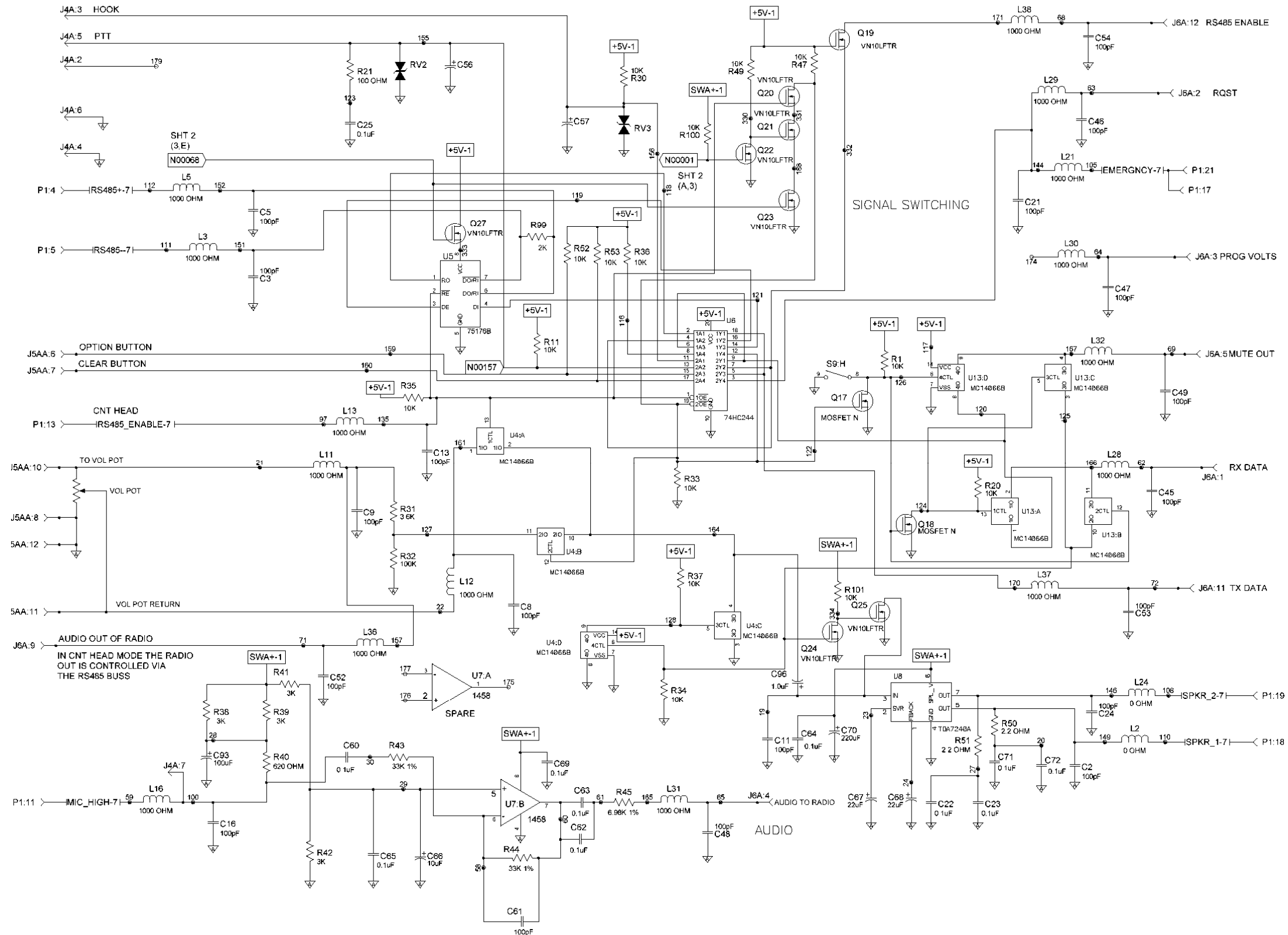


Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger  
 (Revisions Through R5A)  
 (Sheet 2 of 3)

