Maintenance Manual

M-RK™
Standard Vehicular Charger
344A4616P1

Enhanced Vehicular Charger
344A4616P2

ERICSSON

NOTICE!

This manual covers Ericsson and General Electric products manufactured and sold by Ericsson Inc.

NOTICE!

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitution of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

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ILLUSTRATIONS

SPECIFICATIONS*

GENERAL

Size (H x W x D)	200 x 176 x 50 mm (7.8 x 6.9 x 1.9 inches)
Weight	1.2 Kg (2.6 lbs. [avoir.])
Indicator Lights	
Charging (high rate)	Yellow LED
Ready	Green LED
Transmit	Red LED (P2 only)
Repeater Enabled	Red LED (P1 only)
Radio Latch	Rotary knob with push-button release (lockable)
Maximum Recharge Times	
1200 mAh Battery Pack	60 minutes
1700 mAh Battery Pack	60 minutes
Temperature Limits	
Charging	+5 to +45°C
Operating	-30 to +60°C
Charge Fault Detection	shorted cell and charge temperature limits
Duty Cycle	100% receive, 10% transmit

ELECTRICAL

Nominal Input Voltage	13.8 Vdc (negative ground)
Input Voltage Limits	10.8 to 16.6 Vdc

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SPECIFICATIONS*

Maximum Current Drains	
Off	5 mA
On And Not Charging	100 mA
Charging And Radio Squelched	2.0 Amperes
Charging And Ext. Spkr. At Rated Output	3.5 Amperes
Battery Charge Currents	
Fast Charge	1200 mA ±150 mA
Slow Charge	100 mA ±20 mA
External Speaker Amplifier Rated Audio Power Output	10 Watts
External Speaker Amplifier Maximum Audio Distortion	5% at 10 Watts
External Speaker Amplifier Frequency Response	±1 dB from 300 to 3000 Hz
Antenna Port Impedance	50 ohms
Maximum Antenna Port Loss	1.0 dB from UDC to TNC connector

ENVIRONMENTAL TESTS

STANDARD	METHOD	PROCEDURE	TEST
MIL STD 810-C/D	514.2	VIII CAT F	Vibration
	514.2	X	Vibration
	514.3	I CAT 1 & 10	Vibration
MIL STD 810-C/D	516.2	I & II	Shock
	516.3	I	Shock
MIL STD 810-C/D	502.1	I	Low Temperature
	502.2	II	Low Temperature
MIL STD 810-C/D	501.1	I	High Temperature
	501.2	II	High Temperature
MIL STD 810-C/D	501.2	II	Operational Temperature
MIL STD 810-C/D	503.1	I	Temperature Shock
MIL STD 810-C/D	503.2	I	Temperature Shock
MIL STD 810-C/D	507.1	II	Humidity
	507.2	II	Humidity
MIL STD 810-C/D	500.1	II	Low Pressure
	500.2	II	Low Pressure
EIA RS-316-B			Temperature
EIA RS-316-B			Supply Voltage
EIA RS-316-B			Vibration
EIA RS-316-B			Humidity

* These specifications are intended primarily for use by service personnel. Refer to the appropriate Specification Sheet for complete specifications.

DESCRIPTION

Ericsson GE Vehicular Charger/Repeater units 344A4616P1 (Part 1) and 344A4616P2 (Part 2) provide a mobile charging capability for either the M-RK I or M-RK II personal hand held radios. These charger/repeater units operate with either the standard high capacity (19A149838P1 - 1200 mAh), or the extra high capacity (344A3278P1 - 1700 mAh) nickel-cadmium battery packs. The personal radio battery pack has a charging current applied whenever the radio is inserted into the charging sleeve. An enable/disable function is included for the Part 1 (Vehicular Repeater System) charger.

With the Part 1 charger, the Vehicular Repeater System is active only when the M-RK radio is **not** in the charging sleeve. When the M-RK is out of the charging sleeve only then can the M-RK transmitted signal be routed through the repeater. Inserting the radio into the charging sleeve switches off the repeater.

With the radio out of the charging sleeve, the repeater enable switch must also be in the enable position for repeater operation. This switch is part of the repeater receiver. When it is in the on position the **RED** LED labeled **RPT** lights.

When a radio is inserted into the charger, charging contacts are automatically made at the back of the radio. A radio detect microswitch (S1), located near the charging contacts, applies power and the fast charge begins, provided the battery is in the acceptable temperature range. A second microswitch determines the charging rate required based upon battery size.

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

The radio can be operated while in a Part 2 charger. Provision for this operation is designed into the charger with a vehicular antenna and a remote microphone connected at the bottom of the charger (Refer to Figure 1B). The connections to the radio required for this operation are made through the **U**niversal **D**evices **C**onnector **(UDC)** when the radio is inserted in the charger by turning the front panel rotary latch knob clockwise to the locking position. In this position the UDC contacts meet with mating contacts on the M-RK I or II personal radio for operation and the radio is locked into the charger. Pushing a release button on the top of the rotary latch knob releases and disconnects the radio from operation. This release button arrangement is supplied with a key that can be used to lock the push-button in the clockwise (locked) position. With the lock engaged, the release cannot be pressed. This locks the radio to the charger and it cannot be removed.

STANDARD VEHICULAR CHARGER (344A4616P1)

The front panel of this charger contains three (3) indicator lights; **RPT**, **RDY**, and **CHRG**, an **ON/OFF** switch for the Repeater Radio and the **UDC ROTARY LATCH KNOB** (Refer to Figure 1A and 1B).

(1) Indicator Lights:
RPT (Red) - Lights if the Repeater Radio is powered ON.

RDY (Green) - Lights if the Battery is 90 to 100 percent charged and the charger reverts to "trickle" charge.

CHRG (Yellow) - Lights when radio is first inserted in the charger. Indicates Radio is being "fast" charged.

(2) Repeater ON/OFF switch:
Turning this switch ON any time the M-RK personal radio is out of the charger powers the repeater radio and lights the Red Indicator light.

(3) UDC Rotary Latch Knob:
This knob latches the M-RK personal radio in the charger and only secures the radio into the charger. When the latch is activated, no other electrical connections are made to the radio. It should ***always*** be latched when the radio is in the charger and the vehicle is moving.

ENHANCED VEHICULAR CHARGER (344A4616P2)

The front panel of this charger contains three (3) indicator lights; **TX, RDY**, and **CHRG**, an **ON/OFF** volume control switch for operation of the M-RK personal radio as a mobile radio, an option push-button, and the **UDC ROTARY LATCH KNOB** (Refer to Figure 1A).

(1) **Indicator Lights**:
TX (Red) - Lights if the M-RK transmitter is active.

RDY (Green) - Lights if the Battery is 90 to 100 percent charged and the charger reverts to "trickle" charge.

CHRG (Yellow) Lights when radio is first inserted in the charger. Indicates Radio is being "fast" charged.

(2) **ON/OFF** Volume Control Switch:

This switch powers the radio for operation as a mobile. Check to assure that the UDC LATCH KNOB is in the "engaged" position.

(3) **Option Push-Button**:
This button can be programmed for many functions, but factory programming causes the same action as the M-RK "Clear" function. (See the M-RK Operator's Manual LBI-38732 (or LBI-38733).

(4) **UDC Rotary Latch Knob**:
This knob latches the M-RK personal radio in the charger and connects the UDC to all circuits within the charger to allow M-RK radio operation as a mobile radio. It should ***always*** be latched when the radio is in the charger and the vehicle is moving.

ELECTRICAL DESCRIPTION

The M-RK Vehicular Charger provides the following electrical functions (see to Figure 2):

- Accessory connector
- Alternator noise/transient filter
- High rate constant current source
- Charge control
- Power Supply
- Charge control microcontroller
- Hi/Low temperature limit detector
- Audio Amplifier
- 5-Volt regulator
- Remote control logic interface
- Microphone connector
- Antenna connector
- **U**niversal **D**evices **C**onnector **(UDC)**
- Bypassing
- Shielding

Accessory Connector

A DB15 Accessory Connector (CN1) provides connections for the power cable, speaker leads emergency foot switch, hookswitch and optional control unit leads to the charger. DC power from the vehicle battery is routed through the on/off power switch in the radio insert and then to the alternator noise filter.

Alternator Noise/Transient Filter

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

High Rate Constant Current Source

This is an active constant current source used to regulate charge current. It has adequate heatsinking to dissipate the heat created with 16.5 Vdc input and a battery pack with one shorted cell.

Charge Control

The charge control enables or disables the high rate constant charge current. This circuit is connected in the constant current source and is controlled by the charge control microcontroller (IC4)

Power Supply

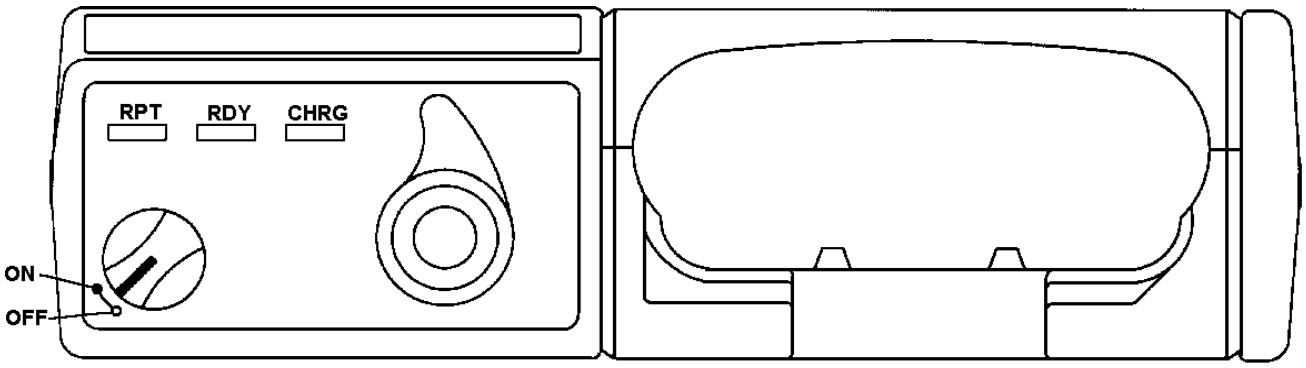
This is a current limited, constant voltage power supply which is enabled when the radio is in the transmit condition. This power supply will power the radio when the battery is completely discharged by forcing a minimum voltage of 7.5 V to appear across the battery pack. The current limiting prevents damage to the regulator when a battery pack with one or more shorted cells is in the charging insert. This power supply is enabled by the **T/R** output lead at the radio UDC. The red PTT indicator lights when the power supply is enabled. The power supply is designed to prevent the trickle charge from flowing into the power supply when the power supply is turned off and in the receive mode.

