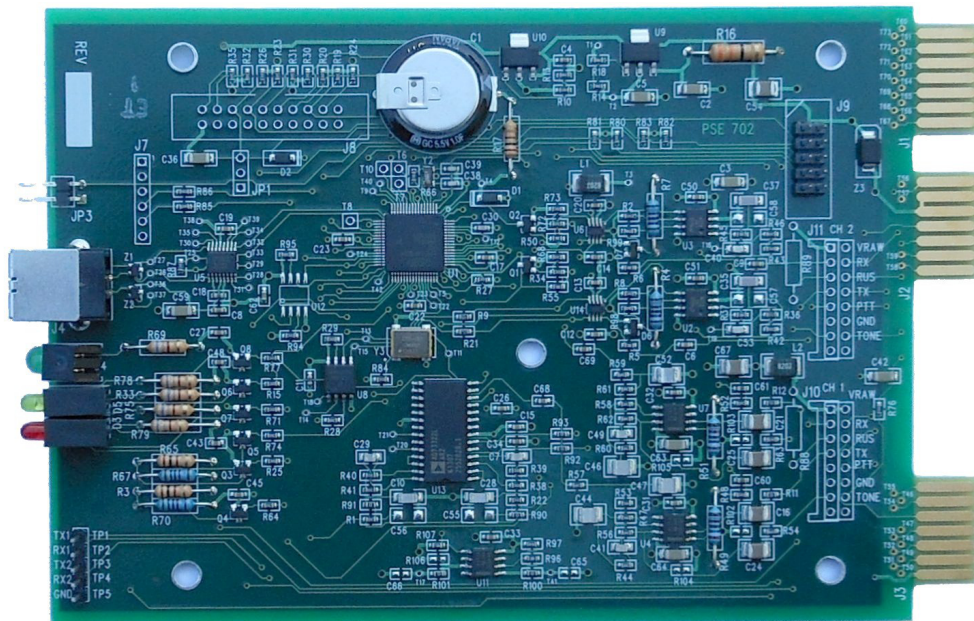


PSE-702 Dual Channel Repeater Controller Operator's Guide

Version 2.8, November 19, 2013

Conforms to Firmware Version 3.2.2

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Change History

Version	Date	Who	Description
1.00	7.24.2012	NLH	Created HTML version of the reference guide. Added diagram for RxTx paths, added photos Added glossary tooltips, replaced some footnotes with tooltips Added change history; revised path description; edited DTMF command entry section; added audio links to CW sound files Cleanup formatting of command parameters, examples, and tables Added link to Repeater setup; made test HTML file from print option; added testpoints photo Added photos with callouts of LEDs, DIP switches, moved testpoints photo to RX level adjust section, maxed content windows for small-screen browser windows Updated tables to shrink to small browser windows
1.00	7.28.2012	ALP	Moved image directory, updated links
	9.23.2012	NLH	Added DTMF versions voice-related commands.
1.10	10.7.2012	NLH	Added console equivalent commands for voice ID; some format changes to tables
1.11	11.23.2012	NLH	Added new commands related to voice announcements; removed txf A flag
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1.3	12.26.2012	NLH	Created a new chapter for DTMF commands and began updating content with new commands
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2.63	1.27.2013	NLH	Added rxf flag M and DTMF command #41. Changed firmware version to 2.6.3.
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2.67	2.6.2013	NLH	Added B flag for txf command, and DTMF #12, to enable/disable courtesy beeps for a transmitter.
2.68	4.5.2013	NLH	Corrected syntax for DTMF command #21. Updated firmware version to 2.7.
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	10/25/2013	ALP	Rendered to text and reformatted in LibreOffice. Corrections based on ALP and KMV review of function names and parameter lists compared to firmware source files. Corrections from EAS review of draft document
2.8	11/19/2013	ALP	Removed schematic from Operator's Manual and made separate document.

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1 Overview

1.1 Introduction

The PSE-702 is a state-of-the-art two-channel repeater controller that makes extensive use of digital signal processing (DSP). It supports two independent receiver and transmitter channels. The audio for each channel is digitized immediately after a gain block and anti-aliasing filter. Once digitized, all processing is handled with firmware. The resulting audio is output on DAC channels and low-pass filtered before going to the output gain block. CTCSS encode/decode, CTCSS rejection filtering, de-emphasis, DTMF decoding, audio store and forward, cross point switching, and so on, are performed in firmware.

The device is controlled by a 32 bit ARM microcontroller and uses 16 bit precision ADCs and DACs for audio signal conversion. The printed circuit board is a multilayer surface mount design with through-hole parts in places that make it more convenient to adapt the board to non-standard applications.

Configuration is performed using a standard computer terminal (such as HyperTerminal or TeraTerm), interfaced to the board using an on-board USB to serial interface so a user can connect using a standard USB cable (that is, a user-supplied USB to serial cable is not required). Most configuration parameters may be changed remotely using DTMF tones.

1.2 Conventions

Text in curly braces { }: Indicates a parameter that must be entered. Do not enter the braces themselves, just the parameter they represent.

Text in Courier New font: Indicates text that is entered into or printed on the operator console.

1.3 Acknowledgments

Pion and Simon Electronics would like to thank the following people for their help in creating this product:

- Steve Fritts W4YJ, who's outstanding efforts in testing prototypes for us under real-world conditions, and who's help and insightful suggestions, have made this product possible. A special thank you, Steve.
- Willmajean French KD7HP, who also helped test an early prototype and had many helpful suggestions,
- Nanci Hamilton, who spent many hours testing the board, as well as collecting and organizing information about the board and creating the beta test support operator's manual which is the forerunner of this document.
- Kerri Veenstra, who helped convert the online beta test operator's manual into the manual's current form.

2 Installation and Setup

The PSE-702 is designed for installation in GE MASTR-II base station radios. Before the PSE-702 can function properly as a repeater controller, the host GE MASTR-II must be configured as a repeater, and the receiver and transmitter must be properly adjusted as specified by GE.

See the Repeater Setup page on our website for instructions about how to configure the MASTR-II as a repeater.

To adjust your equipment properly, see the GE LBIs for your specific receiver and transmitter. The LBIs can be found on the Repeater Builder website at: <http://www.repeater-builder.com/rbtip/geindex.html>

The PSE-702 expects the following inputs to and outputs from the repeater. All are supplied by the GE MASTR-II base station via the control shelf audio slot connectors. See section 12.4 for more details regarding these signals:

- Supply voltage (VRAW) is supplied by the 10 volt regulator card in the MASTR-II station control shelf.
- Active high unsquelched signal (RUS) from the MASTR-II receiver.
- Active low push-to-talk signal (PTT) to the MASTR-II exciter.
- Audio signal from the MASTR-II receiver (VOL_SQ_HI).
- Audio signal to the MASTR-II exciter (TX_AUDIO_HI).

2.1 Standard Mastr II Installation

The PSE-702 supports two receivers, Receiver 1 and Receiver 2, and two transmitters, Transmitter 1 and Transmitter 2. In the standard Mastr II application, Receiver 1 and Transmitter 1 are connected to the receiver and exciter of the Mastr II via the card edge connectors in the audio slot of the control shelf card rack (see Illustration 1.

2.2 Setup Instructions

A properly adjusted GE MASTR-II receiver provides a 1.0 VRMS audio level on the VOL/SQ HI signal when excited by a 1 KHz audio tone with 3 KHz deviation. A properly adjusted transmitter limits the

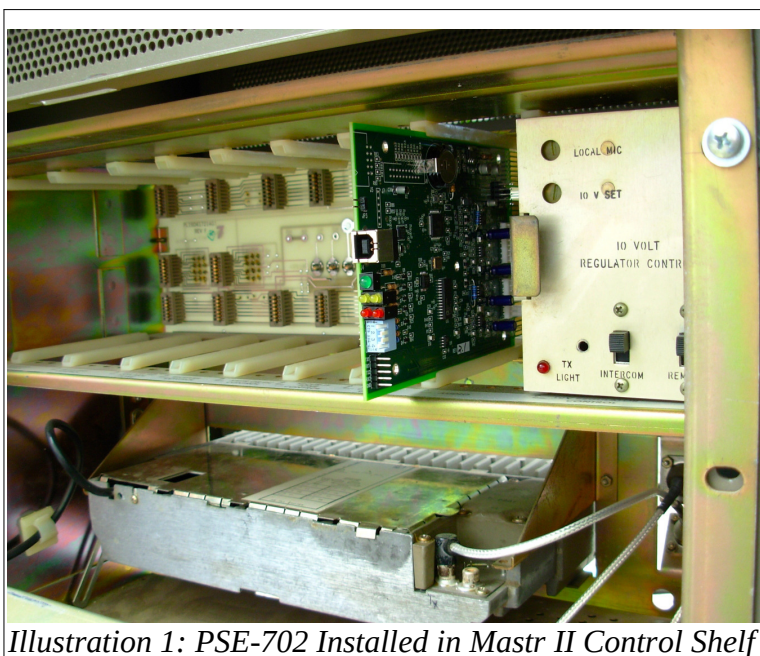


Illustration 1: PSE-702 Installed in Mastr II Control Shelf

output deviation of the transmitted RF signal to 5 KHz or less. The remainder of this chapter assumes that the transmitter and receiver are adjusted according to the instructions in the GE LBIs.

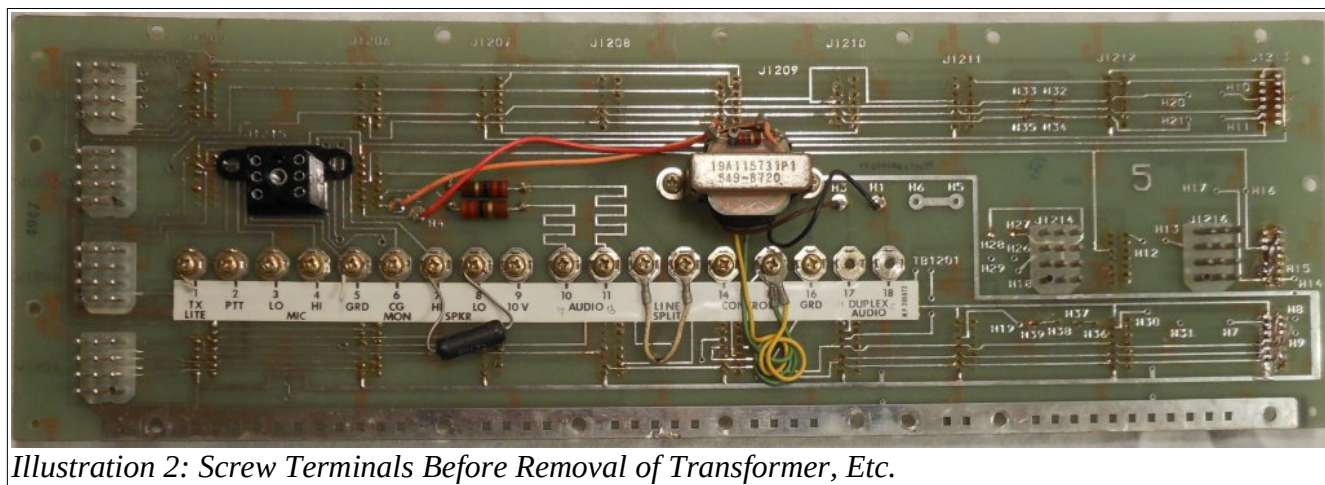
The PSE-702 interfaces to the receiver and transmitter in the radio cabinet via signals on the control shelf motherboard. This interface is made automatically when you plug the PCB into the audio card slot of the control shelf. No further wiring is necessary, unless you wish to use CTCSS encoding on the exciter. In that case see section 2.2.3 for details about how to install the jumper on your system board.

2.2.1 Installing the PSE-702 Inside a MASTR-II Cabinet

Open the MASTR-II cabinet and install the PSE-702 in the AUDIO slot (not the REPEATER CONTROLLER slot) in control shelf above the radio cabinet. The AUDIO slot is the one directly adjacent to the 10-volt regulator. All other boards except the 10 volt regulator should be removed. Install the PSE-702 with the component side toward the 10-volt regulator, as shown in Illustration 1 on page 10. Be sure to insert the board all the way into the slot so that it fully engages the card-edge connectors on the motherboard.

2.2.2 Connecting to the 2nd (Link) Radio

When the PSE-702 is plugged into the control shelf audio slot, connections to Receiver 2 and Transmitter 2 are automatically routed to the screw terminals on the rear of the motherboard. Illustration 2 shows these terminals on a typical motherboard.



In many Mastr II systems these screw terminals were used for telephone line interfacing for phone-patch applications and have resistors and transformers attached to these terminals. If you are using this connection to radio 2, make sure you remove any transformers or resistors that may be connected to the screw terminals used by the PSE-702. If your installation uses these screw terminals for phone-patch or something else, see section 8 for alternative radio 2 interfacing instructions. The remainder of this section will discuss how to interface using the screw terminals.

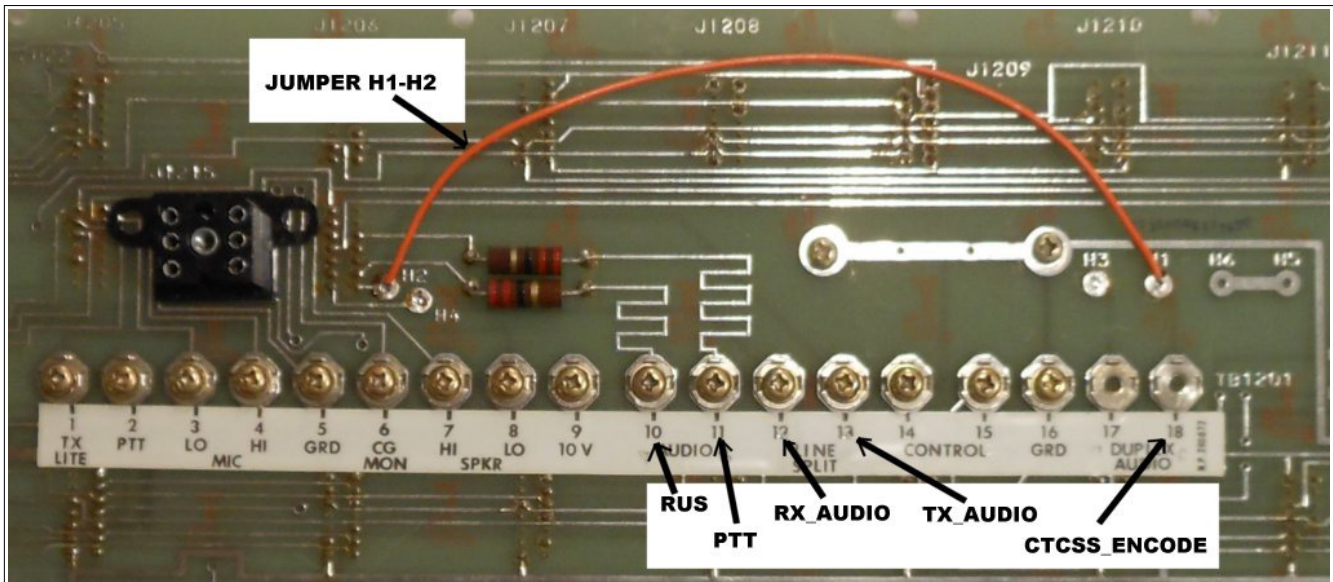


Illustration 3: Screw Terminals, After Removal of Transformer, Etc. and Installation of Jumper

The screw terminals are assigned to the link radio signals as follows:

Screw Terminal Number	Screw Terminal Name	PSE-702 Signal	Description
10	AUDIO	RUS Channel 2 Input	RUS signal for receiver channel 2. The 22 ohm series resistor will have no effect and may be left in the circuit. This signal should come from radio 2's squelch output.
11	AUDIO	PTT Channel 2 Output	PTT signal for receiver channel 2. The 22 ohm series resistor will have no effect and may be left in the circuit. This signal should go to radio 2's PTT input.
12	LINE SPLIT	Rx Audio Channel 2 Input	Audio into PSE-702 receiver channel 2 port. This signal should come from radio 2 receiver audio output.
13	LINE SPLIT	Tx Audio Channel 2 Output	Audio out of PSE-702 transmitter channel 2 port. This signal should go to radio 2 exciter audio input.
16	GRD	Ground	Mastr II ground terminal. If your cable to radio 2 is shielded, connect the ground and shield together here.
18	DUPLEX AUDIO	CTCSS Encode Channel 2 Output	CTCSS encode signal output. Should be connected to radio 2 exciter CTCSS input. Needs to have jumper H1-H2 installed to complete the circuit

Table 1: Link Radio Interface Screw Terminal Signal Assignments

Simply screw the corresponding signals from your link radio into the screw terminals to make the connection to the PSE-702. Use shielded wire for the best results. Screw the shield into the ground terminal (screw terminal #16) of the Mastr II.

2.2.3 Installing the Jumper for CTCSS Encoding

The PSE-702 brings the CTCSS encoder signal for Transmitter 1 to the exciter in the radio cabinet by routing it to the COMP_AUDIO signal. The COMP_AUDIO signal is present in standard MASTR-II base stations, and routes from the AUDIO slot in the control shelf motherboard to P934 pin 2 on the system board inside the radio cabinet. A jumper must be installed inside the radio cabinet to connect the COMP_AUDIO signal to the CG_HI pin to route the CTCSS tone to the exciter.



Illustration 4: CTCSS Jumper Installation on System Board

Illustration 4 shows the placement of the jumper in the radio cabinet. The jumper is placed between connectors P934 pin 2 (COMP_AUDIO) and P908 pin 7 (CG_HI) on the system board. Illustration 5 shows a close-up of the jumper placement. Illustration 6 shows the connection made by the jumper on the system board PCB layout.