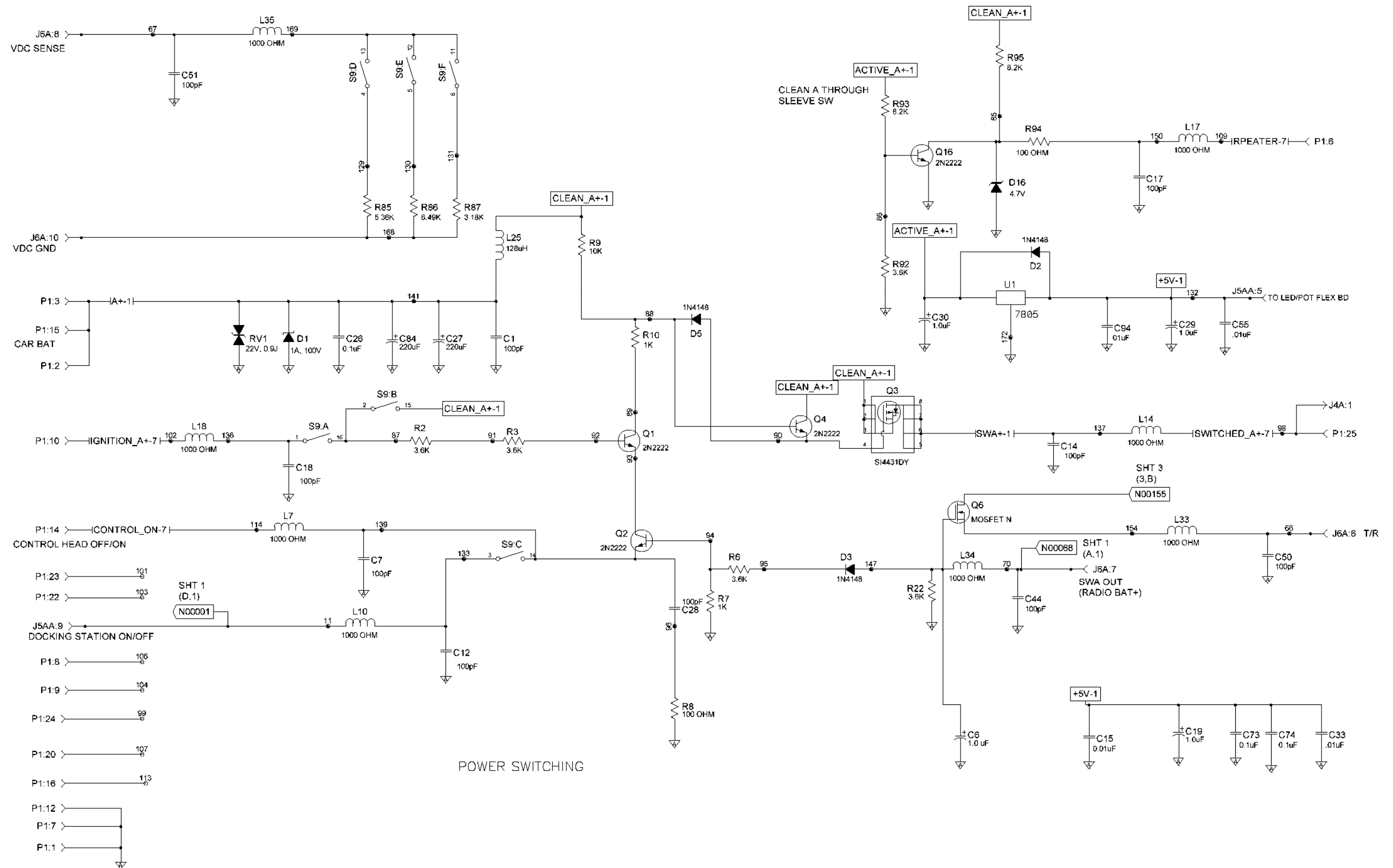


Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger  
(Revisions Through R5A)

