Radius GR300

ZR310 Community Repeater Panel

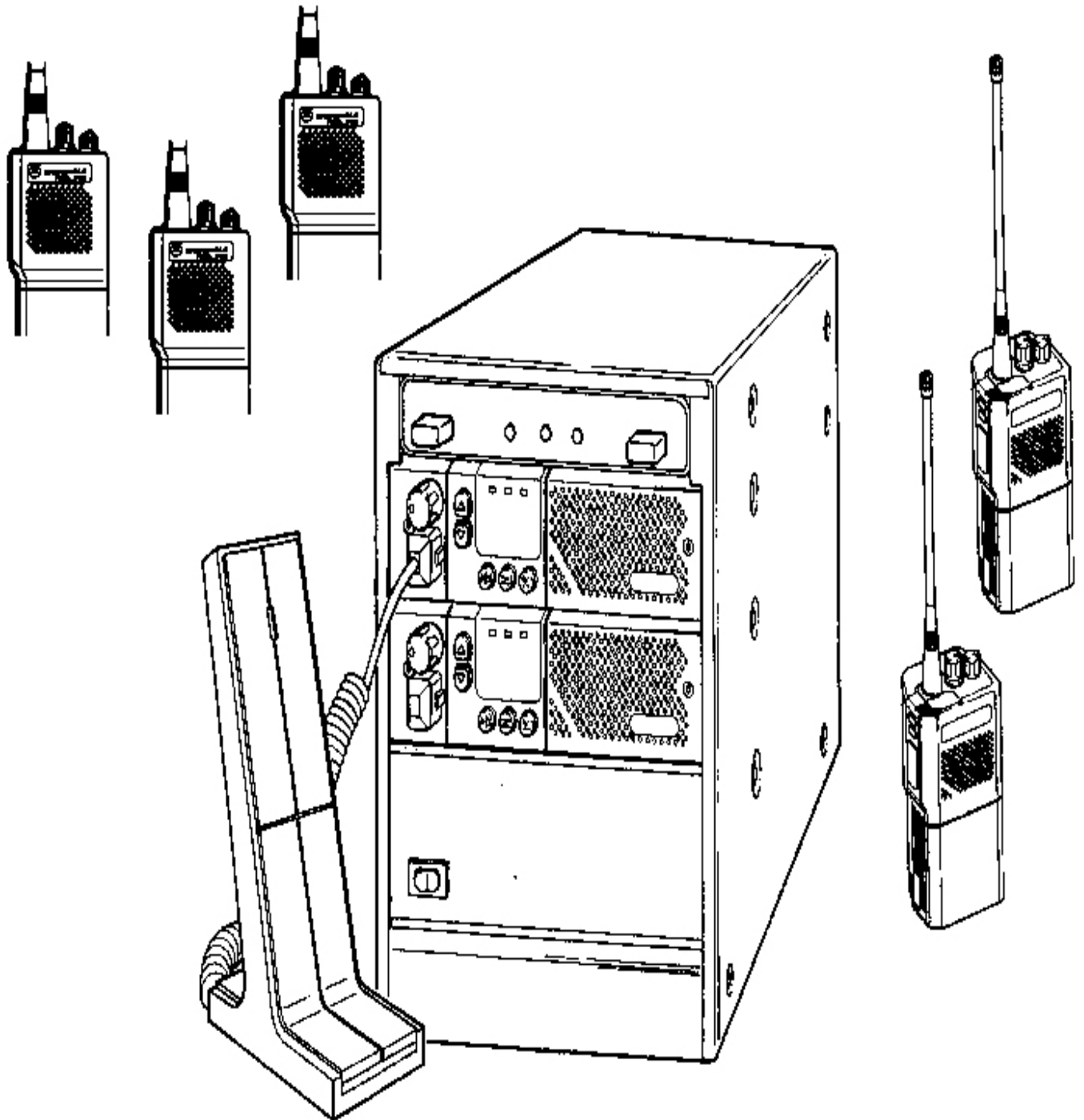## Service Manual

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Appendix A - DTMF Commands

Section 1
Introduction

Overview

The ZR310 is a community repeater panel (Figure 1-1) which provides individualized repeater service for up to 70 customers or customer groups on a single RF channel. It acts an interface between a GM300 transmit radio, and a GM300 receive radio, providing TPL and DPL encode/decode, repeat audio processing, and all timer functions. An internal database holds the various attributes associated with each user group. Nearly all of the ZR310's functions can be customized for each of the 50 TPL tones and 20 DPL codes.

You can program all of the functions of the ZR310 in three ways:

- Remotely, using DTMF over the radio channel
- Locally, with the Motorola RIB compatible interface for connection to a computer
- By using a touch-tone telephone

Standard Features

The following is a list of ZR310 Community Repeater Panel features.

- Decoding / Encoding for 50 TPL tones and 20 DPL codes.
- Remote control and programming via DTMF radio, or DTMF from a telephone plugged into the programming jack.
- Remote enable / disable of all user groups.
- Per-user programming.
- Cross-tone, cross-code, tone-code encoding.
- Privacy made prevents "barge-ins".
- Vacant tones and codes can be reserved.
- Courtesy tone.
- Automatic station ID per user.
- Accessory PTT input with selectable TPL / DPL encode.
- Repeater set-up / knockdown remote DTMF commands.

System Configuration

Unlike a conventional community repeater panel. which usually consists of a system card (or equivalent circuitry) and up to 70 different plug-in tone cards, the ZR310 incorporates one card that allows system and user programming.

System Functions

System programming replaces the system card in a conventional community repeater panel. The system function controlled by the ZR310 software are listed below:

- System Access Code
- Repeater Set-up / Knockdown
- Time-out Timer
- Courtesy Tones Frequency
- Anti-Kerchunker Filter
- Station ID
- Speed, Timer, Frequency
- Program Mode Access Code
- Accessory PTT TPL / DPL Encode
- Carrier Repeat ID

Section 1
Introduction

User Functions

In the ZR310, assigned user numbers are the equivalent to the 70 plug-in tone cards contained in a conventional community repeater panel. The following steps describe the process the ZR310 uses to find user information.

1. The ZR310 detects a code or tone.
2. The code / tone is decoded to a user number.
3. The user number points to the area in the database containing information about that particular user. Re to Table 3-1 for code / tone to number conversion.

The user functions controlled by the ZR310 software are listed below:

- User Enable
- TPL or DPL Encode
- Reserve Mode
- TX Hang Time
- Morse ID Call Sign
- Courtesy Tone
- Co-Channel Protect Selection
- Privacy Mode

Physical Description

The ZR310 is a self-contained repeater interface component designed to fit into the top shelf of the GR300 Repeater Station.

The front panel (Figure 1-1) contains

- Audio adjustment
- TPL / Set-up adjustment
- LED indicators. to display the status of the various functions
- Programming jack, used for DTMF telephone programming or local programming with an IBM PC via an RIB programming interface
- Interconnections to the transmit and receive radios are made via the 16-pin Transmit and Receive connectors located in the rear of the panel.