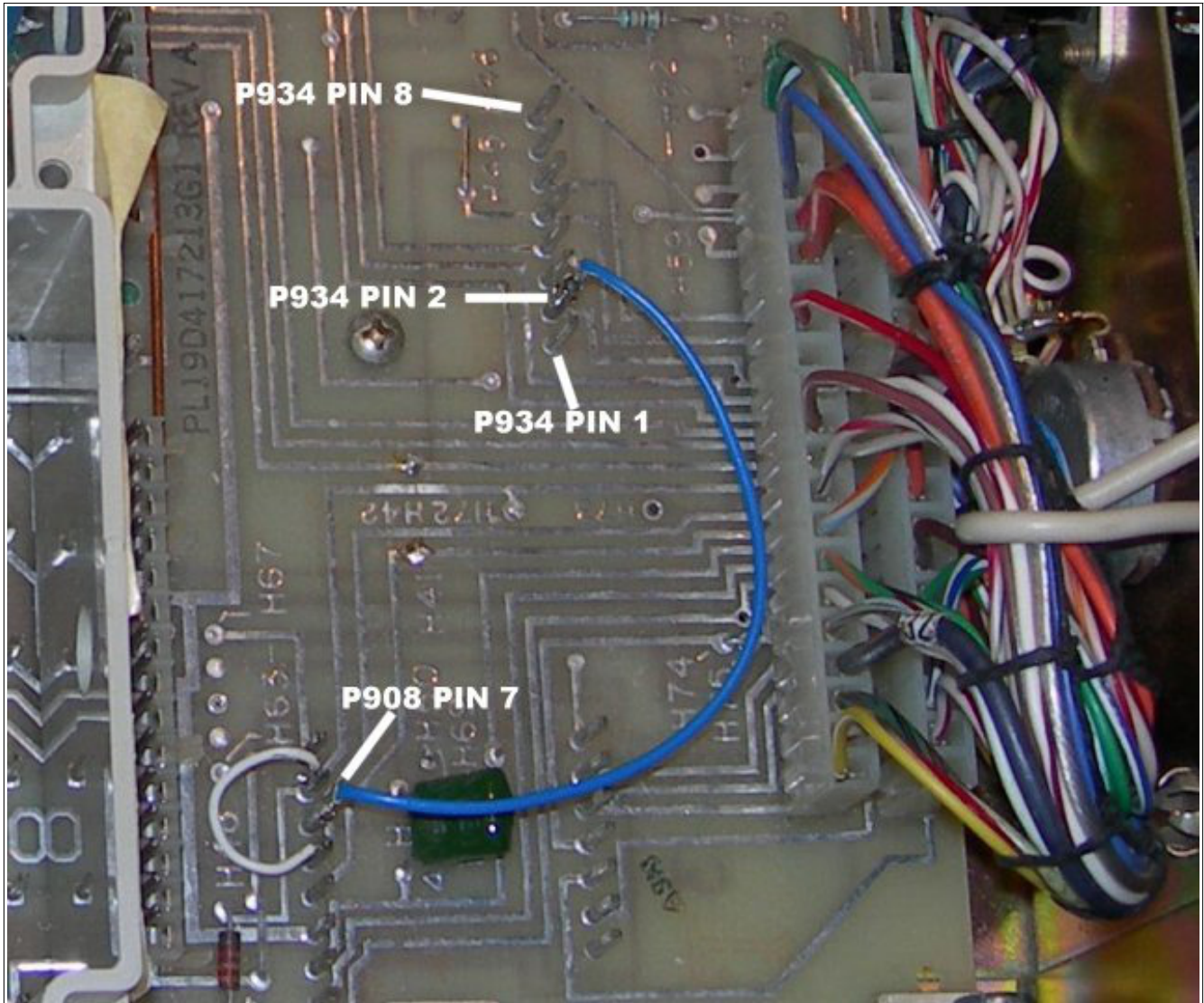


Illustration 5: CTCSS Jumper Installation on System Board, Closeup

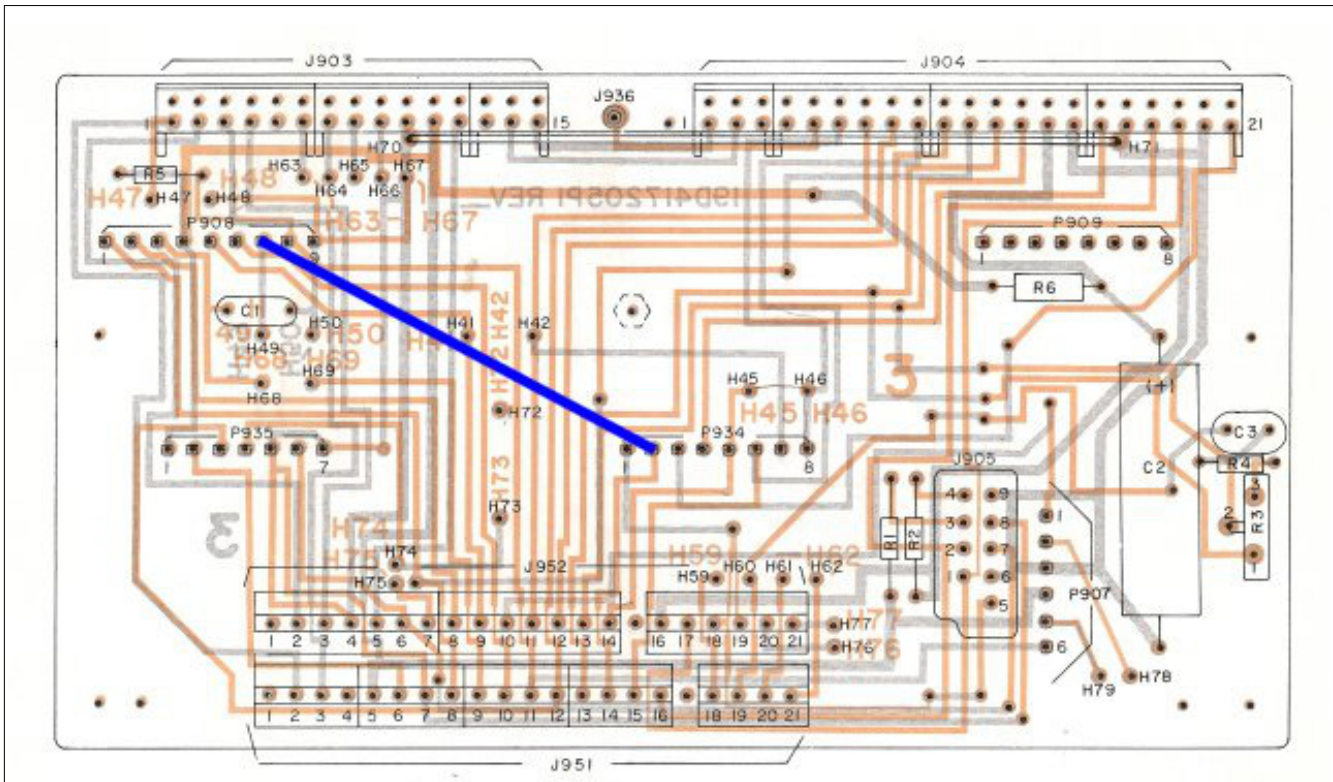


Illustration 6: CTCSS Jumper Placement on PCB Layout Diagram

2.3 USB Port Communications Setup

Connect the USB cable to the PSE-702 and to your PC. Some PCs already contain the required drivers. If your PC does not automatically load the drivers, unplug the USB cable from the PC and install the drivers first. The drivers and installation instructions are contained on the CD that was supplied with your board. Updated drivers may be available for other operating systems by visiting the FTDI website: <http://www.ftdichip.com/FTDrivers.htm>. Use the VCP drivers from their site.

Once you have drivers installed, connect the USB cable between the PC and PSE-702. Then run a terminal emulator such as HyperTerminal (available under the Accessories section of the Start Menu on Windows XP machines), or install an alternate terminal emulation program such as TeraTerm (supplied on the PSE-702 software CD).

After installing the terminal emulator, run the terminal, set the serial port parameters to 19,200 baud, 8 data bits, 1 stop bit, no parity, and no handshake. Power up the PSE-702 and press RETURN on your keyboard, and you should see a sign-on prompt similar to the one below.

```
PSE-702 Operator Console:  
Firmware Version 3.2.2 Sep  2 2013 11:47:06  
EEPROM Checksum was OK on power-up.
```

>

2.4 Adjusting the Receiver Audio Levels

The receiver channels are designed to work best with the receiver's discriminator output adjusted to provide a 1 VRMS audio output when the receiver is excited with a 1000 Hz tone at 3000 Hz deviation. This is the standard setup for the MASTR-II and is described in the receiver GE LBI for receiver alignment. The PSE-702 is capable of accepting a range of input signals, however. This section describes how to adjust the input amplifier/attenuator to get the best dynamic range from your receiver.

The audio levels for both receivers can be adjusted using one of the following procedures. There are several ways to generate the input signals necessary for proper adjustment. The method you should use depends on the kind of test equipment you have available. Here are three methods, listed in the order of preference. Disable the transmitter using the `txf` command (section 9.4.10) to prevent it from transmitting while adjusting the receiver level.

1. Using an RF generator: The RF generator can be a stand-alone instrument or part of a service monitor.
2. Using a hand-held transmitter with DTMF tones only.
3. Using the default value.

2.4.1 Initial Test Equipment Setup

Connect the PSE-702 to a PC running a terminal emulator via the USB port. See section 2.3 for details.

Connect the negative lead of your multimeter to test-point GND (TP5), and the positive lead RX1 (TP2) to set level for Receiver 1 or RX2 (TP4) to set the level for Receiver 2. All test points are on the card edge (see Illustration 7, page 17, and Illustration 8, page 18).

Set the multimeter to read AC volts RMS (or use one of the formulae in section 12.1 if your meter doesn't read RMS). Note that the signal on TP2 or TP4 is audio frequency AC riding on top of approximately 1.2 VDC bias, so if your meter does not capacitively couple to the test point, you should use a capacitor between the test point and your meter. A value of 22uF rated for at least 10 volts should be sufficiently large to give good accuracy. (The + terminal of the capacitor should connect to the test point).

2.4.2 Using an RF Generator to Set Receiver Levels

Set the RF generator to apply an on-frequency signal to the MASTR-II receiver antenna port, modulated with a 1 KHz audio tone at 3 KHz RF modulation, at a sufficiently high RF signal level (approximately 10 uV) to open squelch and insure a full-quieting signal.

Using the `rxla` command (section 9.3.8) or `rxl` command (section 9.3.7), adjust the receiver

channel's digital potentiometer until the voltmeter reads 270 mVRMS +/- 30 mVRMS.

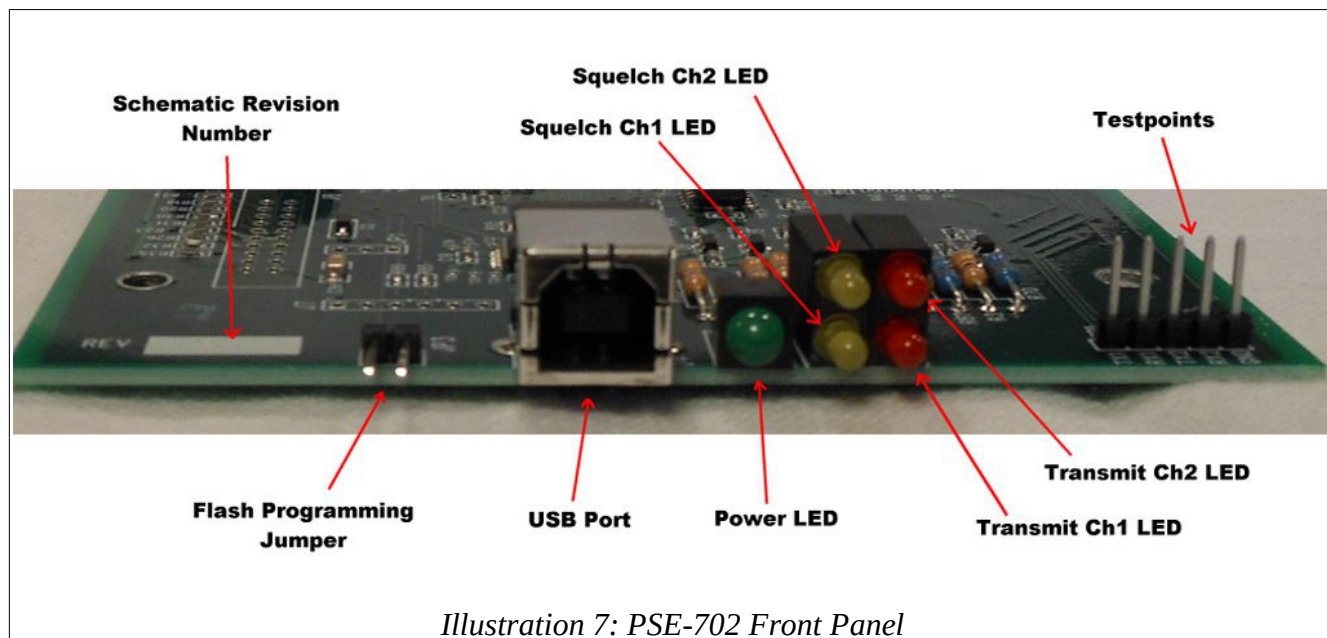
2.4.3 Using a Transmitter with DTMF tones to Set Receiver Levels

This method relies on the fact that most modern HTs and mobiles with DTMF capability transmit their DTMF codes at approximately 3 KHz deviation.

Set the hand-held to transmit on the repeater's receive frequency. Adjust the repeater's squelch so that the hand-held breaks squelch and generates a full-quieting signal.

While transmitting a DTMF tone using the hand-held, use the `rx1a` command (section 9.3.8) or `rx1` command (section 9.3.7) to adjust the receiver's digital potentiometer until the voltmeter reads 270 mVRMS +/- 30 mVRMS.

2.4.4 Using Default Receiver Level Setting



Use the `rx1` command (see section 9.3.7) to set the receiver channel's digital potentiometer to the default level specified in section 9.5.8. If your MASTR-II is properly adjusted to provide 1.0 VRMS from the discriminator when excited by a 1000 Hz tone at 3000 Hz deviation, this should work just fine.

Note: PSE-702 boards are adjusted to this level before shipment.

2.5 Adjusting the Transmitter Audio Levels

Before adjusting the transmitter level adjust the receiver level as in section 2.4 on page 16. The audio levels for both transmitters can be adjusted using the following procedures. The adjustment method you should use depends on the kind of test equipment you have available. Here are three methods, listed in the order of preference.

1. Using a function generator or hand-held and a modulation meter
2. Using a hand-held and a voltmeter
3. Using the default value

2.5.1 Initial Test Equipment Setup

Connect the negative lead of your multimeter to test point GND (TP5), and the positive lead TX1 (TP1) to set level for Transmitter 1 or TX2 (TP3) to set the level for Receiver 2. (See Illustration 8) Set the multimeter to read AC volts RMS (or use one of the formulae in section 12.1 if your meter doesn't read RMS).

Note that the signal on TP1 or TP3 is capacitively coupled but when connected to a radio, a DC bias may be present. If your meter does not capacitively couple to the test point, you should use a capacitor between the test point and your meter. A value of 22uF rated for at least 10 volts (25 volts if you are using alternative application gain settings) should be sufficiently large to give good accuracy. (The + terminal of the capacitor should connect to the test point).

If you disabled the transmitter while setting up the receiver levels, be sure to re-enable it using the `txf` command (section 9.4.10) before continuing. You may also want to disable the transmitter timeout timer if you need to run the transmitter for extended periods. See section 9.4.9

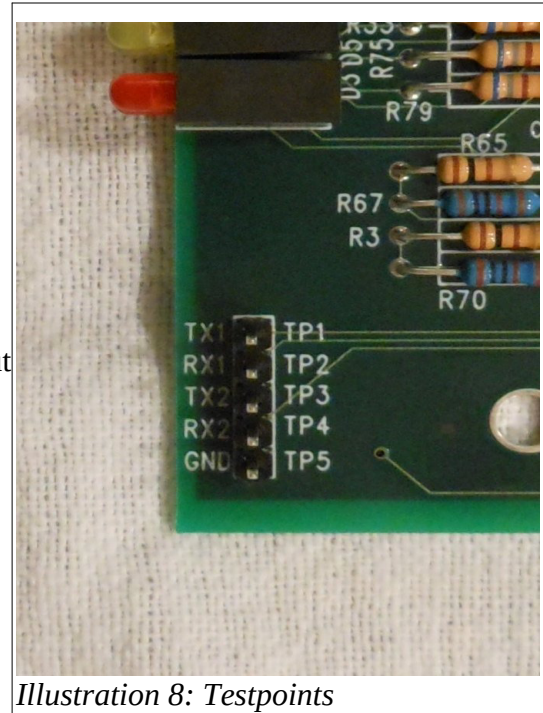


Illustration 8: Testpoints

2.5.2 Using a Modulation Meter to Set Transmitter Levels

Connect your modulation meter to the exciter output, or set it up to listen on the air. Set up your function generator to give a 1 KHz tone at 3 KHz deviation level into your receiver, which should cause squelch to open and cause the PSE-702 to repeat the audio through to the exciter.

Monitor the deviation on the modulation meter connected to the exciter. Using the `txl` command from the PSE-702 operator console (see section 9.4.11), adjust the transmitter channel gain until the modulation meter shows a deviation level of 3 KHz (or the same level as the input modulation).

2.5.3 Using a Hand-Held and Voltmeter to Set Transmitter Levels

Configure the repeater so that it does not mute DTMF tones through the transmitter. See section 9.4.10. Use your hand-held to transmit the DTMF '*' character into the repeater. Monitor the multimeter voltage and use the `txl` command from the PSE-702 operator console (see section 9.4.11), to adjust the transmitter channel gain until the multi meter reads 100 mVRMS AC. This voltage level is approximately correct to produce 3000 Hz deviation in most MASTR-II excitors.

2.5.4 Using the PSE-702 Tone Command

On the PSE-702 console, enter the `tone` command (see section 9.4.12) to generate a 1000 Hz tone. Using the `txl` command from the PSE-702 console (see section 9.4.11), adjust the transmitter gain until the multimeter reads 100 mVRMS AC. This voltage level is approximately correct to produce 3000 Hz deviation in most MASTR-II exciters.

Issue the `tone` command at the PSE-702 console to turn the tone output off.

2.5.5 Using Transmitter Level Default Settings

Use the `txl` command from the PSE-702 console (see section 9.4.11) to set the transmitter channel's digital potentiometer to the default specified in section 9.5.8. This value will be approximately correct for a Mastr II exciter if you use the `rxla` command to set your receiver audio gain.

2.6 Using the PSE-702 Front Panel

Illustration 7 on page 17 shows the PSE-702 front panel, close-up of the USB port connector, status LEDs, and the test points.

2.6.1 Status LEDs

Five LEDs on the PSE-702 indicate status. When the green LED is illuminated, the board is powered on. The yellow LEDs, when illuminated, indicate that receiver 1 (closest to the board) or receiver 2 (top) is active. The red LEDs, when illuminated, indicate that transmitter 1 (closest to the board) or transmitter 2 (top) is active.

2.7 Connecting the PSE-702 to a Computer Using USB

If you have not already installed a driver for the FTDI USB to COM port interface, install the driver appropriate for your operating system on your computer.

