Model 38-MAX Serial Number _____ Software Version _____

NOTE: Please check for change information at the end of this manual.

Z E T R O N

Model 38-MAX Repeater Panel Instruction Manual

#025-9263B.1

SECTION	TITLE
1	Introduction
2	Specifications
3	Operation
4	Programming
5	Installation
6	Repair
7	Quick Reference

* *

The programming codes for the Model 38-MAX are not the same as those for the Model 38. Please consult Section 4 for Model 38-MAX programming codes.

* *

QUICK! --- GET ME ON THE AIR!

If this is your first Model 38-MAX Repeater Tone Panel, your first question is probably, "What do I have to do to enable a tone?" Here's the answer:

Before you can work with the Model 38-MAX, it must be installed. *Follow the installation procedures in Section 5.* Installation should be accomplished by a qualified radio service technician. Get your transceiver (on the repeater frequency with a touch-tone keypad) ready to enable some tones.

ACCESS THE PROGRAM MODE

To access the program mode, key up and press "12038#". A chirp should be heard coming back from the repeater (the chirp, or 5 beeps, is the "go-ahead" prompt tone). If the program mode is not accessed, check the DTMF LED on the front panel to see if it lights with every key pressed.

PROGRAM MODE PROMPT TONES

During programming, the Model 38-MAX will issue prompt tones to indicate how it's doing. A "warble" or "dee-doo dee-doo dee-doo" tone indicates an invalid command, or error condition exists. A "chirp" or "bip bip bip bip bip" indicates proper completion of a command, and ready for the next command. A "bip bip" indicates ready for more digits or a value. When exiting the program mode a "ringing" sound will be sent to verify exit from the program mode. If a key is not pressed within 90 seconds, the Model 38-MAX will exit automatically.

PROGRAMMING EXAMPLES:

1. Access the program mode by pressing 12038# (5-beep heard).

2. Enable users
   - 67.0 Hz (user 1), Press 110# 1# 1# (5-beep heard)
   - 123.0 Hz (user 19), Press 110# 19# 1# (5-beep heard)
   - 250.3 Hz (user 49), Press 110# 49# 1# (5-beep heard)
   - 023 DCS (user 51), Press 110# 51# 1# (5-beep heard)
   - 432 DCS (user 120), Press 110# 120# 1# (5-beep heard)

3. Exit the program mode by pressing 99# (ringing heard).

4. Test the repeater.

* * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * *

The programming codes for the Model 38-MAX are different than for the Model 38. Please consult Section 4.

* *

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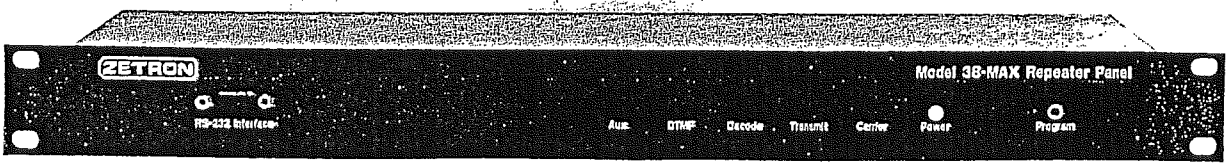
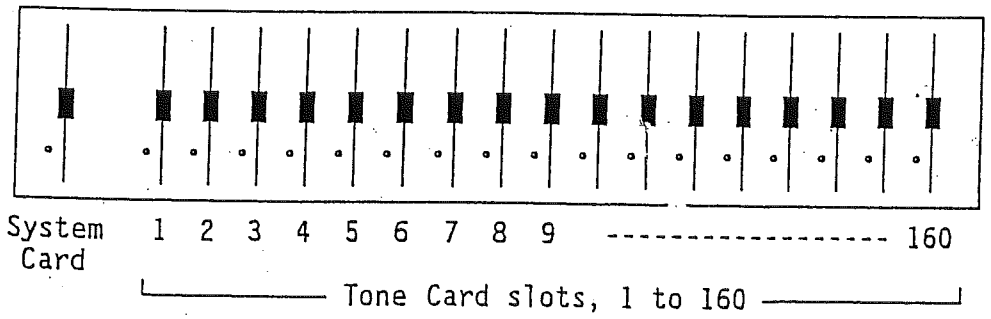
1. INTRODUCTION



The Zetron Model 38-MAX is a community repeater panel that provides individualized repeater service to up to 160 different customers or customer groups. It's a complete interface between a transmitter and receiver, providing CTCSS encode/decode, repeat audio processing, and all timer functions. It can be remote-controlled from a variety of sources, and includes an RS-232 serial port for connection to computers and printers. An internal database keeps track of all airtime use and, for accounting purposes, downloads into Zetron's airtime billing package. Nearly all of the functions can easily be customized for each of the 50 CTCSS tones and 110 DCS codes.

SYSTEM CONFIGURATION COMPARED TO CONVENTIONAL REPEATER TONE PANEL

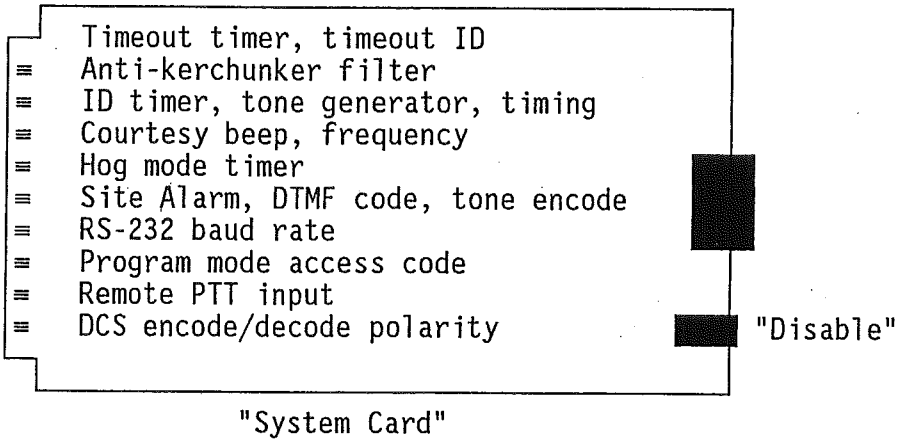


A conventional community repeater tone panel usually is made up of two components, a system card (or equivalent circuitry) and plug-in tone cards.

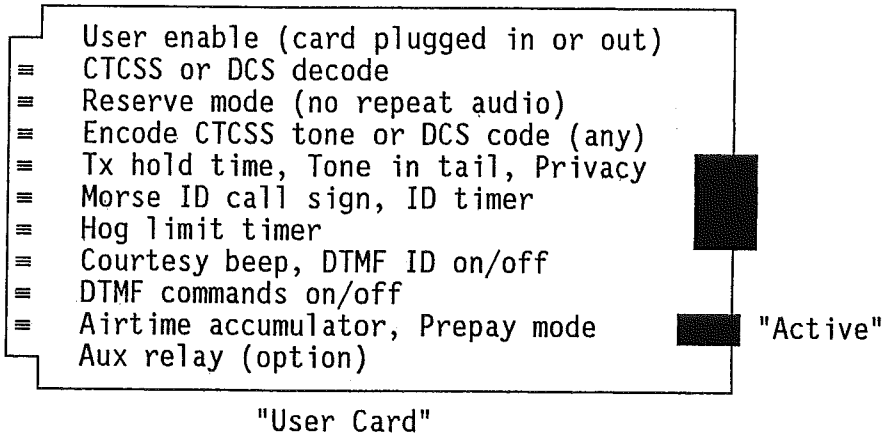
The system card provides functions such as the repeater transmit hold time and timeout timer. Some system cards provide the repeat audio path between receiver and transmitter with a high pass filter.

A typical repeater panel has individual plug-in cards for each CTCSS tone or DCS code to be decoded. Each card provides the decoding and encoding for a single CTCSS tone or DCS code. Usually no other functions or features are provided by a community repeater tone panel.

Model 38-MAX System Functions
The Model 38-MAX can be conceptualized by comparing its software features to the conventional "system and tone" plug-in cards. The Model 38-MAX incorporates "system programming" to control the features listed below on the "system card".



Model 38-MAX User Functions
The Model 38-MAX has the equivalent of 160 "tone cards", which are called "Users" or "User Numbers". Each user card may be configured for the specific application for the customer. The programmable items for each user are listed on the user card below:



FEATURES

* Decoding for 50 CTCSS tones and 110 DCS codes
* Remote control RS-232 or DTMF programming
* RS-232 programming while in operation
* Remote enable/disable of all tones/codes
* Airtime tallied for each tone and code
* Per-user programming
* Cross-tone, cross-code, tone-code encoding
* Temporary enable/disable of cross encoding
* Airtime hog penalty
* Prepaid airtime feature
* Privacy mode prevents "barge-ins"
* Vacant tones and codes can be reserved
* Courtesy tone and tail bips
* Automatic Morse ID per user
* Stuck microphone identification
* Remote PTT input for wireline takeover
* DTMF paging when site alarm triggered
* Site alarm active confirmation tone
* Accounting PC software available

2. SPECIFICATIONS

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2. SPECIFICATIONS

DECODER SPECIFICATIONS

Frequency Range	67 to 254.1 Hz
Number of Tones	50
Tone Sensitivity	3 dB SINAD or better with ToneLock circuitry
Tone Bandwidth	1%
No. Digital Codes	110 (Can be any octal DCS codes from 000 to 777)
Decode Release	Detects reverse burst, DCS "turn-off" code, and loss of carrier
Input Impedance	50 kΩ AC coupled (For connection to unsquelched discriminator audio)

ENCODER SPECIFICATIONS

Frequency range	67.0 to 254.1 Hz
Digital codes	Any octal number 000 to 777
Freq. Accuracy	0.1 Hz
Freq. Stability	Crystal controlled
Output Amplitude	0.0 to 3.0 or 0.0 to 0.3 V selectable
Output Mode	Flat for direct FM or de-emphasized for phase modulated transmitters
Output Distortion	Less than 1%
Impedance	Less than 1 kΩ AC coupled

TONE ENCODER SPECIFICATIONS

Morse ID Freq.	1,200 Hz; adjustable ±800 Hz
Beep Frequency	1,000 Hz; adjustable 400 to 4,000 Hz
DTMF Encoder	Standard DTMF tones

GENERAL SPECIFICATIONS

Connections	Discriminator; Push-To-Talk; CTCSS Output; Tx Audio; Alarm Input; Power; Ground; Carrier; Aux
Connector Type	Detachable screw terminal
Transmit	SPDT relay
Adjustments	Four adjustments from rear panel: Input Level; CTCSS Encode Level; Output Level; Sq threshold
Alarm Input	Contact closure to ground
Indicators	Power; Carrier; Decode; Transmit; DTMF; Aux
Local Prog. Port	Front-panel jacks for local DTMF or RS-232 programming
Serial Data Port	RS-232 compatible, follows XON/XOFF protocol. Baud rates: 150; 300; 600; 1200; 2400; 4800; 9600
Rear Switches	Audio Input Level (high/low); Audio Input (flat/de-emphasized); CTCSS Output Level (high/low); CTCSS Output (flat/de-emphasized); Audio Output Level (high/low); COR (internal/external); COR Polarity (positive/negative)
Current Consumption	100 mA at 13.6 VDC
Oper. Voltage Range	11.0 to 15.0 VDC
Repeat Audio	Flat or de-emphasized
Rack-Mount Size	1.7 in x 19 in x 4.8 in
Weight	2.2 lb
Operating Temp.	0 to 65 degrees Celsius

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Temporary defeat of cross-tone or cross-code encoding 3-6

Anti-kerchunker filter 3-7

Remote PTT function 3-7

3. OPERATION

CTCSS TONES AND DIGITAL CODES

The Model 38-MAX monitors the channel for CTCSS tones and/or digital squelch codes (DCS). When a tone or code is detected, it is converted into a user number (see Table 3-1). The user number points to an area of memory that contains information about that particular user. Table 3-1 shows the factory-set default DCS decode numbers, but they are fully user programmable (see Section 4 for programming information).

Table 3-1. Tone-to-User Number Default Conversions

User	Decode	User	Decode	User	Decode	User	Decode
1	67.0	41	203.5	81	d 165	121	d 445
2	69.4	42	206.5	82	d 172	122	d 446
3	71.9	43	210.7	83	d 174	123	d 452
4	74.4	44	218.1	84	d 205	124	d 454
5	77.0	45	225.7	85	d 212	125	d 455
6	79.7	46	229.1	86	d 223	126	d 462
7	82.5	47	233.6	87	d 225	127	d 464
8	85.4	48	241.8	88	d 226	128	d 465
9	88.5	49	250.3	89	d 243	129	d 466
10	91.5	50	254.1	90	d 244	130	d 503
11	94.8	51	d 023	91	d 245	131	d 506
12	97.4	52	d 025	92	d 246	132	d 516
13	100.0	53	d 026	93	d 251	133	d 523
14	103.5	54	d 031	94	d 252	134	d 526
15	107.2	55	d 032	95	d 255	135	d 532
16	110.9	56	d 036	96	d 261	136	d 546
17	114.8	57	d 043	97	d 263	137	d 565
18	118.8	58	d 047	98	d 265	138	d 606
19	123.0	59	d 051	99	d 266	139	d 612
20	127.3	60	d 053	100	d 271	140	d 624
21	131.8	61	d 054	101	d 274	141	d 627
22	136.5	62	d 065	102	d 306	142	d 631
23	141.3	63	d 071	103	d 311	143	d 632
24	146.2	64	d 072	104	d 315	144	d 654
25	151.4	65	d 073	105	d 325	145	d 662
26	156.7	66	d 074	106	d 331	146	d 664
27	159.8	67	d 114	107	d 332	147	d 703
28	162.2	68	d 115	108	d 343	148	d 712
29	165.5	69	d 116	109	d 346	149	d 723
30	167.9	70	d 122	110	d 351	150	d 731
31	171.3	71	d 125	111	d 356	151	d 732
32	173.8	72	d 131	112	d 364	152	d 734
33	177.3	73	d 132	113	d 365	153	d 743
34	179.9	74	d 134	114	d 371	154	d 754
35	183.5	75	d 143	115	d 411	155	d ___
36	186.2	76	d 145	116	d 412	156	d ___
37	189.9	77	d 152	117	d 413	157	d ___
38	192.8	78	d 155	118	d 423	158	d ___
39	196.6	79	d 156	119	d 431	159	d ___
40	199.5	80	d 162	120	d 432	160	d ___

USER VALIDATION

The Model 38-MAX is always watching the receiver audio for the presence of a valid user. All 50 CTCSS tones can be enabled or disabled. All 110 of the DCS codes can be enabled or disabled. For information on enabling or disabling a user, refer to Section 4.

