

Professional Digital Two-Way Radio System

MOTO**TRBO™** Repeater

Installation Guide

DR 3000 Repeater



Foreword

This manual is intended for use by experienced technicians familiar with similar types of equipment. Specifically, it contains installation information required for the MOTOTRBO Repeater.

Product Safety and RF Exposure Compliance

See *Installation Requirements for Compliance with Radio Frequency (RF) Energy Exposure Safety Standards* on page ii.

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Installation Requirements for Compliance with Radio Frequency (RF) Energy Exposure Safety Standards

ATTENTION!

This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC/ICNIRP limits. This radio device is NOT authorized for general population, consumer, or any other use.

To ensure compliance to RF Energy Safety Standards:

- Install only Motorola approved antennas and accessories
- Be sure that Product Safety and RF Safety Booklet enclosed with this radio is available to the end user upon completion of the installation of this radio

Before using this product, the operator must be familiar with the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with each radio (Motorola Publication part number 6866537D37) to ensure compliance with Radio Frequency (RF) energy exposure limits.

For a list of Motorola-approved antennas and other accessories, visit the following web site which lists approved accessories for your radio model:

<http://www.motorola.com/governmentandenterprise>

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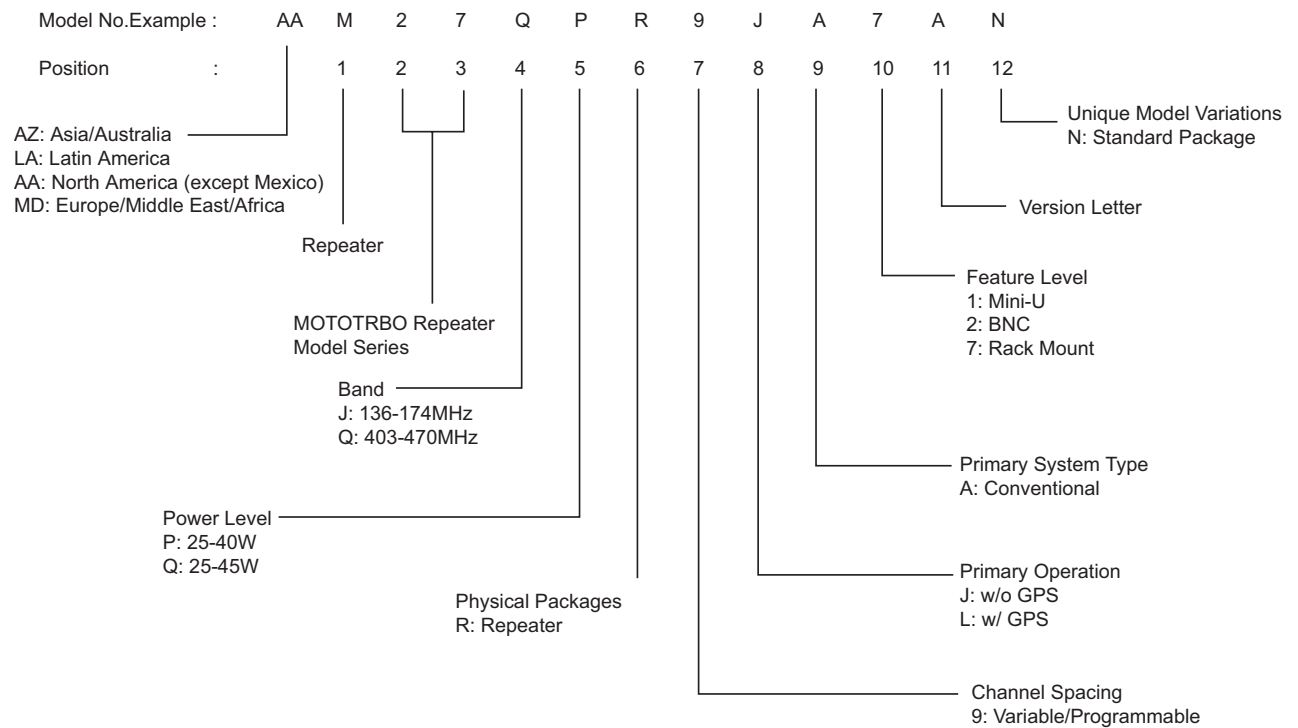
Related Publications

DR 3000 Basic Service Manual.....	6866576D03
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Repeater Model Numbering Scheme



Chapter 1 Pre-Installation Considerations

Proper installation ensures the best possible performance and reliability of the MOTOTRBO Repeater. Pre-installation planning is required. This includes considering the mounting location of the repeater in relation to input power and antennas. Also to be considered are site environment conditions, the particular mounting method (several available), and required tools and equipment.