The CD accompanying the PSE-702 contains USB drivers for Windows, Linux, and Macintosh. Installation procedures vary by operating system, but the basic process is:

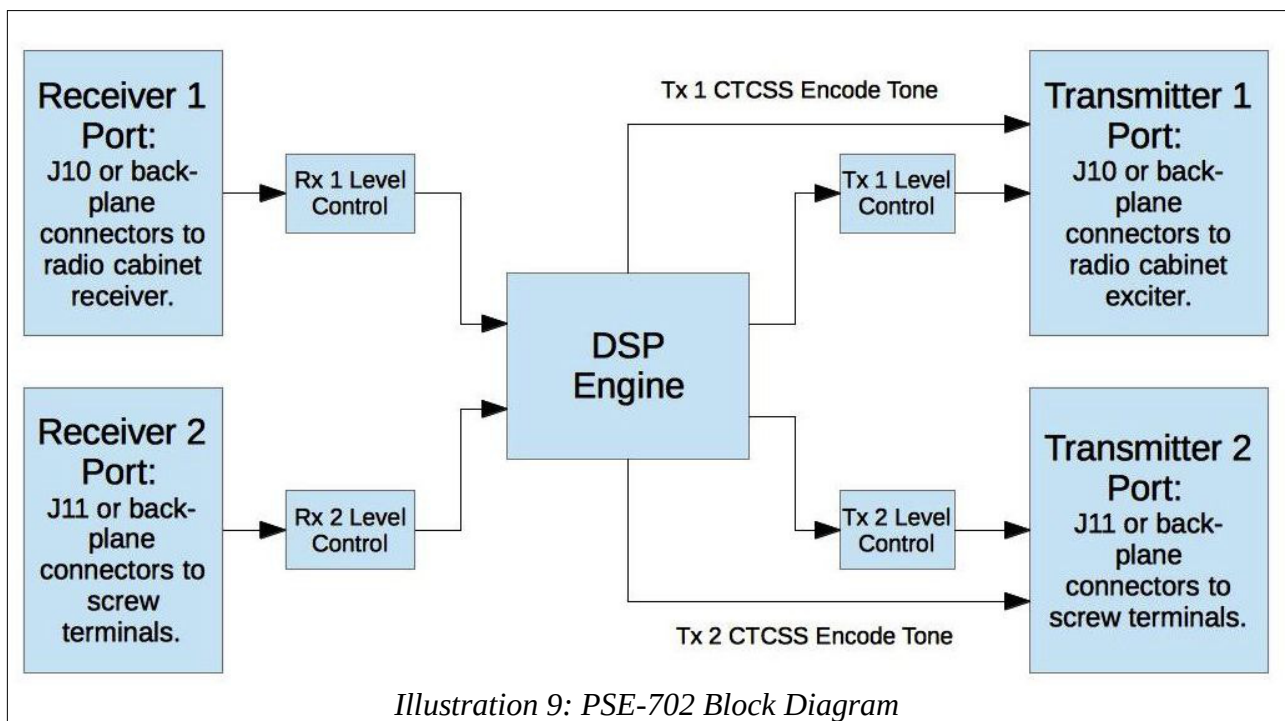
1. Make sure that the USB cable for connecting the PSE-702 and the computer is disconnected.
2. Double-click the installation executable.
3. Follow the instructions on the screen.
4. On your computer, open a terminal emulation program, such as HyperTerminal or TeraTerm. (HyperTerminal can be found on virtually all older Windows compatible machines under the Accessories sub-menu. It has been discontinued in Windows as of Windows Vista. TeraTerm is on the PSE-702 CD or can be found with a web search. There are similar programs for Mac and Linux which are free and easily available from a web search).
5. Set up the terminal emulation program to use 19200 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
6. Install the USB cable between the PSE-702 (see Figure 5: PSE-702 front panel, close-up of the

USB port, status LEDs, and the DIP switches) and one of the USB ports on your computer.

7. Power up the PSE-702, and then press ENTER. You should see a sign-on message from the terminal port similar to the one in section 2.3.

Make a note of the firmware version and date. This will be helpful to know. We make firmware updates available on the Support page of the Web site (www.pionsimon.com) from time to time, so you will want to check the site regularly to see if an update is available.

If you do not get the sign-on message when the PSE-702 is powered up, check your cables, connectors, serial port settings, MASTR-II 10-volt regulator, and so on. (We check each board individually before shipping to insure that the USB interface works properly). When the PSE-702 is powered on, the green power-on LED should light up.



2.8 User Parameter Configuration Using PC Console

Determine how you want to configure the PSE-702. It helps if you write down the settings you will need in advance. If you are going to use voice identification for the transmitters or play announcements, then it helps to have simple audio statements in mind or written on paper so that you can record the audio more easily.

1. Record the audio files you will need using the `freq` command. (See section 9.3.10 on page 45).
2. Play the audio files back using the `fplay` command to make sure they are acceptable in clarity and quality. (See section 9.5.17 on page 64).

3. Determine if you are going to use DTMF for controlling the board, and if so, whether or not to use a password to restrict access (section 9.5.5). Also decide if the default command character (#) is acceptable, and if not, what other character should be used instead. (See section 9.5.4).
4. Using the `sdi` command (See section 9.3.5), select the CTCSS decode frequency for each receiver.
5. Configure the receiver flags with the `rxf` command (See section 9.3.6).
6. Configure courtesy beeps. (See section 9.3 and 9.4.1).
7. Using the PSE-702's `sem` and `sei` commands (See section 9.4.2 and 9.4.3), select the desired CTCSS encode mode and frequency to be encoded. Note that this can be a different tone than the tone that is being decoded.
8. Using the `tone` command (See section 9.4.12), enable PTT and CTCSS encoding. Adjust the exciter's CG modulation potentiometer for proper tone deviation level (approximately 750 Hz) as per GE's transmitter alignment procedure.
9. Configure the transmitter flags with the `txf` command. Determine if you are going to use voice or CW identification, and then set up the transmitter ID. (See section 9.4).
10. Using the `path` command, set up the paths between the receivers and transmitters. (See section 4).
11. Set up any announcements you are going to use. (See section 5).
12. Review your configuration using the `status` command. (See section 9.5.6).
13. Test the settings.
14. When you are comfortable that your configuration is complete, make a backup of the settings using the `dump` command.

3 Design Architecture

A block diagram of the PSE-702 is shown in Illustration 9, page 20. The PSE-702 consists of:

- Two identical receiver ports
- Two identical transmitter ports
- A digital signal processing (DSP) unit connecting the receivers and transmitters.

3.1 Receiver Ports

The receiver ports capacitively couple the audio signal from two receivers into the DSP unit. Each receiver port has a digitally controlled potentiometer and gain block which allows the operator to set the audio level using the operator console. The audio level can also be set automatically. See section 9.3.8 for setup details. The audio from each receiver is then fed into its own channel in the DSP unit.

3.2 Transmitter Ports

The transmitter ports receive audio from the DSP unit, filter it and scale it to the level necessary to drive the repeater's exciters. The transmitter amplifiers provide a constant gain. Audio output level is controlled by the DSP unit and is configured using the operator console. The output is capacitively coupled to the exciter. See section 2.5 for information on how to set the transmitter port gain.

3.3 Digital Signal Processing (DSP) Unit

The DSP engine performs several functions:

- Allows the operator to route the audio connection(s) between receivers and transmitters via a crosspoint switch.
- Provides de-emphasis filtering on receiver audio.
- Decodes CTCSS tones that can be present in the received audio.
- Filters out CTCSS tones from the transmitter audio.
- Generates CTCSS encoder tones for transmission.
- Decodes DTMF tones that can be present in the received audio.
- Generates Morse code tones and courtesy beeps and mixes them with the transmitter audio.
- Provides for digital storage and replay of transmitter IDs and messages.

3.3.1 Crosspoint Switch

The DSP unit contains a crosspoint switch that is controlled by the `path` command. It allows the operator to configure the way audio is routed between receivers and transmitters. The operator can configure the controller to route audio from either receiver to either or both transmitters. Audio routing

is handled by the path command, which is discussed in section 4 starting on page 24.

3.3.2 De-emphasis Filtering

In most applications pre-emphasized audio is supplied to the controller via the receiver discriminator output. If audio is pre-emphasized, the operator must select a de-emphasis profile in order to provide natural sounding audio. The PSE-702 provides multiple de-emphasis settings. See section 9.3.9 for details. The default setting works well for the Mastr II if you are using discriminator audio.

3.3.3 CTCSS Tone Decoder

The PSE-702 contains an integrated CTCSS decoder for each receiver channel. No additional hardware is necessary to decode CTCSS tones. See section 7.1 for details.

3.3.4 CTCSS Blocking Filter

The CTCSS blocking filter removes incoming CTCSS tones from the outgoing audio. There are multiple options for this filter. See section 7.1 for more details.

3.3.5 DTMF Tone Decoder

The DSP unit decodes Dual-tone multi-frequency (DTMF, also known as Touch Tone) signals to allow many parameters to be remotely configured, and to allow remote control of the transmitters. See section 10.1 for a list of commands. When DTMF tones are received the transmitter may optionally be muted to prevent re-transmission of the tones. See section 9.4.10 for details.

3.3.6 Audio Tone Generator

The audio tone generator generates tones for courtesy beeps and CW identification. Frequency, level, and CW word rate are configurable by the operator. See section 9.4 for details.

3.3.7 Digital Audio Store and Replay

The PSE-702 can record and play back voice messages on either channel for ID and announcements. Voice messages are stored in variable length files in non-volatile memory. See section 5 for details.

3.3.8 CTCSS Tone Encoder

The PSE-702 contains an integrated CTCSS encoder. No additional hardware is necessary to encode CTCSS tones, however it is necessary to install a jumper on the system board to route the tone signal from the PSE-702 to the tone input on the Mastr II exciter (see section 2.2.3). There are two tone encoders, one associated with each of the two transmitter channels.

4 Paths

The PSE-702 connects receivers and transmitters together by means of a crosspoint switch. The crosspoint is configured by *path* commands.

Paths are stored in a table in non-volatile memory. Each path is given a unique position in the table and can be created, changed, or deleted by the operator using commands from either the terminal or remotely via DTMF codes. The contents of the path table can be listed using the operator console. It is much easier to maintain the path table using the operator console than by DTMF codes because both help and feedback are possible, while commands using DTMF codes are only able to respond with OK or ERR. There is also no way to read out the current contents of the path table using DTMF.

When a receiver becomes unquelled, the system searches the path table for a path that can connect that receiver to a transmitter. There can be more than one path associated with each receiver, and every path that matches that receiver is enabled when the receiver goes unquelled. Therefore multiple transmitters can be connected to one receiver if multiple paths exist for that receiver. The repeater operator controls which transmitters are enabled by which receivers by entering paths into the path table corresponding to the connections desired.

For example, if a repeater operator wishes receiver 1 to be connected to transmitters 1 and 2, then he or she enters two paths into the table: one path to connect receiver 1 to transmitter 1, and another path to connect receiver 1 to transmitter 2. Whenever receiver 1 goes unquelled, the controller finds two paths associated with receiver 1 and enables them both, thereby routing the audio from that receiver to both transmitters. If the operator wishes to use a receiver for control only, no path need be entered, and when that receiver goes unquelled, no transmitter will retransmit that receiver's audio.

4.1 Priority

Paths are assigned *priority* by the repeater operator when the path is entered. Priority controls how the audio is handled if two receivers try to access the same transmitter at the same time. Three priorities are possible: Low, Medium (Mix), or High, designated in the path table by the letters L, M, and H, respectively.

Paths with higher priority interrupt paths with lower priority at the same transmitter. For example, if receiver 1 goes unquelled and has a path to transmitter 1 that is low priority, and receiver 2 goes unquelled with a path to the same transmitter with medium or high priority, the audio from receiver 2 preempts the audio from receiver 1 and listeners only hear the audio from receiver 2. When receiver 2 squelches, if receiver 1 audio is still present, the transmitter resumes transmitting the lower priority audio from receiver 1.

If the path for two receivers have the same priority (either low or high), the first one to unquell is granted the transmitter (first come, first served) and the other one is not heard until the first squelches. As soon as the first receiver squelches, the audio from the second receiver is heard on the transmitter.

4.2 Audio mixing

If two receivers both have paths enabled with medium priority to the same transmitter at the same time,

their audio mixes in the assigned transmitter. This allows both receiver channels to be heard at the same time, which can be useful during nets and other applications.

4.3 Path setup and maintenance

Paths are entered, changed, and deleted using the commands in sections 9.5.

5 Voice Identification, Announcements, and File System

The PSE-702 contains a 4 MB flash file system which is used to store operator-settable parameter values and audio files for later playback. Audio files can be used for either voice ID or periodic announcements such as club meeting announcements, net time announcements, etc..

5.1 Audio File Management

This section describes how to record, play, list and delete audio files. You can record over five minutes of audio, divided into up to eight files, numbered 1 to 8. A file can be any length, from 0 seconds up to a maximum length determined by the remaining size of the available memory.

5.1.1 Recording an Audio File

To record an audio file, first use the `files` command (section 9.5.14) to determine which file numbers are already used. Any other file number from 1 to 8 is available to record. If you record audio to an existing file, the new audio is appended to the end of the file.

Once you have determined the proper file number, enter the `frec` command (section 9.3.10) using the receiver channel and file number, then press `ENTER`. After entering the command, you have up to ten seconds to key the repeater on the selected receiver channel and begin speaking. When the receiver goes un-squelched the system begins recording immediately. When you are finished recording, un-key the repeater. The console then displays the length of the file in seconds, and the time remaining in memory. The file can now be used for either a voice ID or an announcement.

If you enter the `frec` command and wish to cancel the recording, you can either wait 10 seconds, after which the command will time out, or you can press `ESC` to cause the command to be immediately canceled.

5.1.2 Listing All Audio Files

A list of recorded audio files may be obtained at the operator console by using the `files` command. See section 9.5.14. The `files` command provides the file number, length in seconds of the file, total recorded time, and total time remaining in memory.

5.1.3 Playing Back an Audio File

Audio files may be reviewed by playing them back using the `fplay` command (see section 9.5.17). Files may be played back on either transmitter, regardless of which receiver was used to record it. However, keep in mind that audio files are recorded using the de-emphasis setting for the receiver from which they were recorded. If an audio file was recorded using a receiver with no de-emphasis and is played back and listened to with a hand-held or mobile, the additional pre-emphasis applied by the repeater's exciter will probably cause the audio to sound unnatural.

5.1.4 Deleting Audio Files

Audio files may be deleted using the `fdel` command (see section 9.5.15). When a file is deleted it is

no longer available to play as an ID or announcement, and the memory used by the file is returned to the system to be reallocated when another file is recorded.

5.1.5 Formatting the Flash File System

The file system must be formatted before it can be used. The system is pre-formatted at the factory before shipment, but there is a format command (section 9.5.16) which can be used if the operator wishes to reformat the system. If the flash is formatted, all previously stored audio files will be erased.

5.2 Using Audio Files for Voice ID

The PSE-702 can be configured to play a voice ID instead of the conventional CW ID. To do this, record the ID audio file using the procedure above, designate the resulting file as the voice ID for a particular transmitter using the `vid` command (section 9.4.4), and then enable voice ID on that transmitter using the `txf` command's `v` flag (section 9.4.10).

The voice ID file plays back on the same schedule as the CW ID. The time between IDs is selectable using the `tmr` command. If, while the voice ID is playing, a user keys up the same repeater channel, the voice ID stops and the system immediately switches to CW ID, which is transmitted at reduced volume under the user's audio. Since CW ID will be used in this case, it is important to set the CW ID string even if you intend to use a voice recording for your primary ID source.

5.3 Using Audio Files for Announcements

The PSE-702 can be configured to play one or more audio files over the air at regular intervals selected by the repeater operator. These files, called 'announcements', can be used to announce nets, club meetings, or any other appropriate events. When played over the air, announcements cause the repeater to properly ID at the same times designated for normal user audio.

Like user audio paths, announcements are assigned a priority. If an announcement starts to play and a user keys up the repeater during the announcement audio, the relative priorities between the announcement and the user audio path determine which audio source is allowed to continue to transmit. If the user audio path is higher priority, the announcement is interrupted and postponed for one minute. If the announcement has equal or higher priority, it continues to play and the user audio is not heard until the announcement is complete. If the announcement and user audio both have medium priority, the audio mixes at the transmitter and both are heard simultaneously.

If a user is currently keyed up on the repeater channel on which an announcement is scheduled to play, the announcement will be delayed until the user unkeys.

To create an announcement, follow these steps:

1. Record the audio file (or files) using the `frec` command.
2. Schedule the announcement to play at the proper time on the proper transmitter using the `anno` command.
3. Enable the announcement using the `eanno` command.

5.3.1 Scheduling an Announcement

Announcements can be scheduled to play at regular intervals by using the `anno` command (section 9.4.14). If you enter the `anno` command without any parameters, a list of all currently scheduled announcements will print on the operator console.

5.3.2 Deleting an Announcement Schedule

To delete an existing announcement schedule, use the `danno` command (section 9.4.13). Note that this deletes the schedule only. It does not delete the announcement's audio file. To delete the audio file use the `fdel` command (section 9.5.15). It is not necessary to delete an announcement's schedule to make it stop playing temporarily. See the next section.

5.3.3 Enabling or Disabling an Announcement

Once an announcement schedule has been entered, the announcement must be *enabled* before it will play. Announcements are enabled or disabled using the `eanno` command (section 9.5.13). This allows the operator to record an announcement, enter its schedule, and then enable or disable it when necessary.

For example, if you have a club meeting on the 2nd Tuesday of the month and want to play an announcement for it every hour starting from the day before, you record the announcement and schedule it for hourly play, and then disable it until the Monday before the meeting. On that Monday you enable the announcement and let it play, then disable the announcement after the club meeting on Tuesday. From then on you simply enable it when you want it to play, and disable it when you don't. You don't need to re-enter the schedule or re-record it.

6 Courtesy Beeps

The PSE-702 allows the operator to configure courtesy beeps as single beep, double beep, or Morse character tone sequences that play on a transmitter when the repeater user unkeys. Tone frequency and duration are programmable, as is the delay after the receiver squelches before the beep. Courtesy beeps can also be disabled entirely.

Courtesy beeps are configured on a per-receiver basis to allow users to identify which receiver carried the audio. This is useful in linked applications in which the local receiver and link receiver have different courtesy beeps. However, beeps may be enabled or disabled on a per-transmitter basis also. This means that, for example, if you have a IRLP or Echolink channel and you don't want beeps routed there, but you do want beeps from the receiver to go to the local repeater transmitter, you can disable the beeps on the IRLP channel and enable them on the transmitter channel.

