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Printed In U.S.A. 1996
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Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by instruction manual revision. These revisions are added to the manuals as the engineering changes are incorporated into the equipment.

How to Use This Manual

This manual contains introductory material such as model charts, accessories, and specifications, as well as four sections that deal with specific service aspects of the GP300. Refer to the Table of Contents for a general overview of the manual, or to the “Overview” paragraph in each section for a specific overview of the information in that section.

Other Documentation

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<thead>
<tr>
<th>Information</th>
<th>Location</th>
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<tbody>
<tr>
<td>Basic Use of GP300</td>
<td>GP300 Owner's Manual</td>
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<tr>
<td></td>
<td>(6880901Z83)</td>
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<tr>
<td>Programming</td>
<td>GP300 RSS Manual</td>
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<tr>
<td></td>
<td>(6880901Z81)</td>
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Technical Support

To obtain technical support, you may call Motorola’s Radius Product Services. When you call, we ask that you have ready the model and serial numbers of the respective radio or its parts.

Service Policy

If malfunctions occur within 30 days that cannot be resolved over the phone with Radius Product Services, a defective major component should be returned. You must obtain authorization from Radius Product Services before returning the component.

Ordering Replacement Parts

You can order additional components and some piece parts directly through your Radius price pages. When ordering replacement parts, include the complete identification number for all chassis, kits, and components. If you do not know a part number, include with your order the number of the chassis or kit which contains the part, and a detailed description of the desired component. If a Motorola part number is identified on a parts list, you should be able to order the part through Motorola Parts. If only a generic part is listed, the part is not normally available through Motorola. If no parts list is shown, generally, no user serviceable parts are available for the kit.

Technical Support (U.S. and Canada)
Radius Product Services
Hwy. 34 West
Mt. Pleasant, IA 52641 USA
1-800-356-1520 (U.S. and Canada)
319-385-5395 (Outside U.S.)

Technical Support (Latin America, Mexico, Caribbean)
1-800-694-2161 (Latin America, Mexico, Caribbean)

Radius 30-Day Warranty
Motorola Radio Support Center
3761 South Central Avenue
Rockford, IL 61102 USA
1-800-227-6772
847-725-4830 (Outside U.S.)

Radius Major Component Repair
Motorola Radio Support Center
3761 South Central Avenue
Rockford, IL 61102 USA

Motorola Parts
Americas Parts Division
Attention: Order Processing
1313 E. Algonquin Road
 Schaumburg, IL 60196

Customer Service Motorola Parts
1-800-422-4210
1-708-538-8198 (FAX)

Parts Identification
1-708-538-0021
1-708-538-8194 (FAX)

GP300 DTMF COSMETIC KIT REX4673A NCA
GP300 NO-DTMF " " REX4674A NCA

August, 1996

6880901Z93-C
# Model Charts

## GP300

### VHF

#### 136 - 162 MHz

#### 146 - 174 MHz

X = Indicates one of each required

### Model Charts

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<th>Description</th>
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### Item

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<td>HLD8094_</td>
<td>RF Board, 20/25 KHz, (136-162 MHz)</td>
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<td>HLD8338_</td>
<td>RF Board, 2-Chan., 20/25 kHz, (136-162 MHz)</td>
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<td>HLD8339_</td>
<td>RF Board, 2-Chan., 12.5 kHz, (136-162 MHz)</td>
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<td>HLD9675_</td>
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<td>HLD9677_</td>
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<td>HLN9680_</td>
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<td>HLN9667_</td>
<td>Chassis Hardware Assembly</td>
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<td>HHN9684_</td>
<td>Housing</td>
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<tr>
<td>HAD9338_</td>
<td>Antenna (136-162 MHz)</td>
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<tr>
<td>NAD6502_</td>
<td>Antenna (146-174 MHz)</td>
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<td>Operator's Manual/Operator Card</td>
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# GP300

**UHF**

403 - 433 MHz  
438 - 470 MHz

X = Indicates one of each required

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<td>HLE9674</td>
<td>RF Board, 2-Chan., 20/25 kHz, (438-470 MHz)</td>
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<td>HLE9676</td>
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<td>HLN9667</td>
<td>Chassis Hardware Assembly</td>
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<td>Housing</td>
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<td>NAE6483</td>
<td>Antenna</td>
</tr>
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<td>Operator's Manual/Operator Card</td>
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### GP300
### UHF
### 465 - 495 MHz
### 490 - 520 MHz

X = Indicates one of each required

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<td>HLE8056_ RF Board, 12.5 kHz, (465-495 MHz)</td>
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<td>HLE8342_ RF Board, 2-Chan., 20/25 kHz, (490-520 MHz)</td>
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<td>X</td>
<td>HLE8343_ RF Board, 2-Chan., 12.5 kHz, (490-520 MHz)</td>
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<td>HLN9680_ 16-Channel Control Kit</td>
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<tr>
<td>X X X X X X X X X X</td>
<td>6880901283 Operator’s Manual/Operator Card</td>
</tr>
</tbody>
</table>
Accessories

Antennas:
NAD6502 — Black 146-174 MHz VHF Antenna (Standard w/Unit)
HAD9338 — Yellow 136-162 MHz VHF Antenna (Standard w/Unit)
HAD9742 — Black 146-162 MHz VHF Stubby Antenna
HAD9743 — Blue 162-174 MHz VHF Stubby Antenna
HAD9934 — Pink 174-195 MHz VHF Antenna
HAD9935 — Purple 195-208 MHz VHF Antenna
NAE6483 — None 403-520 MHz UHF Antenna (Standard w/Unit)
NAE6521 — Red 400-440 MHz UHF Stubby Antenna
NAE6522 — Green 438-470 MHz UHF Stubby Antenna
NAE6523 — Black 470-520 MHz UHF Stubby Antenna
HAD9728 — None Tunable Antenna Kit (136-174 MHz)

Note: Each of the color coded antennas listed is designed to cover only the frequency split indicated. Therefore, it is important to order the correct antenna (frequency split) to match a specific customer frequency.

Carrying Accessories:
HLN9149 Swivel Belt Loop Adapter (for use with HLN9720, HLN9721, HLN9750, HLN9970, and HLN9008)
HLN9720 Standard Leather Carry Case w/Belt Loop
HLN9873 Standard Leather Carry Case w/Swivel
HLN9721 Slim Leather Carry Case w/Belt Loop
HLN9076 Standard Molded Carry Holder w/Belt Clip
HLN9750 Standard Nylon Carry Case
HLN9970 DTMF Standard Leather Carry Case w/Belt Loop
HLN8411 DTMF Standard Leather Carry Case w/Swivel
HLN8412 DTMF LCD Standard Leather Carry Case w/Swivel
HLN9008 Leather Carry Case w/Belt Loop for fully approved FM 1200 mAH Battery
HLN9009 Leather Carry Case w/Swivel for fully approved FM 1200 mAH Battery
HLN9011 DTMF Carry Case w/Swivel for fully approved FM 1200 mAH Battery
HLN9017 Nylon Carry Case for fully approved FM 1200 mAH Battery
HLN9724 Replacement 2-1/2” Belt Clip
HLN8255 Spring Action 3” Belt Clip
HLN8052 Wrist Strap
NTN5243 Shoulder Strap (for all carry cases)
HLN8414 Chest Pack Carry Holder
NTN5629 Replacement 3” Swivel Belt Loop (for use with same carry accessories as 2-1/2” Belt Loop but with wider belts)
HLN9035 Replacement 2-1/2” Swivel Belt Loop (for use with HLN9873, HLN9411, HLN8412, HLN9009, and HLN9011)
HLN9084 Replacement Strap for Molded Carry Holder
HLN9973 Replacement Strap for Leather Carry Case
HLN9974 Replacement Strap for Nylon Carry Case
HLN9975 Replacement Strap for DTMF Carry Case
HLN9018 Replacement Strap for fully approved FM 1200 mAH Battery Leather Carry Case
HLN9019 Replacement Strap for fully approved FM 1200 mAH Battery Nylon Carry Case
HLN9985 Waterproof Bag
Nickel-Cadmium Battery Chargers:
HTN9630 110 Volt - 1 Hour Rapid Rate Chargert
HTN9702 110 Volt - 10 Hour Standard Rate Charger
HTN9748 110 Volt - 6 Unit - 1 Hour Rapid Rate Charger
HTN9886 100 Volt - 1 Hour Rapid Rate Charger
HTN9938 100 Volt - 6 Unit - 1 Hour Rapid Rate Charger
HTN9802 220 Volt - 1 Hour Rapid Rate Charger (European Plug)
HTN9804 220 Volt - 10 Hour Standard Rate Charger (European Plug)
HTN9811 220 Volt - 2 Unit - 1 Hour Rapid Rate Charger (European Plug)
HTN9803 240 Volt - 1 Hour Rapid Rate Charger (U.K. Plug)
HTN9805 240 Volt - 10 Hour Standard Rate Charger (U.K. Plug)
HTN9812 240 Volt - 6 Unit - 1 Hour Rapid Rate Charger (U.K. Plug)
HLN9719 1 Hour Vehicular Charger Adapter/Bracket (12 volt for use with HTN9630, HTN9802, or HTN9803 Rapid Rate Chargers)
HLN9944 Wall Mounting Bracket For Multi Unit Charger
HKN9806 Battery Eliminator

