SUPPLEMENT to Instruction Manual
68P81015E70
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# SPECIFICATIONS (MAIN RADIO)

## GENERAL

<table>
<thead>
<tr>
<th>MAXIMUM BATTERY DRAIN</th>
<th>Standby @ 13.8 V</th>
<th>1.2A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Receive @ 13.8 V</td>
<td>3.2A</td>
</tr>
<tr>
<td></td>
<td>Transmit @ 13.6 V</td>
<td>17.0A</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>NUMBER OF FREQUENCIES</th>
<th>8 transmit/8 receive</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SQUELCH</th>
<th>&quot;Private-Line&quot; Tone-Coded Squelch and carrier squelch</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>13&quot; W x 24-3/4&quot; L x 3-3/8&quot; D (330mm x 629mm x 85mm)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>WEIGHT</th>
<th>Approx. 40 lbs (18.1 kg). 65 lbs (27.2 kg) with accessories</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>METERING</th>
<th>A single-scale 0 to 50 microampere meter or Motorola portable test set can be used to make all measurements essential to tuning and testing.</th>
</tr>
</thead>
</table>

## TRANSMITTER

<table>
<thead>
<tr>
<th>RF POWER OUTPUT</th>
<th>30 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT IMPEDANCE</td>
<td>50 ohms</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>SPURIOUS AND HARMONIC EMISSIONS</th>
<th>75 dB below carrier</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>FREQUENCY STABILITY</th>
<th>± .0005% from -30°C to +60°C ambient (+25°C reference) and ±15% primary voltage variation.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>MODULATION</th>
<th>15F2 and 16F3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>± 5 kHz for 100% @ 1 kHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FREQUENCIES</th>
<th>FCC-assigned Emergency Medical Service frequencies: 468.000, 468.025, 468.050, 468.075, 468.100, 468.125, 468.150, and 468.175 MHz</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AUDIO SENSITIVITY</th>
<th>0.08 V ± 3 dB for 60% maximum deviation @ 1 kHz</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>FM NOISE</th>
<th>60 dB below 60% maximum deviation @ 1 kHz</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>AUDIO RESPONSE</th>
<th>+1, -3 dB of a 6 dB/octave pre-emphasis characteristic from 3 to 3 kHz</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>AUDIO DISTORTION</th>
<th>Less than 3% @ 1 kHz, 60% maximum deviation</th>
</tr>
</thead>
</table>

## RECEIVER

<table>
<thead>
<tr>
<th>CHANNEL SPACING</th>
<th>25 kHz</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>FREQUENCIES</th>
<th>FCC-assigned Emergency Medical Service frequencies: 463.000, 463.025, 463.050, 463.075, 463.100, 463.125, 463.150, and 463.175 MHz</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SPURIOUS AND IMAGE REJECTION</th>
<th>-100 dB (transmitter unkeyed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-85 dB (transmitter keyed)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EIA MODULATION ACCEPTANCE</th>
<th>± 7 kHz minimum</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>FREQUENCY STABILITY</th>
<th>± .0005% (± .0002% with optional channel element) from -30°C to +60°C ambient (+25°C reference) with ±15% primary voltage variation.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AUDIO OUTPUT</th>
<th>10 watts @ less than 5% distortion</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>20 dB QUIETING SENSITIVITY</th>
<th>0.5 uV</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>EIA SINAD SENSITIVITY</th>
<th>0.35 uV</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SELECTIVITY</th>
<th>-90 dB (EIA SINAD)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>INTERMODULATION</th>
<th>-80 dB (EIA SINAD)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SENSITIVITY: TONE-CODED SQUELCH</th>
<th>0.25 uV or less</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SENSITIVITY: CARRIER SQUELCH</th>
<th>0.25 uV or less (at threshold)</th>
</tr>
</thead>
</table>

*SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE*

**FCC LICENSE DESIGNATIONS:**

Transmitter — CC4164
Receiver — RC0003
### GENERAL
- **MAXIMUM BATTERY DRAIN**: Receive @ 13.8 V 3.2A
- **NUMBER OF FREQUENCIES**: 4
- **SQUELCH**: "Private-Line" Tone-Coded Squelch and carrier squelch
- **DIMENSIONS**: 11-1/8" W x 10-7/8" L x 3" D (282mm x 276mm x 76mm)
- **WEIGHT**: Approx. 11 lbs (5 kg)
- **METERING**: A single-scale 0 to 50 microampere meter or Motorola portable test set can be used to make all measurements essential to tuning and testing.

### RECEIVER
- **CHANNEL SPACING**: 50 kHz
- **FREQUENCIES**: FCC-assigned Emergency Medical Service frequencies: 458.025, 458.075, 458.125, and 458.175 MHz
- **SPURIOUS AND IMAGE REJECTION**: -100 dB (transmitter unkeyed)
  -85 dB (transmitter keyed)
- **EIA MODULATION ACCEPTANCE**: ±7 kHz minimum
- **FREQUENCY STABILITY**: ±0.0005% (±0.002% with optional channel element) from -30°C to +60°C ambient (+25°C reference) with ±15% primary voltage variation.
- **AUDIO OUTPUT**: 10 watts @ less than 5% distortion
- **20 dB QUIETING SENSITIVITY**: 0.5 uV
- **EIA SINAD SENSITIVITY**: 0.35 uV
- **SELECTIVITY**: -90 dB (EIA SINAD)
- **INTERMODULATION**: -80 dB (EIA SINAD)
- **SENSITIVITY: TONE-CODED SQUELCH**: 0.25 uV or less
- **SENSITIVITY: CARRIER SQUELCH**: 0.25 uV or less (at threshold)

---

**SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE**

**FCC LICENSE DESIGNATION:**
Receiver — RC0129

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**SAFETY INFORMATION**
The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to any two-way mobile radio equipment. Normal use of this radio will result in exposures far below the OSHA limit. There are no reported incidents of physical damage resulting from the use of this type radio. However, the following precautions are recommended:

**DO NOT** operate the transmitter when someone outside the vehicle is within two feet of the mobile antenna.

**DO NOT** operate the transmitter near unshielded electrical blasting caps or in an explosive atmosphere.
# EMS Systems

## Motorola

### Model Chart

For
EMS Duplex Repeater System

450-470 MHz

---

**Code:**

X = ONE ITEM SUPPLIED

\[ \square \] = NUMBER OF ITEMS SUPPLIED

**Note:** Refer to Instruction Manual 68F6030D001 for details concerning the Q152A Dual Control Package.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Q1564C</td>
<td>ECG MODULATOR PRE-AMPLIFIER MODULE</td>
</tr>
<tr>
<td>Q1565R</td>
<td>CABLE KIT</td>
</tr>
<tr>
<td>Q1566R</td>
<td>ESCUTCION AND HARDWARE KIT</td>
</tr>
<tr>
<td>Q1571X</td>
<td>ESCUTCION PRE-AMPLIFIER BOARD</td>
</tr>
<tr>
<td>Q1572X</td>
<td>ESCUTCION AND TESTING KIT</td>
</tr>
<tr>
<td>Q1573R</td>
<td>ESCUTCION ALTRIPE BOX</td>
</tr>
<tr>
<td>Q1584A</td>
<td>TRUNK EXTENSION KIT</td>
</tr>
<tr>
<td>Q1585A</td>
<td>EMS DIPLEX REPEATER</td>
</tr>
<tr>
<td>Q1586A</td>
<td>EMS DIPLEX REPEATER</td>
</tr>
<tr>
<td>Q1588X</td>
<td>EMS RADAR PULSE DUAL CONTROL UNIT (SEP NOTE)</td>
</tr>
<tr>
<td>TPIN220A</td>
<td>HOUSING KIT</td>
</tr>
</tbody>
</table>

---

### EMS Package Radio Models

## Motorola

### Model Chart

For
EMS Package Radio Models

460-471 MHz

30 Watts RF Power

**Code:**

X = ONE ITEM SUPPLIED

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1590A</td>
<td>RADIO CABLE (11-FT)</td>
</tr>
<tr>
<td>Q1606A</td>
<td>AUDIO TELEMETRY MULTIPLEX MODULE</td>
</tr>
<tr>
<td>Q1610R</td>
<td>AUDIO TELEMETRY MODULE</td>
</tr>
<tr>
<td>Q1621A</td>
<td>KSCI CHG AND HARDWARE KIT</td>
</tr>
<tr>
<td>Q1624A</td>
<td>AUDIO REPEATER MODULE</td>
</tr>
<tr>
<td>Q1634A</td>
<td>AUDIO KIT</td>
</tr>
<tr>
<td>Q1638A</td>
<td>AUDIO REPEATER BOARD</td>
</tr>
<tr>
<td>Q1649A</td>
<td>KSCI CHG AND HARDWARE KIT</td>
</tr>
<tr>
<td>Q1651X</td>
<td>REPEATER CONTROL MODULE</td>
</tr>
<tr>
<td>Q1653A</td>
<td>REPEATER CONTROL BOARD</td>
</tr>
<tr>
<td>Q1656A</td>
<td>ECG MODULATOR PRE-AMPLIFIER MODULE</td>
</tr>
<tr>
<td>Q1664A</td>
<td>ECG DIPLEX REPEATER</td>
</tr>
<tr>
<td>Q1670A</td>
<td>AUXILIARY RECEIVER</td>
</tr>
<tr>
<td>Q1671A</td>
<td>1-1/2-LB. AUXILIARY RECEIVER</td>
</tr>
<tr>
<td>TA6502X</td>
<td>DIPLEX REPEATER MODULAR CABLE</td>
</tr>
<tr>
<td>TUN6521X</td>
<td>MODEL ANTENNA</td>
</tr>
<tr>
<td>TUN6522X</td>
<td>MULTI-PORT CONTROL HEAD</td>
</tr>
<tr>
<td>TUN6523X</td>
<td>HOUSING KIT</td>
</tr>
<tr>
<td>TUN6524A</td>
<td>CONTROL HEAD CABLE</td>
</tr>
<tr>
<td>TM6544A</td>
<td>CABLE AND WIRE KIT</td>
</tr>
<tr>
<td>TM6545A</td>
<td>HANDSET HANDLE KIT</td>
</tr>
<tr>
<td>TN6544A</td>
<td>HANDSET</td>
</tr>
<tr>
<td>TN6544A</td>
<td>MOBILE SPEAKER KIT</td>
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## EMS Basic Radio Models
### Current Versions

**MOTOROLA**

**Model Chart**

For 450-512 MHz Duplex/Repeater

"MICOR" EMS Basic Radio Sets

**Code:**
- X = One Item Supplied
- = One Item Supplied Dependent on Frequency Range.
- 4 = Number Indicates Quantity Supplied

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>KLS1216X</td>
<td>Receiver Channel Element</td>
<td>X</td>
</tr>
<tr>
<td>KLS1204X</td>
<td>&quot;VIBRASENDER&quot; Resonant Reed</td>
<td>X</td>
</tr>
<tr>
<td>OVE102A</td>
<td>Duplexer and Chassis Kit</td>
<td>X</td>
</tr>
<tr>
<td>OVE108A</td>
<td>Duplexer Kit</td>
<td>X</td>
</tr>
<tr>
<td>OVE105A</td>
<td>Duplexer Hardware Kit</td>
<td>X</td>
</tr>
<tr>
<td>OVE106A</td>
<td>Harmonic Filter</td>
<td>X</td>
</tr>
<tr>
<td>QUN9154</td>
<td>Repeater Interface Cable Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9153</td>
<td>Antenna Cable Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9152</td>
<td>Auxiliary Receiver Cable Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9151</td>
<td>Interconnect Cable Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9150</td>
<td>Antenna Coupler Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9149</td>
<td>Dual &quot;PL&quot; Decoder</td>
<td>X</td>
</tr>
<tr>
<td>QUN9148</td>
<td>Dual &quot;PL&quot; Decoder Board</td>
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</tr>
<tr>
<td>QUN9147</td>
<td>&quot;PL&quot; Decoder Board</td>
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</tr>
<tr>
<td>QUN9146</td>
<td>EMS Squelch Gate Board</td>
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<tr>
<td>QUN9145</td>
<td>EMS Squelch Gate Interconnect Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9144</td>
<td>Squelch Gate Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9143</td>
<td>Interface Board</td>
<td>X</td>
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<tr>
<td>QUN9142</td>
<td>Hardware Kit</td>
<td>X</td>
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<tr>
<td>QUN9141</td>
<td>Auxiliary Audio Board</td>
<td>X</td>
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<tr>
<td>QUN9140</td>
<td>Auxiliary Audio Board with Multiplex</td>
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<tr>
<td>QUN9139</td>
<td>Frequency Select Matrix Board</td>
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<tr>
<td>QUN9138</td>
<td>&quot;PL&quot; Decoder Board</td>
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<tr>
<td>QUN9137</td>
<td>Exciter Output Filter</td>
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<tr>
<td>QUN9136</td>
<td>Duplex Antenna Filter Network</td>
<td>X</td>
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<tr>
<td>QUN9135</td>
<td>Duplex Injection Filter</td>
<td>X</td>
</tr>
<tr>
<td>QUN9134</td>
<td>Power Amplifier and Heat Sink</td>
<td>X</td>
</tr>
<tr>
<td>QUN9133</td>
<td>Ceramic Filter</td>
<td>X</td>
</tr>
<tr>
<td>QUN9132</td>
<td>Exciter Board</td>
<td>X</td>
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<tr>
<td>QUN9131</td>
<td>&quot;VIBRASENDER&quot; Resonant Reed</td>
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<tr>
<td>QUN9130</td>
<td>4-Freq. 25 MHz Receiver Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9129</td>
<td>4-Freq. 25 MHz Receiver Board</td>
<td>X</td>
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<td>QUN9128</td>
<td>4-Freq. 25 MHz Receiver Board</td>
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<td>QUN9127</td>
<td>4-Freq. 25 MHz Receiver Board</td>
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<td>QUN9126</td>
<td>4-Freq. 25 MHz Receiver Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9125</td>
<td>AC/DC and Squelch Board</td>
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<td>QUN9124</td>
<td>&quot;PL&quot; Encoder</td>
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<td>QUN9123</td>
<td>Audio Power Amplifier Kit</td>
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</tr>
<tr>
<td>QUN9122</td>
<td>Power Control Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9121</td>
<td>Interface Board</td>
<td>X</td>
</tr>
<tr>
<td>QUN9120</td>
<td>Duplex Hardware Kit</td>
<td>X</td>
</tr>
<tr>
<td>QUN9119</td>
<td>Installation Kit</td>
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</tr>
<tr>
<td>QUN9118</td>
<td>Tuning Tool</td>
<td>X</td>
</tr>
</tbody>
</table>
# EMS Basic Radio Models

## Earlier Versions

### Model Chart

**FOR 450-470 MHZ DUPLEX/REPEATER**

- **MICOR®** EMS Basic Radio Set
- **1-8 FREQUENCY MODEL** EQUIPPED
- WITH **'PRIVATE-LINE'® TONE-CODED SQUELCH**
- AND AUXILIARY RECEIVER
- 30-WATT RF OUTPUT

### Code:

- **X** = ONE ITEM SUPPLIED
- **#** = NUMBER OF ITEMS SUPPLIED DEPENDS ON NUMBER OF FREQUENCIES USED
- **O** = TWO ITEMS SUPPLIED