1. Courtesy beep configuration is performed as follows
2. Decide which type of beep to use to identify a particular receiver. Configure the beep type using the `cbm` command (section 9.3.1).
3. If you choose to have a Morse character beep, use the `cbc` command to set the character (section 9.3.2).
4. If you choose a single or multiple tone beep, configure the frequency and duration of the beep(s) using the `cbt` command (section 9.3.3).
5. Set the time delay from squelch-closed to start-of-beep using the `cbd` command (section 9.3.4).
6. Set the volume of the courtesy beep using the `cb1` command (section 9.4.1). Note that the level depends on the transmitter channel, not the receiver channel.
7. Make sure the beep is enabled at the transmitter using the `txf` command (section 9.4.10).

7 CTCSS Encoder and Decoder

The PSE-702 contains an integrated CTCSS tone encoder and decoder. This section discusses them in detail and explains how to set up and configure them.

7.1 CTCSS Decoder

The CTCSS decoder is capable of decoding one sub-audible tone per receiver channel. One of 37 tones between 67 Hz and 250.3 Hz may be selected for decoding by using the `sdi` command (section 9.3.5). The CTCSS decoder for each receiver may be enabled or disabled individually by using the `rx f` command's `P` flag (section 9.3.6).

If CTCSS decoding is enabled (`rx f P` flag set to 1), the decoder watches for the presence of the selected tone on the received audio whenever carrier squelch is open for that receiver. If the tone is present, the decoder passes the received audio to the transmitters selected by the receiver's path setting(s). If the tone is not present, no audio passes and the transmitters are not activated.

7.1.1 Keep Alive Timer

When receiving a weak signal the user's audio may come and go rapidly ("picket fencing"). In such cases, it is usually desired that the CTCSS decoder remain locked on the tone, keeping the squelch open. The tone CTCSS decoder contains a timer that keeps the squelch open if the tone is lost for up to 1 second. While this is a long time, the decoder relies on carrier squelch to quickly close squelch when a user unkeys. If the user transmits a reverse-burst signal it also acts to close tone squelch quickly when the repeater is being operated with open carrier squelch.

CTCSS Tone Blocking Filter

Operators usually do not want received CTCSS tones to be re-transmitted by the repeater. The PSE-702 contains two CTCSS blocking filters which may be selected to attenuate tones below 300 Hz.

There are 3 options for CTCSS blocking provided by the `filt` command (section 9.3.9):

0 (No CTCSS blocking): If you are not using CTCSS tones, you may prefer selection 0 because it allows more low-frequency audio (near and below 300 Hz) to go through to the transmitter for a more natural sound.

1 (Third order blocking filter): If you are using CTCSS tones below 150 Hz you will probably find selection 1 to be adequate, and it provides for minimal attenuation of audio near 300 Hz. Many operators find this setting provides adequate blocking for all CTCSS tones.

2 (Fourth order blocking filter): If you are using CTCSS tones above 150 Hz you may find selection 2 gives more attenuation than selection 1, at the cost of slightly more attenuation of audio lows near 300 Hz.

7.2 CTCSS Encoder

Each transmitter channel has an associated CTCSS encoder. The encoders output a tone at a level of approximately 0.6 VRMS at a frequency selected by the operator by using the `sei` command (section

9.4.3). The tone output is enabled or disabled via the `txf` command's `P` flag. (section 9.4.10)

7.2.1 Encoder Mode

The tone encoder operates in one of two different modes (RUS or PTT) configurable using the `sem` command (section 9.4.2): In RUS mode the tone is encoded whenever there is user audio from a receiver that is unscelched with a path assigned to the transmitter in question. The encoder will continue to operate until the receiver squelches. This allows user audio to be encoded, but shuts off the encoder during IDs and hang-time. This is the preferred mode to use with Echolink and IRLP. In PTT mode the tone is encoded whenever the transmitter is transmitting. This means all user audio, courtesy beeps, IDs, announcements etc. are encoded.

7.2.2 Reverse Burst

The tone encoder also has reverse-burst generation capability in either RUS or PTT mode. Reverse burst is enabled or disabled using the `txf` command's `R` flag (section 9.4.10). If the `R` flag is set, the encoder performs a 235 degree phase-reversal of the encode signal and continue to transmit an additional 180 milliseconds before shutting off the transmitter. The reverse burst helps to squelch the tone decoder in the user's radios more quickly than simply dropping the encode tone when the transmitter shuts off.

7.2.3 Jumper Setup

In order to use the CTCSS encoder on channel 1 in plug-in Mastr II applications it is necessary to install a jumper on the system board. See section 2.2.3 for details.

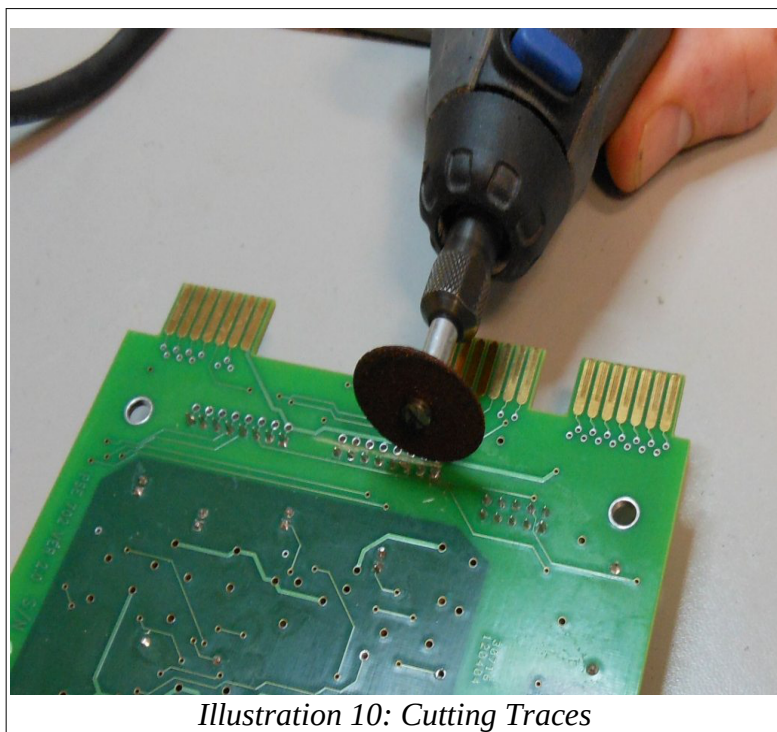


Illustration 10: Cutting Traces

8 Adapting the PSE-702 to Non-Standard Applications

It is possible to use the PSE-702 in many applications that do not involve the GE Mastr II series repeaters.

8.1 Radio Connectors J10 and J11

If you cannot or do not wish to use the Mastr II motherboard connectors to connect the PSE-702 to your radio, you may also use either or both of the two pin headers J10 and J11. J10 contains the signals for connecting Transmitter 1 and Receiver 1, and J11 contains the signals for connecting Transmitter 2 and Receiver 2. The signals are shown in Table 14, page 91.

The SIP headers at J10 and J11 accept Molex type terminals on 0.1 inch centers. The terminal inserts accept 22 to 30 AWG wire. The following parts can be used:

- Terminal housing: Molex number 22-01-2065, Digikey number WM2616-ND, Mouser number 538-22-01-2065.
- Terminal inserts: Molex number 08-55-0102, Digikey number WM2312-ND, Mouser number 538-08-55-0102.

While it helps to have the proper crimp tool for the inserts, it is possible to do an acceptable job of crimping by using needle-nose pliers. If you use pliers, we recommend applying a small amount of solder after crimping. Be careful not to use too much solder, or the insert will not fit properly in the connector housing. To purchase a connector with a pigtail already attached, see the products page on our web site.

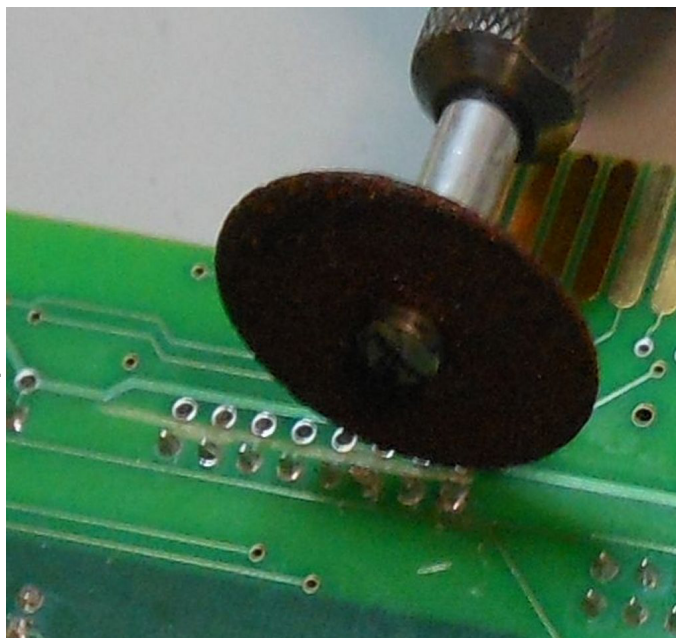


Illustration 11: Close-Up of Cutting Traces

8.2 Isolating J10 and/or J11 from the Card-Edge Connectors

The PSE-702 normally interfaces to the Mastr II via the card-edge connectors in the audio slot of the control shelf. If you wish to install and use either or both pin headers at J10 or J11 to interface your radio(s) **and** you are also going to insert the PSE-702 into the Mastr II control shelf motherboard (to interface the other radio and/or obtain power and mechanical mounting), you **must** isolate the appropriate pin header's signals from the card-edge fingers. (Note that if you do not plan to insert the PSE-702 into the control shelf motherboard you don't need to do this).

To isolate either or both J10 or J11, cut the traces on the back side of the board between the two rows of the connector. A Dremel tool with a cut-off wheel makes this easy. See Illustration 10 and Illustration 11. Don't cut too deep into the board and stay between the pins. It is easier to avoid

damaging the header's thru-holes by installing the header before cutting. Remember, all you have to do is cut the foil traces. (If you plan on using the pin headers in your installation you can order your PSE-702 with the traces pre-cut for no extra charge). If you do a clean job at this you can always reverse the process by soldering new wires between the pin rows where the foils were cut.

8.3 Raw Power Supply Voltage

The PSE-702 is designed to accept input power from approximately 9 to 14 volts. See section 11.1 for exact limits. In most non-Mastr II applications operators will most likely want to use "12 volt DC" power, which actually can range from about 10.5 volts to 14 volts.

Using input voltages higher than 10 volts puts additional strain on the 3.3 volt regulator U9. To reduce this strain, R33 drops the input voltage and dissipates some of the heat that would otherwise be dissipated by U9. If necessary you can increase the value of R33 when using higher than 10 volts for the raw supply. R33 is a 1/2 watt through-hole resistor to make it easy to change. The board uses approximately 100 mA and the LM317 at U9 needs a minimum of 6.5 volts to regulate properly, so size R33 accordingly. For a supply of 13.8 volts, use a 68 ohm, 1 watt resistor for R33. Stand it up off the board about 1/4" to allow air circulation around the resistor body.

Both J10 and J11 have raw supply voltage pins, so you can supply the PSE-702 through these connectors if not using the Mastr II.

8.4 Receiver Gain

In some applications it may be desirable to increase the receiver amplifier (U2B and U3B) gain. This can be easily done by replacing R4 (channel 1) and/or R7 (channel 2). These resistors are through hole to facilitate easy replacement. The receiver gain resistors are set to 10K ohms at the factory for a gain of 2. To increase the gain use the following formula:

$$R = (A - 1) * 10K$$

Where:

R is the value of resistor R4 or R7.

A is the desired gain.

For example, for a gain of 3.5, change R4 or R7 to 25 K ohms.

Note that the output of the receiver amplifiers is limited to 0.7 volts by the diodes following the amplifier output. This is to protect the input of U13. This limiter will cause distortion if the receiver gain is too high.

8.5 Transmitter Gain

Transmitter amplifiers U4A and U7A are capable of providing up to approximately 9 volt p-p drive (with a 10 volt power supply) into load impedance greater than 10K ohms. The Mastr II excitors normally require only 100 mV RMS AC (280 mV p-p) drive for 3000 Hz deviation output, and the transmitter amplifier gain is set to a value of 2 at the factory. R49 controls the gain for U4A (channel 1) and R51 controls the gain for U7A (channel 2). The gain formula is:

$$R = A * 10K$$

Where:

R is the value of resistor R49 or R51.

A is the desired gain.

The output of the transistor amplifiers should be kept below 9V p-p to prevent distortion.

8.6 RUS and PTT Adjustment

The RUS and PTT circuits are designed to provide flexibility when adapting the PSE-702 to applications other than the Mastr II.

8.6.1 RUS Circuit

The RUS circuit for channel 1 is shown on page 4 of the schematic. Since the circuits for channels 1 and 2 are identical, the circuit will be discussed relative to channel 1 only.

Resistor R88 is not installed by default. It may be used to interface to open collector drivers that require a pullup to the supply. R88 will pull up the RUS signal to +VRAW, which is the board's raw supply voltage (+10V for Mastr II applications). R88 is a through-hole resistor facilitating installation and modification. R68 insures that the RUS signal is pulled low enough to shut off Q1 in applications that use drivers that can only source current.

The firmware can control whether the sense of the RUS signal is active low or high. See section 9.3.6 for details.

8.6.2 PTT Circuit

The PTT circuit is shown on page 4 of the schematic. Since the circuits for channels 1 and 2 are identical, the circuit will be discussed relative to channel 1 only.

R70 is installed by default providing a circuit which can either source or sink current. To convert to an open collector circuit (if, for example, the radio has a built-in pull-up resistor), you can remove R70. If you need more source current you can change R70's value. R3 limits the current through Q4. If you want to limit the current further, use a bigger resistor for R3. To get more current, use a smaller resistor. Be sure to observe the maximum current limit on Q4. See the MMBT3904 data sheet for details. Both R70 and R3 are through hole resistors.

The firmware can control whether the sense of the PTT signal is active high or low. See section 9.4.10 for details.

9 Operator Console Command Reference

Each command that can be issued using the operator console is explained in this section. For each command, a brief description is provided, followed by the operator console syntax.

The first character shown on the operator console syntax line is the command prompt. Following the prompt is the name or number of the command, then the command's parameters, if any.

Following the syntax statement, each parameter is listed and explained. Parameters are shown in curly brackets. Do not enter the curly brackets when entering the command.

One or more examples for each command are given.

9.1 Overview

9.1.1 Entering Commands using the Operator Console

To access the operator console, follow the instructions for Connecting the PSE-702 to a Computer Using USB. The operator console displays a right angle bracket at the beginning of a line to signify that it is ready to receive a command. Commands consist of a command name followed by its parameters, if any. Parameters are separated from each other and from the command name by a blank space character. To execute a command is executed, press the ENTER key.

If the command is properly executed, the console displays OK at the end of the line, and provides a new command prompt on the next line. If an error occurs when entering the command, an error message prints instead, and a command prompt is given on the next line. Table 2 lists the most common error messages and explains what each error means.

Message	Description
Syntax error or extra spaces at end of line.	The command was found but was improperly entered. An expected parameter can be missing, more parameters than necessary can have been entered, or an alphabetic word can have been entered where the system expected a number. A comma can have been accidentally used instead of a space to separate parameters, or instead of a period when entering a decimal value, and so on. You can also get this message if extra spaces were entered after the last parameter before pressing ENTER.
Parameter out of range.	One or more parameters are out of range. Check the command description and make sure all the parameters are within limits.
Command not found.	The command name was typed incorrectly. No such command was found. Commands are case sensitive, and all commands should be entered using lowercase letters. Enter a '?' command to get a list of valid command names.

Table 2: Error Messages

9.1.2 Using the Help System

9.1.2.1 Listing Command Names

You can obtain a list of all available command names at any time by typing

```
> ?
```

at the command prompt. Here is an example list:

```
> ?
```

```
PSE 702 terminal interface command names:
```

```
cbc      cbd      cbl      cbm      cbt      cwr      cwl      help
?        id       sdi      sei      sem      path     dpath    anno
danno    eanno    ttpena   ttpwd    ttchar   rxf      filt     rxl
rxla     tone     status   dump     ver      tmr      txf      txl
def      format   vid      files    reset    tonetab  freq     fdel
fplay    playid
```

```
OK
```

```
>
```

9.1.2.2 Listing Command Names and Descriptions

You can obtain a list of available commands at any time by typing

```
> help
```

at the command prompt.

9.1.2.3 Listing Command Syntax and Parameters

You can quickly get syntax and parameter information about a particular command by typing

```
> help {command_name}
```

followed by ENTER, where {command name} is the name of the command in question. For example, when you enter the command "help tmr" at the prompt and press ENTER, the command syntax and parameter descriptions are displayed:

```
> help tmr
Set transmitter timers
tmr {chan} {id} {timeout} {hang}
Where:
chan      Transmitter channel number (1 or 2)
id        ID timer in sec (60 to 1920). 0 = no ID
timeout   Tx timeout in sec (10 to 600). 0 = no timeout
hang      Hang time duration in mS (0 to 10000)
Parameters in {} are required; parameters in [] are optional.
>
```

9.1.3 Displaying Current Parameter Settings

If a command uses parameters (and most of them do), you can see the current state of the parameters by typing the name of the command alone, without any parameters, and then pressing ENTER. For example, the `tmr` command sets timer parameters for ID, transmitter timeout, and hang time. To see the current parameter settings, type

```
> tmr
```

and press ENTER. The console responds by displaying the current value of the timers for each transmitter channel on the operator console, as shown here:

```
> tmr
tmr 1 420 180 1500
tmr 2 420 180 1500
>
```

This shows that for both channels 1 and 2, the ID timer expires in 420 seconds (7 minutes), the transmitter timeout is 180 seconds (3 minutes), and the hang time is 1500 milliseconds (1.5 seconds).