Section 1
Introduction

Housing Assembly

Fan Assembly
(in rear)

Repeater
Interface
Component

Shorting Plug(s)

Tx Radio

Rx Radio

Power Supply

Duplexer
(behind plate)
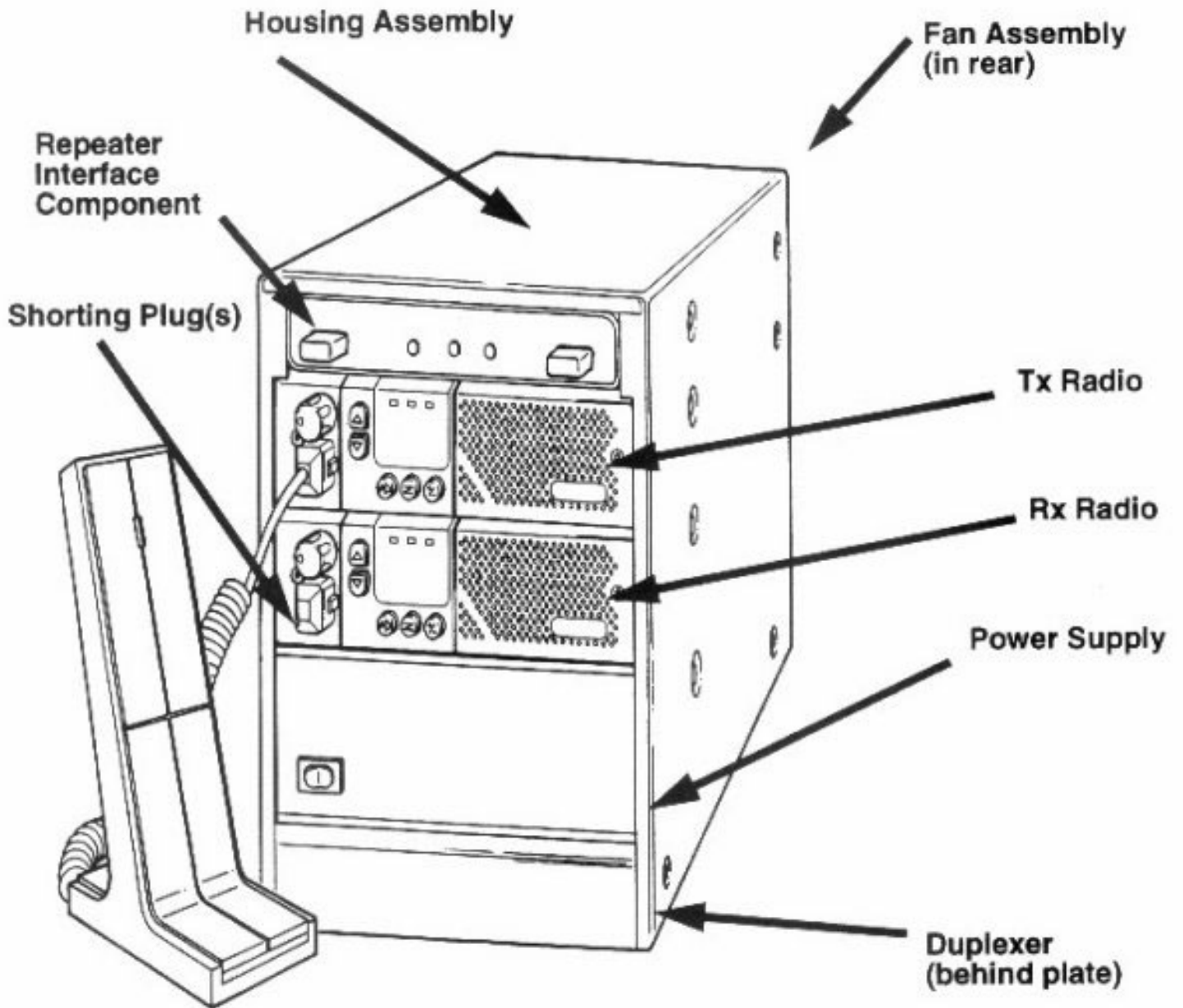
Section 2
Installation

Overview

This section explains how to install the ZR310 community Repeater Panel into the GR300 and complete the cable connections that were started in the Installation section of the GE300 Maintenance Manual. If you require access to the indicators, jumpers, or other components, refer to the Maintenance section for disassembly procedures.

Equipment Required For Installation

The following equipment is required for installation:

- a communications service monitor and ONE of the following
- a hand-held or mobile radio with DTMF encode capability
- a DTMF telephone
- a PC capable of running the Motorola radio service software (RSS)
- an ANSI terminal communications program

Installation Procedures

If you have followed the installation procedures found in the Installation section of the GR300 main manual, the GR300 is assembled. Now you need only to install the ZR310, finish the required cable connections, reinstall the fan assembly, and perform the required tests and adjustments. To identify the parts and their corresponding call outs, refer to Figure.

Assembly

Perform the following steps to install the ZR310 into the GR300 housing and to complete cable connections. The RF and repeater cables should already be connected to the radios, if you installed them according to the Installation section of the GR300 Maintenance Manual.

Install the ZR310 Into the GM300

1. STOP! Before going any further, did you make sure that the jumpers inside the GM300 transmit and receive radios were set to the correct positions? (Refer to table 2-2.)
2. Place the ZR310 on the top shelf of the GR300 repeater housing, allowing the rear panel to be partially exposed.
3. Connect the receive radio repeater connector to the ZR310 **Receive** connector (Figure 2-1).
4. Connect the transmit radio repeater cable to the ZR310 **Transmit** connector.
5. Position the ZR310 so that its mounting screw holes are aligned with the corresponding mounting holes on the repeater housing
6. Using a T25 Trox screwdriver, secure the ZR310 to the repeater housing using two M5x0.8x8 machine screws (7).
7. One end of the equipment power cable has only one connector. Connect it to the top connector on the power supply (Figure 2-2).
8. The other end of the equipment power cable has two connectors. Connect one of these connectors to the receive radio and the other to the transmit radio.
9. Connect the lower frequency radio to the LOW port on the rear of the duplexer. (Figure 2-3).
10. Connect the higher frequency radio to the HIGH port on the rear of the duplexer. (Figure 2-3).
11. Thread the grounding nut onto the grounding lug.

CAUTION
To avoid damage to cable tabs and radio components,
install cables with locking tabs up

Section 2
Installation
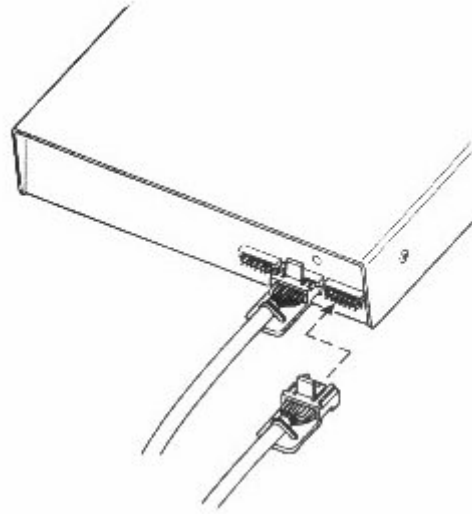
Figure 2-1. ZR310, Rear View
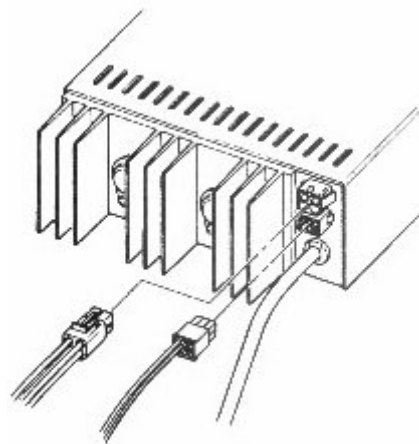
Figure 2-2. Power Supply, Rear View
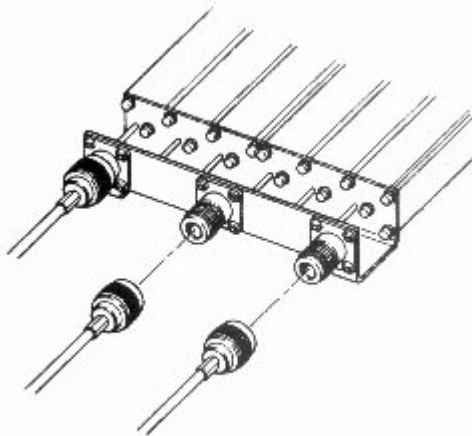
Figure 2-3. Duplexer, Rear View

Section 2
Installation

Fan Installation

Perform the following steps to reinstall the fan assembly in the repeater housing. Due to a limited amount of space in the back of the repeater housing, you must connect the power cable before installing the fan. To free both hands for easier installation of the power cable, you may want to rest the fan assembly on top of the repeater housing.