DISABLED TONES

When a disabled CTCSS tone is detected, the time accumulator will keep track of the airtime used by that tone. This feature lets the system manager gain information about the CTCSS tones that are in use on the channel, perhaps by another repeater in the area.

ENABLED USERS

When an enabled tone or DCS code is detected, the transmitter will be keyed. Depending on programming, the system will do one of the following:

1. Encode nothing
2. Regenerate the received tone or code
3. Encode a different tone or DCS code (cross-tone encoding)

CARRIER ONLY (OPEN REPEATER)

The Model 38-MAX can be programmed to repeat based on just carrier, sometimes called "carrier controlled repeat" or "open repeater". In this mode the Model 38-MAX will provide simultaneous tone/open repeater operation; users that have CTCSS or digital squelch encode operate normally, users that have no encode repeat also. This allows a mix of CTCSS tone users with open repeat capability that is ideal when adding tone users to an existing open repeater.

To enable carrier (COR) for repeat, a user number is identified as the "CARRIER" repeat user. This allows all standard user-programmable features for open repeat, including: enable/disable for the carrier user, CTCSS or DCS encoding, airtime accumulation, etc. If the COR user number is set to "0", no carrier repeat is available.

RESERVED USERS

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

WHAT HAPPENS WHEN A MOBILE UNKEYS

When a mobile unkeys or the CTCSS tone is no longer detected, the Model 38-MAX will take some actions. The possibilities are described below.

Prepaid Customer Low-Airtime Warning
The owner of the Model 38-MAX can allow a customer to purchase a block of airtime in advance (see Section 4, User Commands). These prepaid blocks decrease as the customer uses the repeater. When the remaining airtime falls below 2 hours, a low-airtime warning chirp will be heard when the user unkeys. The chirp sounds like a fast "bee-doo-bee-doo-bee-doo". If the airtime drops to zero, the tone is "reserved" as described above. A prepaid user who falls all the way into the reserved mode will still hear warning chirps upon unkeying.

Morse Code Station Identification
When an enabled user unkeys, the Model 38-MAX looks to see how long that user has been talking. If the user has been talking longer than the Morse ID interval time (which defaults to 15 minutes, but which is user programmable from 1 to 99 minutes), then the call sign will be sent. Each CTCSS tone has its own call sign and individual ID interval timer. The Morse ID is sent at the selected ID speed (4 to 25 words per minute) but limited to a minimum of 15 wpm during repeater ID. The call is sent at 30% deviation (which meets FCC Part 90 rules) so that voice communication can still occur during the ID. Note that if the Morse ID is not programmed or if it is programmed as "blank", an ID will not be sent. A single system ID may also be programmed for use in co-op and private carrier applications.

Reserve Mode
If a user is in the reserve tone mode, a chirp will be sent when the user unkeys. This gives a positive indication of active reserve tone mode.

Airtime Accumulation
The Model 38-MAX keeps track of the airtime used by each customer group on the channel. Both enabled and disabled users are logged. The airtime is stored in "hours:minutes:seconds" format and will hold up to 250 hours per user. The airtime counts may be retrieved over the channel or via the RS-232 port. The airtime may be set to accumulate including or excluding the repeater transmit hold time (see Section 4).

Last User Identification via DTMF
If it is not time to send the Morse ID or if the ID is blank, the Model 38-MAX will check to see if the user is configured to send "Last User ID". If that is the case, then the user number will be sent via fast DTMF. This enables the system manager to identify which users are active on the system in real time. All that is required to monitor the users is a DTMF decoder with display capability.

Courtesy Tone
If the "Last User ID" is disabled, the Model 38-MAX will check to see if the user requires the courtesy beep. If that is the case, then the beep will be sent. The beep frequency may be set from 400 to 4000 Hz (default setting is 1000 Hz). A system programming setting (tail bips) can enable the courtesy tone to be sent every second during the transmit hold time. If a 400 Hz tone is heard just prior to the transmitter unkeying, a system memory error has been detected. To find out which part of memory is in error, see Section 4, Diagnostic and Setup Commands.

Privacy Mode
Finally at this time, the Model 38-MAX continues looking for CTCSS tones. If the last user is set for "Privacy Mode", then no other CTCSS tones will be allowed on the system until the tx-hold (repeater tail) has expired.

REPEATER HOLD TIME

The programmable repeater tail or tx-hold timer is adjustable from 0.0 to 9.9 seconds. When a mobile unkeys, the Model 38-MAX will begin monitoring for a valid CTCSS tone to be received again. If a valid tone is not detected within a timeout period, the CTCSS encode will be shut off or the DCS turn-off code will be sent (if it was previously on). After a 0.2 second delay, the transmitter PTT will be dropped. This method will remove the second squelch tail heard by the mobiles when the repeater transmitter unkeys. Repeater tail bips may be enabled to beep once every second during the repeater hold time.

The Model 38-MAX includes a "First Tx Hold" system timer feature. This can be used to extend the repeater transmit hold time after the mobile unkeys for the first dispatch call. This feature allows the called mobile extra time to respond to the call before other users can access the repeater (if busy channel lockout or privacy mode is used). The conditions to get first tx hold are: new CTCSS or DCS decoded and transmission greater than the anti-kerchunker time.

Just before the repeater unkeys, a 2000 Hz beep may be heard. The beep indicates the site alarm input is currently active (for more information, see Section 4). The beep will be sent after the CTCSS or DCS encode tone is turned off so that normal users will not hear the beep.

ENCODE DURING TRANSMITTER-HOLD TIME

When a valid user unkeys, the CTCSS or DCS encode may be left on during the tx-hold time (transmitter hold time or repeater tail) or turned off. This feature is programmable for each user. When using a control station phone patch through the repeater, the encode should be turned off during tx-hold. This allows the phone patch to know when the mobile has unkeyed, as opposed to knowing when the repeater has dropped off the channel. When using the repeater for dispatch only, the encode may be left on during the tx-hold time to keep the mobile decoders open. This feature eliminates the decode delay observed in the mobile between transmissions.

TIMEOUT TIMER

While mobiles are conversing through the repeater, a timeout timer is running. If a mobile does not unkey within the timeout period, warning tones will be sent, and then the transmitter PTT will be dropped. This is a "stuck mic" time-out feature.

TIMEOUT USER IDENTIFICATION

After a timeout occurs, the system may be set to transpond (via slow DTMF) the user number of the mobile that is still keyed up. The repeater will key up every 15 seconds while the mobile is transmitting and send the user number. This feature can be enabled or disabled by the system manager.

DTMF REGENERATION

The Model 38-MAX may be used to regenerate DTMF tones over the radio channel for applications involving mobile DTMF decoders or telephone interconnects. DTMF regeneration ensures that all DTMF signaling occurs at the same tone level. DTMF regeneration can occur for any or all users. A user commands the repeater to regenerate DTMF digits by sending a DTMF "*" for longer than 1 second. When the digit is released, the Model 38-MAX squelches the repeat audio and begins regenerating all DTMF tones received from the user until no digit has been received for the interdigit timeout (programmable; factory set at 4 seconds). All 16 DTMF tones can be regenerated.

AIRTIME HOG PENALTY

The airtime hog penalty feature allows the system manager to penalize "airtime hogs" so that other users on the system have a chance to complete dispatch calls. This feature prevents a user from conversing through the repeater for a penalty duration (programmable from 10 to 9990 seconds) if the user has recently exceeded the maximum allowable conversation time limit (from 1 to 99 minutes).

A long-winded talker who is approaching the end of the conversation time limit hears warning tones (sounding like "bee-doo") 1 per second for 20 seconds prior to cut-off. When users are cut-off (i.e., become penalized), the system ignores them for the programmed penalty duration. To avoid an impending hog penalty, the user must let the repeater transmitter unkey for an idle duration (from 1 to 99 seconds), giving another mobile a chance to use the system. If another user keys up or if the idle duration is met, the conversation timer is reset.

The hog penalty is programmable on/off for each tone, and all users have their own penalty timers in case there are multiple hogs on the system. The system manager may forgive all hogs by performing a "long DTMF reset" (holding any digit for longer than 15 seconds), which re-enables penalized users.

TEMPORARY CROSS-TONE OR CROSS-CODE ENCODING

Temporary cross-tone or cross-code encoding allows the system manager to converse with a subscriber on any CTCSS tone or DCS code. This mode is a temporary cross-tone or cross-code assignment which allows users on different tones/codes to communicate. It is enabled/disabled on a per-user basis and accessed with a DTMF command sequence. An alert signal is sent during the transmitter hang time while the temporary cross-tone or cross-code mode is active.

The command sequence is as follows:

1. If the DTMF regenerate mode is enabled for the user, a long "#" (longer than 2 seconds) plus a tone or code number, then a "#" (# 12#) will activate cross-encoding.

2. Any channel activity will encode the originating mobile's tone or code.

3. When the originating mobile transmits, the called mobile's CTCSS tone or digital code will be encoded.

4. The tx-hold time is set at 30 seconds during cross-encoding.

5. An "eeddll-eeddll-eeddll" queuing tone will indicate cross-encoding is active.

6. A long "#" (longer than 0.75 second) will exit the mode.

TEMPORARY DEFEAT OF CROSS-TONE OR CROSS-CODE ENCODING

In many dispatch systems the Model 38-MAX is programmed to always perform cross-tone or cross-code encoding, which enables the dispatcher to communicate with vehicles operating on a different tone or code, but prevents the vehicles from communicating directly with each other. The dispatcher is usually the center of all communications: when a vehicle needs to relay information to another vehicle, the dispatcher must listen to one vehicle, then transmit the information to the other vehicle. This method wastes airtime and increases the chance of miscommunication. If the dispatcher temporarily defeats cross-encoding, users can talk amongst themselves, and the dispatcher doesn't have to relay information.

Temporarily defeating cross-encoding is enabled/disabled on a per-user basis and accessed with a DTMF command sequence. An alert tone is sent in the squelch tail while the cross-encoding is active.

The command sequence is as follows:

1. If the DTMF regenerate mode is enabled for the user, a long "0" will enter the car-to-car mode.

2. The tx-hold time is set at 30 seconds during the cross-tone mode.

3. An "eeddll-eeddll-eeddll" queuing tone will indicate that cross-tone encoding is defeated.

4. A long "#" (longer than 0.75 second) will exit the mode.

ANTI-KERCHUNKER FILTER

The anti-kerchunker filter cancels the transmitter hold time (or repeater tail) and drops the repeater transmitter immediately if a mobile transmission is less than the programmed anti-kerchunker time. This serves two main purposes:

1. Sometimes, a human voice creates a frequency that the repeater interprets as a valid CTCSS tone. Without an anti-kerchunker filter, the repeater would key up on this tone and stay keyed up for the entire transmitter hold time. This unnecessary transmission wastes airtime and interferes with normal voice transmissions on the false tone. The timing requirement of the anti-kerchunker filter, though, keeps the transmitter from staying up for the hold times, reducing interference to a co-channel repeater.

2. The anti-kerchunker discourages customers from clicking (kerchunking) the PTT just to hear the satisfying hum as the transmitter stays up for the transmitter hold time.

REMOTE PTT FUNCTION

The site alarm input may be used as a "Remote PTT" function. This feature is initiated by the site alarm input being pulled to ground by a contact closure or other input. When the alarm input goes active, any repeater activity will be suspended, then the programmed CTCSS tone or DCS code will be encoded, the repeat audio squelched, and the transmitter keyed. This condition will continue until the site alarm input is released.

This feature can be used for wireline control of the transmitter from a remote control, or by wiring the local mic PTT to this input, a method of local control to talk to specific users.

For more information, see Section 4, System Commands.

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4. PROGRAMMING

INTRODUCTION

The Model 38-MAX can be programmed from a variety of sources:

1. CRT/display terminal with an RS-232 serial port directly connected to the Model 38-MAX.

2. CRT/display terminal with an RS-232 serial port connected to a modem on a phone line to the repeater site, and an auto-answer modem connected to the Model 38-MAX.

3. CRT/display terminal with an RS-232 serial port connected to a packet radio controller attached to a control station, and a packet controller at the repeater site connected to the Model 38-MAX.

4. DTMF over the radio channel, from a mobile, base station, or handheld.

5. A Zetron Model 8B connected to a base station or mobile for over-the-air programming.

This section describes first the RS-232 (or CRT) programming method and then the DTMF programming method. Programming commands, which are used by both methods, are described at the end of this section.

A quick reference for DTMF programming and programming log sheets are found in Section 7.

RS-232 PROGRAMMING

Introduction

The easiest method of communicating with the Model 38-MAX for setup, test, monitoring, and installation of users, is through the use of the RS-232 port. All programming is done with friendly menu-driven prompts, all in plain English. The programming is done with an RS-232 display terminal or computer, and may be active even while the Model 38-MAX is in normal operation (except during setup). Most RS-232 terminals or computers running a communications program may be used. If using an IBM PC or compatible, Zetron can supply a communications disk to aid programming.

The Model 38-MAX may be connected directly to an RS-232 terminal or computer when the equipment is collocated. When direct connection is not possible, other methods may be considered. If a phone line is available at the repeater site, modems may be used to remotely program the Model 38-MAX. Packet controllers may also be used to move RS-232 data over the radio channel.

Serial Interface Connections

The computer/CRT/RS-232 port on the Model 38-MAX is compatible with RS-232C signals and uses an asynchronous ASCII serial communications protocol. Only three wires need to be connected from your terminal to the serial-I/O connector on the Model 38-MAX (labeled RS-232 Interface on the front panel). For the pin connections, see Section 5, Programming Connections, Typical Connection to a Computer or Video Terminal subsection.

Set your terminal for 8 bits per character, no parity bit, and 1 stop bit (for details, see the reference manual for your terminal). The Model 38-MAX defaults to 1200 baud.