9.2 Alphabetical List of Console Commands

Table 3: Alphabetical List of Console Commands

Command	Description	Section	Parameters	DTMF commands
?	Display Command List	9.5.10	None	None
anno	Schedule an Announcement	9.4.14	{tx_chan} {fileNum} {priority} {period}	#21
cbc	Set Courtesy Beep Character	9.3.2	{rx_chan} {char}	None
cbd	Set Courtesy Beep Delay	9.3.4	{rx_chan} {delay}	None
cb1	Set Courtesy Beep Level	9.4.1	{tx_chan} {level}	#31
cbm	Set Courtesy Beep Mode	9.3.1	{rx_chan} {mode}	#52
cbt	Set Courtesy Beep Frequency and Duration	9.3.3	{rx_chan} {tone} {freq} {duration}	#50, #51
cw1	Set Morse Code (CW) Level	9.4.7	{tx_chan} {cwLevel}	#32
cwr	Set Morse Code (CW) ID Rate and Frequency	9.4.8	{tx_chan} {cwRate} {freq}	#53, #54
danno	Delete an Announcement	9.4.13	{tx_chan} {file}	#24

Command	Description	Section	Parameters	DTMF commands
def	Restore Factory Defaults	9.5.8	{code}	None
dpath	Delete Path	9.5.2	{source} {dest}	#22
dump	Dump Parameters to Console	9.5.18	None	None
eanno	Enable Announcement Playback	9.5.13	{file} {enable}	#27
fdel	Delete File	9.5.15	{file}	#71
files	Display File System Status	9.5.14	None	None
filt	Set Receiver Channel Filters	9.3.9	{rx_chan} {type} {index}	#45
format	Format File System	9.5.16	{file}	None
fplay	Audio File Playback	9.5.17	{tx_chan} {file}	#72
frec	Audio File Record	9.3.10	{tx_chan} {file}	#70
help	View Help	9.5.12	{command}	None
id	Set Transmitter's CW ID string	9.4.5	{tx_chan} {"string"}	#25
path	Set Receiver to Transmitter Path	9.5.1	{rx_chan} {tx_chan} {priority}	#20
playid	Play Transmitter ID	9.4.6	{tx_chan}	#26
reset	Reset the Microcontroller	9.5.9	None	#90
rxfl	Set Receiver Option Flags	9.3.6	{rx_chan} {Dx} {Lx} {Px} {Rx}	#40, #41
rxl	Adjust Receiver Channel Audio Level	9.3.7	{rx_chan} {rxLevel}	None
rxla	Set Receiver Channel Audio Level Automatically	9.3.8	{rx_chan}	None
sdi	Set Receiver's CTCSS Decoder Frequency	9.3.5	{rx_chan} {index}	#60
sei	Set Transmitter's CTCSS Encoder Frequency	9.4.3	{tx_chan} {index}	#61

Command	Description	Section	Parameters	DTMF commands
sem	Set Transmitter's CTCSS Encoder Mode	9.4.2	{tx_chan} {mode}	#62
status	Print Parameters to Console	9.5.6	None	None
tmr	Set Transmitter Channel Timers	9.4.9	{tx_chan} {idTmr} {txTimeout} {hangTime}	#56, #57, #58
tone	Output a Test Tone	9.4.12	{tx_chan}	None
tonetab	Print the CTCSS Tone Table (Must type 'help tonetab').	9.5.11	None	None
ttchar	Set DTMF Command Character	9.5.4	{char}	None
ttpena	Disable or Enable DTMF Password	9.5.5	{enable}	None
ttpwd	Set DTMF Password String	9.5.3	{string}	None
txf	Set Transmitter Option Flags	9.4.10	{tx_chan} {Bx} {Dx} {Lx} {Px} {Rx} {Tx} {Vx}	#12, #10, #11, #13, #16, #17
txl	Set Transmitter Audio Level	9.4.11	{tx_chan} {txLevel}	#30
ver	Print Firmware Version Number to Console	9.5.7	None	None
vid	Set Transmitter Voice Identification	9.4.4	{tx_chan} {file}	#59

9.3 Receiver Commands

The console commands in this section affect the setup of the receiver channels.

9.3.1 Set Courtesy Beep Mode

You can set the PSE-702 to use a single tone, a pair of tones, or a CW (Morse code) character as the courtesy beep for a receiver. Or, you can set it so that no courtesy tone is used. Use this command to specify the mode that you want to use. The default is a single tone for both receivers.

Operator Console Syntax:

```
> cbm {rx_chan} {mode}
```

Parameters:

{rx_chan}: The receiver channel number (1 or 2) of the receiver to which the

command applies.

{mode} : The number associated with the desired mode, as shown in the following table.

Mode	Description
0	Courtesy beep disabled
1	Single tone beep
2	Two tone beep
3	Morse code character

Table 4: Courtesy Beep Modes

Example:

```
>cbm 2 2
```

This example sets receiver 2's courtesy beep to a pair of tones.

9.3.2 Set Courtesy Beep Character

You can set the PSE-702 to use a CW (Morse code) character as the courtesy beep for a receiver. Use this command to specify the character you want to use.

Operator Console Syntax

```
> cbc {rx_chan} {char}
```

Parameters:

{rx_chan}: The receiver channel number (1 or 2) to which the command applies.

{char}: The character to be used for the courtesy beep. The character can be any one of the following:
 ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789/- . ?

Example:

```
> cbc 2 K
```

This example sets receiver 2's courtesy beep to be the character K in Morse code (— - —).

9.3.3 Set Courtesy Beep Frequency and Duration

This command sets the courtesy beep frequency and duration for the tone or tones.

Operator Console Syntax:

```
> cbt {rx_chan} {tone} {freq} {duration}
```


Parameters:

- `{rx_chan}`: The receiver channel number (1 or 2) of the channel for which the command applies.
- `{tone}`: The number corresponding to the tone to which the command applies (either 1 or 2). If you are using a single tone beep, you use tone 1 only.
- `{freq}`: The frequency, in Hz, of the courtesy beep. The frequency can be set to between 400 and 2000 Hz, inclusive. The default is 700 Hz.
- `{duration}`: The number of milliseconds the tone should be heard. The duration can be between 50 and 1,000 milliseconds. The default is 100 milliseconds.

Example:

```
> cbt 2 2 720 1000
```

This example sets the second tone of receiver 2's courtesy beep to 720 Hz for one (1) second.

9.3.4 Set Courtesy Beep Delay

This command sets the amount of time the PSE-702 waits after a transmission ends before sending a courtesy beep for a receiver channel.

Operator Console Syntax:

```
> cbd {rx_chan} {delay}
```

Parameters:

- `{rx_chan}`: The receiver channel number (1 or 2) to which the command applies.
- `{delay}`: The number of milliseconds from the close of squelch to the start of the courtesy beep. The delay can be between 100 and 10,000 milliseconds. The default is 500 milliseconds.

Example:

```
> cbd 2 1000
```

This example sets receiver 2's courtesy beep to occur 1 second after squelch closes.

9.3.5 Set Receiver's CTCSS Decoder Frequency

This command allows the operator to select the CTCSS frequency that shall be decoded to unsquelch a selected receiver. This command does not enable CTCSS decoding on the receiver channel; it only sets the decoder's frequency. To enable or disable tone decoding, see the description of the P flag in the Set Receiver Flags command.

Operator Console Syntax:

```
> sdi {rx_chan} {index}
```

Parameters:

{rx_chan}: The receiver channel (1 or 2) to which the command applies.

{index}: A code number identifying the particular CTCSS tone to decode for the selected receiver. The default is 10, which corresponds to 100.0 Hz. Table 5 (page 42) gives the correspondence between the {index} parameter and the CTCSS frequency to be decoded.

Index	Frequency	Index	Frequency	Index	Frequency
0	67.0	13	110.9	25	167.9
1	71.9	14	114.8	26	173.8
2	74.4	15	118.8	27	179.9
3	77.0	16	123.0	28	186.2
4	79.7	17	127.3	29	192.8
5	82.5	18	131.8	30	203.5
6	85.4	19	136.5	31	210.7
7	88.5	20	141.3	32	218.1
8	91.5	21	146.2	33	225.7
9	94.8	22	151.4	34	233.6
10	100.0	23	156.7	35	241.8
11	103.5	24	162.2	36	250.3
12	107.2				

Table 5: CTCSS Frequency Index

Example:

```
> sdi 1 23
```

This example sets receiver 1 to decode 156.7 Hz.

9.3.6 Set Receiver Flags

Use this command to set the various flags governing the operation of the selected receiver.

When entering this command at the operator console, you can change one or more flags at a time. It is not necessary to enter every flag following the channel number, but you must specify at least one. The order of the flags in the command is not significant. If a particular flag is not entered, its value is unchanged. The flag designators (D, L, P, and R) can be entered using either upper or lowercase letters.

Operator Console Syntax:

```
> rxf {rx_chan} {Lx} {Px} {Rx}
```

Parameters:

- {rx_chan}: Channel number (1 or 2) to which the receiver flag settings apply. At least one flag must be specified in the command.
- {Lx}: L flag. The character L followed immediately by 0 or 1 to set RUS level to active low or active high (respectively) on the selected channel. This parameter is optional and if not entered, the value will be unchanged. The default is L1.
- {Px}: P flag. The character P followed immediately by 0 or 1 to disable or enable (respectively) the CTCSS decoder on the selected channel. This parameter is optional and if not entered, the value will be unchanged. The default is P0. This flag tells the controller whether or not to require a CTCSS tone on the user's audio signal, before opening the receiver's squelch. With the flag set to 0, the controller will allow signals to repeat even if they do not contain the CTCSS tone (carrier squelch only). With the flag set to 1, the controller will not allow a signal to repeat unless it contains the CTCSS tone.
- {Rx}: R flag. The character R followed immediately by 0 or 1 to diable (mute) or enable (unmute) a receiver. A muted receiver still can receive DTMF commands, but it will not turn on any transmitters or activate any paths. The purpose of this command is to allow a receiver to be disabled (for example, if it is picking up noise) so that it cannot transmit, but still allow it to receive DTMF commands. This parameter is optional and if not entered, its value will be unchanged. The default is R1.

Examples:

```
> rxf 1 L1 P1
```

This example sets receiver 1 to RUS High and enables CTCSS input tone. The flags for deemphasis (D) and enable (R) are unchanged.

```
>rxf 2 D1 P0
```

This example enables de-emphasis and turns off CTCSS decoding on receiver 2, and does not change the active level. The flags for level (L) and enable (R) are unchanged.

9.3.7 Adjust Receiver Channel Audio Level

Use this command to adjust the digital potentiometer associated with the specified receiver channel.

See section 2.4 for a description of how to adjust this level properly.

Operator Console Syntax:

```
> rxl {rx_chan} {level}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver level setting applies.

{level}: Volume level in percent (0 to 100). The default setting is 45 percent.

Example:

```
> rxl 2 50
```

This example sets the digital potentiometer for receiver channel 2 to 50 percent volume.

9.3.8 Set Receiver Channel Audio Level Automatically

This command can be used to automatically set the receiver channel audio gain. You should apply a tone to the audio input for the receiver in question before executing this command. The recommended standard tone is 1KHz tone frequency at a 3KHz deviation level, or about 1 volt AC RMS (2.8 Vp-p) at the input pin. It is also possible to use a DTMF tone if a standard tone is not available. In this case the “*” tone is the best to use. If you intend to use CTCSS decoding, include the CTCSS tone on your test tone at approximately 700 Hz modulation.

While applying the test tone to the receiver channel's input pin, execute the `rxla` command on the console. The receiver level will be set automatically within a few seconds. After the level is set you should measure approximately 270mV RMS AC at the receiver test point (TP2 or TP4).

After using this command to set the receiver level you can use the `rxl` command in section 9.3.7 to fine-tune the result for your particular installation. However, in most cases the value found by the `rxla` command will be optimal.

Operator Console Syntax:

```
> rxla {rx_chan}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver level setting applies.

Example:

```
> rxla 1
```

This example sets the digital potentiometer for receiver channel 1

9.3.9 Set Receiver Channel Filters

This command allows the operator to select filters to be used on the receiver channel. There are two filter types: De-emphasis and CTCSS Rejection.

Operator Console Syntax:

```
> filt {rx_chan} {type} {index}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver level setting applies.

{type}: 'D' for de-emphasis, 'R' for CTCSS rejection.

{index}: Select the index from the following table.

Index	De-Emphasis	CTCSS Rejection
0	No de-emphasis applied to input signal.	No CTCSS rejection filter applied to input signal.
1	750us de-emphasis filter applied to input signal	3 rd order CTCSS rejection filter applied to input signal.
2	Not used.	4 th order CTCSS rejection filter applied to input signal

Notes:

If you are not using CTCSS decoding in the repeater you may wish to turn off the CTCSS rejection filter for better low frequency audio response. If you are using a CTCSS tone in the range of 67 Hz to 153 Hz the 3rd order filter should be adequate. If you are using a tone above 153 Hz you may wish to use the 4th order filter for better tone suppression in the output at the expense of some low frequency audio.

Examples:

```
> filt 2 D 1
```

This example turns on de-emphasis for receiver 2.

```
> filt 1 R 2
```

This example turns on the 4th order CTCSS rejection filter for receiver 1.

```
> filt 1 D 0
```

This example turns off de-emphasis for receiver 1.

9.3.10 Record an Audio File

Use this command to set the recorder so that the next time squelch is opened, the recorder records the incoming audio to a file. The operator has 10 seconds after issuing the command for the recorder to begin recording. When the receiver is keyed, the audio is captured and stored in the selected file.

If the selected file already contains data, the PSE-702 will report an error. To record new audio in a file (and erase the current contents), use the Delete File command.

Operator Console Syntax:

```
>frec {rx_chan} {file}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver level setting applies.

{file}: A number 1 through 8 indicating which file to record.

Note: Recordings are made with the de-emphasis setting in use at the selected receiver channel. See section 9.3.9.

Example:

```
>freq 2 1
```

This example sets receiver 2 to receive the audio for file 1.

9.4 Transmitter Commands

9.4.1 Set Courtesy Beep Level

This command sets the courtesy beep parameters for each transmitter channel. The courtesy beep can also be disabled entirely. To disable the courtesy beep, see 9.4.10.

Operator Console Syntax:

```
> cb1 {tx_chan} {level}
```

Parameters:

{tx_chan}: The transmitter channel number (1 or 2) of the channel for which the command applies.

{level}: The audio level at which the courtesy beep will sound. The level can be set to between 0 and 100 percent. The default is 20 percent.

Example:

```
> cb 2 70
```

This example sets transmitter 2's courtesy beep at a 70 percent audio level.

9.4.2 Set Transmitter's CTCSS Encoder Mode

Use this command to set a transmitter's CTCSS Mode.

Operator Console Syntax:

```
> sem {tx_chan} {mode}
```

Parameters:

{tx_chan}: 1 or 2, identifying the transmitter channel.

{mode}: 1 or 2, depending on the desired mode See table below.

Mode Number	Mode Name	Description
1	RUS	CTCSS is encoded onto the transmitted audio only while the receiver is unquelled. (This is the default).
2	PTT	CTCSS is encoded onto the transmitted audio whenever PTT is asserted.

Table 6: CTCSS Encode Mode Parameter

Example:

```
> sem 1 1
```

This example sets transmitter 1 to encode only while the receiver is unquelled.

9.4.3 Set Transmitter's CTCSS Encoder Frequency

Use this command to select the CTCSS frequency to output on the transmitter's encoder channel. Note that this command does not enable CTCSS encoding on the transmitter channel; it only sets the encoder's frequency. To enable or disable encoding, see the description of the P flag in the Set Transmitter Flags command.

Operator Console Syntax:

```
> sei {tx_chan} {index}
```

Parameters:

{tx_chan}: The transmitter channel (1 or 2) to which the command applies.

{index}: A code number identifying the particular CTCSS tone to encode for the selected transmitter. The default is 10, which corresponds to 100.0 Hz. Table 5 on page 42 gives the correspondence between the {index} parameter and the CTCSS frequency to be encoded.

Example:

```
> sei 2 1
```

This example sets transmitter 2 to use the audio tone 71.9Hz for CTCSS.

9.4.4 Set Transmitter Voice Identification

Use this command to specify an audio file and playback parameters for voice identification of a transmitter.

Operator Console Syntax:

```
> vid {tx_chan} {file}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) to assign to play the selected audio identification file.

{file}: The number (1 through 8) of the file that contains the audio identification.

Examples:

```
>vid 1 5
```

This command selects the audio in file number 5 to be the ID for transmitter 1.

```
>vid
vid 1 2
vid 2 1
>
```

This command displays the list of currently configured voice IDs.

9.4.5 Set Transmitter Morse Code (CW) Identification

Use this command to set the Morse code identification string (CWID) transmitted by transmitter 1 or 2.

Operator Console Syntax:

```
> id {tx_chan} {"string"}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the CWID string applies.

{string}: A sequence of letters or numbers that a transmitter will transmit to identify itself. The string must be at least 3 characters in length. The default value is "NO CWID". The CWID string can store up to 19 characters.

Notes:

When entering the string using the operator console, the characters must be enclosed in quotation marks, because a blank space can be a legitimate character in the string. Blank spaces cause a momentary pause during the playback of the identification string.

Example:

```
> id 1 "W7NLH"
```

This example sets the identification for transmitter 1 to W7NLH.

9.4.6 Play Transmitter ID

Use this command to play the identification (either voice or CW ID) for the selected transmitter.

Operator Console Syntax:

```
> playid {tx_chan}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) on which to play the ID.

Example:

```
> playid 1
```

This command plays the ID for transmitter 1 over the air.

9.4.7 Set Morse Code (CW) Level

Use this command to set the Morse code (CW) volume level for transmitter channels 1 and 2 respectively.

Operator Console Syntax:

```
> cw1 {tx_chan} {level}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the CW (Morse code) ID parameter settings apply.

{level}: CW ID volume level in percent (0 to 100). The default is 20 percent.

Example:

```
> cw1 1 50
```

This example sets the CW rate for transmitter 1 to 50 percent volume.

9.4.8 Set Morse Code (CW) ID Rate and Frequency

Use this command to set the Morse code (CW) rate (in wpm) and frequency for transmitter channels 1 and 2 respectively.

Operator Console Syntax:

```
> cwr {tx_chan} {rate} {freq}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the CW (Morse code) ID parameter settings apply.

{rate}: CW rate in words per minute (wpm). 10 wpm is minimum, 20 wpm is maximum. The default is 20 wpm.

{freq}: CW tone frequency in Hz. 400 Hz is min, 2000 Hz is max. The default is 800 Hz.

Example:

```
> cwr 1 10 700
```

This example sets the CW rate for transmitter 1 to 10 wpm at 700 Hz.

9.4.9 Set Transmitter Timers

Use this command to set the timers on the specified transmitter to the values specified by the parameters.

Operator Console Syntax:

```
> tmr {tx_chan} {idTmr} {txTimeout} {hangTime}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the timer settings apply.

{idTmr}: Duration of the ID timer in seconds. A setting of zero disables the ID timer. 60 seconds is the minimum setting; 1920 seconds is the maximum. The default is 420 seconds (7 minutes).

{txTimeout}: Duration of transmit timeout setting in seconds. Setting the transmit timer to zero disables the timer. 10 seconds is the minimum setting; 600 seconds is the maximum. The default is 180 seconds (3 minutes).