### Item | Description
---|---
AR610BA-SPE | RECEIVER RF & IF BOARD
KN102A | CHANNEL ELEMENT, RECEIVER/TRANSMITTER
TLE642A | EXCITER BOARD
TLE621A | EXCITER OUTPUT FILTER
TLE148A | 15-WATT RF POWER AMPLIFIER & HEAT SINK
TLN4262A | POWER CONTROL BOARD
TPE621B-SP1 | DUPLEX ANTENNA NETWORK
TPE6262A | DUPLEX INJECTION METER
QPE202 | PREAMPLIFIER & FILTER
TLN6463-SP1 | CONTROL (INTERCONNECT) BOARD
QLN5401A | SQUELCH GATE BOARD
QSN544A | SQUELCH GATE INTERFACE BOARD
QRN131A | REPEATER INTERFACE CABLE
QLN555A | AUXILIARY AUDIO BOARD
TUN575R-SP1 | AUDIO I. OUTPUT BOARD
TLN6429B | AUDIO POWER AMPLIFIER BOARD
TLN572A | 'PRIVATE-LINE' ENCODER BOARD
QSN620A | 'VIERASCORDER' RESONANT Reed (FORMERLY TLN524A)
TLN6291B | 'PRIVATE-LINE' DECODER BOARD
QLN6281A | 'VIERASCORDER' RESONANT Reed
QLN629A | FREQUENCY SELECT MATRIX BOARD
TLN437AB-SPZ | HARDWARE KIT
TCN111A | TUNING TOOL
TCN112A-SP1 | 8-FREQUENCY CONTROL HEAD
QKN207A | CONTROL CABLE, 10-FOOT
QKN555A | CONTROL HEAD POWER CABLE KIT
QKN555A | CABLE & TUBE KIT
TMLN606A | HANDSET
TCLN564A | HANDSET HANG-UP BOX
TSN606D | MOBILE SPEAKER
FALN62A | ANTENNA
QNN622A | HOUSING
QLN1917B | REPEATER CONTROL MODULE (FORMERLY QNN1917)
TLMN620A | INSTALLATION KIT
QKN520A | RECEIVER RF & IF BOARD
QKN522A | JUNCTION BOX
QKN520A | RECEIVER CABLE KIT
QKN582A | Aux Receiver Antenna Cable
QKN582A | Aux Receiver Antenna Cable
QKN582A | Aux Receiver Interconnect Cable Kit
QKN582A | Aux Receiver Hardware Kit
QKN520A | Aux Receiver Squelch Gate Board
QKN520A | Aux Receiver Interface Board
QKN520A | Aux Receiver Interface Board
QNN623A | Antenna Coupler
TPE612A-SP1 | RF PREAMPLIFIER

MICOR® AND 'PRIVATE-LINE'® ARE REGISTERED TRADEMARKS OF MOTOROLA, INC.
FOREWORD

1. 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 Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, revision suffix numerals are added to the affected kit model number. For example, a TLN4448A becomes a TLN4448A-1 with the first revision, TLN4448A-2 with the second revision, etc.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced when the suffix number changed. With this information, the technician can find the information for the current version, and any previous version, of the equipment covered by the manual.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 800 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Division
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Division products.

Orders for all parts except crystals, active filters, code plugs, channel elements, and "Vibrasender"* and "Vibrasponder"* resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.
5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications and Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road
Schaumburg, Ill. 60196
Phone: 312-576-7322
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 21076
Phone: 301-796-8600
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
P. O. Box 85036
San Diego, California 92138
Phone: 714-578-2222
TWX: 910-335-1634

GULF STATES AREA PARTS
8550 Katy Freeway
Suite 128
Houston, Texas 77024
Phone: 713-932-8955

SOUTHWESTERN AREA PARTS
P. O. Box 34290
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P. O. Box 368
Decatur, Georgia 30031
Phone: 504-981-9800
TWX: 810-766-0876

5.3 CANADIAN ORDERS

CANADIAN MOTOROLA ELECTRONICS COMPANY
National Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 416-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC. OR MOTOROLA AMERICAS, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-0869
Telex: 722443 or 722424
Cable: MOTOL Parts

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

ALL MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P. O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131

68P81025E81-L
1. EMS RADIO SYSTEM

1.1 The Emergency Medical Services (EMS) radio system provides an effective communications link between a paramedic with his patient and the emergency staff at a hospital or trauma center. The system takes advantage of the higher power mobile radio in the ambulance used as a repeater to enhance communications between the EMS portable radio at the site of patient encounter and the staff at the hospital. When the patient is removed to the ambulance, the ambulance radio acts in the normal (non-repeat) mode to keep the paramedic in touch with the hospital. Electrocardiogram (ECG) strips can be sent both from the patient encounter site and from the ambulance (with optional QLN1919B ECG Modulator/preamplifier Module).

1.2 The system incorporates “Private Line” squelch so that several hospitals can share the same frequency. When operating under normal conditions in the repeat mode, the mobile radio will repeat only those transmissions accompanied with the correct PL code. If it becomes necessary to operate with a different hospital (such as during a catastrophic emergency situation) a ROAM switch can be operated to disable the PL squelch repeater requirement; this allows communications with and repeating of all on-frequency signals regardless of PL code. Improper operation will result if REPEAT and ROAM are selected while operating on the dispatch channels, F9 and F10.

2. DUAL CONTROL

Dual control (Q1508A-9A) provides a second radio control group which can be located in the rear of the ambulance accessible to the paramedic while he is attending a patient being transported. This control group allows the paramedic to directly control such functions as frequency selection, repeat and/or roam operation, and use of the telemetry multiplex circuits. A powered rear speaker is available as an option. Intercom capability is provided between the rear control group and the driver’s control group. The rear control group can be supplied for handset or hands-free (headset and footswitch) operation. This option is described in Dual Control manual 68P81030E90.

3. ECG TELEMETRY AND MULTIPLEX

3.1 One of the principal functions of the EMS system is the relaying of electrocardiographic data from the patient to the hospital for review and evaluation by the professional staff at the cardiac care unit (CCU) or the intensive care unit (ICU). Since this information has frequency components as low as 1/2 cycle per second, it cannot directly frequency modulate the RF carrier but rather frequency modulates a 1400 Hz carrier and occupies the 1150 Hz to 1650 Hz space of the audio spectrum (see Figure 2).

Figure 1. Duplex EMS Radio System in Repeat Mode

Figure 2. Frequency Spectrum of a Non-Multiplex System
3.2 In a non-multiplex system, either electrocardiographic (ECG) data or voice messages are transmitted but not both simultaneously. This type of system is adequate for many EMS system applications since an ECG data transmission can be sent in a fraction of a minute. Refer to manual 68P81029E45 for complete description of a non-multiplex system.

3.3 Improved communication between paramedic and doctor are achieved in the "duplex/multiplex" EMS system which is described in this supplement. The duplex/multiplex system allows the paramedic to send an ECG strip, relay vital signs to the hospital, and allows the doctor to give emergency instructions back to the paramedic, ALL SIMULTANEOUSLY. Thus continuous communication is achieved in a situation where time is vital.

3.4 The duplex-multiplex technique is achieved by reserving sections of the transmit audio spectra for different purposes and transmitting the combined audio to the hospital (see Figure 3). The circuit and system technique required to allow the system to operate duplex/multiplex is fully described later is this supplement.

4. EQUIPMENT DESCRIPTION

4.1 RADIO SYSTEMS

Table 1. EMS Radio Systems

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2035A</td>
<td>Duplex/Repeater with Single Receiver</td>
</tr>
<tr>
<td>Q2033A</td>
<td>Duplex/Repeater with Auxiliary Receiver and Duplex Multiplex</td>
</tr>
<tr>
<td>Q2034A</td>
<td>Duplex/Repeater with Auxiliary Receiver (Dual PL) and Duplex Multiplex</td>
</tr>
</tbody>
</table>

The above radio systems include one of the package radio models shown in Table 2 plus the QLN1919C ECG Modulator/Preamplifier Modulator described in this manual and the Q1508A Hands-Free Dual Control Package described in instruction manual supplement 68P81030E90.

4.2 RADIO PACKAGES

Table 2. EMS Radio Packages with Accessories

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1505A</td>
<td>Duplex/Repeater with Auxiliary Receiver (Non-Multiplex) — No Longer Available</td>
</tr>
<tr>
<td>Q1855A</td>
<td>Duplex/Repeater with Single Receiver</td>
</tr>
<tr>
<td>Q1853A</td>
<td>Duplex Repeater with Auxiliary Receiver and Duplex Multiplex</td>
</tr>
<tr>
<td>Q1854A</td>
<td>Duplex/Repeater with Auxiliary Receiver (Dual PL) and Duplex Multiplex</td>
</tr>
</tbody>
</table>

4.2.1 The Q1505A and Q1853A are the basic mobile EMS duplex/repeater systems. Both systems utilize two separate receivers to receive and repeat messages from both the portable and the hospital at the same time. The only difference between the two models in that the Q1853A has duplex/multiplex capability as described in paragraph 2.3 of the Theory of Operation. The Q1505A radio is no longer available.

4.2.2 The Q1855A is similar to the Q1853A except that it uses only a single receiver. This radio is used in systems where the added capability of two independent receivers are not required. Note that although operation in the repeat mode is simplex (i.e. only one transmission can be repeated at a time), the radio itself is push-to-talk duplex and will allow duplex communications with the hospital and with the portable if the portable unit is duplex.

4.2.3 The Q1854A is similar to the Q1853A and includes duplex/multiplex capability. In addition the auxiliary receiver is equipped with a two PL tone decoder and each frequency can be programmed to respond to one of the two PL codes allowing operation of different portable units thru a single mobile repeater.

4.3 RADIO SETS

Table 3. EMS Radio Sets

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1506A</td>
<td>Duplex/Repeater Radio Set</td>
</tr>
<tr>
<td>Q1802A</td>
<td>Duplex/Repeater Radio Set (equipped for duplex-multiplex operation)</td>
</tr>
</tbody>
</table>

Figure 3. Frequency Spectrum of a Duplex-Multiplex System
4.3.1 These radio sets are similar except that the Q1802A uses the QLN7225A Auxiliary Audio Board instead of the QLN5855A to facilitate duplex multiplex operation.

4.3.2 The UHF “Micor” FM two-way duplex/repeater radio with auxiliary receiver described in this supplement is designed specifically for use in Emergency Medical Service (EMS) communications systems. The main receiver is tuned for operation on frequencies assigned by the FCC for ambulance/hospital communications. The auxiliary receiver is tuned for operation on frequencies assigned by the FCC for portable/ambulance repeater communications. The two receivers provide full two-way repeat capability, permitting telephone-type communication between portable and base station through the vehicular repeater.

4.3.3 Most components of the radio set are the same as those described in the UHF “Micor” radio set instruction manual. This supplement describes only those major components that are unique to UHF “Micor” duplex/repeater mobile radio models. The model chart in this supplement lists all of the radio set major component assemblies.

4.3.4 The operating modes of this UHF “Micor” duplex/repeater radio are particularly suited to EMS applications. These operating modes are:

- Duplex — The receivers remain in full operation at all times. This permits the radio operator to engage in telephone-type communication with the base station. The mobile unit is continuously able to hear the base station, even while transmitting.

- Repeat — The radio set re-transmits any on-channel signal that contains the proper “Private-Line” (PL) tone code received by either the main or the auxiliary receiver. This, for example, allows a low-power portable coronary telemetry radio to take advantage of the high-power transmitter and efficient antenna system of the mobile radio unit. The radio set monitors all on-channel radio signals. If telemetry signals are being retransmitted, the radio set operator can activate a filter that removes the telemetry signal from the monitored audio. Voice transmissions from the radio set may be made at any time.

- Emergency Repeat — The radio set re-transmits all on-channel signals from both receivers, regardless of PL tone code. As in the repeat mode, the radio set operator is able to monitor all on-channel signals and filter telemetry signals out of the monitored audio. Voice transmissions can be made at any time. Repeat priorities can be established by jumper options for portable-to-base, base-to-portable, first-come-first-serve, or simultaneous transmission of the outputs of both receivers.

4.4 AUXILIARY RECEIVER

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1507A</td>
<td>EMS Auxiliary Receiver</td>
</tr>
<tr>
<td>Q1589A</td>
<td>EMS Auxiliary Receiver (Dual PL)</td>
</tr>
</tbody>
</table>

These radio sets are similar except that the Q1589A uses the QLN1974A Dual “Private-Line” Decoder instead of the TLN4294B “Private-Line” Decoder Board.

### MAJOR COMPONENTS

1. **INTRODUCTION**

Figure 4 identifies each of the major components of the main radio set. Those components marked with an asterisk (*) are unique to UHF “Micor” duplex/repeater radio sets and are described in the following paragraphs. All other major components are described in the basic radio set instruction manual 68P81015E70.

2. **DESCRIPTION OF MAIN RADIO UNIQUE MAJOR COMPONENTS**

2.1 **TLN4930C-SP16 CONTROL (INTERCONNECT) BOARD**

This control board is a modified version of the TLN4930C Control (Interconnect) Board described in the basic radio set instruction manual. The modifications facilitate the following radio set features:

- Interconnections between circuit boards.
- Duplex operation by disabling receiver audio muting while the transmitter is keyed.
- Hang-up box disabling for “PL” defeat during emergency repeat operation.
- Additional decoupling of frequency select lines.

2.2 **TLN5163B-SP1 AUDIO & SQUELCH BOARD**

The audio & squelch board used in duplex/repeater UHF “Micor” radio sets is basically the same as the TRN6540A Audio & Squelch Board described in the basic radio set instruction manual. The differences are as follows:

- The audio signal is routed through the audio and squelch board and repeater control module circuitry for the processing and filtering needed for duplex/repeater operation.
b. Several components are added for improved rf filtering.

c. A jumper connects continuous regulated +9.6 volts in place of switched +9.6 volts to allow the audio & squelch board to remain in operation while the transmitter is keyed.

2.3 QLN5855A AUXILIARY AUDIO BOARD

The auxiliary audio board circuits perform the following functions:

a. Receiver audio signal processing — In repeater operation the receiver audio signals are applied to the exciter audio input. The auxiliary audio board circuits combine the audio from both the main and the auxiliary receivers, filter out the "PL" tone, provide de-emphasis, and determine the repeat audio level at the exciter audio input.

b. Monitor audio muting — Monitor audio is muted in the receivers under non-intercom and no-signal conditions.

c. Unsquelched indicator inversion and buffering (main receiver only) — The unsquelched indicator signal from the main receiver audio & squelch board is inverted and amplified before application to the repeater control logic circuits on the squelch gate board.

d. Repeat priority logic — establishes PTT priority between the auxiliary receiver and main receiver in repeat mode.

1. Main receiver has priority — jumper JU6 used.

2. Auxiliary receiver has priority — jumper JU5 used.

3. First come-first serve priority — jumpers JU5 and JU6 used.

4. No priority — jumpers JU5 and JU6 omitted.

2.4 QLN5603A SQUELCH GATE BOARD

The basic operating modes of the squelch gate board are duplex (non-repeat) and duplex/repeat. The squelch gate circuits provide the following functions:

Duplex and Repeat Modes:

a. Receiver enabling while transmitter is keyed — Regulated +9.6 volts is applied through the squelch gate board to the receiver switched +9.6 volt input. This keeps the receiver in operation while the transmitter is keyed.

b. Audio mute disabling — In duplex and repeater operation the receiver audio circuits must remain in continuous operation. The squelch gate board prevents the receiver audio from being muted while the transmitter is keyed.

