



Model 250 Tone Remote Adapter  
Installation Manual

025-9472C

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## Compliance Statements

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This equipment meets the applicable Industry Canada Terminal Equipment Technical Specifications. This is confirmed by the registration number. The abbreviation, IC, before the registration number signifies that registration was performed based on a Declaration of Conformity indicating that Industry Canada technical specifications were met. It does not imply that Industry Canada approved the equipment.

The Ringer Equivalence Number (REN) for this terminal equipment is 0.1. The REN assigned to each terminal equipment provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the RENs of all the devices does not exceed 5.0.

<b>Information on Disposal of Old Electrical and Electronic Equipment and Batteries (applicable for EU countries that have adopted separate waste collection systems)</b>	
	Products and batteries with the symbol (crossed-out wheeled bin) cannot be disposed as household waste. Old electrical and electronic equipment and batteries should be recycled at a facility capable of handling these items and their waste byproducts.
	Contact your local authority for details in locating a recycle facility nearest to you.  Proper recycling and waste disposal will help conserve resources whilst preventing detrimental effects on our health and the environment.  Notice: The sign "Pb" below the symbol for batteries indicates that this battery contains lead.

## Safety Summary



**Warning!** For your safety and the protection of the equipment, observe these precautions when installing or servicing Zetron equipment.

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- Follow all warnings and instructions marked on the equipment or included in documentation.
- Only technically qualified service personnel are permitted to install or service the equipment.
- Be aware of and avoid contact with areas subject to high voltage or amperage. Because some components can store dangerous charges even after power is disconnected, always discharge components before touching.
- Never insert objects of any kind through openings in the equipment. Conductive foreign objects could produce a short circuit that could cause fire, electrical shock, or equipment damage.
- Remove rings, watches, and other metallic objects from your body before opening equipment. These could be electrical shock or burn hazards.
- Ensure that a proper electrostatic discharge device is used, to prevent damage to electronic components.
- Do not attempt internal service of equipment unless another person, capable of rendering aid and resuscitation, is present.
- Do not work near rotating fans unless absolutely necessary. Exercise caution to prevent fans from taking in foreign objects, including hair, clothing, and loose objects.
- Use care when moving equipment, especially rack-mounted modules, which could become unstable. Certain items may be heavy. Use proper care when lifting.

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## Release History

Release	Enhancements/Changes
<b>Rev C</b> 04 Mar 2009	Updated manual to current document template Removed the schematics from the rear of the manual Added new radio specific application note and cable kit to the list of those available. See Radio Specific Application Notes on page 19 Corrected documentation errors in describing operating mode 13, see Table 1 on page 11, see Table 11 on page 23, see Table 12 on page 24, and Table 14 on page 27

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# Introduction

## Overview

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The Model 250 Tone Remote Adapter provides a means of connecting a base station radio to industry standard tone remote encoders, such as Zetron's 260 and 280 desksets or series 4000 communications consoles. The adapter connects to an audio circuit or leased line from the tone remote(s) and to the unique interface of the base station radio. The base station can range from a simple, low-cost mobile radio to a rugged, high-power, continuous-duty station. It all depends on the particular application.

The Model 250 includes features typically found only in high-end remote control stations. In addition to the usual monitor and transmit functions, the Model 250 provides channel selection for up to 15 frequencies and up to six control outputs. Typical uses for the control outputs include:

- Channel or mode control
- PL strip
- Repeat (talk-through) enabled/disable
- PL select
- Coded or Clear
- Scan on/off
- Carrier squelch or tone squelch
- Latched or momentary functions
- Minimum or maximum squelch settings
- Door unlock
- Transmit power control
- Main or backup antenna select

The programmable settings for the Model 250 include 14 pre-set configurations that cover most of the potential applications for the unit. This can significantly reduce the time required to install the unit.

Built-in installation aids ensure accurate and reliable setup with the minimum of test equipment. The necessary audio level adjustments are quick and easy. Detachable connectors make cabling an easy job, and pre-wired cables are available for several models of popular radios.

## Features

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- Adds a remote control dispatch interface to base station radios
- Compatible with industry standard tone remote control format
- Up to 15 channel operation
- Up to 8 auxiliary control function outputs (three of which can be configured as either latched or momentary)
- Includes 14 pre-set, installer selectable, control configurations to cover a wide range of applications
- Standard Transmit (Push-to-Talk) and Monitor functions
- High quality audio with automatic compensation for line losses as well as compensation for near/far variations between remotes
- Channel select and control outputs resume their previous state after power failure
- Selectable two-wire or four-wire line interfaces
- Selectable guard tone frequency to support a wide range of applications
- Digital signal processing provides reliability, stability, and eliminates internal adjustments
- Small profile requires the minimum amount of rack space, 19" rack mount option available



# Installation



**Caution!** This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this manual and commonly used radio practices, it may cause interference to radio communications. The installation of the Zetron Model 250 Tone Remote Adapter should be accomplished by personnel with experience in radio and tone remote systems.

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## Getting Started

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The installation of the Zetron Model 250 should be a fairly easy task for any qualified radio technician. The interface wiring and the necessary level adjustments have been kept to a minimum.

There are three main phases to installing a Model 250. They are:

1. Deciding which one of the 14 preset operating modes (see Table 1) best suits the intended use of the radio system and configuring the front panel switches 1-to-4 to place the Model 250 in this mode. This phase also includes setting switches 5, 6, 7, and 8 as necessary to select the RX audio source and determine the operating characteristics of I/Os 6, 7, and 8.
2. Physically connecting the Model 250 to the line coming from the remotes and to the radio it will operate. (see Hardware Interface starting on page 12)
3. Performing the final level checks and adjustments to ensure proper operation of the system. (see Adjustments starting on page 15)

## Tools and Equipment

The following list covers the necessary and desirable tools and equipment for performing a Model 250 installation. Ready-made cables for interfacing the unit to a radio may be purchased from Zetron.

- Standard electrical and electronic hand tools. This includes a variety of screw drivers and alignment tools. If you have not yet made up the interface cable (or purchased one from Zetron), it also includes a crimping tool. Depending on how the line from the tone remotes or console is terminated at the radio site, you may also need a crimping tool for RJ-11 modular connectors.
- Service monitor
- AC Volt meter capable of giving readings in Vrms
- A handheld radio (or other suitable radio) capable of operating on the base station frequency (including generating/decoding any PL or DPL required)

## Selecting an Operating Mode

The Model 250 has been equipped with 14 preset operating modes. These operating modes have been carefully developed to cover the broadest possible range of applications.

To select a particular operating mode, the technician only has to set the first four switches on the front panel of the unit (while the power is turned off).