{hangTime}: Duration of the hang timer in milliseconds. 1 millisecond is min; 10000 milliseconds is max. Setting the hang-timer to zero disables the timer. The default setting is 1500 milliseconds.

Example:

```
> tmr 1 600 20 150
```

This example sets the timer for transmitter 1 to identify itself every 600 seconds (10 minutes), to time out after 20 seconds, and to wait 150 milliseconds before dropping out.

9.4.10 Set Transmitter Option Flags

Use this command to set the various flags governing the operation of the selected transmitter.

Operator Console Syntax:

```
> txf {tx_chan} {Bx} {Dx} {Lx} {Px} {Rx} {Tx} {Vx}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter flag settings apply.

{Bx}: B flag. The character B followed immediately by 0 or 1 to disable or enable the courtesy beep on the selected transmitter. The default is 1 (enabled).

{Dx}: D flag. The character D followed immediately by 0 or 1 to unmute or mute (respectively) DTMF audio transmission while entering DTMF commands on the selected channel. The default setting is 1 (muted).

1 causes DTMF commands to be muted when the DTMF command character (the # character is the default) is received to mark the start of a PSE-702 command. For example, when you enter 4567 from the DTMF keypad, it is

transmitted, and you will hear the tones. If you enter #4567, you will hear the beginning of the #, and all else will be muted. If you enter 45#67, you will hear 45 and the beginning of #, then all else will be muted. This allows the typical numeric sequences used in IRLP or Echolink systems to be passed through to the transmitter whether or not muting is selected.

0 causes all DTMF (including commands) to be transmitted (unmuted).

- {Lx}: L flag. The character L followed immediately by 0 or 1 to set PTT level to active low or active high (respectively) on the selected channel.
- {Px}: P flag. The character P followed immediately by 0 or 1 to disable or enable (respectively) CTCSS encoders (master enable/disable) on the selected channel.
- {Rx}: R flag. The character R followed immediately by 0 or 1 to disable or enable (respectively) a CTCSS reverse burst on the selected channel. Reverse-burst, if enabled, causes the PSE-702 to reverse the phase of the CTCSS tone by 235 degrees and hold PTT active for an additional 160 milliseconds after it would otherwise shut off. Reverse-burst enables some receivers to squelch more quickly thereby eliminating a squelch tail.
- {Tx}: T flag. The character T followed immediately by 0 or 1 to disable or enable (respectively) the selected transmitter itself. Once the transmitter is disabled, it responds with an OK in CW, does an ID, and then no further transmissions take place until the transmitter is re-enabled.
- {Vx}: V flag. The character V followed immediately by 0 or 1 to disable or enable (respectively) voice identification for the transmitter. When voice identification is enabled, a pre-recorded audio file is transmitted when the transmitter identifies itself. See the `freq` command (section 9.3.10) for instructions for recording an audio file. When voice ID is disabled, CW ID is used.

Notes:

- When voice ID is selected for a transmitter, there is a cases in which a CW ID will still actually be performed: If a voice ID has started and a repeater user keys up the transmitter, the transmitter will switch to CW and complete the ID.
- It is not necessary to enter every flag when entering this command. One or more flags may be entered in a single command, and the flags may be in any order. If a particular flag is not entered, its value is unchanged. The flag designators B, D, L, P, R, T, and V can be entered using either upper- or lowercase letters.

Example:

```
> txf 1 B0 D1 L1 P1 R1 T1 V1
```

This command sets transmitter 1 to:

- Disable courtesy beep

- Enable DTMF audio commands
- Enable CTCSS encoder
- Set PTT to active high
- Enable reverse burst
- Enable transmission
- Enable voice identification

9.4.11 Set Transmitter Audio Level

Use this command to set the audio level associated with the specified transmitter channel. See the repeater setup procedure in Adjusting the Transmitter Audio Levels for a description of how to set this level.

Operator Console Syntax:

```
> txl {tx_chan} {level}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter level setting applies.

{level}: Audio level index (0 to 100). See note below.

Notes:

The audio level setting ranges from 0 to 100 and increases logarithmically. The value 0 corresponds to approximately -28 dB, the value 58 (the default) corresponds to approximately 0 dB, and the value 100 corresponds to approximately +20 dB. Each count corresponds to approximately 0.48 dB.

Examples:

```
> txl 1 50
```

This command sets the digital potentiometer for transmitter 1 to 50 per cent volume.

9.4.12 Output a Test Tone

Use this command to output a 1000 Hz sine wave test tone at a level corresponding to 3/5 full scale on the selected channel. If CTCSS encoding is enabled, this command also outputs a CTCSS tone.

The command operates as a toggle. When it is first issued, the tone is turned on. When it is issued again, it is turned off. A tone can be output on either channel 1 or 2, but cannot be present on both channels simultaneously.

Operator Console Syntax:

```
> tone {tx_chan}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which to send the test tone.

Examples:

```
> tone 2
```

This command sends a 1000 Hz tone to transmitter 2.

9.4.13 Delete an Announcement

Use this command to delete the schedule for an announcement the selected transmitter. It does not delete the announcement audio file, but drops it from the playback schedule.

Operator Console Syntax:

```
> danno {tx_chan} {file}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) corresponding to the channel to which the schedule applies.

{file}: The number (1 through 8) corresponding to the file that contains the announcement audio.

Example:

```
> danno 1 7
```

This command deletes the schedule for the announcement in file 7 for transmitter 1.

9.4.14 Schedule an Announcement

Use this command to schedule an announcement to be played back at a selected time and interval. The priority of the announcement determines whether the announcement can be pre-empted by a user transmission, or if the announcement can pre-empt a user who is already transmitting, or if the announcement audio and the user audio are to be mixed.

If an announcement for the file number you select is already scheduled, the new announcement will be given the same enable status (see the Enable Announcement Playback command) as the existing one. Otherwise, the new announcement will be scheduled with playback disabled. You can enable or disable it using the eanno command in section 9.5.13.

Operator Console Syntax:

```
> anno {tx_chan} {file} {period} {priority}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) to assign to play the selected announcement.

{file}: The number (1 through 8) of the file that contains the announcement audio.

{period}: The number of minutes between successive playbacks of the announcement.

{priority}: The priority for the selected announcement. On the console, use one of the following letters to select the corresponding priority.

Priority	Description
H	High priority
M	Medium/Mix priority
L	Low priority

Table 7: Console Encoding of Path and Announcement Priority

Examples:

```
> anno 1 5 120 L
```

This command schedules the audio in file number 5 to play back on transmitter 1 every 2 hours at low priority. If a user is keyed up at the time the announcement is scheduled to play, or keys up while the announcement is playing, then he or she takes priority over the announcement, and the system will reschedule the announcement to play in one minute.

9.5 System Commands

9.5.1 Set Receiver to Transmitter Path

Use this command to configure the connections between your receivers and transmitters for your particular repeater configuration. You can assign zero, one, or two transmitters to transmit the audio from each receiver.

Operator Console Syntax:

```
> path {rx_chan} {tx_chan} {priority}
```

Parameters:

{rx_chan}: The receiver channel number, which can be either 1 or 2.

{tx_chan}: The transmitter channel number, which can be either 1 or 2.

{priority}: A is a single character identifying the priority of the path as given in Table 7 page 54. A signal with a higher priority is given preference over those of lower priority. Signals of equal priority are handled on a first come, first served basis. Signals of medium priority mix if they are active on the same transmitter at the same time.

Notes:

If a path is entered with the same receiver and transmitter number as an existing path, the new path replaces the existing one. (Note that it doesn't really make sense to have two paths with the same receiver and transmitter numbers).

Examples:

```
> path 1 1 H
```

This command creates a path for transmitter 1 to transmit audio from receiver 1. The path has high priority, which means it will take precedence over any audio from any path with a lower priority.

```
> path 1 1 H
> path 2 2 H
```

These are the default paths configured in the PSE-702. These commands cause receiver 1 to transmit on transmitter 1 only, and receiver 2 to transmit on transmitter 2 only. This is a typical setup for a dual non-linked repeater. Priority in this scenario is not used, and remains at the default, which is high.

```
> path 1 1 H
> path 1 2 H
> path 2 1 H
> path 2 2 H
```

These commands cause transmitters 1 and 2 to transmit audio from receiver 1, and cause both transmitters to also transmit audio from receiver 2. This is a typical full-duplex linked repeater system. Because all paths are high priority, when one receiver goes unsquelched and causes the transmitters to transmit its audio, the other receiver is ignored. Receiver priority is first come, first served.

```
> path 1 1 H
> path 1 2 H
```

These commands cause receiver 1 to transmit on both transmitters, while receiver 2 has no paths to a transmitter at all. (However, receiver 2 can still be used for DTMF control. Audible confirmation signals from the PSE-702 will not be heard, however, since it is not connected to a transmitter).

This setup could be used for a single channel repeater with a control receiver.

9.5.2 Delete Path

Use this command to delete a path that has been defined between a receiver and a transmitter.

Operator Console Syntax:

```
> dpath {rx_chan} {tx_chan}
```

Parameters:

{rx_chan}: The receiver channel for the path to delete, where 1 is receiver 1 and 2 is receiver 2.

{tx_chan}: The transmitter channel for the path to delete, where 1 is transmitter 1 and 2 is transmitter 2.

Example:

```
> dpath 1 2
```

This command deletes a defined path between receiver 1 and transmitter 2.

9.5.3 Set DTMF Password

Use this command to set the password for DTMF command input. The DTMF password must be entered to enable the system to accept DTMF commands.

Operator Console Syntax:

```
> ttpwd {string}
```

Parameters:

{string}: A sequence of letters or numbers containing the password characters. The password can contain only valid DTMF characters: numbers 0-9, letters A through D. The default password is "8958". The minimum password length is 4 characters and the maximum is 8 characters. The Restore Factory Defaults command can be used to restore the factory default setting but this command erases ALL operator-entered parameters.

Notes:

Even if you don't plan on using DTMF commands to configure your PSE-702, we highly recommend changing the DTMF password to a value other than the factory-set default to prevent someone else from controlling your repeater.

Example:

```
> ttpwd 12345
```

This example sets the password for DTMF operations to 12345.

9.5.4 Set DTMF Command Character

Use this command to set the DTMF character that starts a DTMF command sequence. The default is #. Changing the command character from # to another value can be useful if, for example, the repeater is already set up to use # to begin another function. You can set up the PSE-702 to accept DMF

commands that start with any one of the following characters: * A B C D #

Operator Console Syntax:

```
> ttchar {char}
```

Parameters:

{char}: Any one of the six allowed characters: * A B C D #. When entering a letter from the console, it does not matter if they are upper or lowercase.

Notes:

All of the examples in this guide assume the command character is set to the default value, namely, #.

Example:

```
> char C
```

This command sets the PSE-702 to accept command sequences starting with the character C.

9.5.5 Enable or Disable DTMF Password

Use this command to enable a password as a requirement before the PSE-702 will accept DTMF command input. When enabled, the DTMF password must be entered as part of the Log In to DTMF command (#00) to allow the system to accept DTMF commands. When this option is disabled (which is the default), the PSE-702 accept DTMF commands without a password.

Operator Console Syntax:

```
> ttpena {flag}
```

Parameters:

{flag}: 1 to enable the requirement for a DTMF password, and 0 to disable the requirement for a DTMF password.

Notes:

When no DTMF password is required, the PSE-702 accepts valid DTMF commands from any source. To restrict DTMF entry, you should enable the DTMF password.

Examples:

```
> ttpena 1
```

This example enables the DTMF password.

9.5.6 Output Parameter Status

This command outputs a report of the current settings for all parameters to the operator console, formatted to be easily read. It contains the same information as the Output Parameter Dump command, but is easier to read.

Operator Console Syntax:

```
> status
```

Parameters: None

Note:

The Status command is intended to provide the operator with a way to check parameters after performing a setup. To save or backup parameters offline for later restore see the dump command in section 9.5.18 on page 64.

9.5.7 Print Firmware Version to Console

Use this command to send the current version, date and time to the console.

Operator Console Syntax:

```
> ver
```

Parameters: None

Example:

```
> ver
Firmware Version 2.6, Jan 6 2013 17:00:51
OK
```

This example shows a typical version number command and response.

9.5.8 Restore Factory Defaults

Use this command to reload the factory defaults into all operational parameters. All operator-entered parameters are replaced with the factory defaults. Be careful when using this command. It is intended to restore a non-operational system back to operational status in case of a crash or severe misconfiguration.

Operator Console Syntax:

```
> def {code}
```

Parameters:

{code}: The literal number 8958. This code is required to insure that you are executing this command deliberately.

Notes:

The defaults are listed in the following table.

Table 8: Default and Limiting Values for Parameters

Parameter	Console command	DTMF command	Lower Limit	Default Value	Upper Limit	Units
Receiver channel number	Any command taking a rx_chan parameter		1		2	
Transmitter channel number	Any command taking a tx_chan parameter		1		2	
ID timer	tmr	#56	60	420	1,920	Seconds.
Transmitter timeout	tmr	#57	10	180	600	Seconds
Hang timer	tmr	#58	1	1,500	10,000	Milliseconds

Parameter	Console command	DTMF command	Lower Limit	Default Value	Upper Limit	Units
CW ID	id	#26	Limits not applicable. Default is “NO CWID”			
Courtesy beep frequency	cbt	#50	400	700	2,000	Hz
Courtesy beep duration	cbt	#51	50	100	1,000	Milliseconds
Courtesy beep delay	cbd	None	100	500	10,000	Milliseconds
Courtesy beep mode	cbm	None	See Table 4. Default is single tone			
Courtesy beep level	cbl	#31	0	20	100	Percent
Morse code rate	cwr	#53	10	20	20	Words per Minute
Morse code frequency	cwr	#54	400	800	2,000	Hz
Morse code level	cwl	#32	0	20	100	Percent
Mute DTMF on transmit	txf	#13	Values are 0 for disabled, 1 for enabled. Default is 0 (Disabled)			
PTT active low or active high	txf	None	Values are 0 for active low, 1 for active high. Default is 0 (Active low)			
CTCSS encoder	txf	#11	Values are 0 for disabled, 1 for enabled. Default is 0 (Disabled)			
CTCSS reverse burst	txf	#16	Values are 0 for disabled, 1 for enabled. Default is 0 (Disabled)			
Transmitter enable	txf	#17	Values are 0 for disabled, 1 for enabled. Default is 1 (Enabled)			
De-emphasize audio	rx f	None	Values are 0 for disabled, 1 for enabled. Default is 1 (Enabled)			
RUS active low or active high	rx f	None	Values are 0 for active low, 1 for active high. Default is 1 (Active high)			

Parameter	Console command	DTMF command	Lower Limit	Default Value	Upper Limit	Units
CTCSS decoder	rxf	#40	Values are 0 for disabled, 1 for enabled. Default is 0 (Disabled)			
Disable or enable receiver	rxf	#41	Values are 0 for disabled, 1 for enabled. Default is 1 (Enabled)			
Receiver channel audio level	rxl	None	0	45	100	Percent.
Transmitter channel audio level	txl	#30	0	58	100	Index. See sec. 9.4.11
Receiver CTCSS decoder frequency	sdi	#60	0	10 (100 Hz)	36	Index. See Table 5
Transmitter CTCSS encoder frequency	sei	None	0	10 (100 Hz)	36	Index. See Table 5
Transmitter CTCSS encoder mode	sem	#62	See Table 6. Default is RUS mode.			
Receiver 1 path	path	#20	Default is Transmitter 1			
Receiver 2 path	path	#20	Default is Transmitter 2			

Example:

```
> def 8958
Defaults have been set. OK
```

The example shows the only way in which the command can be used. Once the command is entered with the code number 8958, the parameter memory is erased and replaced with the factory defaults.

9.5.9 Reset the Microcontroller

Use this command to reset the microcontroller. You use this command to reset the board without cycling power off and on.

Operator Console Syntax:

```
> reset
```

Parameters: None

9.5.10 Display List of Command Names

Sometimes you know there is a command to do what you need but you just can't think of the name. Use this command to display a list of console operator command names.

Operator Console Syntax:

```
> ?
```

Parameters: None

Example:

```
> ?
cbc      cbd      cbl      cbt      cwr      cw1      help
?        id       sdi      sem      path     dpath    anno
danno    eanno    ttpena   ttchar   rxf      rx1      tone
status   dump     ver      txf      tx1      def      format
vid      files    reset    freq     fdel     fplay    playid
```

OK

This example shows a typical display of all command names available from the operator console.

9.5.11 Print the CTCSS Tone Table

This command prints the CTCSS tone table that is used to find the index for entering CTCSS tones using the `sdi` and `sei` commands in section 9.3.5 and 9.4.3 respectively.

Operator Console Syntax:

```
> help tonetab
```

Parameters: None

9.5.12 View Help

Use this command to display help for console operator commands.

Operator Console Syntax:

```
> help {command}
```

Parameters:

{command}: This parameter is optional. If no parameter is specified, the command produces a list of all console operator commands. If a valid console operator command is specified, the command produces a syntax statement and description of the parameters associated with the specified command.

Examples:

```
> help
```

This example displays a list of all commands available from the operator console.

```
> help rxl
```

This example displays the syntax statement for the `rxl` command, along with a brief description of each parameter.