If this is the first time installing this type of equipment, it is highly recommended that the user read:

- this entire installation section before beginning the actual installation, and
- the Motorola Quality Standard Fixed Network Equipment Installation manual, R56 (6881089E50), specifically refer to the information on ground connection for lightning protection.

1.1 Installation Overview

The following information is an overview for installing the MOTOTRBO Repeater and ancillary equipment. Step-by-step procedures for each of the major installation tasks are then provided beginning in Section 2, Mechanical Installation.

- Plan the installation, paying particular attention to environmental condition at the site, ventilation requirements, and grounding and lightning protection.
- Unpack and inspect the equipment.
- Mechanical install the equipment at the site.
- Make necessary electrical and cabling connections, including the following:
 - AC input cabling
 - Coaxial cables to transmit and receive antennas
- Perform a post-installation function checkout test of the equipment to verify proper installation.
- Proceed to the Optimization procedures to customize the repeater parameters per customer specifications (e.g. operating frequency, PL, codes, color code, etc.).

1.2 Environmental Conditions at Intended Installation Site



If the repeater is to be installed in an environment which is usually dusty or dirty (and so does not meet the air quality requirements), the air used to cool the repeater modules must be treated using appropriate filtering devices. Dust or dirt accumulating on the internal circuit boards and modules is not easily removed, and can cause such malfunctions as overheating and intermittent electrical connections.

The repeater may be installed in any location suitable for electronic communications equipment, provided that the environmental condition do not exceed the equipment specifications for temperature, humidity, and air quality.

1.2.1 Operating Temperature Range

-30°C (-22°F) to +60°C (+140°F)

This is the temperature measured in close proximity to the repeater. For example, if the repeater is mounted in a cabinet, the temperature within the cabinet is measured.

1.2.2 Humidity

Not to exceed 95% relative humidity @ 50°C (122°F).

1.2.3 Air Quality

For equipment operating in an environmentally controlled environment with repeater(s) rack mounted, the airborne particle level must not exceed 25 µg/m³.

For equipment operating in an area which is not environmentally controlled (repeater(s) cabinet mounted), air borne particle level must not exceed 90 µg/m³.

1.3 Equipment Ventilation

The repeater is equipped with a cooling fan that is used to provide forced convection cooling. When planning the installation, observe the following ventilation guidelines:

- Customer-supplied cabinets must be equipped with ventilation slots or openings in the front (for air entry) and back or side panels (for air to exit). If several repeaters are installed in a single cabinet, be sure ventilation openings surround each repeater to allow for adequate cooling.
- All cabinets must have a least 15 cm (6 inches) of open space between the air vents and any wall or other cabinets. This allows adequate air flow.
- When multiple cabinets (each equipped with several repeaters) are installed in an enclosed area, make sure the temperature within each cabinet does not exceed the recommended/ maximum operating temperature of +16°C (+140°F). It may be necessary to have air conditioning or other climate control equipment installed to satisfy the environmental requirements.

1.4 AC Input Power Requirements

The repeater is equipped with a switching power supply, this assembly operates from 100Vac to 240Vac at 47 to 63Hz AC input power. A standard 3-prong line cord is supplied to connect the power supply to the AC source.

It is recommended that a standard 3-wire grounded electrical outlet be used as the AC source.



The AC socket outlet must be installed near the equipment and must be easily accessible.

The outlet must be connected to an AC source capable of supplying a maximum of 280W. For a nominal 110/120Vac input, the AC source must supply 5A and should be protected by circuit breaker rated at 15A. For a nominal 220/240Vac input, the AC source must supply 3A and should be protected by a circuit breaker rated at 10A.

1.4.1 Circuit Overloading

Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment ratings should be used when addressing this concern.

1.5 Equipment Mounting Methods

The MOTOTRBO Repeater may be mounted in a rack, bracket or cabinet (available as accessories).

1.6 Site Grounding and Lightning Protection



Proper site grounding and lightning protection are vitally important consideration. Failure to provide proper lightning protection may result in permanent damage to the radio equipment.