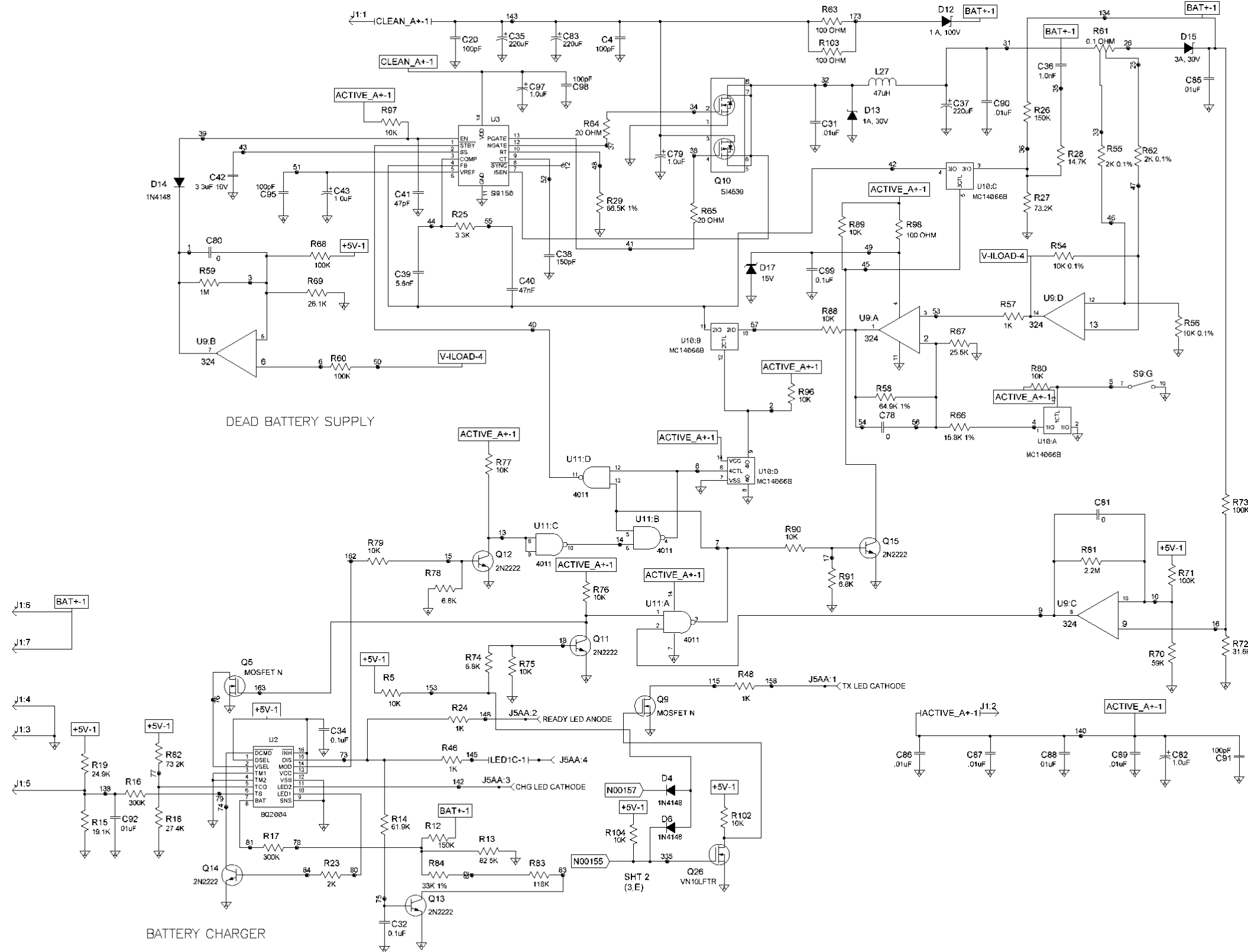
(Sheet 3 of 3)



**Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger**  
 (Revisions R6A and Higher)  
 (40342401, Sheet 1, Rev. 0)