Charge Control Microprocessor

Functions performed by this controller are:

1. Shorted cell detection
2. Battery removal sensor
3. Battery charger latch
4. Minus delta V sensor for charge control
5. Charge indicator control and fault display

STANDARD/REPEATER CONTROL M-RK VEHICULAR CHARGER 344A4616P1



ENHANCED M-RK VEHICULAR CHARGER 344A4616P2

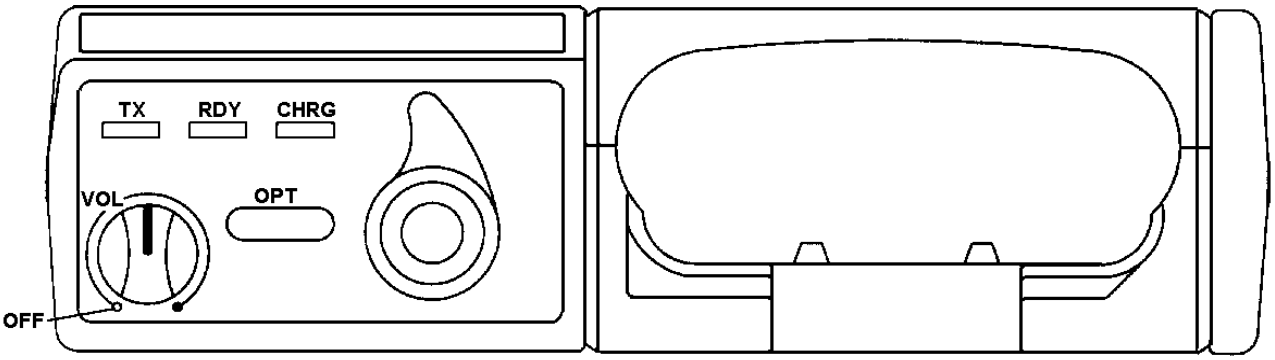


Figure 1A - M-RK Vehicular Chargers

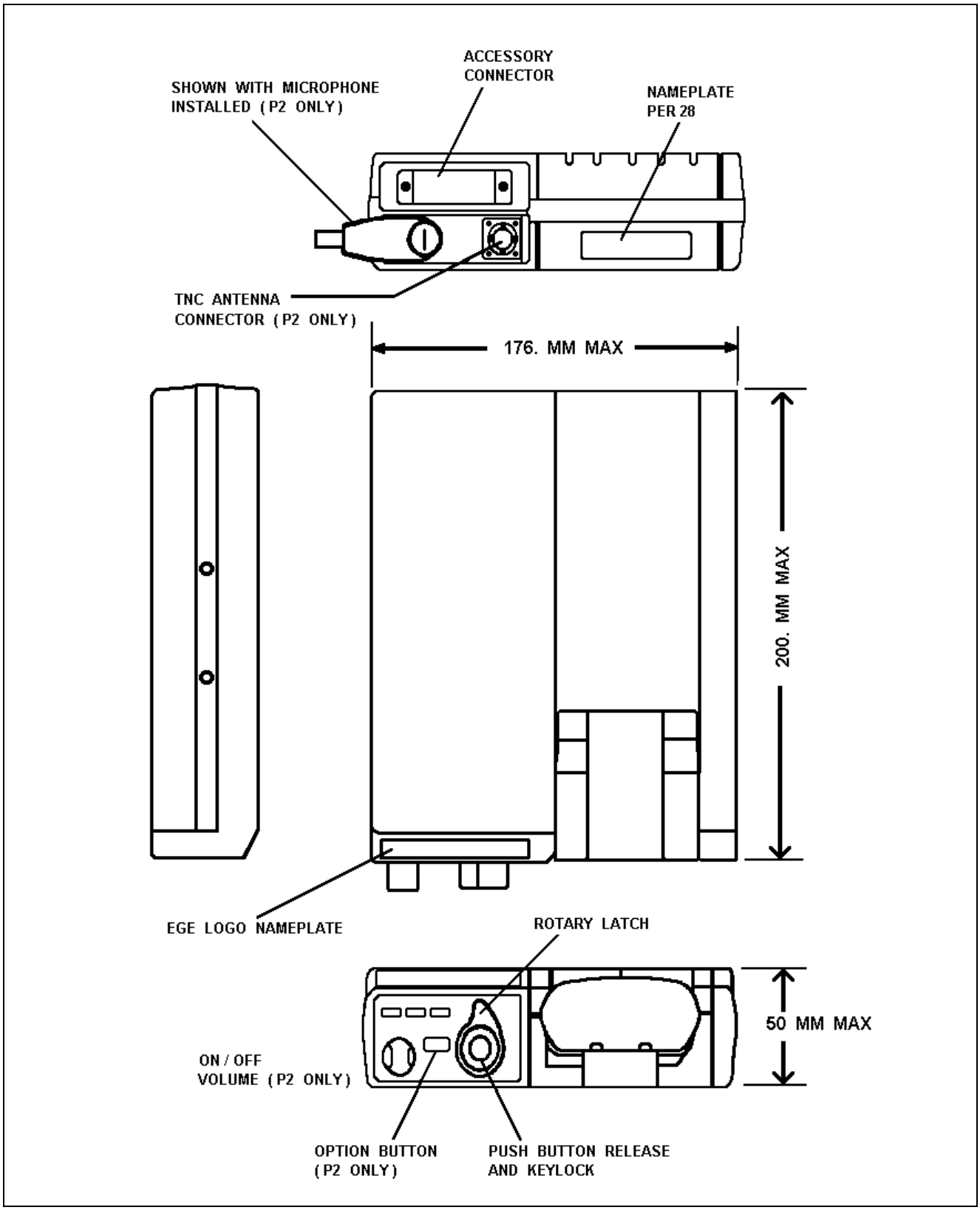


Figure 1B - M-RK Vehicular Charger

Hi/Low Temperature Limit detector

This circuit measures battery pack temperature by monitoring the resistance on the battery thermistor. It provides a signal to the charge control microprocessor if the battery is in acceptable temperature limits for fast charging.

Audio Amplifier

Receiver audio at a fixed level from the radio UDC is amplified by this audio amplifier (IC6) to 10 watts of audio power output. The audio level is adjusted by an audio taper volume control (VR1) in the vehicular 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. Audio transients caused by enabling or disabling the amplifier are minimized so that they are not audible. The amplifier is capable of continuous duty operation at rated power.

5-Volt Regulator

This regulator (IC2) provides DC power for the radio control microprocessor and the charge control microprocessor if necessary. The regulator provides a reset signal for the microprocessors if it falls out of regulation due to low input voltage.

Remote Control Logic Interface

The Remote Control Logic Interface takes serial data control signals from the radio UDC and translates these signals to IEE485 logic levels. This is to comply with the **ORION™** control unit data interface. This logic is standard on all 344A4616P2 chargers.

Microphone Connector

The microphone connector provides connections for the external microphone, PTT switch, Channel Guard hookswitch and earpiece audio for external handsets.

Antenna Connector

This is a TNC connector which is connected to the radio UDC RF connector with low loss coax. Termination's are carefully shielded to prevent RF energy from interfering with the charger electronics.

Universal Devices Connector (UDC)

The M-RK Universal Devices Connector (PCB4) provides control and audio interface leads for the 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 charger has an internal dip switch that can connect one of three resistor values to the sense pin. The values of the three resistors are 3160, 5360 and 6490 ohms. The M-RK vehicular charger is shipped from the factory with the 3160 ohm resistor connected. The software is written so that with this configuration, the remote control operation is enabled. The **ORION** control unit will assume full control of radio operation including remoting of the M-RK display information.

RF Bypassing

Because the vehicular charger may be installed in vehicles containing other high powered radio equipment, all leads connecting to the charger are passed to prevent malfunction caused by RF energy fed into the charger. The charger operates normally when a 10 watt transmitter coupled through a 3 dB pad is AC coupled to any pin on the microphone, power or accessory connector.

Shielding

The charge control microprocessor is capable of creating signals that will interfere with the normal operation of the M-RK receiver. The microprocessor is shielded so that harmonics of the clock frequencies used can not be heard by the M-RK radio receiver. The M-RK is programmed to exact harmonics of internal clock frequencies. When the antenna connected to a 1/4 wave antenna placed 1 meter from the charger, no self quieting or heterodyne signals should be heard.

OPERATION

MOBILE CHARGER

Operation of the Charger is possible in three configurations:

1. as a standard vehicular charger and repeater control.
2. as an Enhanced Charger providing added operational features.

3. as an Enhanced Charger operating through the **ORION™** Control Head. For operation in configuration (3) see the applicable Operator's Manual.

Standard Vehicular Charger (with Repeater) (344A4616P1)

Operation of the chargers is automatic when the M-RK personal radio is inserted into the charging sleeve. The radio is inserted in the charger when the battery pack needs recharging. With the charger standard model, no operation of the radio is possible while the radio battery is charging. Operation of the radio with this model charger is done after the personal radio battery is charged, it is removed from the charger and (normally) is taken outside the vehicle and operated through a repeater radio. Note that the vehicular repeater is automatically disabled when the radio is in the charger unit for recharging. Charging commences immediately, whether or not the UDC INTERFACE is engaged.

The radio is normally operated through a vehicular repeater with this charger to improve communication range. For this operation, the operator takes the following steps:

1. Remove the radio from the charger.
2. Turn on the radio.
3. Turn on the vehicular repeater using the small knob at the lower left corner of the radio front panel. The RPT indicator light, in the upper left corner of the front panel, glows RED when the repeater is ON.
4. After monitoring the channel for activity and finding it free, press PTT and make your call.

Enhanced Vehicular Charger (344A4616P2)

The Enhanced Vehicular Charger (344A4616P2) allows the M-RK Personal radio to operate in the charger while the battery pack is simultaneously being charged. The procedure is as follows:

1. Before attempting to insert the M-RK personal radio in the charger, verify that the ROTARY LATCH KNOB is in the released position. If not, unlock if necessary and press down on the RELEASE BUTTON until the knob snaps to the released position.