1. Connect the fan assembly power cable between the bottom connector of the power supply and the fan assembly connector that extends out the rear (refer to Interconnect Cabling Diagram)

2. Side the yellow lead of the fan assembly power cable containing the thermistor into the thermistor clip (Figure 2-4).
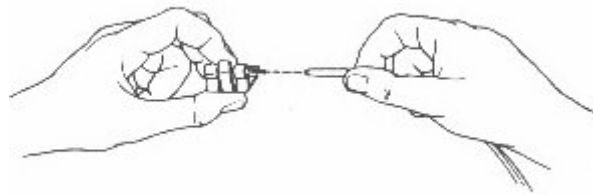
Figure 2-4. Thermistor Clip

3. Using a Torx screwdriver, secure the thermistor clip to the mounting hole located on the transmit radio heat sink with a M5x0.8x8 taptite screw (Figure 2-5).

Section 2
Installation
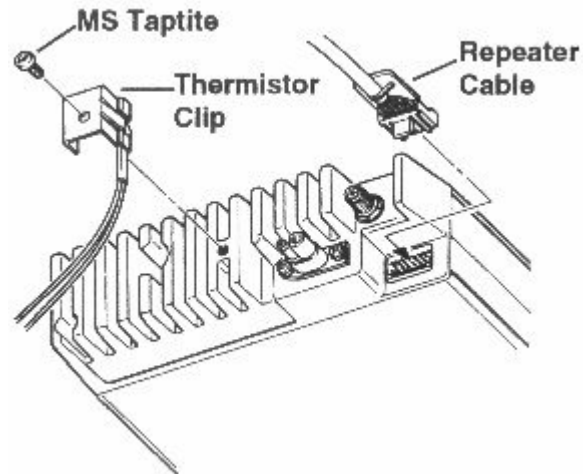
Figure 2-5. Transmit Radio, Rear View

Locate the cable tie wrap supplied with the GR300.

Section 2
Installation

TOP SHELF

2

MIDDLE SHELF

TAB (FOR POWER SUPPLY)

1

7

3

4

5

6

4

8
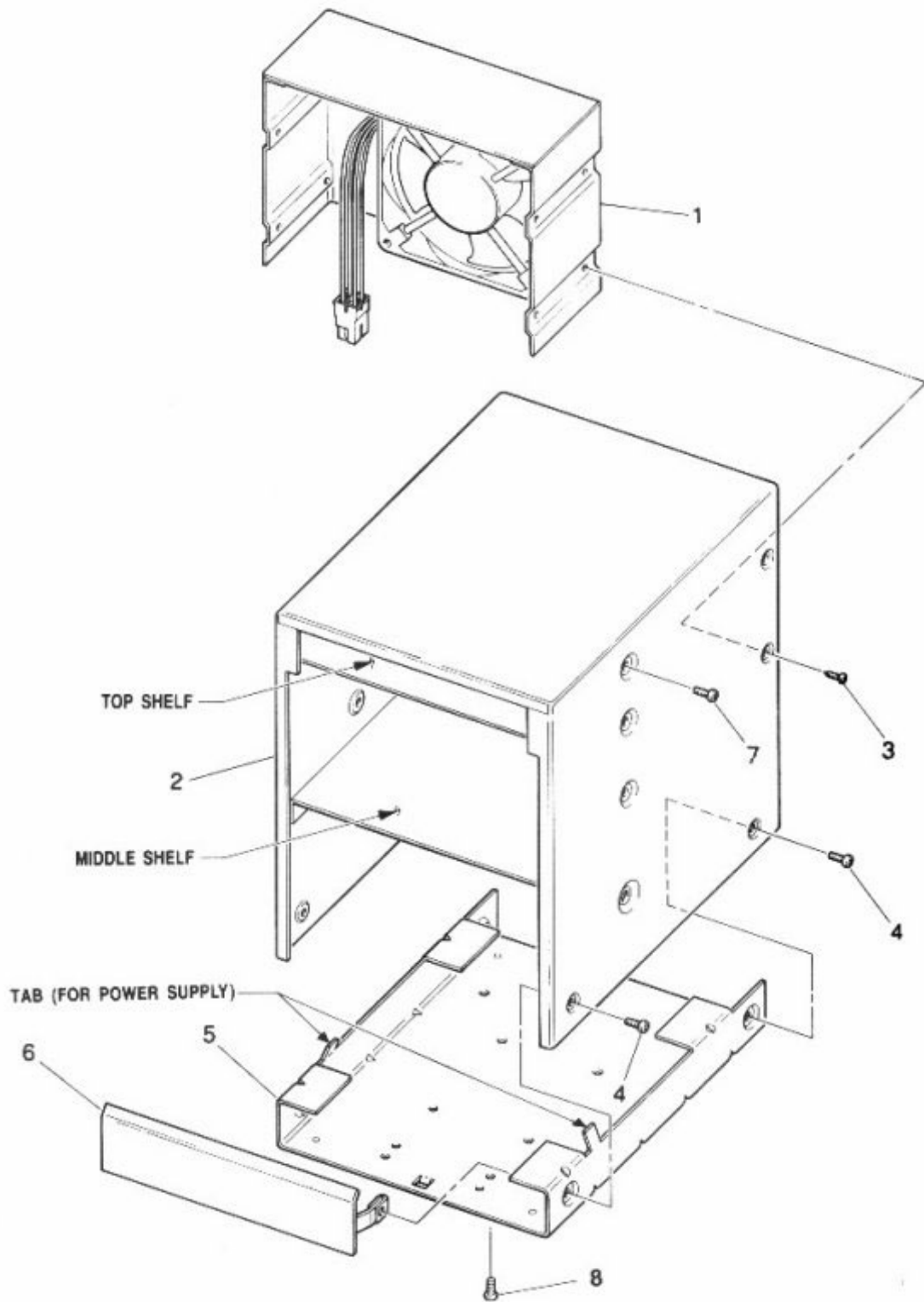
Figure 2-6.

Section 2
Installation

GR300 Housing Kit HLN8391_

Item	Part Number	Description	Qty.
1	None	Fan Assembly	1
2	1580675B01	Cover	1
3	0310943M59	Screw, Taptite, M3.5x0.6x6	4
4	0310907A91	Screw, Machine, M3.5x0.6x8	4
5	0780676B01	Base Tray	1
6	6480495C01	Front Plate	1
7	0310907B08	Screw, Machine, M5x0.8x8	8
8	03136993	Screw, Machine, 6-32x3/8"	4

Table 2-1. Receive Radio Jumper Settings (GM300 16 Channel Models)

GM300 Jumper	R*I*C*K	ZR310	ZR320	ZR330	i50R
JU551	B	A	B	B	B
JU651	X	X	X	X	X
JU701	X	X	X	X	X

Table 2-1. Transmit Radio Jumper Settings (GM300 16 Channel Models)

GM300 Jumper	R*I*C*K	ZR310	ZR320	ZR330	i50R
JU551	X	X	X	X	X
JU651	A	A	A	A	A
JU701	A	B	A	A	X

4. Bundle the cables with the cable tie wrap.

5. Dress the cables so they don't extend out the back of the GR300.

6. Position the fan assembly (1) in the repeater housing (2).

7. Align the set of mounting screw holes on the rear of the fan assembly with the corresponding mounting holes on the repeater housing.

8. Using a T15 Torx screwdriver and four M3.5x0.6x6 taptite screw (3), secure the fan assembly to the repeater housing.

9. Verify that all screws are tight and all cables have been connected properly. Refer to the Interconnect Cabling Diagram located in the back of the manual.

Section 2
Installation

> **NOTE**
> You will not install the front plate of the repeater
> housing until you have completed all tests and
> adjustments under the heading Tests and Adjustments.

Initial Turn-On

The following steps describe the process of turning on the ZR310 for the first time.

