



MOTOROLA

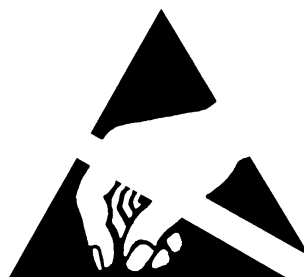
GM1200E

Mobile Radio

Basic Service Manual

68P64115B12

CAUTION



ELECTROSTATIC SENSITIVE DEVICES

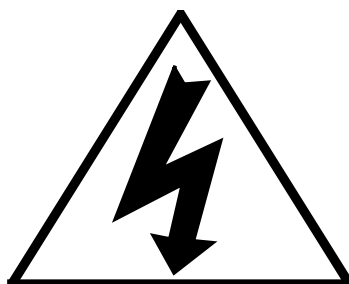
PRECAUTIONS SHOULD BE TAKEN TO MINIMIZE THE RISK OF DAMAGE BY ELECTROSTATIC DISCHARGE TO ELECTROSTATIC SENSITIVE DEVICES (ESDs).

ANY DEVICES EMPLOYING METAL OXIDE SILICON (MOS) TECHNOLOGY ARE PARTICULARLY SUSCEPTIBLE.

CIRCUIT DIAGRAMS MARKED WITH THE ABOVE SYMBOL INDICATE ELECTRONIC CIRCUITS (PECs) FOR WHICH ESD HANDLING PRECAUTIONS ARE NECESSARY.

THE USER SHOULD REFER TO BS5783, 1984: HANDLING OF ELECTROSTATIC SENSITIVE DEVICES. THIS BRITISH STANDARD SUPERSEDES DEF STAN 59-98, ISSUE 2.

WARNING



SAFETY WARNINGS

THE ELECTRICAL POWER USED IN THIS EQUIPMENT IS AT A VOLTAGE HIGH ENOUGH TO ENDANGER LIFE.

BEFORE CARRYING OUT MAINTENANCE OR REPAIR, PERSONS CONCERNED MUST ENSURE THAT THIS EQUIPMENT IS ISOLATED FROM THE ELECTRICAL SUPPLY AND TESTS ARE MADE TO ENSURE THAT ISOLATION IS COMPLETE.

WHEN THE SUPPLY CANNOT BE ISOLATED, MAINTENANCE AND REPAIR MUST BE UNDERTAKEN BY PERSONS WHO ARE FULLY AWARE OF THE DANGERS INVOLVED AND WHO HAVE TAKEN ADEQUATE PRECAUTIONS TO PROTECT THEMSELVES.

COMPONENTS CONTAINING BERYLLIUM OXIDE ARE USED IN THIS EQUIPMENT. DUST FROM THIS MATERIAL IS A HEALTH HAZARD IF INHALED OR ALLOWED TO COME INTO CONTACT WITH THE SKIN.

GREAT CARE MUST BE TAKEN WHEN HANDLING THESE COMPONENTS WHICH MUST NOT BE BROKEN OR SUBJECTED TO EXCESSIVE HEATING. DEFECTIVE COMPONENTS MUST BE DISPOSED OF IN ACCORDANCE WITH CURRENT INSTRUCTIONS.

LEAD ACID BATTERIES MAY BE FITTED AS THE STANDBY BATTERY. CARE MUST BE TAKEN WHEN REMOVING OR INSTALLING THESE BATTERIES TO:

1. ENSURE THAT THE TERMINALS ARE NOT SHORTED TOGETHER.
2. PREVENT SPILLAGE OF THE CORROSIVE ELECTROLYTE.

Basic Service Manual

Contents

Chapter

1.0 General

Gives a brief introduction into the manual; the service policy, models and technical specifications.

2.0 Maintenance

Describes how to disassemble/assemble the radio for maintenance purposes and provides lists of test equipment.

3.0 Accessories

Gives service details and provides a list of accessories available for the radio.

4.0 Radio Tuning Procedure

Provides detailed radio tuning procedure for all bands available.

Appendix

A.0 PL (CTCSS) / DPL Codes

B.0 External Device Connectors

C.0 Non Prescribed Data (NPD) Application Notes

Contents

Chapter 1

General

Table of Contents

| Paragraph | Page |
|---|------|
| 1.0 Introduction | 1 |
| 2.0 Scope of Manual | 1 |
| 3.0 How to Use This Manual | 1 |
| 4.0 Warranty and Service Support | 1 |
| 4.1 Warranty Period | 1 |
| 4.2 After Warranty Period | 2 |
| 4.3 Piece Parts | 2 |
| 4.4 Technical Support | 2 |
| 4.5 Associated Documentation | 2 |
| 5.0 Model Chart | 3 |
| 5.1 Service Options | 4 |
| 6.0 Technical Specifications | 5 |
| 6.1 General | 5 |
| 6.2 Transmitter | 5 |
| 6.3 Receiver | 6 |
| 6.4 Self-Quieting Frequencies | 6 |

1.0 Introduction

This chapter outlines the scope and use of the basic service manual and provides an overview of the warranty and service support.

2.0 Scope of Manual

This manual is intended for use by technicians familiar with similar types of equipment. It contains levels 1 and 2 service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date maybe incorporated by a complete Basic Service Manual revision to your Product Manual or alternatively as additionson a chapter basis.

3.0 How to Use This Manual

The basic service manual contains a general chapter giving information on warranty and support, model charts and technical specifications. Chapters 2 and 3 contain level 1 and level 2 service information for the radios and accessories respectively. Chapter 4 contains radio tuning procedures. Refer to the Table of Contents for a general overview of the manual.

4.0 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return-for-exchange" or "return-for-repair" by an authorised Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorised Motorola Dealer.

4.1 Warranty Period

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. To ensure the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radios back to the appropriate Motorola warranty depot, please contact Customer Services. All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

4.2 After Warranty Period

After Warranty period, Motorola continues to support products in two ways.

Firstly, Motorola's Radio Parts and Service Group (RPSG) offer a repair service to both end users and dealers at competitive prices.

Secondly, RPSG supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair. To assist in this level of service, a Detailed Service Manual containing level 3 repair information may be purchased separately.

4.3 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola Radio Parts and Service Group (RPSG). If a generic part is listed or only a part description is listed, the part is not normally available from Motorola. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All orders for parts/information should include the complete Motorola identification number. All part orders should be directed to your local RPSG office.

Head Office
Motorola G.m.b.H.
European Parts Department
65232 Taunusstein
Germany

4.4 Technical Support

Motorola Product Services is available to assist the dealer/distributors in resolving any malfunctions which may be encountered. Initial contact should be by telephone whenever possible. When contacting Motorola Technical Support, be prepared with the product model number and the unit's serial number.

4.5 Associated Documentation

| <i>Publication Number</i> | <i>Description</i> |
|---------------------------|--|
| 68P64115B15 | GM1200E Detailed Service Manual (for Level 3 repair only) |
| 68P64117B01 | Shared Mobile Radio Systems (SMR) using MPT1327 A System Integrators Cookbook |
| 68P02900X57-A | Data Application Notes for 1200 Series Radios |
| ELN4683A | 1200 Series Product Manual |

5.0 Model Chart

| Description | | Model | | | | | | | | Item | | Description | |
|---|---------------------------|--------------|---|---|---|---|---|---|-------------|------|--------------------------------------|-------------|--|
| GM1200E | 403-470MHz 12.5kHz 25W DB | M08RHA4CK5_N | | | | | | | | | | | |
| GM1200E | 403-470MHz 25kHz 25W DB | M08RHA6CK5_N | | | | | | | | | | | |
| GM1200E | 403-470MHz 12.5kHz 25W KD | M08RHH4CK6_N | | | | | | | | | | | |
| GM1200E | 403-470MHz 25kHz 25W KD | M08RHH6CK6_N | | | | | | | | | | | |
| GM1200E | 136-174MHz 12.5kHz 25W DB | M08KHA4CK5_N | | | | | | | | | | | |
| GM1200E | 136-174MHz 25kHz 25W DB | M08KHA6CK5_N | | | | | | | | | | | |
| GM1200E | 136-174MHz 12.5kHz 25W KD | M08KHH4CK6_N | | | | | | | | | | | |
| GM1200E | 136-174MHz 25kHz 25W KD | M08KHH6CK6_N | | | | | | | | | | | |
| <p>GM1200E 403-470 MHz UHF 136-174 MHz VHF</p> <p>X = Indicates one of each required</p> | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | GBN6147_ | | Packaging Kit | | |
| X | X | | | | X | X | | | GCN6109_ | | Control Head Model K5 Blank | | |
| | | X | X | | | | X | X | GCN6110_ | | Control Head Model K6 Keypad/Display | | |
| | | X | X | | | | X | X | GMN6146_ | | Enhanced Compact Microphone | | |
| | | X | X | | | | X | X | GLN7324_ | | Low Profile Trunnion Kit | | |
| X | | X | | | | | | | GUE1124_ | | RF & HSG UHF 12.5kHz 5-25W | | |
| | X | | X | | | | | | GUE1125_ | | RF & HSG UHF 25kHz 5-25W | | |
| | | | | X | | | X | | GUD1326_ | | RF & HSG VHF 12.5kHz 5-25W | | |
| | | | | | X | | X | | GUD1327_ | | RF & HSG VHF 25kHz 5-25W | | |
| X | X | X | X | X | X | X | X | X | GKN6270_ | | Power Cable | | |
| | | X | X | | | | X | X | 68P64110B08 | | GM1200E User Guide M/L | | |

5.1 Service Options

| Model | | Description | | | | | | | | |
|---|--------------|-----------------------------------|---|---|---|---|---|---|------------|-----------------------------|
| | M08RHA4CK5_N | GM1200E 403-470MHz 12.5kHz 25W DB | | | | | | | | |
| | M08RHA6CK5_N | GM1200E 403-470MHz 25kHz 25W DB | | | | | | | | |
| | M08RHH4CK6_N | GM1200E 403-470MHz 12.5kHz 25W KD | | | | | | | | |
| | M08RHH6CK6_N | GM1200E 403-470MHz 25kHz 25W KD | | | | | | | | |
| | M08KHA4CK5_N | GM1200E 136-174MHz 12.5kHz 25W DB | | | | | | | | |
| | M08KHA6CK5_N | GM1200E 136-174MHz 25kHz 25W DB | | | | | | | | |
| | M08KHH4CK6_N | GM1200E 136-174MHz 12.5kHz 25W KD | | | | | | | | |
| | M08KHH6CK6_N | GM1200E 136-174MHz 25kHz 25W KD | | | | | | | | |
| <p>GM1200E 403-470 MHz UHF 136-174 MHz VHF X = Indicates one of each required</p> | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | Item | Description |
| | X | | | | | | | | ENUD1061AS | GM1200E UHF 12.5kHz MD534AD |
| | | X | | | | | | | ENUD1062AS | GM1200E UHF 25kHz MD514AD |
| | | | X | | | | | | ENUD1063AS | GM1200E UHF 12.5kHz MD534AE |
| | | | | X | | | | | ENUD1064AS | GM1200E UHF 25kHz MD514AE |
| | | | | | X | | | | ENUE1071AS | GM1200E VHF 12.5kHz MD334AD |
| | | | | | | X | | | ENUE1072AS | GM1200E VHF 25kHz MD314AD |
| | | | | | | | X | | ENUE1073AS | GM1200E VHF 12.5kHz MD334AE |
| | | | | | | | | X | ENUE1074AS | GM1200E VHF 25kHz MD314AE |

6.0 Technical Specifications

6.1 General

| SPECIFICATION ITEM | TYPICAL VALUE |
|-------------------------------|---|
| Frequency Range | UHF: 403-470 MHz VHF: 136-174 MHz |
| Channel Spacing | 12.5 kHz or 20/25kHz |
| Frequency Stability | ±2ppm (UHF) / ±5ppm (VHF) |
| Power Supply | 10.8 to 15.6V dc, negative earth |
| Dimensions | K5 Model - 44x168x160 mm (HxWxD) K6 Model - 55x185x167 mm (HxWxD) |
| Weight | 1030g |
| Operational Temperature | - 25°C to + 55°C |
| Storage Temperature | - 40°C to + 85°C |
| Antenna Connection | 50Ω BNC |
| Environmental - Mechanical | Vibration IEC 68/2/27 and Shock IEC 28/2/6 European Dust & Water protection IP54 |
| - Electrical | ETS300-086 RF Specifications ETS300-113 Cyclic Keying Requirements ETS300-279 EMC Requirements ETS300-219 Signalling |

6.2 Transmitter

| SPECIFICATION ITEM | TYPICAL VALUE |
|--------------------------------|---|
| Channel Spacing | 12.5kHz or 20/25kHz |
| Output Power | 5-25W |
| Modulation Limiting | <±2.5kHz (12.5kHz); <±4kHz (20kHz); <±5kHz (25kHz) |
| FM hum & noise (CCITT) | >40dB (12.5kHz); >45dB (20/25kHz) CCITT |
| Conducted/Radiated Emission | <0.25μW (0.1...1000MHz); <1μW (1...4GHz) |
| Adjacent Channel Power | <-60dB (12.5kHz); <-70dB (20/25kHz) |
| Audio Response (300 - 3000 Hz) | Flat or pre-emphasised |
| Audio Distortion | <5% @ 1kHz, 60% deviation |
| Transmit turn on time | <25msec |

6.3 Receiver

| SPECIFICATION ITEM | TYPICAL VALUE |
|-----------------------------------|---|
| Channel Spacing | 12.5kHz or 20/25kHz |
| Sensitivity @ 12.5kHz or 20/25kHz | < 0.35 μ V (12dB SINAD) |
| Intermodulation | >65dB ETS; >70dB with Base Option |
| Adjacent Channel Selectivity | >60dB (12.5kHz); >70dB (20/25kHz) ETS |
| Spurious Rejection | >70dB ETS |
| Audio Distortion @ Rated Audio | <5% |
| Hum and Noise (CCITT) | >40dB (12.5kHz); >45dB (20/25kHz) CCITT |
| Audio Response (300 - 3000 Hz) | Flat or De-Emphasised |
| Co-channel Rejection | <12dB (12.5kHz); <8dB (20/25kHz) ETS |
| Conducted /Radiated Emission | <2nW (0,1..1000MHz); <20nW (1..4GHz) |
| Receive after transmit time | <25msec |
| Audio Output Power | <13W external |

6.4 Self-Quieting Frequencies

Self-quieting frequencies are frequencies that are also generated by the radio and cause internal interference. On these frequencies the interference caused by the self-quieter spur is great enough that a radio will not meet its receiver sensitivity specification.

The frequencies are: UHF 403.2, 420, 436.8 and 453.6MHz.
VHF 151.2 and 168MHz.