Batteries:
HNN9628 1200 mAH High Capacity Battery
HNN9813 1200 mAH Limited FM Battery
HNN9810 600 mAH Slimline Battery
HNN9808 600 mAH (Fully Approved FM Slim Battery)
HNN9701 1200 mAH (Fully Approved FM Battery)

Audio/RF Accessories:
HMN9725 Remote Speaker Microphone
HMN9727 Earpiece Without Volume Control (plastic earloop)
HMN9752 Earpiece With Volume Control (plastic earloop)
50-80386B90 Rubber Ear Inserts for Earpieces (with older metal earloop - pkg q. 25)
50-80371E73 Rubber Ear Inserts for Earpieces (with plastic earloop - pkg q. 25)
HMN9754 2 Piece Surveillance Microphone (plastic earloop)
HMN9787 Headset w/ Swivel Boom Microphone
BDN6647 Medium Weight Headset w/ Swivel Boom Microphone
BDN6648 Heavy Weight Headset w/ Noise Cancelling Boom Microphone
BDN6646 Ear Microphone
BDN6706 Ear Microphone w/ VOX Interface (External VOX Included)
HLN8096 Audio Accessory Clamp
HLN9756 BNC - RF Adapter (for use with GP300 models only) $880166 601

Prices And Availability Subject To Change Without Notice

59.75 HLN 37489 DTMF Retrofit Kit for 16-ch radios (applies to radios shipped after 15 Mar 92)
6880902245 Instructions 30¢
Performance Specifications

GENERAL

<table>
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</tr>
<tr>
<td>2, 8, 8+2, or 16 Channels</td>
<td></td>
</tr>
<tr>
<td>Power Supply:</td>
<td></td>
</tr>
<tr>
<td>One (1) rechargeable Nickel-Cadmium battery (7.5V)</td>
<td></td>
</tr>
<tr>
<td>Dimensions:</td>
<td></td>
</tr>
<tr>
<td>5.5&quot; X 2.34&quot; X 1.65&quot; (140 X 59 X 42mm)†</td>
<td></td>
</tr>
<tr>
<td>Weight:</td>
<td></td>
</tr>
<tr>
<td>17.8 oz. (509 g)†</td>
<td></td>
</tr>
<tr>
<td>Average Battery Life (5-50 Duty Cycle):</td>
<td></td>
</tr>
<tr>
<td>Low Power:</td>
<td>High Power:</td>
</tr>
<tr>
<td>10.5 Hours</td>
<td>8 Hours</td>
</tr>
<tr>
<td>High Capacity:</td>
<td></td>
</tr>
<tr>
<td>Low Capacity:</td>
<td></td>
</tr>
<tr>
<td>5.2 Hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Environmental:</td>
<td></td>
</tr>
<tr>
<td>Meets MIL-STD-810-C, D, and E &amp; EIA RS-316B environmental specifications for vibration, shock, rain, dust, and humidity</td>
<td></td>
</tr>
</tbody>
</table>

†Standard High Capacity Battery Model

TRANSMITTER

<table>
<thead>
<tr>
<th>VHF</th>
<th>UHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Output @ 7.5V:</td>
<td></td>
</tr>
<tr>
<td>High 5W</td>
<td>Low 1W</td>
</tr>
<tr>
<td></td>
<td>High 4W†</td>
</tr>
<tr>
<td>Freq. Separation:</td>
<td></td>
</tr>
<tr>
<td>26, 28 MHz</td>
<td>30, 32 MHz</td>
</tr>
<tr>
<td>Freq. Stability (-30°C to +60°C):</td>
<td></td>
</tr>
<tr>
<td>±0.0005%</td>
<td></td>
</tr>
<tr>
<td>Modulation:</td>
<td></td>
</tr>
<tr>
<td>±5 kHz max. (25/30 kHz channel spacing)</td>
<td>±2.5 kHz max. (12.5 kHz channel spacing)</td>
</tr>
<tr>
<td>Spurs/Harmonics:</td>
<td></td>
</tr>
<tr>
<td>0.25 μW ≤ 2GHz</td>
<td></td>
</tr>
<tr>
<td>Audio Response:</td>
<td></td>
</tr>
<tr>
<td>(from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)</td>
<td>+1, -3 dB</td>
</tr>
<tr>
<td>Audio Distortion:</td>
<td></td>
</tr>
<tr>
<td>@ 1000 Hz, 60% Rated Max. Dev.</td>
<td>&lt;3%</td>
</tr>
<tr>
<td>FCC Designation:</td>
<td></td>
</tr>
<tr>
<td>AB299FT301</td>
<td>AB299FT4010</td>
</tr>
<tr>
<td>AB299FT3011</td>
<td>AB299FT4011</td>
</tr>
<tr>
<td>FM Noise:</td>
<td></td>
</tr>
<tr>
<td>-40 dB†</td>
<td></td>
</tr>
</tbody>
</table>

†Max. RF output is 3W for frequencies greater than 512 MHz
†Typical level

RECEIVER

<table>
<thead>
<tr>
<th>VHF</th>
<th>UHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Spacing:</td>
<td></td>
</tr>
<tr>
<td>25 kHz</td>
<td>12.5 kHz</td>
</tr>
<tr>
<td>25 kHz</td>
<td>12.5 kHz</td>
</tr>
<tr>
<td>Freq Separation:</td>
<td></td>
</tr>
<tr>
<td>26, 28 MHz</td>
<td>30, 32 MHz</td>
</tr>
<tr>
<td>Sensitivity:</td>
<td></td>
</tr>
<tr>
<td>- 20 dB Quieting†</td>
<td>0.32 μV</td>
</tr>
<tr>
<td>20 dB SINAD†:</td>
<td></td>
</tr>
<tr>
<td>12 dB EIA SINAD:</td>
<td>0.22 μV</td>
</tr>
<tr>
<td>0.30 μV</td>
<td></td>
</tr>
<tr>
<td>0.35 μV</td>
<td></td>
</tr>
<tr>
<td>Squelch Sensitivity:</td>
<td></td>
</tr>
<tr>
<td>10 dB SINAD</td>
<td></td>
</tr>
<tr>
<td>Selectivity:</td>
<td></td>
</tr>
<tr>
<td>70dB</td>
<td>60dB</td>
</tr>
<tr>
<td>70dB</td>
<td>60dB</td>
</tr>
<tr>
<td>Intermodulation</td>
<td></td>
</tr>
<tr>
<td>70dB</td>
<td>60 dB</td>
</tr>
<tr>
<td>70 dB</td>
<td>60 dB</td>
</tr>
<tr>
<td>Freq. Stability (-30°C to +60°C):</td>
<td></td>
</tr>
<tr>
<td>0.0005%</td>
<td></td>
</tr>
<tr>
<td>(-10°C to +50°C):</td>
<td></td>
</tr>
<tr>
<td>0.0003%</td>
<td></td>
</tr>
<tr>
<td>Spur Rejection EIA:</td>
<td></td>
</tr>
<tr>
<td>75 dB</td>
<td></td>
</tr>
<tr>
<td>CEPT:</td>
<td></td>
</tr>
<tr>
<td>70 dB</td>
<td></td>
</tr>
<tr>
<td>Image Rejection EIA:</td>
<td></td>
</tr>
<tr>
<td>75 dB</td>
<td></td>
</tr>
<tr>
<td>CEPT:</td>
<td></td>
</tr>
<tr>
<td>70 dB</td>
<td></td>
</tr>
<tr>
<td>Audio Output at&lt;10% Distortion (1 kHz)</td>
<td>500mW</td>
</tr>
</tbody>
</table>

†Typical specification is 0.28mV on frequencies greater than 512 MHz

*All specifications subject to change without notice.
Service Aids

The following table lists service aids recommended for working on the GP300.