1. Remove protective covers from both radios LED displays

2. Connect the power cable into a 115/230Vac power source

> **NOTE**
> The "115/230" switch on the bottom of the power
> supply must be in the position corresponding to the
> power source. You should have done this during the
> GR300 basic assembly.

3. Turn on the power supply. The unit is on when the red portion of the switch is visible.

4. Turn on both radios by rotating the volume controls clockwise.

5. Verify that the ZR310 green Power LED is illuminated, the display windows on both radios are illuminated and the fan is operating.

Diagnostic Commands - Refer to Programming Section, Diagnostic Commands.

Programming - To customize the ZR310 to your particular application, refer to the Programming section.

Section 3
Operation

Overview

Theis section describes the basic operation of the ZR310 Community Repeater Panel. Included is a list of all TPL and DPL tone codes with their decoded user numbers. Refer to the programming section of this manual to customize your community repeater.

Basic Operation

Installing the ZR310 in the GR300 Repeater Station converts the GR300 Repeater Station into a multi -user community repeater. The ZR310, via a microprocessor, performs data management to simultaneously decode and encode TPL and DPL tones.

TPL Tones and DPL Codes

The ZR310 monitors the channel for TPL Tones and/or DPL codes. When it detects a tone or code, it implements conversion to a user number (Table 6-2). Next, it points to the area in the database that contains information about that particular user. The DPL decode numbers in the table are user programmable.

User Validation

The ZR310 is always monitoring the receive audio for the presence for a valid user. You can enable or disable any of the 50 TPL tones, and any combination of the 20 DPL codes. For information on how to enable or disable a user, refer to the programming section of this manual.

Enabled Users

When the ZR310 detects an enabled TPL tone or DPL code, it will check to see if the user is enabled or disabled. A disabled user is ignored and is not repeated.

Co-Channel Protection

For each user, you can select co-channel protection on/off. If the ZR310 detects an enabled TPL/DPL user when co-channel protection is transmitting, it will check to see if a carrier is present on the repeater transmit channel. If the transmit channel is busy (possibly due to paging or other activity not present on the repeater receive channel), the ZR310 will "protect the channel" and wait for it to clear before keying the transmit radio. The co-channel protection feature determines whether or not the ZR310 has priority on the channel.

Section 3
Operation

Regenerated TPL/DPL/CSQ

When you key the transmit radio, depending on the programming, the ZR310 will

- Encode nothing for carrier squelch
- Regenerate the received TPL ton or DPL code

Encode a different TPL tone or DPL code (cross-tone encoding)

Carrier Repeat

The ZR310 can also be configured as a "carrier repeater", or sometimes called an "open repeater". In this mode, any activity on the receive radio causes the transmit radio to key.

The ZR310 can also provide tone control (TPL/DPL) and open repeater operation simultaneously. In other words, users that have no encode (CSQ) repeat just like users that have TPL or DPL encode. This allows a mix of TPL/DPL users with one repeat capability and is ideal when upgrading TPL/DPL users to an existing open repeater channel.

To enable carrier repeat, a user number is identifies as the "carrier" repeater user. This allows all standard user programmable features for open repeat, including enable/disable for the carrier user, TPL or DPL encode encoding, courtesy tone, etc. If the user number is set to "0", no carrier repeater is available.

Reserved Users

If a user is "reserved", the repeat audio will be squelched an a beep tone sent on the transmit audio when the user tries to use it. A chirp tone is sent when the user unkeys to indicate reserve mode.

When a User Unkeys Radio

When a user radio unkeys, or the TPL/DPL is no longer detected, the ZR310 will take some actions. The following paragraphs describe possibilities of that action.

Morse Code Station Identification

When an enabled user unkeys, the ZR310 checks how long it has been since the last time the station ID has been sent. If the time has been longer than the Morse ID interval time (initially 15 minutes, user programmable 1-99 minutes), then the ZR310 sends the call sign. Each user group has its own call sign and individual ID interval timer. The Morse ID is sent at the selected ID speed of between 4 and 25 words per minute. The call is sent at 30% deviation (FCC part 90 rules) so that voice communication still occurs during the voice ID.

NOTE
If the Morse ID is not programmed, or the first
character is programmed as a "space", no ID is sent.
You can program a single system ID for use in co-op
and private carrier applications.

Section 3
Operation

Reserve Mode

If the user is in the reserve mode when unkeying, a "chirp" is sent. This chirp gives a positive indication of active reserve mode.

Courtesy Tone

The ZR310 will next check to see if the user requires the courtesy beep. If so, then it sends the beep one second after the transmit radio unkeys. The beep frequency can be sent from 400 to 2500 Hz (default setting is 1000 Hz). If the user is a 400 Hz tone just after the GR300 unkeys, potential failure has been detected.

Barge In (Privacy Mode)

Finally, the ZR310 continues checking for TPL/DPL. If the last user is set for "privacy mode", then no other users will be allowed on the system until the transmit hold time (repeater "tail") expires.

Repeater Hang Time

The programmable repeater "tail" or transmit hold timer is adjustable from 0.0 to 25.0 seconds. When the user radio unkeys, the ZR310 begins monitoring for valid TPL/DPL tones to be received. If a valid user is not detected within a specified timeout period, the IPL decode shuts off or the DPL turn off code is sent (if it was previously on). After a 0.2 second delay, the transmit radio PTT is dropped. This method removes the second squelch tail heard by the mobiles when the user radio unkeys.

Encode During Transmit Hold Time

When a valid user unkeys, the TPL or DPL encode may be left on or turned off during the transmit hold time. This feature is programmable for each user. When using a control station phone patch through the repeater, you should turn off the encode during transmit hold. Turning off the encode allows the phone patch to distinguish whether the mobile has unkeyed or the repeater has dropped off the channel. When using the repeater for dispatch only, you may leave the encode on during the transmit hold time to keep the mobile decoders open. This feature eliminates the decode delay observed in the mobile between transmissions.

Stuck Mic Timeout Timer

While the Gm300 mobile radios are conversing through the repeater, a timeout is running. If a mobile does not unkey within the time period, double beeps are sent, and the transmit radio PTT is dropped.

Anti-Kerchunker Filter

The anti-kerchunker filter cancels the transmit hold time (or repeater tail) and drops the transmit radio immediately if a mobile transmission is less than the programmed anti-kerchunker time. This discourages customers from clicking (kerchunking) the PTT just to hear the transmit radio.

Accessory PTT Encode

An Accessory device such as a tone remote or local microphone may key the transmit radio, and take over control of the repeater. The accessory may need the ZR310 to encode a particular TPL tone or DPL code in order to communicate with a specific user group. The ZR310 includes a programmable "Accessory PTT" encode setting to accomplish this function. Whenever an accessory keys the transmit radio, the ZR310 disables the repeater transmit hold time until 30 seconds of "no accessory transmit" has expired.

Section 3
Operation

Repeater Set-up/Knockdown

The system operator may remotely enable or disable the ZR310 operation. When in "knockdown" state, the ZR310 effectively disables the transmit radio. (Refer to Programming section, DTMF Command Descriptions, System Commands, Repeater Set-up/Knockdown.)

Section 4
Theory of Operation

Overview

This section provides the experienced technician with a thorough understanding of the ZR310 circuits and their operation. This information will aid the technician in troubleshooting the equipment.

Circuit Description

Use this detailed circuit description in conjunction with the schematic diagrams in the back of the manual.

Microprocessor

To ensure an orderly power up sequence to microprocessor U1. and its peripheral devices, the active low reset signal is not brought up until the 12 vdc supply has stabilized. Zener diodes CR5, R22/C28, and U4D accomplish this task. The delayed reset also gives crystal Y1 time to stabilize. An additional reset input comes from the long DTMF reset circuit. This circuit is a fail safe device to allow the system operator to reset the unit remotely by keying a DTMF digit for longer than 12 seconds.