NOTE

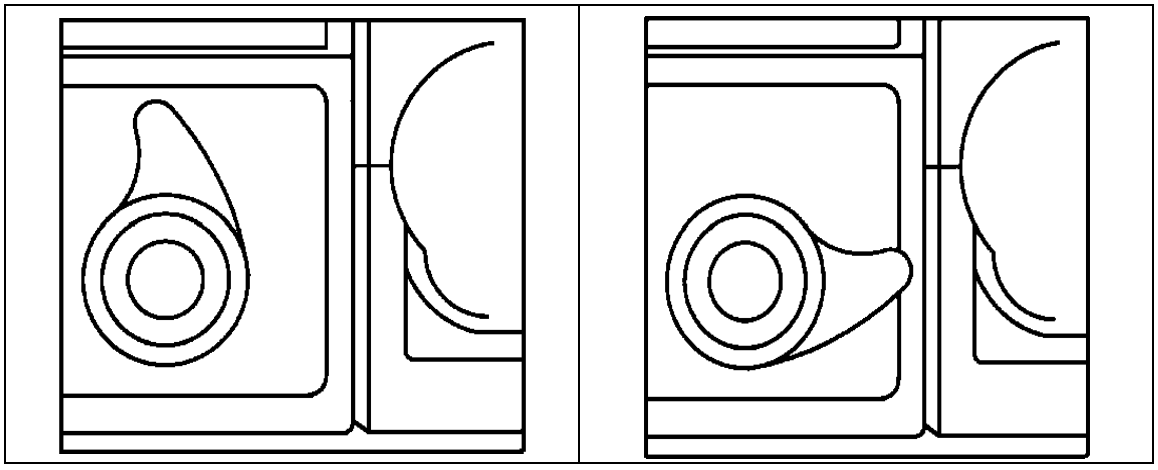
The radio unit should never be inserted or removed from the charger using the antenna as a handle.

2. Insert the M-RK 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 (as shown in Figure 2). When fully inserted, the radio extends approximately 1/8" inch above the front of the charger. The fast charge begins immediately and the yellow charge indicator is illuminated.
3. Engage the interfacing UDC by turning the ROTARY LATCH KNOB approximately 1/4 turn in a clockwise direction until it clicks into the latched position. This connects the M-RK radio to the Vehicular 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 ROTARY LATCH KNOB.
4. If desired, the radio can now be locked into the charger to prevent unauthorized removal. To lock the radio in the charger, insert the key in the hole in the RELEASE BUTTON, turn in a clockwise direction until it stops and remove the key. To unlock the radio, insert the key and turn it in a counterclockwise direction.
5. Turn the radio on by rotating its power on-off/VOLUME knob clockwise out of the detent (OFF) position.
6. The charger and radio are now set for mobile operation. Use the charger VOLUME CONTROL KNOB to adjust the external speaker volume level and use the MICROPHONE PTT button to transmit. The red TRANSMIT INDICATOR lights when the radio is transmitting.
7. When removal of the M-RK is necessary, disengage the UDC INTERFACE by pressing down on the RELEASE BUTTON until the ROTARY LATCH KNOB snaps to the released position. (If the Rotary Latch Knob is locked, it must be unlocked before it will snap release. See step 5. above.) Grip the radio on its sides and pull it out of the charger.

NOTE

NEVER insert or remove the radio from the charger unit by pulling on the antenna, or using it as a handle, as this may damage the antenna.

Figure 2 - Charger with M-RK II Personal Radio Inserted



UDC Released **UDC Engaged**

Figure 3 - UDC Rotary Latch Knob

BATTERY CHARGER DETAILS

NOTES

To maximize nickel cadmium battery life, the M-RK vehicular chargers are designed with automatic controls which limit the rapid charging of M-RK batteries 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 yellow LED which blinks at a slow rate.

If a slow blinking, yellow 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.

In a vehicular application, with either high ambient temperature inside or outside of the vehicle, the automatic charging control will often prevent rapid charging or limit the time of rapid charging.

In other situations, where the operator inserts and 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 M-RK radio (with its battery pack) is placed in the charger, the radio battery pack is charged. The fast or "rapid" charge feature, normally is applied immediately, and is controlled by the microprocessor 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 yellow charge indicator 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 rate and completes the charge. During the "trickle" charge the green ready indicator is illuminated.
- The yellow CHARGE INDICATOR lights when the unit is fast charging.
- If the CHARGE INDICATOR 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, or a defective battery pack.
- The yellow CHARGE INDICATOR turns off and the green READY INDICATOR turns on when the unit has completed the fast charge and the "trickle" charge commences.
- If the battery pack is completely dead, M-RK mobile mode operation can continue normally (with a P2 Enhanced Charger unit). To do this, insert the radio (with the dead battery pack) into the charger and engage the UDC INTERFACE for operation.
- Normal engagement of the UDC INTERFACE is not necessary for battery charge operation, but is required to operate an M-RK Personal radio in the enhanced vehicular charger during the charging cycle. The UDC INTERFACE ROTARY LATCH KNOB should also be in the "engaged" position whenever the vehicle is moving, for both the standard and enhanced models, to firmly hold the radio in the charger in case of an accident.

CIRCUIT ANALYSIS

CHARGING CIRCUITS

Input Clamp, Filter And Power Switch

Operating power for the charger is applied to connector CN1, Pins 1 (-) and 15 (+). Zener diode D1 provides over-voltage and reverse-polarity protection for the charger by clamping excessive or reverse voltages. Capacitors C2 and C3 and inductor L1 form a pi-filter for the dc input power.

Inserting a battery pack into the slot closes on/off power switch SW1 located near the bottom of the charger slot. With this switch closed, 13.8 Vdc (nominal) power from CN1, Pin 15 is applied to the 12-Volt switching regulator circuit IC1 and the fast-charge microcontroller circuit IC4. This turns the charger on.

Battery Pack Capacity Sensing Switch

Switch SW2 is used to sense the capacity of the battery pack. This is a normally-open switch located just below SW1 in the charger slot. SW2 will close only when an extra-high capacity battery pack is installed in the slot.

When SW2 closes, PNP transistor Q3 switches the current-limit rating of 12-Volt switching regulator IC1 to provide extra current needed during a fast charge.

12-Volt Switching Regulator Circuit

The 12-Volt switching regulator circuit is formed by integrated circuit IC1, transformer T1, MOSFET (Metal-Oxide Semiconductor Field Effect Transistor) Q1, and associated components. This circuit outputs a well-regulated 12.0 Vdc power source over the specified input voltage range (10.8 - 16.6 Vdc) to provide the charging power to the slow and fast charge circuits. It supplies approximately 2.0 amperes of current during fast-charge periods.

Switching regulator IC1 (MB3759) is the heart of the 12-Volt regulator circuit. It switches transistors Q1 and Q2 on and off to develop alternating currents in the primary and secondary of T1. The resulting secondary currents are rectified by D4, filtered by C14, and applied to the slow and fast-charge series pass elements (R29 and Q4 respectively).

Feedback for the regulator is provided by the attenuator network formed by resistors R19 - R21. The feedback voltage on IC1, Pin 1 is 5.0 Vdc. An error amplifier in IC1 compares this voltage to a reference voltage that is generated within the IC. The error amplifier output then controls the switching control circuitry in IC1.

MOSFET Q1 is mounted on the on the aluminum heat sink inside the unit to provide heat dissipation. However, since it is operating in the non-linear region, Q1 generates very little heat under normal operating conditions. Transistor Q2 controls the conduction of Q1. When the base of Q2 goes low, Q2 conducts harder and Q1 shuts off. When the base of Q2 goes high, Q2 conducts less and Q1 switches on. This switching on and off causes the alternating current in transformer T1.

Fast-Charge Circuit

The fast (rapid) charge circuit incorporated in the charger is a microcontroller-controlled circuit (IC4) that senses several battery conditions to determine if the battery pack needs to be and can be fast charged. The microcontroller circuit monitors the battery pack terminal voltage and internal temperature.

Slow-Charge Circuit

If the unit is not fast charging, it will slow charge the battery pack. The slow charge circuit is a simple trickle-charge circuit that is formed by 2-Watt dropping resistor R29 and diode D6. When the fast-charge circuit turns off, these components supply approximately 4 milliamps of current from the 12-Volt switching supply.

DEAD BATTERY POWER SUPPLY (VEHICULAR CHARGER ONLY)

The dead battery operation feature allows the radio to fully operate (transmit and receive) when it is placed in the charger with a dead battery pack. When the radio is in receive mode (both squelched and unsquelched) it is powered by currents from both the slow-charge and rapid-charge circuits. If the radio is keyed while it is charging, regulator IC7 and associated components prevent the battery pack terminal voltage from dropping below 7.5 Vdc. These components from the dead battery power supply.

The dead battery power supply only turns on when the radio is transmitting. When the T/R OUT line (UDC, Pin 6) from the radio transitions low, the supply is enabled by transistors Q11, Q19 and associated components. With T/R OUT low, Q19 is off. Since the collector of Q19 is pulled to 5 Vdc by R87, Q11 turns off and the dead battery supply turns on.

EXTERNAL SPEAKER AMPLIFIER (VEHICULAR CHARGER ONLY)

Integrated circuit IC6 (LA4475) is the audio power amplifier IC that drives the external speaker. This IC is mounted on the aluminum heat sink inside the unit to provide heat dissipation. Audio from the radio on the RX AF OUT line (UDC, Pin 9) passes through a mute switch in IC5 and the volume control before it is applied to IC6 for amplification.

One switch in quad bilateral switch IC5 (4066 type) is used as the mute switch. This switch is controlled by the MUTE OUT line (UDC, Pin 5) from the radio. The radio pulls this line low (typically less than 0.1 Vdc) to completely mute the external speaker. The MUTE OUT line is connected to the control input of the switch at IC5, Pin 5. When the external speaker audio is active (not muted), MUTE OUT is high and the RX AF OUT audio passes though IC5 (Pin 4 to Pin 3) to volume control VR1.

Volume control VR1 provides operator adjustment for the external speaker audio. This rotary control also has an on/off switch that allows the operator to turn the repeater operation on or off through transistor Q23.

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 VR1 is applied to the

input of IC6 at Pin 13. Typical signal level at Pin 13 is ____ V rms (_____ V p-p) when VR1 is fully clockwise and the radio is receiving a 1 kHz tone.