One of the most important considerations when designing a communications site is the ground and lightning protection system. While proper grounding techniques and lightning protection are closely related, the general category of site grounding may be divided into the following section.

1.6.1 Electrical Ground

Ground wires carrying electrical current from circuitry or equipment at the site is included in the category of electrical ground. Examples include the AC or DC electrical power used to source equipment located at the site, and wires or cables connected to alarms or sensors located at the site.

1.6.2 RF Ground

This type of ground is related to the transmission of the radio frequency energy to earth ground. An example of RF grounding is the use of shielding to prevent or at least minimize the leakage of unwanted RF transmissions from communications equipment and cables.

1.6.3 Lightning Ground

Providing adequate lightning protection is critical to a safe reliable communications site. RF transmission cables, and AC and DC power lines must all be protected to prevent lightning energy from entering the site building.

Although a comprehensive coverage of the site grounding technique and lightning protection is not within the scope of this instruction manual, there are several excellent industry sources for rules and guidelines on ground and lightning protection at communications site.

NOTE: Motorola recommends the following reference source:

Motorola Quality Standards Fixed Network Equipment

Installation Manual R56.....6881089E50

1.6.4 Equipment Grounding Guidelines

The repeater is equipped with a ground screw located on the rear of the repeater power supply module. This screw is used to connect the repeater to the site ground point. It is assumed that all antenna cables, and AC or DC power cabling, has been properly grounded and lightning protected by following the industry rules and guidelines.

1.7 Power Supply Connections

Refer to 4.1.1 AC Input Power Connection on page 4-1 for the recommended AC input power connection and to 4.1.2 Ground Connection on page 4-2 for the recommended ground connection.

Notes

Chapter 2 Mechanical Installation

This section describes the procedures to unpack and mechanically install the MOTOTRBO Repeater. A variety of mounting methods are possible, depending on which type of cabinet or rack (if any) has been selected to house the repeater(s). Installation procedures are provided for each of the cabinet and rack types.



Be sure to observe proper electrostatic discharge precautions if modules must be removed from the repeater.

2.1 Unpacking Equipment



Inspect the equipment for damage immediately after unpacking, and make a report of the extent of any damage to the transportation company and to Motorola.

2.2 Transferring Equipment from Shipping Container to Rack or Cabinet

The repeater is shipped in a box. Upon delivery, the equipment must be removed from the container and transferred to a rack or cabinet.

NOTE: Customer-supplied cabinets and racks must have mounting rail and hole spacing compatible with EIA Universal 48.3 cm (19 inches) specifications. Cabinets must provide adequate ventilation (as detailed on page 3) and must meet the following criteria:

- 41.3 cm (16.25 inches) deep
- 48.3 cm (19 inches) wide
- 13.4 cm (5.25 inches) high

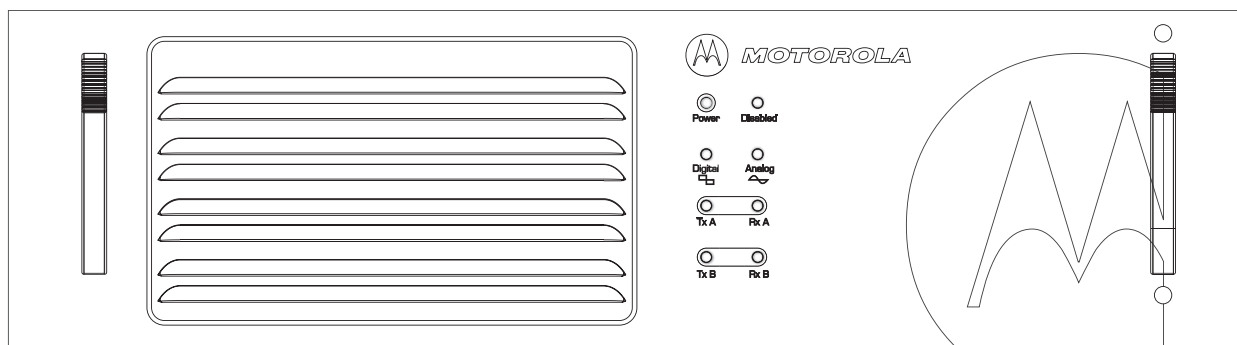
Two mounting rails 5 cm (2 inches) from front cabinet with front mounting holes 5.7 cm (2.25 inches) apart (center to center).