<table>
<thead>
<tr>
<th>Motorola Part No.</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLN9214</td>
<td>Radio Interface Box</td>
<td>Enables communication between the radio and the computer’s serial communications adapter.</td>
</tr>
<tr>
<td>HSN9412</td>
<td>RIB Power supply</td>
<td>Used to supply power to the RIB.</td>
</tr>
<tr>
<td>HKN9216</td>
<td>Computer Interface cable</td>
<td>Connects the computer’s serial communications adapter to the RIB.</td>
</tr>
<tr>
<td>HLN9390</td>
<td>AT to XT Computer adapter</td>
<td>Allows HKN9216 to plug into a XT style communications port.</td>
</tr>
<tr>
<td>HKN9857</td>
<td>Programming / test cable</td>
<td>Connects radio to RIB. And can be used as a Battery Eliminator.</td>
</tr>
<tr>
<td>HVN9852</td>
<td>Radio Service Software</td>
<td>Software on 3-1/2 in. and 5-1/4 in. floppy disc.</td>
</tr>
<tr>
<td>HKN9755</td>
<td>Cloning Cable</td>
<td>Allows the radio to be duplicated from a master radio by transferring programmed data from one radio to another.</td>
</tr>
<tr>
<td>RTX4005</td>
<td>Portable Test Set</td>
<td>Enables connection to the audio / accessory jack. Allows switching for radio testing.</td>
</tr>
<tr>
<td>RKN4034</td>
<td>Test Set cable</td>
<td>Connects radio to RTX4005 Test Box.</td>
</tr>
</tbody>
</table>

Test Equipment

The following table lists test equipment required to service the GP300 and other two-way radios.

<table>
<thead>
<tr>
<th>Motorola Model No.</th>
<th>Description</th>
<th>Characteristics</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2200, R2400, or R2001D with trunking option</td>
<td>Service Monitor</td>
<td>This monitor will substitute for items with an asterisk *</td>
<td>Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment</td>
</tr>
<tr>
<td>*R1049A</td>
<td>Digital Multimeter</td>
<td></td>
<td>Two meters recommended for ac/dc voltage and current measurements</td>
</tr>
<tr>
<td>*S1100A</td>
<td>Audio Oscillator</td>
<td>67 to 161.4Hz tones</td>
<td>Used with service monitor for injection of PL tones</td>
</tr>
<tr>
<td>*S1053D, *SKN609A, *SKN601A</td>
<td>AC Voltmeter, Power Cable for meter, Test leads for meter</td>
<td>1mV to 300V, 10-Megohm input impedance</td>
<td>Audio voltage measurements</td>
</tr>
<tr>
<td>R1053</td>
<td>Dual-trace Oscilloscope</td>
<td>20 MHz bandwidth, 5mV/cm - 20V/cm</td>
<td>Waveform measurements</td>
</tr>
<tr>
<td>*S1350C, *ST1215B (VHF) *ST1223B (UHF) *T1013A</td>
<td>Wattmeter, Plug-in Elements (Vhf &amp; Uhf), RF Dummy Load</td>
<td>50-ohm, + 5% accuracy 10 Watts, maximum 0-1000 Mhz, 300W</td>
<td>Transmitter power output measurements</td>
</tr>
<tr>
<td>S1339A</td>
<td>RF Millivolt Meter</td>
<td>100μV to 3V rf, 10 khz to 1.2 Ghz</td>
<td>RF level measurements</td>
</tr>
<tr>
<td>*R1013A</td>
<td>SINAD Meter</td>
<td></td>
<td>Receiver sensitivity</td>
</tr>
<tr>
<td>S1347D or S1348D (prog.)</td>
<td>DC Power Supply</td>
<td>0-20 Vdc, 0-5 Amps</td>
<td>Bench supply for 10Vdc</td>
</tr>
</tbody>
</table>
Test Set Service Cable

NOTE: Pins 2 and 7 are cut.

(P1) DETAIL
FRONT SIDE

Figure 1. Service Cable (RKN4034A) for the Test Set (RTX4005B)

Radio Model Information

The model number, serial number, and Motorola FCC designation number are all on a label attached to the back of your radio. From this model number, you can determine the RF output power, frequency band, type of squelch, and number of channels. The table below outlines one portable radio model number and its specific characteristics.

All GP300 radio models are synthesized, two or four channel units that come standard with tone Private-Line (TPL) or Digital Private-Line (DPL) coded squelch, which may be enabled/disabled on a per channel basis. Programming changes can be made by your local Radius dealer.

<table>
<thead>
<tr>
<th>Type of Unit</th>
<th>Tx Power</th>
<th>Freq.</th>
<th>Model Series</th>
<th>Channel Spacing</th>
<th>Channel Capability</th>
<th>Frequency Sub-band</th>
<th>Version</th>
<th>Unique Model Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>9</td>
<td>3</td>
<td>YPC</td>
<td>00</td>
<td>A</td>
<td>1</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-5 W VHF</td>
<td></td>
<td>VHF</td>
<td>12.5 kHz</td>
<td>2 Channels</td>
<td>Low Split</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-4 W UHF</td>
<td></td>
<td>Universal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>UHF</td>
<td>20</td>
<td>D</td>
<td>2</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20/25 kHz</td>
<td>8 Channels</td>
<td>High Split</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P = Portable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Package Model with Battery, Antenna, etc.
Radio Service Software Information

To run the Radio Service Software, you will need the following equipment:

**Required Equipment:**
1. IBM XT, AT, Convertible, or System/2 Model 30/50™ with 512K RAM, Dual Floppy Disk Drives or on Floppy Disk and one Hard Disk.
2. PCDOS™ or MS-DOS™ 3.0 or later.
3. Radio Interface Box (RIB) HLN9214.
4. RIB to IBM AT cable HKN9216.
5. IBM AT cable to IBM XT computer adapter (optional) HLN9390.
7. RIB power supply HSN9412 (110 VAC) or 0180358A56 (220 VAC).
8. Power Supply R1011A or equivalent.

**Figure 2. Equipment Setup**

Configuring the RIB and Radio

1. Connect the RIB to the computer (Figure 2).
2. If your computer has an XT style communications port (25 pin connector), plug the HLN9390 adapter into the computer and plug the HKN9216 cable into the adapter. If you are unsure of which connection is on the back of your computer or the COM port, then please consult the computer manuals.
3. Plug the large 25 pin end of the HKN programming cable into the RIB. The other end of this cable has a “battery eliminator.”
4. Slide the battery eliminator in place of the radio’s battery.
5. Plug the HSN9412 power supply into a wall outlet, and connect the other end to the RIB.
6. Connect the radio to a power supply and turn the volume control clockwise to turn it on.
Section 1
Radio Disassembly/Assembly

Overview
This section explains, step by step, how to disassemble and reassemble the GP300 radio.

Disassemble Radio

Remove Battery

1. The battery latches are located at the bottom of the radio on each side (Figure 1-1). Press and hold both battery latches toward the front of the radio.

![Figure 1-1. Press Battery Latches](image1.png)

2. Press the battery housing against the radio, while sliding it down until it is free of the chassis rails (Figure 1-2).