Audio power amplifier IC6 provides approximately _____ 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 (CN1, Pins 18 and 19). Switched dc operating power for IC6 is applied to IC6, Pin 3 from the collector of transistor Q4. Inductor L4 and the capacitors connected IC6, Pin 3 provide filtering and decoupling for the dc supply.

EXTERNAL MICROPHONE AMPLIFIER (VEHICULAR CHARGER ONLY)

The external microphone amplifier circuit consist of +6 volt regulator IC8, operational amplifier IC9 and Field Effect Transistor Q15. The input to the amplifier is through microphone connector CN2, Pin 1 and connects through dc blocking capacitor C58 to the negative input terminal of IC9 (Pin 6). Voltage regulator IC8 provides the +6 volts required to operate IC9. Transistor Q15 controls the feedback for IC9 and the gain of the amplifier. When the **P**ush-**T**o-**T**alk **(PTT)** switch on the external microphone is pushed, the gate of Q15 goes low and the amplifier circuit provides ____dB of gain for the microphone input. The output of the amplifier is from IC9, Pin 7 through blocking capacitors C63 and C103 to the UDC, PCB4, Pin 4 (TP4) **EXT. MIC IN**.

MAINTENANCE

The Maintenance section contains Disassembly Procedures Troubleshooting Procedures, and Adjustment Procedures. A Test Adaptor can be constructed to

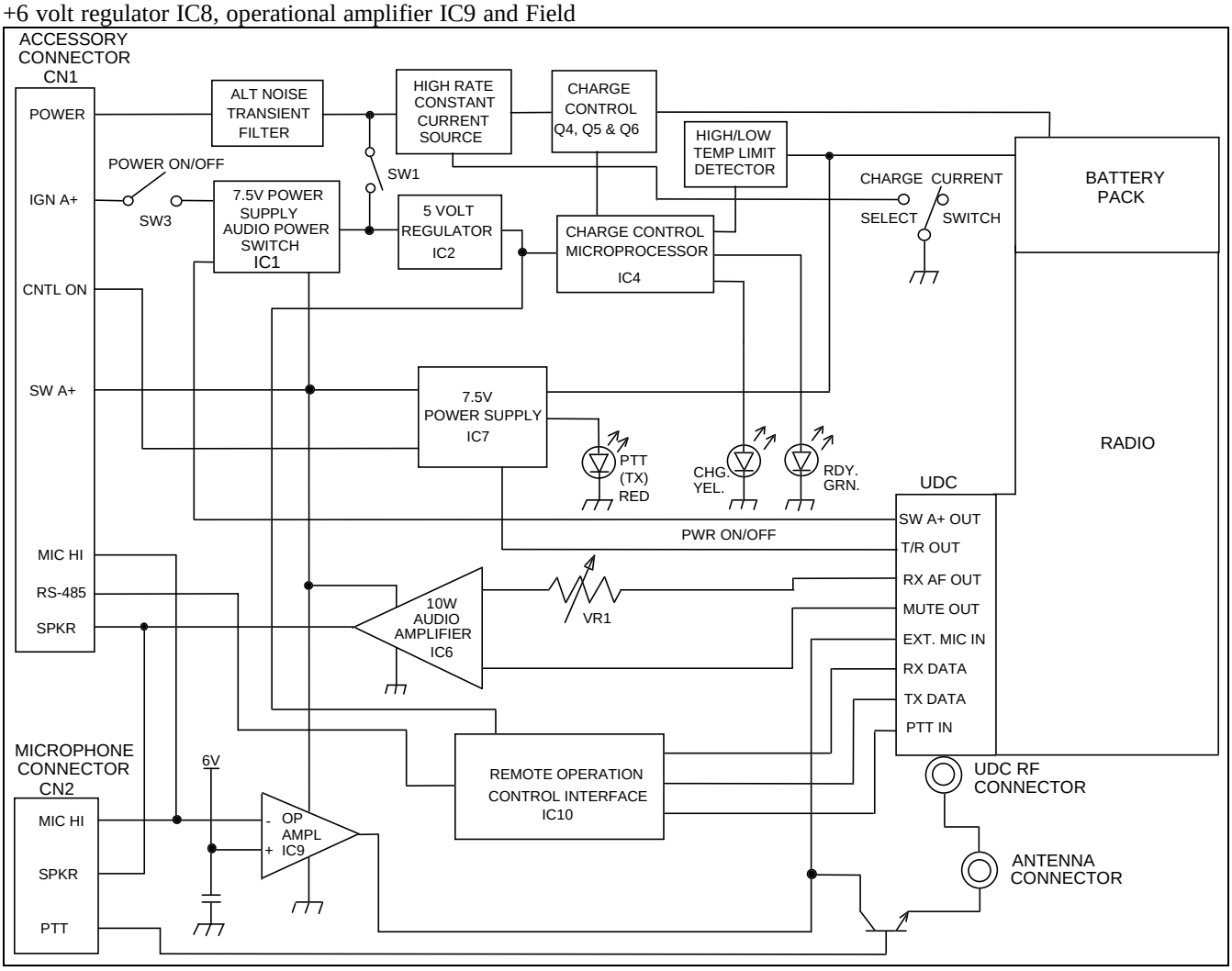


Figure 4- M-RK Vehicular Charger Block Diagram

facilitate servicing the Vehicular Charger. The Test Adaptor is used to simulate actual battery pack conditions and determine if the charger is working properly. Simulations include cold battery pack, battery pack normal range temperature, and hot battery pack. Information pertinent to construction of the Test Adaptor is found in the last section of this manual.

DISASSEMBLY PROCEDURE

1. Remove radio from charger (UDC in released position).
2. Remove charger from vehicle.
3. Remove the Charger Top Cover.
   a. Remove three Phillips head screws from the bottom of the charger near the back edge.
   b. Next, remove the sliding radio cover (polycarbonate resin) section of the top cover. This cover slides down toward the back of the charger after the bottom edge is raised to escape small locking ridges in the mating plastic piece. Free the sliding cover by inserting the tip of a flat blade screw driver in the small notch at the back center of the cover and gently pry to lift the cover over the ridges and slip it back about 3/8 inches. From this position the sliding portion of the cover can be lifted straight up and off.
   c. The remainder of 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° from horizontal, and then slipped forward and off. The front panel with all switches and indicators remains attached to the base casting.
4. Remove the four (4) Phillips head screws from the RF protective shield covering the circuit components.

ADJUSTMENT PROCEDURE

The only adjustment to the M-RK vehicular charger is the setting of dip switches S3 and S5. The factory DIP switch settings for both the Part 1 and Part 2 chargers is as follows:

SW3	1	2	3	4	5	6	7
Part 1	ON	OFF	ON	ON	ON	OFF	OFF
Part 2	ON	OFF	ON	ON	ON	OFF	OFF

SW5	1
Part 1	OFF
Part 2	

The M-RK radio is designed with Rx an Tx serial data ports the UDC. This allows the radio to be remotely controlled. The Part 2 vehicular charger contains remote control logic (IC10) which buffers these data signals to IEE-485 levels that are compatible with the ORION control units. M-RK software is written so that this remote control operation is enabled when the 3160 ohm resistor(SW3-5) is connected to the UDC sense pin. In this configuration, the ORION control unit assumes full control of radio operation including remoting of the M-RK display information.

The following switch settings are required for several operational modes. Any switch settings not defined below cannot be used and must be avoided.

	SWITCH NUMBERS						
	1	2	3	4	5	6	7
Ignition A+ - Inhibited	ON	OFF	X	X	X	X	X
Ignition A+ - Enabled	OFF	ON	X	X	X	X	X
Option Switch - Inhibited	X	X	X	ON	X	X	X
Option Switch - Enabled	X	X	X	OFF	X	X	X
Display Invert - Normal	X	X	X	X	ON	OFF	OFF
Display Invert - Inverted	X	X	X	X	OFF	ON	X
ORION Control Head - inhibited	X	X	ON	OFF	OFF	OFF	OFF
ORION Control Head - Enabled	X	X	OFF	OFF	OFF	OFF	OFF

X -DON'T CARE

BATTERY PACK TEST SIMULATOR CONSTRUCTION

This test battery pack simulator must be adapted to a dummy battery pack which will fit into the sleeve of the charger under test. The dummy battery pack should have a mechanism to operate the microswitch in the charger sleeve so that charge currents for short and long batteries can be measured.