Repeat Mode Only:

a. Transmitter keying — When the radio set is operating in the repeat mode, the transmitter keys when the proper rf signal and PL code are received. If the emergency repeat mode is selected, then only the proper rf signal is required to key the transmitter. In the emergency repeat mode the transmitter keys when the proper rf signal is received, regardless of PL code. This permits repeater operation in emergency situations with base stations or portable equipment not having the correct repeater access PL code.

b. "Private-Line" switch disabling — When the radio set is operating in the repeat mode, the squelch gate board circuits disable the hand set hang-up box PL switch input to the radio. This converts the radio receiver to carrier squelch operation, permitting the local vehicle operator to monitor the repeater channel.

c. Repeater squelch control — When the radio set is in the repeat mode, the factory set squelch control on the squelch gate board replaces the control head squelch control. The control head squelch control is then inoperative.

2.5 QLN5604A SQUELCH GATE INTERFACE BOARD

The squelch gate board plugs into the squelch gate interface board, which provides interconnections, via a QKN8134A Repeater Interface Cable, to the radio set control board, auxiliary audio board, and radio set power/control connector P901. A push-pin on the board provides a B+ source for the optional receiver rf preamplifier.

2.6 QKN8134A REPEATER INTERFACE CABLE

This cable interconnects the squelch gate board (via the squelch gate interface board), auxiliary audio board and control (interconnect) board. Two of the four connectors plug onto pins on the control (interconnect) board, one connector connects to the auxiliary audio board, and the remaining connector connects to the squelch gate interface board. Six wires connect to spare pins on radio set power/control connector P901.

2.7 QFE1024A DULEXER AND FILTER

2.7.1 The QFE1024A Duplexer permits simultaneous transmission and reception with a single antenna. This is accomplished by isolating the transmitter and
receiver antenna terminals while providing continuous rf paths to the antenna for both the transmitter and receiver. Two notches in the receive leg bandpass of this duplexer permit operation of two receivers and one transmitter from one antenna, if desired. The duplexer is factory tuned and does not require retuning in the field.

2.7.2 A harmonic filter between the transmitter output and the duplexer transmitter leg input attenuates any spurious transmitter signals before they reach the antenna. The filter is not tunable.

2.8 TFE6233B-SP1 DUPLEX ANTENNA NETWORK

The antenna network used in these duplex/repeater radio sets is a modified version of the antenna network used in simplex radio set models. The antenna switch is removed and part of the low pass filter that is at the antenna connector in standard antenna networks is separately housed and mounted near the duplexer. The transmitter rf signal out of the antenna network passes through the separate low-pass filter, through the duplexer, and then to the antenna.

2.9 TFE6262A DUPLEX INJECTION FILTER

The duplexer injection filter isolates the exciter offset mixer spurious products from the receiver mixer spurious products. Refer to the ADJUSTMENTS section of this manual for tuning instructions.

2.10 QLE6236A ANTENNA COUPLER

The antenna coupler permits the main receiver and the auxiliary receiver to share a common input from one antenna. The coupler provides, (1) impedance matching between the receiver port of the duplexer and each receiver, and (2) isolation of the two receiver inputs from each other. Due to the signal splitting characteristics of the coupler, a 3 dB insertion loss is present between the input leg (from the duplexer) and each output leg to the receivers. Compensation for this insertion loss is provided by the rf preamplifier. The antenna coupler is a completely sealed unit and contains no adjustable components.

2.11 TLE8192A-SP1 RF PREAMPLIFIER

The rf preamplifier provides compensation for the insertion losses in the duplexer receiver leg and antenna coupler. The rf preamplifier kit includes a printed circuit board and housing. All electrical components are accessible by removing cover plates. The rf preamplifier circuit consists of two tuned-lines and a grounded gate FET amplifier.

2.12 QLN5970A FREQUENCY SELECT MATRIX BOARD

The frequency select matrix board provides the same function performed by the 12-channel diode matrix board in the duplex/repeater radio sets without an auxiliary receiver. This board contains rf chokes and capacitors for additional decoupling of the frequency selection inputs.

2.13 TRE1203BA-SP5 RECEIVER RF AND I-F BOARD

This receiver rf and i-f board is a modified version of the TRE1203BA Receiver RF and I-F Board described in the basic radio set instruction manual. The modification consists of adding four rf chokes in series with the frequency select lines to the control board.

2.14 QLN5677A JUNCTION BOX

This junction box contains interconnection wiring to allow use of the auxiliary receiver with the main radio.

3. DESCRIPTION OF AUXILIARY RECEIVER UNIQUE MAJOR COMPONENTS

Figure 5 identifies each of the major components of the auxiliary receiver. Those components marked with an asterisk (*) are unique to the auxiliary receiver and are described in the following paragraphs. All other major components are described in the basic radio set instruction manual.

3.1 QLN5699A CONTROL (INTERCONNECT) BOARD

This control board provides the following functions:

a. Power distribution and filtering.

b. Interconnection between circuit boards.

c. Frequency selection routing for the auxiliary receiver.

d. Interconnection with the main receiver via the auxiliary radio cable kit and the junction box.

For details, refer to the auxiliary receiver control (interconnect) board schematic diagram and circuit board detail attached to this supplement.
3.2 QLN5698A AUXILIARY RECEIVER SQUELCH GATE BOARD

The squelch gate board used in the auxiliary receiver is similar to the TRN6540 Audio and Squelch Board described in the basic radio set instruction manual. The differences are as follows:

a. The differential amplifier, complementary amplifier, audio power amplifier circuit board, and all circuitry required for these amplifiers have been deleted.

b. Squelch gate functions required for repeater operation are provided.

Complete information pertaining to the squelch gate and its relation to the basic radio set is contained in the Theory of Operation section.

3.3 QLN5700A RECEIVER INTERFACE BOARD

The receiver interface board plugs into the control (interconnect) board and the receiver rf and 1-f board to provide the required interconnections between the two boards.

3.4 QKN8210A INTERFACE CABLE

This cable interconnects the squelch gate functions between the control (interconnect) board and the squelch gate board.

4. ACCESSORIES

4.1 TCN1112A-SP12 CONTROL HEAD

This version of the standard TCN1112A Control Head is modified to isolate the microphone PTT line from the transmit indicator and provide a separate ground return for the frequency selector switch. The “Extender” switch on the back of the control head is inoperative.

4.2 QLN1917B REPEATER CONTROL MODULE

This module mounts in a “Micor” “Systems 90” enclosure and is an integral part of the EMS duplex/repeater mobile radio system. The repeater control module performs the following functions:

a. Repeater enabling — Closing the RPT switch sets up the radio set to repeat when the proper rf signal and PL tone are received.

b. Emergency repeater enabling — Closing both the RPT and ROAM switches enables the radio set to repeat any received signal, whether or not it has the proper PL tone.

c. Audio filtering — Closing the FLTR switch inserts a 1400 Hz, 35 dB notch filter into the auxiliary receiver audio signal path to attenuate received telemetry signals. This effectively removes telemetry signals from the audio signal monitored at the local vehicle receivers. The repeated telemetry transmission is unaffected.

Figure 1. Auxiliary Receiver Major Component Location
d. Monitor audio combining — Combines the monitor audio from the auxiliary receiver with the monitor audio from the main receiver.

e. Microphone audio muting — The microphone audio input is muted during repeater operation to prevent the background noise picked up by the handset microphone from interfering with repeater transmissions. The microphone audio input is un muted when the handset PTT switch is operated.

4.3 QLN1918B AUDIO TELEMETRY MULTIPLEX MODULE

This module replaces the repeater control module in EMS Duplex/Repeater radio systems with duplex-multiplex capability and provides for simultaneous voice audio and telemetry (multiplex) transmissions. The module provides all functions normally provided by the repeater control module as well as those required for multiplex.

4.4 QLN2042A REPEAT AUDIO PROCESSING (RAP) MODULE

The repeat audio processing module is used in EMS Duplex/Repeater radios which have duplex-multiplex capability. The module processes main receive repeat audio and is described in instruction section 68P81032E77 in this manual.

4.5 QLN7225A AUXILIARY AUDIO BOARD

This auxiliary audio board replaces the standard board in EMS duplex/ repeater radios, which have duplex-multiplex capability (Model Q1802A radio set).

The board performs all the functions of the standard board (including repeat audio gating logic) except for processing of main receiver repeat audio which is now handled by the repeat audio processing module explained previously. The QLN7225A auxiliary audio board is described in instruction section 68P81032E78 in this manual.

4.6 QLN1974A DUAL "PRIVATE-LINE" DECODER

This board allows the auxiliary receiver to be operated on either of two PL codes to allow monitor and repeat operation in two EMS networks. The receive PL codes are jumper programmable at the frequency select matrix on the auxiliary receiver control board to provide automatic PL selection with channel selection. This board is described in instruction section 55-SP32751.

4.7 QLN1919C ECG MODULATOR/ PREAMPLIFIER MODULE

A Model QLN1919C "Systems 90" ECG Modulator Preamplifier is a common accessory in EMS systems. This accessory is described in detail in this manual; its interconnections are included on the system interconnect diagram in this supplement. All "Micor" "Systems 90" accessories except the alternate control module and the voice privacy adapter are compatible with this EMS radio system.

4.8 QKN8207A AND QKN8208A RADIO CABLES

These radio cables interconnect the radio set, auxiliary receiver, and accessories.

THEORY OF OPERATION

1. INTRODUCTION
1.1 GENERAL

The following paragraphs describe theory of operation for circuits that are unique to UHF "Micor" duplex/repeater radio sets with auxiliary receiver. Refer to the radio set instruction manual for theory of operation of all other circuits.

1.2 DUPLEX OPERATION

In general, when the radio set is in the duplex mode the receivers operate continuously and the transmitter operates whenever the push-to-talk switch on the handset is closed. The duplexer and antenna coupler allows simultaneous transmitter and receiver operation using a single antenna.

1.3 REPEATER OPERATION

In repeater operation the radio set operates as it does in the duplex mode except that the transmitter keys whenever (1) either receiver unsequecles and (2) the correct PL tone has been received. Depending on the repeat priority option selected, audio from either, or both receivers, is applied to the transmitter exciter. If "emergency repeat" operation is selected, the transmitter keys whenever either receiver unsequecles whether or not the proper PL tone has been received. As in duplex operation, the duplexer and antenna coupler allow simultaneous transmission and reception with a single antenna.

2. FUNCTIONAL OPERATION

2.1 The ECG telemetry signal used in Motorola MICOR EMS repeater systems consists of a frequency-modulated sub-carrier at 1400 Hz with a maximum deviation of ±250 Hz. Prior to being multiplexed with the telemetry signal, voice audio signals are passed through a notch filter which attenuates all signals in the frequency range from 1150 Hz
with microphone and ECG telemetry transmission before it is fed to the exciter. Main receiver emitter follower audio is picked up at the control head and coupled to the repeat audio processing module where it passes through noise cancelling amplifier U1A to remove common mode noise components on both the audio and shield wires. The audio is then gated by Q2 so that receive audio from the base leg is retransmitted only when the proper repeat conditions are met. The audio is then adjusted for proper repeat level by R14 and the PL tones are removed. Finally U1B provides the de-emphasis characteristic and also the amplification necessary to compensate for loss through the PL filter. The processed base leg repeat audio is routed directly to the limiter input on the audio/telemetry module. From this point the audio path is identical to that described in paragraph 3.3.

3.3 MICROPHONE AUDIO FLOW

3.3.1 Microphone audio is gated by series switch Q1 which allows audio to pass when the microphone PTT switch is depressed. In dual control systems, front microphone audio is gated with rear microphone audio in the front interface module QLN1920A and the combined handset audio output is routed to the microphone audio gate input on the audio/telemetry multiplex module.

3.3.2 From the output of Q1, microphone audio is applied to limiter U1G and filter bypass Q101 simultaneously. If MUX is not selected filter bypass Q101 is enabled, which connects a low impedance path bypassing the limiter and transmit notch circuitry thus providing normal microphone output level to the exciter. If, however, MUX is selected, Q101 is inhibited and microphone audio passes through limiter Q101 and limit adjust control R110, which limits microphone audio deviation to 2 kHz in the multiplex mode. From there, microphone audio is passed through the transmit notch filter which provides a minimum of 13 dB attenuation of all audio frequencies in the ECG telemetry band from 1150 Hz to 1650 Hz. This is required so that voice audio will not interfere with telemetry information.

3.3.3 From the output of the transmit notch filter (or filter bypass), the microphone audio is combined with ECG telemetry at U3A, is buffered by Q2 and then fed via the cable kit to the radio where it connects with outboard receiver repeat audio at the exciter input.

3.3.4 ECG TELEMETRY AUDIO FLOW

3.3.4.1 The following discussion applies specifically to mobile repeater systems equipped with the ECG Modulator/Preamplifier Module option. If ECG telemetry is being repeated from a portable unit, the audio flow will be identical to that explained previously in paragraph 3.2.

3.3.4.2 ECG telemetry is only applied to the input to the Audio/Telemetry Multiplex Module if the ECG button is depressed and the mobile radio is therefore keyed.

3.3.4.3 If the mobile unit is selected for MUX operation, telemetry deviation reduction switch Q301 in combination with ECG level adjust pot R67 limits the ECG telemetry deviation to 2 kHz. If the system is not selected for MUX, Q301 is off and ECG telemetry is transmitted at maximum deviation level. From R67 the ECG signal is applied to ECG gate Q10 which blocks the telemetry in the event REPEAT is selected or microphone PTT is pressed in the MUX mode thus providing push-to-talk interrupt capability. The local ECG inhibit condition eliminates the possibility of ECG from the mobile interfering with repeated telemetry from the portable.

3.3.4.4 From Q10 the telemetry signal is applied to a low pass filter which attenuates second and higher order harmonics. This is required in multiplex systems so that annoying ECG signal harmonics are not transmitted and heard at the demodulator console. From the low pass filter, the telemetry is applied to combining amplifier U3A where it is combined with voice audio, to buffer Q2, and then via the radio cable where it is combined with repeat audio at the exciter input.

INSTALLATION

1. RADIO SET AND ANTENNA

Refer to the installation instructions in the radio set instruction manual and in the instruction section packed with the antenna.

2. CABLE, CONTROL HEAD, AND ACCESSORIES

Because of the radio cable and the "Systems 90" accessories used with the EMS system, disregard the
OPERATION

Figure 1. Control Group Operating Controls and Indicators

1. RADIO SET

1.1 CONTROLS AND INDICATORS
(See Figure 1)

ON/OFF Switch — Controls all power to the radio (main power switch), a green tab appears when power is on.

VOLUME Control — This control adjusts the audio level to the handset or speaker.

Radio Channel Selector — Selects the desired channel for transmitting and receiving.

SQUELCH Control — Controls the received signal strength required to turn on the receiver audio circuits and mutes radio noise when no signal is being received.

MUX Switch — Alternately enables/disables the multiplex mode of operation. The MUX switch must be activated to enable two-way simultaneous repeating of voice and telemetry or simultaneous transmission of voice and telemetry from the mobile ECG module.

NOTE
Some systems are equipped with a FLTR button instead of a MUX button.

FLTR or MUX Indicator — Illuminates (brightly) when the filter or multiplex operation is selected.

RPT Switch — Alternately enables/disables the Repeat mode of operation and also allows the radio operator to monitor all on-channel carrier squelch transmissions.