Chapter 2

Maintenance

Table of Contents

| Paragraph | Page |
|---|------|
| 1.0 Overview | 1 |
| 2.0 Disassemble the Radio | 1 |
| 2.1 Remove the Control Head | 1 |
| 2.2 Remove the Top Cover..... | 1 |
| 2.3 Remove the Transceiver Board | 2 |
| 2.4 Disassemble the Control Head | 3 |
| 3.0 Assemble Radio | 4 |
| 3.1 Assemble the Control Head..... | 4 |
| 3.2 Replace the Transceiver Board | 4 |
| 3.3 Replace the Top Cover and Control Head..... | 4 |
| 4.0 Exploded View Diagrams and Parts | 5 |
| 5.0 Service Aids | 7 |
| 6.0 Test Equipment | 8 |

1.0 Overview

This chapter explains, step by step, how to disassemble and assemble the radio, to transceiver board level. The chapter also contains a list of test equipment required to service the radio.

2.0 Disassemble the Radio

2.1 Remove the Control Head

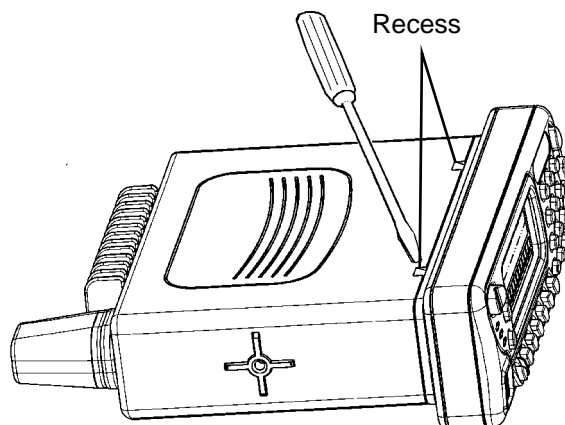


Figure 2-1 Control Head Removal.

1. Insert a small flat blade screw driver, or similar, in the recess between the control head and the transceiver (to minimise cosmetic damage to the radio cover start from the bottom side).
2. Press until the side of the control head releases and then repeat the operation on the opposite side of the radio.
3. Pull the control head away from the transceiver.
4. Remove the flex from the socket on the control head board.

2.2 Remove the Top Cover

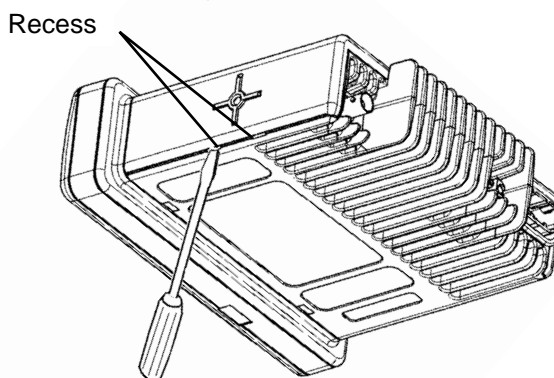


Figure 2-2 Top Cover Removal.

1. Insert a small flat blade screw driver in the side recess of the radio chassis.
2. Lift the top cover over the chassis.

2.3 Remove the Transceiver Board

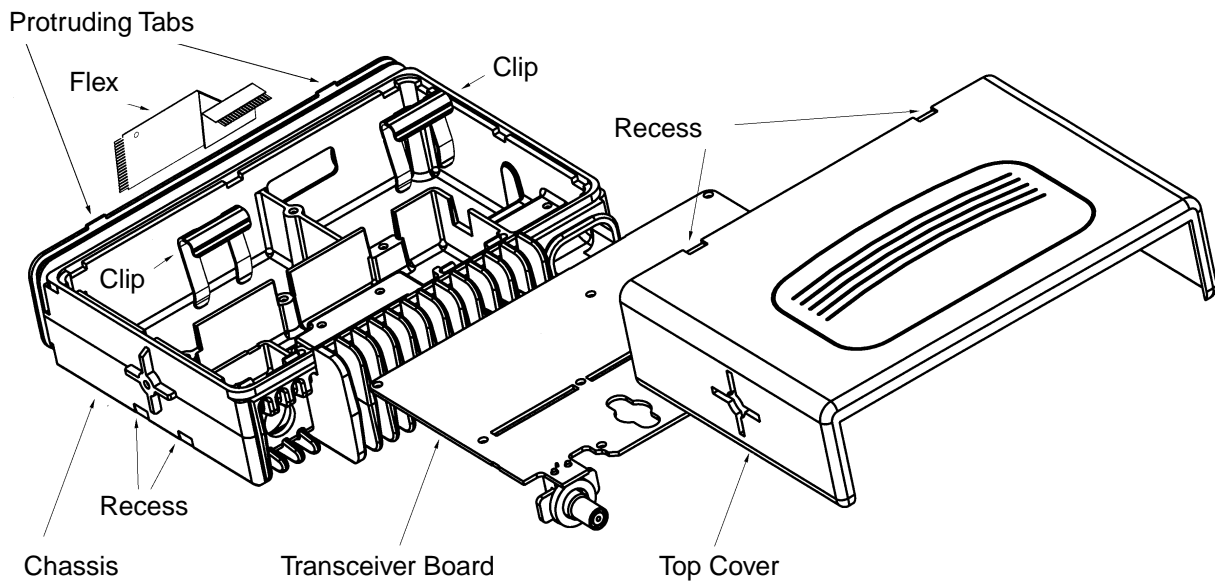


Figure 2-3 Transceiver Board Removal.

1. Remove the power and antenna connector retaining clips by inserting a small flat blade screw driver between the clip and the top of the chassis wall and gently prying the clip upwards.
2. Remove 13 screws from the transceiver board using a T8 TORX driver.
3. Carefully remove the transceiver board by rotating it out of the chassis:
Slowly lift the board on the front edge, the side with the connector that mates with the control head, and pull gently toward the front of the radio.

CAUTION: The thermal grease can act as an adhesive and cause the leads of the heat dissipating devices to be over stressed if the board is lifted too quickly.



2.4 Disassemble the Control Head

1. To remove the printed circuit board from the control head front housing, first split control head into front and rear housing. In the front housing, insert a small blade screw driver in the side groove near the four protruding tabs of the printed circuit board. Remove the board from the control head front housing.
2. Remove the keypad from the control head housing by lifting up the rubber keypad. Care should be taken not to touch or get other contaminants on the conductive pads on the under side of the keypad or conductive contacts on the printed circuit board.
3. Remove the LCD module from the LCD frame attached to the PCB.

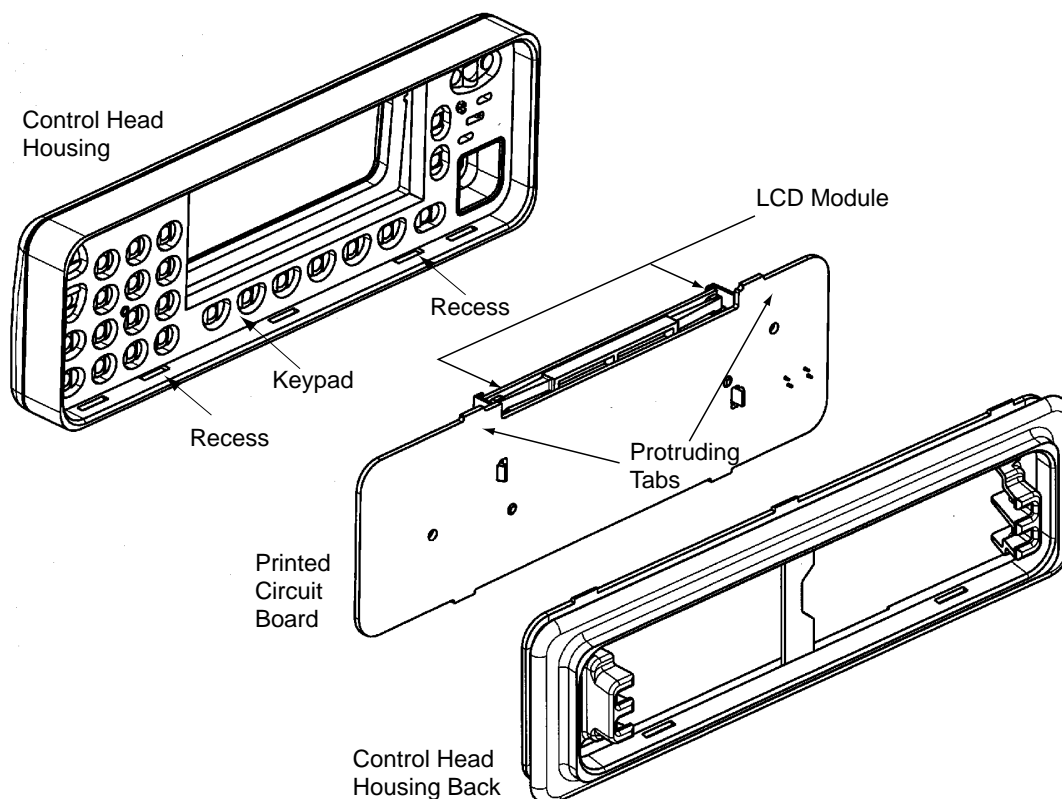


Figure 2-4 Control Head Assembly.

3.0 Assemble Radio

3.1 Assemble the Control Head

1. Ensure that the LCD module and frame are correctly positioned on the PCB.
2. Place the keypad onto the board assembly, making sure the keypad is flush with the board.
3. During the installation of the printed circuit board, ensure the four protruding tabs snap into the recesses.

3.2 Replace the Transceiver Board

1. Inspect and if necessary, reapply thermal grease to the heatsinking pads in the chassis.
2. Before installing the connector retaining clips, ensure that the board is sitting flush on the chassis mounting surface.
3. Install the 13 screws with 0.4 -07 NM (4-6 in lbs) of torque using a T8 TORX driver.

3.3 Replace the Top Cover and Control Head

1. Position the top cover over the chassis and replace. Ensure that the cross snaps into the recesses.
2. Connect the control head to the radio by the flex.

3. Press the control head onto the radio chassis until the protruding tabs on the chassis snap into the recesses inside the control housing, see Figure 2-5.

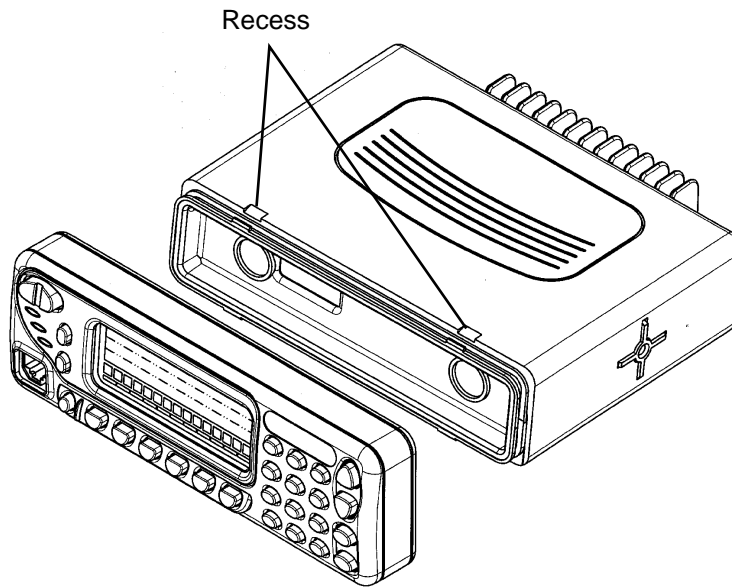


Figure 2-5 Control Head Replacement.

4.0 Exploded View Diagrams and Parts

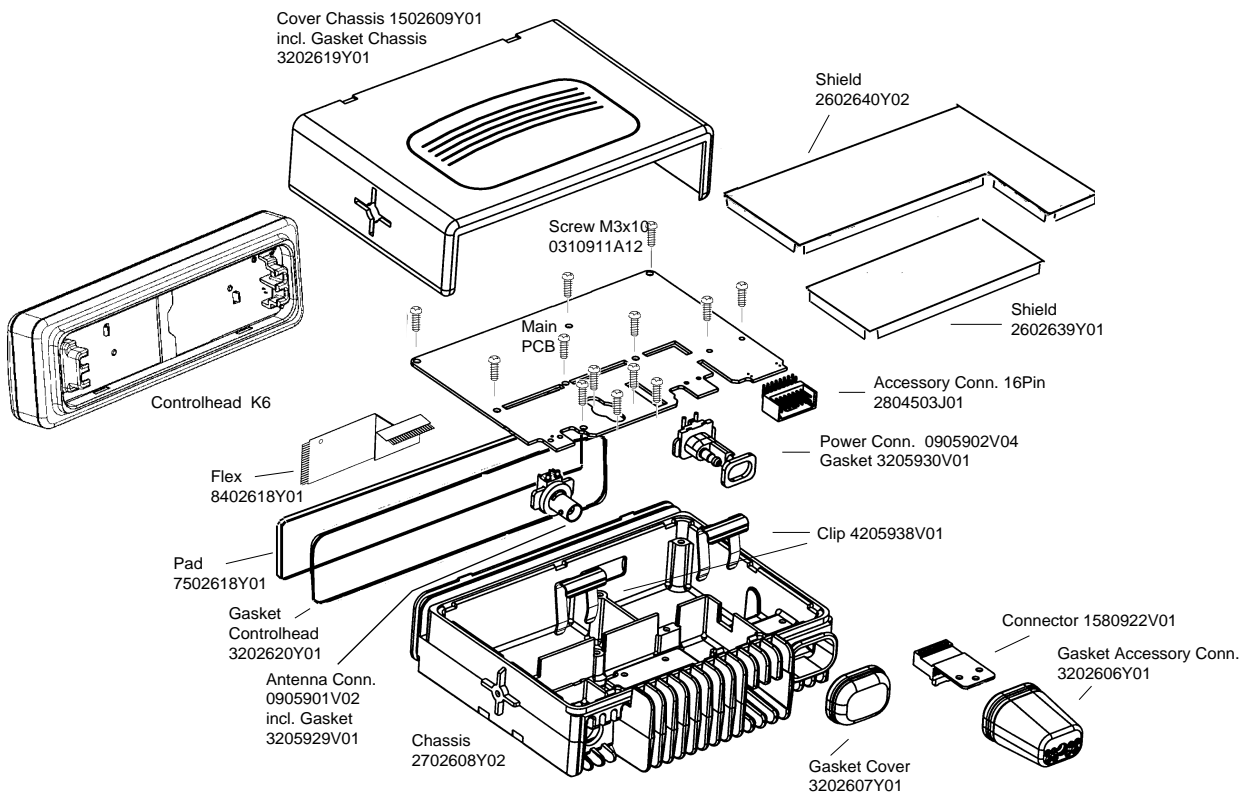


Figure 2-6 Radio Exploded View Diagram.