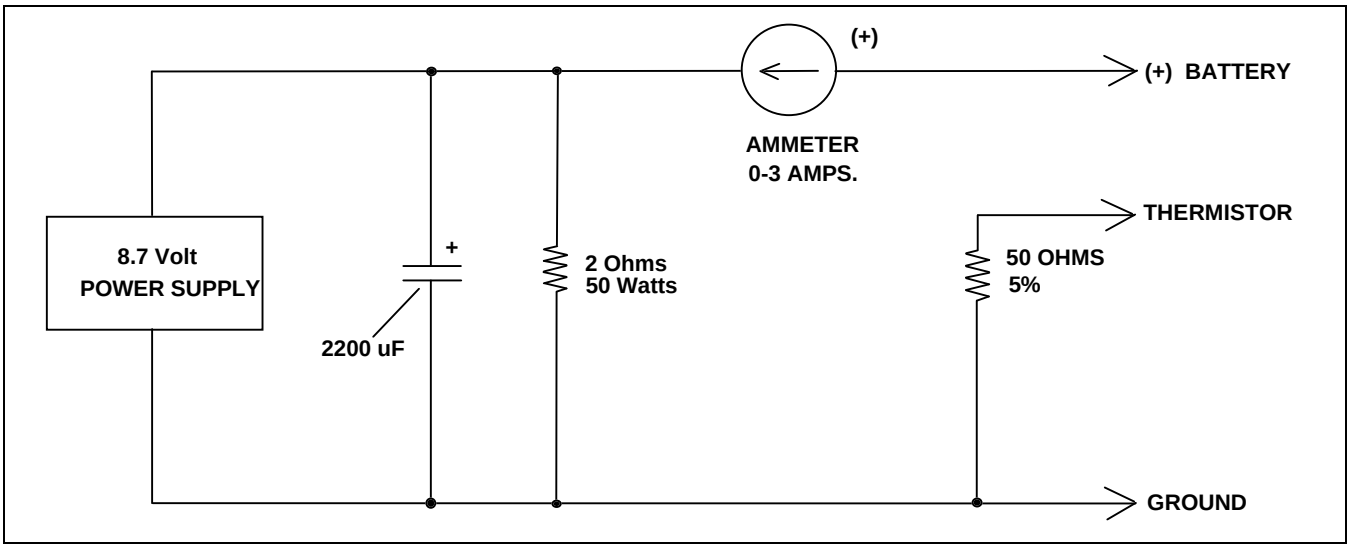


Figure 5 - Battery Pack Test Simulator

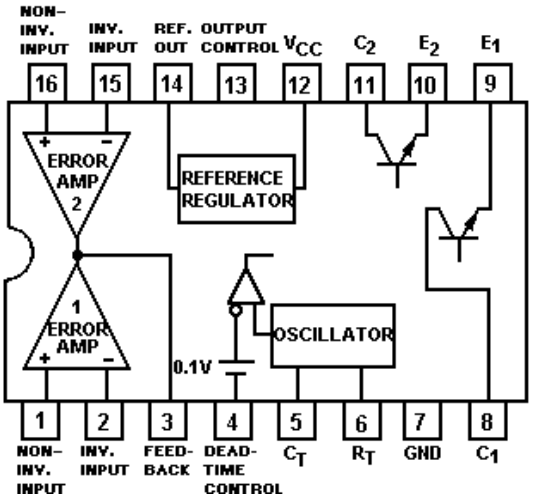
TEST PROCEDURE

1. With the vehicular charger connected to the normal 13.8 Vdc supply, plug the test circuit (adaptor) into the charging sleeve. When inserted, the yellow LED **"CHRG"** indicator must light.
2. Calibrate the adaptor by setting the 8.7-volt supply to 8.7 Vdc ± 0.1 Vdc. the ammeter on the adapter must read the following:

SHORT BATTERY CHARGE CURRENT	LONG BATTERY CHARGE CURRENT
1170 to 1430 mA	1710 to 2090 mA

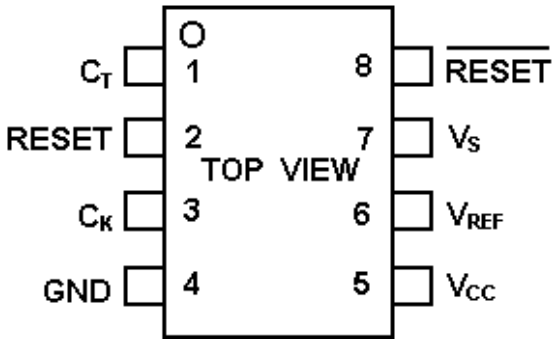
Linear: Switching Regulator IC1, IC7
(FUJITSU MB3759PF OR NEC µPC494GS)

CONNECTION DIAGRAM (Top View)

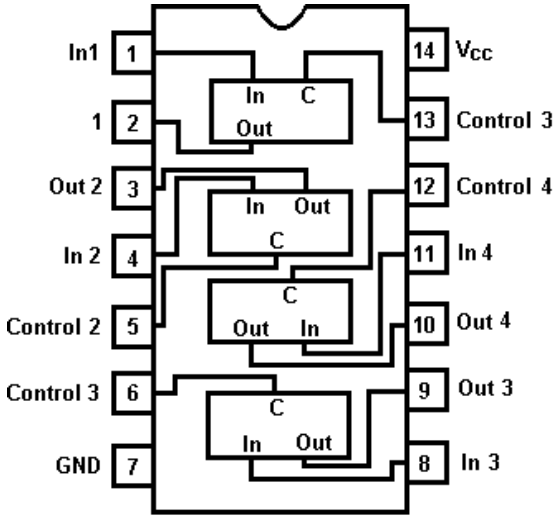


Regulator Auxiliary Function IC3
(FUJITSU MB3773PF)

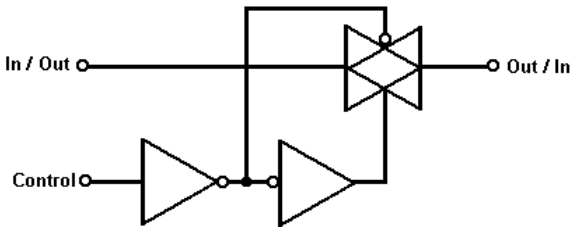
PIN ASSIGNMENT



Digital: Quad Bilateral Switch IC5
(HITACHI HD74HC4066FP OR NEC µPD74HC4066GS)



LOGIC DIAGRAM (1/4)



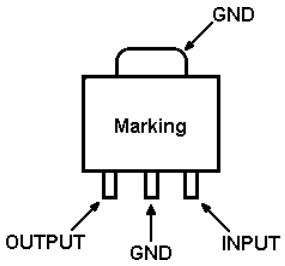
FUNCTION TABLE

Control	Switch
L	OFF
H	ON

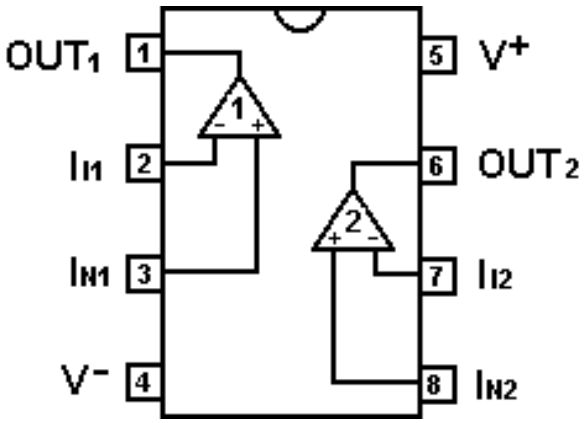
$GND \leqq Vin \leqq Vcc$

$GND \leqq Vout \leqq Vcc$

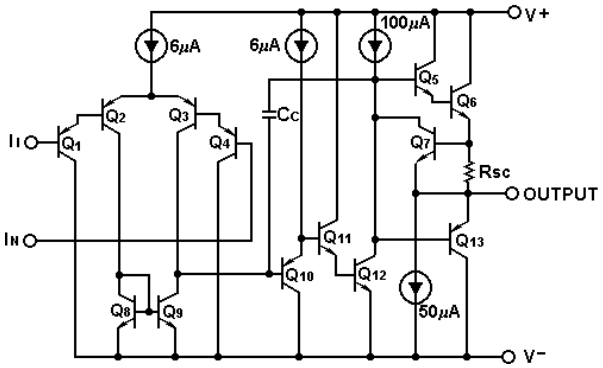
Linear: +6-Volt Regulator IC8
(JRC NJM78L06T OR NEC µPC78L06T)



Linear: Operational Amplifier IC9
(NEC μPC358G2 OR HITACHI HA17904FP)



EQUIVALENT CIRCUIT (1/2 Circuit)



VEHICULAR CHARGER MAIN BOARD
344A4616P1 (PCB1)
Issue 1

SYMBOL	PART NUMBER	DESCRIPTION
PCB2		Vehicular Charger LED Board
		- - - -CONNECTORS- - - -
CN7		6-Conductor With Leads.
		- - - - - - -LEDS- - - - - - - -
LED1		Yellow, Rectangular.
LED2		Green, Rectangular.
LED3		Red, Rectangular.
PCB3		Microphone Connector
PCB4		Universal Devices Connector
		- - - -CAPACITORS- - - -
C1	**NOTE:** Parts listed are for reference only.	Ceramic: 0.1 µF ±10%, 25 V.
C2		Electrolytic, aluminum: 330 µF, 25 V.
C3		Electrolytic, aluminum: 1500 µF, 25 V.
C4		Ceramic: 0.1 µF ±10%, 25 V.
C5		Electrolytic, aluminum: 220 µF, 25 V.
C6		Ceramic: 0.1 µF ±10%, 25 V.
C7		Ceramic: 470 pF ±5%, 50 V.
C8		Ceramic: 0.1 µF ±10%, 25 V.
C9		Electrolytic, aluminum: 4.7 µF, 50 V.
C10 thru C13		Ceramic: 0.1 µF ±10%, 25 V.
C14		Electrolytic, aluminum: 1500 µF, 16 V.
C15 and C16		Ceramic: 0.1 µF ±10%, 25 V.
C17 and C18		Ceramic: 0.01 µF ±10%, 50 V.
C19		Electrolytic, aluminum: 100 µF, 25 V.
C20		Electrolytic, aluminum: 10 µF, 25 V.
C21		Ceramic: 0.1 µF ±10%, 25 V.
C22		Electrolytic, aluminum: 1 µF, 25 V.
C23		Ceramic: 0.1 µF ±10%, 25 V.
C24 and C25		Ceramic: 100 pF ±5%, 50 V.
C26 and C27		Ceramic: 0.1 µF ±10%, 25 V.
C28		Electrolytic, aluminum: 1 µF, 25 V.
C29		Ceramic: 0.1 µF ±10%, 25 V.
C30		Electrolytic, aluminum: 1 µF, 25 V.
C31 and C32		Ceramic: 0.1 µF ±10%, 25 V.
C67 thru C75		Ceramic: 0.001 µF ±10%, 50 V.
C78 thru C80		Ceramic: 0.001 µF ±10%, 50 V.
C101 C102		Ceramic: 0.1 µF ±10%, 25 V.
		- - - - -DIODES- - - - -
D1		Suppresser.
D2		Silicon.
D3		Silicon, zener.
D4		Silicon.
D5 and D6		Silicon.
D7		Silicon: Dual diodes, common cathode.
D8		Silicon: Dual diodes, common cathode.
D9		Silicon: Dual diodes in series.
D10 and D11		Silicon: zener.
D15		Silicon: Dual diodes, common cathode.
D18		Silicon: Dual diodes, common cathode.
D22		Silicon, zener.
		- - - - -INDUCTORS- - - - -
L1		Inductor.
		- - -TRANSISTORS- - -
Q1		Silicon, N-channel MOSFET.
Q2		Silicon, PNP.
Q3		Silicon, PNP (with bias resistors).
Q4		Silicon, PNP.
Q5		Silicon, NPN.
Q6		Silicon, PNP (with bias resistors).
Q7		Silicon, PNP.
Q8		Silicon, PNP (with bias resistors).
Q9		Silicon, PNP.
Q20		Silicon, NPN.
		- - - -CONNECTORS- - - -
CN1		DB-25 Connector
CN3		6-pin Solder in place
		INTEGRATED CIRCUITS
IC1		Linear: Switching Regulator.
IC2		Linear: +5-Volt Regulator.
IC3		Regulator Auxiliary Function
IC4		Digital: Microcontroller.
IC5		Digital: Quad Bilateral Switch.
		- - - - RESISTORS- - - -
R1		Metal film: 100 ohms ±5%, 1/10 W.
R2		Metal film: 4.7 ohms ±5%, 1/10 W.

*** COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.**

Continued

Continued

SYMBOL	PART NUMBER	DESCRIPTION
R3		Metal film: 2K ohms ±5%, 1/10 W.
R4		Metal film: 10 ohms ±5%, 1/10 W.
R5		Metal film: 10K ohms ±5%, 1/10 W.
R6		Metal film: 22K ohms ±1%, 1/10 W.
R7		Metal film: 100K ohms ±5%, 1/10 W.
R8		Metal film: 1K ohms ±5%, 1/10 W.
R9		Metal film: 2.2K ohms ±5%, 1/10 W.
R10		Metal film: 47K ohms ±1%, 1/10 W.
R11		Metal film: 18K ohms ±1%, 1/10 W.
R12		Metal film: 1K ohms ±5%, 1/10 W.
R13		Metal film: 1.5K ohms ±1%, 1/10 W.
R14		Metal film: 100 ohms ±5%, 1/10 W.
R15		Metal film: 56K ohms ±1%, 1/10 W.
R16		Metal film: 130K ohms ±1%, 1/10 W.
R17		Metal film: 4.7K ohms ±5%, 1/10 W.
R18		Metal film: 0.1 ohms ±10%.
R19		Metal film: 1.5K ohms ±1%, 1/10 W.
R20		Metal film: 10K ohms ±1%, 1/10 W.
R21		Metal film: 8.2K ohms ±1%, 1/10 W.
R22		Metal film: 100 ohms ±5%, 1/10 W.
R23		Metal film: 4.7K ohms ±5%, 1/10 W.
R24		Carbon: 150 ohms ±5%, 1/2 W.
R25		Carbon: 120 ohms ±5%, 1/2 W.
R26		Metal film: 10K ohms ±5%, 1/10 W.
R27		Metal film: 1.2K ohms ±5%, 1/10 W.
R28		Metal film: 1.5K ohms ±5%, 1/10 W.
R29		Metal film: 82 ohms ±5%, 2 W.
R30 and R31		Metal film: 2.2K ohms ±5%, 1/10 W.
R32 and R33		Metal film: 47K ohms ±5%, 1/10 W.
R34		Metal film: 5.6K ohms ±5%, 1/10 W.
R35		Metal film: 1M ohms ±5%, 1/10 W.
R36 and R37		Metal film: 300 ohms ±5%, 1/10 W.
R38		Metal film: 4.7K ohms ±5%, 1/10 W.
R39		Metal film: 10K ohms ±1%, 1/10 W.
R40		Metal film: 18K ohms ±1%, 1/10 W.
R41		Metal film: 47K ohms ±5%, 1/10 W.
R42		Metal film: 51K ohms ±1%, 1/10 W.
R43		Metal film: 4.7K ohms ±5%, 1/10 W.
R45		Metal film: 1K ohms ±5%, 1/10 W.
R46		Metal film: 2.2K ohms ±5%, 1/10 W.
R47		Metal film: 5.1K ohms ±5%, 1/10 W.
R48		Metal film: 68K ohms ±5%, 1/10 W.
R49		Metal film: 47K ohms ±1%, 1/10 W.
R50		Metal film: 4.7K ohms ±5%, 1/10 W.
R51		Metal film: 120 ohms ±5%, 2W.
R52		
R53		Metal film: 1K ohms ±5%, 1/10 W.
R54		Metal film: 100 ohms ±5%, 1/10 W.
R55		Metal film: 3 ohms ±5%, 1/10W.
R90		Metal film: 2K ohms ±5%, 1/10 W.
R91		
R92		Metal film: 510 ohms ±5%, 1/10 W.
R100 thru R102		Metal film: 2K ohms ±5%, 1/10 W.
R103		Metal film: 5.1K ohms ±5%, 1/10 W.
R108		Metal film: 1.8K ohms ±5%, 1/10 W.
R109		Metal film: 10K ohms ±1%, 1/10 W.
		- - - - -SWITCHES- - - - -
SW1		Short Battery Microswitch
SW2		Long Battery Microswitch
SW3		7-position DIP switch.
		- - - - -VIBRATOR- - - - -
X1		Ceramic: 1.0 MHz.
		-VARIABLE RESISTOR-
VR1		10K ohm variable resistor
		- - -TRANSFORMER- - -
T1		Transformer
		- - - - -TERMINALS- - - -
TP13-15		Sliding, Spring loaded, Charging Current and Signal.
		- -MISCELLANEOUS- -
	344A4616P10	Power Cable for Part 2 charger.
	344A4616P11	Mounting bracket and hardware for Part 1&2.
	344A4616P12	Power Cable for Part 1 charger.

VEHICULAR CHARGER MAIN BOARD
344A4616P2 (PCB1)
Issue 1

SYMBOL	PART NUMBER	DESCRIPTION
PCB2		Vehicular Charger LED Board
		- - - -CAPACITORS- - - -
C105 and C106		Ceramic: 0.1 µF ±10%, 25 V.
C107	**NOTE:** Parts listed are for reference only.	Ceramic: 0.001 µF ±10%, 25 V.
C108		Ceramic: 0.1 µF ±10%, 25 V.
C109		Ceramic: 0.001 µF ±10%, 25 V.
C110 and C111		Ceramic: 0.1 µF ±10%, 25 V.
		- - -CONNECTORS- - -
CN7		6-Conductor With Leads.
		- - - - - -LEDS- - - - - -
LED1		Yellow, Rectangular.
LED2		Green, Rectangular.
LED3		Red, Rectangular.
		INTEGRATED CIRCUITS
IC11		Digital: Dual J-K Flip-Flop with Clear
IC12		Digital:
IC13 and IC14		Digital: Schmitt Trigger.
		- - -TRANSISTORS- - -
Q21		Silicon, NPN:
		- - - -RESISTORS- - - - -
R94		Metal film: 10K ohms ±5%, 1/10 W.
		- - - - SWITCHES- - - - -
SW4		Momentary contact, SPST.
PCB3	344A4485	Microphone Connector
PCB4	344A3859	Universal Devices Connector
		- - - -CAPACITORS- - - -
C1		Ceramic: 0.1 µF ±10%, 25 V.
C2		Electrolytic, aluminum: 330 µF, 25 V.
C3		Electrolytic, aluminum: 1500 µF, 25 V.
C5		Electrolytic, aluminum: 220 µF, 25 V.
C6		Ceramic: 0.1 µF ±10%, 25 V.
C7		Ceramic: 470 pF ±5%, 50 V.
C8		Ceramic: 0.1 µF ±10%, 25 V.
C9		Electrolytic, aluminum: 4.7 µF, 50 V.
C10 thru C13		Ceramic: 0.1 µF ±10%, 25 V.
C14		Electrolytic, aluminum: 1500 µF, 16 V.
C15 and C16		Ceramic: 0.1 µF ±10%, 25 V.
C17 and C18		Ceramic: 0.01 µF ±10%, 50 V.
C19		Electrolytic, aluminum: 100 µF, 25 V.
C20		Electrolytic, aluminum: 10 µF, 25 V.
C21		Ceramic: 0.1 µF ±10%, 25 V
C22		Electrolytic, aluminum: 1 µF, 25 V.
C23		Ceramic: 0.1 µF ±10%, 25 V
C24 and C25		Ceramic: 100 pF ±5%, 50 V.
C26 and C27		Ceramic: 0.1 µF ±10%, 25 V.
C28		Electrolytic, aluminum: 1 µF, 25 V.
C29		Ceramic: 0.1 µF ±10%, 25 V.
C30		Electrolytic, aluminum: 1 µF, 25 V.
C31 and C32		Ceramic: 0.1 µF ±10%, 25 V.
C33		Ceramic: 0.01 µF ±10%, 50 V.
C34 and C35		Ceramic: 0.15 µF ±10%, 25 V.
C36 and C37		Electrolytic, aluminum: 220 µF, 16 V.
C38		Electrolytic, aluminum: 100 µF, 16 V.
C39		Electrolytic, aluminum: 100 µF, 25 V.
C40		Ceramic: 0.001 µF ±10%, 50 V.
C41		Ceramic: 0.1 µF ±10%, 25 V.
C42 and C43		Electrolytic, aluminum: 100 µF, 16 V.
C44 and C45		Electrolytic, aluminum: 1000 µF, 25 V.
C46		Electrolytic, aluminum: 22 µF, 25 V.
C47		Ceramic: 0.1 µF ±10%, 25 V.
C48		Ceramic: 470 pF ±5%, 50 V.
C49		Ceramic: 0.01 µF ±10%, 50 V.
C50 thru C52		Ceramic: 0.1 µF ±10%, 25 V.
C53		Electrolytic, aluminum: 100 µF, 25 V.
C54		Electrolytic, aluminum: 1000 µF, 25 V.
C55		Electrolytic, aluminum: 2200 µF, 10 V.
C56		Ceramic: 0.1 µF ±10%, 25 V.
C57		Electrolytic, aluminum: 100 µF, 25 V.
C58		Ceramic: 0.1 µF ±10%, 25 V.