RPT Indicator — Illuminates (brightly) when the Repeat mode is selected.

ROAM Switch — When the radio is in the Repeat mode AND the Roam mode, all on-channel transmissions will be repeated regardless of the “Private-Line” (PL) code. The Roam button should never be pressed unless the repeat mode is selected.

NOTE
The ROAM switch and indicator are labeled EMER on some earlier systems.

ROAM Indicator — Illuminates (brightly) when the Roam mode is selected.

Transmit Indicator (Red) — Illuminates when the radio vehicle transmitter is keyed, in the Repeat mode when a message is being repeated, or when ECG information is being transmitted.

1.2 OPERATION

1.2.1 Receiving Radio Messages

Step 1. Set the control head ON-OFF switch to the ON position. The receiver(s) operates continuously while the radio is turned on.

Step 2. Select the desired radio channel.

Step 3. Remove the handset from its hang-up cradle. The receiver now operates with carrier squelch. All signals on the selected channel can be heard.

Step 4. Turn the SQUELCH control fully counterclockwise. Adjust the control head VOLUME control for a comfortable listening level.

Step 5. Turn the control head SQUELCH control clockwise until the speaker noise just stops.

Step 6. Replace the handset in its hang-up cradle. The receiver now operates with PL tone coded squelch. Only signals from your radio system can unsquelch the receiver.

1.2.2 Transmitting Radio Messages

Step 1. Select the desired radio channel.
Step 2. Remove the handset from its hang-up cradle and monitor the channel for activity.

Step 3. If the radio channel is not in use, hold down the PTT button on the handset handle and speak slowly and distinctly into the handset microphone.

NOTE
It is not necessary to release the PTT button to receive a reply. The receiver operates at all times.

1.2.3 Repeating Radio Messages

Step 1. Set the control head controls as described in the procedure entitled RECEIVING RADIO MESSAGES.

Step 2. Depress the RPT button on the control head. The RPT indicator brilliance increases and the radio set is now enabled to re-transmit any received radio signal that contains the proper PL tone frequency. All radio signals on the selected channel are monitored in the radio set speaker, but only those signals with the proper PL tones are able to activate the repeater transmitter. The control head transmit indicator light turns on whenever the transmitter is “on the air”.

NOTE
The radio set handset can be used to transmit messages while the radio set is in the Repeat mode. If the repeater is enabled during your voice transmission, the two messages are transmitted simultaneously.

Step 3. To return to non-repeat operation, depress the control head RPT button and allow it to return to the “out” position. The RPT indicator is then dimly illuminated.

1.2.4 Roam Repeat Operation

Step 1. Set the control head operating controls as described under “Repeating Radio Messages”.

Step 2. Depress the ROAM pushbutton. The RPT and ROAM indicators are then brightly lit. The radio set operates as described under “Repeating Radio Messages”, except that all received radio signals are repeated, whether or not they contain a PL tone.

2. ECG MODULATOR

Two models of the ECG Preamplifier are used in MEMCOM mobile repeater systems. The current model has three pushbuttons on the front panel ON, CAL, and LD CHK. The earlier model has three pushbuttons on the front panel ECG, OFF, and CAL and a TT jack for patient monitor cable.

2.1 CONTROLS AND INDICATORS

ON Switch — Alternately enables/disables the transmission of ECG information. Depressing the ON switch allows information from the patient-attached electrodes, inputted through the ECG input jack, to be transmitted directly to the hospital. With ECG ON the radio is keyed; pressing the ON switch a second time turns the ECG off and the radio may then be used for normal two-way communications.

ECG Input Jack — This 6-pin jack, located on an adapter box near the control group, is used to connect the patient monitor cable. A TT jack is provided for connection of a patient monitor oscilloscope or for connection of the older style patient monitor cable.

CAL Switch — Alternately enables/disables the Calibrate function. With the CAL switch on, a 1-millivolt squarewave signal is transmitted that may be used at the hospital for adjustment of equipment.

LD CHK Switch — Allows patient lead impedance to be checked. With the CAL switch on and the momentary LD CHK button held in, the squarewave signal is superimposed on the ECG signal and the squarewave amplitude is an indication of the impedance of patient-connected electrodes.

2.2 OPERATING TRANSMISSION OF ECG INFORMATION

Step 1. Place the associated radio in operation and check for the desired operating frequency.

Step 2. When a clear channel has been determined, depress the ON and CAL switches. Indicators will be brightly illuminated. Allow sufficient time for initial adjustment of the receiver and monitoring equipment at the hospital.

NOTE
Transmitter is “on the air” when the ON button is depressed.

Step 3. Attach the patient electrodes and insert the plug in the ECG input jack. Press and hold the momentary LD CHK button.

NOTE
When the cable is connected at the ECG input jack and the LD CHK button is pressed, the signal level at the receiver end will indicate the electrode contact impedance (greater signal indicates poorer contact). If the signal after connection does not increase to more than two times the level before connection at the ECG jack, the electrode and cable connection will be judged adequate.
Step 4. When the reception and electrode contact have been verified, depress the CAL switch a second time (indicator dimly illuminated) to remove the calibration signal.

Step 5. With the ECG cable connected and the ON indicator illuminated (ON switch depressed), the ECG signal is connected into the transmitter and the transmitter is keyed for normal continuous operation until disabled. It can be disabled by pressing the ON switch a second time.

CAUTION
Failure to properly connect the ECG Adapter (i.e. LEAD I to LEAD I or LEAD II to LEAD II) will result in ECG artifact. Also, precaution should be taken to prevent the patient from making contact with the ECG ground.

MAINTENANCE AND ADJUSTMENTS

1. INTRODUCTION

Refer to the SERVICING INFORMATION section of the UHF “Micor” radio set instruction manual for maintenance and adjustment instructions for the basic radio. Maintenance and adjustment of circuits unique to EMS duplex/repeater UHF “Micor” radio sets with auxiliary receiver are covered in the following paragraphs.

2. DUPLEXER

2.1 GENERAL

The duplexer has been factory-tuned for proper operation on channels allocated by the FCC for the Emergency Medical Service. Field adjustment of the duplexer is neither necessary nor advisable. DO NOT attempt to disassemble or repair the duplexer in the field. If the duplexer is damaged or malfunctions, replace it as a unit. If faulty duplexer operation is suspected, this can be verified by measuring the notch attenuation and insertion loss of each leg of the duplexer.

2.2 TEST EQUIPMENT

2.2.1 An rf generator-voltmeter pair capable of 65 dB of dynamic range is required for checking the duplexer. Two possible combinations of equipment are as follows:

a. HP608 RF Generator and HP8405A Vector Voltmeter with 50-ohm feedthrough tees.

b. Motorola S1239A RF Generator used with 30 dB gain amplifier (such as Boonton Type 230A) as the generator assembly, and Boonton 91CA RF Voltmeter with 50-ohm tip. If the harmonic content of the generator is high, a low-pass filter such as the TFE6130A or TFE6252A at the output of the amplifier may be necessary.

2.2.2 In addition to the generator and voltmeter, a frequency counter capable of operation in the 450-470 MHz range and a 50-ohm load are required. To maintain a low VSWR 50-ohm system it is recommended that 3 dB and/or 6 dB 50-ohm pads are used at generator output and voltmeter input. Also, cable lengths should be kept as short as possible between the pads and the duplexer.

2.3 DUPLEXER RECEIVER LEG ATTENUATION CHECK

Step 1. Set the rf generator frequency to 468.288 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Set the rf generator output level to obtain a reading on the upper scales of the rf voltmeter. This reading should be at least 65 dB above the rf voltmeter noise level. Note rf voltmeter level.

Step 4. Connect the rf generator to the duplexer antenna terminal. Connect the rf voltmeter to the duplexer receiver terminal. Connect the 50-ohm load to the duplexer transmitter terminal.

Step 5. The rf voltmeter level should be greater than 65 dB below the reference level noted in Step 3.

Step 6. Repeat the rf generator to 467.888 MHz and repeat Step 2 through Step 5.

2.4 DUPLEXER TRANSMITTER LEG ATTENUATION CHECK

Step 1. Set the rf generator frequency to 463.288 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Set the rf generator output level to obtain a reading on the upper scales of the rf voltmeter. This reading should be at least 65 dB above the rf voltmeter noise level. Note rf voltmeter level.

Step 4. Connect the rf generator to the duplexer transmitter terminal. Connect the rf voltmeter to the duplexer antenna terminal. Connect the 50-ohm load to the duplexer receiver terminal.

Step 5. The rf voltmeter level should be greater than 65 dB below the reference level noted in Step 3.
Figure 1. Duplexer Front Plate

Figure 2. Receiver Leg Measurement Using Vector Voltmeter

Figure 3. Receiver Leg Measurement Using RF Voltmeter
Step 6. Retune the rf generator to 462.888 MHz and repeat Step 2 through Step 5.

2.5 DUPLEXER RECEIVER LEG INSERTION LOSS CHECK

Step 1. Set the rf generator frequency to 463.175 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Adjust the rf generator output level for a convenient reference on the rf voltmeter.

Step 4. Connect the rf generator to the duplexer antenna terminal. Connect the rf voltmeter to the duplexer receiver terminal. Connect the 50-ohm load to the duplexer transmitter terminal.

Step 5. The rf voltmeter reading should be less than 1.5 dB below the reference level noted in Step 3.

2.6 DUPLEXER TRANSMITTER LEG INSERTION LOSS CHECK

Step 1. Set the rf generator frequency to 468.000 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Adjust the rf generator output level for a convenient reference on the rf voltmeter.

Step 4. Connect the rf generator to the duplexer transmitter terminal. Connect the rf voltmeter to the duplexer antenna terminal. Connect the 50-ohm load to the duplexer receiver terminal.

Step 5. The rf voltmeter reading should be less than 1.5 dB below the reference level noted in Step 3.

3. ANTENNA NETWORK

3.1 GENERAL

Field servicing of the antenna network is not recommended. When an antenna network is found to be defective, it must be replaced as a unit.

3.2 PERFORMANCE TESTS

A check of the forward and reflected power meter readings (refer to paragraph 7, Power Control Board, in the attached instruction manual, for procedure and proper meter readings) can be made to determine if the power detector circuits on the antenna network are functioning properly or are defective. The transmitter leg insertion loss of the antenna network should be approximately 1 dB (a power loss of 20%). Use the following procedure to check the insertion loss.

Step 1. Connect a thru-line wattmeter, a dummy load, and a second thru-line wattmeter (a wattmeter with attached load could replace the dummy load and second thru-line wattmeter) to the antenna connector and calibrate the wattmeters relative to each other.

Step 2. Connect the load and second wattmeter to the antenna network output and, using adapter cables, connect the thru-line wattmeter between the transmitter final amplifier and the antenna network.

NOTE To insure accurate readings take care that low VSWR cable connections are made at all points.

Step 3. Check the readings on the two power meters for a loss of approximately 1 dB (20% power loss).

4. DUPLEX INJECTION FILTER

CAUTION

The duplexer injection filter cannot be aligned using exciter meter readings. Peaking this filter while operating into the exciter will cause loss of receiver mixer injection and degradation of receiver performance.

4.1 TEST EQUIPMENT

4.1.1 General

The duplexer injection filter adjustments can be accomplished with an rf voltmeter and an rf signal generator rated for stable operation at 450 MHz. Because the injection filter is peak-tuned, neither the rf generator nor the rf voltmeter needs to have a wide dynamic range. To maintain a low VSWR 50-ohm 3 dB or 6 dB pads should be used between the rf signal generator output and the injection filter input, and between the injection filter output and the rf voltmeter.

4.1.2 RF Signal Generator Frequency Measurement

The rf signal generator frequency must be accurately determined for proper injection filter alignment. If the rf signal generator does not have an accurate frequency readout, a frequency counter capable of stable operation at 450 MHz must be used to measure the rf signal generator output frequency.

4.2 ADJUSTMENT PROCEDURE

Step 1. Remove the duplex injection filter from the radio set. Figure 1 of this instruction manual supplement shows the mounting location.

CAUTION

The duplex injection filter must be disconnected from the radio set for proper adjustment.
Step 2. Connect the rf signal generator through both 50-ohm pads to the rf voltmeter.

Step 3. Set the rf signal generator output frequency to 451.388 MHz.

Step 4. Set the rf signal generator output level to at least 10 dB above the rf voltmeter noise level. Write down both the signal generator attenuator reading and the rf voltmeter reading for later reference.

Step 5. Connect the rf signal generator through one of the 50-ohm pads used in Step 2 to the injection filter INPUT connector. Connect the rf voltmeter through the other 50-ohm pad used in Step 2 to the injection filter OUTPUT connector.

Step 6. Increase the rf signal generator output level until an indication is seen on the rf voltmeter.

Step 10. Repeat Step 8, but tune the 3rd adjustment.

Step 11. If the three adjustments have been peak-tuned and the rf voltmeter reading is at the reference established in Step 4, the rf signal generator output level should be no more than 3.5 dB higher than the Step 4 rf signal generator reference level. If the rf signal generator is more than 3.5 dB above reference, this adjustment procedure must be repeated.

5. MAIN RECEIVER SQUELCH GATE BOARD

5.1 METER READINGS

The metering receptacle on the squelch gate board provides an easy means to determine if the squelch gate board is receiving appropriate inputs and is functioning properly. Using a metering adapter cable with a Motorola portable test set, plug the adapter cable white “metering” plug into the squelch gate board metering receptacle. The adapter cable red “control” plug need not be connected to the control board. Table 1 lists the minimum acceptable test set readings at meter positions 1 through 4 under various conditions.

5.2 ADJUSTMENT PROCEDURE

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce an unmodulated signal at the selected channel main receiver frequency.

Step 3. Depress the RPTR pushbutton on the radio set control head.

CAUTION
Do not depress the ROAM pushbutton.

Step 4. Set the rf signal generator output level to the receiver 14 dB quieting point.

<table>
<thead>
<tr>
<th>Table 1. Squelch Gate Metering Limits</th>
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<tbody>
<tr>
<td>METER POSITION</td>
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</table>
Step 5. Turn squelch gate SQUELCH control R1217 counterclockwise until the main receiver unsquelches, then turn R1217 clockwise until the main receiver just squeles.

Step 6. Disconnect the signal generator and return the radio set to the duplex operating mode.

Step 11. Disconnect the test equipment and reconnect the coaxial cables to the receiver rf deck rf input terminals. Return the radio set to the duplex operating mode.

7. AUXILIARY RECEIVER SQUELCH GATE BOARD

CAUTION
Do not key the radio or select the emergency repeat mode while making these adjustments.

7.1 AUXILIARY RECEIVER SQUELCH ADJUSTMENT

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce an unmodulated signal at the selected channel auxiliary receiver frequency.

Step 3. Set the rf signal generator output level to the receiver 14 dB quieting point.

Step 4. Turn auxiliary receiver squelch gate SQUELCH control R232 counterclockwise until the auxiliary receiver unsquelches, then turn R232 clockwise until the receiver just squeles.

Step 5. Disconnect the signal generator.

7.2 AUXILIARY RECEIVER MONITOR AUDIO LEVEL ADJUSTMENT

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce a signal at the selected channel main receiver frequency. Set the signal generator 1 kHz modulation for 3 kHz deviation. Set the rf signal generator output level for full receiver quieting.

Step 3. Connect an ac voltmeter across the speaker terminals and adjust control head VOLUME control to obtain a convenient reference audio level.