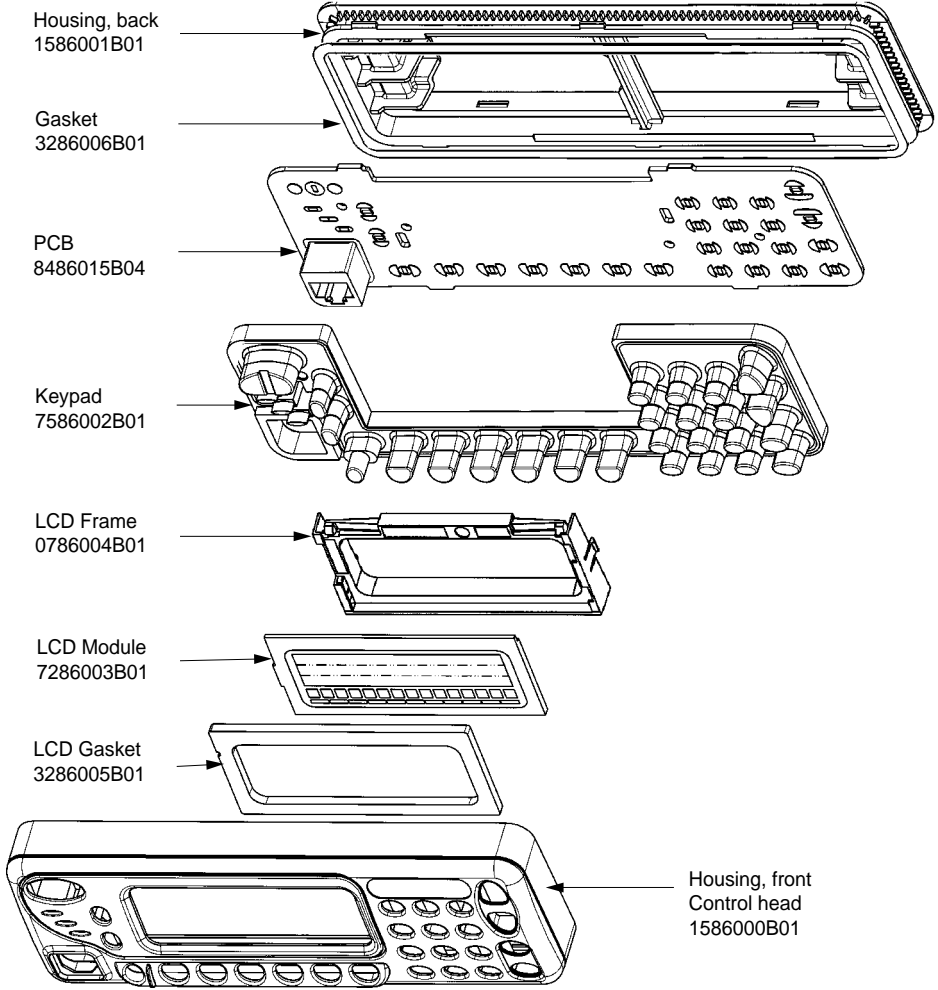


Figure 2-7 Control Head for Display/Keypad Radio Model.

5.0 Service Aids

The list in table 2-1 includes service aids recommended for working on the GM1200E radio.

Table 2-1 Service Aids.

| PART No. | DESCRIPTION | APPLICATION |
|-----------------|--------------------------|--|
| GTF376 | Test Box Cable | Connects radio to GTF180 test box. |
| GTF374 | Combined Interface Cable | Connects radio to RLN4008 RIB. |
| GTF377 | Combined Interface Cable | Connects Databox radio to RLN4008 RIB. |
| GPN6133 | Power Supply | Used to supply power to the radio. |
| GKN6266 | DC Power Cable for radio | Interconnects radio to power supply. |
| GTF180 | Test Box | Enables connection to the universal connector. Allows switching for radio testing. |
| RLN4008 | Radio Interface Box | Enables communications between the radio and the computer's serial communications adapter. |
| EPN4040 | Power Supply | Used to supply power to the RIB (240 VAC). |
| EPN4041 | Power Supply | Used to supply power to the RIB (220 VAC). |
| 3080369B72 | Computer Interface Cable | Connects the computer's serial communications adapter (9 pin) to the RIB. |
| 3080369B71 | Computer Interface Cable | Connects the computer's serial communications adapter (25 pin) to the RIB. |
| ENVN4001 | MPT1327 1200E Series | DPS Dealer Software, 3.5" floppy disks. |
| ENVN4002 | MPT1327 1200E Series | DPS Network Software, 3.5" floppy disks. |

6.0 Test Equipment

The list in table 2-2 includes all standard test equipment required for servicing two-way mobile radios, as well as several unique items designed specifically for servicing the GM1200E radio. Battery-operated test equipment is recommended when available. The "Characteristics" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

Table 2-2 Recommended Test Equipment.

| MODEL No. | DESCRIPTION | CHARACTERISTICS | APPLICATION |
|--|---|--|--|
| R2000 Series | System Analyser | This monitor will substitute for items with an asterisk (*) | Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment. |
| *R1150C | Code Synthesizer | | Injection of audio and digital signalling codes |
| *S1053D *HM-203-7 *SKN6008A *SKN6001A | 220 VAC Voltmeter 110 VAC Voltmeter Power Cable for Meter Test Leads for Meter | 1mV to 300V, 10M Ω Input impedance | Audio voltage measurements |
| *S1350C *ST1213B (VHF) *ST1223B (UHF) | Watt Meter Plug-in Element RF Dummy Load | 50 ohm, \pm 5% accuracy 10 Watts, maximum 0-1000 MHz, 300W | Transmitter power o/p measurements |
| R1065A | Load Resistor | 10-watt Broadband | For use with Wattmeter |
| S1339A | RF Millivolt Meter 10kHz to 1.2 GHz | 100 μ V to 3V RF | RF level measurements |
| *R1013A | SINAD Meter | | Receiver sensitivity measurements |
| S1347D or S1348D (programmable) | DC Power Supply | 0-20Vdc, 0-5 Amps | Bench supply for 13.2Vdc current limited |

* Any of the R2000 Series system analysers will substitute for items with an asterisk (*)

Chapter 3

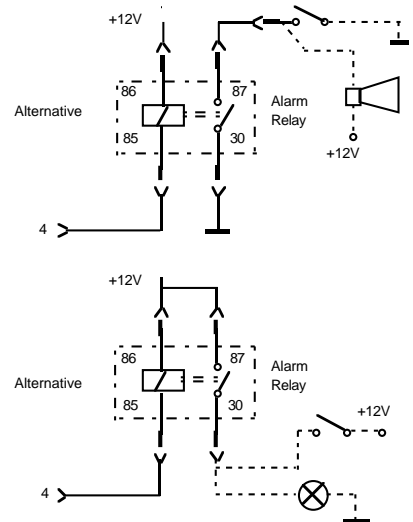
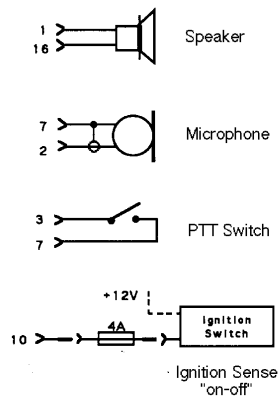
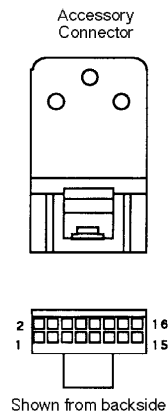
Accessories

Table of Contents

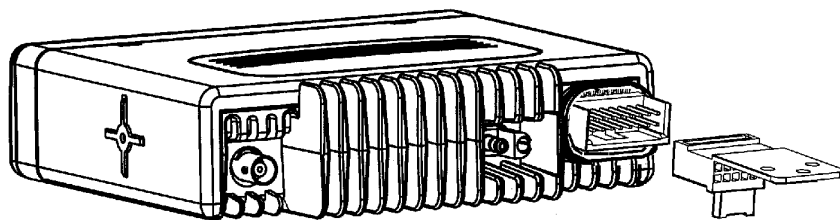
| Paragraph | | Page |
|------------|---|------|
| 1.0 | GM1200E Accessory Connector Plan | 1 |
| 2.0 | GM1200E Accessory Diagrams | 2 |
| 2.1 | Speaker GSN6059 5.5ins/130mm, 13 Watts..... | 2 |
| 2.2 | Handset HMN9416 (P/O HMN3141) Mechanical Exploded View..... | 3 |
| 2.3 | Enhanced Compact Microphone GMN6146 Mechanical Exploded View..... | 5 |
| 2.4 | DTMF Microphone GMN6148 Mechanical Exploded View..... | 7 |
| 2.5 | Base Tray GLN7318/GLN7326..... | 11 |
| 2.6 | Remote Mount Front / Rear Housing Kits GLN7331 / GLN7332 Mechanical Exploded View..... | 12 |
| 2.7 | Power Supply GPN6133 (EMC/CE Approved) | 13 |
| 2.8 | Power Supply HPN8393 (Not EMC Approved)..... | 14 |
| 3.0 | List of Accessories | 16 |

1.0 GM1200E Accessory Connector Plan

CAUTION: The accessory connections shown are not compatible to some other models of Motorola radios. Check the appropriate accessory or technical manual for further information.



CAUTION: 1. **DO NOT** short pin 1 or 16 on the accessory connector to ground, this may damage the radio.

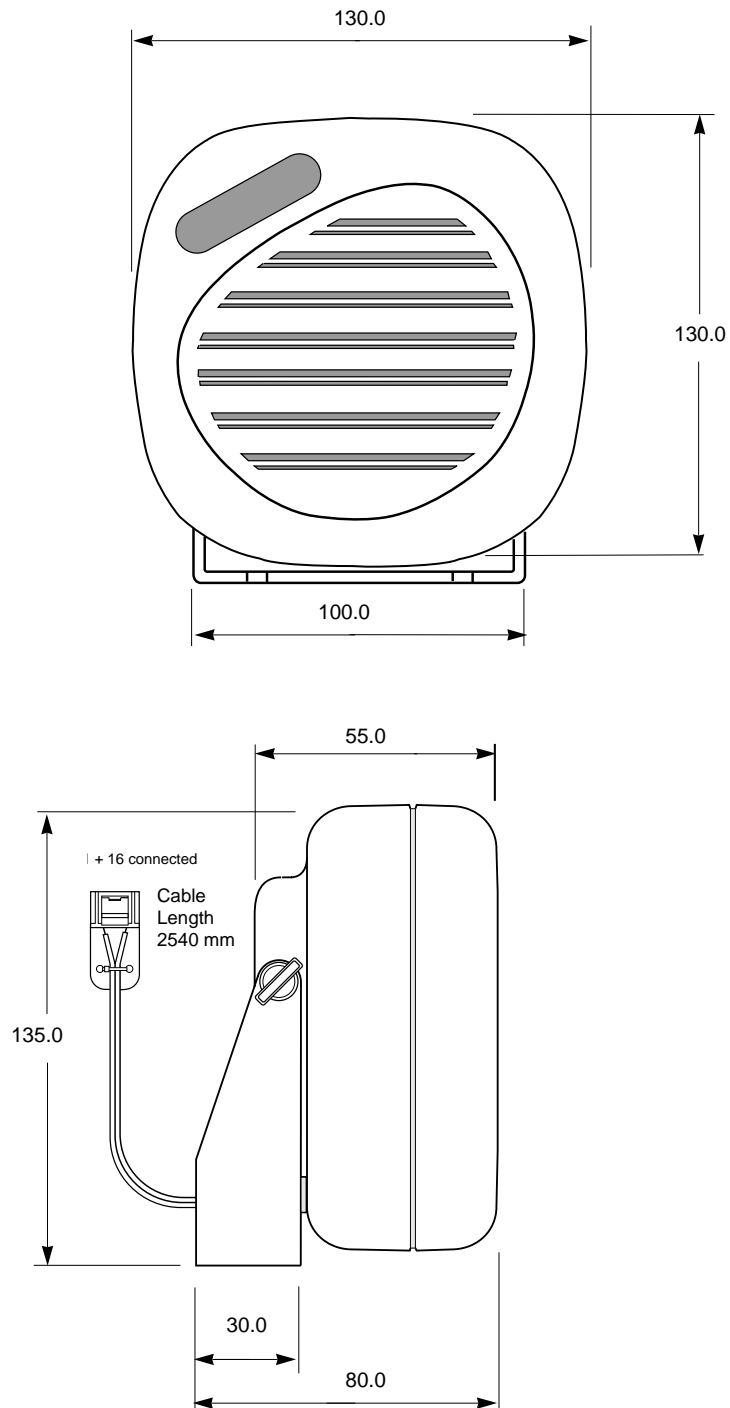


CAUTION: Ensure correct position of the accessory connector.