Continued

Continued

SYMBOL	PART NUMBER	DESCRIPTION
C59 and C60		Ceramic: 0.01 µF ±10%, 50 V.
C61		Ceramic: 0.1 µF ±10%, 25 V.
C62		Ceramic: 100 pF ±5%, 50 V.
C63 and C64		Ceramic: 0.1 µF ±10%, 25 V.
C67 thru C100		Ceramic: 0.001 µF ±10%, 50 V.
C101 thru C103		Ceramic: 0.1 µF ±10%, 25 V.
C104		Ceramic: 0.001 µF ±10%, 50 V.
C112		Ceramic: 0.001 µF ±10%, 50 V.
		- - - - - -DIODES- - - - - -
D1		Suppresser.
D2		Silicon.
D3		Silicon, zener.
D4		Silicon.
D5 and D6		Silicon.
D7		Silicon: Dual diodes, common cathode.
D8		Silicon: Dual diodes, common cathode
D9		Silicon: Dual diodes in series.
D10 and D11		Silicon: zener.
D12		Silicon: Dual diodes, common cathode.
D13		Silicon: Dual diodes, common cathode.
D14 thru D16		Silicon: Dual diodes, common cathode.
D17		Silicon, zener.
D18, D19		Silicon: Dual diodes, common cathode.
D20, D21		Silicon: Dual diodes in series.
D22		Silicon, zener.
		- - - -INDUCTORS- - - -
L1		Inductor.
L2		Inductor.
L3		
L4		
		- - -TRANSISTORS- - -
Q1		Silicon, N-channel MOSFET.
Q2		Silicon, PNP.
Q3		Silicon, PNP (with bias resistors).
Q4		Silicon, PNP.
Q5		Silicon, NPN.
Q6		Silicon, PNP (with bias resistors).
Q7		Silicon, PNP

SYMBOL	PART NUMBER	DESCRIPTION
Q8		Silicon, PNP (with bias resistors).
Q9		Silicon, PNP.
Q10, Q11		Silicon, PNP (with bias resistors).
Q12		Silicon, NPN.
Q13		Silicon, PNP.
Q14		Silicon, P-channel MOSFET.
Q15		Silicon, N-channel MOSFET.
Q16 thru Q19		Silicon, NPN (with bias resistors).
Q20		Silicon, NPN.
Q22		Silicon, NPN (with bias resistors).
Q23		Silicon, PNP (with bias resistors).
		- -CONNECTORS- -
CN1		DB-25 Connector.
CN2		7-pin Solder in place.
CN3		6-pin Solder in place.
CN4		12-pin Solder in place.
CN5		7-pin Solder in place.
CN6		9-pin Solder in place.
CN7		6-Conductor With Leads.
CN8		12-pin Solder in place
CN9		Co-axial connector
CN10		Co-axial TNC connector
		INTEGRATED CIRCUITS
IC1		Linear: Switching Regulator.
IC2		Linear: +5-Volt Regulator.
IC3		Regulator Auxiliary Function
IC4		Digital: Microcontroller.
IC5		Digital: Quad Bilateral Switch.
IC6		Linear: Audio Amplifier.
IC7		Linear: 7.5 Volt Switching Regulator.
IC8		Linear: +6-Volt Regulator.
IC9		Linear: Op Amp.
IC10		RS-485 Communications Interface
		- - - - -RESISTORS- - - - -
R1		Metal film: 100 ohms ±5%, 1/10 W.
R2		Metal film: 4.7 ohms ±5%, 1/10 W.
R3		Metal film: 2K ohms ±5%, 1/10 W.
R4		Metal film: 10 ohms ±5%, 1/10 W.
R5		Metal film: 10K ohms ±5%, 1/10 W.
R6		Metal film: 22K ohms ±1%, 1/10 W.
R7		Metal film: 100K ohms ±5%, 1/10 W.
R8		Metal film: 1K ohms ±5%, 1/10 W.
R9		Metal film: 2.2K ohms ±5%, 1/10 W.
R10		Metal film: 47K ohms ±1%, 1/10 W.
R11		Metal film: 18K ohms ±1%, 1/10 W.
R12		Metal film: 1K ohms ±5%, 1/10 W.

Continued

Continued

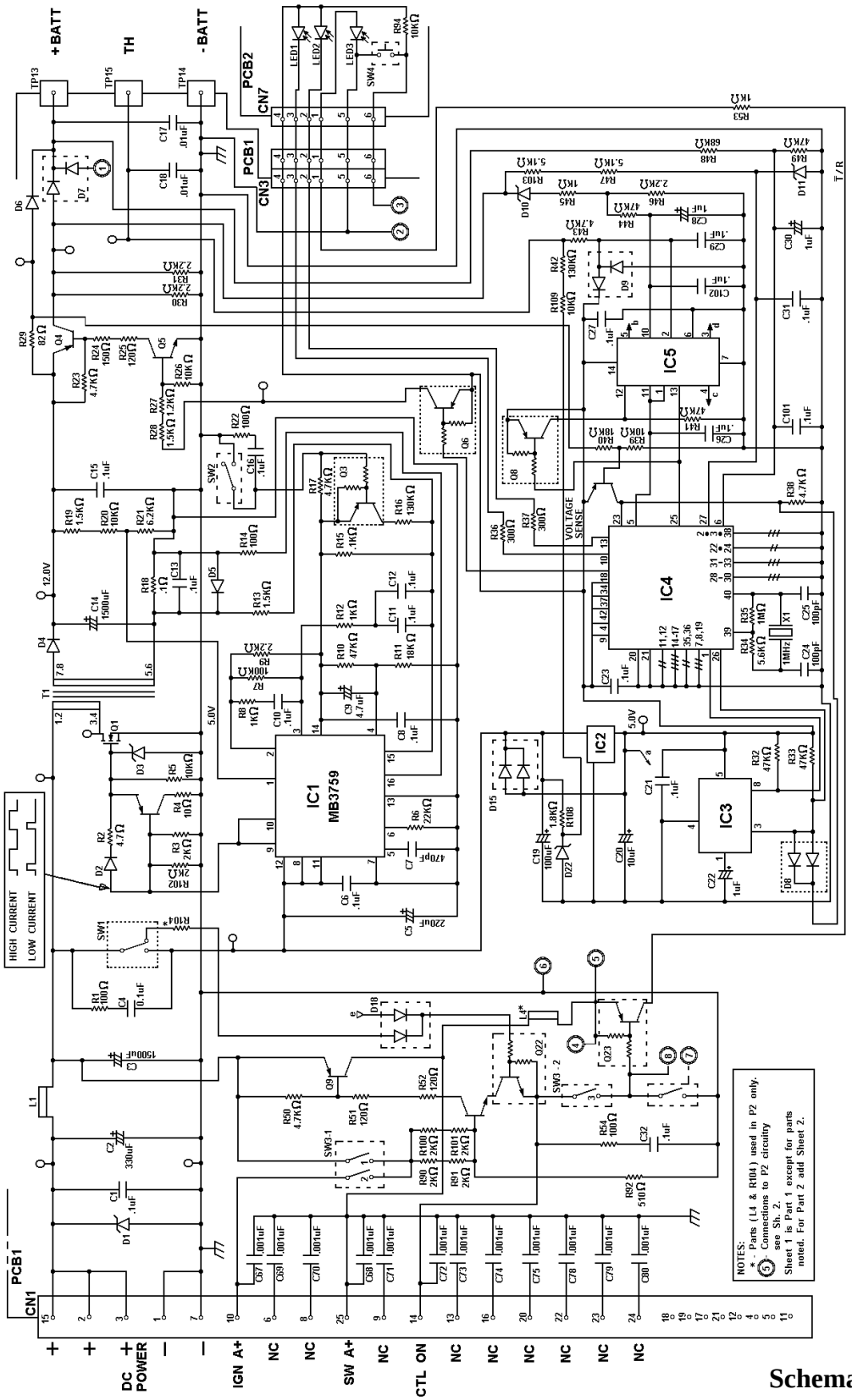
SYMBOL	PART NUMBER	DESCRIPTION
R13		Metal film: 1.5K ohms ±1%, 1/10 W.
R14		Metal film: 100 ohms ±5%, 1/10 W.
R15		Metal film: 56K ohms ±1%, 1/10 W.
R16		Metal film: 130K ohms ±1%, 1/10 W.
R17		Metal film: 4.7K ohms ±5%, 1/10 W.
R18		Metal film: 0.1 ohms ±10%.
R19		Metal film: 1.5K ohms ±1%, 1/10 W.
R20		Metal film: 10K ohms ±1%, 1/10 W.
R21		Metal film: 8.2K ohms ±1%, 1/10 W.
R22		Metal film: 100 ohms ±5%, 1/10 W.
R23		Metal film: 4.7K ohms ±5%, 1/10 W.
R24		Carbon: 150 ohms ±5%, 1/2 W.
R25		Carbon: 120 ohms ±5%, 1/2 W.
R26		Metal film: 10K ohms ±5%, 1/10 W.
R27		Metal film: 1.2K ohms ±5%, 1/10 W.
R28		Metal film: 1.5K ohms ±5%, 1/10 W.
R29		Metal film: 82 ohms ±5%, 2 W.
R30 and R31		Metal film: 2.2K ohms ±5%, 1/10 W.
R32 and R33		Metal film: 47K ohms ±5%, 1/10 W.
R34		Metal film: 5.6K ohms ±5%, 1/10 W.
R35		Metal film: 1M ohms ±5%, 1/10 W.
R36 and R37		Metal film: 300 ohms ±5%, 1/10 W.
R38		Metal film: 4.7K ohms ±5%, 1/10 W.
R39		Metal film: 10K ohms ±1%, 1/10 W.
R40		Metal film: 18K ohms ±1%, 1/10 W.
R41		Metal film: 47K ohms ±5%, 1/10 W.
R42		Metal film: 51K ohms ±1%, 1/10 W.
R43		Metal film: 4.7K ohms ±5%, 1/10 W.
R44		Metal film: 47K ohms ±5%, 1/10 W.
R45		Metal film: 1K ohms ±5%, 1/10 W.
R46		Metal film: 2.2K ohms ±5%, 1/10 W.
R47		Metal film: 5.1K ohms ±5%, 1/10 W.
R48		Metal film: 68K ohms ±5%, 1/10 W.
R49		Metal film: 47K ohms ±1%, 1/10 W.
R50		Metal film: 4.7K ohms ±5%, 1/10 W.
R51, R52		Metal film: 120 ohms ±5%, 2W.
R53		Metal film: 1K ohms ±5%, 1/10 W.
R54		Metal film: 100 ohms ±5%, 1/10 W.
R55		Metal film: 3 ohms ±5%, 1/10W.
R56		Metal film: 220 ohms ±5%, 1W.
R57, R58		Metal film: 3 ohms ±5%, 1/10W.
R59		Metal film: 22K ohms ±1%, 1/10 W.
R60		Metal film: 100K ohms ±5%, 1/10 W.
R61		Metal film: 1K ohms ±5%, 1/10 W.
R62		Metal film: 2.2K ohms ±5%, 1/10 W.
R63		Metal film: 1K ohms ±5%, 1/10 W.
R64		Metal film: 10K ohms ±5%, 1/10 W.
R65		Metal film: 47K ohms ±5%, 1/10 W.
R66 and R67		Metal film: 1K ohms ±1%, 1/10 W.
R68		Metal film: 1K ohms ±5%, 1/10 W.
R69		Metal film: 2.2K ohms ±5%, 1/10 W.
R70		Metal film: 10K ohms ±5%, 1/10 W.
R71		Metal film: 47 ohms ±5%, 1/4 W.
R72		Metal film: 0.1 ohms ±1%, 1/10 W.
R73		Metal film: 8.2K ohms ±1%, 1/10 W.
R74		Metal film: 4.7K ohms ±5%, 1/10 W.
R75		Metal film: 5360 ohms, 1/10 W.
R76		Metal film: 6490 ohms, 1/10 W.
R77		Metal film: 3160, 1/10 W.
R78		Metal film: 100K ohms ±5%, 1/10 W.
R79		Metal film: 3K ohms ±5%, 1/10 W.
R80		Metal film: 620 ohms
R81, R82		Metal film: 33K ohms ±5%, 1/10 W.
R83		Metal film: 10K ohms ±5%, 1/10 W.
R84		Metal film: 220K ohms ±5%, 1/10 W.
R85 thru R88		Metal film: 10K ohms ±5%, 1/10 W.
R89 thru R91		Metal film: 2K ohms ±5%, 1/10 W.
R92		Metal film: 510 ohms ±5%, 1/10 W.
R93		Metal film: 3K ohms ±5%, 1/10 W.
R94		Metal film: 10K ohms ±5%, 1/10 W.
R95		Metal film: 62K ohms ±5%, 1/10 W.
R96 thru R98		Metal film: 100 ohms ±5%, 1/10 W.
R99		Metal film: 1.5K ohms ±5%, 1/10 W.
R100 thru R102		Metal film: 2K ohms ±5%, 1/10 W.
R103		Metal film: 5.1K ohms ±5%, 1/10 W.
R104, R105		Open
R108		Metal film: 1.8K ohms ±5%, 1/10 W.
R109		Metal film: 10K ohms ±1%, 1/10 W.