Memory is functionally divided into three sections: (1) program memory, (2) operating memory, (3) protected database memory. Program memory resides in ERROR U8 and stores the actual operating instructions that make the ZR310 work as a community repeater panel. Operating memory is provided by static read/write memory RAM U3 and the internal memory in microprocessor U1. The ZR310 performs computations and maintains a data buffer in this area. Database memory contains all the user and system programming values and must be retained regardless of how often power is lost. To do this, the ZR310 stores the user and system programming values in EEPROM U5.

Peripheral timers and counters, U14 and U15 are available to the microprocessor. The counter IC's contain thee timers each which are used for tone generation and internal timing functions.

The microprocessor is able to directly control 8 I/O lines that interface to its Port 1 register on pins 13 through 20. These carry information from the various digital control outputs and inputs.

Serial Communications

Asynchronous data transfer is accomplished via a microprocessor U1's internal UART. The UART receives data through pin 11 of the microprocessor but first it is buffered to be compatible with the Motorola RIB interface via Q10/Q11/U16A. Data is transferred through pin 12 of U4 then is buffered with the same RIB interface circuit. The RIB interface baud rate is connected by the baud clock output on pin 6 of timer U15. This baud clock output is applied to the microprocessor U1 bit clock input on pin 10.

TPL/DPL Decoding

Unquenched discriminator receive audio passes through unity gain stage U18B then gets low pass filtered by U18C and U18A. This removes the voice component from the audio. The U18D and the R66/C63 filters make up a zero crossing detector, which applies the resulting digital signal to the microprocessor on pin 17. The microprocessor performs the actual decoding for the TPL tones and DPL codes using proprietary digital signal processing techniques.

DTMF Decoding

The mobile audio from the receive radio discriminator passes through unity gain stage U18B, then low pass filtered by U16C. Finally the signal is presented to the DTMF encoder/decoder U10. U12A is used to switch the audio to the DTMF decoder between receiver audio, and a DTMF telephone plugged into the programming socket J1. When a telephone (or any low impedance) is plugged into J1, U16B will sense the voltage drop across RP7D and switch the audio to the DTMF decoder.

Section 4
Theory of Operation

TPL Encoding

Two signals are used for TPL generation:

- Clock frequency at the exact TPL rate from the microprocessor
- Clock frequency at 64 times the TPL rate from the timer module

These signals are fed into a switched capacitor low pass filer U17, then sent to the transmitter.

DPL Encoding

For generating DPL signals, the microprocessor sends the digital code out its pin 9. Data inversion is done inside the microprocessor if required. The timer module produces a high frequency clock signal that is fed into the low pass filter U17. Operation is very similar to TPL encoding described above.

Beep Tone Encoding

Timer U15 generates progress tones (Morse ID, warning beeps, etc). Square wave output is filtered and summed at the transmit audio junction U11D, then it passes through the output buffer amp to the transmitter audio input at P2-2.

Squelch/Repeater Audio

The repeat audio is passed through input unity gain stage U18B, the audio hi-pass filter U11 and U11A to remove the TPL/Digital encode, de-emphasized by the R29/R30/C34 network and finally to squelch gate.

U12B and U12C. The microprocessor controls the squelch gate. The repeat audio is summed at the transmit audio junction U11D, then passes through the output buffer amp to the transmitter audio input at P2-2

CSQ Input

From the 8 or 16 channel GM300 radio, U4B and U4F are used to select the CSQ input connection and polarity. The COR logic signal is presented to the microprocessor input port pin 20.

Section 5
Maintenance

Overview

This section contains information and procedures that will enable the technician to proform preventive maintenance and troubleshooting techniques on the ZR310 Community Repeater Panel. Fault isolation and component-level troubleshooting are not covered in the section.

Preventive Maintenance

Preventive maintenance of the ZR310 consists of:

- Visual inspection
- Periodic cleaning
- Checks using diagnostic commands entered via the DTMF keyboard

Visual Inspection

Check that external surface of the equipment are clean, that connecting cables are not damaged, and that connections are firm. A detailed inspection of the interior electronic circuitry is not needed or desired.

Cleaning

Periodically clean smudges and grime from the exterior housing. Use a soft, non-abrasive cloth moistened in a mild soap and water solution. Rinse the surface using a second cloth moistened in clean water.

Diagnostic Commands

Refer to Programming section, Diagnostic Commands.

Disassembly

In order to inspect the cable and other components, and to remove the top cover, you must remove the ZR310 from the GR300 housing. Complete the steps in paragraphs 3.1 and 3.2 to accomplish this.

Removal

To remove the ZR310 from the repeater housing, perform the following steps:

1. Place the GR300 power switch to off and unplug the ac line from the ac supply outlet.

2. Using a T15 Torx screwdriver, remove the four M3.5x0.6x6 taptite screws (3) that secure the fan assembly to the repeater housing.

3. Remove the fan assembly (1) and rest it on top of the repeater housing.

Section 5
Maintenance

<div align="center">

NOTE
In order to have enough room to move the fan
assembly around and to remove the ZR310, you will
have to cut the cable tie wrap. Make sure that you
obtain another cable tie wrap for use when
reassembling the GR300.

</div>

4. Using a T25 torx screwdriver, remove the two M5x0.8x8 machine screws that secure the ZR310 to the repeater housing.

5. Remove the ZR310 from the repeater housing.

6. Disconnect the transmit and receive radio repeater cables from the transmit and receiver connectors.

Top Cover Removal

To remove the top cover from the ZR310 for inspection of components and to make necessary adjustments, perform the following steps.

1. Using a #1 Phillips screwdriver, remove the four #4-40x3/16" flathead machine screws.

2. Remove top cover.

Troubleshooting

There are two forms of troubleshooting:

- Finding problems with the ZR310 "system: operations. The troubleshooting charts provided in Table 2-2 will aid in resolving these system issues.

- Repair of a defective ZR310. An experienced technician with the commonly available test equipment, the schematic diagram located in the back of this manual and the PC overlays should have no difficulty finding the problem area and faulty component(s).

The ZR310 schematic diagrams provide the circuit detail for isolating malfunctioning components. [The troubleshooting charts provides....]

Before proceeding with troubleshooting, scan Table 5-1 to determine if you can solve the existing malfunction. By reading this information, you could save valuable time by isolating the circuit where the faulty component os located.

Problem/Indication	Possible Solution
400Hz beep just before transmit radio unkeys	Memory problem
Memory automatically reset to default positions	At reset/power: > 15 errors detected
Unit fails	Reset unit: send DTMF digit from mobile/handheld radio to repeater site for > 15 seconds
ZR310 does not detect TPL tones	Carrier LED is off

Section 6
Programming

Overview

This section contains information and procedures that allow the technician to program the ZR310.

You can program the ZR310 in the following ways:

- Motorola RIB compatible interface, using a computer running Motorola radio service software (RSS) designed for the ZR310

- DTMF over the radio channel ("over-the-air") from a mobile, base station, or handheld

- DTMF from a telephone plugged into the programming jack on the front of the ZR310

- ZR310 monitor program via RS232 Communications Program'

Programming Via Radio Service Software (RSS)

We recommend that you program the ZR310 using a PC that runs the Motorola Radio Service Software (RSS), because it is the easiest programming method. Using this software allows you to access the programmable features of the ZR310 from user-friendly screens on the PC. You can archive the final configuration for safekeeping or later examination.

The programming port on the ZR310 is hardware compatible with the Motorola RIB. The RSS will prompt the system installer to plug into the ZR310 so that the configuration can be read or written to the ZR310.

Getting Started

At the Main Menu:

      1. Press F3 (Get/Save)

You will see the Get/Save Screen, Radio Mode (Figure 6-1).