Step 4. Without changing the rf signal generator output level or the VOLUME control setting, retune the rf signal generator to the selected channel auxiliary receiver frequency.

Step 5. Set the MONITOR AUDIO LEVEL pot R235 on the auxiliary receiver squelch gate board clockwise to obtain the same audio level on the ac voltmeter noted in Step 3.

Step 6. Disconnect the rf signal generator.
8. RF PREAMPLIFIER ALIGNMENT

CAUTION
The rf preamplifier cannot be aligned using receiver meter readings. Peaking this amplifier while operating into both receivers will result in improper alignment and degradation of receiver quieting sensitivity.

8.1 TEST EQUIPMENT

The rf preamplifier can be aligned with an rf signal generator rated for stable operation at 450-470 MHz and an rf voltmeter with a 50-ohm tip. If the rf signal generator does not have an accurate frequency readout, a frequency counter capable of stable operation at 450 MHz must be used to measure the rf signal generator output frequency.

8.2 ALIGNMENT PROCEDURE

CAUTION
Do not key the radio transmitter or damage to the signal generator will result.

NOTE
Before proceeding with adjustment of the rf preamplifier, both receivers should be properly aligned and checked for 20 dB quieting sensitivity at the rf deck inputs.

Step 1. Set control head ON/OFF switch to the OFF position.

Step 2. Remove the squelch gate board.

Step 3. Connect pin 11 to pin 13 on the squelch gate interface board connector P1201.

Step 4. Remove rf cable connection between radio set and auxiliary receiver at the radio set connector.

Step 5. Connect rf voltmeter 50-ohm tip to radio set auxiliary receiver antenna connector.

Step 6. Turn on radio power and connect rf signal generator to main radio antenna connector.

Step 7. Set the rf signal generator output frequency to 460.500 MHz.

Step 8. Set the rf signal generator output level to 1000 uV.

Step 9. Adjust C2 on rf preamplifier for a peak reading on the rf voltmeter. This adjustment is critical and care should be used to ensure peak tuning. For maximum sensitivity, reduce rf signal generator output as necessary to obtain a near full-scale reading on a lower scale of the rf voltmeter.

Step 10. Set the rf signal generator output frequency to 463.100 MHz.

Step 11. Readjust rf signal generator output level to 1000 uV.

Step 12. Adjust C1 on rf preamplifier for a peak reading on the rf voltmeter.

Step 13. Reset the rf signal generator output frequency to 460.500 MHz.


Step 15. Disconnect rf voltmeter and reconnect auxiliary receiver antenna cable to radio set.

Step 16. Leaving rf signal generator connected to radio set antenna terminal, perform 20 dB quieting sensitivity checks on both receivers. If either, or both receivers fail to meet the specified quieting sensitivity specification, repeat the rf preamplifier adjustment procedure.

Step 17. Disconnect rf signal generator, remove jumper from squelch gate interface board connector and replace squelch gate board.

Figure 5. RF Preamplifier
Adjustment Locations
1. ADVANTAGES OF CURRENT SYSTEMS

1.1 Table 1 below lists the original three basic EMS mobile radio models and the current models which have replaced them. This table shows the advantages of the current radio model over the earlier radio model. In each case, the later system model contains all features of the earlier one plus additional capability.

1.2 The Q1855A is the same as the Q1853A except it does not have the second receiver or the multiplex modules. The Q1854A is the same as the Q1853A except that the auxiliary receiver also has dual PL capability.

2. DUPLEX-MULTIPLEX CONVERSION

2.1 The Q2106A Duplex-Multiplex Field Conversion Kit has been established to facilitate conversion of Q1505A systems into the equivalent of Q1853A Systems. Full details on conversion procedures are given in section 68P81108E49.

2.2 Conversions of other EMS systems to include such features as duplex-multiplex, dual receiver, and two-PL decode capability on auxiliary receiver is possible. Table 2 presents a summary of field conversion possibilities. Consult your Motorola representatives for advice and help in making these conversions.

Table 2. Comparison of Current EMS Models to Earlier Models

<table>
<thead>
<tr>
<th>EARLIER SYSTEM MODEL</th>
<th>CURRENT SYSTEM MODEL</th>
<th>ADVANTAGES OF CURRENT MODEL OVER EARLIER MODEL</th>
</tr>
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<tbody>
<tr>
<td>Q1503A</td>
<td>Q1855A</td>
<td>System can easily be upgraded to two receivers and duplex-multiplex.</td>
</tr>
<tr>
<td>Q1505A</td>
<td>Q1853A</td>
<td>Duplex-Multiplex capability.</td>
</tr>
<tr>
<td>Q1588A</td>
<td>Q1854A</td>
<td>Duplex-Multiplex capability</td>
</tr>
<tr>
<td>Model No.</td>
<td>Present System</td>
<td>Equivalent Ugraded System</td>
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<tr>
<td>Q1503A*</td>
<td>Single Receiver System</td>
<td>Not Easily Field Convertible To Two Receiver System</td>
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<tr>
<td>Q1505A*</td>
<td>Dual Receiver System (Non-Multiplex)</td>
<td>Q1853A Duplex/Multiplex</td>
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<tr>
<td>Q1588A*</td>
<td>Dual Receiver System (Non-Multiplex) with 2 PL Decode on Aux. Revr</td>
<td>Q1854 Duplex/Multiplex</td>
</tr>
<tr>
<td>Q1855A</td>
<td>Single Receiver System (Non-Multiplex)</td>
<td>Q1505A* Dual Receiver System (Non-Multiplex)</td>
</tr>
<tr>
<td>Q1855A</td>
<td>Same as above</td>
<td>Q1588A* Dual Receiver System (Non-Multiplex) w/2 PL Decode on Aux Revr</td>
</tr>
<tr>
<td>Q1855A</td>
<td>Same as above</td>
<td>Q1853A Dual Receiver System Duplex Multiplex</td>
</tr>
<tr>
<td>Q1855A</td>
<td>Same as above</td>
<td>Q1854A Dual Receiver System Duplex Multiplex 2 PL Decode on Aux Revr</td>
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<tr>
<td>Q1853A</td>
<td>Dual Receiver System with Duplex Multiplex</td>
<td>Q1854A 2 PL Decode on Aux Revr</td>
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**NOTES:**

1. The ECG Modulator/Preamplifier Module QLN1919C can be added to any of the above systems in the field if not already equipped. Refer to instruction section 68P81037E76 in this manual.

2. The Q1508A/Q1509A Dual Control Accessory packages are compatible with all of the above systems. For details refer to the duplex/multiplex with dual control interconnect in this manual and dual control manual 68P81030F90.

3. Model numbers followed by an asterisk (*) are earlier version systems and have been replaced with models which have expanded capability. They are included here for reference only for field modification assistance.
to 1650 Hz by 13 dB. In this way, voice signal interference to the ECG telemetry signal is eliminated when the two signals are combined for transmission.

2.2 The peak amplitudes of the voice and telemetry signals are limited and adjusted before combining so that the maximum transmitter deviation produced by the composite signal does not exceed 4 kHz and each signal makes up 50% of the peak amplitude of the composite signal. The 4 kHz deviation limit ensures that the composite signal level is below the normal clipping level of the transmitter IDC circuits to prevent possible intermodulation distortion between the voice and telemetry signals.

2.3 Duplex/multiplex provides a variety of operational transmit and repeat transmit modes with multiplexed voice and ECG telemetry signals.

- **In the repeat mode** it allows simultaneous transmission through the mobile repeater of multiplexed voice and ECG telemetry signals from the portable unit with voice messages from the hospital base unit. The base unit voice signal received at the mobile repeater is processed and filtered prior to retransmission to eliminate interference to multiplexed ECG telemetry from the portable.

- **In the repeat mode** it allows simultaneous transmission of voice messages from the mobile repeater control position with multiplexed voice and ECG telemetry signals from the portable that are being repeated. The mobile handset (or headset) microphone audio signal is processed and filtered prior to transmission to eliminate interference to the ECG telemetry signal from the portable.

- **In the local, or non-repeat, mode** it allows multiplexed voice and ECG telemetry transmissions to be made from the mobile unit using the optional QLN1919B ECG Modulator/Preamplifier module.

2.4 The additional circuits required for the duplex/multiplex option are included on the QLN1918B Audio/Telemetry Multiplex Module and the QLN2042A Repeat Audio Processing Module which are located at the control group, and the QLN7225A Auxiliary Audio Board which is located in the radio. The former two modules mount in a "MICOR" "Systems-90" accessory housing to form an integral part of the EMS duplex/repeater mobile radio system. The QLN1918B Audio/Telemetry Multiplex Module replaces the QLN1917B Repeater Control module, providing the same repeater control functions and the added circuits required for multiplexing of the audio and ECG telemetry.

2.5 In the repeat mode, the QLN2042A Repeat Audio Processing Module takes the mobile radio main receiver audio signal, which is received from the hospital base unit and processes the signal for repeat purposes. The processed signal is then passed through the transmit audio path of the QLN1918B Audio/Telemetry Multiplex Module before being routed to the radio for retransmission. In the multiplex mode, the repeat audio passes through the transmit audio multiplex circuits prior to retransmission, thus eliminating possible interference to repeated ECG telemetry signals from the portable unit.

2.6 The QLN7225A Auxiliary Audio Board replaces the QLN5855A in the repeater radio and contains the necessary circuitry to provide a suitable gating level output to interface with the QLN2042A Repeat Audio Processing Module. In addition, the QLN7225A provides all the circuitry required to process repeat audio from the portable unit (paramedic audio).

3. TRANSMIT AUDIO FLOW FUNCTIONAL DESCRIPTION

3.1 INTRODUCTION

The duplex/multiplex EMS system differs from a non-multiplex system in three specific areas: (1) transmit audio filtering and gating is added (located on QLN1918A Audio/Telemetry Multiplex Module), (2) main receiver repeat audio is now processed at the control group (via QLN2042A Repeat Audio Processing module), and (3) new repeat audio gating circuits are required (located on QLN7225A Auxiliary Audio Board) to interface with the control group repeat audio circuitry. Refer to figure 4 for details of the transmit audio flow scheme for non-multiplex and duplex-multiplex systems.

3.2 REPEAT AUDIO FLOW

3.2.1 The repeat audio flow for duplex-multiplex systems differs from non-multiplex systems because of the requirement that the doctor’s transmission (from base station leg) be filtered in the ECG passband so that the doctor does not interfere with the patient ECG signal he is monitoring. A description of the repeat audio flow for duplex-multiplex systems is given below.

3.2.2 Auxiliary receiver emitter follower audio is first gated by Q1302 so that the receive audio from the portable leg is retransmitted only when the proper repeat conditions are met. The audio is then preamplified by U1301A, adjusted for proper repeat level by R1313, and the PL tones are removed. Finally, U1301B provides the necessary amplification to compensate for signal loss through the PL filter. The processed portable leg repeat audio is then coupled with transmit audio from the control group and fed to the exciter for transmission.

3.2.3 In order to allow main receiver repeat audio to pass through the transmit notch filter, this audio is processed entirely at the control group and combined...
**PARTS LIST**

**IMPORTANT**

**USE ONLY THE FOLLOWING MOTOROLA**

**PART NUMBERS—WHEN ORDERING REPLACEMENT PARTS**

**CABLE KITS**

QKN8207A Control Cable
QKN8208A Auxiliary Receiver Cable
TKN6456A Control Head Power
TKN6458A Cable and Fuse Kit

**PL-4077-O**

<table>
<thead>
<tr>
<th>REFERENCE SYMBOL</th>
<th>MOTOROLA PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1101,1102</td>
<td>65-86099</td>
<td>FUSE, cartridge: 1-1/4&quot; x 1/4&quot;; 7.5 A; 32 V (see XF1101, 1102 for fuseholder) (TKN6456A)</td>
</tr>
<tr>
<td>P1103</td>
<td>65-84161B01</td>
<td>1-1/8&quot; x 13/32&quot;; 40 A; 32 V (TKN6458A)</td>
</tr>
</tbody>
</table>

**NOTE**

See XFI1103 for fuseholder

**CONNECTION, plug:**

includes:

- 14-84556B01 BODY: (BLK): 20-contact type
- 9-84151B01 TERMINAL, contact: female; 19 req'd.
- 14-84556B02 BODY: (BLUE): 20-contact type
- 9-84151B01 TERMINAL, contact: female; 11 req'd.

includes:

- 9-8406B01 BODY: 37-contact type; includes only "A" and "B" contacts

**WIRE, electrical: stranded:**

- No. 16 ga., coded GRN; 89" length req'd. (TKN6456A)
- No. 18 ga., coded GRN; 12" length req'd. (TKN6456A)
- No. 8 ga., coded BLK; 5-1/2" length req'd. Requires but does not include 29-84528B03 LUG, ring tongue
- No. 18 ga., coded ORG; 5" length req'd. (TKN6456A)
- No. 18 ga., coded ORG; 9" length req'd. (TKN6456A)
- No. 8 ga., coded RED; 2' length req'd. Requires but does not include 29-824434 LUG, ring tongue (TKN6458A)
- No. 8 ga., coded RED; 25-1/2" length req'd.
- Cable, 17-conductor; 18" length req'd.

**FUSEHOLDER, "in-line" type:**

consists of:

- BODY
- CAP
- TERMINAL, contact; 2 req'd.
- SPRING (TKN6456A)
- 9-84277B02 (TKN6458A)

**NON-REFERENCED ITEMS**

- 54-8498B01 LABEL (negative ground); for P1015
- 42-867839 CLAMP, cable; requires (but does not include) 42-893444 HKOK, cable clamp ("S" hook)
- 42-84275B01 BRACKET, fuseholder mounting (for XF1103)
- 9-84151B01 TERMINAL, contact; female; 20 supplied
- 37-31922 SLEEVE, neoprene; 2 supplied

**QKN82126A Cable Kit**

<table>
<thead>
<tr>
<th>CONNECTOR, plug:</th>
</tr>
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<tbody>
<tr>
<td>14-84556B05</td>
</tr>
<tr>
<td>9-84151B01</td>
</tr>
</tbody>
</table>

**P1**

- BODY, 20-circuit (ORG)
- CONTACT, terminal, female; 13 req'd.
- P2

- BODY, 20-circuit (VIO)
- CONTACT, terminal, female; 11 req'd.