If you have problems with the connection and see a few nonsense characters on the screen, the Model 38-MAX baud rate may need to be changed. To change the baud rate, use DTMF programming commands (see the DTMF Programming subsection). If still nothing happens, try reversing the transmit and receive data pins on your terminal.

Remote Programming over a Phone Line

The Model 38-MAX may be programmed (or monitored) over a telephone line without disrupting Model 38-MAX function. This can be quite valuable when a phone line is available at the site. To connect the Model 38-MAX to a phone line, an auto-answer modem needs to be installed between the phone line and the Model 38-MAX RS-232 port. Multiple Model 38-MAXs or other units programmable via RS-232 may be programmed over a single telephone line with the use of an RS-232 port selector (see Figure 4-1).

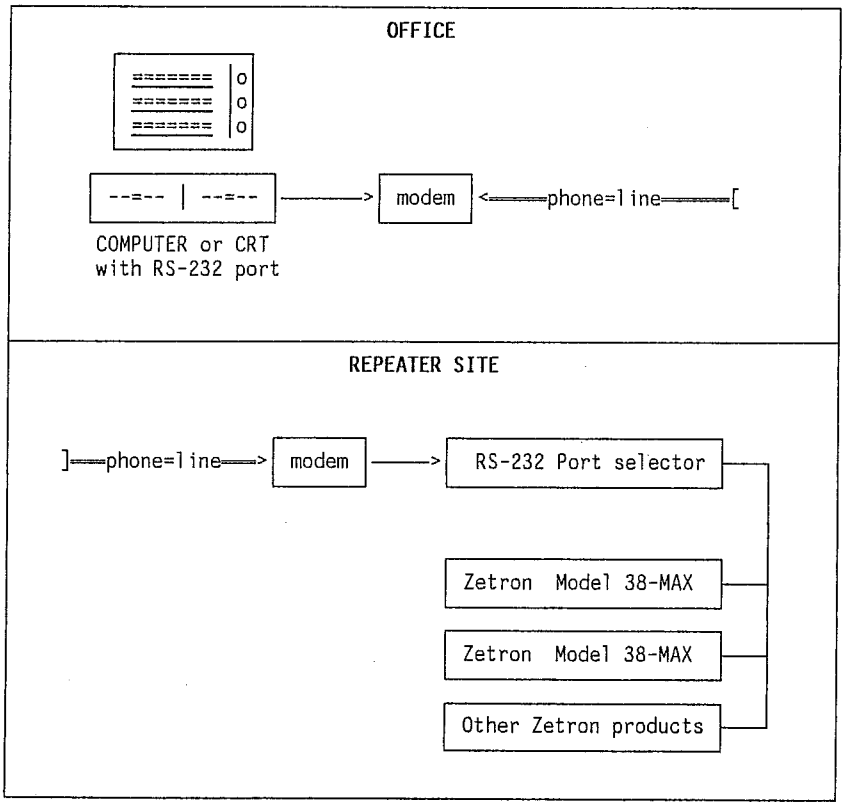


Figure 4-1. Remote Programming over a Phone Line

For connection details, see Section 5.

XON/XOFF Protocol
The Model 38-MAX follows "XOFF/XON" protocol. This sequence prevents data from flowing too rapidly for the display device (printer/terminal) or host to assimilate. If the Model 38-MAX receives an "XOFF" code (Control S), the data output will pause until a "XON" code (Control Q) is received.

RS-232 Buffer
The RS-232 port has a "type-ahead" buffer to allow the input to get ahead of the printout. This feature should be used with caution since the operator cannot see the results of an input command immediately. The buffer does allow faster programming once the operator gets used to it.

Access to Programming
When a user first accesses the Model 38-MAX either over the phone line or when directly connected, the message " Enter Password --> _ " will appear. This prevents unauthorized access to the programming information. The password is the same five-digit program access code used for DTMF programming (default is 12038). The only difference in the access codes is a trailing "#" is not used in RS-232 programming. If the code is incorrect, the terminal will beep, delay 1 second, beep, and repeat this sequence 10 times. This slows down any hackers from attempting to find the access code by trial and error methods.

Command Descriptions
Except for the standby, exit, and operate commands, the RS-232 programming commands provide the same functions as the DTMF programming commands and are described in the programming commands subsections (User Commands, System Commands, and Diagnostic and Setup Commands) at the end of this section.

Standby Command
The RS-232 programming task is the lowest priority for the Model 38-MAX, so when users are active on the channel, the RS-232 programming menu outputs will begin to slow down. This command is provided at the main menu level to disable the Model 38-MAX and provide for much faster programming when using baud rates above 300. Be sure to re-enable the Model 38-MAX (by using the operate command) when programming is completed.

Operate Command
The operate command from the main menu has two functions:

1. It will return from the standby command.

2. It will enable decoding of any new DCS users just added.

Exit Command
The unit may be set back to the password prompt by entering the exit command from the main menu. It is not necessary to exit the RS-232 mode, as the Model 38-MAX will operate while programming. Only when in the Setup menu or when using the Standby command, does the unit disable the repeat function. The exit command will also enable decoding of any new DCS users just added.

RS-232 PROGRAMMING MENUS AND SCREENS

Main Menu

```
Enter password --> _


Zetron Model 38-MAX Repeater Panel
Copyright 1986-1994, Version 1.1

    1. System
    2. Users
    3. Setup
    4. Monitor
    5. Realtime display
    6. Exit
    7. Sign on msg
    8. Standby
    9. Operate

Enter a Number:
```

User Menu

```
----- User -----
 1. View/Edit
 2. List enabled
 3. List airtime
 4. Clr airtime
 5. List all users

Enter a Number: _
```

During list airtime or list all users, the printout may be aborted by pressing any key.

Program a User Screen

```
Enter first user: 13
Enter last user (return if same): 15

Select an item to program or enter 0 for the menu.

Items to program (user 16 110.9  2Z shown) are:

 1 User enable = Off
 2 DCS decode  = 0 110.9  2Z
 3 Encode      = 16 110.9  2Z
 4 Txhold time = 20
 5 CTCSS tail  = Off
 6 Morse Id    =
 7 Reserve mode= Off
 8 Privacy mode= Off
 9 Que beep    = Off
10 Last user ID= Off
11 DTMF cmds   = Off
12 Hog limit   = 0
13 Prepay mode = Off
14 Airtime     = 000:00:00
15 DCS airtime = Off
16 Aux relay   = Off


Enter a Number: _
```

```
Prompt for each user? (Y/N): Yes

User           Setting
-------------- ----------------------------------------
 13 100.0  1Z  Privacy mode= On
 14 103.5  1A  Privacy mode= Off
 15 107.2  1B  Privacy mode= Off - change (Y/N):
```

System Menu

```
--- System Programming ---   Enter ? to repeat this menu

 1. COR user#      = 0              20. Alarm DTMF     =
 2. 1st Tx hold    = 20             21. Alarm tone     = 0   None
 3. AntiKerchunk   = 0              22. Alarm pwr up   = Off
 4. Tail bips      = Off            23. Password       = 12038
 5. Beep freq      = 1000           24. Access user#   = 0
 6. Beep type      = 2              25. Access alarm   = Off
 7. Timeout time   = 3              26. Access delay   = 0
 8. Timeout ID     = Off            27. Mic txhold     = 0
 9. ID interval    = 15             28. Remote type    = 0  Morse
10. ID frequency   = 1200           29. Baud rate      = 1200
11. ID speed       = 22             30. Serial tone#   = Off
12. ID periodic    = Off            31. DCStx invert   = Off
13. ID sys user#   = 0              32. DCSrx invert   = Off
14. Hog idle       = 5              33. DCS bit errs   = 2
15. Hog penalty    = 30             34. CTCSS delay    = 80
16. Hog minimum    = 10             35. CTCSS hold     = 0
17. Hog maximum    = 100            36. Slow CTCSS     = Off
18. Min airtime    = Off            37. Interdigit     = 4
19. Remote PTT     = 0   None

Enter a Number: _
```

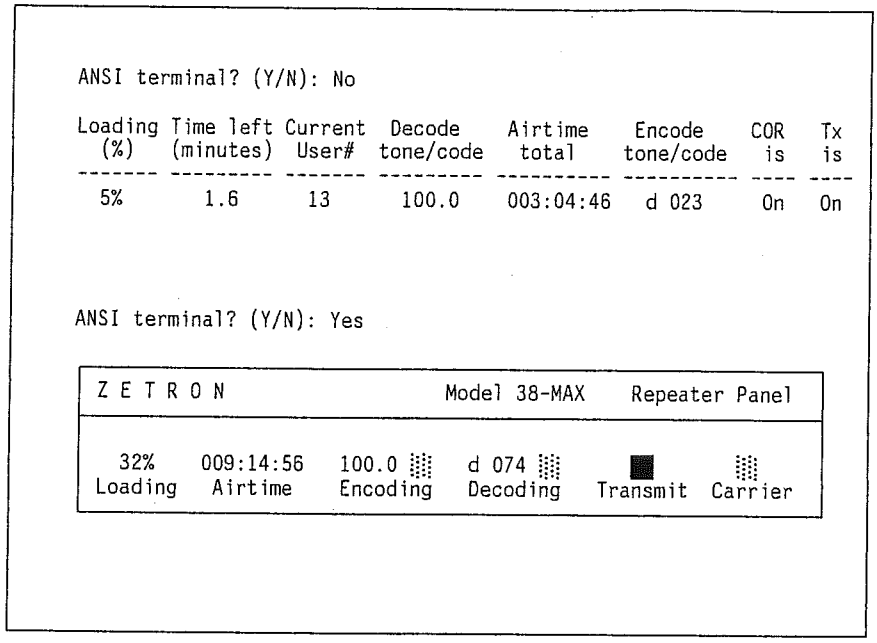
Setup Menu

```
----- Setup ----  Enter ? to repeat this menu

 1. Audio output                    7. Audio tone
 2. CTCSS output                    8. DTMF encode
 3. Audio input                     9. DTMF decode
 4. CTCSS user                     10. QUIET!
 5. CTCSS freq                     11. System test
 6. DCS encode                     12. Setup memory

Enter a Number: _
```

Realtime Display Screen



List All Users Screen

```
User Rx    Tx OSPRLQDAXC  H TxH Id        Airtime
 1  67.0    1 X-X----XX-  0  30 WKRP-995  001:56:12
 2  69.4    2 --X----XX-  0  30 KNCD-335  002:44:30
 3  71.9    3 ---X---XX-  0  30 KDD-2044  001:22:56
 4  74.4    4 ----X---X-  0  20           003:43:48
 5  77.0    5 X--X----X-  0  20           000:20:18
 6  79.7    6 X----X--X-  0  20           001:09:00
 7  82.5    7 -----X--X-  0  20           002:45:54
 8  85.4    8 -----X----  0  20           000:27:35
 9  88.5    9 X----X-X--  0  20           001:13:43


User Rx    Tx OSPRLQDAXC  H TxH Id        Airtime
50 254.1   50 X-X--X----  0  20           000:35:21
51 d 023 565 XX---X---X  0  20           001:22:49
52 d 051 051 XX---X---X  0  25 WNCR-414  001:53:35
53 d 071 071 X--X--X--X  0  35 WNWS295   009:14:56
54 d 162 243 X--X---X-X  0  20           003:39:04
55 d 243 162 X---X----X  0  20           000:56:39
56 d 266 446 X-X--X---X  0  20           000:18:36
57 d 446 266 X-----X--X  0  20           001:23:18
58 d 565 023 X----X---X  0  20           002:05:43
59 d 731 731 X----X---X  0  20           004:41:05
```

Notes:

User= User number, from 1 to 160
Rx = Receive decode tone number/DCS code
Tx = Transmit encode tone number/DCS code
O = Enable/disable (On/Off)
S = Tx tone/code Squelch during repeater tail
P = Privacy mode
R = Reserve mode
L = Last user ID
Q = Queuing beep (Queue)
D = DTMF functions enable
A = Prepay Airtime mode
X = Aux Relay
C = Co-channel/disabled DCS airtime accumulation enable
H = Hog mode limit time
Id = Morse code station ID call sign

The listing may be aborted by pressing any key.

List All Airtime Screen

```
* = Enabled                Each * represents 7 minutes of airtime

*   1  67.0   001:02:01   ********
    3  71.9   000:30:02   ****
*  13 100.0   003:12:32   ***************************
*  15 107.2   000:40:23   *****
   32 173.8   004:32:54   ****************************************
*  36 186.2   002:12:01   ******************
*  37 189.9   000:54:12   *******
   50 254.1   000:12:55   *
*  51 d 023   000:33:21   ****
*  52 d 025   002:32:00   **********************
*  53 d 026   000:44:32   ******
*  63 d 071   000:59:44   ********
*  66 d 074   005:23:21   ************************************************
*  70 d 122   004:34:32   ****************************************

Total airtime            = 00040:35:32
Enabled user airtime     = 00028:14:01
Disabled user airtime    = 00012:21:31
Total transmit time      = 00092:01:41
 <hit any key>
```

The listing may be aborted by pressing any key.

DTMF PROGRAMMING

Programming Using the Model 8B

The Model 8B may be connected to a control station or a mobile transceiver to provide remote programming of the Model 38-MAX. The Model 8B and 38-MAX communicate over the repeater radio channel using DTMF tones. The Model 8B should be set for "LIVE mode". The Model 38-MAX is *NOT* compatible with the Model 8B "PROG" mode.

The Model 38-MAX should be set for a DTMF-type remote unit (see the System Commands subsection).

Programming on the Radio Channel

The Model 38-MAX may be programmed over-the-air using a DTMF-encode-equipped radio. Many handheld radios have a DTMF keypad option, or a DTMF mic, such as the Zetron ZMX or ZML, may be used with a mobile radio or base station. After the Model 38-MAX has been installed, the most popular method of programming is via DTMF.

Access to Programming

To program the Model 38-MAX, the program mode access code must first be entered. The DTMF access code is nnnnn#, where nnnnn is the program mode access code set in the Model 38-MAX (1000 to 32000). The default is 12038#.

* * * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * * *

The access code may require a specific CTCSS tone or DCS code to respond (see the System Commands, Program Mode Access Code subsection).