Table 1 gives a quick listing of all the modes and their attributes. For more detailed information of the various functions associated with each mode, please see “Function Descriptions” on page 24.

Table 1. Model 250 Operating Mode Selections

Mode	0	1	2	3	4	5	6	7	8	9	10	11	12	13
<b>Description</b>	1 Freq Monitor PL strip 6 Wildcard	1 Freq Monitor PL strip 4 PL 2 Wild LineCK	2 Freq Monitor 6 Wild	2 Freq Monitor 4 PL 2 Wild LineCK	4 Freq (1 of 4) Monitor 3 Wild LineCK	7 Freq (1 of 7) Monitor LineCK	8 Freq (binary) Monitor 4 PL	8 Freq (binary) Monitor 3 Wild	12 Freq (binary) Monitor 1 Wild	14 Freq (binary) Monitor	15 Freq (binary)	1 Freq Monitor Latch	8 Freq (binary) Monitor 2 Wild LineCK	14 Freq (BCD) Monitor 1 Wild
<b>Switches 1-4</b>	↓↓↓↓	↓↓↓↑	↓↓↑↓	↓↓↑↑	↓↑↓↓	↓↑↑↑	↓↑↑↓	↓↑↑↑	↑↓↓↓	↑↓↑↑	↑↓↑↓	↑↓↑↑	↑↑↓↓	↑↑↓↑
<b>2050 Hz</b>	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	F15	Monitor	Monitor	Monitor
<b>1950 Hz</b>	PTT	PTT	F1	F1	F1	F1	F1	F1	F1	F1	F1	F1	F1	F1
<b>1850 Hz</b>	F1, PL strip	F1, PL strip	F2	F2	F2	F2	F2	F2	F2	F2	F2	—	F2	F2
<b>1750 Hz</b>	I/O 6 on	I/O 6 on	I/O 6 on	I/O 6 on	I/O 7 on	F7	F7	F7	F3	F3	F3	—	F7	F3
<b>1650 Hz</b>	I/O 6 off	I/O 6 off	I/O 6 off	I/O 6 off	I/O 7 off	—	F8	F8	F4	F4	F4	—	F8	F4
<b>1550 Hz</b>	I/O 8 on	I/O 8 on	I/O 7 on	I/O 7 on	I/O 8 on	—	—	I/O 8 on	F5	F5	F5	—	I/O 8 on	F5
<b>1450 Hz</b>	I/O 8 off	I/O 8 off	I/O 7 off	I/O 7 off	I/O 8 off	—	—	I/O 8 off	F6	F6	F6	—	I/O 8 off	F6
<b>1350 Hz</b>	I/O 1 on	PL 1	I/O 1 on	PL 1	F3	F3	F3	F3	F7	F7	F7	I/O 1 on	F3	F7
<b>1250 Hz</b>	I/O 1 off	PL 2	I/O 1 off	PL 2	F4	F4	F4	F4	F8	F8	F8	I/O 2 on	F4	F8
<b>1150 Hz</b>	I/O 2 on	PL 3	I/O 2 on	PL 3	I/O 6 on	F5	F5	F5	F9	F9	F9	I/O 3 on	F5	F9
<b>1050 Hz</b>	I/O 2 off	PL 4	I/O 2 off	PL 4	I/O 6 off	F6	F6	F6	F10	F10	F10	Reset all	F6	F10
<b>950 Hz</b>	I/O 3 on	—	I/O 3 on	—	—	—	PL 1	I/O 7 on	F11	F11	F11	I/O 4 on	I/O 7 on	F11
<b>850 Hz</b>	I/O 3 off	—	I/O 3 off	—	—	—	PL 2	I/O 7 off	F12	F12	F12	I/O 8 on	I/O 7 off	F12
<b>750 Hz</b>	I/O 4 on	LineCK out	I/O 4 on	LineCK	LineCK	LineCK	PL 3	I/O 6 on	I/O 8 on	F13	F13	I/O 7 on	LineCK out	F13
<b>650 Hz</b>	I/O 4 off	LineCK in	I/O 4 off	LineCK	LineCK	LineCK	PL 4	I/O 6 off	I/O 8 off	F14	F14	I/O 6 on	LineCK in	F14
<b>Functions:</b>														
<b>I/O 1</b>	1350/1250	PL 1	1350/1250	PL 1	F1	F1	Freq bin1	Freq bin1	Freq bin1	Freq bin1	Freq bin1	1350	Freq bin1	Freq BCD1
<b>I/O 2</b>	1150/1050	PL 2	1150/1050	PL 2	F2	F2	Freq bin2	Freq bin2	Freq bin2	Freq bin2	Freq bin2	1250	Freq bin2	Freq BCD2
<b>I/O 3</b>	950/850	PL 3	950/850	PL 3	F3	F3	Freq bin4	Freq bin4	Freq bin4	Freq bin4	Freq bin4	1150	Freq bin4	Freq BCD4
<b>I/O 4</b>	750/650	PL 4	750/650	PL 4	F4	F4	PL1	Low	Freq bin8	Freq bin8	Freq bin8	950	Low	Freq BCD8
<b>I/O 5</b>	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	—	Monitor	Monitor	Monitor
<b>I/O 6 or COR</b>	1750/1650	1750/1650	1750/1650	1750/1650	1150/1050	F7	PL4	750/650	—	—	—	650	—	—
<b>I/O 7 SPST rly</b>	PL strip	PL strip	1550/1450	1550/1450	1750/1650	F6	PL3	950/850	—	—	—	750	950/850	Freq BCD10
<b>I/O 8 SPDT rly</b>	1550/1450	1550/1450	F1 / F2	F1 / F2	1550/1450	F5	PL2	1550/1450	750/650	—	—	850	1550/1450	—

**Note:** Binary frequency select outputs (bin1-bin8) start at 0001. For example; F1=0001, F2=0010 ••• F15=1111. For 3-bit output; F1=001, F8=000.

## Hardware Interface

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The hardware interfacing of the Model 250 can be separated into two parts; the connection to the wireline and the connection to the radio base station.

### Wire Line

Refer to Table 2 for information specific to the line type provided between the Model 250 and the tone remotes or console that control the base station.

1. Check to be sure that the proper audio signals are assigned to the correct pins on the RJ 11 connector (for your line type) and plug the line into the LINE connector on the rear of the Model 250.
2. Set front panel switches 9 and 10 to the correct positions for your line type.
3. Check/set the position of JP8 to match the required line impedance. This only applies to installations using a 4-wire line interface. See Table 5 on page 15.