**QKN8189A Auxiliary Receiver Antenna Cable**

<table>
<thead>
<tr>
<th>CONNECTOR, plug:</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-844876</td>
</tr>
<tr>
<td>28-82021G01</td>
</tr>
</tbody>
</table>

**P1002A**

- male; single contact

**P1002B**

- male; single contact

**MECHANICAL PARTS**

- 58-854020 ADAPTER, CABLE, coaxial RG58/AU; 78" req'd.
### Parts List

<table>
<thead>
<tr>
<th>Reference Symbol</th>
<th>Motorola Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-848220001</td>
<td></td>
<td>Connector, plug male, single contact</td>
</tr>
</tbody>
</table>

### Mechanical Parts List

**Additional Mechanical Parts for Duplex/Repeater Radio Sets**

<table>
<thead>
<tr>
<th>Reference Number</th>
<th>Connector, plug panel</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-848215G01</td>
<td>Panel side (right and left are the same)</td>
<td>Reel chassis</td>
</tr>
<tr>
<td>27-06541001</td>
<td>Duplex+</td>
<td></td>
</tr>
<tr>
<td>10-065004A</td>
<td>Antenna Coupler</td>
<td></td>
</tr>
<tr>
<td>10-845955M00</td>
<td>Bracket, right angle</td>
<td></td>
</tr>
<tr>
<td>7-84382K01</td>
<td>Squash Gate Shield</td>
<td></td>
</tr>
<tr>
<td>20-84585C00</td>
<td>TFE6252A-SPI</td>
<td>Harmonic Filter</td>
</tr>
<tr>
<td>15-84821E01</td>
<td>Cover, top</td>
<td></td>
</tr>
<tr>
<td>9-84586D02</td>
<td>MBC Connector, right-angle</td>
<td></td>
</tr>
<tr>
<td>9-87318C21</td>
<td>Connector, right-angle, threaded</td>
<td></td>
</tr>
<tr>
<td>43-85620G</td>
<td>Spacer, used to mount</td>
<td></td>
</tr>
<tr>
<td>4-86504G</td>
<td>TFE6252A-SPI</td>
<td>Harmonic Filter, 2 req'd.</td>
</tr>
<tr>
<td>73-84586E01</td>
<td>Antenna Coupler</td>
<td></td>
</tr>
<tr>
<td>61-84586E01</td>
<td>RF Pre-amplifier</td>
<td></td>
</tr>
</tbody>
</table>

### QKN8210A Interconnect Cable

<table>
<thead>
<tr>
<th>Reference Symbol</th>
<th>Motorola Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-845710D03</td>
<td>Panel side (right and left are the same)</td>
<td>Reel chassis</td>
</tr>
<tr>
<td>9-842770001</td>
<td>Antenna Coupler</td>
<td></td>
</tr>
</tbody>
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### Mechanical Parts

<table>
<thead>
<tr>
<th>Reference Number</th>
<th>Connector, plug panel</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-848215G01</td>
<td>Panel side (right and left are the same)</td>
<td>Reel chassis</td>
</tr>
<tr>
<td>27-06541001</td>
<td>Duplex+</td>
<td></td>
</tr>
<tr>
<td>10-065004A</td>
<td>Antenna Coupler</td>
<td></td>
</tr>
<tr>
<td>10-845955M00</td>
<td>Bracket, right angle</td>
<td></td>
</tr>
<tr>
<td>7-84382K01</td>
<td>Squash Gate Shield</td>
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<td>Harmonic Filter</td>
</tr>
<tr>
<td>15-84821E01</td>
<td>Cover, top</td>
<td></td>
</tr>
<tr>
<td>9-84586D02</td>
<td>MBC Connector, right-angle</td>
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<tr>
<td>9-87318C21</td>
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<td>43-85620G</td>
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<td>Harmonic Filter, 2 req'd.</td>
</tr>
<tr>
<td>73-84586E01</td>
<td>Antenna Coupler</td>
<td></td>
</tr>
<tr>
<td>61-84586E01</td>
<td>RF Pre-amplifier</td>
<td></td>
</tr>
</tbody>
</table>
1. DESCRIPTION

The antenna network connects the transmitter final power amplifier stage to the transmitter output connector; it replaces the antenna switch in the standard radio. The duplexer allows a single antenna to be used for both transmit and receive signals at the same time. The antenna coupler allows two receivers to be connected to the receive port of the duplexer.

2. THEORY OF OPERATION

2.1 QLE6236A ANTENNA COUPLER

The antenna coupler permits the main receiver and the auxiliary receiver to share a common input from one antenna. The coupler provides (1) impedance matching between the receiver port of the duplexer and each receiver, and (2) isolation of the two receiver inputs from each other. Due to the signal splitting characteristics of the coupler, a 3 dB insertion loss is present between the input leg (from the duplexer) and each output leg to the receivers. Compensation for this insertion loss is provided by the rf preamplifier.

2.2 TFE6233B-SP1 DUPLEX ANTENNA NETWORK

2.2.1 Refer to the Antenna Network and Duplexer diagram. This circuit provides the following functions.

- Connects the transmitter final power amplifier stage to the transmitter output connector at all times.
- Provides the transmitter final power output stage with a low VSWR 50-ohm load during transmit independent of the load presented to the transmitter output connector.
- Attenuates all transmitter carrier harmonics.
- Provides dc voltages proportional to forward and reverse power appearing at the transmitter output connector.

2.2.2 Circulator

The circulator is a 3-port device which takes advantage of the unique magnetic properties of yttrium iron garnet (YIG). By subjecting a transmission line circuit sandwiched between two YIG discs to a critical value of static magnetic field, a device can be made which is non-reciprocal in nature. That is, a signal entering port 1 of the circulator leaves at port 2 and a signal entering port 2 leaves at port 3. In general a signal entering any port will leave at an adjacent port (in the direction of the arrow). This characteristic is used to advantage in the antenna network. The transmitter is always connected to the circulator at port 1 and the antenna is always connected to port 2 of the circulator through the duplexer, and port 3 is connected to a 50-ohm, 50-watt load. This circuit arrangement provides the transmitter power amplifier output stage with a low VSWR 50-ohm load independent of the condition of the load connected to the antenna connector. Whenever a mismatched load appears at the antenna connector, the reflected power from the mismatched load enters port 2 of the circulator and is routed to port 3 and the 50-ohm load inside the unit.

2.2.3 Power Detectors

To provide an input to the power control board indicating the power level out of the transmitter, a peak voltage detector is coupled through a capacitive divider to the coaxial line at the transmitter input port of the circulator. This detector provides a dc voltage proportional to the square root of the power entering port 1 of the circulator. A peak voltage detector is also
used to sense the peak voltage across the 50-ohm load in the unit. Under most normal operating conditions, the power dissipation in the load is only a few watts. However, under extreme conditions of antenna mismatch and a high power radio, the reflected power could approach the power dissipation (50 watts) capability of the load. To protect the load against such a condition, the rf voltage across the load is sensed and a dc voltage proportional to the rf voltage is fed back to the power control board. When the rf voltage across the load starts to increase beyond the normal safe range, the power control decreases the power output of the transmitter to maintain a safe dissipation in the 50-ohm load.

2.2.4 50-Ohm Load

The 50-ohm load has a low VSWR in the UHF band. It absorbs the maximum reflected power from the antenna while monitoring this VSWR. To accomplish this, the load is constructed using thick-film techniques and is mounted on a beryllia block to achieve good thermal conduction of the dissipated power to the heat sink.

2.3 QFE1024A DUPLEXER AND FILTER

2.3.1 The duplexer is a three-port circuit that allows the simultaneous use of a single antenna by the receiver and transmitter. It performs the following functions:

- Connects transmitter output and receiver input to antenna at all times.
- Provides attenuation in the transmitter leg of duplexer at receiver frequency to essentially eliminate receiver desensitization due to transmitter sideband noise.
- Provides attenuation in the receiver leg of duplexer at transmitter frequency to essentially eliminate receiver spurious responses due to transmitter carrier frequency energy.

2.3.2 The duplexer contains four resonant cavities in the transmitter leg and three resonant cavities in the receiver leg. These cavities are coupled together and to the duplexer antenna connector through resonant sections of coaxial cable. The transmitter output signal passes through an additional low pass filter to further attenuate transmitter carrier harmonics before entering the duplexer.
**PARTS LIST**

**MODEL TLE8192A-SP1**

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2</td>
<td>20±3±10% or 20±3±10%</td>
</tr>
<tr>
<td>C3</td>
<td>21±10%</td>
</tr>
<tr>
<td>C4</td>
<td>21±10%</td>
</tr>
<tr>
<td>C5</td>
<td>23±10%</td>
</tr>
<tr>
<td>J1, J2</td>
<td>9±10%</td>
</tr>
<tr>
<td>L1, L3</td>
<td>47±8300μH</td>
</tr>
<tr>
<td>L2, L4</td>
<td>24±800μH</td>
</tr>
<tr>
<td>Q1</td>
<td>48±80μH</td>
</tr>
<tr>
<td>R1, R2</td>
<td>6.1±10%</td>
</tr>
<tr>
<td>R3</td>
<td>330±10%, 1/4W</td>
</tr>
<tr>
<td>R4</td>
<td>47±10%, 1/4W</td>
</tr>
</tbody>
</table>

**RESISTORS**

- For optimum performance, resistors must be ordered by Motorola Part number.

**DIAGRAM**

The received signal from the duplexer receiver terminal is coupled directly into the input tuned-line of the preamplifier through the INPUT jack. This tuned-line passes the desired signal and matches the relatively low FET input impedance to the 50-ohm input line. The signal is capacitively coupled to the source terminal of the FET where it is amplified and then capacitively coupled to the output tuned-line. The output tuned-line is a high Q tank circuit. It passes the desired signal and matches the relatively high FET output impedance to the 50-ohm output line.

**NOTE 1**

1. All components within this box are mounted on printed circuit board.
2. All capacitors, resistors, and integrated circuits must be ordered by Motorola Part number.
3. All voltage ratings are measured with a 75KΩ ohm potentiometer.
4. See parts list.
FUNCTION

Although the circuit operation is essentially the same as for the standard TRN5460 Audio and Squelch boards, described in the attached UHF "Merry" radio set Instruction manual, the main receive audio signal path has been revised to improve additional processing of the input and output audio signals. For details refer to the attached TLN5165B-SPI Audio and Squelch Board schematic diagram. Note that the entire follower output of IC28 is fed to the auxiliary audio board to provide the input audio signal. The audio signal is then returned to the audio and squelch board, amplified in the preamplifier section of IC28. It then passes through a clipper circuit, which combines with the monitor output from the auxiliary receiver. The processed monitor audio is then applied to the differential amplifier input of IC28 by way of the volume control and auxiliary audio board. Refer to the appropriate IC, board, or component descriptions and schematics for detailed circuit operation.
SQUELCH GATE AND SQUELCH GATE INTERFACE BOARD
MODELS QL5060A AND QL5060A.
THEORY OF OPERATION

INTRODUCTION
When the radio is in the 'standby' status, the squelch gate is held off to reduce the noise on the audio to the minimum level. The squelch is then actuated by a signal from the receiver. When the squelch is on, the audio is passable only when the signal is large enough.

DEFLECT MORE SELECTION
When the squelch gate is open, the trigger capacitor is charged by means of the resistors 50K-0-2QR1. When QR2 is energized, the following conditions exist:

- The squelch gate opens, allowing the squelch signal to be heard.
- QR2 is turned on, allowing the squelch signal to be heard.
- The squelch is disabled.

SQUELCH GATE AND SQUELCH INTERFACE BOARD

MODEL QLS560A AND QLS560A

PARTS LIST

FUNCTION
- When QR2 is open, the squelch gate is open, allowing the squelch signal to be heard.
- VK2300 is the main receiver output and the squelch signal is passed to the squelch gate.

REPEATER OPERATION
- The audio signal is to be monitored by the main receiver and the squelch gate is open, allowing the squelch signal to be heard.
- When the audio signal is strong enough to break through the squelch gate, the squelch gate is turned off, allowing the audio signal to be heard.

- The high on the main receiver output PTT cable is connected to the squelch gate, allowing the squelch signal to be heard.

CAUTION
- Ensure that the squelch gate is closed, if both squelch gates are selected while operating on the PTT.
FUNCTION

The frequency select matrix board provides the additional node matrix for selection of frequencies F3 through F12. The select inputs from the radio front plug P901 connect through interconnecting to the matrix board.
1. INTRODUCTION

The QLN7225A Auxiliary Audio Board is designed specifically for use in a duplex/multiplex Emergency Medical Service (EMS) mobile repeater system. The board is different from the Motorola Model QLN5855A Auxiliary Audio Board (described in Motorola UHF Duplex/Repeater with Auxiliary Receiver Manual 68P81029E45) used in other EMS repeater systems in that main receiver repeat audio is processed on a separate repeat audio processing module instead of on the auxiliary audio board itself. Gating of main receiver audio, however, is still controlled by this auxiliary audio board. The board physically mounts in the "Micor" FM two-way duplex/repeater radio and performs the following function:

- Auxiliary receiver audio signal processing — In repeater operation the auxiliary receiver audio signal is applied to the exciter audio input. The auxiliary audio board circuits filter out the "PL" tone, provide de-emphasis, and determine the auxiliary receiver repeat audio level at the exciter audio input.

- Monitor audio muting -- Monitor audio is muted in the receivers under non-intercom and no-signal conditions.

- Unsquelched indicator inversion and buffering (main receiver only) -- The unsquelched indicator signal from the main receiver audio & squelch board is inverted and amplified before application to the repeater control logic circuits on the squelch gate board.

- Repeat priority logic -- establishes priority of repeat audio between the auxiliary receiver and main receiver when the system is in repeat mode.

1. Main receiver has priority -- jumper JU6 used.

2. Auxiliary receiver has priority -- jumper JU5 used.

3. First come—first serve priority -- jumpers JU5 and JU6 used.

4. No priority -- jumpers JU5 and JU6 omitted.

2. CIRCUIT DESCRIPTION

2.1 AUXILIARY RECEIVER REPEAT AUDIO CIRCUIT

2.1.1 In repeat operation receiver audio gate Q1302 passes audio from the emitter follower of the audio and squelch board in the auxiliary receiver to the input of repeat audio preamplifier U1301A. When the radio set is in the duplex mode or is unsquelched, the output of AND gate CR1303—CR1304 is low, keeping Q1302 turned off. If jumper JU1303 is in, the board is connected for the PL repeat mode. Audio gate Q1302 turns on only when repeater PTT enable and the receiver PL decoder output both go high. This makes the output of AND gate CR1303—CR1304 go high. If jumper JU1304 is in (and JU1303 is out) the board is connected for carrier squelch repeat operation. The AND gate output goes high and the respective receiver audio gate passes audio when repeat PTT enable and the inverted unsquelched indicator of the auxiliary receiver are both high. As shipped from the factory, JU1303 is inserted, connecting the unit for PL repeat operation.

CAUTION
Incorrect operation will result if both jumpers (JU1303 and JU1304) are connected.

2.1.2 Repeat audio amplifiers U1301A and U1301B amplify and de-emphasize the signal from the audio gates in repeater operation. Auxiliary receiver
audio adjust R1309 sets the auxiliary receiver audio level to match the main receiver audio level. Repeat level adjust R1313 establishes the repeat audio output level and high-pass filter C1306—L1301—C1307—C1308—L1302 removes low-frequency components, such as PL tones, from the repeat audio signal.

### 2.2 MAIN RECEIVER REPEAT AUDIO ENABLE

Transistor Q1301 controls the gating of main receiver repeat audio on the repeat audio processing board. When Q1301 is off pulldown resistor R22 on the repeat audio processing board turns off Q3 allowing the gate of Q2 to go high which enables audio to pass through Q2. When Q1301 is conducting it puts a high logic level (\( \pm 3.2 \) volts) on the base of Q3 turning that transistor on to disable Q2 and prevent audio from passing through.

### 2.3 AUDIO MUTING

Front and rear audio muting circuits are included on the auxiliary audio board for those installations that include optional dual control accessories. In single-control systems front audio gate Q1309 is turned on whenever either receiver is unmuted.

### 2.4 AUDIO BUFFER

Audio buffer Q1310 matches the monitor audio output from the preamplifier stage of IC201 on the audio and squelch board to the muted monitor audio input of the "Systems 90" Repeater Control Module.

### 2.5 UNSQUELCHED INDICATOR INVERTER

Unsquelched indicator inverter Q1303—Q1304 inverts the unsquelched indicator from IC202 on the audio and squelch board and buffers the signal for application to the squelch gate board. The unsquelched indicator goes low when either receiver unsquelches.