* *

The Model 38-MAX will key and send a "chirp" when the program mode is accessed. A delay before acknowledging is user programmable, as well as the possibility of sending the site alarm (see the System Commands, Site Alarm/Remote PTT subsection).

During programming, the repeater will remain keyed to keep other mobiles from trying to access the channel. Since the repeater transmitter is continuous duty, this should not present a problem. The DTMF programming commands are not repeated out the transmit audio as a security measure. The transmitter may be unkeyed during programming (except during prompt beeps). For more information, see the Diagnostic and Setup Commands, PTT On/Off subsection.

Entering a Command
To execute a DTMF programming command, a DTMF number is entered followed by the "#" key. All numbers may be entered with or without leading zeros (1 may be entered as 0001 or 1). While entering a number, the "*" key may be used as a "clear entry" key.

Some commands send a progress or prompt tone while programming, and all commands send either a go-ahead or error tone after completion of the command (See Table 4-1). If an error is detected while programming, the Model 38-MAX will send an error tone over the transmit audio. A successfully completed command is identified by a chirp tone.

Table 4-1. Progress Tones Heard during Program Mode

Sound	Meaning
Chirp (7-beeps)	Go-ahead; ready for a command.
Warble (dee-doo-dee-doo)	Error; invalid command or out of range data.
Ringing (electronic)	Leaving program mode; return to normal operation.
500 Hz, Low Bip-Bip	Current setting is zero, disabled, or off.
2 KHz, High Bip-Bip	Current setting is one, enabled, or on.
1 KHz, Bip-Bip	Current setting is not zero or one.
DTMF tones	Settings or airtime data sent to remote display unit.

All programmable values may be verified (via DTMF response) and/or changed. To verify or change a setting, simply enter the command. The Model 38-MAX will return a prompt tone indicating the current setting as shown in Table 4-1. For example:

1. If the value is currently zero, a 500-Hz low bip-bip will be heard.
2. If the value is currently set to "ON" (or a programmable range of 0 to 1), a 2000-Hz high bip-bip will be heard.
3. If the value is currently neither zero nor one, a 1000-Hz bip-bip will be heard.

The value will then be sent via DTMF to the selected type of remote display unit (Zetron Model 8B, CSI RDU, or Comm Spec DI-16). If the remote unit is selected as Morse ID, the value will not be sent.

After the value has been verified, it may be left unchanged by pressing the "#" key, or it may be changed by entering a new value followed by the "#" key.

If the programming radio does not switch from transmit to receive very quickly, a delay before sending the prompt tones may be programmed (see the MIC HOLD command). Note that you don't have to wait for the prompt tones before entering the next command as all commands are internally buffered; however, it is a good idea to listen for the proper acknowledgement tones.

While in the program mode, a key must be depressed every 90 seconds. If there is no activity for 90 seconds, the Model 38-MAX returns to normal operation mode.

Care should be taken to ensure all programmable settings are recorded for future reference. Section 7 provides programming log sheets.

Exit from the Program Mode
To exit the program mode, key in 99#. A prompt tone (sounds like ringing) confirms exit from the program mode. Note that the Model 38-MAX will exit automatically when no DTMF digits are decoded for a 90-second period.

DTMF PROGRAMMING COMMAND LIST

The following listings of all DTMF programming commands are divided into three subsections:

1. User commands – for items selectable on a per-user basis. Table 4-2 lists the tone-to-user number default conversions.

2. System commands – for items that relate to overall system operation

3. Diagnostic and setup commands – to aid the installer in system setup

List of DTMF User Commands

Commands identified with "nn" may have the user number entered to program a single user. Where "uuu" is indicated, a user number from 1 to 160 may be entered. To program all users with the same information, enter 999.

DTMF command	Per-user main items (uuu = 999 = change all users)
110# nnn# n#	Enable/disable user number "nnn" (1=on, 0=off)
112# nnn# nnn#	DCS decode, 000-777
113# uuu# n#	Airtime accumulation and decode for disabled DCS users (on/off)
120# uuu# n#	CTCSS/DCS encode during tx-hold, on/off
122# uuu# nnnn#	CTCSS/DCS encode, 0=off 1-50=CTCSS 1000-1777=DCS
123# uuu# nnn#	Transmit hold time, 0-25.0 sec
130# uuu# n#	Reserve mode on/off, disables repeat audio
140# uuu# n#	Anti-barge-in on/off, no new users until tx-hold
150# uuu# n#	Courtesy beep tone, on/off
152# uuu# n	Last user DTMF ID, on/off
160# nnn# nn# nn#..	Morse code station ID, up to 8 characters
161# nnn#	Playback a users ID, verify call sign
170# uuu# n#	DTMF commands on/off
180# uuu# n#	Aux relay enable/disable (if installed)
99#	Exit DTMF program mode

DTMF command	Per-user airtime items
1501# uuu# n#	Prepay mode on/off, counts airtime up or down
1510# uuu# nn#	Hog mode conversation time limit, 0.1-25.0 minutes
1521# nnn#	List minutes:seconds
1522# nnn#	List hours:minutes
1523# nnn#	List hours
1530# nnn#	Clear a user's airtime
1531# nnn#	Add n hours to users airtime, for prepay
3501#	List all airtime counts, hold * to stop
3502# 25327#	Clear all airtime counts
99#	Exit DTMF program mode

Table 4-2. Tone-to-User Number Default Conversions

User	Decode	User	Decode	User	Decode	User	Decode
1	67.0	41	203.5	81	d 165	121	d 445
2	69.4	42	206.5	82	d 172	122	d 446
3	71.9	43	210.7	83	d 174	123	d 452
4	74.4	44	218.1	84	d 205	124	d 454
5	77.0	45	225.7	85	d 212	125	d 455
6	79.7	46	229.1	86	d 223	126	d 462
7	82.5	47	233.6	87	d 225	127	d 464
8	85.4	48	241.8	88	d 226	128	d 465
9	88.5	49	250.3	89	d 243	129	d 466
10	91.5	50	254.1	90	d 244	130	d 503
11	94.8	51	d 023	91	d 245	131	d 506
12	97.4	52	d 025	92	d 246	132	d 516
13	100.0	53	d 026	93	d 251	133	d 523
14	103.5	54	d 031	94	d 252	134	d 526
15	107.2	55	d 032	95	d 255	135	d 532
16	110.9	56	d 036	96	d 261	136	d 546
17	114.8	57	d 043	97	d 263	137	d 565
18	118.8	58	d 047	98	d 265	138	d 606
19	123.0	59	d 051	99	d 266	139	d 612
20	127.3	60	d 053	100	d 271	140	d 624
21	131.8	61	d 054	101	d 274	141	d 627
22	136.5	62	d 065	102	d 306	142	d 631
23	141.3	63	d 071	103	d 311	143	d 632
24	146.2	64	d 072	104	d 315	144	d 654
25	151.4	65	d 073	105	d 325	145	d 662
26	156.7	66	d 074	106	d 331	146	d 664
27	159.8	67	d 114	107	d 332	147	d 703
28	162.2	68	d 115	108	d 343	148	d 712
29	165.5	69	d 116	109	d 346	149	d 723
30	167.9	70	d 122	110	d 351	150	d 731
31	171.3	71	d 125	111	d 356	151	d 732
32	173.8	72	d 131	112	d 364	152	d 734
33	177.3	73	d 132	113	d 365	153	d 743
34	179.9	74	d 134	114	d 371	154	d 754
35	183.5	75	d 143	115	d 411	155	d ___
36	186.2	76	d 145	116	d 412	156	d ___
37	189.9	77	d 152	117	d 413	157	d ___
38	192.8	78	d 155	118	d 423	158	d ___
39	196.6	79	d 156	119	d 431	159	d ___
40	199.5	80	d 162	120	d 432	160	d ___

List of DTMF System Commands

DTMF command	System programmable items	units	lo	hi	default
201# nnn#	Carrier repeat user number	user#	0	160	0
202# nnn#	First transmit hold time	.1 sec	1	250	20
203# nn#	Anti-kerchunk time	.1 sec	0	50	0
204# n#	Tail bip enable	on/off	0	1	0
205# nnnn#	Courtesy tone frequency	freq	400	4000	1000
206# n#	Stuck mic timeout time	minutes	0	9	3
207# n#	Stuck mic timeout DTMF ID	on/off	0	1	0
208# nn#	ID interval	minutes	1	99	15
209# nnnn#	ID frequency	freq	400	2000	1200
210# nn#	ID speed, words/minute	WPM	4	25	22
211# n#	ID periodic enable	on/off	0	1	0
212# nnn#	ID system user	user#	0	160	0
213# nn#	Hog mode idle time	seconds	1	99	5
214# nnn#	Hog mode penalty time	10 sec	1	999	30
215# nnn#	Hog mode dynamic minimum	.1 min	5	250	10
216# nnn#	Hog mode dynamic maximum	.1 min	8	250	100
217# n#	Accumulate airtime w/tx-hold	on/off	0	1	0
218# nnnn#	Remote PTT CTCSS/DCS	CTCSS/DCS	0	1777	0
219# nnnn#	Site alarm CTCSS/DCS	CTCSS/DCS	0	1777	0
220# n#	Site alarm at power up	on/off	0	1	0
221# nnnnn#	Program mode access code	number	1000	32000	12038
222# nnn#	Program mode access user	user#	0	160	0
223# n#	Program mode access alarm	on/off	0	1	0
224# nn#	Program mode access delay	seconds	0	30	0
225# n#	Radio DTMF hold time	seconds	0	3	0
226# n#	RS-232 port baud rate	150-9600	1	7	4
227# n#	Remote unit, ID-DTMF-RDU-DI16	select	0	3	0
228# n#	Serial tone output	on/off	0	1	0
229# n#	DCS encode invert	on/off	0	1	0
230# n#	DCS decode invert	on/off	0	1	0
231# n#	DCS acquire bit errors	bits - 1	1	4	2
232# nnn#	CTCSS turnoff delay	millisec	1	250	75
233# nn#	CTCSS hold time	.1 sec	0	25	0
234# n#	DTMF interdigit timeout	seconds	1	9	4
235# n#	Slower CTCSS decode	on/off	0	1	0
236# n#	Courtesy tone type	sounds	1	7	2
270# cc..	Site alarm DTMF digits		up to 8 digits		
99#	Exit DTMF program mode				

List of DTMF Diagnostic and Setup Commands

DTMF command	System setup / diagnostics
300#	Repeater disable
302#	PTT Off (will key up during commands)
303#	Squelch repeat audio
304#	Unsquelch repeat audio when carrier is active
305# nnnn#	Encode CTCSS/DCS 0=off, 1-50=CTCSS, 1000 1777=DCS
306#	Encode CTCSS sweep
307# nnnn#	LF encode, 50.0-300.0 Hz.
308# nnnn#	Generate an audio tone 400-3000 Hz. End with *
309# 25327#	Reset unit to factory defaults
310# nn#	Encode a DTMF digit, 0-15, 99=off
311#	Send the site alarm
360#	List the number of enabled users
361#	List the enabled user numbers
362#	List the number of program mode accesses
363#	List the number of resets
364#	List the number of power fails
365#	List the number of users with data errors
366#	List the users with data errors
367#	List the system diagnostic status
368#	Clear the reset/power fail/access counters
99#	Exit DTMF program mode

PROGRAMMING COMMANDS

The following three subsections describe the programming commands used when programming the Model 38-MAX. These descriptions apply for both methods of programming, RS-232 and DTMF.

USER COMMANDS

Enable a User

To activate a user in the Model 38-MAX, the CTCSS tone must be enabled (which is the same as plugging in a tone card). When a user is enabled, the repeater transmitter will key whenever carrier and the CTCSS tone are decoded. Note that for DCS decode user numbers, the user must be enabled *AND* the decode code must be set to a number between 000 and 777.

Disable a User

To disable a tone, the user number must be disabled (which is the same as unplugging a tone card).

Set Digital Coded Squelch Decode

The Model 38-MAX is capable of decoding all 50 CTCSS tones and up to 110 digital coded squelch (DCS) codes. The digital user numbers are between 51 and 160. Each user "slot" is capable of decoding any DCS code, so the decode "code number" must be set. The selection of DCS polarity is a system command and affects all users. When setting the DCS decode number, the Model 38-MAX will automatically set the encode to the same DCS code.

The user must be enabled and not in reserve mode to function properly.

RS-232

When adding DCS users via RS-232, they will not become active until the main menu operate or exit command is selected.

CTCSS/DCS Encode During Transmit Hold Time

The CTCSS or DCS encode may be left on during the transmit hold time if desired. Normally the repeater encode signal follows the mobile encode. Leaving the encode on during tx-hold eliminates the decode time in the mobiles between transmissions. When enabled, the Model 38-MAX will still drop the CTCSS/DCS encode just prior to unkeying the transmitter, eliminating squelch tails.

When using a control station phone patch through the repeater, encode during transmit hold should be disabled.

When using a scan based CTCSS/DCS trunking system, encode during transmit hold is typically required to be enabled.

CTCSS/DCS Encode
The Model 38-MAX normally encodes the same CTCSS tone or DCS code that it decodes, but it may encode any tone/code or no encode at all. The encode number may be set to a tone number (1-50), or no encode (0), or for DCS, enter the DCS number *PLUS* 1000 (e.g., code 023 would be entered as 1023).

The Model 38-MAX is capable of cross-format operation. That is when decoding CTCSS, it can encode DCS, or when decoding DCS, it can encode CTCSS.

Transmit Hold Time
The transmit hold time is the amount of time the repeater transmitter remains keyed on the channel after mobile activity is no longer detected. It may be set from 0.0 to 25.0 seconds in 0.1 second increments. The default setting is 2.0 seconds.

Reserve a User
A CTCSS tone or DCS code may need to be reserved for future use. If a radio keys up on a reserved user, the repeater transmitter will be keyed but no repeat audio will be cut through. A beep tone will be sent for the duration of the transmission and an alert chirp sent when the user unkeys.

This mode is designed to be used when disabling a user possibly due to a "no-pay" condition or seasonal use. The reserved user function keeps the tone active in the repeater so as to prevent other repeater operators from seeing the tone as available. Note that the user must be enabled as well as reserved.

Privacy Mode (Anti-Barge-In)
The privacy mode (when enabled) will not allow any new CTCSS or DCS users to be decoded during the tx-hold time.