```
> help tonetab
```

This example displays the CTCSS tone index/frequency table.

9.5.13 Enable Announcement Playback

Use this command to enable or disable the playback of an announcement. Disabling an announcement does not delete it or alter its schedule. To schedule an announcement to be played back, use the Schedule Announcement Playback command.

Operator Console Syntax:

```
> eanno {file} {flag}
```

Parameters:

`{file}`: The file number (1 through 8) of the file that contains the announcement audio.

`{flag}`: Can be either 1, which enables playback of the selected announcement, or 0, which disables playback of the selected announcement.

Example:

```
>eanno 6 1
```

This example enables the playback of the audio in file number 6, for any schedule to which it has been assigned.

9.5.14 Display File System Status

Use this command to display the status of the recorded files on the console.

Operator Console Syntax:

```
> files
```

Parameters: None

Example:

```
> files
File 1: 6.3 seconds.
File 2: 6.6 seconds.
File 3: 10.3 seconds.
File 4: 5.0 seconds.
Total recorded time: 28.2 seconds, time left: 323.2
seconds.
```

OK

This example shows that four audio files are stored, the length (playback time) of each file, the total length of the recorded audio stored in the files in the PSE-702, and the length of time still available to use for recording audio files.

9.5.15 Delete File

Use this command to delete a recorded audio file. Up to eight files can be recorded. File 1 contains the voice ID for transmitter 1; file 2 contains the voice ID for transmitter 2.

Operator Console Syntax:

```
fdel {file}
```

Parameters:

{file}: A number (1 through 8) that indicates which file to delete. File 1 contains the ID for transmitter 1, and file 2 contains the ID for transmitter 2.

Example:

```
> fdel 1
```

This example deletes file 1, which contains the voice identification for transmitter 1.

9.5.16 Format File System

Use this command to format the PSE-702 flash memory file system.

Operator Console Syntax:

```
> format 8958
```

Parameters:

8958: You must enter the system password (8958) to run this command. Since the command will erase any files currently stored in memory, the password is required to prevent the command from being run accidentally.

Example:

```
> format 8958
```

This command formats the PSE-702 file system. Any files in the system before it is formatted

are erased.

9.5.17 Audio File Playback

Use this command to play a recorded audio file.

Operator Console Syntax:

```
> fplay {tx_chan} {file}
```

Parameters:

{tx_chan}: The transmitter channel on which to play the file.

{file}: The number of the file (1 through 8) to play.

Example:

```
> fplay 1 1
```

This example plays the audio in file 1 using transmitter 1.

9.5.18 Output Parameter Dump

This command outputs the current settings for all parameters to the operator console. The output is minimally formatted and does not contain page breaks. It can be captured and then played back to the PSE-702 using a terminal emulator to re-enter all parameter values. Use this command to capture current parameter values for playback or for backup (such as when you are preparing to download a new version of the PSE-702 firmware).

Operator Console Syntax:

```
> dump
```

Parameters: None

Notes:

To capture the output of this command, follow these steps:

1. Set your terminal emulator to capture a log file.
2. Enter the status command on the PSE-702 operator console.
3. When the console reports "OK" followed by >, close the log file.
4. Open the log file with a text editor and remove any > symbols and any other messages that are not valid operator console commands.

Then, set your terminal emulator to play back the log file. Set playback rate to a minimum of 10 milliseconds per character and 100 milliseconds per line. See your terminal emulator documentation for instructions on how to set this up.

Example:

```
>dump
```


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```
tmr 1 420 180 1500
tmr 2 420 180 1500
id 1 "NO CWID"
id 2 "NO CWID"
```

:

(Several more parameters will print)

:

```
path 1 1 H
path 2 2 H
path 1 2 H
path 2 1 L
vid 1 1
vid 2 2
```

OK

This example shows the results of a typical dump command.

10 DTMF command reference

10.1 Command List

Most commands for configuring a PSE-702 can be issued from a remote radio that has a DTMF keypad. The commands that can be issued using DTMF are described in detail in this chapter.

For each command, a brief description is provided, followed by the DTMF syntax.

The first character shown on the DTMF syntax line is the command character. By default, it is #, but this can be changed using the operator console (see Set DTMF Command Character). Following the command character is the number of the command, then the command's parameters, if any.

Following the syntax statement, each parameter is listed and explained. Parameters are shown in curly brackets. Do not enter the curly brackets when entering the command.

One or more examples for each command are given.

10.2 DTMF Overview

10.2.1 Policies regarding DTMF

For security and technical reasons, the PSE-702 does not provide the ability to execute all configuration commands using DTMF codes.

10.2.1.1 Security

A few select commands, such as the command that sets the DTMF password, should only be executed by the repeater operator. To insure this is the case, these commands are only available through a console connected to the PSE-702's USB serial interface, which requires physical access to the controller/repeater. This provides protection against what otherwise would be a security vulnerability: namely, that a repeater could potentially be misused by persons who simply had access to both a monitor capable of decoding the DTMF password and this manual (which is available online) to tell them what the commands are.

10.2.1.2 Technical

DTMF commands that could cause a receiver or transmitter to enter a state where it would become unusable have been blocked. For example, the command to set the receiver audio channel level potentiometer is not available using DTMF, because, if it is set too low, the receiver could not receive any additional DTMF commands.

10.2.2 Basic DTMF Operation

Special characters. Every DTMF command begins with a command character, which is # by default but can be changed, followed immediately by the command, and then the command parameters, if any.

DTMF syntax statements. In the DTMF syntax statements in this guide, the command sequence, as entered at a DTMF keyboard, is shown. The entire sequence must be entered in a single continuous

transmission, and then the radio must be unkeyed to receive the PSE-702's response.

PSE-702 responses. The PSE-702 responds with OK in CW when it accepts a DTMF command, and with ERR in CW if it is unable to accept the command.

10.2.3 Logging in to DTMF

If a DTMF password has been enabled for the PSE-702 (see Disable or Enable DTMF Password), the first DTMF command in a session must be the Log In to DTMF command, which is #00, followed by the password. The factory default password is 8958. The password can be changed using the Enter DTMF Password console command.

Once a Log In to DTMF command has been issued and accepted on either channel 1 or 2, the Log In to DTMF command will not be accepted on the other channel until a Log Off DTMF command is received on the active channel, or the DTMF session expires.

When the DTMF password is enabled, the password is set to expire five minutes after the last successful DTMF command is received on the active channel. That is, each successful DTMF command received on the active channel resets the timer for another five minutes. After five minutes have elapsed without a successful DTMF command, the PSE-702 ends the DTMF session. To start a new session, you will need to log in to the system again.

10.2.4 Entering DTMF command sequences

All DTMF commands must begin with # character followed by a numerical sequence for a command. Command parameters are entered immediately after the command number, with no separation character.

You must hold each individual digit in the sequence for a minimum of 200 milliseconds, and the quiet time between digits must be at least 200 milliseconds. The command will be canceled and a timeout message transmitted to the operator if the transmission takes longer than the current setting of the transmitter timeout timer. (See Set Transmitter Channel Timers).

After a DTMF command has been received, the PSE-702 controller responds in CW with OK if the command is accepted, or ERR if the command is not accepted.

You can configure the PSE-702 to either mute or unmute during a DTMF session. See Set Transmitter Flags for more information.

10.2.5 Ending a DTMF session

At the end of a session, enter the command sequence #99 to log off.

10.3 Numerical list of DTMF commands

Command	Description	Section	Parameters	Console command
#00	Log In to DTMF	10.6.3	{password}	None
#10	Enable or Disable a Transmitter	10.5.17	{tx_chan} {x}	txf
#11	Enable or Disable CTCSS Encode	10.5.17	{tx_chan} {x}	txf
#12	Enable or disable Transmitter Courtesy Beep	10.5.15	{tx_chan} {x}	txf
#13	Enable or Disable DTMF Muteing	10.5.13	{tx_chan} {x}	txf
#16	Enable or Disable Reverse Burst	10.5.16	{tx_chan} {x}	txf
#17	Enable or Disable Voice ID	10.5.18	{tx_chan} {x}	txf
#20	Set Receiver to Transmitter Path	10.6.1	{rx_chan} {tx_chan} {priority}	path
#21	Schedule an Announcement	10.5.21	{chan} {file} {priority} {period}	anno
#22	Delete Path	10.6.2	{source} {dest}	dpath
#24	Delete an Announcement	10.5.20	{tx_chan} {file}	danno
#25	Set Transmitter CW ID String	10.5.5	{tx_chan} {string}	id
#26	Play Transmitter ID	10.5.6	{tx_chan}	playid
#27	Enable Announcement Playback	10.6.5	{file} {enable}	eanno
#30	Set Transmitter Audio Level	10.5.19	{tx_chan} {txLevel}	txl
#31	Set Courtesy Beep Level	10.5.1	{tx_chan} {level}	cbl
#32	Set CW ID Audio Level	10.5.7	{tx_chan} {cwLevel}	cwl
#40	Enable or Disable CTCSS Decoder	10.4.5	{rx_chan} {x}	rx f
#41	Mute or Unmute Receiver	10.4.6	{rx_chan} {x}	rx f
#45	Set Receiver Channel Filters	10.4.7	{rx_chan} {type} {index}	filt

Command	Description	Section	Parameters	Console command
#50	Set Courtesy Beep Frequency	10.4.2	{rx_chan} {tone_number} {freq}	cbt
#51	Set Courtesy Beep Duration	10.4.3	{rx_chan} {duration}	cbt
#52	Set Courtesy Beep Mode	10.4.1	{rx_chan}{mode}	cbm
#53	Set CW ID Rate	10.5.8	{tx_chan}{cwRate}	cwt
#54	Set Morse code (CW) ID Frequency	10.5.9	{tx_chan}{cwFreq}	cwt
#56	Set Transmitter Identification Timer	10.5.10	{tx_chan}{idTmr}	tmr
#57	Set Transmitter Timeout Timer	10.5.11	{tx_chan} {txTimeout}	tmr
#58	Set Transmitter Hang Timer	10.5.12	{tx_chan}{hangTime}	tmr
#59	Set Transmitter Voice Identification	10.5.4	{tx_chan}{file}	vid
#60	Set Receiver's CTCSS Decoder Frequency	10.4.4	{rx_chan}{index}	sdi
#62	Set Transmitter's CTCSS Encoder Mode	10.5.2	{tx_chan}{index}	sem
#70	Audio File Record	10.4.8	{file}	frec
#71	Delete File	10.6.6	{file}	fdel
#72	Audio File Playback	10.6.7	{tx_chan}{file}	fplay
#90	Reset Microcontroller	10.6.8	None	reset
#99	Log Off DTMF	10.6.4	None	None

10.4 Receiver Commands

10.4.1 Set Courtesy Beep Mode

This command enables or disables the courtesy beep and determines the mode of the beep to be transmitted: a single tone; a pair of tones; or a CW (Morse code) character.

DTMF Syntax:

```
#52 {rx_chan} {mode}
```

Parameters:

{rx_chan}: The transmitter channel number (1 or 2) of the receiver to which the command applies.

{mode}: The number associated with the desired mode, as shown in the following table.

Courtesy beep modes

Mode	Description
0	Courtesy beep disabled
1	Single tone beep
2	Two tone beep
3	Morse code character

Table 9: Courtesy Beep Modes

Example:

#5222

This example sets transmitter 2's courtesy beep to a pair of tones.

10.4.2 Set Courtesy Beep Frequency

This command sets the courtesy beep frequency of the courtesy beep.

DTMF Syntax:

#50{rx_chan}{tone}{freq}

Parameters:

{rx_chan}: The transmitter channel number (1 or 2) of the channel for which the command applies.

{tone}: The tone number (1 or 2) identifying the tone being set. If a single tone is selected as the courtesy beep mode, the frequency of the first tone is used and the second tone is ignored.

{freq}: The frequency, in Hz, of the courtesy beep. The frequency can be set to between 400 and 2000 Hz, inclusive. The default is 700 Hz.

Example:

#50221000

This example sets the second tone of transmitter 2's courtesy beep at 1000 Hz. If a single tone is selected as the courtesy beep mode, setting the frequency of the second tone has no effect.

10.4.3 Set Courtesy Beep Duration

This command sets the duration of the courtesy beep in milliseconds. The duration is the length of time the selected courtesy beep tone plays after squelch closes on the receiver.

DTMF Syntax:

```
#51{rx_chan}{tone_number}{duration}
```

Parameters:

{rx_chan}: The transmitter channel number (1 or 2) of the channel for which the command applies.

{tone_number}: The tone number (1 or 2) to which the command applies.

{duration}: The length of the courtesy beep in milliseconds. The duration can be set to between 50 and 1000 milliseconds, inclusive. The default is 100 milliseconds.

Example:

```
#5111500
```

This example sets the first tone of transmitter 1's courtesy beep duration to 500 milliseconds.

10.4.4 Set Receiver's CTCSS Decoder Frequency

This command allows the operator to select the CTCSS frequency that shall be decoded to unsquelch a selected receiver. Note that this command does not enable CTCSS decoding on the receiver channel; it only sets the decoder's frequency. To enable or disable decoding, see the description of the P flag in the Set Receiver Flags command.

DTMF Syntax:

```
#60{rx_chan}{index}
```

Parameters:

{rx_chan}: The receiver channel (1 or 2) to which the command applies.

{index}: A code number identifying the particular CTCSS tone to decode for the selected receiver. The default is 10, which corresponds to 100.0 Hz. See section Table 5 for a list of code numbers.

Example:

```
#60123
```

This example sets receiver 1 to decode 156.7 Hz.

10.4.5 Enable or Disable CTCSS Decoder

Use this command to enable CTCSS tone usage for the selected receiver channel.

DTMF Syntax:

```
#40{rx_chan}{x}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver flag setting applies.

{x}: A 0 or 1 to disable or enable (respectively) the CTCSS decoder on the selected channel. The default is 0.

Notes:

This flag tells the controller whether or not to require a CTCSS tone on the user's audio signal, before opening the receiver's squelch. With the flag set to 0, the controller will allow signals to repeat even if they do not contain the CTCSS tone. With the flag set to 1, the controller will not allow a signal to repeat unless it contains the CTCSS tone.

Example:

```
#4011
```

This example sets enables CTCSS input tone on receiver 1.

10.4.6 Mute or Unmute Receiver

Use this command to mute the receiver the selected channel. Use this command to prevent a receiver from being able to transmit or activate any path, but still allow it to receive DTMF commands.

DTMF Syntax:

```
#41{rx_chan}{x}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to address.

{x}: A 0 or 1 to unmute or mute (respectively) the receiver. The default is 0.

Example:

```
#4111
```

This example mutes receiver 1.

10.4.7 Set Receiver Channel Filters

This command allows the operator to select filters to be used on the receiver channel. There are two filter types: De-emphasis and CTCSS Rejection.

DTMF Syntax:

```
#45{rx_chan}{type}{index}
```

Parameters:

{rx_chan}: Channel number (1 or 2) to which the receiver level setting applies.

`{type}`: 0 for de-emphasis, 1 for CTCSS rejection.

`{index}`: Select the index from the table in section 9.3.9 on page 44.

Example:

```
#4511
```

This example selects 3rd order filtering for CTCSS rejection.

10.4.8 Audio File Record

Use this command to set the recorder so that the next time squelch is opened on either receiver, the recorder records the incoming audio to a file. The operator has 10 seconds after issuing the command for the recorder to begin recording. When the receiver is keyed, the audio is captured and stored in the selected file.

If the selected file already contains data, the PSE-702 will report an error. To record new audio in a file (and erase the current contents), use the Delete File command.

DTMF Syntax:

```
#70{file}
```

Parameters:

`{file}`: A number 1 through 8 indicating which file to record. File 1 contains the ID for transmitter 1, and file 2 contains the ID for transmitter 2.

Example:

```
#701
```

This example sets the system to record audio to file 1, which is used to identify transmitter 1.

10.5 Transmitter Commands

10.5.1 Set Courtesy Beep Level

This command sets the courtesy beep level for a selected transmitter channel.

DTMF Syntax:

```
#31{tx_chan}{level}
```

Parameters:

`{tx_chan}`: The transmitter channel number (1 or 2) of the channel for which the command applies.

`{level}`: The audio level at which the courtesy beep will sound. The level can be set to between 0 and 100 percent. The default is 20 percent.

Example:

```
#31270
```

This example sets transmitter 2's courtesy beep audio level at 70 percent.

10.5.2 Set Transmitter's CTCSS Encoder Mode

Use this command to set a transmitter's CTCSS Mode.

DTMF Syntax:

```
#62{tx_chan}{mode}
```

Parameters:

{tx_chan}: 1 or 2, identifying the transmitter channel.

{mode}: 1 or 2, depending on the desired mode:

1 when the transmitter should encode only while the receiver is unscelched.
This is the default.

2 when the transmitter should encode whenever PTT is asserted.

Example:

```
#6212
```

This example sets transmitter 1 to encode only while the receiver is unscelched.

10.5.3 Set Transmitter's CTCSS Encoder Frequency

Use this command to select the CTCSS frequency to output on the transmitter's encoder channel. Note that this command does not enable CTCSS encoding on the transmitter channel; it only sets the encoder's frequency. To enable or disable encoding, see the description of the P flag in the Set Transmitter Flags command 9.4.10.

DTMF Syntax:

```
#61{tx_chan}{index}
```

Parameters:

{tx_chan}: The transmitter channel (1 or 2) to which the command applies.

{index}: A code number identifying the particular CTCSS tone to encode for the selected transmitter. The default is 10, which corresponds to 100.0 Hz. See Table 5 for a list of code numbers. Note that you can also display this table by typing `help tonetab` at the console prompt.

Example:

```
#61123
```

This example sets transmitter 1 to transmit a 156.7 Mz CTCSS tone.

10.5.4 Set Transmitter Voice Identification

Use this command to specify an audio file and playback parameters for voice identification of a transmitter.

DTMF Syntax:

```
#59{tx_chan}{file}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) to assign to play the selected audio identification file.

{file}: The number (1 through 8) of the file that contains the audio identification audio.

Example:

```
#5915
```

This command selects the audio in file number 5 to be the ID for transmitter 1.

10.5.5 Set CW ID String

Use this command to set the Morse code identification string (CWID) transmitted by transmitter 1 or 2.

DTMF Syntax:

```
#25{tx_chan}{string}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the CWID string applies.

{string}: A sequence of letters or numbers that a transmitter will transmit to identify itself. The string must be at least 3 characters in length. The default value is "NO CWID". The CWID string can store up to 19 characters.

Notes:

When entering the string using DTMF codes, the operator must enter a string of DTMF digit-pairs corresponding to the letters, numbers and spaces of the desired string. Each character is represented by a pair of DTMF digits as shown in Table 10: DTMF entry for alphanumeric characters. All characters in the string must be entered without un-keying the transmitter until after the last digit is entered.

Example:

```
#2512233131107
```

This example sets the identification for transmitter 1 to W7NLH.

DTMF entry for alphanumeric characters

CW ID Char	DTMF Digits		CW ID Char	DTMF Digits		CW ID Char	DTMF Digits
A	00		O	14		2	28
B	01		P	15		3	29
C	02		Q	16		4	30
D	03		R	17		5	31
E	04		S	18		6	32
F	05		T	19		7	33
G	06		U	20		8	34
H	07		V	21		9	35
I	08		W	22		/	36
J	09		X	23		-	37
K	10		Y	24		.	38
L	11		Z	25		?	39
M	12		0	26		(space)	40
N	13		1	27			

Table 10: DTMF Encoding of CW ID Characters

10.5.6 Play Transmitter ID

Use this command to play the identification (either voice or CW ID) for the selected transmitter.

DTMF Syntax:

#26{tx_chan}

Parameters:

{tx_chan}: Transmitter number (1 or 2) on which to play the ID.

Example:

#261

This command plays the ID for transmitter 1 over the air.

10.5.7 Set Morse Code (CW) ID Level

Use this command to set the Morse code (CW) volume level for transmitter channels 1 and 2 respectively.