### 2.6 REPEAT AUDIO PRIORITY SWITCH

#### 2.6.1 The repeat audio priority switch determines which receiver audio signal will have priority for repeat transmission purposes. Jumpers JU1305 and JU1306 provide four operational repeat priority modes as follows:

#### 2.6.2 As shipped from the factory, both jumpers are fitted, giving repeat priority to the first receiver to be enabled. If some other priority mode is desired, determine from the table above which jumper(s) should be removed.

#### 2.6.3 In the repeat mode, with both receivers squelched, the repeat PTT enable inputs to the repeat audio priority switch are low, the outputs of NAND gates U1302C and U1302D are high, and the outputs of inverters U1302A and U1302B are low, turning off audio gates Q1301 and Q1302 and making the output of repeater PTT enable buffer Q1307 low.

#### 2.6.4 If the main receiver receives a proper on-channel signal, the corresponding repeat PTT enable input goes high, causing NAND gate U1302D output to go low, driving U1302A inverter output high. If the auxiliary receiver receives a proper on-channel signal, its corresponding repeat PTT enable input also goes high. (1) If JU1306 is connected, NAND gate U1302C input low by the low output at U1302D pin 11. This inhibits NAND gate U1302C, its output remains high, and the auxiliary receiver repeat PTT enable input has no effect. (2) If JU1306 is not connected, or the main receiver repeat PTT enable input is not present, then the output of NAND gate U1302C will go low, driving inverter U1302B output high. (3) If JU1305 is connected, and the main receiver repeat PTT enable is present, then the low output of NAND gate U1302C will drive NAND gate U1302D input pin 12 low and output pin 11 high. The main receiver repeat PTT enable input is thus inhibited until the auxiliary receiver input is removed.

#### 2.6.5 A high level output at inverter U1302A or U1302B enables the corresponding diode AN and gate CR1301—CR1302 or CR1303—CR1304 at the inputs to repeat audio gates Q1301 and Q1302. Depending on the connections for JU1301, JU1302, JU1303 or JU1304, the enabled repeat audio gate will then turn on with proper PL decoder output or unsquelched indicator.

#### 2.6.6 The high level output at inverter U1302A or U1302B is also fed to repeat PTT buffer Q1307 through diode OR gate CR1311—CR1312, producing a high level repeat PTT enable output to the squelch gate.
1. DESCRIPTION

The QLN1974A Dual PL Decoder provides the decoding circuitry for two PL tone-coded squelch tones. The dual PL decoder includes a programmable control gate which allows selection of one of the two tone-codes for each of the eight receiver frequencies. For example, the control gate may be programmed to select tone-code A for use with frequencies R1, R2, and R3, and tone-code B for use with frequencies R4-R8. The dual PL decoder consists of a modified PL decoder board, a dual PL decoder board, and mounting hardware. These items are described in the following paragraphs. The "vibrasponder" resonant reeds used with the dual PL decoder are available as separate items.

2. TLN4294B-SP2 PL DECODER BOARD

This PL decoder board is a modification of the TLN4292B Medel described in the attached instruction manual. It is modified for operation with two or more tone-codes. The modification consists of changing the resonant reed interconnections so that externally mounted resonant reeds may be individually selected and switched into the decoder circuitry. Refer to attached diagram PEPS-28440 for circuit details.

3. QLN5936A DUAL PL DECODER BOARD

This dual PL decoder board is added to the radio set to allow PL decoding of incoming messages with either of two tone-codes. The dual PL decoder board contains resonant reed selection circuitry and two "vibrasponder" resonant reeds. The resonant reed selection circuitry switches the selected "vibrasponder" resonant reed into the TLN4294B-SP2 PL Decoder where it becomes the PL tone-code reference frequency device. Refer to attached diagram PEPS-28439 for circuit details.

The resonant reed selection circuitry consists of two tone gates (Q1 and Q2), and two tone enable switched (Q3 and Q4), one for each of the two "vibrasponder" resonant reeds (PLB and PLA). When switched ground is applied to the cathode of a tone enabling diode (CR4-CR70, bias is removed from tone enable switch Q4 and Q4 turns off. A positive voltage is applied to the base of tone gate Q2 through R7 which causes Q2 to turn-on. The secondary winding of reed PLA is completed through the emitter to collector of tone gate Q2. The positive voltage on the base of tone gate Q2 also reverse biases CR2 allowing a current path to be developed through R4, R3, CR1 and R5. A positive voltage is applied to the base of tone enable switch Q3 which turns-on. Its collector goes low turning tone enable gate Q1 off which opens the secondary winding circuit of reed PLB.

Similarly, when none of the tone enabling diodes (CR4-CR7) are grounded, tone gate Q1 turns on. Q1 completes the secondary winding circuit of reed PLB to the PL decoder. Tone gate Q2 turns-off and opens the secondary winding circuit of reed PLA.

4. QLN5937A MOUNTING HARDWARE KIT

The hardware kit is used to mount the dual tone PL decoder board in the radio set and consists of the following items:

Motorola

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<tr>
<th>Part No.</th>
<th>Description</th>
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<tr>
<td>42B84816B01</td>
<td>CABLE CLIP</td>
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<tr>
<td>3S138891</td>
<td>SCREW, self-tapping 6-32 x 7/16&quot;</td>
</tr>
<tr>
<td>7-06969B01</td>
<td>BRACKET; Dual PL Decoder Mounting</td>
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<td>1V06707B45</td>
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### PARTS LIST

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<tr>
<th>PARTS LIST</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Head 1208-SP12</td>
</tr>
</tbody>
</table>

### FUNCTION

The control head generally performs the same function as the control head identified in the basic order of equipment manual. It has been modified to bring the VMI light and a red light to 3-1005-32 instead of ding to light IV. Red light is red and is present when the hand is pressed in the repair mode.
1. DESCRIPTION

1.1 INTRODUCTION

This module mounts in a "Micor" "Systems*90" enclosure replacing the repeater control module and is an integral part of the EMS duplex/repeater mobile radio system. It provides for simultaneous voice audio and medical telemetry transmission (multiplex) by performing the following functions:

- Repeater enabling — closing the RPT switch sets up the radio set to repeat when the proper rf signal and PL tone are received.

- Emergency repeater enabling — closing both the RTP and ROAM switches enables the radio set to repeat any received signal, whether or not it has the proper PL tone.

- Audio Filtering — closing the MUX switch inserts a 1400 Hz, 13 dB transmit notch filter in the mobile mic audio path to eliminate voice audio that falls in the telemetry signal's frequency spectrum. The closing of the MUX switch also inserts a 1400 Hz, 35 dB receive notch filter into the receiver audio signal path to attenuate received telemetry signals. This effectively removes telemetry from the audio signal monitored at the local vehicle receiver(s). The repeated telemetry transmission is unaffected.

- Monitor audio combining (Q1505A systems only) — combines the monitor audio from the auxiliary receiver with the monitor audio from the main receiver.

1.2 MICROPHONE AUDIO MUTING

1.2.1 In receive only or in repeat operation PTT switch transistors Q3 and Q4 are normally off. Transistor Q5 is on, reverse biasing CR1. The gate of microphone audio mute transistor Q1 is therefore at A- and Q1 is off. When the handset PTT button is pressed, Q3 and Q4 turn on, turning off Q5. The gate of Q1 goes high and microphone audio is gated through Q1 to the microphone audio amplifier.

1.2.2 ECG gate Q10 is normally on. If MUX is not selected, when the handset PTT button closes, Q4 turns on and pulls the gate of Q10 low through R304 and CR13. ECG gate Q10 therefore shuts off and prevents passage of ECG telemetry signals. If MUX is selected, Q7 turns off which in turn brings the cathode of CR17 high and prevents handset PTT from muting the ECG signal in the multiplex mode. In either of the above operating conditions, if the transmitter is keyed by some means other than handset PTT (i.e., ECG or REPEAT PTT) CR12 prevents the audio/telemetry multiplex module PTT switch circuits from being activated. The ECG telemetry signal passes thru Q10, the ECG lowpass filter, and transmit audio combining amplifier U3A and is routed via the cable kit to the exciter audio input. The ECG lowpass filter removes annoying second and third harmonic components of the ECG signal.

1.2.3 In repeater operation the gate of Q10 is pulled low by the repeater set-up line through CR14. Therefore, Q10 remains off at all times.

1.3 1400 Hz TRANSMIT NOTCH FILTER

The purpose of the transmit notch filter is to remove voice audio frequency components that would interfere with the telemetry signal while in the multiplex mode. The notch filter is a two-section active filter that provides about 13 dB of attenuation at 1400 Hz (±250 Hz) when MUX switch S1 on the control panel is depressed.
When $S_1$ is depressed, the following results — $Q_7$ turns off and $Q_{11}$ turns on which applies a low to the gate of filter bypass gate $Q_{10l}$ (via CR102). This low turns $Q_{10l}$ off and therefore only mic audio that passes through the 1400 Hz transmit notch filter is transmitted.

Each section of the notch filter consists of three operational amplifiers with appropriate feedback. Either notched audio or bypassed audio is then applied to U3A. The MUX switch also activates the receive notch (described later).

NOTE

With the MUX switch activated, the mobile operator can talk to the base unit and, simultaneously, medical telemetry, signals can be transmitted. If the system is "Duplex Multiplex," the doctor at the hospital can talk back to the paramedic via the mobile repeater without interfering with the repeated ECG signal which the doctor is monitoring.

In some unique situations such as very poor quieting, operation in the MUX mode may result in weakly received audio at the base unit. In such cases, releasing the MUX switch will increase ECG signal deviation to approximately 4 kHz and will allow microphone PTT to interrupt ECG transmission and provide normal 5 kHz deviation for voice messages.

1.4 NOISE CANCELLING AMPLIFIER

Noise cancelling amplifiers U1A and U2D reduce the noise level on the auxiliary receiver (if a Q1505A is used) and main receiver monitor audio signals. The noise on the audio high lead and the audio shield are in phase and are both referenced to chassis ground. The noise signals are cancelled by applying the audio high and audio shield to opposite-polarity inputs of U1A and U3D. Amplification of the monitor audio signal from the main receiver auxiliary audio board and the squelch gate board of the auxiliary receiver is not impaired, since the monitor audio signal is referenced to the audio shield.

1.5 1400 Hz RECEIVE NOTCH FILTER

The receive notch filter is a two-section active filter that provides about 35 dB of attenuation at 1400 Hz when MUX switch $S_1$ is on the control panel is depressed. Each section of the filter consists of two operational amplifiers, with appropriate feedback and a combining operational amplifier that amplifies the filter section output. The receive notch filter operates continuously, but is bypassed by Q6 when receiver monitor audio filtering is not needed. When $S_1$ is depressed, the following results — $Q_7$ turns off and $Q_{11}$ turns on which applies a low to the gate of filter bypass gate $Q_{6}$ (via R49). This low at gate $Q_6$ turns it off and therefore the receiver monitor audio from the noise-cancelling amplifier output must pass through the 1400 Hz receive notch filter.

2. INSTALLATION

2.1 INTRODUCTION

Installation consists of simply connecting plugs to the two jacks at the module's housing and then making two level set adjustments.

2.2 ECG LEVEL ADJUST

This adjustment is required only when the Motorola Model QLN1919B ECG Mobile Modulator Preamplifier Module is used with the audio/telemetry multiplexer module.

Step 1. Connect an rf wattmeter to the radio set antenna terminal. Terminate the wattmeter in a 50-ohm dummy load.

Step 2. Connect a deviation meter to the radio set.

Step 3. Turn on the radio set and also turn on the ECG module. This will automatically key the transmitter.

Step 4. Press the MUX pushbutton in. Do not depress the RPT or handset PTT switch.

Step 5. Adjust R67 on the audio/telemetry module to obtain $\pm 2$ kHz transmitter modulation deviation.

2.3 MOBILE MICROPHONE ADJUST

Step 1. Connect an rf wattmeter to the radio set antenna terminal. Terminate the wattmeter in a 50-ohm load.

Step 2. Connect a deviation meter to the radio set.

Step 3. Turn on the radio set.

Step 4. Inject a 600 mV, 2 kHz tone at M2-12 on the audio/telemetry module.

Step 5. Press the MUX pushbutton in, and activate handset PTT.

Step 6. Adjust R110 on the audio/telemetry module to obtain $\pm 2$ kHz transmitter modulation deviation.

3. OPERATION

3.1 INTRODUCTION

These operating instructions describe operation of the audio/telemetry module in a "Micor" "Systems®90" duplex/repeater radio set. The audio/telemetry module includes the MUX, RPT, and ROAM switches.
3.2 RECEPTION

Step 1. Set the control head ON-OFF switch to the ON position. The receiver operates continuously while the radio is turned on.

Step 2. Select the desired radio channel.

Step 3. Remove the handset from its hang-up box. The receiver now operates with carrier squelch. All signals on the selected channel can be heard.

Step 4. Turn the SQUELCH control fully counterclockwise. Adjust the control head VOLUME control for a comfortable listening level.

Step 5. Turn the control head SQUELCH control clockwise until the speaker noise just stops.

Step 6. Replace the handset on its hang-up box. The receiver now operates with "Private-Line" tone coded squelch. Only signals from your radio system can unsquelch the receiver.

3.3 TRANSMISSION - DUPLEX OPERATION

Step 1. Select the desired radio channel.

Step 2. Remove the handset from its hang-up box. Monitor the channel for activity.

Step 3. If the radio channel is not in use, hold down the PTT button on the handset handle and speak slowly and distinctly into the handset microphone.

NOTE
In duplex operation it is not necessary to release the PTT button to receive a reply. The receiver operates at all times.

3.4 REPEATER OPERATION

Step 1. Set the control head controls as described in the procedure entitled "TO RECEIVE".

Step 2. Depress the RPT button on the control head. The RPT indicator brilliance increases and the radio set is now enabled to re-transmit any received radio signal that contains the proper "Private-Line" tone frequency. All radio signals on the selected channel are monitored in the radio set speaker, but only those signals with the proper "Private-Line" tones are able to activate the repeater transmitter. The control head transmit indicator light runs on whenever the transmitter is "on the air".

NOTE
The radio set handset can be used to transmit message while the radio set is in the repeater mode. If the repeater is activated during your voice transmission, the two messages are transmitted simultaneously.

Step 3. To return to normal duplex (non-repeat) operation, press the control head RPT button and allow it to return to the "out" position. The RPT indicator is then dimly illuminated.

3.5 ROAM EMERGENCY REPEAT OPERATION

Step 1. Set the control head operating controls as described under "TO RECEIVE".

Step 2. Depress the RPT and ROAM control head pushbuttons. The RPT and ROAM indicators are then brightly lit. The radio set operates as described under REPEATER OPERATION, except that all received radio signals are repeated, whether or not they contain a PL tone.

3.6 ECG TELEMETRY FILTERING

If the repeater is used to repeat ECG telemetry tones from a portable radio, these tones, like all other repeated messages, are monitored at the radio set speaker. To reduce the level of the monitored ECG telemetry tones, depress the control head MUX pushbutton. The MUX indicator is then brightly lit. The repeated ECG telemetry transmission is not impaired in any way and voice messages can still be monitored.

3.7 MULTIPLEX OPERATION

Step 1. Set the control head controls as described in the procedure entitled "TO RECEIVE".