*Table 2. Model 250 Wireline Connections*

Wireline Type	Line Connections (6-conductor RJ-11 Jack)	Switch 9	Switch 10
2-wire	modular jack pins 3 & 4 (center pins)	Up	Down
4-wire, full duplex	Radio RX to wireline pair = pins 3 & 4 (center pins) Wireline to radio TX pair = pins 2 & 5	Down	Up
4-wire, half-duplex	Radio RX to wireline pair = pins 3 & 4 (center pins) Wireline to radio TX pair = pins 2 & 5	Down	Down

### Base Station Radio

The following steps cover the minimum connections necessary to interface the Model 250 to a generic conventional radio station. The figures and tables referred to in these steps follow the list.

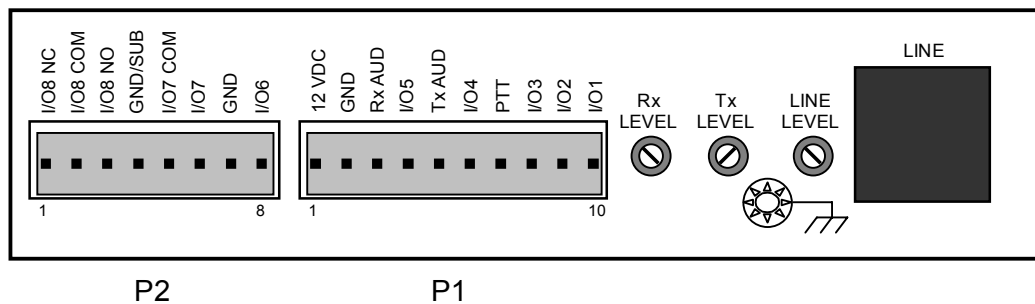
1. **Power Supply:** Connect the +12 Vdc side of the station power supply to P1-pin1. Connect the ground side of the station power supply to P1-pin 2.
2. **Receive Audio:** Find a suitable source of receive audio in the radio. This can be either discriminator audio or processed audio (de-emphasized and squelched), but it should be of “fixed level” (not affected by the setting of an external volume control). Connect this source to P1-pin 3.

- Receive Carrier Detect:** If unscquelched discriminator audio is used for the receive audio in step 2, then a carrier detect signal (or speaker mute signal) must be connected to P2 pin 8 (I/O 6). This signal must drop to less than 0.8 Vdc in its low state and rise to greater than 2.0 Vdc when in its high state. Table 3 shows how to configure front panel switches 5 and 6 for an external carrier detect signal. If squelched discriminator or speaker audio is used, then no external carrier detect signal is connected to the unit.

Table 3. Model 250 Receive Carrier Detect Settings

RX Audio Source	Switch 5	Switch 6	Notes
Unscquelched discriminator audio	Up	Carrier detect polarity Up = Active Low Down = Active High	Receive carrier detect must be connected to I/O 6 (P2-pin 8)
Squelched discriminator audio	Up	Down	Leave I/O 6 (COR input) unconnected
Fixed level, de-emphasized audio (speaker)	Down	—	Switch 6 now sets the I/O 6 output mode

Figure 1. Model 250 Rear Panel



- Transmit Audio:** The transmit audio provided from the Model 250 is intended for the microphone input on the base radio. Connect a wire from P1-pin 5 to the appropriate input on the radio.
- Push-to-Talk (PTT):** The Model 250 keys the transmitter through an FET pull to ground output. (TX = ground, RX = open) Connect P1-pin 7 to the PTT input on the radio.



**Note** If a relay contact is preferred for the PTT function, I/O 7 can be used. Placing JP6 and JP7 in position "B" swaps the function of the PTT pin on P1 and the I/O 7 outputs on P2. See Table 5 on page 15.

- Control Outputs:** The control outputs of the Model 250, I/O 1 through I/O 8, may be used to control various functions of the base station radio or other equipment at the radio site. The outputs I/O 1 through I/O 6 are open-drain FET circuits (inactive outputs are open, active outputs are pulled to ground). I/O 7 and I/O 8 are relays (see Figure 2). Which outputs are available and how they operate

is determined by which operating mode the Model 250 is configured for and the settings of front panel switches 6, 7, and 8.

Connect the appropriate I/O pins to the equipment they control (see Figure 1) and set the switches as necessary per Table 4.

Table 4. Mode Switches for Control Outputs 6, 7, and 8

Switch #	Output	Mode
6	I/O 6	Down = Latched, Up = Timed
7	I/O 7	Down = Latched, Up = Timed
8	I/O 8	Down = Latched, Up = Timed