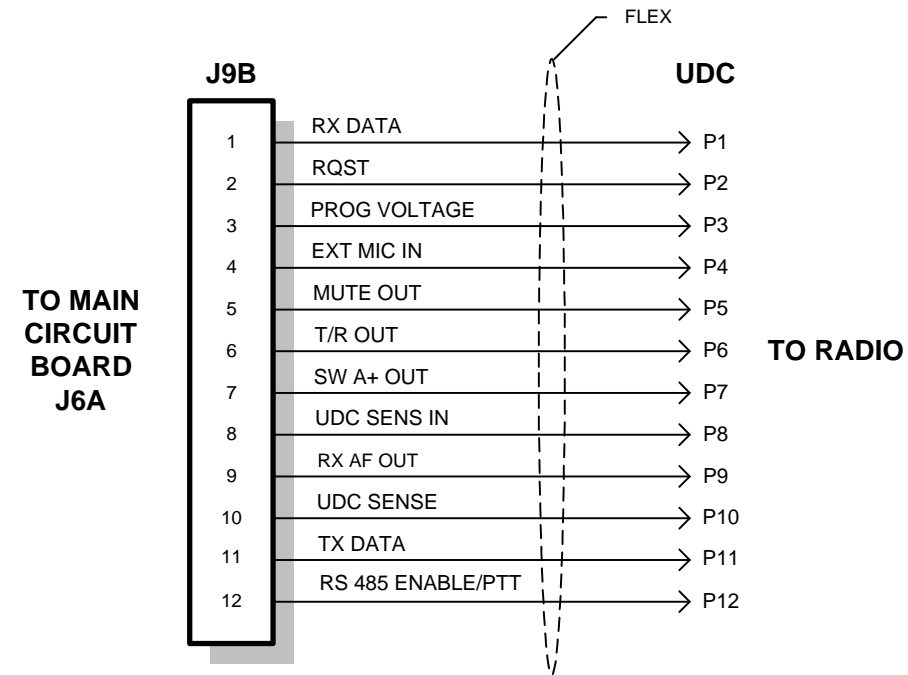


Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger  
 (Revisions R6A and Higher)  
 (40342401, Sheet 2, Rev. 0)