Contact Motorola Technical Support for specific question regarding mounting equipment in customer-supplied cabinets.

Notes

Chapter 3 Indicators and Connectors

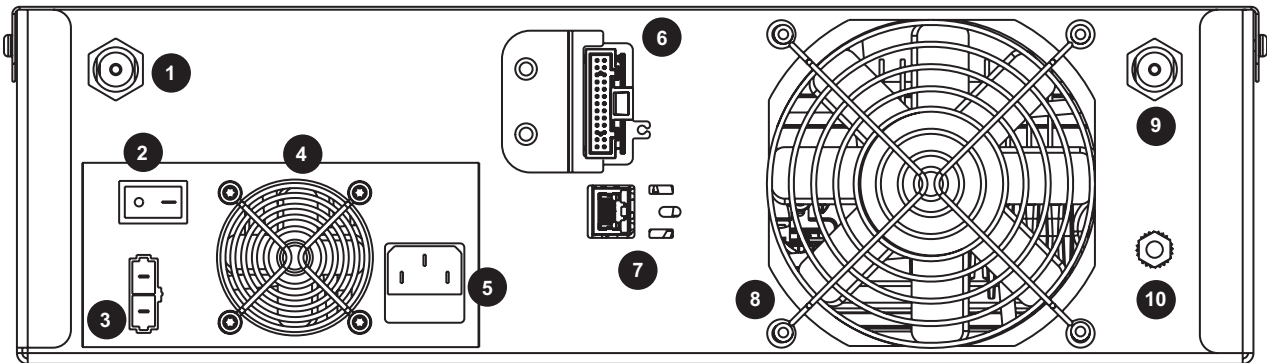
3.1 Front Panel



3.1.1 LED Indicator Descriptions

LED	Status	Description
Power	Solid GREEN	Repeater powered by AC
	Solid RED	Repeater powered by backup battery
	Off	Repeater powered off
Repeater Disable	Solid RED	Repeater function disabled
	Blinking RED	Repeater in self-test mode
	Off	Repeater in normal operational mode
Digital	Solid BLUE	Repeater in Digital Mode
Analog	Solid YELLOW	Repeater in Analog Mode
TX-A	Solid GREEN	Repeater transmitting (Analog)
	Solid GREEN	Repeater transmitting on Slot A (Digital)
RX-A	Solid YELLOW	Repeater receiving a signal for Slot A (Analog)
	Solid YELLOW	Repeater receiving on Slot B (Digital)
TX-B	Solid GREEN	Repeater transmitting on Slot B (Digital)
RX-B	Solid YELLOW	Repeater receiving a signal for Slot B (Digital)

3.2 Rear Panel



3.2.1 Rear Panel Parts

No	Item	Description
1	RX Connector	Type BNC-F
2	Power Supply On/Off Switch	Turns on or off the power to the repeater from both AC input and backup battery. If the switch is off, the repeater will not switch to battery operation.
3	Battery Backup Connector (DC Input)	Backup battery supplies backup power to the repeater. The battery is an optional accessory. The repeater will trickle charge battery, but an external charger is recommended to equalize battery after a prolonged use. Auto switching from AC to battery with loss of AC power is a function of the standard repeater power supply. Supply will automatically switch back to AC operation upon the return of AC power. The front panel power LED switches from green to red when on battery power.
4	Power Supply Fan	Runs continuously.
5	Main Power Supply Connector (AC Input)	100 – 240 Volts
6	26-Pin Accessory Connector	Programming cable plugs in here.
7	Ethernet Connector	(For Future Use)
8	Main Fan	Variable speed. Idles at room temperature. Speeds up with extended use of the repeater.
9	TX Connector	Type N-F
10	Ground Screw	Must be connected to System Ground.

Chapter 4 Electrical Connections

After the MOTOTRBO Repeater has been mechanically installed, electrical connections must be made. This involves making the following connections:

- to power supply via AC power cord, and to
- antenna coax cables

Figure 4-1 shows the position of the repeater external connectors and line cord located on the back panel. The AC power cord is also located at the rear of the repeater.