It is usually a good idea to enable CTCSS/DCS encode during transmit hold time with privacy mode, since no other tones can be used during the hold time of the repeater.

Courtesy Beep
Whenever a user unkeys, the courtesy tone may be sent. The tone frequency can be set with a system command.

When a group of mobiles are close to the repeater with strong (full quieting) signals, it is sometimes hard to tell when a mobile unkeys. The courtesy beep assists in conserving airtime so that each mobile doesn't wait for the repeater to drop each time between transmissions.

The system operator can use this feature on a per-user basis to gain additional revenue from users desiring the beep. It may also be used to indicate certain groups of users.

Last User DTMF Identification
Last user DTMF identification sends the active user number via DTMF when the radio user unkeys. With the use of a DTMF decoder on the repeater output frequency, the system operator can keep track of problem users (misuse of the channel, etc.) by seeing which user was just active. A three digit DTMF code (the user number, 1-160) is sent whenever the user unkeys. The DTMF is sent at high speed, so as to sound similar to a courtesy tone.

DTMF Commands Enable
If this function is on, mobiles may use the following three features:

1. Use a DTMF regenerate mode for use with a phone patch or mobile DTMF decoders.

   The Model 38-MAX regenerates DTMF tones over the radio channel for applications involving mobile DTMF decoders or telephone interconnects. DTMF regeneration ensures that all DTMF signaling occurs at the same tone level. DTMF regeneration can occur for any or all users. A user commands the repeater to regenerate DTMF digits by sending a DTMF "*" for longer than 1 second. When the digit is released, the Model 38-MAX squelches the repeat audio and begins regenerating all DTMF tones received from the user until no digits have been received for the interdigit timeout. All sixteen DTMF tones can be regenerated.

   (programmable; factory set at 4 seconds)

2. Initiate temporary cross-tone mode to communicate with a user on a different tone.

   Temporary cross-tone or cross-code encoding allows the system manager to converse with a subscriber on any CTCSS tone or DCS code. This mode is a temporary cross-tone or cross-code assignment which allows users on different tones/codes to communicate. It is accessed with a DTMF command sequence and can be enabled/disabled on a per-user basis. An alert signal is sent during the transmitter hang time while the temporary cross-tone or cross-code mode is active. Command sequence:

   a. If the DTMF regenerate mode is enabled for the user, a long "#" (longer than 2 seconds) plus a tone or code number, then a "#" (# 12#) will activate cross encoding.

   b. Any channel activity will encode the originating mobile's tone or code.

   c. When the originating mobile transmits, the called mobile's CTCSS tone or digital code will be encoded.

   d. The tx-hold time is set at 30 seconds during cross-encoding.

e. An "eeddll-eeddll-eeddll" queuing tone will indicate cross-encoding is active.

f. A long "#" (longer than 0.75 second) will exit the mode.

3. Access a temporary cross-tone disable mode to allow a group normally disabled by cross-tone to communicate.

   In many dispatch systems the Model 38-MAX is programmed to always perform cross-tone or cross-code encoding, which enables the dispatcher to communicate with vehicles operating on a different tone or code, but prevents the vehicles from communicating directly with each other. The dispatcher is usually the center of all communications: when a vehicle needs to relay information to another vehicle, the dispatcher must listen to one vehicle, then transmit the information to the other vehicle. This method wastes airtime and increases the chance of miscommunication. If the dispatcher temporarily defeats cross-encoding, users can talk amongst themselves, and the dispatcher doesn't have to relay information.

   Temporarily defeating cross-encoding is achieved by a DTMF command sequence, and is enabled or disabled for each user with the "DTMF COMMANDS" enable function. An alert tone is sent in the squelch tail while the cross encoding is active. Command sequence:

   a. If the DTMF regenerate mode is enabled for the user, a long "0" will enter the car-to-car mode.

   b. The tx-hold time is set at 30 seconds during the cross-tone mode.

   c. An "eeddll-eeddll-eeddll" queuing tone will indicate that cross-tone encoding is defeated.

   d. A long "#" (longer than 0.75 second) will exit the mode.

The DTMF commands enable command determines whether or not the user has access to these features. Since they are all accessed by a DTMF sequence, it may be desirable to disable these functions and cause the Model 38-MAX to ignore any DTMF from the mobile.

Prepay Mode
A user may be set for prepay mode. This causes the airtime counter for the user to count down rather than up every second. When the airtime drops below 2 hours, a warning signal is transmitted in the squelch tail every time the user unkeys. If the airtime drops to 0 (zero), the user will be put into reserve user mode, effectively taking the user out of service but reserving the tone for when more airtime is purchased.

For a description of the warning tones, see Section 3, Prepaid Customer Low-Airtime Warning.

Hog Mode

The hog mode feature allows the system operator to penalize "airtime hogs" so that other users on the system have a chance to complete calls. This feature prevents a user from conversing through the repeater for a penalty duration (programmable from 10 to 9990 seconds) if the user has recently exceeded the maximum allowable conversation time limit (from 1 to 25 minutes).

While a user is penalized, the system ignores the user. Warning tones are sent to the user 20 seconds prior to cut-off. To avoid the penalty, the user must let the repeater transmitter unkey for an idle duration (from 1 to 99 seconds) to allow another user to use the system. If another user keys up or if the idle duration is met, the conversation timer is reset.

The hog mode conversation limit time is programmable for each user, and all users have their own penalty timers in case there are several hogs on the system. The system operator may re-enable all penalized users with a "long" DTMF reset" (holding any digit for longer than 15 seconds).

The Model 38-MAX includes an automatic, dynamically allocated conversation time limit feature that may be enabled for specific (or all) users. This limit varies depending upon the current loading of the repeater. To select the dynamic limit timer for a user, set the hog mode conversation time limit to 1.

To disable the hog mode, set it to 0. To set the hog mode, enter the number of minutes (other than 0 or 1) for the conversation time limit.

For information on dynamic limits, penalty, and idle timer settings, see the System Commands subsection.

Display or Change a User's Airtime Counter
The airtime counter for each user may be changed, for example to add additional airtime when the user is in prepay mode. The maximum airtime allowed is 249 hours:59 minutes:59 seconds. If a user exceeds this time, the counter stops at 249:59:59 and won't roll over.

RS-232
The available RS-232 commands are:

List or change a user's airtime
List all airtime counts (bar graph)
List total airtime accumulated by all users
List total repeater transmit time

DTMF
The following list-type commands send back the counts over the repeater channel. These commands are broken up into categories since most remote units only have a four digit display. The available commands are:

List hours:minutes duration for user nn.
List minutes:seconds duration for user nn.
List hours duration for tone nn (for count greater than 99 hours).
Add hours to user "nn's" airtime (for prepay).
List all airtime counts greater than zero
Clear user nn's airtime counter.

The format of the counts sent back over the repeater channel is either DTMF or Morse code (the format is set with a system command. See the System Commands, Remote Display Unit Used for DTMF Programming subsection).

Set Station ID Call Sign

Each user number may have a Morse code ID programmed against it. Each user also has his/her own ID timer. The Morse ID is sent the first time the user unkeys. If the user keys up again, voice communications may occur during the ID. The ID is sent at 30% deviation and at a selectable speed from 15 to 25 words per minute (default is 22). The ID tone frequency may be set (with a system command) from 400 to 2000 Hz (default is 1200 Hz) so as not to interfere with paging or other tone signaling on the channel. The ID interval is set with a system command from 1 to 99 minutes (default is 15 minutes). The call sign may be 0 to 8 characters. A single system ID call sign is also programmable with a system command.

RS-232

When programming via RS-232, if the first character of the ID is set to a space, the ID won't be sent. This feature allows the ID field to be used as a memo field. Account numbers or short names may be used to identify the user group.

DTMF

To program the ID, look at Table 4-3. Find the digits that correspond to the call ID letters and Morse code.

For example, the letter J (Morse code . - - -) is programmed with the digits 15.

Table 4-3. Station ID Cross-Reference

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

To know which digits to use in case you don't have access to Table 4-3, it is easy to remember that the cross-reference table was derived from a normal DTMF or telephone keypad. The first digit refers to whether the letter is the first, second, or third letter that appears on a keypad key, as shown in Figure 4-2.

For example, the letter J is the first letter on the 5 key, so its digits are 15.

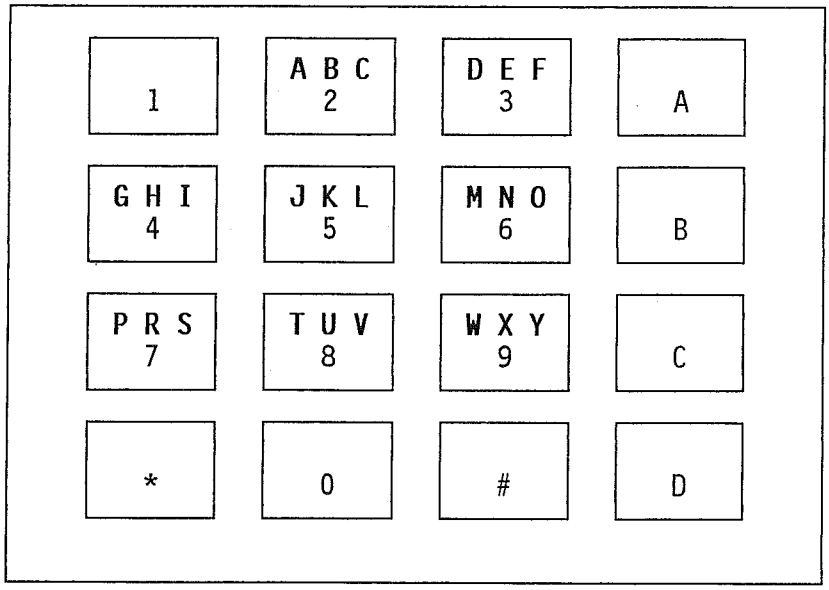


Figure 4-2. DTMF Keypad with Letters Shown

The only letters not represented are Q and Z. Numbers are entered directly. Remember to insert the "#" key between all characters. To enter a call sign less than 8 characters long, press the "#" key for the last code. The call sign will be sent back in Morse code after entering the call. To remove a call sign, enter a "#" for the first character.

Example:
Set call sign WNCR-414 to 100.0 Hz CTCSS tone:

Enter DTMF -->	43#	13#	19#	26#	32#	27#	4#	1#	4# #
Comments -->	ID#	100Hz	W	N	C	R	4	1	4 done

Playback Morse ID
The station ID for a user may be played back for verification over the repeater channel while in the DTMF remote programming mode.

Optional Auxiliary Relay Function
The auxiliary relay option allows the aux relay to close while a predetermined CTCSS tone, DCS code, or group of tones or codes is received. These tones or codes may be programmed independently from the tones or codes used in normal repeater operation. The aux relay will follow the CTCSS or DCS decode for programmed users, closing only while the user is transmitting.

Jumpers allow the system operator to provide a pair of normally open or normally closed contacts. With the auxiliary relay option installed, the Model 38-MAX provides a ground on TB1, pin 8 upon receipt of a tone or code programmed for auxiliary relay activation.

SYSTEM COMMANDS

Carrier Only Repeat (Open Repeater)

The Model 38-MAX can be programmed to repeat based on just carrier, sometimes called "carrier controlled repeat" or "open repeater". In this mode the Model 38-MAX provides simultaneous tone/open repeater operation: users who have CTCSS or DCS encode operate normally, and users who have no encode repeat also. This allows a mix of CTCSS tone users with open repeat capability and is ideal when adding tone users to an existing open repeater.

To enable carrier (COR) for repeat, a user number is identified as the "CARRIER" repeat user. This allows all standard user-programmable features for open repeat, including: enable/disable for the carrier user, CTCSS or DCS code encoding, airtime accumulation, etc. If the COR user number is set to "0", no carrier repeat is available.

First Tx Hold time

The Model 38-MAX includes a "First Tx Hold" system timer feature. This can be used to extend the repeater transmit hold time after the mobile unkeys for the first dispatch call. This feature allows the called mobile extra time to respond to the call before other users can access the repeater (if busy channel lockout or privacy mode is used). The conditions to get "first tx hold" are: new CTCSS or DCS decoded, and transmission longer than the "anti-kerchunker" time.

When using scan based CTCSS/DCS trunking, be sure to set the first tx hold time long enough for the mobiles to acquire the channel.

Anti-Kerchunker Filter

The first transmission from a user must be longer than this time or the repeater transmitter will be dropped. This feature has a dual purpose, the first is to discourage users from "kerchunking" the repeater to death. The second (and most important) purpose is in the case of multiple repeaters, or heavily used channels. When many tones are active on a single channel, it is not uncommon for voice falsing of active CTCSS tones to occur. If the Model 38-MAX Tx-Hold time is set for very long (3 seconds or more), this can interfere with voice communications since the voice false may cause a co-channel repeater to key. The 1-second qualification of the tone removes most all voice false interference problems. The anti-kerchunker filter may be programmed between 0 (off) and 5.0 seconds.

Tail Bips

For some installations a beep tone every second is required during the transmit hold time. To enable the tail bips, the user-programmable courtesy tone must also be enabled. Note that the frequency of the tail bips is selectable using the courtesy tone frequency command.

Courtesy Tone Frequency
The courtesy tone frequency is programmable from 400 to 4000 Hz. The default setting is 1000 Hz. The courtesy tone frequency is also used for various prompt beeps.

The frequency of the courtesy tone may be used to distinguish between co-channel repeaters with different coverage, located at different sites.

Courtesy Tone Type
Seven selections are avaliable for the courtesy tone sound. These sounds may be used to distinguish between co-channel repeaters or area selection. The sounds are:

1. Bip (at the selected courtesy tone frequency)
2. Three-tone (500, 750, 1000)
3. Three-tone (500, 1000, 2000)
4. Three-tone (fast 500, 1000, 2000)
5. Eeddll-eeddll (480, 620, 480, 620)
6. Morse code K (at the courtesy tone frequency)
7. Morse code R (at the courtesy tone frequency)

Stuck Mic Timeout Timer
The timeout timer is the maximum amount of time a mobile may be key-down on the channel. This is a "stuck mic" timeout feature. The timer is reset each time CTCSS decode stops. It may be set from 1 to 9 minutes, in 1-minute increments. The default setting is 3 minutes. During a timeout condition, an alert tone will be sent. Then the repeater transmitter will unkey. If desired, the user number causing the timeout can be identified via DTMF every 15 seconds while the fault exists. This is referred to as Timeout ID.