We recommend that the radio be programmed in repeater mode. To begin programming in repeater mode:

Figure 6-1. Get/Save Screen, Radio Mode

Section 6
Programming

2. Press F6 to change to repeater mode.

You will see the Get/Save Screen, Repeater Mode (Figure 6-2)
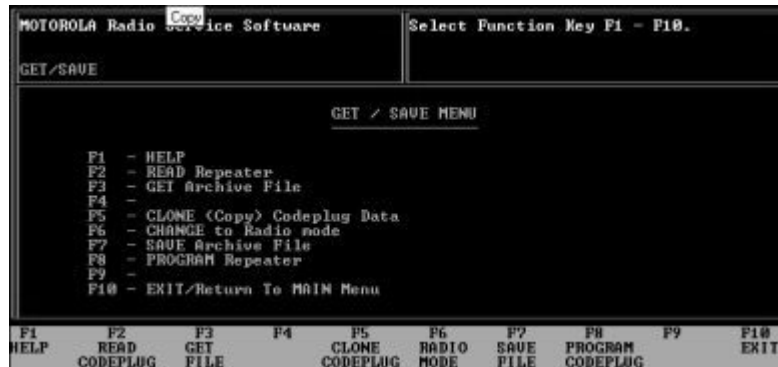
Figure 6-2. Get/Save, Repeater Mode

Programming the Repeater

1. From the Get/Save Menu, Press F2 to read the repeater.

You will see the screen in Figure 6-3.

You have two options: to read the repeater, or to designate it as a generic. You may need to use the generic designation if the option board is not physically accessible (i.e. programming a replacement radio).

To read the repeater:

1. Connect the programming cable to the repeater.

2. Frees F2 to continue.

To designate the repeater as generic:

1. Press F10 to abort
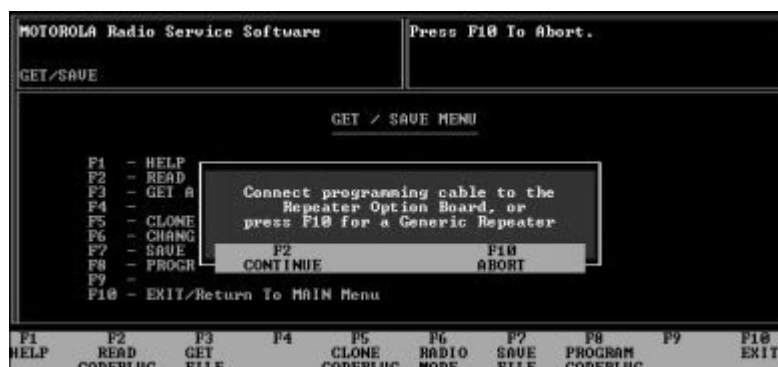
Figure 6-3. Read Repeater Screen

Section 6
Programming

Reading the Transmitter Radio

After reading the repeater, you will see the screen in Figure 6-4.
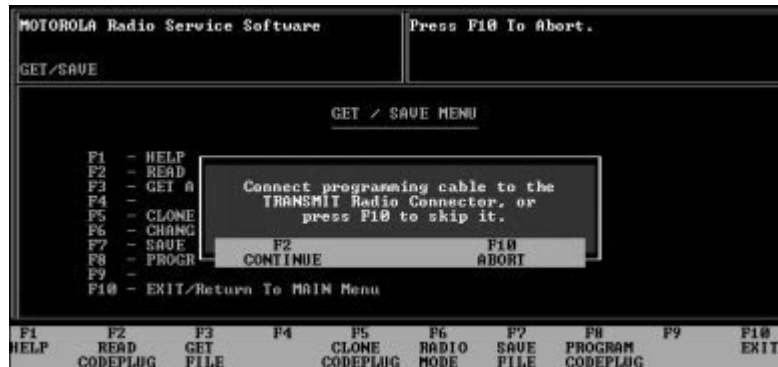
Figure 6-4. Read Transmitter Screen

You have two options: to read the transmitter, or to skip it.

To read the transmit radio:

     1. Connect the programming cable to the transmitter.

     2. Press F2 to continue.

To skip the transmitter:

     1. Press F10 to abort.

If you choose to read the radio, and it has previously been programmed in radio mode, you will see the screen in Figure 6-5.

NOTE
Figure 6-5 is for your information only. It may indicate
that the wrong radio was read.

If custom settings have previously been programmed for the radio, you will see the screen in Figure 6-6.

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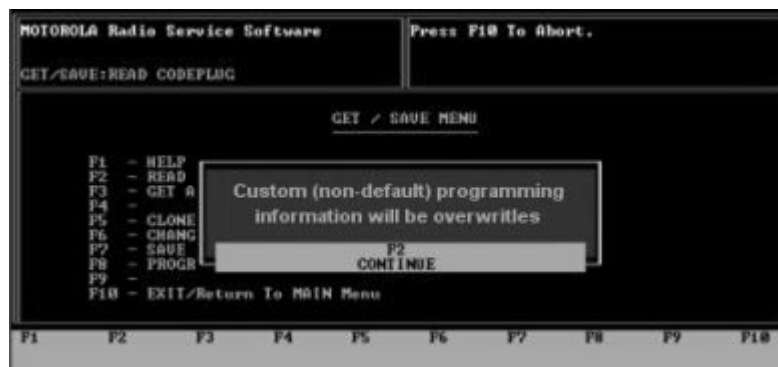
Figure 6-6. Non-Default Information Warning

To allow all programming information to reset to default settings:

    1. Press F2 to continue.

CAUTION

To keep custom programming, you must use radio
mode. If custom settings have previously been
programmed for the radio, you will see the screen in
Figure 6-6. Programming in repeater mode resets all
custom accessory information to its default settings.
Pressing F2 (Continue) will overwrite any custom
programming.

Reading the Receiver

After reading the ZR310 option board and the transmitter, you will see the screen in Figure 6-7.

Figure 6-7. Read Receiver Screen

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You have two choices: to read the receiver, or to skip it

To read the receiver:

> 1. Connect the programming cable to the receiver.

> 2. Press F2 to continue.

To skip the receiver:

> 1. Press F10 to abort.

As with the transmitter, if the radio has previously been programmed in radio mode, the warning screens in Figure 6-5 and Figure 6-6 may appear.

Configuring the System

From the Main Menu:

> 1. Press F4 (Change/View).

> 2. Press F2 (Radio/Wide).

You will see the screen in Figure 6-8.

Figure 6-8. ZR310 Configuration Screen

Table 6-1 lists the functions you can perform from within the ZR310 Configuration Screen.

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Table 6-1. Command Key Function

Command	Function
F1=HELP	Get specific help for highlighted field
F2=GOTO USER	Choose a user number to display (TPL=1-50; DPL=51-70)
F3=PREVIOUS USER	Go to previous active user (both enabled and reserved users are active)
F4=NEXT USER	Go to next active user (both enabled and reserved users are active)
F5=PRINT SCREEN	Print contents of screen.
F6=VIEW ALL	View user summary screens
F7=DELETE USER	Delete currently displayed user from active list.
F8=ADD USER	Add new user to active list
F10=EXIT	Go to previous menu (Change/View)

Table 6-2 lists other keys and their general function.

Table 6-2. Other Key Functions

Key	Function
ESC	Exit Main Menu
Tab/Enter/Return	Accept data currently in field and move prompt forward one field
Shift + Tab	Accept data currently in field and move prompt backward one field
Up / Down Arrow	Scroll through selections or increase/decrease current relative value.
Left/Right Arrow	Move cursor left/right one space
Back space	Erase current character in field and move cursor left one space
Page Up/Page Down	Display previous/next page of information on screen

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Programming

From the ZR310 Configuration Screen, you may set the programmable features. Programmable feature in the ZR310 are divided into three categories:

- System Programmable Fields
- User Programmable Fields
- Diagnostic Tests

System Programmable Fields

The following subparagraphs describe the system commands available for the ZR310.

Program Mode Access Code

The program mode access code is a number between 1000 and 32000.

Morse ID interval, Speed, and Frequency

You can program the Morse Code station identification in frequency, interval and speed. The following table outlines the programmable range and the default settings of each.

Table 6-3. Station ID Programming

	Programmable Range	Default
Frequency	400-2000Hz	1200Hz
Interval	1-99	15 Min
Speed	4-25 wpm	22 wpm

Each user on the ZR310 has its own independent station ID timer that is accurate to one second per interval. When the station ID is sent, the timer is reset. The call is transmitted on the first dispatch message after the timer has expired.