Figure 2. Control Circuits for the Model 250

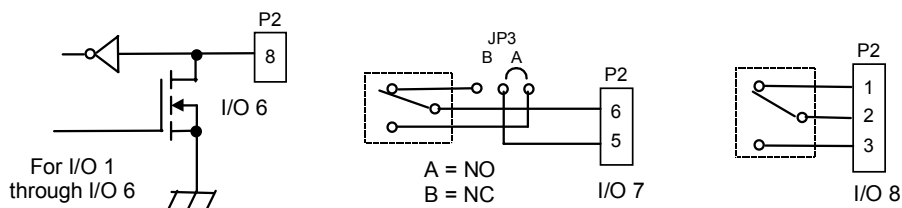


Figure 3. Minimum Connections for a Generic Interface

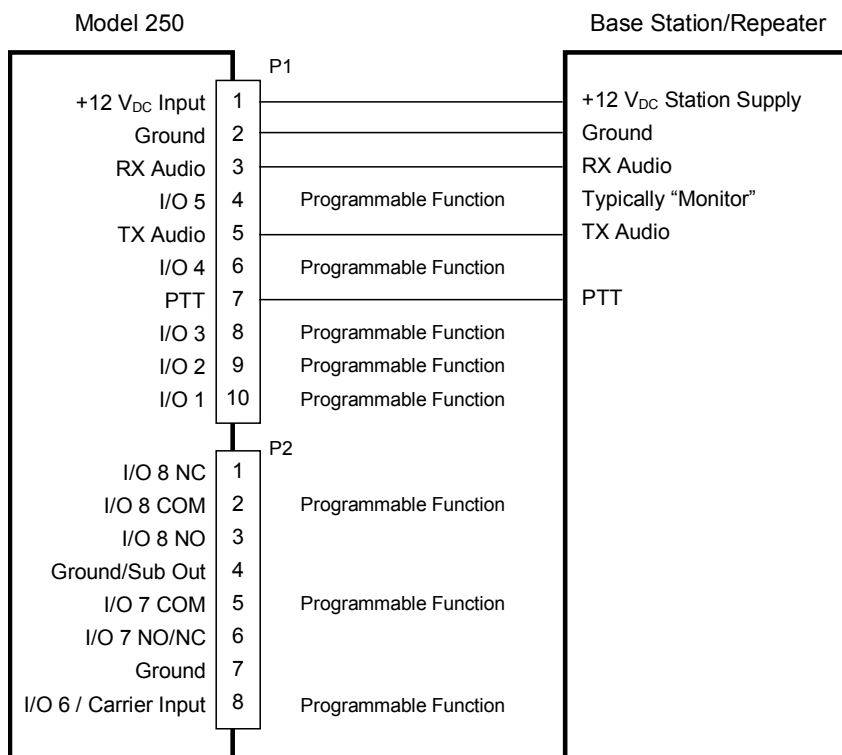


Table 5. Jumpers of the Model 250

Jumper	Functional Description
JP1	This jumper jumpers around a 10 k $\Omega$ resistor (R12) in the TX audio path. Adding or removing this jumper determines the range over which the pot R2 can adjust the TX audio level sent to the transmitter. Default = In [In = high range, Out = low range]
JP2	For future use.
JP3	This jumper selects whether the output pins for I/O 7 (P2 pin-5 & pin-6) represent a pair of normally open or normally closed contacts. Default = A [A = NO, B = NC]
JP4	For future use.
JP5	For future use.
JP6	This jumper determines which pins on the back of the Model 250 are used to output the PTT function. JP6 and JP7 should always be in the same position and should always both be moved together. Default = A [A = P1 pin-7, B = P2 pin-5 & pin-6 (I/O 7)]
JP7	This jumper determines which pins on the back of the Model 250 are used to output the I/O 7 function. JP6 and JP7 should always be in the same position and should always both be moved together. Default = A [A = P2 pin-5 & pin-6, B = P1 pin-7 (PTT)]
JP8	This jumper sets the RX line impedance when a 4-wire interface is used between the remote or console and the Model 250. Default = In, [In = 600 $\Omega$ , Out = High Z ]
JP9	For future use.
JP10	For future use.

## Adjustments

### Basic Adjustments



**Note** To prevent damage to the base station and/or Model 250, make sure the front panel configuration switches have been set prior to supplying power to the unit!

◆ **To make the basic adjustments:**

1. Supply power to the unit, the Status LED should fade from red to green. If the radio level adjustments are to be made on a frequency other than channel 1, send the appropriate channel select TRC command to the unit (using a tone remote controller connected to the wireline).
2. If the unit has been configured for discriminator audio (switch 5 is in the Up position), set switch 6 so that the Status LED blinks rapidly when carrier is present on the channel (unscelched), and is “on solid” when carrier is absent. This is accomplished using a service monitor or radio on the base station receive frequency (be sure to supply the appropriate CTCSS or DCS if required). If scelched discriminator audio is used, set switch 6 so that the LED is always blinking.
3. Write down the current front panel switch settings then remove power. Set switches 1 through 4 Up and 5 through 8 Down (↑↑↑↑↓↓↓xx), then restore power. The unit will key up on the previously selected channel (or channel 1) while generating a 1 kHz audio tone to both the wireline and transmitter.
4. Monitor the base station transmit frequency with the service monitor. Using the TX LEVEL adjustment on the Model 250’s rear panel, set the transmit deviation of the test tone to 65% of the maximum allowed for the channel.



**Note** If the deviation is always too high, or too touchy to adjust, remove jumper JP1 and then try re-adjusting the deviation. See Table 5 on page 15.

5. Monitor the wireline LINE-RX pair (modular jack pins 3&4) using an AC voltmeter. Be sure all remote controllers and/or consoles are connected before making any adjustments. The LINE LEVEL adjustment is typically set for 0.775 Vrms or 0 dBm. Receive levels at the console or remote control units may be adjusted if needed.
6. Move switch 8 to the Up position (↑↑↑↑↓↓↓↑xx). Supply a 1 kHz, full quieting test tone on the base station receive frequency, at 60% of full channel deviation (without CTCSS or DCS). Set the RX LEVEL adjustment so that the Status LED shows solid green. Please note that the Model 250 puts the base station into monitor during test modes. The Status indications during this test are described in Table 6.

*Table 6. Status LED Indications While in Test Mode 1*

Status LED	Meaning
Solid Green	Proper level set
Solid Red	Good level, but level is not adjusted properly
Flashing Red	Poor signal, not 1 kHz, distorted, or level is way out of adjustment
Flashing Green	Close to proper level, but signal is poor quality



7. Remove power, set the front panel configuration switches back to the desired operating mode, then restore power.

## Selecting An Alternate Guard Tone

In order to fit a wide range of applications, the Model 250 Tone Remote Adapter provides a choice of guard tone frequencies.

◆ **To select a frequency other than default (2175 Hz):**

1. Record the current settings of all the front panel switches.
2. Remove power and set the configuration switches to select a new frequency per Table 7.
3. Power up the unit (the Status LED should alternate between red and green) then remove power.
4. Reset the configuration switches for the appropriate operating mode and restore power.

*Table 7. Alternate Guard Tones Available in the Model 250*

Guard Tone Frequency	Configuration Switch Setting
2100 Hz	↑↑↑↑↓↓XX
2175 Hz	↑↑↑↑↓↑XX
2300 Hz	↑↑↑↑↓↓XX
2323 Hz	↑↑↑↑↓↑XX
2600 Hz	↑↑↑↑↓↓XX
2800 Hz	↑↑↑↑↓↑XX
2970 Hz	↑↑↑↑↓↓XX

## An Example Installation

What follows is an example of interfacing the Model 250. It is hoped that this example will help the installer in developing a firm grasp of the more general information provided earlier in this section of the manual.

## Generic Interface Using Operating Mode 9

In this example, the generic interface for operating mode number 9 is covered. The description given for this mode in Table 1 indicates that mode 9 provides channel selection for up to 14 frequencies using a 4-bit binary output to do the selection. It also provides channel monitoring capability via I/O 5. This mode is selected by placing front panel switches 1 and 4 in the up position while switches 2 and 3 remain in the down position ( $\uparrow\downarrow\downarrow\uparrow\text{xxxxxx}$ ).

The settings for switches 5 and 6 will vary depending on the source of receive audio from the radio. See Table 3 for more information on setting these two switches.