The timeout timer may be disabled if desired by entering "0" for the timeout time.

Timeout ID
When a user transmits past the repeater timeout time, the Model 38-MAX will send a warning tone then unkey. If the timeout ID is enabled, the repeater will key up every 15 seconds (while the user is still transmitting) and send the user number via slow DTMF.

Morse ID Frequency, Interval, Speed, and System ID

The Morse code station identification is programmable in frequency, interval and speed. The frequency is programmable from 400 to 2000 Hz (per FCC Part 90 rules); the default setting is 1200 Hz. The interval is selectable from 1 to 99 minutes, with the default being 15. Each user on the Model 38-MAX has his/her own independent station ID timer that is accurate to one second per interval. The timer is reset when the station ID is sent. The call will be transmitted on the first dispatch message after the timer has expired. The Morse ID speed is selectable from 4 to 25 words per minute, the default setting being 22 WPM. During normal dispatch, the minimum speed will be 15 WPM. This allows the "List" functions (using Morse code as a format) to be sent at real slow speed, while maximizing airtime use during normal dispatch.

A user number may be assigned as the "System ID user number" so that the repeater will be identified every ID interval (1 to 99 minutes). Before the system ID is sent, the following conditions must be met:

1. The ID interval timer must expire (adjustable 1 to 99 minutes).

2. The system ID must have a user number programmed.

The system ID may be sent at periodic intervals (independent of repeater use), or only after repeater transmit activity.

When the ID is sent, the Model 38-MAX will reference the system ID user number for the proper CTCSS/DCS encode and the Morse ID to send. A disabled or enabled user number may be used. The transmitter will be keyed and after a 0.75-second delay, the Morse ID is sent.

Hog Mode
The hog mode requires three separate timer functions:

1. Conversation timer

2. Idle timer

3. Penalty timer

The conversation timer is programmable per user from 1 to 99 minutes.

The idle timer runs whenever a mobile is inactive and, when satisfied, will reset the conversation time limit. The idle timer is programmable from 1 to 99 seconds. The default is 5.

The penalty timer is the amount of time a mobile will be disabled when the conversation time limit is reached. The penalty timer is programmable from 10 to 9990 seconds in 10-second increments. The default is 30.

Each user may have hog mode enabled or disabled. To disable hog mode, set the hog user command to zero (see the User Commands, Hog Mode subsection).

Dynamic Conversation Limit Timing
With this feature the system operator can allow certain users to have a conversation time limit that varies dynamically based on the repeater loading.

Two additional timers are included in the Model 38-MAX system programming. They are:

1. Hog minimum airtime

2. Hog maximum airtime

These timers set the minimum conversation time limit for when the repeater is heavily loaded, and the maximum conversation time limit for when the repeater is lightly loaded. Both timers are set in minutes and tenths of minutes, from 0.5 to 25.0 minutes.

To select the Dynamic Limit timer for a user, set the user programmable "Hog Limit" time to "1". Setting it to "0" will disable the Hog Mode limit timer, or setting it to any number other than 0 or 1 will be a fixed conversation limit.

The Dynamic Limit time is calculated as follows:

1. The repeater loading is accumulated over a 12-minute period. If the transmitter is keyed for 9 minutes during the last 12 minutes, the loading would be 75%.

2. The percent loading is used to pick a ratio between the maximum and minimum hog limit times. If the minimum is set to 1 minute, and the maximum is set to 11 minutes, and the loading is 25%, the dynamic hog conversation limit time would be 8.25 minutes.

The conversation time limit warning beeps (double beep, every second) will be sent as follows:

1. If the user is set for a fixed hog limit time, the warning beeps will begin when 40 seconds of time is left.

2. If the user is set for dynamic conversation time limit, the warning beeps will begin when the remaining time drops below 12% of the total allotted time. The user will always get at least 15 seconds, but no more than 40 seconds of warning beeps.

Airtime Accumulator
The airtime accumulator for each user may exclude or include the transmit hold time. This programmable feature allows the system operator to decide whether or not the billable airtime should include the transmit hold time duration.

Site Alarm / Remote PTT
The Site Alarm DTMF sequence can be set for 0-8 digits, including the 0 to 9, *, #, A, B, C, or D keys. The Site Alarm may be sent with a contact closure input, and/or each time power is restored to the Model 38-MAX. When the Alarm is tripped, the Model 38-MAX will wait until dispatch activity is completed, then key the transmitter, select a CTCSS or DCS encode tone, wait 1 second, then send the DTMF. Following the DTMF code, a warble alert tone will be sent. If the alarm is from the contact closure, a slow warble will be heard. If the alarm is from a power up condition, a fast warble will be heard.

The site alarm may also be sent upon program mode access. This can be useful information where unauthorized access is suspected. If the site alarm is enabled for program mode access, the DTMF alarm is sent followed by the last four digits of the Model 38-MAXs serial number. The serial number can be useful for verification of the panel being programmed.

The Model 38-MAX will indicate when the site alarm input is active (input is at ground, or 0 volts). Whenever the transmitter is getting ready to unkey a 2000 Hz beep tone will be sent after the CTCSS encode is turned off. This will indicate to the system operator that the site alarm input is still active. This could indicate the system is still on battery power, or the PA is still too hot, or any other "level sensitive" input condition. Note that normal system users should not be aware of the condition since the beep is sent after the tone encode is turned off.

The site alarm input may be used as a "Remote PTT" function. This feature is initiated by the site alarm input being pulled to ground by a contact closure or other input. When the alarm input goes active, any repeater activity will be suspended, then the programmed CTCSS tone or DCS code will be encoded, the repeat audio squelched, and the transmitter keyed. This condition will continue until the site alarm input is released.

This feature can be used for wireline control of the transmitter from a remote control, or by wiring the local mic PTT to this input, a method of local control to talk to specific users.

When programming via DTMF, the alarm code is entered directly and is terminated with a 3-second timeout (any pause longer than 3 seconds while entering will terminate the code). The timeout is required since the code may contain any DTMF characters including the "#" key.

Programmable functions include:

1. CTCSS or DCS encode sent during the alarm (0=none, 1-50=CTCSS, DCS=1nnn where nnn is the DCS code).

2. Alarm at power up with fast "warble" tone.

3. Site alarm + DTMF serial number sent upon program mode access.

4. Remote PTT tone number/DCS code (0=off, 1-50=CTCSS or 1000-1777=DCS).

Program Mode Access Code
The program mode access code is a number between 1000 and 32000. When programming via remote DTMF, the "#" must be entered after the code (the default access code would be entered as 12038#).

When the program mode is accessed via DTMF over-the-air, a programmable delay may be included after the code is recognized, but before the program mode becomes active. This feature provides added security from hackers using trial-and-error techniques to break into a tone panel. During the delay time, the tone panel continues to operate normally. The delay can be set from 0 to 30 seconds.

For additional security, the site alarm and serial number of the panel may be sent upon access (see the Site Alarm/Remote PTT subsection).

A specific CTCSS tone or DCS code may also be required to access the remote DTMF program mode.

For more information about the access code, see Access to Programming in the RS-232 and DTMF Programming subsections earlier in this section.

Mic DTMF Hold Time
This function allows a delay to be inserted before the prompt tones are sent back to the programming party for use with DTMF programming. In many radios equipped with DTMF encode, the transmitter remains keyed for a short time after releasing a DTMF digit. This can prevents the user from hearing the prompt tones. To remedy this condition, a delay may be programmed into the Model 38-MAX. Enter the number of seconds (from 0 to 3) to delay; the default setting is 0. Note that while programming, the user does not have to wait for the prompt tones. All DTMF is received even while processing a command or issuing a prompt tone.

RS-232 Port Baud Rate
The baud rate of the RS-232 port may be set to any one of the following standard baud rates. The default baud rate is 1200.

Baud Rate —>	150	300	600	1200	2400	4800	9600
Enter # —>	1	2	3	4	5	6	7

Remote Display Unit Used for DTMF Programming
These commands are only used for over-the-air DTMF programming to retrieve and verify data. The Model 38-MAX formats data sent back over the repeater channel for the appropriate remote programming device. The format is either DTMF or Morse code.

For DTMF, the format may be normal DTMF (for a Zetron Model 8B), or formatted for a CSI RDU terminal or a Comm Spec DI-16.

For Morse code format, the speed (from 4 to 25 words per minute) is set with a system command. If a remote DTMF display decoder is not available, it is easy to intrepret Morse code digits since they all are five elements long (see Table 4-4).

Table 4-4. Morse Code Digits

1 = dit dah dah dah dah	(. - - - -)
2 = dit dit dah dah dah	(. . - - -)
3 = dit dit dit dah dah	(. . . - -)
4 = dit dit dit dit dah	(. . . . -)
5 = dit dit dit dit dit	(. . . . .)
6 = dah dit dit dit dit	(- . . . .)
7 = dah dah dit dit dit	(- - . . .)
8 = dah dah dah dit dit	(- - - . .)
9 = dah dah dah dah dit	(- - - - .)
0 = dah dah dah dah dah	(- - - - -)

Serial Tone Output
The RS-232 interface port on the Model 38-MAX may be used to control or inform other equipment of radio channel activity. The Serial Tone Output function may be enabled to transmit an ASCII character via the RS-232 port whenever a CTCSS tone or DCS code is detected.

The character sent is decimal 96 plus the user number being decoded. When the user unkeys, a decimal 96 (ASCII `) character will be sent.

Digital Squelch Code Polarity
Two programmable inverters for DCS encode and decode are incorporated into the Model 38-MAX. Since the polarity of the transmitter may be different between manufacturers, the inverter must be configured for the particular installation. The polarity is either Normal or Inverted. The DCS code being sent is not changed, only the polarity of the bits. A similar DCS decode inverter is programmable. These are system level inverters that operate just like an external transistor inverter circuit.

DCS Acquire Bit Errors
The DCS decoder in the Model 38-MAX may be configured for the number of mismatched bits to allow during DCS acquisition. Of the 23 data bits, some bits may be in error during the initial DCS code qualification, possibly due to poor signal, distortion, or noise. Normally the code must be either an exact match or only one bit error, but this function is programmable from exact match to three bit errors.

Care should be taken if the default value is changed. If more bit errors are allowed, the chance of occasional false decodes will increase. If less bit errors are allowed, the decode speed and sensitivity will decrease.

CTCSS Turnoff Delay
A programmable delay time is incorporated into the Model 38-MAX when CTCSS decode is released. Some radios will encode CTCSS squelch tail elimination (phase reversal or "reverse burst") for too long of a duration. This may cause the tone panel to "re-acquire" the CTCSS at the end of the phase reversal, causing a squelch tail to be heard. In order to eliminate this effect, a delay may be inserted after the phase reversal is detected, effectively disabling the CTCSS decoder for a short time. The default setting should work with all radios.

Decode Hold Time
A programmable timer is provided as a decode hold time. This is the amount of time that CTCSS decode must be false before repeat audio is squelched. The time may be set from 0 to 2.5 seconds in 0.1-second increments.

For DCS decode, the hold time is always a 1.0-second minimum, regardless of where the CTCSS hold timer is set. If the CTCSS hold is set above 1.0 second, it will apply to DCS decode also. Note that during DCS decode, the DCS "turn-off" code will be recognized and squelch repeat audio independent of the hold time. This is DCS Squelch Tail Elimination.

* * * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * * *

This timer should always be set to zero to ensure proper operation with squelch tail elimination. This timer is programmable for special applications only.

* *

DTMF Timeout
The DTMF timeout is used to detect when the mobile has quit entering DTMF digits. It is used during Program Mode access code for maximum inter-digit time, as well as in the DTMF regenerate mode. It is programmable from 1 to 9 seconds, with 4 being the default setting.

DIAGNOSTIC AND SETUP COMMANDS

These commands are provided to aid the system operator and installer in setting up the system. All commands may be used interactively with other commands. For example, the transmitter may be keyed, the repeat audio path opened, a CTCSS tone generated, and a DTMF tone generated all at the same time.

Repeater Disable
The Model 38-MAX may be disabled as to not respond to mobile activity. From RS-232, the top menu Standby command provides the same function.

From DTMF remote programming, this command will take the repeater out of service until the program mode is accessed again, the main power is cycled, or a "long digit DTMF reset" is performed.

PTT On/Off (key the transmitter)
The transmitter may be keyed on and off to test the PTT function.

Note that if the PTT OFF command is selected via DTMF remote programming, the transmitter will still be keyed prior to sending any prompt tones, DTMF and Morse code output.

Repeat Audio Path Open/Close
The audio repeat path may be tested with these commands.

Encode CTCSS Tone or Digital Squelch Code
In order to set the CTCSS and or DCS encode levels, as well as to test decode function of mobiles, the Model 38-MAX must encode a tone or code. The following commands allow any of the 50 standard CTCSS tones, or any frequency between 50.0 and 300.0 Hz to be encoded. For DCS encoding, any octal code may be generated (000-777), to test the decode selection in the mobile, as well as the DCS output polarity.

A CTCSS tone sweep mode will generate CTCSS tones 67.0, 123.0, and 250.3 Hz. Each tone is turned on for 4 seconds. This mode is good for checking the deviation of the tones at each end of the CTCSS limits. All tones should be close in deviation. If not, de-emphasis may need to be switched in or out.

DTMF
For CTCSS tones enter a tone number between 1 and 50. For DCS codes, enter the octal code PLUS 1000 (1000-1777). To turn off the encode, enter "0" as the code.

A command is available to encode a sub-audible frequency between 50.0 and 300.0. Enter the frequency without the decimal. This mode can be used to test the bandwidth of a CTCSS decoder in a mobile. An example would be testing a mobile decoder on 100.0 Hz. By entering 1015# the Model 38-MAX will encode 101.5 Hz, the mobile should unsquelch. Then encode 98.5 Hz, the mobile should still unsquelch. If it doesn't, the decoder bandwidth is wrong, or in the case of a tunable decoder, the center frequency is probably adjusted wrong.

To stop the CTCSS sweep function, hold down the DTMF "*" key for 5 seconds.