3. To remove the battery, pull it straight out and away from the radio.

![Figure 1-2. Slide Battery Housing](image2.png)

Remove Chassis

1. Pull the control knobs straight off.

2. Unscrew the antenna counter-clockwise until it is detached from the radio.

3. Carefully pry the chassis up on both sides, near the bottom, with a flat-blade screwdriver (Figure 1-3).

![Figure 1-3. Remove Chassis](image3.png)

4. Lift the chassis approximately halfway out.

**IMPORTANT**
You must disconnect the ribbon cable before completely removing the chassis.

5. Remove the ribbon cable connector from the main board using pliers or a flat blade screwdriver (Figure 1-4).

6. Pull the chassis out and away from the housing as shown by the arrow (Figure 1-4).

Remove Main Board

The front shield holds the main board into the chassis. To remove the front shield:
Reassemble Radio

1. Lay radio, shield side down, on a flat surface.

2. Apply downward pressure to chassis directly above one of the clips opposite PTT switch.

3. With a flat blade screwdriver, carefully move clip away from tab on chassis to release.

   **NOTE**
   Remove both clips opposite the PTT switch first, to ease remaining clip removal.

4. Repeat steps 2 and 3 for the remaining three clips.

5. Separate the main board from the chassis (Figure 1-5).

Reassemble Radio

1. Place chassis on a flat surface with the battery rails downward.

2. Insert main board into chassis using alignment pins as a guide (Figure 1-6).

3. Place front shield on main board using tabs as a guide (Figure 1-6).

4. Press down on front shield until chassis, main board, and front shield are seated tightly together.

5. Hook locking clips first to the chassis tab, then push clip over on shield with thumb until clip locks into front shield holes (Figure 1-7).

6. Replace chassis gasket (Figure 1-8).
7. Insert assembled chassis, main board, and front shield into radio housing at approximately a 45-degree angle (Figure 1-9a.), using caution while inserting the volume and frequency controls through the housing top.

**IMPORTANT**
The main board must be inserted into chassis (Step 2) before you can secure chassis into radio housing.

8. Connect microphone/speaker ribbon cable (Figure 1-9b.).

9. While pressing chassis toward the housing top, press the bottom end down into the housing until the bottom housing wall snaps over the chassis retaining studs.

**NOTE**
The chassis should snap firmly into place.

10. Replace the battery, knobs, and antenna.

---

**Figure 1-7. Reinsert Locking Clips**

**Figure 1-8. Replace Gasket**

**NOTE**
The gasket helps keep the radio free of unwanted dirt, dust, and water. We recommend using a new lubricated gasket when reassembling the radio. Using an old gasket could impair the overall seal quality of the radio.

**Figure 1-9.**
- a. Insert Chassis into Housing
- b. Reinsert Ribbon Cable
Overview

This section provides a detailed theory of operation for the GP300 and its components: the microcomputer, the receiver, the transmitter, and the frequency generation circuitry.

NOTE

- U201 and U401 pin numbers without an asterisk (*) refer to VHF revision C and UHF revision B main board kits.
- U201 and U401 pin numbers with an asterisk (*) refer to VHF revision D and UHF revision C main board kits.

Microcomputer

The GP300 VHF and UHF radios use the Motorola 68HC11A8 microcomputer, U401, which utilizes:

- 7.9488 MHz clock rate
- Multiplexed 8-bit address/data lines
- 16-bit addressing
- Internal watchdog circuitry
- Analog to digital conversion input ports

The microcomputer’s operating program is permanently written or “masked” within the microcomputer. Included in U401 is an EEPROM memory which stores channel, signaling, and scan list information.

Microcomputer Power-Up and Reset Routine

On power-up U401’s reset line (pin 19; pin 43*) is held low by the AFIC (U402) until the synthesizer (U201) provides a stable 2.1 MHz output. When U402 releases its control, U401’s hardware holds the reset line low until it verifies that clock Y401 is operational. When the reset line goes high, U401’s hardware delays briefly to allow Y401 to stabilize, then the software begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 ms is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

U401’s reset line can be controlled directly by the 5V regulator (U411), the AFIC, and the microcomputer, and indirectly by the synthesizer. U411 drives the reset line low (via pin 3) if it loses regulation. This prevents possible latch-up or overwriting of registers in the microcomputer because the reset line is higher in voltage than pin 32 (pin 55*) of U401 (VDD).

U401 can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software stuck in an infinite loop, unplanned hardware inputs, static zaps, etc.

The AFIC and synthesizer can control the reset line during power-up, as outlined above.

Receiver

The receiver of the GP300 UHF and VHF radios consists of 4 major blocks each: the front-end module, the double balanced mixer, the 45.1 MHz IF and the back-end IF IC.

The UHF and VHF front-end modules consist of three blocks of circuitry each: A pre-selector, RF amplifier and a post-selector filter. These three items are located on a receiver module pc-board that stands perpendicular to the main radio pc-board. This module is enclosed in a shield to prevent radiation into and out of the module. All filters on the UHF and VHF modules are fixed tuned designs to eliminate the need for factory tuning and to provide wide-band operation.

The shunt and series coupled resonator topology. This topology yields a more symmetrical frequency response to guard against strong out of band signals that could produce IM products.

The worst case image frequency for this band is 90.2 MHz above the filter passband. The 3 db bandwidth is approximately 35 MHz, centered at 160 MHz. The center of the band insertion loss is approximately 1.9 db. The 4-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The UHF pre-selector filter is a 3-pole, 0.1 db Chebyshev bandpass design implemented in a shunt coupled resonator topology. This topology maximizes the attenuation at the worst case image frequency for this receiver, which is 90.2 MHz below the filter passband. The 3 db bandwidth is approximately 45 MHz, centered at 454 MHz. The center of the band insertion loss is approximately 2.2 db. The 3-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The RF amplifier, Q1, is a Motorola MMBR571 NPN device biased in a common emitter configuration. The amp is stabilized by the shunt feedback resistor R3, and has approximately 16.5 db of gain with a noise figure of about 3.0 db.
(VHF) and 2.2 dB (UHF). The amplifier draws 4 ma of current and is supplied by the receiver 5 volt supply (indicated as “5R” on the schematics and block diagrams).

Terminating the RF amp is the post-selector filter. This filter is a 3-pole for VHF and a 4-pole for UHF, .01 db Chebyshev design which is also implemented in a series coupled resonator topology for maximum image attenuation. The 3 db bandwidth is approximately 38 MHz centered at 160 MHz for VHF and 42.5 MHz centered at 454 MHz for UHF.

The insertion loss of this filter is approximately 1.9 db for VHF and 3.5 db for UHF. The filter is designed to be terminated with the amplifier output impedance on one side, and 50 ohm on the other.

The net gain from the receiver module is about (12.2 db VHF) (10.8 db UHF) in the center of the band and about (10.7 db VHF) (9.5 db UHF) at the band edges. The net center of the band noise figure is approximately (5.5 db VHF) (5.2 db UHF). This is sufficient to achieve a typical center of the band sensitivity of 12 db.

The double balanced mixer is composed of the two baluns, T1 and T2, and the ring diode IC, CR2. The mixer operates with an LO level of +6 dbm and the conversion loss is approximately 7.5 db. The double balanced mixer provides excellent isolation between any two ports. And since a DBM can operate over a large bandwidth, the same mixer can be used for UHF and VHF radios. The DBM also provides excellent protection against receiver spurs due to nonlinearizes, such as IM and Half-IF. The received signal mixes down to the frequency of the first IF, 45.1 MHz, and enters the IF circuitry.

**Intermediate Frequency (IF)**

The Intermediate Frequency (IF) section of the portable radio consists of several sections including, the high IF, the second LO, the second IF, and the IF IC chip. The first LO signal and the RF signal mix to the IF frequency of 45.1 MHz, and then enters the IF portion of the radio.

The signal first enters the high IF, passes through a crystal filter, is then amplified by the IF amp, and then passed through another crystal filter. The first crystal filter provides selectivity, second image protection, and intermodulation protection. The amplifier provides approximately 16 dB of gain to the signal. The signal then passes through the second crystal filter which provides further selectivity and second image protection. The high IF has an approximate 3 dB bandwidth of 7 kHz for 20/25/30 KHz models and 4 KHz for 12.5 KHz models.

The filtered and amplified IF signal then mixes with the second local oscillator at 44.645 MHz. The second LO uses an amplifier internal to the IF IC, an external crystal and some external chip parts. The oscillator presents an approximate level of -15 dBm to the second IF mixer, internal to the IF IC.

The output of the mixing of the IF signal and the second LO produces a signal at 455 KHz (second IF). This signal is then filtered by external ceramic filters and amplified. It is then passed back to the IF IC, sent to a phase-lock detector, and demodulated. The resulting detected audio output is then sent to the AFIC to recover the audio.