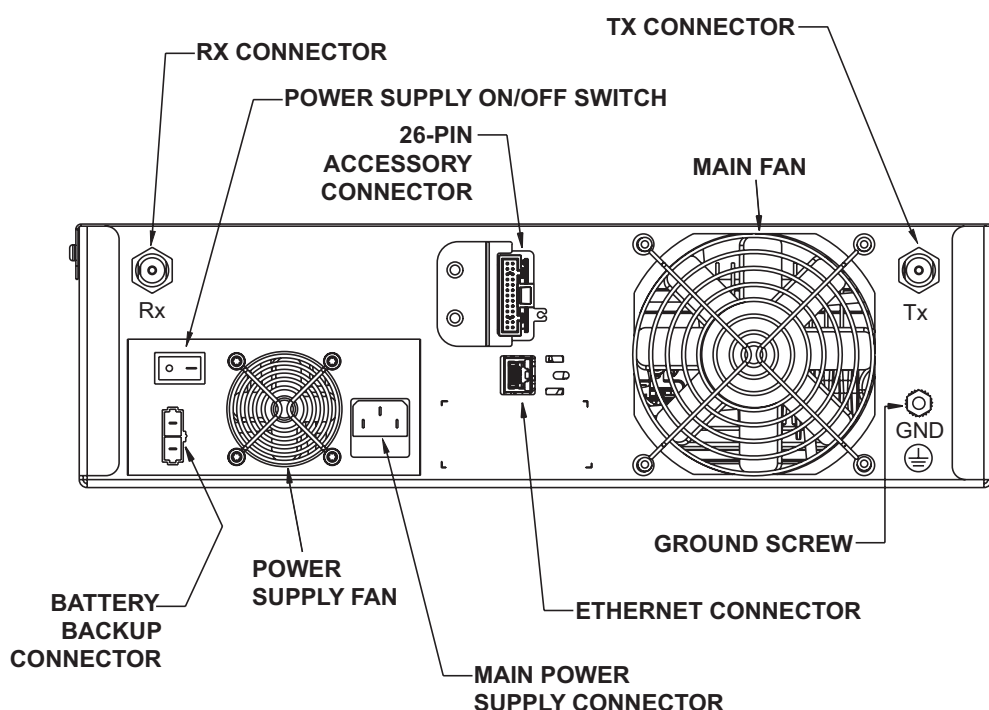


Figure 4-1 Locations of External Connectors at Rear of Repeater

4.1 Power Supply Connections

4.1.1 AC Input Power Connection



Do not apply AC power to the repeater at this time. Make sure that the circuit breaker associated with the AC outlet is turned to **OFF**.

NOTE: The AC socket-outlet must be installed near the equipment and must be easily accessible.

Each repeater ships with a 2.438 m (8 feet) 3-conductor line cord that connects the repeater to a 110/120/220/240Vac source. Figure 4-1 shows the location of the main power supply connector (AC input), where the line cord connects to the repeater. Insert the 3-prong plug into a 110/120/220/240Vac grounded outlet.

If an alternate line cord is required, obtain a suitable line cord, with fittings approved by the safety testing agency in the end-use country, from a certified electrical parts supplier.

4.1.2 Ground Connection

The repeater is equipped with a ground screw located on the rear of the repeater. Connect the ground screw to the site ground point.



Caution

Refer to Motorola Quality Standards Fixed Network Equipment Installation Manual R56 (6881089E50), for complete information regarding lightning protection.



Caution

The repeater is to be connected to a battery supply that is in accordance with the applicable electrical codes for the end use country; for example, the National Electrical Code ANSI/NFPA No. 70 in the U.S.

4.1.3 Battery Backup Connection

The MOTOTRBO Repeater offers the capability of connecting to battery backup power in the event of an AC power failure.

The battery backup system is connected to the repeater through the DC connector mounted at the rear of the repeater.

The repeater power supply will trickle charge the backup battery. If the battery is significantly discharged, it is recommended that an external charger be used to charge the battery.



Caution

The repeater is to be connected to a battery charger that is in accordance with the applicable electrical codes for the end use country; for example, the National Electrical Code ANSI/NFPA No.70 in the U.S.



Figure 4-2 Making Connections to a Backup Battery

4.2 RF Antenna Connections

The transmit and receive antenna RF connection are made using two separate connectors. Coax cable from the receive and transmit antenna must be connected to the N-type (TX) and BNC-type (RX) connectors. The position of these connectors is shown in Figure 4-1. For repeater use, either two antennas with adequate isolation (75 dB - UHF and 85 dB - VHF) between them, or one antenna and a duplexer with at least 75 dB - UHF and 85 dB - VHF isolation between the TX and RX antenna ports is required.