Figure 4. Generic Connections For Operating Mode 9

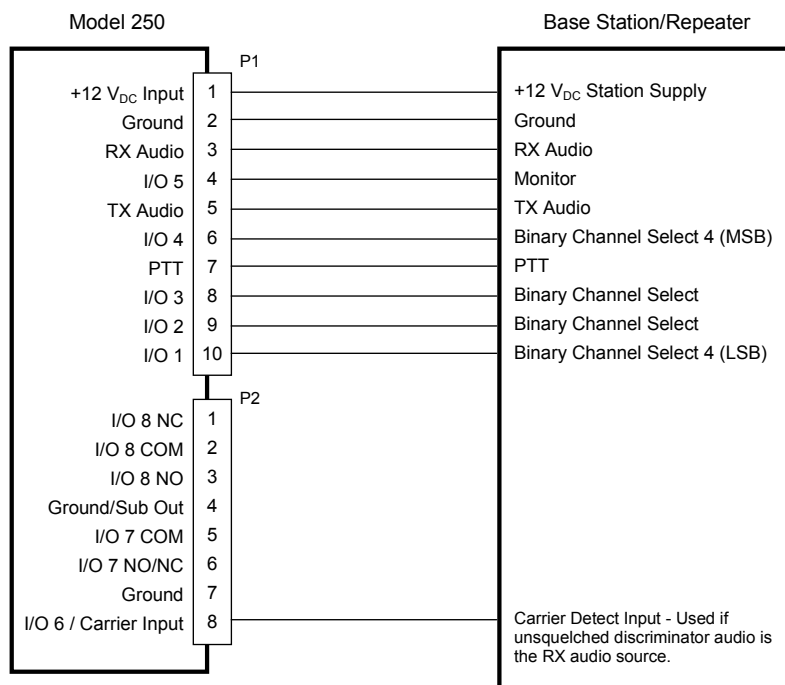


Table 8 shows the assignment of the various function tones in mode 9.

Table 8. Function Tone Assignments for Operating Mode 9

Function Tone	Description	I/O4, I/O3, I/O2, I/O1	I/O5
2050	Monitor	Unchanged	Low
1950	F1	0001	High
1850	F2	0010	High
1750	F3	0011	High
1650	F4	0100	High
1550	F5	0101	High
1450	F6	0110	High
1350	F7	0111	High
1250	F8	1000	High
1150	F9	1001	High
1050	F10	1010	High
950	F11	1011	High
850	F12	1100	High
750	F13	1101	High
650	F14	1110	High

## Radio Specific Application Notes

Zetron has prepared several radio-specific applications notes for interfacing the Model 250 to popular radio equipment. Table 9 lists the applications notes and the ready-made cables available to use with each of them.

Table 9. Radio Specific Application Notes and Cables

Description	Document #	Cable #
Motorola GM300, M120 and R1225	011-0537	950-0328
Kenwood TKR-840 and TKR-740 Repeater	011-0538	950-0329
Kenwood TK-690, TK-790, and TK-890 Transceivers	011-0534	950-0330
Kenwood TK-x180, TK-5x10, or NX-x00 Transceivers	011-0775	950-0956
Motorola MOTOTRBO Mobile Radio	011-0799	950-1017



# Operation

This section concerns itself with explaining the “how” and “why” of normal operation for the Model 250 Tone Remote Adapter.

## Operating Modes

---

The Tone Remote Adapter allows the dispatcher to control various functions of the radio, which typically include transmit/receive, channel selection, monitor, and other control functions depending on the application. The Zetron Model 250 decodes tone remote control (TRC) commands sent by a dispatcher, associates them with a specific function, then sets the control signals to the radio appropriately.

Fourteen pre-set configurations are provided which cover most radio dispatch applications. The operating mode is selected by the installer using four of the front panel configuration switches. These are combinations of frequency selects (channels), control outputs (wild cards), and monitor functions. Typical uses for the outputs include:

- Channel select or radio mode control, may be in “1 of n”, binary, or BCD format
- Monitor, PL strip, or PL select
- Repeat (talk-through audio) enable/disable
- Coded/Clear
- Scan on/off
- Carrier squelch/tone squelch
- Latched or momentary functions, such as Door unlock
- Loose/tight squelch setting
- Transmit power (high/low) control or Main/backup antenna select

To decide which mode is best for the application, review the number of channels required, the radio channel select method (1-of-n, binary, or BCD), whether or not monitor is required, the number of wildcard functions, and whether or not the LineCheck

## Operation

function is desirable. Table 10 and Table 11 describe each operating mode. This includes the tone remote function tones, the action taken in response to each function tone, and what each of the output signals does. Table 12 describes the various functions and capabilities referenced in the previous two tables.

*Table 10. Model 250 Operating Modes 0 to 6*

Mode	0	1	2	3	4	5	6
Description	1 Frequency Monitor PL strip 6 Wildcard	1 Frequency Monitor, 4 PL PL strip 2 Wildcard LineCheck	2 Freq Monitor 6 Wildcard	2 Freq Monitor 4 PL 2 Wildcard LineCheck	4 Freq (1 of 4) Monitor 3 Wildcard LineCheck	7 Freq (1 of 7) Monitor LineCK	8 Freq (Binary) Monitor 4 PL
Switches 1-4⇒	↓↓↓↓	↓↓↓↑	↓↓↑↓	↓↓↑↑	↓↑↓↓	↓↑↓↑	↓↑↑↓
2050 Hz	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
1950 Hz	PTT	PTT	F1	F1	F1	F1	F1
1850 Hz	F1 + PL strip	F1 + PL strip	F2	F2	F2	F2	F2
1750 Hz	I/O 6 on	I/O 6 on	I/O 6 on	I/O 6 on	I/O 7 on	F7	F7
1650 Hz	I/O 6 off	I/O 6 off	I/O 6 off	I/O 6 off	I/O 7 off	-	F8
1550 Hz	I/O 8 on	I/O 8 on	I/O 7 on	I/O 7 on	I/O 8 on	-	-
1450 Hz	I/O 8 off	I/O 8 off	I/O 7 off	I/O 7 off	I/O 8 off	-	-
1350 Hz	I/O 1 on	PL 1	I/O 1 on	PL 1	F3	F3	F3
1250 Hz	I/O 1 off	PL 2	I/O 1 off	PL 2	F4	F4	F4
1150 Hz	I/O 2 on	PL 3	I/O 2 on	PL 3	I/O 6 on	F5	F5
1050 Hz	I/O 2 off	PL 4	I/O 2 off	PL 4	I/O 6 off	F6	F6
950 Hz	I/O 3 on	-	I/O 3 on	-	-	-	PL 1
850 Hz	I/O 3 off	-	I/O 3 off	-	-	-	PL 2
750 Hz	I/O 4 on	LineCK out	I/O 4 on	LineCK	LineCK	LineCK	PL 3
650 Hz	I/O 4 off	LineCK in	I/O 4 off	LineCK	LineCK	LineCK	PL 4
Functions:							
I/O 1	1350/1250	PL 1	1350/1250	PL 1	F1	F1	Freq Binary 1
I/O 2	1150/1050	PL 2	1150/1050	PL 2	F2	F2	Freq Binary 2
I/O 3	950/850	PL 3	950/850	PL 3	F3	F3	Freq Binary 4
I/O 4	750/650	PL 4	750/650	PL 4	F4	F4	PL1
I/O 5	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
I/O 6 (or COR)	1750/1650	1750/1650	1750/1650	1750/1650	1150/1050	F7	PL4
I/O 7 (SPST relay)	PL strip	PL strip	1550/1450	1550/1450	1750/1650	F6	PL3
I/O 8 (SPDT relay)	1550/1450	1550/1450	F1 / F2	F1 / F2	1550/1450	F5	PL2