Step 2. Connect the Motorola Model QLN1919B ECG Mobile Modulator Preamplifier Module to the control head and turn it on. This automatically keys the transmitter.

Step 3. Depress the MUX pushbutton in. The MUX indicator brilliance will increase. When the microphone PTT is activated, the 1400 Hz portion of voice audio will be removed which prevents voice audio from interfering with telemetry transmissions.
1. INTRODUCTION

The RAP module processes main receiver repeat audio. First, it allows audio to pass, only when the main receiver is unsquelched and repeat mode is selected. Second, it amplifies and allows adjustment of main receiver repeat audio to the same level as auxiliary receiver repeat audio. Finally, it removes any PL tone that might accompany main receiver repeat audio so that the PL tone is not retransmitted (repeated).

The QLN2042A RAP Module is made up of a QLN7208A RAP Board, a QLN7209A Escutcheon and Hardware Kit and a QKN8352A Cable Kit.

2. CIRCUIT DESCRIPTION

2.1 Refer to the schematic diagram at the end of this section for the following discussion. Emitter follower audio from the main receiver is applied to the module at J1-16 and routed to noise-cancelling amplifier U1A. This amplifier balances out noise picked up on the cable run between the radio set and the RAP module and provides 6 dB signal gain.

2.2 The audio routed through the module is controlled by audio gate Q2. The gate passes audio (is enabled) when the receiver squelch logic circuitry in the main receiver provides a high (≈9.5 volts) at the base of gate driver Q3 (repeat audio enable).

2.3 Repeat level adjust control R14 balances the level of the main receiver repeat audio to match that of the auxiliary receiver repeat audio. The PL filter network, (which consists of C9, C10, C11, C20, L1, and L2) removes the PL signal from the received audio signal.

2.4 The final stage on the RAP module U1B performs two functions: de-emphasis and amplification. De-emphasis reduces the high frequency components of the audio signal (for correct repeat audio frequency response) and amplification (30 dB) ensures sufficient drive to modulate the repeater transmitter.
# PARTS LIST

QLN2042A Repeat Audio Processing Module  
PL-4573-O

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<th>DESCRIPTION</th>
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**CAPACITORS, fixed, uf; ±10% unless otherwise stated**

**DIODES: (SEE NOTE)**

zener: 9.1 V

**Coils, audio choke, 5 H**

**Transistors: (SEE NOTE)**

NPN; type M9648
FET; type M9652
NPN; type M9642

**Resistors, fixed; ±5%; 1/4 W unless otherwise stated**

**Integrated Circuit: (SEE NOTE)**

type M2027

**NOTE:**

For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
1. APPLICATION

1.1 The ECG Preampifier-Modulator Module is an optional part of the Motorola Emergency Medical Service Radio System. This system is a special adaptation of standard two-way radio and medical monitoring equipment for pre-hospital care of heart patients. Basically, it continuously transmits the in-transit patient’s electrocardiogram (ECG) rhythm strip ahead to the hospital coronary monitoring equipment. A cardiologist may then radio appropriate directions back to ambulance technicians and make advance preparations for reception of the patient at the hospital.

1.2 The Model QLN1919C ECG Preampifier-Modulator adapts a mobile radio for ECG telemetry applications. The ECG unit is supplied with power from the vehicle battery and produces an ECG modulated audio frequency signal which is connected to the microphone input of the radio.

1.3 The QLN1919C includes a ECG Adapter Box which provides an interface to the patient monitor cable. The box mounts near the control group and has a three-wire shielded cable which connects to J102 on the ECG Preampifier Module. J1 on the adapter box accepts the standard 6-pin patient monitor cable. J2 on the adapter box is a TT jack and accepts the older style patient monitor cable. This jack can also be used as a low level output for connection of a patient monitoring oscilloscope.

1.4 Model QLN7478AA ECG Adapter Box is supplied with earlier model QLN1919C ECG Modules. This adapter is wired for an ECG LEAD I. Model QLN7478B ECG Adapter Box supplied with later model QLN1919C ECG Modules is wired for ECG LEAD II. This makes the modulator compatible with the newer cardioscopes wired for ECG LEAD II and allows the cardiologist to take advantage of the increased diagnostic capability of LEAD II monitoring. The QLN7478B is easily identified by the LEAD II legend screened on the front of the box between the two connectors.

CAUTION
Failure to properly connect the ECG Adapter (i.e. LEAD I to LEAD I or LEAD II to LEAD II) will result in ECG artifact. Also, precaution should be taken to prevent the patient from making contact with the ECG ground.

2. DESCRIPTION

2.1 GENERAL

2.1.1 The QLN1919C Preamplifier-Modulator Module consists of a Model QLN5680B Escutcheon & Hardware Kit, a Model QLN7113B Modulator-Preamplifier Circuit Board, a Model QKN8128A Cable Kit, and a QLN7478AA ECG Adapter Box. The module mounts in a standard "Systems 90" accessory housing in the upper card position only.

2.1.2 The QLN1919C Module has an ECG input jack, a CALibrate switch button, an LD CHK (lead check) switch button, and an ON switch button. ON and LD CHK buttons have panel lights which indicates the “on” condition. If the ON button is not depressed, the ECG unit is off. The associated radio may then be used for normal two-way communications. With the ON button depressed the ECG circuit is on, and when properly connected, the mobile radio transmitter is keyed for continuous operation. The CALibration control is a push-on/push-off switch. With the ON button depressed and the CAL button on, a calibration signal is present at the output for use in initial adjustment of the
hospital monitoring equipment. The momentary LD CHK button can then be pressed and held allowing comparison at the hospital of patient contact impedance to the signal previously sent using the standard CALibration resistor.

2.2 ECG MODULATOR-PREAMPLIFIER CIRCUIT BOARD

2.2.1 The ECG modulator-preamplifier circuit board includes a modulator circuit, and ON function switch, and a calibrated on/off switch. In the ON position, patient-attached electrodes may be connected through the ECG input jack to the modulator. The modulator converts the ECG signal to an audio signal which is transmitted directly to the hospital. In the OFF position, the modulator is off and the radio operates independently or as a repeater station to receive and retransmit the ECG signal from a portable ECG transmitter. Each switch position is indicated on the control head panel by a lighted switch button.

2.2.2 The ECG modulator-preamplifier circuit board includes a calibration circuit and a push-on/push-off switch. With the CAL switch on and LD CHK not depressed, the circuit generates a 1-millivolt squarewave signal which may be used at the hospital for adjustment of equipment. With the switch on, and ECG input signal connected at the ECG input jack, and LD CHK pressed, the squarewave signal is superimposed on the ECG audio signal and the squarewave amplitude is an indication of the impedance of patient-connected electrodes.

3. INSTALLATION

The ECG Modulator-Preamplifier Module comes either as a factory equipment option, completely prewired, or as a field installed add on to an existing “Micor” radio set. The ECG Modulator-Preamplifier Module circuit card is installed in the accessory housing, either alone or in combination with other radio accessories. The installation instructions provided here are for the ECG Modulator preamplifier used as the only accessory. For instructions pertaining to multiple installations, refer to the installation instructions supplied with the housing assembly.

3.1 FIELD INSTALLED OPTION

To add the ECG Module in a negative ground system, refer to the schematic diagram and proceed as follows:

Step 1. Slide the circuit card completely in the housing assembly in either position.

Step 2. Install the rear housing cover and secure with two captive screws.

Step 3. Disconnect the black connector (P1101) from the control head.

Step 4. Use the contact removal tool to remove two wires, with pins attached, from P1101 as follows:

- Yellow wire from position 1.
- Black-violet wire from position 9.

NOTE
Steps 5 and 6 are not applicable when the wires extend at least five inches beyond the sleeving on the multiconductor cable.

Step 5. Remove the “S” clamp from the end of the multiconductor cable and move the strain relief back about five inches.

Step 6. Cut approximately five inches of sleeving off the cable. Avoid cutting the insulation of any wires.

Step 7. Insert the pins and wires that were removed from P1101 into the green connector P3 as follows:

- Yellow wire into position 1.
- Black-violet wire into position 10.

Step 8. Insert the pins and wires connected from P3 into P1101 as follows:

- Yellow wire into position 1.
- Black-violet wire into position 9.

Step 9. Reconnect P1101 to the control head and connect P3 to the 22-pin receptacle (P3) on the rear of the circuit card.

Step 10. Disconnect the orange connector (P1) from the Repeater Control Module.

Step 11. Insert the pins and wires connected from P3 into P1 as follows:

- Black-orange wire into position 20.
- Brown wire into position 9.

Step 12. Reconnect P1 to the repeater control module 22-pin receptacle (J1) on the rear of the circuit card.

Step 13. Remove the escutcheon backing and attach escutcheon to the housing assembly front panel.

3.2 FACTORY WIRED OPTION

When the ECG Modulator-Preamplifier Module option is purchased as part of a radio system the wiring changes will have been completed. The individual system components are shipped with all interconnecting cables attached, to permit a thorough system check out before unpacking. To install the radio system proceed as follows.
Step 1. Install the radio and cabling as directed in the radio installation instructions.

Step 2. Install the trunnion bracket and housing assembly as instructed.

Step 3. Connect the black and blue connector to the control head.

Step 4. Connect the green connector (P3) to the ECG Modulator-Preamplifier jack (J3).

Step 5. Connect the orange and violet connectors (P1) and (P2) to the Repeater Control Module jacks (J1) and (J2).

Step 6. Insert the handset plug (P1103) into the control head microphone jack (J1103).

Step 7. Connect the speaker plug (P1104) into the control head speaker jack (J1104).

3.3 ECG ADAPTER BOX

The ECG adapter box should be mounted at a convenient location near the ECG control group.

Step 1. Select the desired location and make sure the cable from the adapter is long enough to reach J102 on the pre-amplifier module.

Step 2. Using the adapter box as a template mark the location of the required screw holes.

Step 3. Drill the holes and mount the adapter box using the two screws provided.

Step 4. Connect the cable from the adapter box to J102 at the rear of the preamplifier module.

3.4 INTERNAL SWITCH CONTACTS

If a particular installation requires the use of internal switch contacts in the ECG Modulator Preamplifier Module, contact a Motorola Field Technical Representative or other technically qualified personnel.

4. OPERATION

Step 1. Place the associated radio in operation and check for the desired operating frequency.

Step 2. When a clear channel has been determined, depress the ON and CAL switches (indicators will be brightly illuminated) and allow sufficient time for initial adjustment of the receiver and monitoring equipment at the hospital.

NOTE
Transmitter is "on the air" when the ON button is depressed.

Step 3. Attach the patient electrodes and insert the plug in the ECG input jack. Press and hold the momentary LD CHK button.

NOTE
When the cable is connected at the ECG input jack and the LD CHK button pressed, the signal level at the receiver end will indicate the electrode contact impedance (greater signal indicates poorer contact). If the signal after connection does not increase to more than two times the level before connection at the ECG jack, the electrode and cable connection will be judged adequate.

Step 4. When the reception and electrode contact have been verified, depress the CAL switch a second time (indicator dimly illuminated) to remove the calibration signal.

Step 5. With the ECG cable connected and the ECG indicator illuminated (ECG switch depressed) the ECG signal is connected into the transmitter and the transmitter is keyed for normal continuous operation until disabled by depressing the ON button a second time (indicator dimly illuminated).

5. PREAMPLIFIER MODULATOR CIRCUIT DESCRIPTION
(Refer to schematic diagram)

Circuit connections between the ECG input jack J102 and the first differential amplifier Q1 constitute a limiter circuit to bypass any large voltage surge and provide rf filtering. This protection circuit is required because the patient-connected electrodes may pick up shock voltages from defibrillator equipment used for patient treatment. Voltage surges of this magnitude could damage the differential amplifiers.

The dual FET transistor Q1 is connected as a differential amplifier. CR4 is a constant-current diode and is used to allow enough current to flow for a stable dynamic bias while maintaining very low ac impedance. Q1 is ac coupled to Q2. Q2 operates in essentially the same way as Q1 with transistor Q3 and its associated circuitry acting as the constant current source. Each stage provides a gain of 10 for a total gain of 100.

Q4 and Q7 form a free-running multivibrator circuit tuned to 1.4 kHz. Q5 and Q6 serve, as the constant current sources which supply the charging current for the frequency determining capacitors C19 and C17. Voltage variations at the bases of Q5 and Q6 modulate these current sources for an effective frequency modulation of the oscillator. The FET transistor Q8 is a source follower for output isolation. Q11 is used for matching into the lower impedance of the mobile transmitter.
Q9 and Q10 form a free-running multivibrator with a frequency of approximately 1 Hz. The relay K1 is switched on and off at this rate. When the relay is closed, a signal of 46 millivolts is developed across the 100-ohm resistor R7. When the CAL switch is depressed, one millivolt of this signal appears across the input voltage divider consisting of the two 10,000-ohm resistors (R2 and R4) and the 23,200-ohm resistor (R3). The resulting signal is the 1.4 kHz audio sub-carrier modulated by a 1-millivolt square wave with a 1 Hz rate. This is the basic calibration signal which may be used for initial adjustment of the ECG monitoring equipment at the hospital.

When an ECG jack is connected at J102 and the LD CHK button is pressed, the skin contact and interelectrode resistance replaces resistor R3. If this resistance is close to 23,200-ohms, the signal amplitude will be approximately 1 millivolt. If the signal amplitude remains within a range of 0.5 to 2 times the 1 millivolt standard, it may be assumed that the electrode connections are satisfactory.

6. ECG PREAMPLIFIER-MODULATOR TROUBLESHOOTING PROCEDURE

6.1 TRANSMITTED SIGNAL NOT RECEIVED

Problem in Transmitter or at receiver location. Troubleshoot transmitter.

6.2 RECEIVER TONE IS POOR OR ABSENT

6.2.1 Problem is in preamplifier-modulator. Make the following checks:

<table>
<thead>
<tr>
<th>Check</th>
<th>Test Point</th>
<th>Correct Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Sub-Carrier Freq.</td>
<td>Feedthrough C21</td>
<td>1.4 kHz ± 100 Hz distorted squarewave @ 1-2 Vrms</td>
</tr>
<tr>
<td>(2) Supply Voltage</td>
<td>Feedthrough C1</td>
<td>12-14 V dc</td>
</tr>
<tr>
<td>(3) Regulated Voltage</td>
<td>Feedthrough C12</td>
<td>8.65-9 V dc</td>
</tr>
</tbody>
</table>

6.2.2 If voltages are proper and signal is present at correct frequency but low level, check Q8, Q11, and associated circuitry.

6.2.3 If subcarrier frequency is not within tolerance or no signal is present, problem is in voltage-controlled oscillator.

6.3.1 Problem is in Q1 and associated circuitry.

6.3.2 If voltages are correct, problem is in Q4, 5, 6, 7, or associated circuitry. If voltages are incorrect, problem is in Q2, 3, or associated circuitry. Add the voltage readings at the two pins. If the sum is within the range of 11.5 to 12.5 V and, two readings differ by more than 0.1 volt, problem is in Q2. If dc voltage at Q2, pins 3 & 7 is not zero, Q2 is bad.

6.3 TONE IS RECEIVED BUT ECG SIGNAL IS POOR

6.4 RECEIVE ECG SIGNAL OK BUT CALIBRATION SIGNAL ABSENT OR POOR

Problem is in calibration oscillator Q9, 10. Check relay contacts. The relay switches with an audible click when circuit is operating.