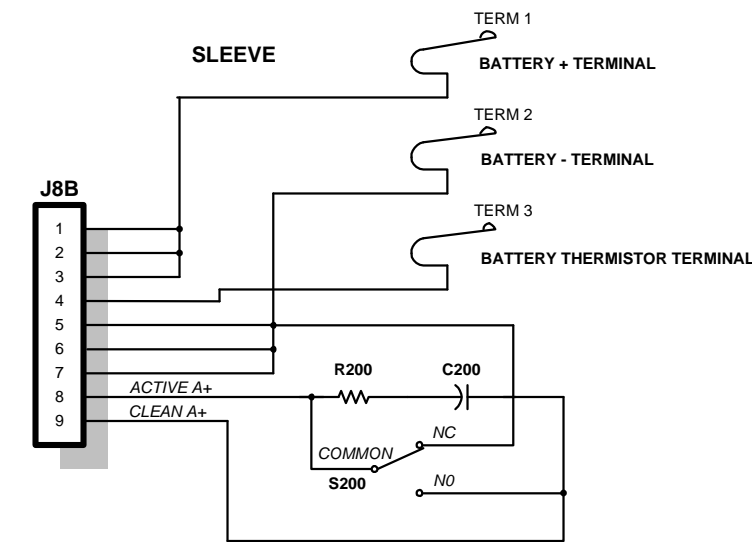


**Prism HP/LPE-200/LPE-50 Enhanced Vehicular Charger**  
 (Revisions R6A and Higher)  
 (40342401, Sheet 3, Rev. 0)

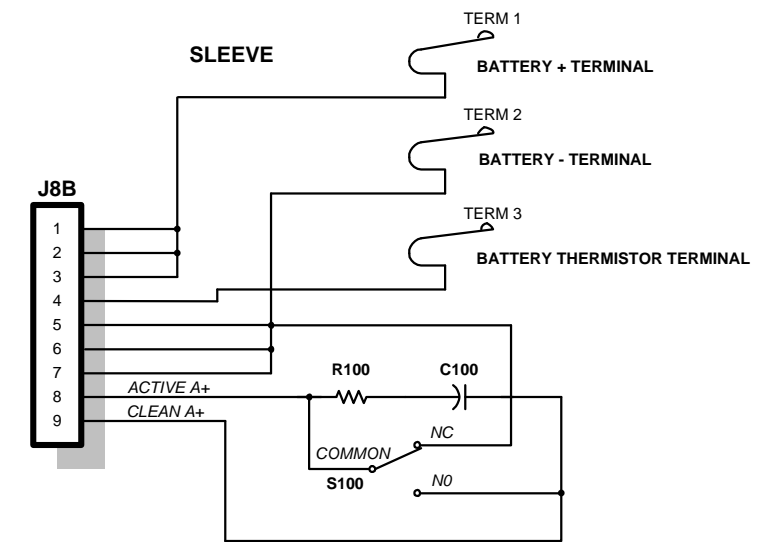




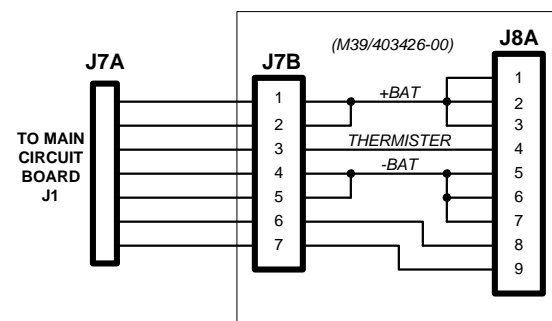
Flex Printed Circuit Board Connection from the Main Circuit Board to the UDC



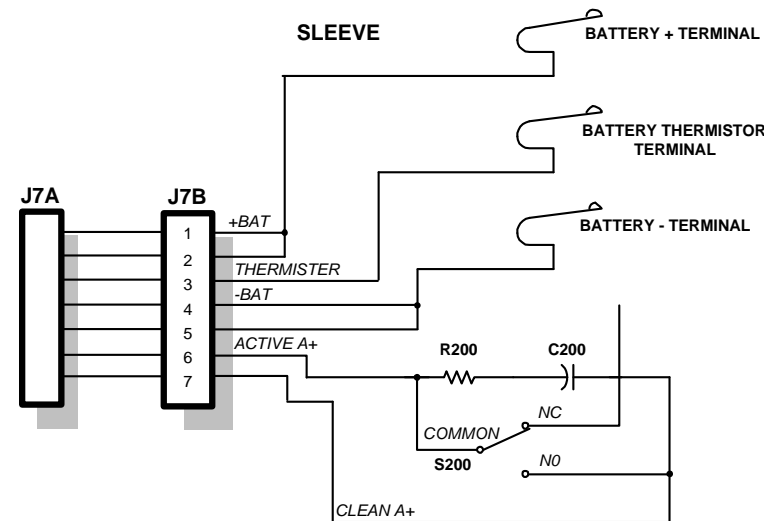
Prism HP/LPE-200/LPE-50 Charging Sleeve (Revisions Through R5A)



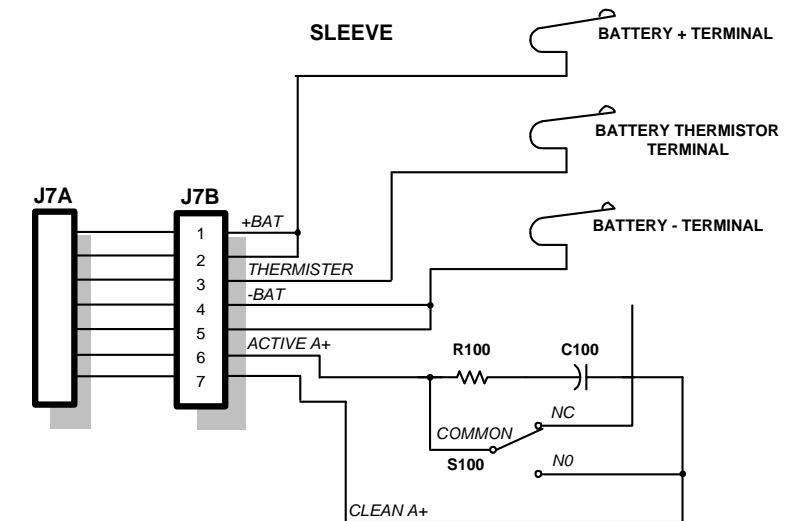
M-RK Charging Sleeve (Revisions Through R5A)