**Note:** I/O outputs 1 through 6 are active low, open drain FETs. On = Low, Off = High.

Table 11. Model 250 Operating Modes 7 to 13

Mode	7	8	9	10	11	12	13
Description	8 Freq (Binary) Monitor 3 Wildcard	12 Freq (Binary) Monitor 1 Wild	14 Freq (Binary) Monitor	15 Freq (Binary)	1 Freq Monitor Latch	8 Freq (Binary) Monitor 2 Wild LineCK	14 Freq (BCD) Monitor 1 Wildcard
Switches 1-4⇒	↓↑↑↑	↑↓↓↓	↑↓↓↑	↑↓↑↓	↑↓↑↑	↑↑↓↓	↑↑↓↑
2050 Hz	Monitor	Monitor	Monitor	F15	Monitor	Monitor	Monitor
1950 Hz	F1	F1	F1	F1	F1	F1	F1
1850 Hz	F2	F2	F2	F2	-	F2	F2
1750 Hz	F7	F3	F3	F3	-	F7	F3
1650 Hz	F8	F4	F4	F4	-	F8	F4
1550 Hz	I/O 8 on	F5	F5	F5	-	I/O 8 on	F5
1450 Hz	I/O 8 off	F6	F6	F6	-	I/O 8 off	F6
1350 Hz	F3	F7	F7	F7	I/O 1 on	F3	F7
1250 Hz	F4	F8	F8	F8	I/O 2 on	F4	F8
1150 Hz	F5	F9	F9	F9	I/O 3 on	F5	F9
1050 Hz	F6	F10	F10	F10	Reset all	F6	F10
950 Hz	I/O 7 on	F11	F11	F11	I/O 4 on	I/O 7 on	F11
850 Hz	I/O 7 off	F12	F12	F12	I/O 8 on	I/O 7 off	F12
750 Hz	I/O 6 on	I/O 8 on	F13	F13	I/O 7 on	LineCK out	F13
650 Hz	I/O 6 off	I/O 8 off	F14	F14	I/O 6 on	LineCK in	F14
Functions:							
I/O 1	Freq Binary 1	Freq Binary 1	Freq Binary 1	Freq Binary 1	1350	Freq Binary 1	Freq BCD1
I/O 2	Freq Binary 2	Freq Binary 2	Freq Binary 2	Freq Binary 2	1250	Freq Binary 2	Freq BCD2
I/O 3	Freq Binary 4	Freq Binary 4	Freq Binary 4	Freq Binary 4	1150	Freq Binary 4	Freq BCD4
I/O 4	Low	Freq Binary 8	Freq Binary 8	Freq Binary 8	950	Low	Freq BCD8
I/O 5	Monitor	Monitor	Monitor	—	Monitor	Monitor	Monitor
I/O 6 (or COR)	750/650	—	—	—	650	—	—
I/O 7 (SPST relay)	950/850	—	—	—	750	950/850	Freq BCD10
I/O 8 (SPDT relay)	1550/1450	750/650	—	—	850	1550/1450	—

Note: I/O outputs 1 through 6 are active low, open drain FETs. On = Low, Off = High.

## Function Descriptions

The descriptions provided in Table 12 will help you to understand both the general operation of the Model 250 and the operating mode descriptions provided in Table 10 and Table 11.

*Table 12. Model 250 Operating Functions*

Function	Description																								
F1 - F7 (one-of-n)	The I/O lines assigned an “Fn” designation are used as individual frequency select outputs. Only one will be active at a time. The current selected frequency output pin will be at ground potential, all others will be open.																								
F1 / F2	This function controls only the I/O 8 relay, for use in two frequency applications. The single I/O 8 relay can select between F1 and F2 since both normally open and normally closed relay connections are made available.																								
Frequency Binary (1, 2, 4, 8)	<p>Binary frequency control for up to 15 channels (depending on the mode selected). The pins are active-high and designed for compatibility with most popular conventional mobile radios designed in the USA.</p> <p>The 4-bit output sequence (binary 8, 4, 2, 1) is as follows;</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>F1 = 0001</td> <td>F5 = 0101</td> <td>F9 = 1001</td> <td>F13 = 1101</td> </tr> <tr> <td>F2 = 0010</td> <td>F6 = 0110</td> <td>F10 = 1010</td> <td>F14 = 1110</td> </tr> <tr> <td>F3 = 0011</td> <td>F7 = 0111</td> <td>F11 = 1011</td> <td>F15 = 1111</td> </tr> <tr> <td>F4 = 0100</td> <td>F8 = 1000</td> <td>F12 = 1100</td> <td></td> </tr> </table> <p>The 3-bit output sequence (binary 4, 2, 1) is as follows;</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>F1 = 001</td> <td>F3 = 011</td> <td>F5 = 101</td> <td>F7 = 111</td> </tr> <tr> <td>F2 = 010</td> <td>F4 = 100</td> <td>F6 = 110</td> <td>F8 = 000</td> </tr> </table>	F1 = 0001	F5 = 0101	F9 = 1001	F13 = 1101	F2 = 0010	F6 = 0110	F10 = 1010	F14 = 1110	F3 = 0011	F7 = 0111	F11 = 1011	F15 = 1111	F4 = 0100	F8 = 1000	F12 = 1100		F1 = 001	F3 = 011	F5 = 101	F7 = 111	F2 = 010	F4 = 100	F6 = 110	F8 = 000
F1 = 0001	F5 = 0101	F9 = 1001	F13 = 1101																						
F2 = 0010	F6 = 0110	F10 = 1010	F14 = 1110																						
F3 = 0011	F7 = 0111	F11 = 1011	F15 = 1111																						
F4 = 0100	F8 = 1000	F12 = 1100																							
F1 = 001	F3 = 011	F5 = 101	F7 = 111																						
F2 = 010	F4 = 100	F6 = 110	F8 = 000																						
Frequency BCD (1, 2, 4, 8, 10)	<p>BCD frequency control for up to 14 channels (mode 13). The pins are active-low and designed for compatibility with many radios designed in Japan. The output sequence (BCD 10, 8, 4, 2, 1) is as follows;</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>F1 = 1 1110</td> <td>F4 = 1 1011</td> <td>F7 = 1 1000</td> <td>F10 = 0 1111</td> </tr> <tr> <td>F2 = 1 1101</td> <td>F5 = 1 1010</td> <td>F8 = 1 0111</td> <td>F11 = 0 1110</td> </tr> <tr> <td>F3 = 1 1100</td> <td>F6 = 1 1001</td> <td>F9 = 1 0110</td> <td>F12 = 0 1101</td> </tr> </table>	F1 = 1 1110	F4 = 1 1011	F7 = 1 1000	F10 = 0 1111	F2 = 1 1101	F5 = 1 1010	F8 = 1 0111	F11 = 0 1110	F3 = 1 1100	F6 = 1 1001	F9 = 1 0110	F12 = 0 1101												
F1 = 1 1110	F4 = 1 1011	F7 = 1 1000	F10 = 0 1111																						
F2 = 1 1101	F5 = 1 1010	F8 = 1 0111	F11 = 0 1110																						
F3 = 1 1100	F6 = 1 1001	F9 = 1 0110	F12 = 0 1101																						
Monitor	The monitor function provides a method of “monitoring” a shared radio channel before transmitting. When the monitor command is received by the Model 250, it will pull output signal I/O 5 low. When any transmit command (F1 - F15) is received, it will release I/O 5 to cancel monitor. This is typically used to temporarily defeat the CTCSS/DCS decoder in the receiver until transmit has occurred.																								
PL Strip	PL Strip provides a method of transmitting without encoding CTCSS or DCS. It is typically used to keep from annoying the dispatch fleet radios during paging. When a PL Strip function is active, the I/O 7 output pin is pulled to ground for the duration of the transmission (it follows the PTT signal). For non-PL Strip transmissions, I/O 7 is inactive.																								
PL1, PL2, PL3, PL4	The PL select outputs are typically used to control the CTCSS/DCS function of the radio receiver and/or transmitter. The (active low) outputs are interlocked such that one (and only one) is active at any given time.																								