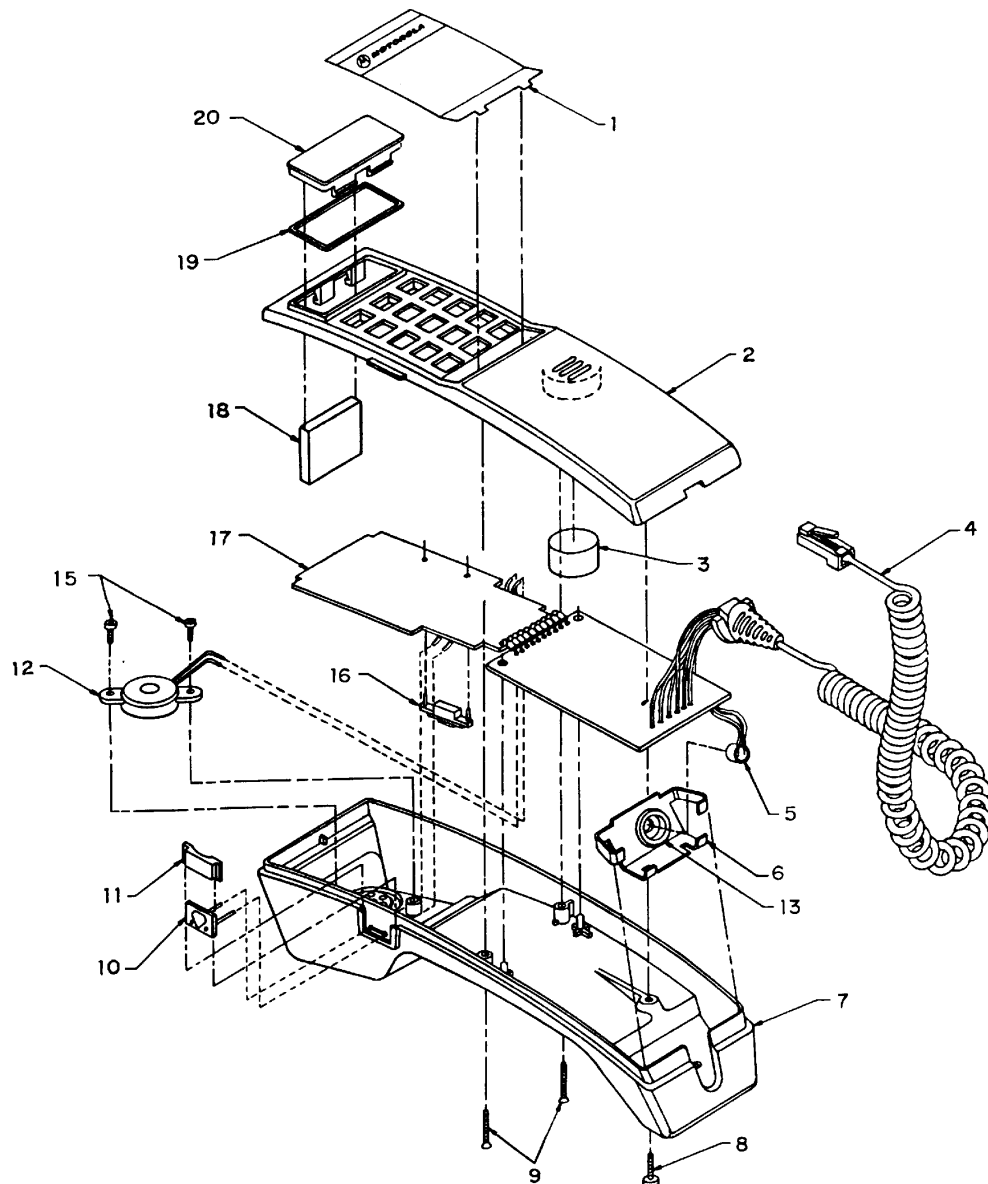


2.0 GM1200E Accessory Diagrams

2.1 Speaker GSN6059 5.5ins/130mm, 13 Watts



2.2 Handset HMN9416 (P/O HMN3141) Mechanical Exploded View



Mechanical Parts List

| <i>Ref No.</i> | <i>Motorola Part No.</i> | <i>Description</i> | <i>Ref No.</i> | <i>Motorola Part No.</i> | <i>Description</i> |
|----------------|--------------------------|-----------------------|----------------|--------------------------|------------------------|
| 1 | 13-80928W01 | Escutcheon | 11 | 38-84658P01 | PTT Button |
| 2 | 15-82281R01 | Top Housing | 12 | | Speaker (LS10) |
| 3 | 75-80927W01 | Top Housing Pad | 13 | 32-80272F16 | Microphone Gasket |
| 4 | 30-06418T01 | Coil Cord Cable | 14 | | Not used |
| 5 | | Mic Cartridge (MK101) | 15 | 03-10944A03 | Tapping Screw |
| 6 | 07-80148G02 | Mic Gasket Bracket | 16 | 43-84312N01 | Reed Switch Spacer |
| 7 | 15-84795P04 | Bottom Housing | 17 | 01-80701Y77 | Circuit Board Assembly |
| 8 | 03-10908A91 | Machine Screw | 18 | 75-80926W01 | Circuit Board Pad |
| 9 | 03-10913B37 | Tapping Screw | 19 | 32-80282F02 | Lens Gasket |
| 10 | | PTT Dome Switch (S11) | 20 | 61-80266F10 | Display Lens |

2.2.1 Description

The HMN3141 Handset and hang-up cup is a slimline telephone handset with push to talk (PTT) button. It is used in place of, and operates similar to, the standard mobile microphone.

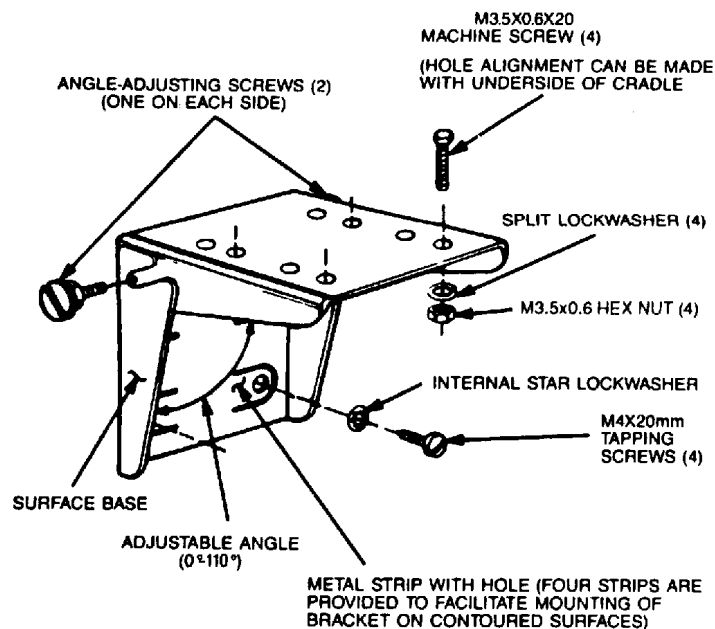
2.2.2 Installation

General

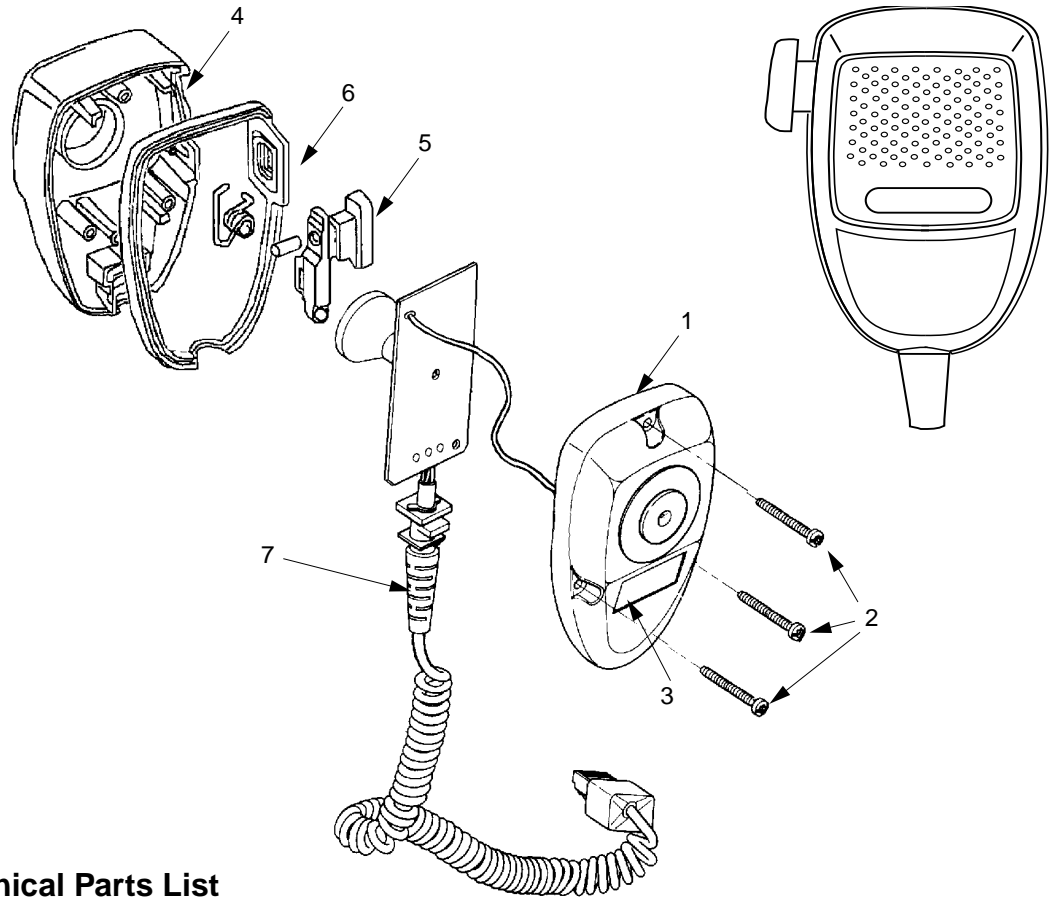
When planning the installation of your handset, it is important that it does not interfere with the operation of the vehicle or its accessories, nor disturb passenger seating or leg space. The handset must be within convenient reach to the user. In general terms, the location of the handset should be similar to the standard mobile microphone.

Adjustable Angle Bracket

1. Verify that the selected mounting surface is strong enough to support the mounting hardware.
2. Use the base of the adjustable angle bracket as a template, then centre punch and drill four 3.4mm diameter holes. Be careful not to damage any wires or other vital vehicle components when drilling the holes.
3. Use the four M4x20mm tapping screws and the internal star lockwashers to mount and secure the bracket.
4. Place the hang-up cup on top of the mounting surface of the mounting bracket and secure it using the four M3.5x0.6x20mm machine screws, lockwashers, and hex nuts provided.
5. Select the angle between the two bases of the adjustable angle bracket (from 0 to 110 degrees) and tighten the two adjusting screws.



**2.3 Enhanced Compact Microphone GMN6146
Mechanical Exploded View**

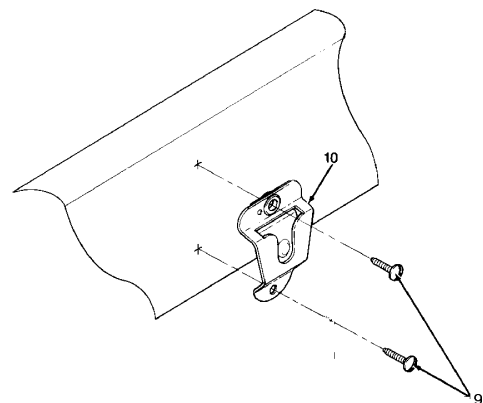


Mechanical Parts List

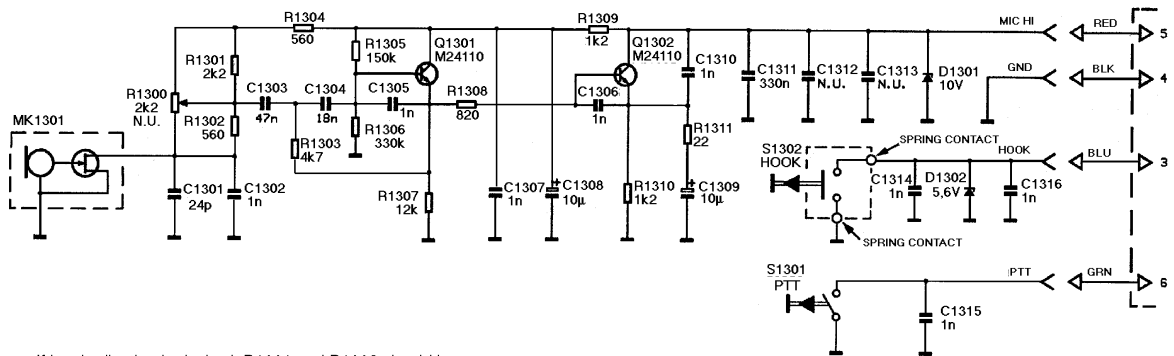
| <i>Ref No.</i> | <i>Motorola Part No.</i> | <i>Description</i> | <i>Ref No.</i> | <i>Motorola Part No.</i> | <i>Description</i> |
|----------------|--------------------------|------------------------|----------------|--------------------------|--------------------|
| 1 | 0180704Y99 | Rear Housing assembly | 5 | 3880568B01 | PTT Button |
| 2 | 0311994A23 | Screw (3 used) | | 7580983Z03 | Rubber Spacer |
| 3 | 5480104R12 | Model Label (GMN6146C) | | 4180150R01 | Spring Tension |
| | 5480104R02 | Model Label (GMN6146B) | 6 | 3280565B01 | Gasket MIC |
| 4 | 1580566B02 | Front Housing | 7 | 3002593Y02 | Coiled Cord |

Hang-Up Clip Parts List

| <i>Ref No.</i> | <i>Motorola Part No.</i> | <i>Description</i> |
|----------------|--------------------------|--------------------------|
| 9 | 03-00139913 | Screw, 8-18x1/2 (3 used) |
| 10 | 01-80743T91 | Hang-up clip |



Schematic Diagram



If level adjusting is desired, R1301 and R1302 should be taken out and be replaced by R1300 (p/n 1805500L04).