Output and Audio Test Tone
An audio test tone may be generated. The tone is produced by the beep generator, and is used for Morse ID and various prompt tones. The amplitude of the tone will change with frequency, since it is not a pure filtered sign wave generator. Any frequency between 400 and 4000 Hz may be encoded.

Reset Unit to Default Settings
Commands are available to reset the entire unit back to factory defaults. This will clear all the system, user, and airtime memory in the Model 38-MAX.

Generate a DTMF Digit on the Repeater Output
A DTMF digit may be generated on the repeater output channel to set the deviation of the transmitter, and the Audio Output adjustment in the Model 38-MAX.

To encode DTMF digit via DTMF remote programming, use following table:

Number	DTMF digit	Number	DTMF digit
0	0	9	9
1	1	10	A
2	2	11	B
3	3	12	C
4	4	13	D
5	5	14	*
6	6	15	#
7	7	99	
8	8		

Send Site Alarm
The site alarm may be sent to verify proper decoding by other equipment.

List the Number of Enabled Users
It may be desirable to know how many users (CTCSS and DCS) are enabled in the Model 38-MAX. For remote DTMF programming, this command will send the information back via Morse code or formatted DTMF.

List the Enabled User Numbers
The active users in the Model 38-MAX may be displayed for reference. For remote DTMF programming, this command will send the information back via Morse code or formatted DTMF.

List Resets, Power Fails, Program Access
The Model 38-MAX totals the number of program mode access, resets, and power fails to assist system troubleshooting. The number of program mode accesses is incremented each time the password is entered. Keep track of who's using the program mode. If the count is higher than expected, a user may be entering a phone number (using a phone patch) which is the program mode access code. The counter limits at 9999 accesses.

The number of resets is also tracked. This lets system operator know how many times the Model 38-MAX was reset by a long DTMF digit, a power line brownout, or from some external source. The counter limits at 9999 resets.

The number of power fails is recorded as well. Each time the Model 38-MAX powers on, a counter is incremented. This is valuable information when power fail conditions are suspect. The counter limits at 9999 power fails.

The system counters may be cleared via DTMF remote programming as needed.

System Test, List Errors
An internal self-test can be requested of the Model 38-MAX. It will report any errors detected in its software program memory, system programming memory, or user database memory. The Model 38-MAX will automatically test its memory every time the transmitter is unkeyed during dispatch. If an error is detected, a 400 Hz. beep will be sent just prior to unkeying. The error can be found with the following commands. If the system error number is 0, all memory is ok. If multiple errors are detected, the sum of the error numbers will be reported. Use the table below to identify the fault:

Error Number	Type of fault
0	Normal operation, no errors
1	EPROM error (fatal)
2	System programming error
4	User database error(s)
8	External RAM error
16	EEPROM archive database error(s)
32	Configuration error (fatal)
64	Microprocessor error

If a user error is indicated, the number of tones with memory errors is important. If only a few tones have errors, they may be reprogrammed by the system operator with little trouble. If many errors are reported, it may be a better idea to clear all memory and reset the system.

If user programming errors are detected, the user numbers in error may be displayed.

5. INSTALLATION

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5. INSTALLATION

INSTALLATION WARNING

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause interference to radio communications. Installation of the Model 38-MAX should only be attempted by qualified radio service personnel.

GENERAL

Connections to the transmitter, receiver, and power are grouped on a detachable screw terminal strip on the rear for ease of installation. The Model 38-MAX includes installation test modes to aid in installation. All adjustments and switches are accessible from the rear (see Figure 5-1). The cover need not be removed.

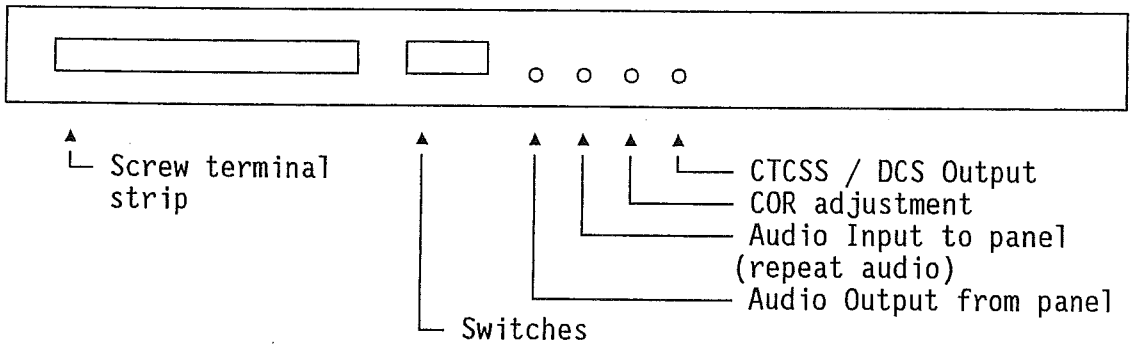


Figure 5-1. Model 38-MAX Back Panel

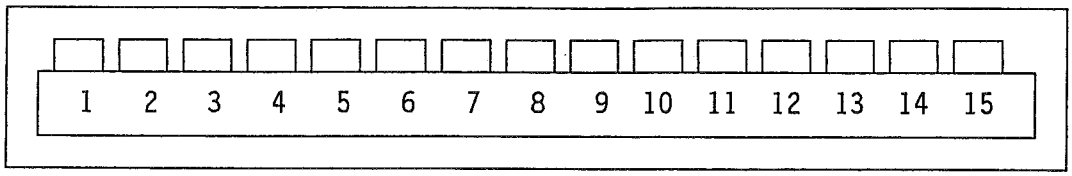
For instructions on installing a new IC chip, see the Installing a New Prom subsection at the end of this section.

EQUIPMENT REQUIRED FOR INSTALLATION

Required equipment includes:

1. A communications service monitor
2. A handheld or mobile radio with DTMF encode capability
3. A VOM (volt-ohmmeter).

SCREW TERMINAL CONNECTIONS



1= AC/DC Input	4= Ground	7= PTT N.O.	10= COR Input	13= CTCSS
2= AC Input	5= PTT N.C.	8= Aux Relay	11= Tx Audio	14= Ground
3= DC Ground	6= PTT C.	9= Alarm In	12= Ground	15= Rx audio

INSTALLATION PROCEDURE

1. Remove the 15-pin screw-terminal connector from the rear panel.

2. POWER SUPPLY: Locate the 12-volt DC supply for the repeater receiver/transmitter. With a VOM, measure the DC voltage. It should be between 11.0 and 15.0. If 12 volt DC is not available, a 9-volt AC wall transformer may be used. For DC operation, connect the power supply ground lead to pin 3, and the positive supply lead to pin 1. For 9-volt AC operation, connect between pins 1 and 2 (pin 1 is internally fused).

3. GROUND CONNECTION: Connect a chassis ground wire from pin 3 to the chassis ground of the transmitter/receiver.

4. TRANSMITTER PTT: For most transmitters, a contact closure to ground will cause the transmitter to key up. For this configuration, connect a wire from pin 7 (relay N.O. contact) to the PTT input of the transmitter, then ground pin 6 (relay common contact).

5. TRANSMITTER AUDIO INPUT: Connect pin 11 to the mic or line input of the transmitter. Shielded cable must be used for this connection, connect the braid to pin 12.

6. CTCSS ENCODE: Connect pin 13 to the direct modulation or CTCSS tone input of the transmitter. Shielded cable must be used for this connection, connect the braid to pin 12.

7. DISCRIMINATOR INPUT: Connect pin 15 to the receiver discriminator output. Shielded cable must be used for this connection, connect the braid to pin 14.

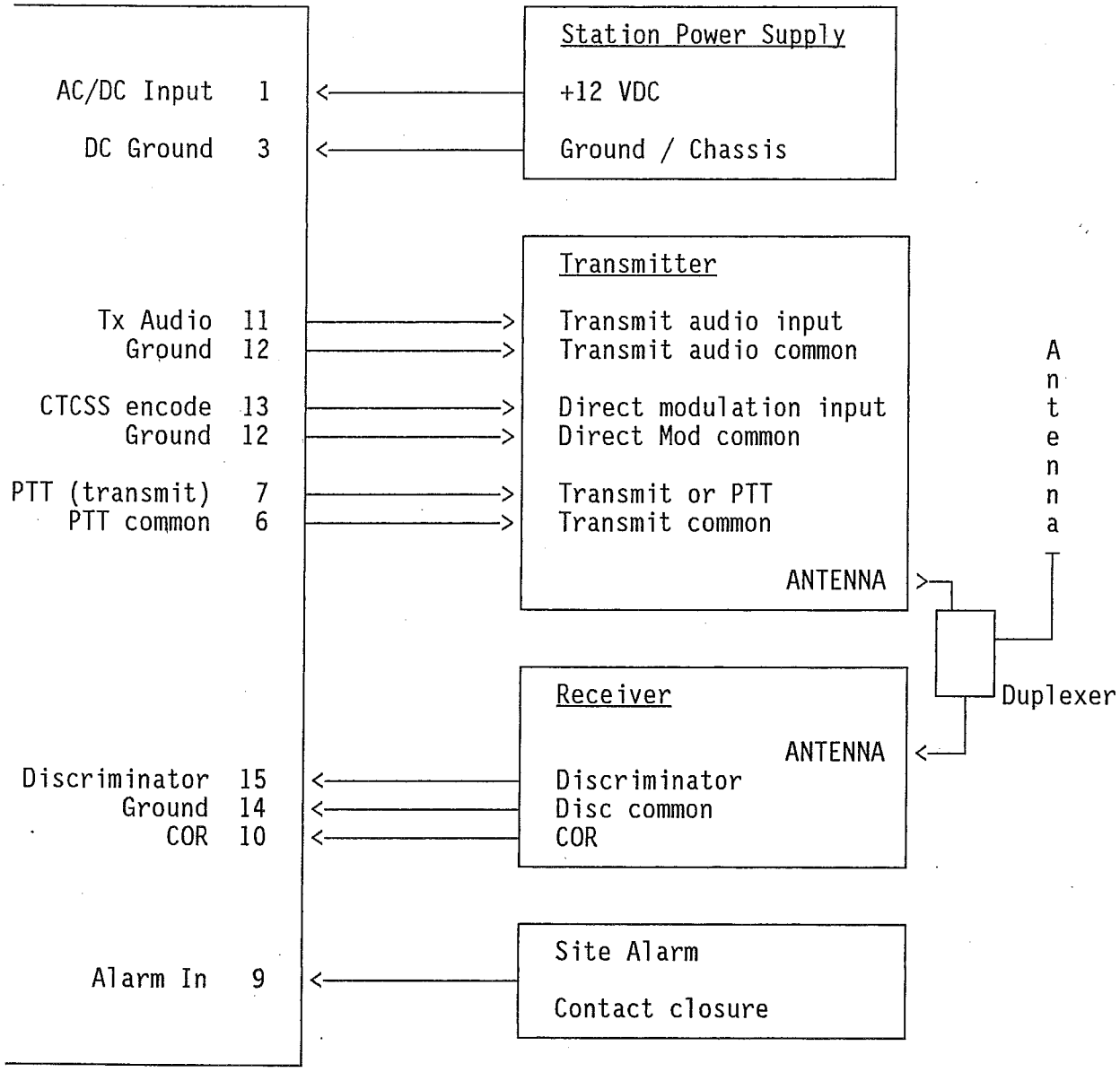
8. COR INPUT: Connect pin 10 to the carrier active sensor in the receiver. The signal must be between 0 and 7 VDC, and change at least 1 volt between carrier and no-carrier conditions. A built in squelch detector can be used if a carrier indication from the receiver is not readily available.

9. ALARM INPUT: Connect pin 9 to alarm input source. Any contact closure to ground will generate the programmed alarm sequence.

10. Reconnect the screw terminal connector.

TYPICAL INSTALLATION DIAGRAM

Model 38-MAX



INSTALLATION TIPS

Replacing older repeater panels with microprocessor-controlled units isn't just a matter of disconnecting the old and plugging in the new. Unlike yesterday's repeater panels, today's units need complete control of all signals sent between a repeater's receiver and transmitter. This allows special services like airtime accumulation for billing purposes, remote control for site visit elimination, and per-subscriber regulatory functions (e.g. "Hog" mode).

The following are some hints for correctly installing a Zetron Model 38-MAX.

Audio Input Connection
Most repeater panels just decode CTCSS tones, and don't handle repeat audio or squelch-related functions. Repeat audio is usually passed between the receiver and transmitter through a "Repeater Audio" circuit board. This board must be removed.

To ensure that CTCSS tones and/or Digital codes will be decoded, and that repeat audio signals will be processed correctly, the Model 38-MAX must be connected to an audio source within the receiver that passes frequencies from 1 Hz to at least 2,000 Hz.

If the internal noise squelch is to be used, the audio source must pass frequencies up to at least 10 kHz. Without such an audio source, the noise detector will operate as a VOX detector only. Many receivers have a signal brought out that is labeled "discriminator". Quite often this signal is low pass filtered, and removes the high frequencies required for proper noise detector operation. Look at the diagram for any caps or filtering in the chain before using the noise detector.

Audio Output Adjustment
The "Audio Output" potentiometer (on the back panel) is not a "repeat audio" level control. It is a deviation control that regulates the levels of the DTMF encode and audible tones (e.g. warning beeps), along with repeat audio.

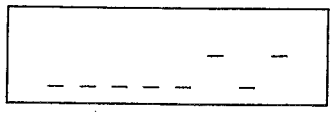
To properly set these levels, put the Model 38-MAX into the Test Mode and have it encode a DTMF tone. Using a service monitor, set the potentiometer for 3 kHz deviation.

The "Audio Output" potentiometer should be adjusted before setting repeat audio deviation with the "Audio Input" potentiometer.

Shielding, Grounding
Using quality shielded cable for audio connections and practicing good grounding techniques will eliminate the possibility of "hiss" and "hum" interfering with the repeat audio.