Function	Description								
I/O X on, I/O X off	<p>General purpose output control lines are often referred to as "wild cards", and can be set or cleared by the dispatcher. These active-low outputs can be used in a wide range of applications such as:</p> <table border="0"> <tr> <td>Repeater (talkthrough) enable/disable</td> <td>Scan on/off</td> </tr> <tr> <td>Carrier squelch/tone squelch</td> <td>Scrambler on/off</td> </tr> <tr> <td>Loose/tight squelch setting</td> <td>Main/backup antenna select</td> </tr> <tr> <td>Transmit power (high/low) control</td> <td>Door unlock</td> </tr> </table> <p>The outputs I/O 6, I/O 7, and I/O 8 may be configured (using the front panel switches) for either "latched" or "momentary" operation.</p>	Repeater (talkthrough) enable/disable	Scan on/off	Carrier squelch/tone squelch	Scrambler on/off	Loose/tight squelch setting	Main/backup antenna select	Transmit power (high/low) control	Door unlock
Repeater (talkthrough) enable/disable	Scan on/off								
Carrier squelch/tone squelch	Scrambler on/off								
Loose/tight squelch setting	Main/backup antenna select								
Transmit power (high/low) control	Door unlock								
LineCheck	<p>When this function is enabled, receiving a 650 Hz function tone sequence causes the Model 250 to send a 750 Hz function tone sequence back to the originating remote or console. It is followed by a beep sequence that gives the dispatcher positive indication that the console, wireline, and tone remote adapter are all intact.</p>								

## Front Panel "STATUS" LED Indications

The Model 250 has only one LED status indicator on the front panel. In order to get as much utility as possible from this single output, it has been given multi-color capability in addition to using various blinking patterns. Table 13 explains the meaning of the various combinations of color and blink rate.

Table 13. Model 250 Front Panel Indications


Indication	Function Description
Red-orange-amber-yellow-green	Mode setup (loading configuration switch settings)
Green	Idle
Green flickering (30ms on, 15ms off)	Idle, Rx carrier detected (audio is being sent to dispatcher)
Yellow	Monitor output engaged
Yellow flickering	Monitor output engaged, Rx carrier detected
Red	Transmit
Red flickering	Transmit, Rx carrier detected
Wink	TRC command detected
Blinking red	Device failure
Blinking amber (500ms on, 500ms off)	Invalid mode select (configuration error, check switch settings)
Alternating red-green	Guard tone frequency selection complete

## Front Panel Switch Settings

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Table 14 provides a quick summary of the functions that can be accessed from the front panel switch. This includes both the preset operating modes and the test modes provided to aid the technician during setup. The following notes apply to the use of the information contained in Table 14.

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 **Note** In general, to avoid entering modes unintentionally, it is best to set the configuration switches to the proper mode with the power off. If switches are moved while the power is on, they are debounced for five (5) seconds before any actions are taken. The end result will be the same.


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 **Note** After a power failure, the channel select, monitor and control outputs are restored to their previous state.


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 **Note** During all test modes, The adapter sets its frequency control outputs to the radio based on the previously selected operating mode. If the unit was in use at all, the channel selected is the one last used in the normal operating mode. If there is no operating history, the unit defaults to channel 1 for that mode.

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 **Note** During the receive level test, the radio is automatically set to "monitor mode".