GEPD 5468

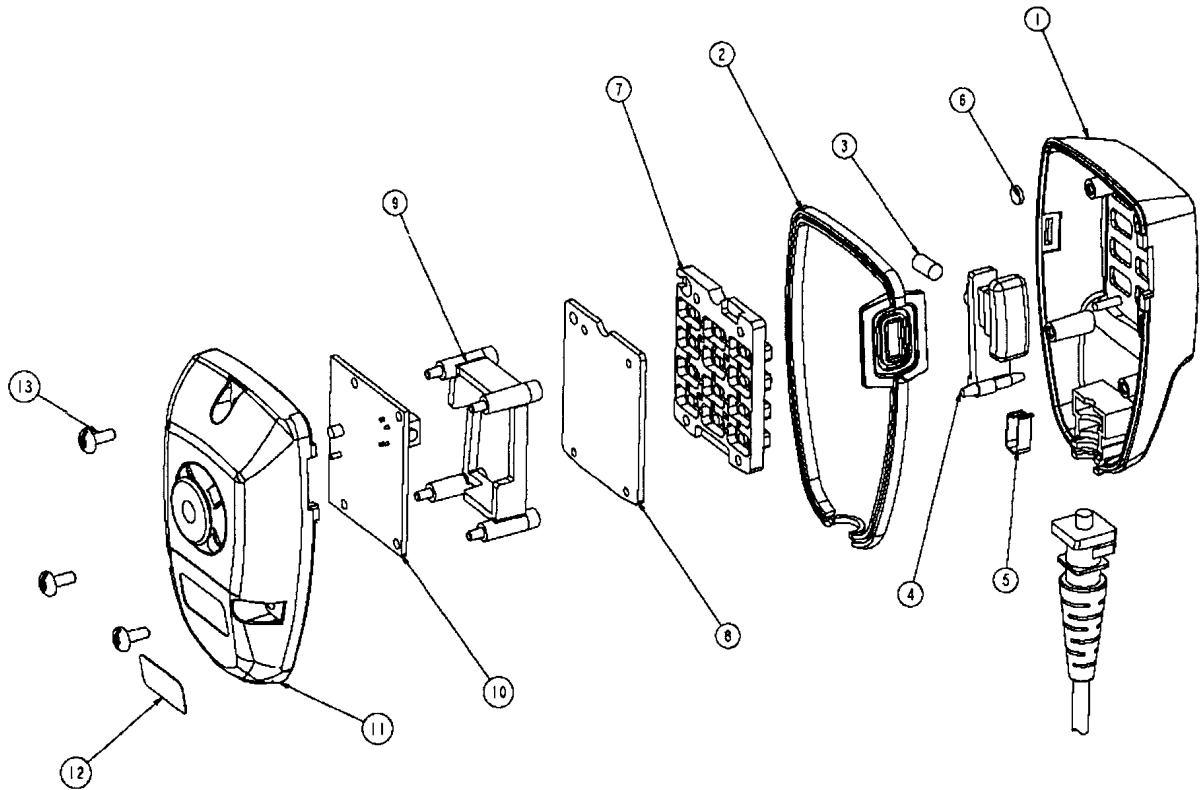
Kit No. GMN6146C

Electrical Parts Lists

| Circuit Ref | Motorola Part No. | Description |
|-------------|-------------------|-------------------------|
| R1300 | 1805500L04 | RES VAR 2.2k (not used) |
| R1301 | 0660076A57 | RES CHIP 2.2k 5 1/8 |
| R1302 | 0660076A43 | RES CHIP 560 5 1/8 |
| R1303 | 0660076A65 | RES CHIP 4.7k 5 1/8 |
| R1304 | 0660076A43 | RES CHIP 560 5 1/8 |
| R1305 | 0660076B05 | RES CHIP 150k 5 1/8 |
| R1306 | 0660076B13 | RES CHIP 330k 5 1/8 |
| R1307 | 0660076A75 | RES CHIP 12k 5 1/8 |
| R1308 | 0660076A47 | RES CHIP 820 5 1/8 |
| R1309 | 0660076A51 | RES CHIP 1.2k 5 1/8 |
| R1310 | 0660076A51 | RES CHIP 1.2k 5 1/8 |
| C1301 | 2113740A38 | CAP CHIP CL1 24p |
| C1302 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1303 | 2113741A61 | CAP CHIP CL2 X7R 47n |
| C1304 | 2113741A51 | CAP CHIP CL2 X7R 18n |
| C1305 | 2113741A21 | CAP CHIP CL2 X7R 1n |

| Circuit Ref | Motorola Part No. | Description |
|-------------|-------------------|------------------------|
| C1306 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1307 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1308 | 2311049J26 | CAP TANT CHIP 10uF 16V |
| C1309 | 2311049J26 | CAP TANT CHIP 10uF 16V |
| C1310 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1311 | 2113743F12 | CER CHIP CAP 330n |
| C1314 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1315 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| C1316 | 2113741A21 | CAP CHIP CL2 X7R 1n |
| Q1301 | 4813824A10 | XSTR NPN 40V .2A |
| Q1302 | 4813824A10 | XSTR NPN 40V .2A |
| D1301 | 4880140L15 | DIODE SOT ZENER 10V |
| D1302 | 4880140L07 | DIODE SOT ZENER 5.6V |
| | 4080164S01 | SWITCH,PTT |
| | 5080258E04 | ELECTRET MIC CTRG |
| | 8402571Y01 | PCB RENA MIC BLK |

**2.4 DTMF Microphone GMN6148
Mechanical Exploded View**

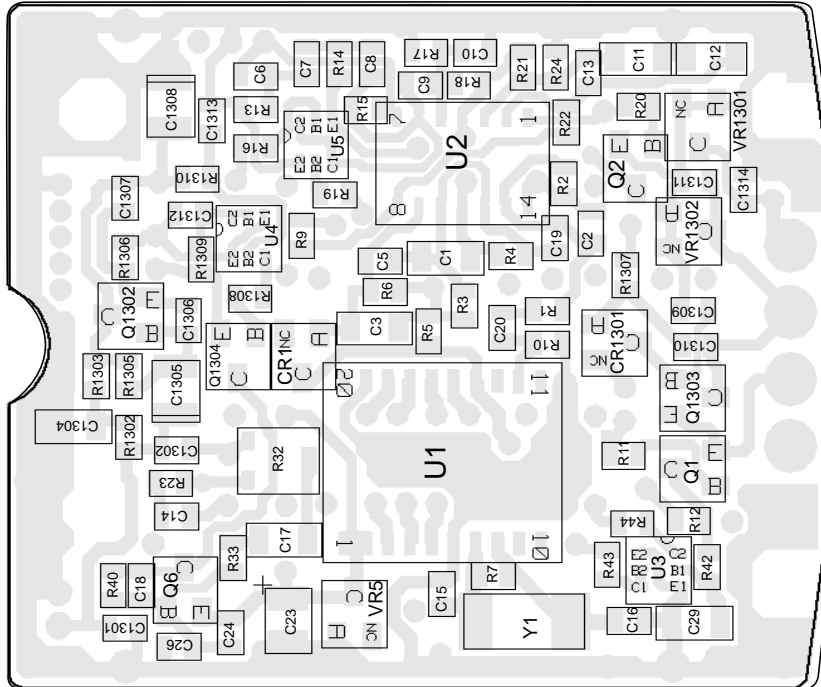


Mechanical Parts List

| Ref No. | Motorola Part No. | Description |
|----------------|--------------------------|----------------------------|
| 1 | 15-80652D02 | Microphone front housing |
| 2 | 32-80565B01 | Microphone gasket |
| 3 | 75-80983Z03 | Rubber Spacer, Switch |
| 4 | 38-80654D01 | Button, push to talk |
| 5 | 41-80658D01 | Spring, PTT |
| 6 | 35-80089D02 | Felt baffle |
| 7 | 75-80655D01 | Keypad |
| 8 | 01-80707Y77 | DTMF Encoder board assy |
| 9 | 42-80656D01 | Spacer |
| 10 | 01-80707Y78 | Switch/Sidetone board assy |
| 11 | 01C80669D01 | Microphone rear Housing |
| 12 | 54-80104R10 | Mic label |
| 13 | 03-139959 | Screw, thread forming |

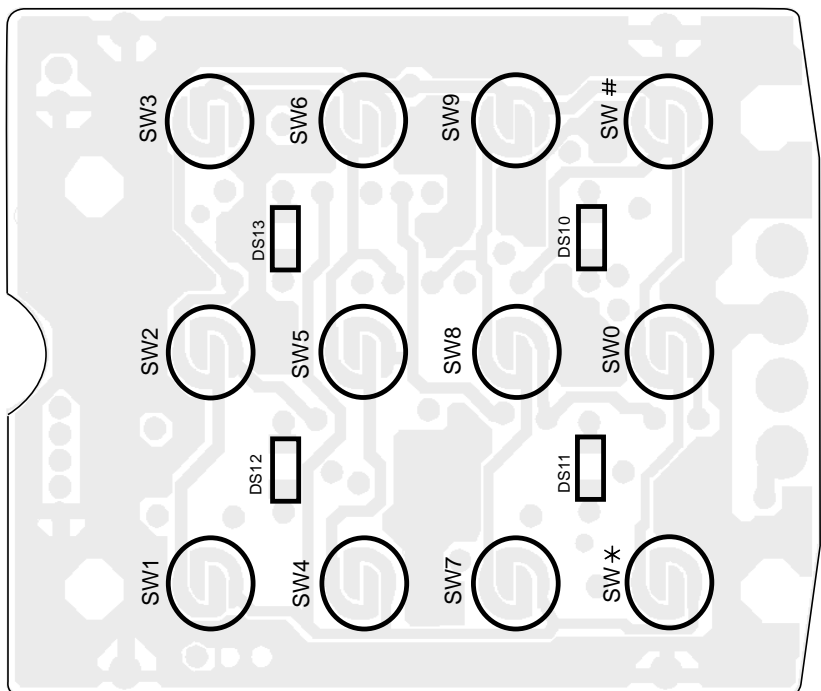


PCB Layout



8402685Y01 GEPD 5469

SHOWN FROM COMPONENT SIDE



8402685Y01 GEPD 5470

SHOWN FROM SOLDER SIDE

Electrical Parts List

GMN6148_

| Circuit Ref | Motorola Part No. | Description | Circuit Ref | Motorola Part No. | Description |
|-------------|-------------------|---------------------|-------------|-------------------|-----------------|
| C1 | 23-11049A07 | 1uF; 16V, 10%, TANT | CR12 | 48-83636N18 | LED; GREEN, SMD |
| C2 | 21-13740A73 | 560pF | CR13 | 48-83636N18 | LED; GREEN, SMD |
| C3 | 23-11049A59 | 10uF; 6V,10%, TANT | CR1301 | 48-13833C04 | BAV70LT1 |
| C5 | 21-13740A59 | 150pF | Q1 | 4880214G02 | MMBT 3904 |
| C6 | 21-13741A45 | 0.01uF | Q2 | 4880214G02 | MMBT 3904 |
| C7 | 21-13741A45 | 0.01uF | Q6 | 4880214G02 | MMBT 3904 |
| C8 | 21-13741A45 | 0.01uF | Q1302 | 48-80214G02 | MMBT 3904 |
| C9 | 21-13740A59 | 150pF | Q1303 | 48-05128M19 | MMBTA 13 |
| C10 | 21-60521G37 | 0.1uF | Q1304 | 48-05128M16 | MMBT 3906 |
| C11 | 23-11049A07 | 1uF; TANT | R1 | 06-60076B01 | 100K |
| C13 | 21-13740A59 | 150pF | R2 | 06-60076B03 | 120K |
| C14 | 21-60521G37 | 0.1uF | R3 | 06-60076A87 | 39K |
| C15 | 21-13740A40 | 30pF | R4 | 06-60076A87 | 39K |
| C16 | 21-13740A40 | 30pF | R5 | 06-60076A73 | 10K |
| C17 | 23-11049A07 | 1uF; TANT | R6 | 06-60076B05 | 150K |
| C18 | 21-13741A45 | 0.01uF | R7 | 06-60076B25 | 1Meg |
| C19 | 21-13740A59 | 150pF | R9 | 06-60076B01 | 100K |
| C20 | 21-13741A45 | 0.01uF | R10 | 06-60076A73 | 10K |
| C23 | 23-11049A30 | 33uF, 6V, 10%, TANT | R11 | 06-60076B01 | 100K |
| C24 | 21-13740A79 | 1000pF | R12 | 06-60076A89 | 47K |
| C26 | 21-13740A79 | 1000pF | R13 | 06-60076A47 | 820 |
| C29 | 23-11049A07 | 1uF; TANT | R14 | 06-60076A47 | 820 |
| C1301 | 21-13740A39 | 27pF, 50V, NPO. | R15 | 06-60076A93 | 68K |
| C1302 | 21-13740A79 | 1000pF | R16 | 06-60076A73 | 10K |
| C1304 | 23-11049A59 | 10uF; 6V, 10%, TANT | R17 | 06-60076A87 | 39K |
| C1305 | 21-13743B23 | 0.330uF | R18 | 06-60076A89 | 47K |
| C1306 | 21-13740A59 | 150pF | R19 | 06-60076A73 | 10K |
| C1307 | 21-13740A79 | 1000pF | R20 | 06-60076A73 | 10K |
| C1308 | 21-11032B14 | 0.15uF | R21 | 06-60076B01 | 100K |
| C1309 | 21-13740A59 | 150pF | R22 | 06-60076A89 | 47K |
| C1310 | 21-13740A59 | 150pF | R23 | 06-60076A65 | 4.7K |
| C1311 | 21-13740A59 | 150pF | R24 | 06-60076A87 | 39K |
| C1312 | 21-13740A59 | 150pF | R32 | 18-60502A13 | 10K VAR; SMD |
| C1313 | 21-13740A59 | 150pF | R33 | 06-60076A63 | 3.9K |
| C1314 | 21-13741A45 | 0.01uF | R40 | 06-60076A65 | 4.7K |
| CR1 | 48-84336R03 | MMBD 7000 | R42 | 06-60076A84 | 30K |
| CR10 | 48-83636N18 | LED; GREEN, SMD | R43 | 06-60076A84 | 30K |
| CR11 | 48-83636N18 | LED; GREEN, SMD | R44 | 06-60076A25 | 100 |

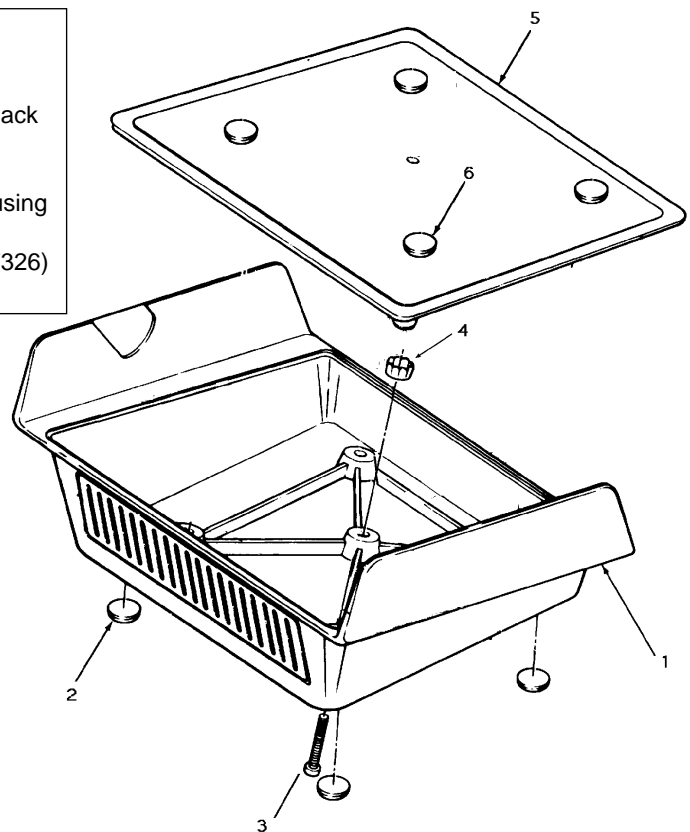
GMN6148_ continued,

| Circuit Ref | Motorola Part No. | Description | Circuit Ref | Motorola Part No. | Description |
|-------------|-------------------|---------------------------|-------------|-------------------|------------------------------------|
| R1302 | 06-60076A57 | 2.2K; 5%, 1/8W | VR5 | 48-80140L05 | 4.7V; 5%, ZENER |
| R1303 | 06-60076A49 | 1K; 5%, 1/8W | VR1301 | 48-80140L17 | 12V; 5%, ZENER |
| R1305 | 06-60076B05 | 150K; 5%, 1/8W | VR1302 | 48-80140L17 | 12V; 5%, ZENER |
| R1306 | 06-60076M01 | 0; RES. JUMPER | Y1 | 48-80915W02 | 3.58 MHZ Resonator |
| R1307 | 06-60076B01 | 100K; 5%, 1/8W | Y2 | 50-80121L01 | Transducer |
| R1308 | 06-60076A81 | 22K; 5%, 1/8W | | 50-13920A04 | ADHESIVE, MIC SHIELD, DTMF ENCODER |
| R1309 | 06-60076B01 | 100K; 5%, 1/8W | | 30-02593Y02 | COIL CORD W. IP54 BOOT |
| R1310 | 06-60076B01 | 100K; 5%, 1/8W | | 84-02685Y01 | Circuit Board EURO DTMF MIC |
| SW1301 | 40-80164S01 | SWITCH, PTT | | 84-80661D01 | Circuit Board, Switch/sidetone |
| U1 | 51-80662D01 | MK53731D DTMF DIALER I.C. | | | |
| U2 | 51-13819A02 | LM2902D OPAMP | | | |
| U3 to U5 | 51-80159R01 | DUAL TRANSISTOR; IMX1 | | | |