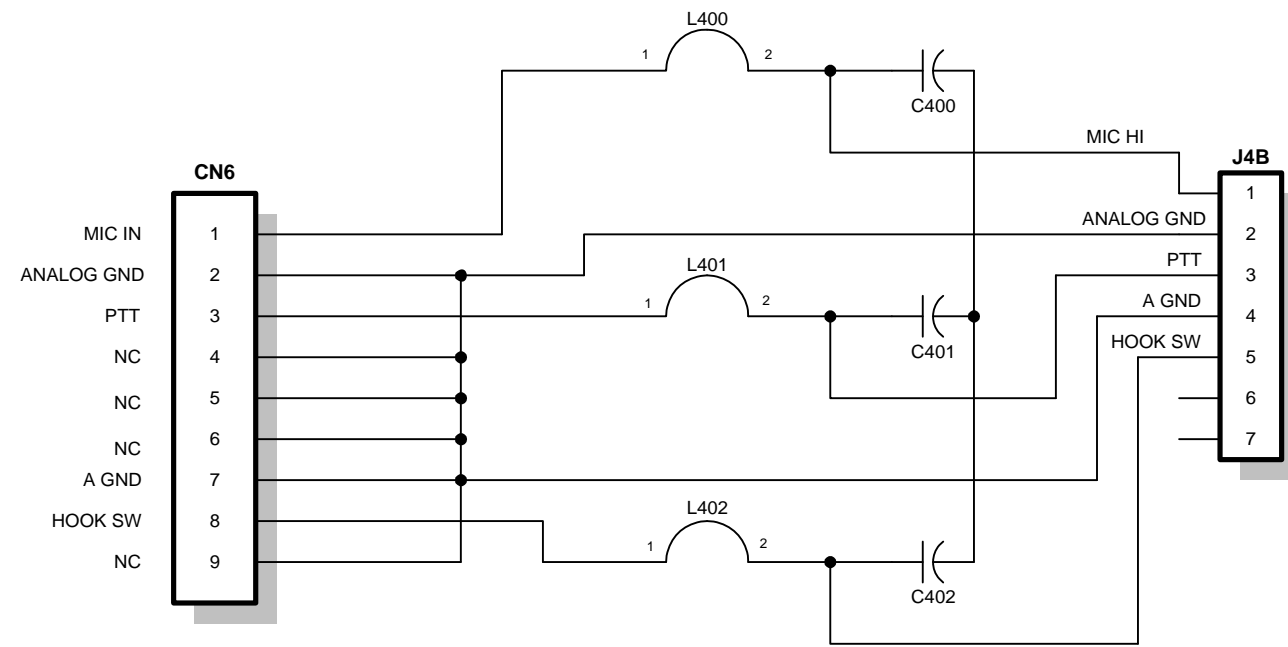
Connects from Main Printed Circuit Board to the Charging Sleeve (Revisions Through R5A)



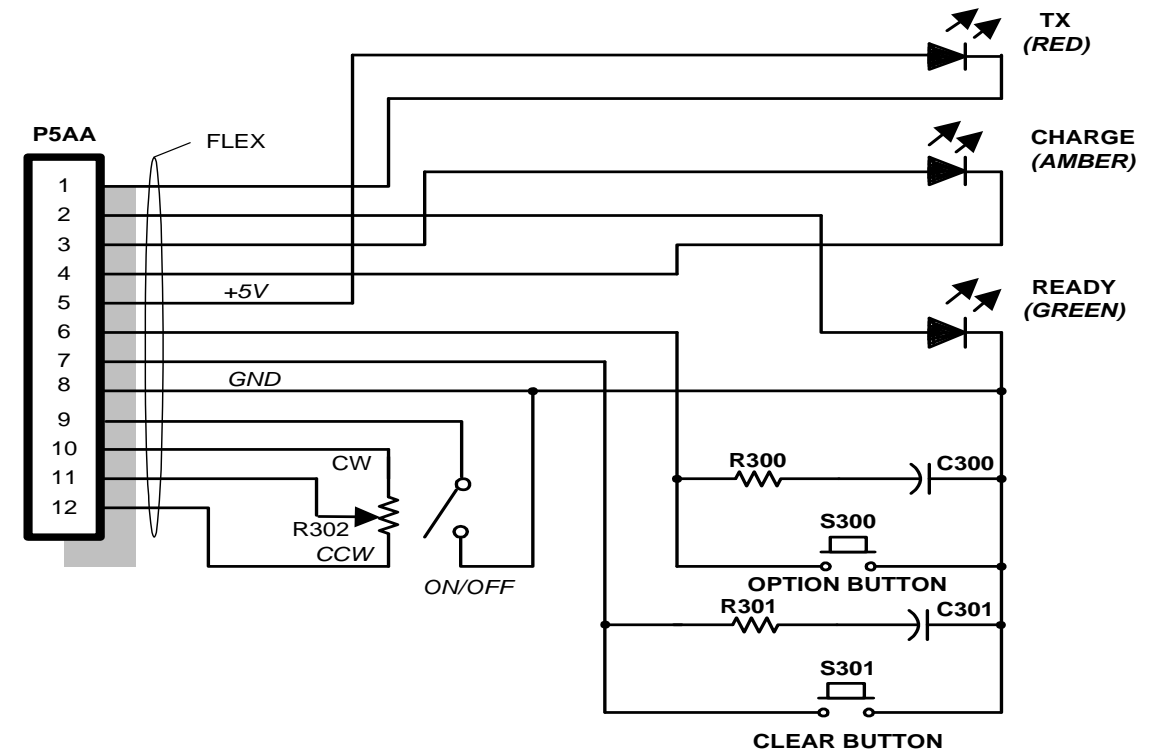
Prism HP/LPE-200/LPE-50 JAGUAR 700P/Pi P7100<sup>IP</sup> P5100 Charging Sleeve (Revisions R6A and Higher)