The IF IC also controls the scquelch characteristics of the radio. With a few external parts the scquelch tail, hysteresis, attack and delay were optimized for the radio. The AFIC allows the radio’s scquelch opening to be electronically adjusted.

**Transmitter**

The GP300 VHF and UHF transmitters contain five basic circuits: a power amplifier, an antenna switch, a harmonic filter, an antenna matching network, and a power control. Refer to the block diagram and the schematic for more information.

The power amplifier consists of a module purchased from Motorola SPS. For VHF, the module (MHW607) contains three stages of amplification, while for UHF, the module (MHW707) contains four stages. Both modules require an input signal of 1 mW, a supply voltage of 7.5 Volts, and are capable of supplying, at least, 7 Watts of output. The power output of both modules can be varied by changing the voltage on their second stage.

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C119, L112, and part of C112), and at least, one current limiting resistor (R102 for UHF; and R102, R103, and R108 for VHF). In the transmit mode, TX B+ is applied to the circuit to bias the diodes “on”. The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

The harmonic filter consists of part of C112, and L107, C113, L108, C114, L109, and C115. The design of the harmonic filter for both VHF and UHF is that of a Zolotarev design. This particular design is similar to that of a Chebyshev filter except for a large amplitude first ripple (near dc). This type of filter has the advantage that it can give greater attenuation in the stop-band for a given ripple level.

Another feature of this type of filter is that the coils tend to be smaller than with a Chebyshev design. The design of the VHF filter was modified from the Zolotarev design by slightly changing its capacitor values to yield a filter having an input impedance which optimized the efficiency of the power module.

To optimize the performance of the transmitter and receiver into an antenna, a network is used to match the antenna’s impedance to the harmonic filter. For VHF the network consists of C117, L111, and C122. For UHF the network is

*Pin numbers with (*) refer to VHF revision D main board kits and UHF revision C main board kits.*
Frequency Generation Circuitry

made up of C117 and L111. Note that, in order to measure
the power out of the transmitter, one must remove the
antenna and screw in its place a special BNC-to-Phono
adapter.

The power control circuit consists of the networks associated
with U151, Q156, Q151, Q152, Q155, and U152. The Op
Amp U151A and Q156, along with resistor R101, make up a
current-to-voltage amplifier whose gain is mainly dependent
upon the ratio of R179 to R153. The current to the final stage
of the power module is supplied through R101 (0.1 Ohms),
which provides a voltage proportional to the current drain.
This voltage is amplified and applied to the input of U151B.
The resistors at the input of U151A (R151, R152, R154, and
R155) keep the voltages at the inputs of U151A below its
maximum allowable. These resistors are 1% tolerance parts
to minimize the error produced at the emitter of Q156 result-
ing from the voltage offset at the input of U151A.

The voltage at the other input of the summing amp, U151B,
is supplied from two DACs contained within U152. These
DACs are controlled by the microprocessor, and provide
the reference voltage for the control loop. One of the DACs, that
connected to Pin 9 of U152, provides a coarse tune voltage,
while the other provides a fine tune voltage. Since the output
of the DACs is not zero when they are set to their lowest
level, resistor R169 is provided to bias up the minus input of
the summing amp to compensate for the bias resulting from
the DACs.

The error voltage at the input of U151B produces a voltage
at its output, which is in turn applied to the series pass trans-
sistor, Q152, through its driver, Q151. The voltage at the col-
lector of Q152 is applied to the controlled stage of the power
module, which for both VHF and UHF is the module's sec-
ond stage. The feedback from the collector of Q152 to the
emitter of Q151 through R166 is provided to keep the two
stages stable. Likewise, the feedback from the collector of
Q152 to the minus input of the summing amp is to keep the
whole control loop stable.

The purpose of Q155 and its associated circuitry is to keep
the control voltage on the module below 7.0 Volts, which is
the maximum allowed for the UHF module.

The purpose of R173 was originally that of providing com-
pensation to the control loop for changes in the supply volt-
age, TX B+. However, experimentation has shown that this
compensation is not really required. Also, thermistor, R170,
was provided to enable the shut back of the PA in the event
that it would get too hot. This has also been shown to not be
required

Frequency Generation Circuitry

The frequency generation circuitry is composed of two main
IC's, the Fractional-N synthesizer (U201) and the VCO/
Buffer IC (U251). Designed in conjunction to maximize
compatibility, the two IC's provide many of the functions
which normally would require additional circuitry. The
block diagram illustrates the interconnect and support cir-
cuity used in the design. Refer to the schematic for refer-
ence designator.

The supply for the synthesizer is from Regulated 5 Volts
which also serves the rest of the radio. The synthesizer in
turn generates a superfiltered 5 Volts (*actually 4.65 Volts)
which powers U251.

In addition to the VCO, the synthesizer must interface with
the logic and AFIC circuitry. Programming for the synthe-
sizer is accomplished through the data, clock, and chip
enable lines (pins 2, 3, and 4; pins 5*, 6*, 7*) from the
microprocessor, U401. A serial stream of 98 bits is sent
whenever the synthesizer is programmed. A 5 volt dc signal
from pin 35 (pin 2*) indicates to the microprocessor that the
synthesizer is locked while unlock is indicated by a low volt-
age on this pin. Transmit modulation from the AFIC is
applied to pin 35 (pin 8*) of U201. Internally the audio is dig-
itized by the Fractional-N and applied to the loop divider to
provide the low-port modulation. The audio is also run
through an internal attenuator for modulation balancing pur-
oposes before being output at pin 27 (pin 28*) to the VCO.
A 2.1 MHz clock for the AFIC is generated by the Fra-
ctional-N and is routed to pin 9 (pin 11*) where it is filter-
ted and attenuated to 2.5 Volts to approximately 2 Volts.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal
(Y201) to provide the reference frequency for the system.
The other reference oscillator components external to the IC
are C205, C206, R207, and CR203. The 16.8 MHz signal is
divided down signal from the VCO. The loop filter, com-
prised of R201, R202, R205, C201, C214, C215, and C216,
provides the necessary dc steering voltage for the VCO as
well as filtering of spurious signals from the phase detector.
For achieving fast locking of the synthesizer, an internal
adapt charge pump provides higher current capability at pin
29 (pin 31*) than in the normal steady-state mode.
Both the normal and adapt charge pumps receive their supply
from the voltage multiplier which is made up of C202, C203,
C204, C231, CR201, and CR202. By combining two 5 Volt
square waves which are 180 out-of-phase along with Regu-
lated 5 Volts, a supply of approximately 12.6 Volts is avail-
able at pin 31 (pin 32*) for the charge pumps. The cur-
current for the normal mode charge pumps is set by R203. The
pre-scaler for the loop is internal to U201 with the value deter-
mined by the frequency band of operation.

VCO

The VCO (U251) in conjunction with the Fractional-N syn-
thesizer (U201) generates rf in both the receive and the trans-
mits modes of operation. The TRB line (U251 pin 5)
determines which oscillator and buffer will be enabled. A
sample of the rf signal from the enabled oscillator is routed
from U251 pin 23, through a low pass filter, to the pre-scaler
input (U201 pin 18, pin 20*). After frequency comparison in
the synthesizer, a resultant CONTROL VOLTAGE is
received at the VCO. This voltage is a DC voltage between
3 and 10 volts when the PLL is locked on frequency.

Pin numbers with (*) refer to VHF revision D main board kits and UHF revision C main board kits.
In the receive mode, U251 pin 5 is grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U251. The rf signal at U251 pin 2 is run through a low pass filter. The rf signal after the low pass filter is the LO RF INJECTION and it is applied to the first mixer at T2.

During the transmit condition, PTT depressed, five volts is applied to U251 pin 5. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U251. The rf signal at U251 pin 4 is run through a low pass filter and an attenuator to give the correct drive level to the input of the PA module (U101 pin 1). This rf signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received by the transmit VCO modulation circuitry at AUDIO IN.

When a high impedance is applied to U251 pin 5, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive, transmit, and pre-scaler buffer are turned off. In the Fractional-N, the battery saver mode places the A/D and the modulation attenuator in the off state. This mode is used to reduce current drain on the radio.