2.5 Base Tray GLN7318/GLN7326

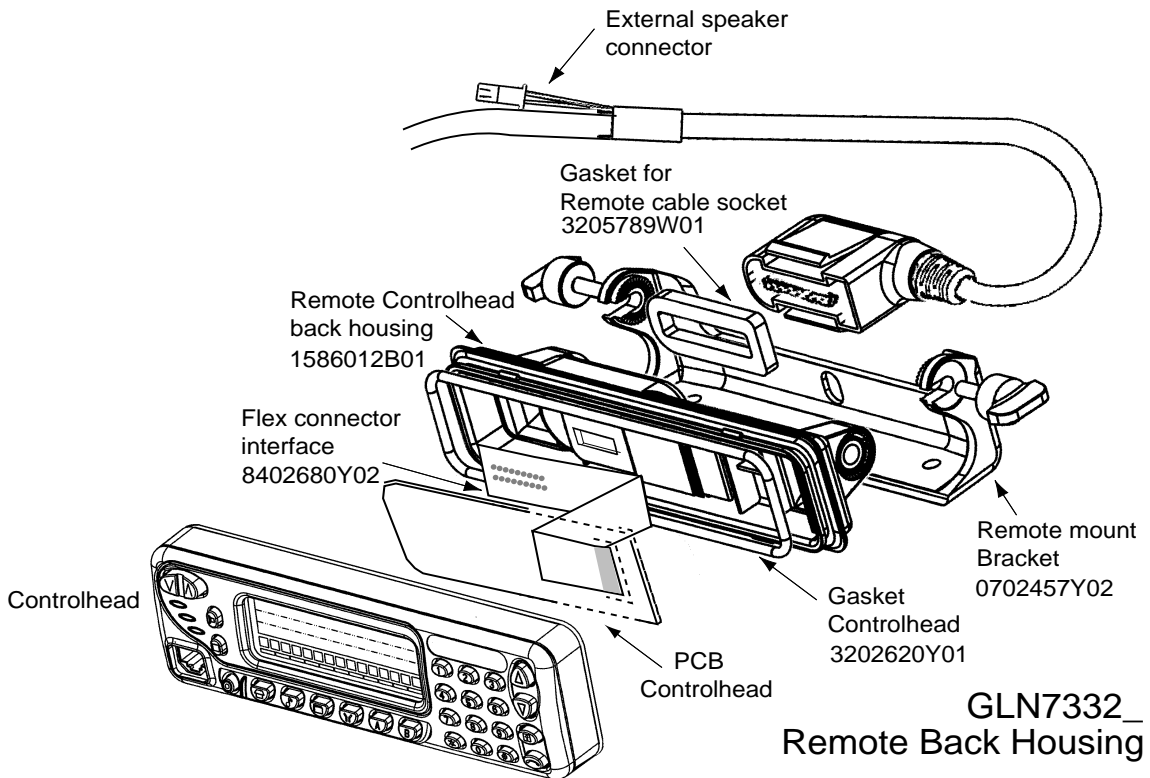
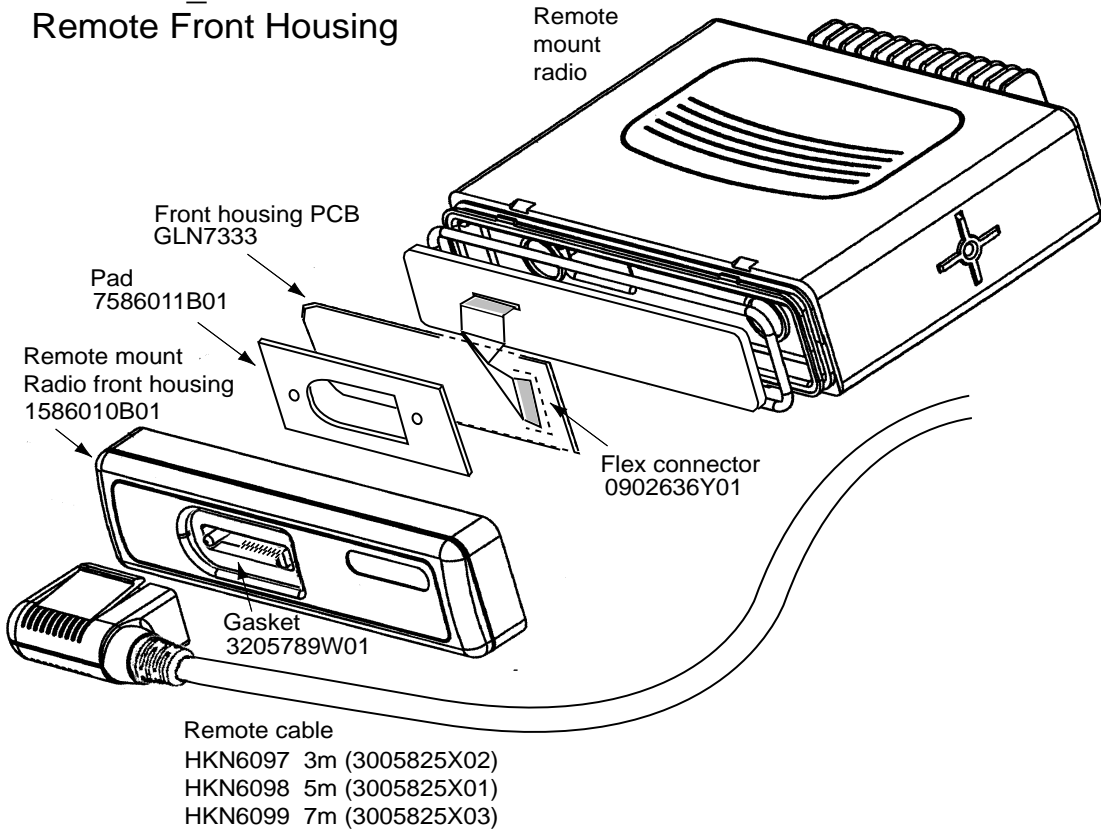
Mechanical Parts List

| Ref No. | Motorola Part No. | Description |
|---------|-------------------|--------------------|
| 1 | 1580155J02 | Base housing |
| 2 | 7510606A06 | Bumper RBR black |
| 3 | 0384725C09 | Screw 4.2x16 |
| 4 | 4205722C02 | Clamp fastener |
| 5 | 1580154J02 | Cover base housing |
| 6 | 7510606A13 | Bumper black |
| | 5080085D03 | Speaker (GLN7326) |
| | | <i>Not shown</i> |



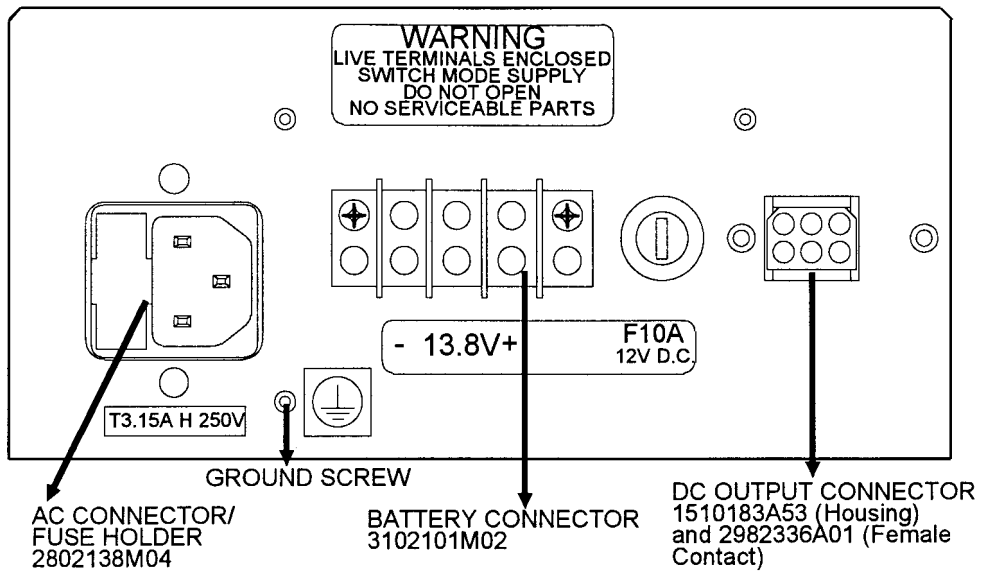
2.6 Remote Mount Front / Rear Housing Kits GLN7331 / GLN7332 Mechanical Exploded View

GLN7331_ Remote Front Housing

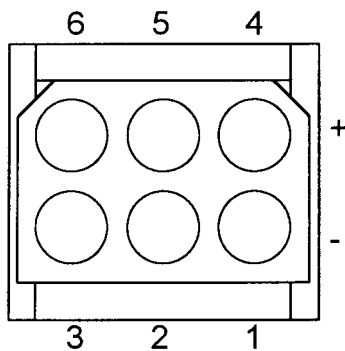


2.7 Power Supply GPN6133 (EMC/CE Approved)

REAR VIEW

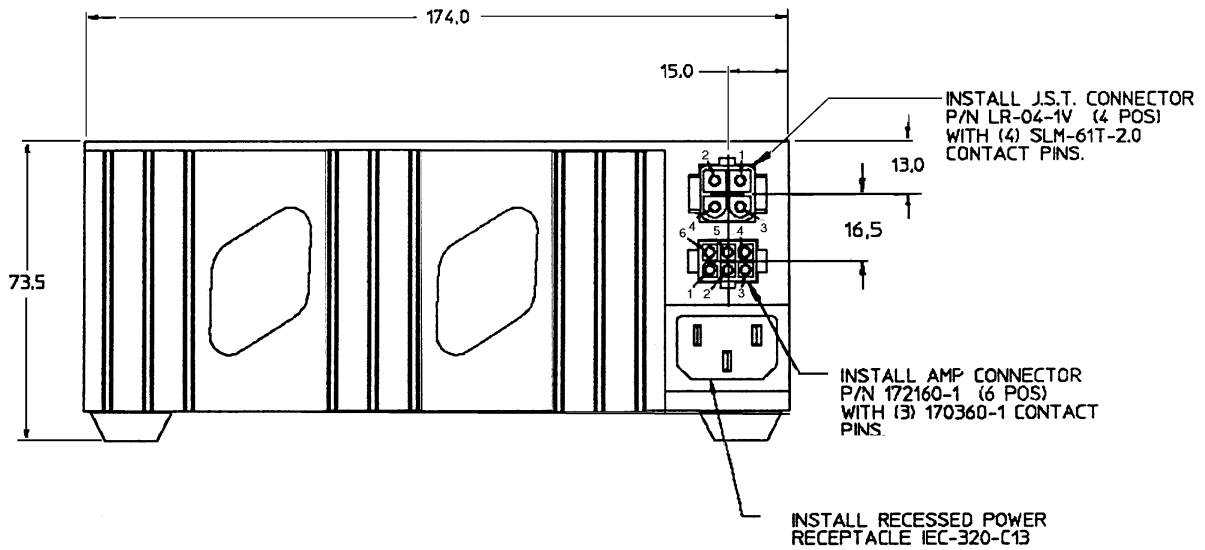


PIN DESCRIPTION OF THE DC OUTPUT MOLEX CONNECTOR:



- Pin 1 - 0 VDC
- Pin 2 - On Battery
- Pin 3 - Not used
- Pin 4 - 13.8 VDC
- Pin 5 - Low Battery
- Pin 6 - Not used

2.8 Power Supply HPN8393 (Not EMC Approved)



Electrical Characteristics

Input Voltages: 105-125VAC; 210-250VAC, 47-63Hz

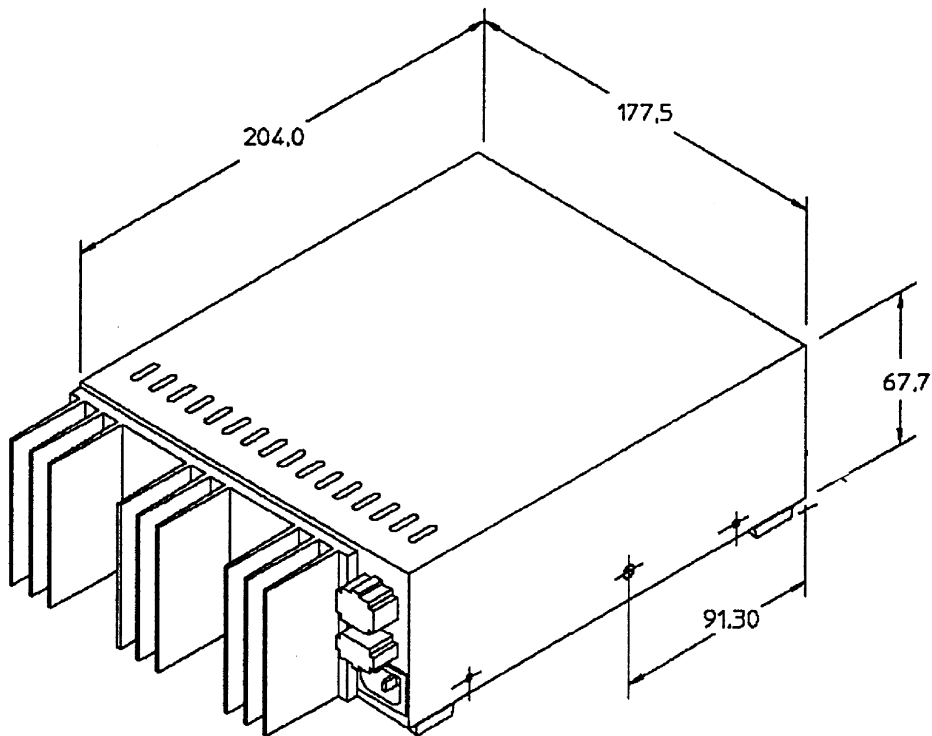
Output Voltage: 13.8VDC \pm 0.1 volts
(internally adjustable 11-15VDC)

Ripple: less than 5mV peak to peak
(full load and low line)

Provides 8 amps continuous duty and 14 amps intermittent duty over an ambient temperature range of -30 to +60°C .