DTMF Syntax:

```
#32{tx_chan}{level}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the CW (Morse code) ID parameter settings apply.

{level}: CW ID volume level in percent (0 to 100). The default is 20 percent.

Example:

```
#32199
```

This example sets the CW identification audio level for transmitter 1 to 99 percent volume.

10.5.8 Set Morse Code (CW) ID Rate

Use this command to set the Morse code (CW) rate (in wpm) for transmitter channels 1 and 2 respectively.

DTMF Syntax:

```
#53{tx_chan}{rate}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the CW (Morse code) ID parameter settings apply.

{rate}: CW rate in words per minute (wpm). 10 wpm is minimum, 20 wpm is maximum. The default is 20 wpm.

Example:

```
#53115
```

This example sets the CW rate for transmitter 1 to 15 wpm.

10.5.9 Set Morse Code (CW) ID Frequency

Use this command to set the Morse code (CW) frequency for transmitter channels 1 and 2 respectively.

DTMF Syntax:

```
#54{tx_chan}{freq}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the CW (Morse code) ID parameter settings

apply.

{freq}: CW tone frequency in Hz. 400 Hz is min, 2000 Hz is max. The default is 800 Hz.

Example:

```
#541700
```

This example sets the CW rate for transmitter 1 to 700 Hz.

10.5.10 Set Transmitter Identification Timer

Use this command to set the identification timer on the specified channel to the value specified.

DTMF Syntax:

```
#56{tx_chan}{idTmr}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the timer settings apply.

{idTmr}: Duration of the ID timer in seconds. A setting of zero disables the ID timer. 60 seconds is the minimum setting; 1920 seconds is the maximum. The default is 420 seconds (7 minutes).

Example:

```
#561300
```

This example sets the timer for transmitter 1 to identify itself every 300 seconds.

10.5.11 Set Transmitter Timeout Timer

Use this command to set the transmitter timeout on the specified channel to the value specified.

DTMF Syntax:

```
#57{tx_chan}{txTimeout}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the timer settings apply.

{txTimeout}: Duration of transmit timeout setting in seconds. Setting the transmit timer to zero disables the timer. 10 seconds is the minimum setting; 600 seconds is the maximum. The default is 180 seconds (3 minutes).

Example:

```
#571170
```

This example sets the timer for transmitter 1 to time out after 170 seconds.

10.5.12 Set Transmitter Hang Timer

Use this command to set the hang timer on the specified channel to the value specified.

DTMF Syntax:

```
#58{tx_chan}{hangTime}
```

Parameters:

{tx_chan}: Transmitter channel number (1 or 2) to which the timer settings apply.

{hangTime}: Duration of the hang timer in milliseconds. 1 millisecond is min; 10000 milliseconds is max. Setting the hang-timer to zero disables the timer. The default setting is 1500 milliseconds.

Example

```
#5811700
```

This example sets the hang timer for transmitter 1 to wait 1700 milliseconds before dropping out.

10.5.13 Set Transmitter Flag to Mute DTMF

Use this command to mute when entering DTMF mode on the selected transmitter.

DTMF Syntax:

```
#13{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter flag settings apply.

{x}: A 0 or 1 to unmute or mute (respectively) DTMF audio transmission while entering DTMF commands on the selected channel. The default setting is 1 (muted).

1 causes DTMF commands to be muted when a # character is received to mark the start of a PSE-702 command. For example, when you enter 4567 from the DTMF keypad, it is transmitted, and you will hear the tones. If you enter #4567, you will hear the beginning of the #, and all else will be muted. If you enter 45#67, you will hear 45 and the beginning of #, then all else will be muted. This allows the typical numeric sequences used in IRLP or Echolink systems to be passed through to the transmitter whether or not muting is selected.

0 causes all DTMF (including commands) to be transmitted (unmuted).

Example:

```
#1311
```

This example mutes audio when DTMF commands are received by transmitter 1.

10.5.14 Set Transmitter Flag to Enable or Disable CTCSS

Use this command to enable or disable CTCSS tone on the selected transmitter.

DTMF Syntax

```
#11{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the setting applies.

{x}: A 0 or 1 to disable or enable (respectively) CTCSS encoders (master enable/disable) on the selected channel.

Example:

```
#1111
```

This example enables CTCSS tone on transmitter 1.

10.5.15 Set Transmitter Flag to Enable or Disable Courtesy Beep

Use this command to enable or disable the courtesy beep on the selected transmitter.

DTMF Syntax:

```
#12{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the setting applies.

{x}: A 0 or 1 to disable or enable (respectively) courtesy beep tone(s) for the selected transmitter.

Example

```
#1211
```

This example enables the courtesy beep tone on transmitter 1.

10.5.16 Set Transmitter Flag Reverse Burst

Use this command to enable or disable reverse burst on the selected transmitter.

DTMF Syntax:

```
#16{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter flag settings apply.

{x}: A 0 or 1 to disable or enable (respectively) a CTCSS reverse burst on the selected channel. Reverse-burst, if enabled, causes the PSE-702 to reverse the phase of the CTCSS tone by 235 degrees and hold PTT active for an additional 160 milliseconds after it would otherwise shut off. Reverse-burst enables some receivers to squelch more quickly thereby eliminating a squelch tail.

Example:

```
#1611
```

This example enables reverse burst on transmitter 1.

10.5.17 Set Transmitter Flag to Enable or Disable a Transmitter

Use this command to enable or disable the selected transmitter.

DTMF Syntax:

```
#10{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter flag settings apply.

{x}: A 0 or 1 to disable or enable (respectively) the selected transmitter itself. Once the transmitter is disabled, it responds with an OK in CW, does an ID, and then no further transmissions take place until the transmitter is re-enabled.

Example:

```
#1011
```

This command enables transmitter 1.

10.5.18 Set Transmitter Flag to Enable or Disable Voice ID

Use this command to enable or disable voice identification of the selected transmitter.

DTMF Syntax:

```
#17{tx_chan}{x}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter flag settings apply.

{x}: A 0 or 1 to disable or enable (respectively) voice identification for the transmitter. When voice identification is enabled, a prerecorded audio file is transmitted when the transmitter identifies itself. See the Audio File Record command for instructions for recording an audio file. When voice ID is disabled, CW ID is used.

Notes:

When voice ID is selected for a transmitter, there are two cases in which a CW ID will actually be performed. These cases are:

If a voice ID has started and a repeater user keys up the transmitter, the transmitter will switch to CW and complete the ID.

If one transmitter is performing a voice ID and the other transmitter attempts to perform a voice ID at the same time, the second transmitter switches to CW ID. This is because

the voice ID module is not currently enabled to handle two transmitters simultaneously. As long as there is no simultaneous demand, both transmitters perform voice ID normally. This issue will be resolved in a future firmware release when the voice ID module has been tested and proved to be capable of handling voice ID on both channels simultaneously.

Example:

```
#1711
```

This command enables voice identification for transmitter 1.

10.5.19 Set Transmitter Audio Level

Use this command to set the digital potentiometer associated with the specified transmitter channel. See the procedure in section 2.5 for a description of how to set this level.

DTMF Syntax:

```
#30{tx_chan}{level}
```

Parameters:

{tx_chan}: Channel number (1 or 2) to which the transmitter level setting applies.

{level}: Audio level index (0 to 100).

Notes:

The audio level setting ranges from 0 to 100 and increases logarithmically. The value 0 corresponds to approximately -28 dB, the value 58 (the default) corresponds to approximately 0 dB, and the value 100 corresponds to approximately +20 dB. Each count corresponds to approximately 0.48 dB.

Example:

```
#30199
```

This command sets the digital potentiometer for transmitter 1 to 99 percent volume.

10.5.20 Delete an Announcement

Use this command to delete the schedule for an announcement the selected transmitter. It does not delete the announcement audio file, but drops it from the playback schedule.

DTMF Syntax:

```
#24{tx_chan}{file}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) corresponding to the channel to which the schedule applies.

{file}: The number (1 through 8) corresponding to the file that contains the announcement audio.

Example:

```
#2417
```

This command deletes the schedule for the announcement in file 7 for transmitter 1.

10.5.21 Schedule an Announcement

Use this command to schedule an announcement to be played back at a selected time and interval. All recordings are made without de-emphasis, so if your system needs de-emphasis on playback, you specify it using this command. You can also set a priority for the announcement, which determines whether the announcement can be pre-empted by a user transmitting, or if the announcement can pre-empt a user who is already transmitting, or if the announcement audio and the user audio are to be mixed.

If an announcement for the file number you select is already scheduled, the new announcement will be given the same enable status (see the Enable Announcement Playback command) as the existing one. Otherwise, the new announcement will be scheduled with playback disabled. You can enable it using the Enable Announcement Playback command.

DTMF Syntax:

```
#21{tx_chan}{file}{priority}{period}
```

Parameters:

{tx_chan}: Transmitter number (1 or 2) to assign to play the selected announcement.

{file}: The number (1 through 8) of the file that contains the announcement audio.

{priority}: The priority for the selected announcement. Use the numbers 1, 2, or 3 to specify high, medium and low priority, respectively.

{period}: The number of minutes between successive playbacks of the announcement.

Example:

```
#21153120
```

This command schedules the audio in file number 5 to play back on transmitter 1 every 2 hours at low priority. If a user is keyed up at the time the announcement is scheduled to play, or keys up while the announcement is playing, then he or she takes priority over the announcement, and the system will reschedule the announcement to play in one minute.

10.6 System Commands

10.6.1 Set Receiver to Transmitter Path

Use this command to configure the connections between your receivers and transmitters for your particular repeater configuration. You can assign zero, one, or two transmitters to transmit the audio from each receiver.

DTMF Syntax:

```
#20{rx_chan}{tx_chan}{priority}
```

Parameters:

{rx_chan}: The receiver channel number, which can be either 1 or 2.

{tx_chan}: The transmitter channel number, which can be either 1 or 2.

{priority}: A number identifying the priority of the path as given in Table 10. A signal with a higher priority is given preference over those of lower priority. Signals of equal priority are handled on a first come, first served basis. Signal of medium priority mix when they are active on the same transmitter at the same time.

Note:

Priority Code	Priority Description
3	High priority
2	Medium (mixing) priority
1	Low priority

Table 11: DTMF Encoding of Path and Announcement Priority

If a path is entered with the same receiver and transmitter number as an existing path, the new path replaces the old one. (Note that it doesn't really make sense to have two paths with the same receiver and transmitter numbers).

Examples:

```
#20111
```

This command creates a path for transmitter 1 to transmit audio from receiver 1. The path has high priority, which means it will take precedence over any audio from any path with a lower priority.

```
#20111
```

```
#20221
```

These are the default paths configured in the PSE-702. These commands cause receiver 1 to transmit on transmitter 1 only, and receiver 2 to transmit on transmitter 2 only. This is a typical setup for a dual non-linked repeater. Priority in this scenario is not used, and remains at the default, which is high.

10.6.2 Delete Path

Use this command to delete a path that has been defined between a receiver and a transmitter.

DTMF Syntax:

```
#22{rx_chan}{tx_chan}
```

Parameters:

{rx_chan}: The receiver channel for the path to delete, where 1 is receiver 1 and 2 is receiver 2.

{tx_chan}: The transmitter channel for the path to delete, where 1 is transmitter 1 and 2 is transmitter 2.

Example:

```
#2212
```

This command deletes a defined path between receiver 1 and transmitter 2.

10.6.3 Log In to DTMF

Use this command to start a DTMF session when a DTMF password has been enabled.

DTMF Syntax:

```
#00{password}
```

Parameters:

{password}: A sequence of numbers that are the password characters. The factory-set default password is 8958. The password can be changed to a unique value using the Set DTMF Password command (tppwd) which can only be issued from the operator console.

Example:

```
#008958
```

This command logs the operator into a factory-set PSE-702 with DTMF password enabled and allows the board to receive DTMF commands.

10.6.4 Log Off DTMF

Use this command to end a DTMF session. This command is used when the DTMF password is enabled and you want to explicitly end a DTMF session when you have finished entering commands. If a password is required and you are logged in, the session will expire automatically after five minutes elapse without a valid DTMF command being received.

DTMF Syntax:

```
#99
```

Parameters: None.

Example:

```
#99
```

This command causes the PSE-702 to stop receiving DTMF commands until it receives another

valid DTMF password command.

10.6.5 Enable Announcement Playback

Use this command to enable or disable the playback of an announcement. Disabling an announcement does not delete it or alter its schedule. To schedule an announcement to be played back, use the Schedule Announcement Playback command.

DTMF Syntax:

```
#27{file}{flag}
```

Parameters:

{file}: The file number (1 through 8) of the file that contains the announcement audio.

{flag}: Can be either 1, which enables playback of the selected announcement, or 0, which disables playback of the selected announcement.

Example:

```
#2761
```

This command enables the playback of the audio in file number 6, for any schedule to which it has been assigned.

10.6.6 Delete File

Use this command to delete a recorded audio file. Up to 8 files can be recorded. File 1 usually contains the voice ID for transmitter 1; file 2 contains the voice ID for transmitter 2.

DTMF Syntax:

```
#71{file}
```

Parameters:

{file}: A number (1 through 8) that indicates which file to delete.

Example:

```
#711
```

This command deletes file 1, which contains the voice identification for transmitter 1.

10.6.7 Audio File Playback

Use this command to play a recorded audio file.

DTMF Syntax:

```
#72{tx_chan}{file}
```

Parameters:

{tx_chan}: The transmitter channel through which to play the file.

{file}: A number (1 through 8) that indicates which file to play.

Example:

#7211

This command plays file 1 on transmitter 1.

10.6.8 Reset Micro-controller

Use this command to reset the micro-controller.

DTMF Syntax:

#90

Parameters: None.

Example:

#90

This command resets the micro-controller. It has the same effect as powering the board off and then on again.

11 Specifications

11.1 Absolute Maximum Ratings

Absolute maximum ratings are those values beyond which damage to the device can occur.

Parameter or Signal	Conditions	Min	Typ	Max	Units
Supply Voltage (Vraw)				15	Volts DC
Receiver Audio Input (RXA1, RXA2)				3.5	Volts AC (RMS)
RUS1, RUS2		-0.7		VRAW	Volts DC
PTT1, PTT2		-0.7		VRAW	Volts DC
Storage Temperature		-40		80	°C

Table 12: Absolute Maximum Ratings

11.2 Operational Ratings

Parameter	Conditions	Min	Typ	Max	Units
Operating Temperature Range		-30		70	°C
Regulated Supply Voltage (VRAW)		9.5	10.0	10.5	Volts DC
RUS input low level	Receiver Squelched		0.0	1.0	Volts DC
RUS input high level	Receiver Unsquelched	2.0			Volts DC
RUS input impedance			10K		Ω
PTT Sink Current	Vout = 0.2	2.0			μA
PTT Source Current	Vout = (Vraw-0.2)			20	μA
RXA input impedance	Fin = 1000 Hz	30			KΩ
Transmit Audio, Load Impedance		500			Ω
VRAW Supply Current (IRAW)			100		μA
CTCSS Encoder Frequency Range		60.0		260.0	Hz
CTCSS Encoder Voltage Level	Rload = 5K ohm (O), fout = 100.0 Hz	480	535	590	mV AC (RMS)

Parameter	Conditions	Min	Typ	Max	Units
CTCSS Output Impedance	f _{out} = 100.0 Hz		450		ohms (Ω)
Reverse Burst Phase Delay			-235		degrees
Reverse Burst PTT Delay			160		milliseconds
DB audio passband	300 to 3000 Hz				Hz
Outgoing CTCSS attenuation, 3 rd Order Filter	192.8 Hz	-12			dB
Outgoing CTCSS attenuation, 3 rd Order Filter	100 Hz	-29			dB
Outgoing CTCSS attenuation, 4 th Order Filter	250.3 Hz	-20			dB
Outgoing CTCSS attenuation, 4 th Order Filter	100.0 Hz	-33			dB
De-emphasis		20 dB / decade (6 dB/octave) from 300 to 3000 Hz			

Table 13: Operational Ratings

12 Appendix

12.1 Useful Conversions for AC Voltmeters

An AC voltmeter is required to set up the PSE-702. Voltages are cited as RMS in these instructions, but many low-cost meters don't read RMS: they read "average." If your meter doesn't read RMS, or if you are using an oscilloscope, use the following conversions factors. Note that these conversions are technically only valid for single-frequency sine waves, but they do make useful approximations.

$$VRMS = 0.707 * V_{peak}$$

$$VRMS = 0.354 * V_{peak-to-peak}$$

$$VRMS = 1.112 * V_{avg}$$

12.2 Updating (Flashing) the PSE-702 Firmware

12.3 Radio Connector Signal Descriptions

The following signals are available on J10 and J11 for alternate applications. J10 contains the signals for receiver and transmitter 1, and J11 contains the signals for receiver and transmitter 2:

Signal	Pin Number	Description
VRAW	1	10-volt regulated power supplied by MASTR-II regulator board.
RX{1 or 2}_RAW	2	Receive Audio. Audio signal from the MASTR-II receiver into the PSE-702. It is supplied by the MASTR-II VOL_SQ_HI signal.
CH{1 or 2}_RUS	3	Receiver Unsquelled. High (2.0 volts) when the receiver is receiving an on-frequency RF carrier. Low (1.0 volts) when receiver is not receiving a carrier.
TX{1 or 2}_AUDIO_BUF	4	Transmit Audio. Audio signal from the PSE-702 into the MASTR-II exciter.
CH{1 or 2}_PTT	5	Push to Talk. This signal goes low (0.2 volts) to enable the MASTR-II transmitter.
GND	6	Zero volt reference, power supply return.
CTCSS{1 or 2}_ENCODE	7	CTCSS encoder signal to MASTR-II exciter. AC signal, ground referenced.
	8	Unused

Table 14: Radio Connector Signals

The following table shows the color coding for the pigtail cables supplied by PSE.

Pin Number	Signal	Color
1	VRAW	Red
2	Rx audio	Orange
3	RUS	Green
4	Tx audio	Violet
5	PTT	Brown
6	GND	Black
7	CTCSS encode	Yellow
8	–	–

Table 15: Radio Connector Pigtail Color Code

12.4 Other connectors

The PSE-702 includes several other connectors. See the schematic for details:

J5 Test connector

J7 Debug serial port connector

J8 JTAG connector

J9 Test header

Warning. Be careful when using the test header for signal monitoring. VRAW (10 volts) is present on pin 1 of this header and damage can result if this voltage is shorted to other pins in the header.

JP3: In System Programming (ISP) jumper

When a PSE-702 is powered on or reset with this ISP jumper (JP3) in place, it enters programming mode.

See Installing new firmware in the PSE-702 flash memory for more information about updating the programming in the PSE-702.