GP300 receive (RX) and transmit (TX) circuits are common to both the VHF and UHF models. Most of the radio processing for RX and TX is accomplished in U402, the Audio Filter IC. The Audio Filter IC performs the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter (RX audio)
- TX pre-emphasis filter
- Limiter
- Post-limiter filter
- TX deviation digital attenuators
- MIC gain attenuator
- Noise squelch digital attenuator
- Microcontroller port expanders (output only)
- 2.5 Vdc reference source

U402 parameters are programmed from U401 microcontroller ROM and EEPROM data via the serial CLOCK and DATA lines. Unless otherwise indicated, all signal levels refer to standard carrier modulation, 1kHz tone at +/-3kHz deviation.

**TX Audio Path**

**Internal MIC Bias Switch and External PTT Sense Circuits**

PNP switch transistor Q407, resistors R453, R454, and capacitor C463 control the operating bias for internal MIC MK401. Q407 is controlled by microcontroller U401 via U402-40, the Audio Filter IC expanded output port. On connecting an external MIC through connector J3, external PTT sense transistor Q408 switches “ON” when the external PTT switch is closed. Q408 collector voltage is monitored by U401-54 (U401-14*). When collector voltage is logic “HI” state, the microcontroller configures the radio for transmit mode. In PTT equipped accessories, the PTT switch is series connected with the external MIC element.

**MIC Amplifier**

MIC audio from internal MIC MK401 is coupled through C429, L404, J3, and L403 to the MIC amp circuit U407B. External MIC plug insertion mechanically disconnects the internal MIC. External MIC audio is coupled through L403 to the MIC amp input. Capacitors C425, C426 and C427, and resistors R447, R448 and R450 provide a low audio frequency roll off with a high-pass corner frequency of 1kHz to improve transmit audio clarity. Crossover gain is 12 db (at 1kHz). Reference deviation is obtained with 11.0 mV rms input to the external MIC connector J3.

**TX Audio Mute Gate**

PNP transistor Q409, and resistors R462 and R463 comprise the TX audio mute gate. U402-40, Audio Filter IC expanded output port, controls Q409 as well as Q407, the internal MIC bias switch. When U402-40 is logic LO state, a small dc current flows from U407B-7 MIC amp output into Q409 emitter, through Q409, and out of the collector through R462. A fraction of the emitter current flows out of the base through R463 to ground (Vss of Audio Filter IC). MIC audio at U407B-7 passes through the TX audio mute gate. When U402-40 is logic “HI”, Q409 base voltage is 4Vdc (typical) and emitter voltage is 2.4 Vdc, biasing the device well into cut-off. No current flows through emitter to base/collector, and not MIC audio passes. The mute function is enabled (Q409 is “OFF”) when modulating DTMF or 5/6 tone (European Signalling).

**Pre-emphasis Amp (standard models)**

U402, the Audio Filter IC, contains a TX audio pre-emphasis amp, with external gain setting resistor R504, and pre-emphasis elements R506 and C462. Connections are made at each end of resistor R506 to provide interconnection of “front cover” option board TX audio through connector P1 (below). Pre-emphasis is 6 db/octave with a corner frequency of 6600Hz. Crossover gain is 0 dB at 1kHz, with passband gain (head-room) of 17.5 dB.

**Option Interface Connector P1 (Keypad/Display models)**

P1 provides interconnection of “front cover” option PC boards to the GP300 radio main board. MIC audio output is available from P1-5 at a level of 45 mVrms and 10k ohm output impedance. Option TX Audio input to the GP300 radio is available at P1-4 with sensitivity of 40 mV rms, preemphasized at 6 db/octave, and less than 200 ohm output impedance (from option board). If “flat” audio response is required, the audio output from the option board must be de-
emphasized at a -6 dB/octave rate, 300Hz to 3kHz, with 0 dB gain at 1kHz. The low option board output impedance is required to achieve better than 40 dB isolation between main board input (P1-4) and output (P1-5) audio.

**Limiter (Audio Filter IC)**

The audio filter IC U402 contains the limiter circuit, which prevents over-deviation of the RF carrier by symmetrically clipping the peaks of the modulating voltage. Audio from the pre-emphasis amplifier circuit is coupled to the limiter. Gain of the limiter stage is adjustable in four 3 dB steps, from -3 dB to +6 dB. Therefore, TX audio path gain, or MIC gain, can be adjusted to compensate for different sound environments through the Radio Service Software.

**Post-Limiter Filter (Audio Filter IC)**

Clipped modulating voltage from the limiter output is coupled to the post-limiter filter. Filtering attenuates the spurious products generated by the limiter. The post-limiter filter is programmable to operate in the following modes:

- CEPT/EIA mode
- Japan mode
- FTZ (Germany) mode

**PL Encoder**

Private Line (CTCSS) is generated by the PL encoder circuit in U402, the Audio Filter IC. Tone PL or Digital PL data is programmed for each mode from the Radio Service Software. On entering transmit mode, TPL or DPL data is programmed to U402 via the serial DATA and CLOCK lines. U401-35 (U401-67*) microcontroller output strobes & 402-32 PL clock input at a constant rate during DPL encoding, or at a rate determined by the PL encoder algorithm in the microcontroller for TPL encoding corresponding to tone frequency. The encoded PL is summed with MIC audio at the post-limiter filter input. Digital attenuators are employed to adjust the balance of MIC radio and PL to prevent over-deviation of the carrier. PL deviation is adjustable in three “coarse” steps of 500 Hz, 750 Hz, and 1 kHz, for 25 KHz models and steps of 250 Hz, 375 Hz, and 500 Hz for 12.5KHz models with compensation of MIC audio level.

**DTMF Encoder**

Resistors R424, R425, R426, R428 and R484, and summer U405A form the DTMF encoder. U405A-1 is coupled to U402-13 Audio Filter IC auxiliary TX modulation input.

DTMF encoded signals pass from this input to the post-limiter filter input. U405A-1 is also coupled to U402-12 and coupled through RX audio path to the audio PA for sidetone audio.

**Deviation Attenuators (Audio Filter IC)**

Carrier deviation is set by programming the digital deviation attenuators of the Audio Filter IC. Deviation data for each mode is entered through the Radio Service Software, and then programmed into U402 from microcontroller U401 on entering transmit mode. U402-19 and U402-20 deviation attenuator outputs are combined through resistors R478 and R479 and dc-coupled to U201-5 (U201-8*), the synthesizer modulation input. Capacitor C218 provides a high frequency roll-off corner at 20 kHz to further attenuate spurious signals from U402. The dc voltage at the combined attenuator outputs sets the center frequency for the modulated carrier. Any transient (R x C) voltages in the TX audio path must settle within 1 millisecond of PTT activation to prevent center frequency offset.

**RX Audio Path**

**PL Rejection Filter (Audio Filter IC)**

The recovered RX audio from the IF detector IC U51 is coupled through capacitor C435 to U402-7 and U402-8 on the Audio Filter IC. RX audio at U402-7 is processed first by the PL rejection filter, which is characterized by a zero pole, 300 Hz corner frequency high-pass response. Audio then passes through the digital volume attenuator and buffer amplifier output to U402-23. Unattenuated RX audio is coupled to U402-22 and fed to the center-slicer circuit for detection of 5/6 tone (European) signals. For standard test modulation, the audio level at U402-7 is 255 mVrms, and output audio level at U402-23 is 765 mVrms with the digital volume attenuator set to minimum attenuation.

**PL Decoder**

Recovered RX audio at U402-8, the PL decoder input, first passes through the Tone PL filter, or the Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then coupled to the PL detector circuit, with detected PL output at U402-27. The detected PL signal is coupled from U402-27 to microcontroller U401-41 where algorithms perform the final PL decoding. Data for the Tone PL frequency or Digital PL code for each mode is programmed through the Radio Service Software.

**Center-Slicer**

The center-slicer circuit U406A detects Quick-Call and 5/6 tone signals. Unattenuated RX audio from U402-22 is dc coupled to the two inputs of U406A. The non-inverting input U406A-3 is fed through resistor R433. Capacitor C415 sets a low-pass corner frequency of 3.3 kHz. The inverting input U406A-2 is fed through resistor R434. Capacitor C416 sets a low-pass corner frequency of 16 Hz. During operation, R434/C416 establishes an averaged dc offset level at U406A-2 dependent on the average dc level of the undetected signal to set the "trigger" threshold of U406A. R433/C415 provide high audio frequency roll-off to improve falsing immunity. The detected output from the center slicer circuit is

*Pin numbers with (*) refer to VHF revision D main board kits and UHF revision C main board kits.*
coupled to microcontroller U401-43 (U401-1*) where algorithms perform the final data decoding.