---

Table 14. Model 250 Front Panel Switch Settings

Switch Setting	Function/Mode	Configuration
1234-----	Mode Selection	See Operating Modes in lower part of the table.
-----5-----	Rx de-emphasis	↓ = Speaker audio. ↑ = Discriminator, and I/O 6 is COR Input
-----6-----	I/O 6 action	↓ = Latched. ↑ = Timed momentary (500 ms) or COR polarity
-----7---	I/O 7 action	↓ = Latched. ↑ = Timed momentary (500 ms)
-----8--	I/O 8 action	↓ = Latched. ↑ = Timed momentary (500 ms)
-----9-	Line type	↓ = 4-Wire ↑ = 2-Wire
-----0	4-Wire Duplex	↓ = Half duplex ↑ = Full duplex (FDX requires 4-Wire line)
—	—	<b>Operating Modes:</b>
↓↓↓XXXXXX	Mode 0	1 Frequency, Monitor, PL strip, 6 Wildcards
↓↓↓↑XXXXXX	Mode 1	1 Frequency, Monitor, PL strip, 4 PL, 2 Wildcards, LineCheck
↓↓↑XXXXXX	Mode 2	2 Frequency, Monitor, 6 Wildcards
↓↓↑↑XXXXXX	Mode 3	2 Frequency, Monitor, 4 PL, 2 Wildcards, LineCheck
↓↑↓XXXXXX	Mode 4	4 Frequency (1 of 4), Monitor, 3 Wildcards, LineCheck
↓↑↓↑XXXXXX	Mode 5	7 Frequency (1 of 7), Monitor, LineCheck
↓↑↑XXXXXX	Mode 6	8 Frequency (binary), Monitor, 4 PL or 4 Frequency (binary, Monitor, 4 PL, PL strip)
↓↑↑↑XXXXXX	Mode 7	8 Frequency (binary), Monitor, 3 Wildcards
↑↓↓XXXXXX	Mode 8	12 Frequency (binary), Monitor, 1 Wildcard
↑↓↑XXXXXX	Mode 9	14 Frequency (binary), Monitor
↑↓↑↓XXXXXX	Mode 10	15 Frequency (binary)
↑↓↑↑XXXXXX	Mode 11	1 Frequency, Monitor, Latched functions
↑↑↓XXXXXX	Mode 12	8 Frequency (binary), Monitor, 2 Wildcards, LineCheck
↑↑↑XXXXXX	Mode 13	14 Frequency (BCD), Monitor
—	—	<b>Test Modes:</b>
↑↑↑↑↓↓↓XX	Tx level test	PTT on, 1KHz tone to line at 0 dBm, 1KHz tone to Tx at 85% dev.
↑↑↑↑↓↓↑XX	Rx level test	Rx audio level set. Green = Ok, Red = Low or High, Blinking = poor signal quality
↑↑↑↑↓↑↓XX	AGC disable	PTT on, Line Rx to Radio Tx audio enabled, auto level and AGC are disabled
↑↑↑↑↓↑↑XX	Tone sweep	PTT on, tone to Line and Tx at 404 Hz, 1004 Hz, 2804 Hz, quiet, 4 seconds each
—	—	<b>Guard Tone Selection Modes: (unit remembers the setting)</b>
↑↑↑↑↑↓↓XX	2100 Hz guard	Turn the power off, set the switches, turn power back on, wait for blinking LED
↑↑↑↑↑↓↑XX	2175 Hz guard	
↑↑↑↑↑↓XX	2300 Hz guard	
↑↑↑↑↑↑XX	2323 Hz guard	
↑↑↑↑↑↓XX	2600 Hz guard	
↑↑↑↑↑↑XX	2800 Hz guard	
↑↑↑↑↑↑↓XX	2970 Hz guard	



# Troubleshooting

## Problems and Answers

Table 15 contains several potential problems you might encounter with a tone remote system using the Model 250 and provides suggested actions for taking care of each problem.

*Table 15. Trouble Shooting Problems & Answers*

Problems	Answers
The Model 250 does not seem to respond to any TRC function tones sent to it.	<p>Make sure that the Status LED on the Model 250 winks with the receipt of every TRC command. If not then check the following:</p> <ul style="list-style-type: none"> <li>a) Make sure the audio coming from the remote or console is connected to the proper pins on the Model 250 modular jack.</li> <li>b) Make sure the Model 250 is configured for the proper guard tone frequency, or reselect it (see <i>Selecting An Alternate Guard Tone</i> on page 17).</li> </ul>
Dispatch audio is being transmitted, but the dispatcher never hears anything returning from the mobile users.	Make sure switches 5 and 6 are set properly, and that a valid carrier detect signal is connected (if required). See <i>Base Station Radio</i> on page 12.
Receive audio is arriving at the dispatch control point in fine condition; however, whenever the dispatcher tries to transmit, the Status LED on the Model 250 goes red, then fades to green, and the radio transmitter never keys up.	Check the station power supply. If it is not adequate for the maximum station load, it is probably going into current limiting whenever the radio tries to key and dropping below +10.5 VDC. This is causing the Model 250 to reset itself due to the low voltage.



# Specifications

## General

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<b>Power:</b>	10.5 Vdc to 16 Vdc, at 500 mA, unregulated supply
<b>Operating Temperature:</b>	-30° to +70° Celsius, 95% relative humidity at +50° (non-condensing)
<b>Indicators:</b>	Power, and Status
<b>Adjustments:</b>	RX audio, TX audio, Line TX
<b>Configuration/Setup:</b>	Accomplished using front panel switches
<b>Dimensions:</b>	8.25" (210 mm) x 5.25" (133 mm)x 1.25" (32 mm) (L x W x H)
<b>Weight:</b>	1.4 pounds (0.64 kg)

## Radio Interface

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<b>Connectors:</b>	Two detachable connectors, one 8-pin, the other 10-pin both are 0.156" crimp-pin style
<b>Audio Connections:</b>	For RX the unit uses either discriminator or speaker audio For TX the unit uses the mic audio input
<b>Control Outputs:</b>	Total of nine (9) Seven (7) open-drain outputs (including PTT and Monitor) Two (2) relays

## Line Interface

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<b>Connector:</b>	RJ11 modular jack
<b>Line Type:</b>	Balanced 600 $\Omega$ , either 2 wire (semi-duplex) or 4 wire (full-duplex)
<b>Secondary Protection:</b>	High voltage clamps with fusing elements to protect line interface circuits
<b>RX Audio AGC:</b>	Can compensate for line losses up to 20 dB
<b>Guard Tone Frequency:</b>	Defaults to 2175 Hz, other frequencies available via DIP switch setting (see Configurable Items)
<b>Function Tone Frequencies:</b>	15 available, 650 Hz to 2050 Hz in 100 Hz steps
<b>Audio Filtering:</b>	Guard tone notch and hi-pass filters in both directions (line-to-TX and RX-to-line)

## Serial Port

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<b>Connector:</b>	Modular, 6-pin, off-set keyed
<b>Interface Adapter:</b>	Converts standard RS-232 levels to TTL levels, presents a DB-25 connector towards the PC, and an RJ-11 towards the Model 250
<b>Please Note:</b>	The serial port on the front of the Model 250 is provided to support future expansion of the product. Currently it is used only in production.

## Configurable Items

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<b>RX Audio Source:</b>	Discriminator audio or radio speaker audio
<b>Carrier Detect Polarity:</b>	Normal or inverted
<b>Control Output Mode:</b>	Latched or momentary, selectable for each of three outputs independently
<b>Guard Tone Frequency:</b>	Selectable 2100 Hz, 2175 Hz, 2300 Hz, 2325 Hz, 2600 Hz, 2800 Hz, and 2970 Hz
<b>Line Type:</b>	2-wire, 4-wire half-duplex, 4-wire full duplex
<b>Set Up Test Modes:</b>	Five (5) test modes to facilitate setup and adjustment, selectable from the front panel switch
<b>Operating Modes:</b>	14 preset configurations



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