(4 Pos) Positions 1 and 2 are positive power output terminals and positions 3 and 4 are for negative power output terminals for 14 amp max. current.

(6 Pos) Position 1 is negative power output terminal for 3 amp max current. Positions 2,3,6 are empty. Position 4 is positive 13.8VDC power output terminal. Position 5 is positive trickle charge output terminal.



3.0 List of Accessories

Mechanical Hardware Kits:

| | |
|---------|-------------------------------------|
| GLN7324 | Low Profile Trunnion Kit (Standard) |
| GLN7317 | High Profile Trunnion Kit |
| GLN7320 | In-Dash Mount, DIN install. Kit |
| GLN7325 | IP54 seal, accessory connector |
| HLN9457 | Accessory Connector Facility Kit |

Microphones:

| | |
|---------|--|
| GMN6146 | Enhanced Compact Microphone (Standard) |
| GMN6148 | DTMF Microphone |
| HMN3141 | Handset with Hang-up cup |
| HMN3000 | Desk Microphone |

Speakers:

Speaker connecting cables are provided with a 16-pin accessory connector plug.

| | |
|---------|-------------------------------|
| GSN6059 | 13 W External Speaker, square |
|---------|-------------------------------|

Cables:

| | |
|----------|---|
| GKN6270 | Battery power cable 3m, 10A fuse (Standard) |
| GKN6271 | Ignition switch cable |
| ENKN4000 | MAP27 Interface Cable |

Other

| | |
|---------|-----------------------------------|
| GKN6272 | Alarm, Relay and Cable Kit |
| GLN7323 | External PTT |
| GLN7326 | Base Tray (with internal speaker) |
| GPN6126 | 24/12V DC Converter, 6A |
| GPN6127 | 24/12V DC Converter, 15A |
| GPN6133 | EMC approved Power Supply |
| HPN4002 | Non-EMC approved Power Supply |
| HPN8393 | Non-EMC approved Power Supply |

Chapter 4

Radio Tuning Procedure

Table of Contents

| Paragraph | Page |
|--|----------|
| 1.0 GM1200E Tuning Procedure..... | 1 |
| 1.1 General | 1 |
| 1.2 PA Bias Voltage..... | 2 |
| 1.3 Battery Threshold | 3 |
| 1.4 Transmitter Power | 3 |
| 1.5 Reference Oscillator | 4 |
| 1.6 Front-End Pre-Selector..... | 4 |
| 1.7 Rated Volume | 5 |
| 1.8 Squelch..... | 6 |
| 1.9 Transmit Voltage Limit..... | 6 |
| 1.10 Transmit Deviation Balance (Compensation) | 6 |
| 1.11 Transmit Deviation Limit | 7 |
| 1.12 Signalling Alignments | 7 |

Table of Contents

1.0 GM1200E Tuning Procedure

1.1 General

The recommended hardware platform is a 386 or 486 DX 33 PC (personal computer) with 8 Mbytes RAM, MS DOS 5.0™, Windows 3.1™, and DPS (Dealer Programming Software). These are required to align the radio. Refer to your DPS Installation Manual for installation and setup procedures for the required software; the user manual is accessed (and can be printed if required) via the DPS.

To perform the alignment procedures, the radio must be connected to the PC, RIB (Radio Interface Box), and Universal Test Set as shown in figure 4-1.

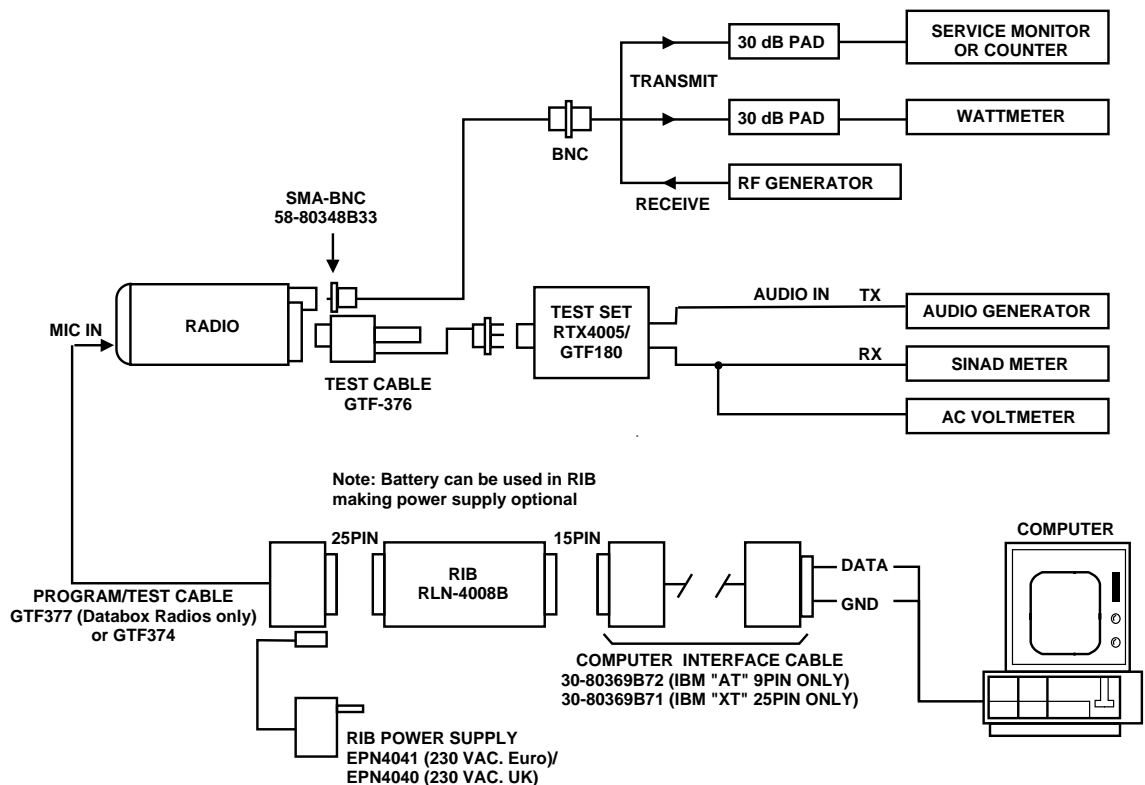


Figure 4-1 Radio Alignment Test Setup

All tuning procedures are performed from the Service menu.

Before going into the Service menu, the radio must first be read using the File / Read Radio menu (if the radio has just been programmed with data loaded from disk or from a newly created codeplug, then it must still be read so that the DPS will have the radio's actual tuning values).

All Service windows read and program the radio codeplug directly; you do NOT have to use the DPS Read Radio / Write Radio functions to program new tuning values.

CAUTION: **DO NOT** switch radios in the middle of any Service procedure. Always use the Program or Cancel key to close the tuning window before disconnecting the radio. Improper exits from the Service window may leave the radio in an improperly configured state and result in seriously degraded radio or system performance.



The Service windows introduce the concept of the “Softpot”, an analog SOFTWARE controlled POTentiometer used for adjusting all transceiver alignment controls. A softpot can be selected by clicking with the mouse at the value or the slider or by hitting the TAB key until the value or the slider is highlighted.

Each Service window provides the capability to increase or decrease the ‘softpot’ value with the mouse, the arrow keys or by entering a value with the keyboard. The window displays the minimum, maximum, and step value of the softpot. In addition transmitter tuning windows indicate the transmitter frequency and whether the radio is keyed.

Adjusting the softpot value sends information to the radio to increase (or decrease) a DC voltage in the corresponding circuit. For example, increasing the value in the Reference Oscillator tune window instructs the radio microprocessor to increase the voltage across a varactor in the reference oscillator to increase the frequency. Pressing the Program button stores all the softpot values of the current window permanently in the radio.

In ALL cases, the softpot value is just a relative number corresponding to a D/A (Digital-to-Analog) generated voltage in the radio. All standard measurement procedures and test equipment are similar to previous radios.

Refer to the DPS on-line help for information on the tuning software.

Perform the following procedures in the sequence indicated.

Note: All tuning procedures must be performed at a supply voltage of 13.2V unless otherwise stated.
The Modulation Analyzer to measure the deviation should be set to frequency modulation with de-emphasis switched off and all high pass filters switched off.

1.2 PA Bias Voltage

Adjustment of the PA Bias is critical for proper radio operation. Improper adjustment will result in poor operation and may damage the PA FET device. For this reason, the PA bias must be set before the transmitter is keyed the first time.

Note: For certain radio models there are two bias voltage settings. For these radios both ‘ Bias 1 Voltage ’ and ‘ Bias 2 Voltage ’ need to be adjusted when aligning the PA Bias. For models that only have one bias voltage setting, the ‘ Bias 2 Voltage ’ will be shown in grey on the service menu.

1. From the Service menu, select Transmitter Alignment.
2. Select Bias Voltage Tuning to open the bias voltage tuning window. If the control voltage is out of range, an error message will be displayed. In this case the radio hardware has a problem and tuning must be stopped immediately.
3. Click the button labelled “0” to set the quiescent current temporarily to 0 mA
4. Measure the DC current of the radio. Note the measured value and add the specified quiescent current shown in table 4-1. The result is the tuning target.
5. Adjust the current per the target calculated in step 4.
6. Click the Program button to store the softpot value.

Table 4-1 Quiescent Current Alignment

| RF-Band | Target |
|------------------|-----------|
| UHF | 440mA±10% |
| VHF / 300-390MHz | 150mA±15% |

1.3 Battery Threshold

The radio uses 2 battery threshold levels Tx High and Tx Low to determine the battery condition.

The Program buttons must only be activated when the power supply is set to the indicated voltage. If the DPS detects that the voltage is not within the expected range for the threshold in question then a message will be displayed to warn that the radio may not be set up correctly for the alignment operation.

CAUTION: Inadvertant use of the program buttons may result in radio failure.



1. From the Service menu, select Transmitter Alignment.
2. Select Battery Threshold to open the battery threshold tuning window. The current softpot values are displayed for information only and cannot be edited.
3. Set the supply voltage to the value indicated for TX High.
4. Click the TX High Program button to store the softpot value for TX High.
5. Set the supply voltage to the value indicated for TX Low.
6. Click the TX Low Program button to store the softpot value for TX Low.
7. Close the window by clicking Cancel.

1.4 Transmitter Power

The radio has two power level settings, a high power level setting, and a low power level setting.

IMPORTANT: To set the transmitter power for customer applications use the Common Radio Parameters window under the Edit menu and set the “Low Power Level” and “High Power Level” powers to the desired values. Only if the transmitter components have been changed or the transmitter does not transmit with the power set in the Common Radio Parameters window the following procedure should be performed.

CAUTION: When setting the Transmitter Power DO NOT EXCEED THE RECOMMENDED POWER SET LIMITS of 25W.



The advanced power setting technology employed in the radio makes use of two reference power level settings along with parameters describing the circuit behaviour. To determine these parameters the DPS requires the power values measured for two different settings.

1. From the Service menu, select Transmitter Alignment.
2. Select RF Power Tuning to open the RF power tuning window. The window will indicate the transmit test frequencies to be used.
3. Select Point 1 value of the first frequency.
4. Click Toggle PTT to key the radio. The status bar will indicate that the radio is transmitting.
5. Measure the transmitter power on your power meter.
6. Enter the measured value in the box Point 1.
7. Select Point 2 value of the first frequency.
8. Measure the transmitter power on your power meter.
9. Enter the measured value in the box Point 2.
10. Click Toggle PTT to dekey the radio.
11. Repeat steps 3 - 10 for all test frequencies shown in the window.
12. Click Program to store the softpot values.

1.5 Reference Oscillator

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation, but also a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

1. From the Service menu, select Transmitter Alignment.
2. Select Reference Oscillator to open the reference oscillator tuning window. The tuning window will indicate the target transmit frequency.
3. Click Toggle PTT to key the radio. The status bar will indicate that the radio is transmitting.
4. Measure the transmit frequency on your frequency counter.
5. Adjust the reference oscillator softpot in the tuning window to achieve a transmit frequency within the limits shown in table 4-2.
6. Click Toggle PTT again to dekey the radio and then press Program to store the softpot value.

Table 4-2 Reference Oscillator Alignment

| RF-Band | Target |
|-----------|---------|
| All bands | ±150 Hz |

1.6 Front-End Pre-Selector

Alignment of the front-end pre-selector is normally not required on these radios. Only if the radio has poor receiver sensitivity or the pre-selector parts has been replaced the following procedure should be performed. The softpot value sets the control voltage of the pre-selector. Its value needs to be set at 7 frequencies across the frequency range.

1. Set the test box (GTF180) meter selection switch to the "Audio PA" position and connect a SINAD meter to the "METER" port.
2. From the Service menu, select Receiver Alignment.
3. Select Front End Filter to open the pre-selector tuning window. The window will indicate the receive test frequencies to be used.

4. Select the first test frequency shown, and set the corresponding value to the start value shown in table 4-4.
5. Set the RF test generator to the receive test frequency, and set the RF level to 10 μ V modulated with a 1 kHz tone at the normal test deviation shown in table 4-3.
6. Measure the RSSI voltage at accessory connector pin 15 with a dc voltmeter capable of 1 mV resolution.
7. Change the softpot value by the stepsize shown in table 4-4 and note the RSSI voltage. The target softpot value is achieved when the measured RSSI voltage change between step 6 and step 7 is lower than the tuning target for the first time. The tuning target, shown in table 4-4, is expressed as the percentage of the measured RSSI voltage and must be recalculated for every tuning step. If the measured RSSI voltage decreases before the target value has been achieved, approximation should be stopped and the current softpot value should be used as target value. Set test box (GTF180) audio switch to the "SPKR" position. The 1 kHz tone must be audible at the target value to make sure the radio is receiving.
8. Repeat steps 4 - 7 for all test frequencies shown in the window.
9. Click the Program button to store the softpot values.