Continued

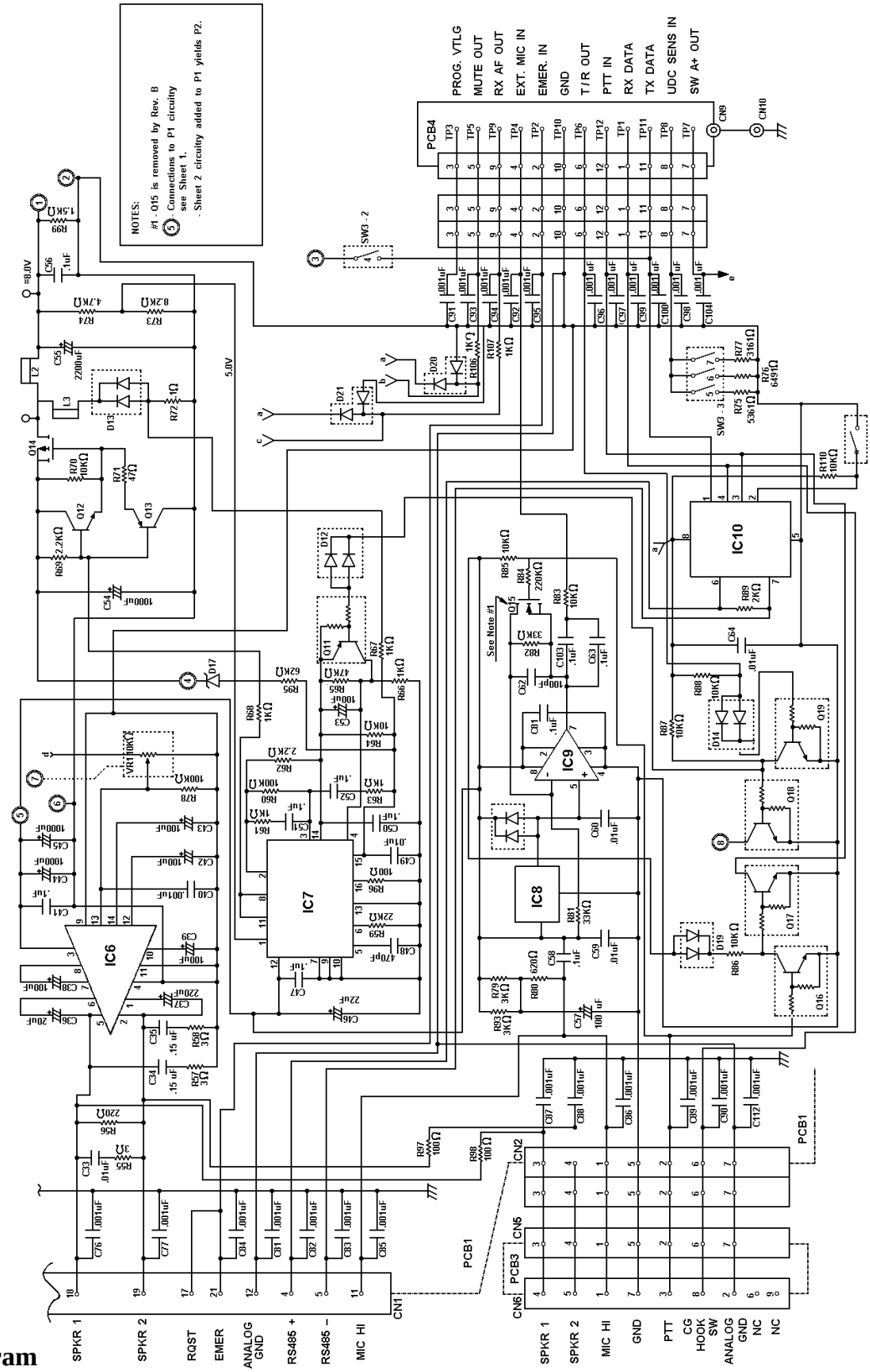
Continued

SYMBOL	PART NUMBER	DESCRIPTION
		- - - - -SWITCHES- - - - -
SW1		Short Battery Microswitch
SW2		Long Battery Microswitch
SW3		7-position DIP switch.
SW4		Momentary contact, SPST.
SW5		1-position DIP switch.
		- - - - - - VIBRATOR - - - - - -
X1		Ceramic: 1.0 MHz.
		-VARIABLE RESISTOR-
VR1		10K ohm variable resistor
		- - - -TRANSFORMER- - - -
T1		Transformer
		- - - -TERMINALS- - - -
TP13-15		Sliding, Spring loaded, Charging Current and Signal

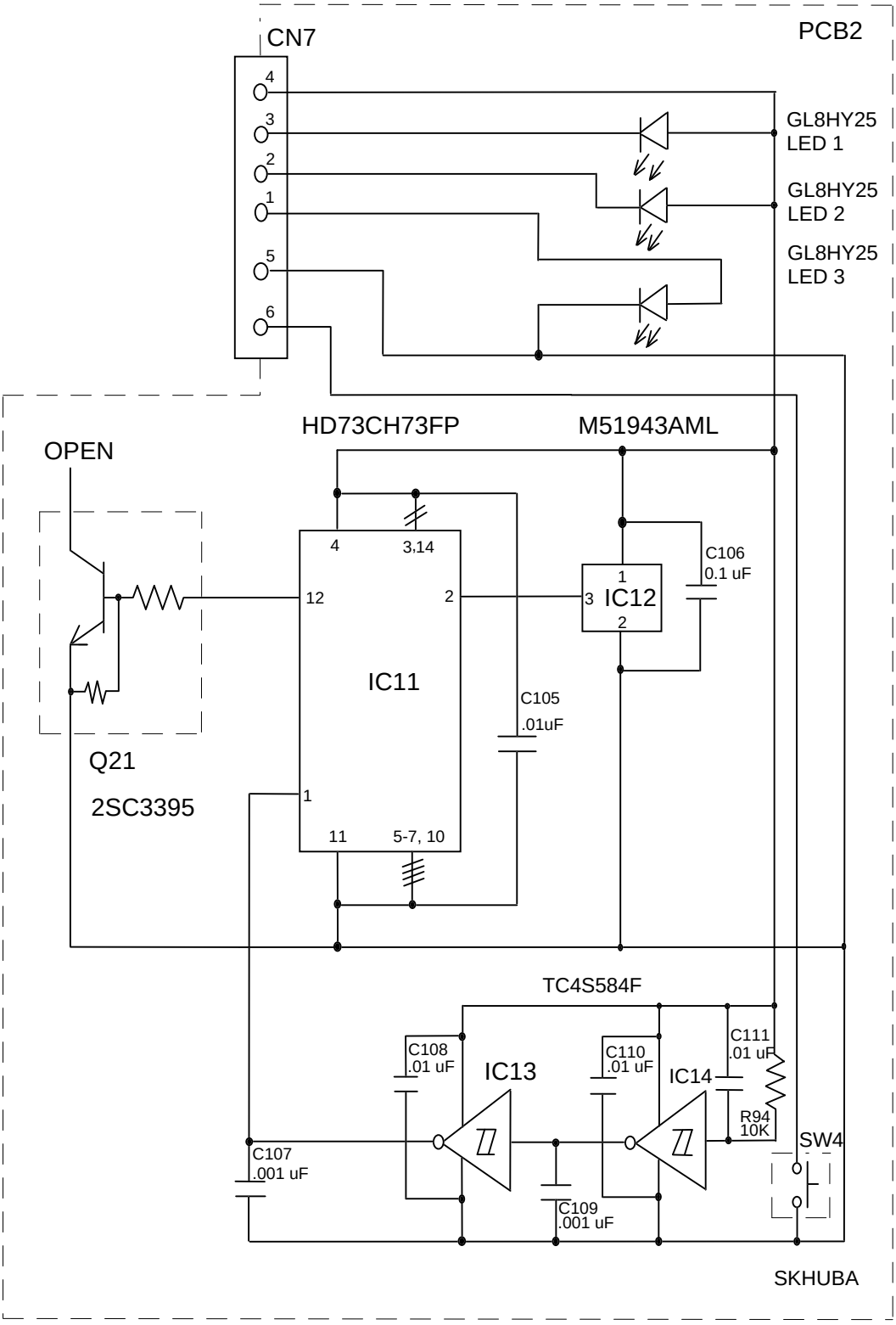
(Intentionally Left Blank)



Schematic Diagram 1/3



Schematic Diagram 2/3



LED Display Board PCB2
3/3

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