During normal dispatch, the minimum character speed will be 15 wpm. This allows the "List" functions (using Morse code as a format) to be sent at very slow speed, while maximizing airtime use during normal dispatch.

Courtesy Tone Frequency

The courtesy tone is used for courtesy tone and prompt beeps. It is programmable in frequency from 400 to 2500 Hz, and the default setting is 1000 Hz.

A possible reason to change the frequency could be to differentiate between co-channel repeaters to know which repeater site is active.

System ID User Number

A user number may be assigned as the "System ID user number" so that the repeater will identify every ID interval (1 to 99 minutes).

Before sending the System ID, the following conditions must be met:

- The system ID interval timer must expire (adjustable 1 to 99 minutes).
- The ZR310 must be inactive (TPL/DPL Decode LED off).
- The System ID must have a number programmed.

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The ZR310 will reference the system ID user for the proper TPL/DPL encode and the Morse ID to send. You can use a disabled or enabled user number.

The Morse code station ID is sent after a 0.75 second key up delay.

Carrier Only Repeat (Open Repeater)

You can program the ZR310 to repeat based on just the carrier, sometimes called "carrier controlled repeat", or "open repeater". In this mode, the ZR310 provides simultaneous tone/open repeater operation for users that have TPL or DPL encode or that have no encode repeat. Both types of users operate normally. This allows a mix of TPL tone users with open repeat capability and is ideal when adding tone users to an existing open repeater.

To enable the carrier (CSQ) for repeat, you can identify a user number as the "carrier repeat user". This allows all standard user-programmable features for open repeat, including enable/disable, TPL or DPL code encoding, etc for the carrier user, if the CSQ user number is set to "0", no carrier repeat will be available.

Accessory PTT TPL/DPL encode

An accessory device such as a tone remote or local microphone may key the transmit radio, and take over control of the repeater. The accessory may need the ZR310 to encode a particular TPL tone or DPL code in order to communicate with a specific user group. The ZR310 incudes a programmable " Accessory PTT encode" settings to accomplish this function. When an accessory keys the transmit radio, the ZR310 will disable the repeater transmit hold time until 30 seconds of no accessory transmit has expired.

Anti-Kerchunker Timer

The anti-kerchunker timer may be programmed between 0 (off) and 5.0 seconds.

The first transmission from a user must be longer than the anti-kerchunker timer value or the programmed transmit hold time will not be used. This discourages users from "kerchunking" the repeater.

Timeout Timer

The timeout timer is a "stuck mic" timeout feature. Its setting determines the maximum amount of time a mobile may transmit on the channel. Each time the TPL/DPL decode stops, the timer is reset. It may be set from 1 to 9 minutes, in one minute increments, and the default setting is 3 minutes. During a timeout condition, you will hear an alert tone before the transmit radio unkeys.

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User Programmable Fields

Enable a User

To activate a user in the ZR310, you must enable the TPL tone or DPL code user number. The transmit radio keys when the carrier and the TPL tone or DPL code are decoded.

Set the Status line as Enable to activate a user.

Reserve a User

You may need to reserve a TPL tone or DPL code for future use. If a user keys up on a "reserved" user number, the transmitter will be keyed but it does not cut through a repeat audio. It sends a beep tone for the duration of the transmission. This mode is to disable a user for seasonal use or a possible "no-pay" condition. A reserved user will keep the tone active in the repeater, preventing other co-channel repeater operators from seeing the tone as "available".

NOTE
Before reserving a user, you must enable that user

Receive (Rx) Squelch Decode

The ZR310 can decode all 50 TPL tones and up to 20 DPL codes. The TPL user numbers are 1-50, and they have fixed frequencies. The DPL user numbers are 51-70. Each of these user "slots" in the database can decode any valid DPL code, so you must set the digital "code number". When you set the DPL decode number, the ZR310 will automatically set the encode to the same DPL code. (Refer to Table 6-3 for TPL tones / DPL codes.)

Station ID Call Sign

A station ID call sign is a Morse code ID assigned to a particular user. This ID may be eight characters long, and may be any combination of numbers or letters.

You can program an individual Morse code ID for each user number. The first time the user unkeys, the ZR310 sends the Morse code ID. If the user keys up again, voice communications may occur during the ID. The ID is sent at 30% deviation and a selectable speed from 4 to 25 (default is 22) words per minute (meets FCC Part 90 regulations). With System Programming, you can set the ID tone frequency from 400 to 2000 Hz so that it does not interface with paging or other tone signalling on the channel. You can set the ID interval from 1-99 minutes. You may also program a single System ID call sign. Refer to Table 6-4 for the Station ID Cross Reference and Table 6-5 for the TPL tone / DPL code conversions.

Transmitter Hang Time

The transmitter hang time is the amount of time the repeater transmitter remains keyed on the channel after mobile activity is no longer detected. The transmitter hang time must be set to a value between 0.0 and 25.0.

TPL/DPL Encode During Transmitter Hang Time

Normally the repeater encode signal follows the mobile encode. However, You can leave a TPL or DPL encode on during the transmitter hang time. By leaving the encode on, you can eliminate the decode time between transmissions, thus not losing any audio.

Choose Y to leave the encode on during transmit hang time, or no to turn it off.

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View All Users

To view the user numbers"

1. Press **F6** to view all

Figure 6-9 is the TPL User Screen, which shows users 1-50. Figure 6-10 is the DPL User Screen, which shows users 51-70.

NOTE

The F6 key will now toggle between the TPL User and
the DPL User Screens.

Figure 6-9. TPL Users

Radio Parameters

From the Main Menu

1. Press F4 to see the Change / View Menu.
2. Press F5 for the Mode screen.

This screen will vary, depending on the type of repeater option board that you have read. If you have read a ZR310, you may choose between types of ZR310 option boards:

- Community PA (with public address)
- Community RMT (with tone remote--C100)

Figure 6-11 and Figure 6-12 are examples of the screens you might see.

If you skipped the repeater, the screen may list the Repeater Type as "Generic".

When the cursor is positioned on the Repeater Type line, the up/down arrow keys will toggle between the different types.

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Figure 6-100. DPL Users

Figure 6-11. Can't do
Figure 6-12. Can't do

Low Battery Alert

To program the repeater to send out a warning signal when its battery gets low:

1. From the Main Menu, press F4 to see the Change/View Menu.
2. Press F7 to access the Signalling Menu.
3. Press F2 to see the screen in Figure 6-13.
4. Using the arrow keys, move the cursor to the space next to "Low Battery".
5. Using the up/down arrows, choose Y to set the low battery alarm on.
6. Press F10 to exit.

Customizing Your Accessories

The repeater may be customized in radio mode. To set custom accessory information:

Figure 6-13. Radio Wide Screen

1. From the Main Menu, press F4 to see the Change/View menu.

2. Press F2 to access Radio Wide.

3. Press F9 for the Accessory Connector Configuration.

You will see the screen in Figure 6-14.

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Figure 6-14. Radio Wide Accessory Screen

4. Set the desired custom information.

5. Press F10 to exit.

CAUTION
Repeater mode will not keep custom information.
Therefore, if you customize your radios, you may limit
yourself to always programming in radio mode.

For more information, refer to the Basic RSS Manual.

Programming Over-The-Air

You can program the ZR310 using a portable radio with a DTMF keypad. While programming the unit. it is helpful, but not required, to have a secondary receiver (i.e. scanner, monitor receiver) tuned to the repeater output frequency. This enables you to hear the prompt tones generated by the ZR310. The access code is user-programmable (System Programming, in this section).

All numbers may be entered with or without leading zeros (i.e. the number 1 may be entered as 0001#, 001#, 01# 1#). Some commands send a progress or prompt tone while programming, and all commands send either a "go-ahead" or "error" tone after completion of the command. A "chirp" tone follows a successful command, and a "warble" tone denotes an error. If the programming radio switches slowly from transmit to receive (possibly due to a keypad interdigit transmit hold time), you may program a delay before sending the prompt tones (see the Mic Hold command). Although you do not have to wait for each prompt tone before entering the next command (because all commands are internally buffered), we recommend that you listen for the corresponding tones.