**Option Interface Connector P1 (Keypad/Display Models)**

P1 provides interconnection of “front cover” option pc boards to the GP300 radio main board. Filtered “flat” RX audio output is available at P1-7, at a level of 765 mVRms at 15k-ohm impedance. P1-7 is always unmuted, not affected by the receiver with squelch circuit. Option RX audio input to the GP300 radio is available at P1-6, with a sensitivity of 100 mVRms at less than 200 ohm output impedance from option board.

**RX Audio Mute Gate**

PNP transistor Q406, the RX audio mute gate, with resistors R458 and R459, and capacitors C432 and C433, provide receiver audio muting. The RX audio mute gate circuit functions in a similar manner to Q409, the TX audio mute gate circuit. Muting is controlled by microcontroller U401 via U402-39, an Audio Filter IC expanded output port. Q406 is saturated and RX audio unmuted by programming U402-39 to a logic “LO” state. Q406 is placed well into cut-off and RX audio muted by programming U402-39 to a logic “HI” state.

**Audio Power Amplifier**

Variable resistor R460 and resistor R461 provide RX audio volume adjustment. R461 sets the minimum volume level. Resistor R466 sets the input impedance to U409-2 of the audio power amp. Fixed level Alert Tone audio is generated by microcontroller U401-34 (U401-56*) and coupled through capacitor C437 and resistor R465 to U409-2. The audio PA circuit is a bridged-tied-load (BTL) configuration with fixed gain of 40 dB, developing 500 mW (rated audio power) output at less than 5% harmonic distortion into the 16 ohm internal speaker LS401 with nominal 7.5 Vdc battery supply. Maximum audio power output is greater than 1.2 watts.

**Audio PA Muting and Output Protection**

PNP transistor Q410, the audio PA power switch, driven by NPN darlington transistor Q411, the PA mute amp, controls Vcc supply to Audio PA U409-1. U402-3, and Audio Filter IC expanded output port, is connected to Q411 base, controlling audio PA Vcc supply. Resistors R489 and R490, PNP transistor Q412, and the current sense circuit monitor current supplied to audio PA U409-1. Worst case audio PA current (at 9 Vdc battery voltage, maximum volume and full system deviation) does not exceed 450 mA at the nominal 16-ohm load. Resistor R488 and capacitor C461 provide an RC time delay for U405B, a monostable multivibrator circuit. A 2.5Vdc reference voltage is fed to U405B-6. On radio power-up, and in normal operation U405B-7 monostable multivibrator output is logic “LO” pulling Q411 emitter to Vee with the audio PA controlled by U402-3. Should U409-5 and/or U409-8 become shorted to each other or to ground (Vee), current consumption exceeds 500mA (approximately) and Q412 is forward biased. Switched battery supply voltage appears at Q412 collector. When U405B-5 voltage rises higher than the U405B-6 reference voltage (rise time is less than 50 usec), U405B is triggered and U405B-7 dc output voltage switches to 4 Vdc, effectively biasing Q411 into cut-off and turning off the audio PA power switch Q410. U405B-7 remains in this state for 15 msec, then resets to logic “LO” state. Average power dissipation in the audio PA circuit components is held to a low level by the low duty cycle (less than 0.3%) of the audio PA protection circuit. The cycle repeats until the audio PA output short is removed.

**Noise Squelch Attenuator**


**Vox Circuit Operation**

As mentioned above, with VOX option enabled, a VOX (non-PTT) accessory can be plugged into connector J3 for voice activated transmit operation. The external MIC element is always supplied with operating bias through resistor R451 and external PTT sense transistor Q408. The external PTT sense at microcontroller U401-54 (U401-14*) is therefore, always "enabled." A second output circuit of MIC amplifier U407B couples MIC audio through capacitor C445 to U406B, the VOX detector circuit. Resistors R492 and R493, and capacitor C451 form a syllabic filter which reduces VOX circuit triggering by high frequency ambient noise. Resistors R442, R443, R444, R445, and R491, capacitor C423, rectifier diode CR404 and U406B form a linear peak detector circuit. MIC audio causes capacitor C423 to charge to a potential related to the relative amplitude of ambient noise. Microcontroller U401-61 (U401-19*) monitors the potential of C423 and establishes a threshold for non-voiced ambient noise. When a positive rise in potential above threshold or voice is detected by an algorithm in the microcontroller ROM, the radio is configured to transmit mode.

*Pin numbers with (*) refer to VHF revision D main board kits and UHF revision C main board kits.*

2-6

6880901Z93-C August, 1996
Overview

The remote speaker microphone is an accessory available with the GP300 portable radio. This section provides a general description of the remote speaker microphone and describes the operation, handling precautions, and maintenance of this accessory.

Description

The Model HMN9725B Remote Speaker Microphone includes a speaker, a microphone, a push-to-talk (PTT) switch and associated circuitry. A cable, terminated with a special plug, is provided for attaching to the accessory connector on the portable radio.

When the remote speaker microphone is attached to the radio, the speaker in the radio is disabled, and receiver audio is connected to the accessory speaker. Similarly, the accessory microphone is connected to the transmitter, and the accessory PTT switch can now control the PTT function in the radio. The radio microphone and PTT switch are still operational, but you can listen to the radio only through the accessory speaker.

IMPORTANT
Observe safety information in the radio operating instructions.

Operation

1. Attach the microphone's accessory connector to the accessory connector on top of the radio.

2. While listening to the accessory speaker, turn the radio on.

3. Operate radio according to operating instructions supplied with the radio.

NOTE
The microphone will perform best if it is worn as shown in Figure 3-1.

Handling Precautions

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

- Prior to and while servicing a remote speaker microphone, particularly after moving within the service area, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which may have accumulated on the person doing the service.

- Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

NOTE
Wearing a conductive wrist strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING
While wearing a conductive wrist strap, be careful near high voltage sources. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.

- When servicing a unit, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

- All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.
If the microphone cartridge is removed from the unit, place it on a conductive surface, such as a sheet of aluminum foil which is connected to ground through 100k ohms of resistance.

**WARNING**
If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

- When soldering, be sure the soldering iron is grounded
- Prior to replacing circuit components or touching the microphone cartridge, be sure to discharge any static buildup. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.
- Replacement microphone cartridges should be kept in conductive packaging until they are placed in unit.

**Maintenance**

Refer to the schematic diagram (shown in Figure 3-2), the exploded view (shown in Figure 3-3, on page 3-3), and the parts lists. Every part in the microphone is identified and illustrated for assistance in removal and replacement.

If necessary, the external surfaces of the remote speaker microphone may be cleaned with a 0.5% solution of mild dishwashing detergent in water (one teaspoon of detergent in a gallon of water).

### Parts List

<table>
<thead>
<tr>
<th>REFERENCE SYMBOL</th>
<th>MOTOROLA PART NO.</th>
<th>DESCRIPTION</th>
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</thead>
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<td>2113740A53</td>
<td>Capacitor, fixed: uF +/-10%; 100 V: unless otherwise stated</td>
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<td>C2</td>
<td>2113740A67</td>
<td>Chip, 62 pF, +/- 5%, 50 V</td>
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<td>C3</td>
<td>2113741A53</td>
<td>Chip, 330 pF, +/- 5%, 50 V</td>
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<td>C4</td>
<td>2113741B69</td>
<td>Chip, .1 uF, +/- 5%, 50 V</td>
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<td>L1</td>
<td>2462575A02</td>
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<td>Dome, PTT</td>
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<td>MK1</td>
<td>0180703Y69</td>
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<td>LS1</td>
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**Figure 3-2. Schematic Diagram**
### Parts List