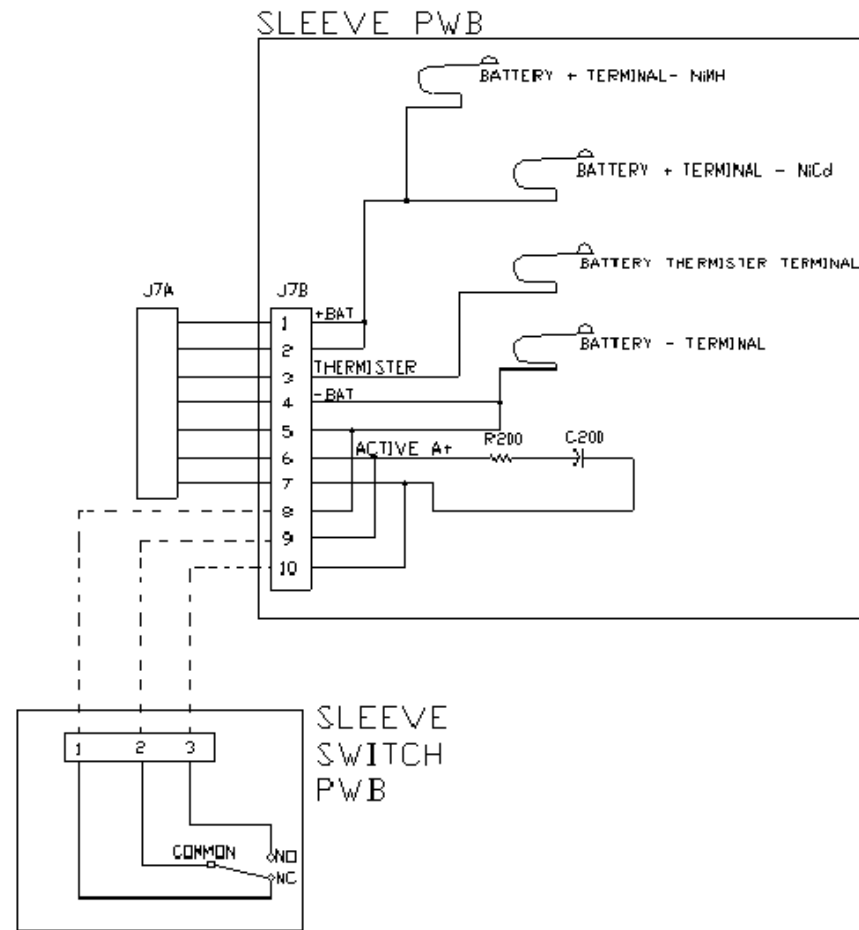
M-RK Charging Sleeve (Revisions R6A and Higher)



Microphone Interface Board



LED/VOLUME FLEX 7028020500  
Connects from Main Printed Circuit Board to the Indicator Panel



Contact Board Schematic: Dual Position with NiMH contact  
 BML 161 67/162 & BML 161 67/172 only  
 JAGUAR 700P/Pi, P7100<sup>IP</sup> and P5100