NOTE
At any time while programming the unit, if no DTMF key
is pressed for 90 seconds, the ZR310 will exit program
mode automatically.

Entering the Program Mode

The transmit radio remains keyed during the program mode to keep other radios from trying to access the system and interface with programming. A command is provided to unkey the transmit radio (diagnostic commands), and if this command is selected, the radio will key only to send prompt tomes.

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Programming

The following steps describe how to enter the programming mode:

    1. Enter a program mode access code.

    2. Press the "#" key.

NOTE
The default access code is 12310#

---

    3. Listen for three chirps, which indicate proper access.

Exiting the Program Mode

The following steps describe how to exit the program mode:

    1. Enter 99.

    2. Press the "#" key.

    3. Listen for the ringing prompt tone, which confirms that you have exited program mode.

Entering a Command

The following steps describe how to enter a command:

    1. Enter a DTMF number.

    2. Press the "#" key. Some commands require additional numbers (i.e. cross tone encoding).

NOTE
If you make an error while entering a number the "*" key
function as a "clear entry" key.

Commands are grouped in three main categories:

- System Commands
- User Commands
- Diagnostic Commands

Each command is described under "DTMF Command Descriptions" on page 6-8. A quick reference commands summary is shown in the tables in Appendix A. If you are familial with DTMF commands, you may skip this section and program the ZR310 using the information given in Appendix A.

For commands identified with "uu" you may enter the user number to program a single user. To program all users (1-70) at once, enter "99" as the user number.

Section 6
Programming

Program Mode Access Code

The following paragraphs describe the system, user and diagnostic commands available for the ZR310 when programming "over-the-air" or via telephone. These include the options available with RSS programming. For detailed information about each option, refer to the paragraphs under "Programming Via Radio Service Software (RSS)" on page 6-1. Enter each command as described in the "Programming Over-The-Air" on page 6-7.

System Commands

Repeater Set-up/Knockdown

The system operator may remotely enable (set-up) or disable (knockdown) the ZR310 operation. When in "Knockdown" state, the ZR310 effectively disables the transmit radio.

To disable (knockdown) the repeater:

    1. Enter 300#

NOTE
This command will take the repeater out of service until
you reaccess the program mode, cycle the main power, or
perform a "long DTMF digit reset".

Example:

300# - Take repeater out of service.

Stuck Mic Timeout Timer

    1.   Enter 201#.
    2.   Enter time t# in one-minute increments (1-9).

Example:

201# 5# - Set timeout to 5 minutes.

Mic DTMF Hang Time

The mic DTMF hang time feature allows you to insert a delay before the ZR310 sends back prompt tones during DTMF programming. This option is useful for over-the-air programming. In many radios equipped with DTMF encode, the transmit radio does not unkey immediately after it releases a DTMF digit. As long as the radio is still keyed, the prompt tones do not sound on the programmer's radio. To remedy this condition, you can program the ZR310 to delay sending the prompt tones. You can set the delay from 0 to 3 seconds, in one-second increments, and the default setting is 0.

    1.   Enter 281#.
    2.   Enter time t# in one-second increments (0-3).

Example:

281# 2# - Set 2-second delay before prompt tones.

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Carrier Repeat (CSQ) User

1. Enter 203#.
2. Enter the CSQ user number uu# (0-70).

Example:

203# 49# - CSQ users repeat as user 49

Courtesy Tone

1. Enter 209#.
2. Enter the beep frequency ffff# in Hz (400-2500).

Example:

209# 1200# - Set courtesy tone to 1200 Hz

System ID User

1. Enter 208#.
2. Enter the user number uu# (0-70, where 0 = off).

Example:

208# 49# Sets user 49 as the system user.

Station ID Frequency

1. Enter 206#.
2. Enter the frequency ffff# in Hz.

Example:

206# 1000# - Set station ID frequency to 1000 Hz.

Station ID Interval

1. Enter 205#.
2. Enter time tt# in minutes (1-99).

Example:

205# 15# - Set station ID interval to 15 minutes.

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Station ID Speed

1. Enter 207#.
2. Enter speed ss# in words per minutes (4-25, Default = 22).

Example:

207# 15# - Set station IS speed to 15 minutes.

Appendix A
DTMF Commands

Table A-1. DTMF System Commands

Command	Function	Parmeter
201# t#	Set stuck mic timeout timer to t minutes	t=1-9 minutes
202# tt#	Set anti-kerchunker filter timer to t.t seconds	tt=0.1-5.0 seconds (0=disable)
203# uu#	Set CSQ user number uu	uu=0-70
204# nn#	Accessory PTT TPL/DPL, 0=off	nn=50 for TPL, 1000-1777 for DPL
205# tt#	Set station ID interval to tt	tt=1-99 minutes
206# ffff#	Set station ID tone frequency to ffff Hz	ffff=400-2500 Hz
207# ss#	Set station ID speed to ss WPM	ss=4-25 WPM
208# uu#	Set system ID user number to uu	uu=0-70 (0=off)
209# ffff#	Set courtesy beep tone frequency ffff	ffff=400-2500 Hz
210# n#	DPL acquire maximum bit errors	
213# nn#	TPL turnoff code detect delay	
214# aaaaa#	Set program mode access code aaaaa	aaaaa=0-32000
281# t#	Set Mic DTMF hang time to t seconds	t=1-3 seconds
300#	Repeater Knockdown	
99#	Exit Program Mode	

Table A-2. DTMF User Commands

Command	Function	Parameter
110# uu#	Disable user number uu	uu=1-70
111# uu#	Enable user number uu	uu=1-70
112# uu# ee#	Set user uu's DPL decode to code number ee	uu=51-70
115# uu#	Enable user uu's co-channel busy protect	
116# uu#	Disable user uu's co-channel busy protect	
120# uu#	Disable user uu's TPL/DPL encode during transmit hold time	
121# uu#	Enable user uu's TPL/DPL encode during transmit hold time	
122# uu#	To translation, user uu encodes tone/code ee	ee=0 for CSQ, 1-50 for TPL, or 1000=uu for DPL
123# uu# ttt#	Set tramsit hang time tt.t for user uu	ttt=0.0-25.0 seconds
130# uu#	Disable user uu reserve mode disabled, normal repeat audio operation	
131# uu#	Enable user uu reserve mode, doesn't pass repeat audio	
140# uu#	Disable user uu privacy mode, normal operation	
141# uu#	Enable user uu privacy mode, no new users allowed until transmit radio drops out	
151# uu#	Enable user uu courtesy tone	
150# uu#	Disable user uu courtesy tone	
160# uu#	Set users uu's Morse ID to xx, xx, ...	xx, xx, ... up to 8 characters
161# uu#	Play back user uu's ID	

Appendix A
DTMF Commands

Table A-2. DTMF Diagnostic Commands

Commands	Function	Parameter
301#	PTT on	
302#	PTT off (keys up when sending progress tones)	
303#	Repeat audio disable, squelch/unsquelch test	
304#	Repeat audio enable, squelch/unsquelch test	
305# tt#	Encode TPL tone tt	tt=1-50 or 0=none
305# tttt#	Encode DPL code tttt	tttt=octal code + 1000
306#	TPL tone sqeep, end with DTMF #	50 to 300 Hz
307# ffff#	Encode TPL frequency fff.f	ffff=50.0-300.0
308# ffff#	Encode frequency ffff	400-3000 Hz or 0=none
309# 25327#	Clear all memory, setup default settings	
360#	List the number of enabled users	
361#	List the enabled user numbers	
362#	List the number of program mode accesses	
363#	List the number of resets	
364#	List the number of power fails	
365#	List the number of users with memory errors	
366#	List the User numbers with errors	
367#	List the system error number	

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