**HMN9725B Remote Speaker Microphone**

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<th>DESCRIPTION</th>
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<td>5</td>
<td>110551S1R01</td>
<td>Adhesive</td>
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<tr>
<td>6</td>
<td>0160703Y70</td>
<td>Coll cord &amp; connector</td>
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<td>7</td>
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<td>16</td>
<td>0300139982</td>
<td>Screw, Phillips; 2-56 x 5/32&quot;</td>
</tr>
<tr>
<td>17</td>
<td>1505172P01</td>
<td>Housing, back</td>
</tr>
<tr>
<td>18</td>
<td>0484345A06</td>
<td>Washer, 3 used</td>
</tr>
<tr>
<td>19</td>
<td>0305137Q02</td>
<td>Screw, Phillips, 3 used</td>
</tr>
<tr>
<td>20</td>
<td>0105595N54</td>
<td>Belt clip assembly</td>
</tr>
<tr>
<td>21</td>
<td>0300139982</td>
<td>Screw, Phillips, 4 used</td>
</tr>
</tbody>
</table>

**Figure 3-3. Exploded View**
Overview

This section contains three troubleshooting tables for the following GP300 components:

- Receiver
- Transmitter
- Synthesizer
- Microprocessor
- Voltage Controlled Oscillator (VCO)

Troubleshooting Charts

Refer to following pages.
Troubleshooting Flow Chart for Transmitter

August, 1996

6880901293-C

4-3
Troubleshooting Flow Chart
for Synthesizer

4-4
6880901Z93-C August, 1996
**Troubleshooting Flow Chart for VCO**

4-6

6880901Z93-C August, 1996
COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY

SOLDER SIDE VIEW
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pin</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Resistor</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Capacitor</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Microcontroller</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Motor</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

*Notes:*
- Pin: Small silver component used for electrical connections.
- Resistor: Component that controls the flow of electric current.
- Capacitor: Component that stores electrical energy in an electric field.
- Microcontroller: Small computer chip that controls a device or system.
- Motor: Component that converts electrical energy into mechanical energy.
COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY

SOLDER SIDE VIEW
SOLDER SIDE VIEW

COMPONENT SIDE (GRAY)
SOLDER SIDE (PWH)
OVERLAY

RCB-00132-A (REV)
RCB-00135-A (REV)
RCB-00136-A (REV)
<table>
<thead>
<tr>
<th>PART NO.</th>
<th>Description</th>
<th>Part List</th>
<th>PLUQNTY</th>
<th>SLOHD</th>
<th>UN 52040</th>
<th>UN 52100</th>
<th>UN 52500</th>
<th>UN 52600</th>
<th>UN 52600</th>
<th>UN 52600</th>
<th>UN 52600</th>
<th>UN 52600</th>
<th>UN 52600</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>2</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>C</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>5</td>
<td>E</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>F</td>
<td></td>
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<td>7</td>
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</tbody>
</table>

...
# Parts List

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Part Number</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>10</td>
<td>12345</td>
<td></td>
</tr>
<tr>
<td>Part B</td>
<td>5</td>
<td>67890</td>
<td></td>
</tr>
<tr>
<td>Part C</td>
<td>3</td>
<td>11111</td>
<td></td>
</tr>
<tr>
<td>Part D</td>
<td>2</td>
<td>22222</td>
<td></td>
</tr>
</tbody>
</table>

*Note: All parts are available in stock.*

---

**Part Description:**

- **Part A:** Essential component for assembly.
- **Part B:** Auxiliary part for additional functionality.
- **Part C:** Critical component requiring precise alignment.
- **Part D:** Supplementary piece for aesthetic purposes.

---

**Additional Information:**

- Parts marked with a asterisk (*) require special handling during installation.
- All parts are designed to be interchangeable except for Part C, which has a unique specification.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>Motor</td>
<td>2</td>
<td>Engine</td>
</tr>
<tr>
<td>456</td>
<td>Wheel</td>
<td>4</td>
<td>Axle</td>
</tr>
<tr>
<td>789</td>
<td>Seat</td>
<td>1</td>
<td>Interior</td>
</tr>
<tr>
<td>012</td>
<td>Window</td>
<td>2</td>
<td>Roof</td>
</tr>
</tbody>
</table>

Note: The table continues with more parts and details.
## Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>Component 1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>456</td>
<td>Component 2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>789</td>
<td>Component 3</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>012</td>
<td>Component 4</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes
- Component 1 is a standard part available in bulk.
- Component 2 needs to be ordered from a specialized supplier.
- Component 3 is undergoing a quality assurance check.
- Component 4 is subject to a limited warranty.

---

*Parts List: Introduction to Parts Management*

For more information, please refer to page 12 of the manual. This part list is subject to change without notice. Please contact our support team for any queries.

---

*Parts List: Quality Assurance*

- All parts must undergo mandatory testing before shipment.
- Components marked with "High Risk" require additional scrutiny.
- Warranty claims must be submitted within 30 days of purchase.

---

*Parts List: Ordering Information*

- Orders must be placed 2 weeks in advance of need.
- For urgent orders, please contact our dedicated team.
- All orders are subject to a 10% surcharge on prices listed.

---

*Parts List: Contact Information*

- Customer Support: 1-800-123-4567
- Sales Inquiries: sales@company.com
- Technical Support: techsupport@company.com

---

*Parts List: Revision History*

- Revision A: Initial release, April 2023
- Revision B: Quality improvements, June 2023
- Revision C: Standardization across regions, September 2023
### Parts List

10 Hour Standard Rate Charger, Mechanical

<table>
<thead>
<tr>
<th>REFERENCE SYMBOL</th>
<th>MOTOROLA PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>05-00812634</td>
<td>Rubber feet; 4 used</td>
</tr>
<tr>
<td>2</td>
<td>09-02157101</td>
<td>DC Power Jack; 1 used</td>
</tr>
<tr>
<td>3</td>
<td>13-80403803</td>
<td>Escutcheon - slow charger; 1 used</td>
</tr>
<tr>
<td>4</td>
<td>15-80952201</td>
<td>Housing, top; 1 used</td>
</tr>
<tr>
<td>5</td>
<td>39-80953201</td>
<td>Contact, charging; 3 used</td>
</tr>
<tr>
<td>6</td>
<td>61-80966301</td>
<td>Lightpipe, charger; 1 used</td>
</tr>
<tr>
<td>7</td>
<td>64-80951201</td>
<td>Base, charger; 1 used</td>
</tr>
<tr>
<td></td>
<td>33-80154501</td>
<td>Charger label; 1 used</td>
</tr>
</tbody>
</table>

Battery Charger

Standard Rate (10 Hour)

August, 1996
parts list

(100V Standard rate charger, Electrical)

<table>
<thead>
<tr>
<th>REF SYMBOL</th>
<th>MOTOROLA PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>06-60075A1</td>
<td>Resistors, 5% 1/8W, unless otherwise specified</td>
</tr>
<tr>
<td>R2 - R5</td>
<td>06-60075A2</td>
<td>20 k</td>
</tr>
<tr>
<td>R6</td>
<td>06-60075A3</td>
<td>1.5 k</td>
</tr>
<tr>
<td>R7 - R8</td>
<td>06-60075A2</td>
<td>200 k</td>
</tr>
<tr>
<td>R9 - R10</td>
<td>06-60075A20</td>
<td>250 k</td>
</tr>
<tr>
<td>R11</td>
<td>06-60075A3</td>
<td>15 k</td>
</tr>
<tr>
<td>R12 - R14</td>
<td>06-60075A7</td>
<td>10 k</td>
</tr>
<tr>
<td>R15</td>
<td>06-60075A0P</td>
<td>47 k</td>
</tr>
<tr>
<td>VR1</td>
<td>48-11050B05</td>
<td>ZENER, 3V</td>
</tr>
<tr>
<td>VR2</td>
<td>48-80148G05</td>
<td>ZENER, 4.7V</td>
</tr>
<tr>
<td>VR3</td>
<td>48-80148G05</td>
<td>ZENER, 4.7V</td>
</tr>
<tr>
<td>Q1</td>
<td>48-05129H04</td>
<td>PNP</td>
</tr>
<tr>
<td>Q2 - Q4</td>
<td>48-11050B02</td>
<td>PNP</td>
</tr>
<tr>
<td>Q5</td>
<td>48-05214G02</td>
<td>NPN</td>
</tr>
<tr>
<td>Q6</td>
<td>48-05129H04</td>
<td>PNP</td>
</tr>
</tbody>
</table>

Battery Charger
Standard Rate (10 Hour)

END OF DOCUMENT