The repeater can key up at any time due to input from a subscriber unit or a CW ID. Please insure that all power is switched off before disconnecting the transmit antenna.

4.2.1 Duplexer Selection

The selection of the duplexer is critical to system performance. The use of a notch (band reject) duplexer is possible in some systems that are not located at high RF density sites. A duplexer like the HFE8400 (406 – 450 MHz) or RFE4000 (450 – 470 MHz) or HFD8465 (150 – 160 MHz) is adequate. Note that these duplexers are good for 4 to 7 MHz TX/RX spacings. Select another duplexer for other TX/RX spacings.

The duplexer must be able to handle at least 50 Watts continuously. For the best system range, the insertion loss should be less than 2 dB. If the repeater is used in higher RF density sites, the use of a bandpass duplexer is recommended.

4.2.2 Antenna Selection

The selection of the antenna is critical to system performance. The selected antenna must be 50 Ohm impedance and capable of at least 50 Watts. Gain antennas may be used to increase system coverage. Please take note of licensing restrictions when selecting gain antennas. Some services or regions may have antenna gain or system ERP limitations.

The antenna must be connected to the duplexer with a high grade 50 Ohm transmission line (Helix). The line must have connectors to match the connectors on the duplexer and antenna. For proper antenna installation, please also consult the Motorola Quality Standards Fixed Network Equipment Installation Manual R56 (6881089E50).



It is important that all antenna cables are grounded at the point they enter the building.



The antenna design is the customer's responsibility. All aspects of the antenna design must comply with the relevant local regulations.

Notes

Chapter 5 Post-Installation Checklist

After the MOTOTRBO Repeater has been mechanically installed and all electrical connections have been made, power may now be applied and the repeater checked for proper operation.

5.1 Applying Power

Before applying power to the repeater, make sure all boards are securely seated in the appropriate connectors on the backplane and that all RF cables are securely connected.

Turn ON the circuit breaker controlling the AC outlet that is supplying power to the repeater Power Supply Module.

5.2 Verifying Proper Operation

Operation of the repeater can be verified by:

- observing the state of the 8 LEDs located on the front panel, and
- exercising radio operation.



Some repeater components can become extremely hot during operation. Turn off all power to the repeater, and wait until sufficiently cool before touching the repeater.

5.2.1 Front Panel LEDs

After turning ON the repeater power (or after a repeater reset), the 8 LEDs on the repeater front panel:

- are all lit for about one second to indicate that they are functional.
- go off for one second.
- now indicate operational status of the repeater.

5.3 Archiving

5.3.1 Copying the Repeater Codeplug Data to a Computer

Backup the repeater's codeplug data by using the Customer Programming Software (CPS) on a computer.

Notes

Appendix A EMEA Regional Warranty, Service and Technical Support

1.0 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 authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

1.1 Warranty Period and Return Instructions

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. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources (Please see page A-3). 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.

1.2 After Warranty Period

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

1. Motorola's Managed Technical Services (MTS) offers a repair service to both end users and dealers at competitive prices.
2. MTS supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

2.0 European Radio Support Centre (ERSC)

The ERSC Customer Information Desk is available through the following service numbers:

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 05 72	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK :	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:
Tel: +49 30 6686 1555

Please use these numbers for repair enquiries only.

3.0 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 Products and Solutions Organization (RPSO). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

Orders for replacement parts, kits and assemblies should be placed directly on Motorola's local distribution/dealer organisation or via Motorola Online at: <http://emeaonline.motorola.com>

* The Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

4.0 Technical Support

Motorola Product Services is available to assist the dealer/distributors in resolving any malfunctions which may be encountered.

North Europe - Stephen Woodrow
Telephone: +44 (0) 1256 488 082
Fax: +44 01256 488 080
Email: CSW066@motorola.com

Central and East Europe - Siggie Punzenberger
Telephone: +49 (0) 6128 70 2342
Fax: +49 (0) 6128 95 1096
Email: TFG003@email.mot.com

Russia and Belarus - Oleg Machnev
Telephone: +7 495 785 0150
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Email: COM005@email.mot.com

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Email: laurent.irrmann@motorola.com

5.0 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.
<http://www.motorola.com/governmentandenterprise/contactus>



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