Table 4-3 Normal Test Deviation.

| Channel Spacing | Deviation |
|-----------------|-----------|
| 12.5 kHz | 1.5 kHz |
| 20 kHz | 2.4 kHz |
| 25 kHz | 3 kHz |

Table 4-4 Start Value for Front-End Pre-selector Tuning.

| RF-Band | Target | Stepsize | Start Value |
|------------|--------|----------|-------------|
| UHF | 0.42% | -2 | Maximum |
| VHF | 0.5% | +2 | Minimum |
| 300-350MHz | 0.84% | -2 | Maximum |
| 336-390MHz | 0.31% | -2 | Maximum |

1.7 Rated Volume

The rated volume softpot sets the volume at normal test modulation.

1. Set test box (GTF180) meter selection switch to the "AUDIO PA" position and the speaker load switch to the "MAXAR" position. Connect an AC voltmeter to the test box meter port.
 2. From the Service menu, select Receiver Alignment.
 3. Select Rated Volume to open the rated volume tuning window. The screen will indicate the receive test frequency to be used.
 4. Set the RF test generator to the receive test frequency, and set the RF level to 1mVolt modulated with a 1 kHz tone at the normal test deviation shown in table 4-3. Set test box (GTF180) audio switch to the "SPKR" position. The 1 kHz tone must be audible to make sure the radio is receiving.
 5. Adjust the value of the softpot to obtain rated audio volume (as close to 3.87 Vrms).
- Note:** The voltage at the meter port of the testbox GTF180 is only half the voltage at the speaker.
6. Click the Program button to store the softpot value.

1.8 Squelch

The squelch softpots set the signal to noise ratio at which the squelch opens. The squelch value needs to be set at 7 frequencies across the frequency range.

1. Set the test box (GTF180) meter selection switch to the "Audio PA" position and connect a SINAD meter to the "METER" port.
2. From the Service menu, select Receiver Alignment.
3. Select Squelch Attenuation to open the squelch attenuation tuning window. The window will indicate the receive test frequencies to be used.
4. Select the first test frequency shown, and set the corresponding value to 0.
5. Set the RF test generator to the test frequency and modulate the signal generator at the normal test deviation shown in table 4-3, with 1 kHz tone. Adjust the generator for a 8-10 dB SINAD level (weighted with psophometric filter).
6. Adjust the softpot value until the squelch just closes.
7. Monitor for squelch chatter; if chatter is present, repeat step 6.
8. When no chatter is detected, select the next softpot and repeat steps 4 - 7 for all test frequencies shown in the window.
9. Click the Program button to store the softpot values.

1.9 Transmit Voltage Limit

The transmit control voltage limit softpot sets the maximum power control voltage. All 7 voltage limit softpots are tuned and programmed automatically when the Program button is clicked.

1. From the Service menu, select Transmitter Alignment.
2. Select Voltage Limit to open the voltage limit tuning window.
3. Set the Power Factor to 1.3.
4. Click the Program button to store the softpot values.

1.10 Transmit Deviation Balance (Compensation)

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesiser low frequency port) lines. Compensation algorithm is critical to the operation of signalling schemes that have very low frequency components (e.g. DPL) and could result in distorted waveforms if improperly adjusted. The compensation value needs to be set at 7 frequencies across the frequency range.

1. From the Service menu, select Transmitter Alignment.
2. Select Modulation Attenuation to open the deviation balance tuning window. The window will indicate the transmit test frequencies to be used.
3. Set the Test Box (GTF180) meter selector switch to the "GEN" position, and inject a 80 Hz tone at 200 mVrms into the "Audio In" port. (The deviation measured at step 6 should be about 1-4kHz.) Connect an AC meter to the meter port to insure the proper input signal level.
4. Select the first test frequency shown in the window.
5. Click Toggle PTT to key the radio. The status bar will indicate that the radio is transmitting.
6. Measure the transmitter deviation.

7. Change the input tone to 3 kHz, 200 mVrms.
8. Adjust the deviation to within $\pm 2\%$ of the value recorded in step 6.
9. Check the deviation at 80 Hz again and repeat step 7-8, if it has changed since step 6.
10. Click the Toggle PTT to dekey the radio.
11. Repeat steps 3 - 10 for the remaining test frequencies.
12. Click the Program button to store the softpot values.

Note: The step size change for step 8 is approximately 2.5% softpot value.

1.11 Transmit Deviation Limit

The transmit deviation limit softpot sets the maximum deviation of the carrier. The deviation value needs to be set at 7 frequencies across the frequency range.

1. From the Service menu, select Transmitter Alignment.
2. Select Reference Attenuation to open the reference attenuation tuning window.
3. Set the maximum value and press Program to store the softpot value.
4. From the Service menu, select Transmitter Alignment.
5. Select VCO Attenuation to open the deviation limit tuning window. The window will indicate the transmit test frequencies to be used.
6. Set the Test Box (GTF180) meter selector switch to the "GEN" position, and inject a 1 kHz tone at 800 mVrms into the "Audio In" port. Connect an AC meter to the meter port to ensure the proper input signal level.
7. Select the first test frequency shown in the window.
8. Click the Toggle PTT to key the radio. The status bar will indicate that the radio is transmitting.
9. Adjust the transmitter deviation to the value shown in table 4-5.
10. Click the Toggle PTT to dekey the radio.
11. Repeat steps 8 - 10 for the remaining test frequencies.
12. Click the Program button to store the softpot values.

Table 4-5 Transmitter Deviation

| Channel Spacing | Deviation |
|-----------------|-------------|
| 12.5 kHz | 2.2-2.3 kHz |
| 20 kHz | 3.4-3.6 kHz |
| 25 kHz | 4.3-4.6 kHz |

1.12 Signalling Alignments

1.12.1 MPT RSSI Threshold Level

The Program buttons must only be activated when the required signal is input to the radio and the radio is receiving. If the DPS detects that the input signal is not within the expected range for the RSSI level in question then a message will be displayed to warn that the radio may not be set up correctly for the alignment operation.

CAUTION: Inadvertant use of the program buttons may result in radio failure.



1. Set test box (GTF180) meter selection switch to the "AUDIO PA" position and the speaker load switch to the "MAXAR" position.
2. From the Service menu, select Receiver Alignment.
3. Select RSSI to open the RSSI tuning window. The screen will indicate the receive test frequency to be used.
The softpot values are displayed for information only and cannot be edited.
4. Set the RF test generator to the receive test frequency, and set the RF level to the value indicated for RSSI Level 0, modulated with a 1 kHz tone at the normal test deviation shown in table 4-3. Set test box (GTF180) audio switch to the "SPKR" position. The 1 kHz tone must be audible to make sure the radio is receiving.
5. Click the Program button to store the softpot value for RSSI Level 0.
6. Repeat steps 4 - 5 for the remaining RSSI levels.
7. Click the Cancel button to close the window.

1.12.2 MPT1327 Transmit Deviation / DTMF Transmit Deviation

The MPT1327 Deviation Softpot is used to tune the FFSK signalling deviation. Tuning is performed at one frequency. The radio generates an alternating bit pattern for tuning. Values for other frequencies are calculated by the radio software.

The DTMF Deviation Softpot is used to tune the DTMF signalling deviation. Tuning is performed at one frequency. The radio generates a DTMF signal for tuning. Values for other frequencies are calculated by the radio software.

1. From the Service menu, select Transmitter Alignment.
2. Select Signalling Deviation to open the signalling deviation tuning window.
3. Select the MPT value and click the Toggle PTT to key the radio. The status bar will indicate that the radio is transmitting.
4. Adjust the transmitter deviation to the value shown in table 4-6.
5. Click the Toggle PTT to dekey the radio.
6. Repeat steps 3 - 5 for DTMF deviation.
7. Click the Program button to store the softpot value.

Table 4-6 Signalling Deviation

| Channel Spacing | MPT 1327 | Deviation |
|-----------------|-------------|-------------|
| 12.5 kHz | 1.4-1.6 kHz | 1.5-1.8 kHz |
| 20 kHz | 2.2-2.6 kHz | 2.4-2.8 kHz |
| 25 kHz | 2.8-3.2 kHz | 3.0-3.4 kHz |

Appendix A

PL/DPL Codes

Table of Contents

| Paragraph | | Page |
|------------|--|------|
| 1.0 | PL Codes and Digital PL (DPL) Codes | 1 |
| 1.1 | PL Codes | 1 |
| 1.2 | Digital PL (DPL) Codes | 1 |

Table of Contents

1.0 PL Codes and Digital PL (DPL) Codes

The following have been tested and are acceptable for programming into any transmit or receive frequency.

1.1 PL Codes

| GROUP A | | GROUP B | | GROUP C | |
|---------|-------|---------|-------|---------|-------|
| Code | Freq | Code | Freq | Code | Freq |
| XZ | 67.0 | XA | 71.9 | WZ | 69.3 |
| XB | 77.0 | YZ | 82.5 | WA | 74.4 |
| YB | 88.5 | ZA | 94.8 | WB | 79.7 |
| 1Z | 100.0 | 1A | 103.5 | YA | 85.4 |
| 1B | 107.2 | 2Z | 110.0 | ZZ | 91.5 |
| 2A | 114.8 | 2B | 118.8 | ZB | 97.4 |
| 3Z | 123.0 | 3A | 127.3 | 5B | 162.2 |
| 3B | 131.8 | 4Z | 136.5 | 8Z | 206.5 |
| 4A | 141.3 | 4B | 146.2 | | |
| 5Z | 151.4 | 5A | 156.7 | | |
| 6A | 173.8 | 6Z | 167.9 | | |
| 7Z | 186.2 | 6B | 179.9 | | |
| M1 | 203.5 | 7A | 192.8 | | |
| M3 | 218.1 | M2 | 210.7 | | |

1.2 Digital PL (DPL) Codes:

| | | | | | |
|-----|-----|-----|-----|-----|-----|
| 023 | 025 | 026 | 031 | 032 | 036 |
| 043 | 047 | 051 | 053 | 054 | 065 |
| 071 | 072 | 073 | 074 | 114 | 115 |
| 116 | 122 | 125 | 131 | 132 | 134 |
| 143 | 145 | 152 | 155 | 156 | 162 |
| 165 | 172 | 174 | 205 | 212 | 223 |
| 225 | 226 | 243 | 244 | 245 | 246 |
| 251 | 252 | 255 | 261 | 263 | 265 |
| 266 | 271 | 274 | 306 | 311 | 315 |
| 325 | 331 | 332 | 343 | 346 | 351 |
| 356 | 364 | 365 | 371 | 411 | 412 |
| 413 | 423 | 431 | 432 | 445 | 446 |
| 452 | 454 | 455 | 462 | 464 | 465 |
| 466 | 503 | 506 | 516 | 523 | 526 |
| 532 | 546 | 565 | 606 | 612 | 624 |
| 627 | 631 | 632 | 654 | 662 | 664 |
| 703 | 712 | 723 | 731 | 732 | 734 |
| 743 | 754 | | | | |

Appendix B

NPD Application Notes

Table of Contents

| Paragraph | Page |
|--|------|
| 1.0 Non Prescribed Data (NPD) Calls | 1 |
| 2.0 Calls with DTE connected to External Data Connector (Radio Accessory Connector) | 1 |
| 2.1 DTE Initiated Call (Outgoing Calls) | 1 |
| 2.2 Calls Initiated by another Radio Unit (Incoming Calls) | 1 |
| 3.0 Calls with DTE connected to Internal Data Connector (Radio Option Connector) | 1 |
| 3.1 DTE Initiated Call (Outgoing Calls) | 1 |
| 3.2 Calls Initiated by another Radio Unit (Incoming Calls) | 2 |
| 4.0 Other Calls | 2 |
| 4.1 Voice Calls | 2 |
| 4.2 Status Calls | 2 |
| 4.3 Mixed Calls | 2 |

Table of Contents

1.0 Non Prescribed Data (NPD) Calls

Non Prescribed Data calls utilising external Data Terminal Equipment (DTE) can be made using the GM1200E Databox radio as the carrier.

Call protocol is by a combination of control line handshakes, the complexity of which depends on the intelligence of the DTE.

2.0 Calls with DTE connected to External Data Connector (Radio Accessory Connector)

2.1 DTE Initiated Call (Outgoing Calls)

- Call set-up is initiated on 'Call 1' which should be programmed with an address including the 'Non Prescribed Data' (NPD) call modifier (*31*).
- When the traffic channel data path is set up, the radio will enable the audio input and output lines (with the microphone and loudspeaker lines disabled) and then signal that the DTE is Clear to Send (CTS).
- The DTE will send and receive audio signals using the PTT line as direction control.
- Call clear can be from either DTE or radio.
 - DTE will remove the signal from 'Call 1' or signal on 'Call Clear'.
 - Radio will remove the CTS line signal.

2.2 Calls Initiated by another Radio Unit (Incoming Calls)

- Incoming calls will be indicated by a signal on the CTS.
- The call will be "answered" by the DTE signalling on 'Call 1'.
- The call will continue and clear as described above in section 2.1

3.0 Calls with DTE connected to Internal Data Connector (Radio Option Connector)

3.1 DTE Initiated Call (Outgoing Calls)

It is possible for the radio to call up to 3 different destinations (addresses) by using a combination of Call 1 and Call 2 lines to signal one of three possibilities (Call N).

- Call set-up is initiated on 'Call N' which should be programmed with an address including the 'Non Prescribed Data' (NPD) call modifier (*31*).
- When the traffic channel data path is set up, the radio will enable the audio input and output lines (with the microphone and loudspeaker lines disabled) and then signal that the DTE is Clear to Send (CTS).
- The DTE will send and receive audio signals using the PTT line as direction control.
- Call clear can be from either DTE or radio.
 - DTE will remove the signal from 'Call N' or signal on 'Call Clear'.
 - Radio will remove the CTS line signal.

3.2 Calls Initiated by another Radio Unit (Incoming Calls)

- Incoming calls will be indicated by a signal on the CTS.
- The call will be “answered” by the DTE signalling on ‘Call 3’ (i.e.Call 1 and Call 2 lines both enabled).
- The call will continue and clear as described above in section 3.1

4.0 Other Calls

4.1 Voice Calls

It is possible to set up voice calls internally or externally using the procedures described above by omitting the NPD call modifier from the called address. In this case the audio paths will be set up to use the external microphone and loudspeaker with the volume pre-set. It is not possible to adjust the volume from inside the radio.

4.2 Status Calls

It is possible to signal status calls internally or externally.

- Status is sent by signalling on ‘Call N’ to a pre-set address using the Status call modifier.
- The radio will send the pre-set status call to the pre-programmed address.
- Call “success” will be signalled with a pulse on the CTS line.

4.3 Mixed Calls

Due to the ambiguity necessarily introduced by the very simple handshaking techniques employed, users should only consider mixing Data/Voice/Status calls if they are confident that their DTE is capable of correctly interpreting the handshakes under all conditions for all incoming and outgoing call types likely to be encountered.