INITIAL REAR PANEL SETTINGS

The Model 38-MAX provides rear panel switches so that internal jumper straps are not required. For new installations, the switches should be set in the following positions:



Sw 1= Input Gain, on=low
Sw 2= Audio Out Gain, on=low
Sw 3= CTCSS Out Gain, on=low
Sw 4= Audio De-Emphasis, on=yes
Sw 5= CTCSS De-Emphasis, on=yes
Sw 6= COR internal/external, on=int
Sw 7= COR Polarity, on=negative
Sw 8= COR Pull-Up, on=yes

All adjustments (audio out, audio in, CTCSS out) should be set to mid point before turning the unit on.

TESTS AND ADJUSTMENTS, INITIAL TURN-ON

1. Connect the Model 38-MAX to the radio using the installation instructions on the following pages, or follow the application note supplied (if one exists) for your specific radio.

2. Preset the jumpers and level adjustment pots using the information on the previous pages.

3. Connect a clip lead to the site alarm input of the Model 38-MAX (pin 9).

4. Connect the communications service monitor to the antenna, set for receive deviation display on the repeater transmit frequency.

5. Power on the Model 38-MAX and immediately pulse the site alarm jumper to ground at least five times during the first five seconds of power up. This will cause the Model 38-MAX to access the following test sequence.

    1. PTT on.
    2. DTMF digit 5 encoded.
    3. CTCSS mid tone encode.
    4. CTCSS high tone.
    5. CTCSS low tone.
    6. DPL code 023.
    7. Repeat audio enabled.
    8. PTT off.

    Each test lasts 15 seconds and may be advanced by grounding the SITE ALARM. The test will repeat 20 times (approx. 40 minutes if left unattended).

6. Hit the site alarm input (ground) until the DTMF digit is being encoded on the transmit channel. Set the deviation for 3kHz (or 60% of maximum allowable deviation) using the AUDIO OUTPUT level adjustment.

7. Hit the site alarm again to advance to the CTCSS output test. Set the CTCSS OUTPUT adjustment for 700Hz deviation of the PL encode tone.

8. Hit the site alarm again then verify the deviation of the 250Hz CTCSS tone is between 600Hz and 1000Hz deviation.

9. Hit the site alarm again then verify the deviation of the 67Hz CTCSS tone is between 600Hz and 1000Hz deviation. If the tones are not close to the same deviation, check the setting of the CTCSS DE-EMPHASIS switch.

10. Hit the site alarm again then verify the deviation and polarity of DPL code 023, it should be between 600Hz and 1000Hz deviation.

11. Hit the site alarm again then verify the operation of the CARRIER LED on the front panel. Generate a carrier signal on the repeater input (receiver) frequency, then reduce the RF level until the led goes out. The LED should follow the squelch noise from the receiver, and is usually controlled by the receiver squelch knob. If the LED doesn't light, adjust the COR level until the CARRIER LED follows carrier on the channel.

    Now supply a test tone of known deviation on the receiver frequency, then monitor the deviation of the transmit frequency. Adjust the AUDIO INPUT GAIN for unity gain (input deviation = output deviation). If the level cannot be adjusted high enough, move switch 1, then readjust. Now insert 500 Hz, 1000 Hz, and 2000 Hz. The output deviation should be flat. If not, move switch 4 then readjust. Note that if you are using a DTMF test tone, do not hold the digit for greater than 8 seconds or a reset will occur.

* * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * *

DO NOT use the AUDIO OUTPUT control to adjust the repeat audio level! The AUDIO INPUT control MUST be used for repeat level.

* *

TONE PANEL PERFORMANCE TEST

Put your repeater to the test. To insure maximum performance from a repeater system, all elements of the system must be functioning properly. The repeater is much like a chain in that the total performance is only as good as the weakest part. To guard against weak links, the system should be thoroughly tested including:

* Receive antenna and feed line
* Receiver sensitivity
* Tone panel sensitivity and audio response
* Transmitter power, purity and deviation
* Duplexer or combiner
* Transmitter feed line and antenna

To test the receiver and tone panel, follow the steps below:

1. Set a service monitor to generate a full quieting signal on the repeater receiver frequency. Verify the "CARRIER" LED is lit when signal is applied to the receiver.

2. Encode a 1-kHz audio tone at 3-kHz deviation.

3. Encode a valid (enabled) CTCSS tone (67-250 Hz) at 12% (typically 600 Hz) deviation, verify the "DECODE" and "TRANSMIT" LEDs are lit.

4. Reduce the RF signal strength into the receiver until the "DECODE" LED goes out, then increase it until the LED just goes back on. With a SINAD meter connected to the speaker terminals of the receiver, note the SINAD reading. This number represents the decode sensitivity of the tone panel.

   NOTE: The squelch control of the receiver may have to be set "open" during the test to keep the "Carrier" indication on to the tone panel, and unsquelched audio to the SINAD meter.

   The lower the SINAD reading, the better the tone panel. For good operation, the tone panel must decode CTCSS at 6dB SINAD or lower. Zetron tone panels should decode CTCSS tones reliably at 3dB SINAD.

5. Measure the RF input (in microvolts) signal strength into the receiver. The lower the number, the higher the sensitivity. For most UHF receivers, a desirable number is around 0.35 μV for 12-dB SINAD. The squelch adjustment in the receiver should be set between 3 and 6 dB SINAD.

INTERFACE CONNECTION DIAGRAMS

CONNECTION TO A GE MASTR III BASE/REPEATER

For: Zetron Model 38-MAX
To: GE MASTR III base/repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	P5.1 (A+ / DC Power)
12 volts AC input	2	---	
DC ground	3	Black	P2.2, P2.3 (Power ground)
Ground	4	Drain	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	P2.13 (Repeat PTT In)
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	P3.5 (CAS)
Tx audio	11	Blue	P5.8 (Repeat Audio)
Ground	12	---	
CTCSS/DCS encode	13	Green	P3.14 (CTCSS Encode)
Ground	14	Brown	P4.2
Discriminator in	15	White	P2.5 (Demodulated Audio)

MASTR II CONFIGURATION:

1. Connectors P2, P3, P4, and P5 are located on the GE Mastr III backplane.

2. Cut the printed wire pattern at JP-1 on the T/R Shelf's backplane 19d902948.

3. Program the base station using the standard PC programming software. For proper operation, the station firmware must be 344A3307G12 (Group 12) or higher (Mastr III System Board - U4).

4. Program the following parameters in the Mastr III:

   a. Repeater (Single Channel only)
   b. Repeater Panel option
   c. RF duplex
   d. No TX CG or RX CG (leave blank)
   e. Set the TX Pot to 200.
   f. Set the Cg pot to 255.
   e. No CCT or DODT Timers (set to 0)
   f. Remote Control optional

5. Set the repeat and CTCSS modulation levels by adjusting the Zetron Model 38-MAX. See the Tests and Adjustments, Initial Turn-On subsection.

CONNECTION TO A GE MASTR II BASE/REPEATER

For: Zetron Model 38-MAX
To: GE MASTR II base/repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Station Supply +12VDC
12 volts AC input	2	---	
DC ground	3	Black	Station Supply Ground
Ground	4	Drain	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	J931 Pin 14, Local PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	J932 Pin 18, CAS
Tx audio	11	Blue	J933 Pin 6 OLD, Control board P2 Pin 4 NEW IDA
Ground	12	---	
CTCSS/DCS encode	13	Green	J933 Pin 3, CG Hi
Ground	14	Brown	J933 Pin 2, CG Lo
Discriminator in	15	White	J606 on IF/Audio/Sq board

MASTR II CONFIGURATION:

1. Two versions of the GE Repeater Control Panel exist. The "Earlier" version is identified by multiple plug-in cards, the 10 volt regulator card being on the far right. The "Later" version is a single panel (no plug-in cards), and is identified by the local mic connector, speaker and volume knob on the front. All connections are the same except the for TX AUDIO. On "Late" models, the audio is connected to the "battery alarm audio" point.

2. Remove the jumper between H16 and H17 (if installed) on the 10-volt regulator card.

3. If DCS decode is required, discriminator audio MUST be connected to J606 on the IF/Audio/Squelch board. If only CTCSS tone decode is required, discriminator audio may be connected to Volume Squelch Hi (J932 Pin 3).

4. Remove any existing repeater tone panel (card-per-tone), and "Repeater Audio" and/or "Repeater Control" cards (if installed).

5. If digital coded squelch encode is to be used, the exciter MUST be the newer style "FM" unit. If using the Audio Processor board number 19C321542G1, C105 must be 10uf, and C110 must be 22uf for proper digital encoding.

CONNECTION TO A GE CUSTOM MVP

For: Zetron Model 38-MAX
To: GE Custom MVP
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Inside front panel, S701 (switched side)
12 volts AC input	2	---	
DC ground	3	Black	Chassis Ground
Ground	4	Drain	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	System Audio Squelch board, J911 (PTT)
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	System Audio Squelch board, J912 (CAS)
Tx audio	11	Blue	Exciter board, P902 Pin 4 (Mic Hi)
Ground	12	---	
CTCSS/DCS encode	13	Green	Exciter board, P902 Pin 9 (CG Hi)
Ground	14	Brown	Exciter board, P902 Pin 5 (Mic Lo)
Discriminator in	15	White	IF Detector board, junction of R606/R608/C622

GE MVP CONFIGURATION:

1. Cut circuit trace on top of System Audio Squelch board which runs from U902 pin 6 toward R11. cut trace close to U902. This disables receiver muting on PTT.

2. Install a jumper between J904 pin 2 (rx osc control) and J904 pin 1 (10v reg) on the System Audio Squelch board. This provides a source of unswitched 10V to the receiver oscillator at all times.

CONNECTION TO A GE EXEC II BASE

For: Zetron Model 38-MAX
To: GE Exec II base
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	J904 pin 8
12 volts AC input	2	---	
DC ground	3	Black	J904 pin 5
Ground	4	Drain	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	H6 or J907 pin 10
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Q923 collector (CAS)
Tx audio	11	Blue	J902 pin 4
Ground	12	---	
CTCSS/DCS encode	13	Green	J902, pin 9 (CG Hi)
Ground	14	Brown	J904 pin 5
Discriminator in	15	White	J907, pin 8 (vol hi)

GE EXEC II CONFIGURATION:

To modify the radio for full duplex (repeater) operation, make the following changes on the System Audio Squelch board:

1. Remove Q905, or disconnect Q905 collector.
2. Install a wire jumper from Q908 emitter to Q908 collector.
3. Short CR901 cathode to CR902 cathode.
4. Care should be taken not to damage the transmitter PA due to continuous duty operation.

CONNECTION TO A GENERAL ELECTRIC MASTR PRO REPEATER

For: Zetron Model 38-MAX
To: General Electric Mastr Pro Repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	TB501 Pin 8 or 9, +12.6V
12 volts AC input	2	---	
DC ground	3	Black	TB501 Pin 11 or 12, GRD
Ground	4	Drain	No connection
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	TB502 Pin 10, XMIT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	TB502 Pin 16, COS FEED
Tx audio	11	Blue	J902 Pin 2, MIKE HI (mic connector)
Ground	12	---	
CTCSS/DCS encode	13	Green	P101 Pin 10, Tone Encoder In (xmitter)
Ground	14	Brown	No connection
Discriminator in	15	White	TB502 Pin 2, AUD CPLR HI

INSTALLATION NOTES:

1. Connect transmit audio directly to the microphone connector.

2. Verify the transmitter is equipped with the channel guard encode option. Remove any existing CTCSS tone encoder hardware.

3. Disable any channel guard decode in the receiver, or connect TB502 Pin 11 (CG MON) to ground.

CONNECTION TO AN ICOM IC-RP1510 REPEATER

For: Zetron Model 38-MAX
To: ICOM IC-RP1510 repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connections
12 volts AC/DC in	1	Red	Anode DC, pwr bus
12 volts AC input	2	---	
DC ground	3	Black	J2 pin 1, GND (logic board)
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	J2 pin 5, PTT (logic board)
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	P5 pin 2, Sqlsw (green wire rx unit)
Tx audio	11	Blue	Junction of R49 and C20 (logic board)
Ground	12	---	
CTCSS/DCS encode	13	Green	Right side of R43 (logic board)
Ground	14	Brown	J2 pin 3, GND (logic board)
Discriminator in	15	White	Negative side of C32 (logic board)

RADIO CONFIGURATION:

1. Remove R22 (22K) to isolate PTT indication to control logic.
2. Isolate PTT control line from control logic by cutting trace next to J2 pin 6 (PTT).
3. Remove C20 (0.1uf) to isolate voice audio from summing amp.
4. Change R43 to 10K ohm, and cut trace between IC8 pin 7 and R43.
5. Remove C32 (0.47uf) to isolate discriminator output from logic board.

OPERATIONAL NOTES:

1. Squelch control on front panel sets COR for tone panel and speaker.
2. Front panel speaker will monitor all channel activity.
3. Microphone set on front panel will still function.
4. This transmitter is not capable of DCS encode.

CONNECTION TO AN E.F. JOHNSON CR1000 REPEATER

For: Zetron Model 38-MAX
To: E.F. Johnson CR1000
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Pin 21, Level Adjust Card
12 volts AC input	2	---	
DC ground	3	Black	Pin 24, Level Adjust Card
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Pin 19, Level Adjust Card
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 12, Level Adjust Card
Tx audio	11	Blue	Pin 18, Level Adjust Card
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 22, Level Adjust Card
Ground	14	Brown	Ground
Discriminator in	15	White	Pin 11, Level Adjust Card

CR1000 CONFIGURATION:

1. Move the wire in the receiver off of J211, connect to U201 pin 6. This provides unfiltered receive audio to the Model 38-MAX.

2. Disconnect one side of C709 on the Level Card.

3. Set the Repeat switches to: Access=tone, Repeat=off.

CONNECTION TO AN E.F. JOHNSON CR1010 REPEATER

For: Zetron Model 38-MAX
To: E.F. Johnson CR1010
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Logic Drawer Pin 15, +13.8V
12 volts AC input	2	---	
DC ground	3	Black	Logic Drawer Pin 13, Gnd
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Logic Drawer Pin 23, $\overline{PTT}$
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Logic Drawer Pin 19, Fast squelch
Tx audio	11	Blue	Exciter Drawer Pin 1, Tx audio
Ground	12	---	
CTCSS/DCS encode	13	Green	Logic Drawer Pin 18, Tx tone CG
Ground	14	Brown	Ground
Discriminator in	15	White	Logic Drawer Pin 5, CG Audio

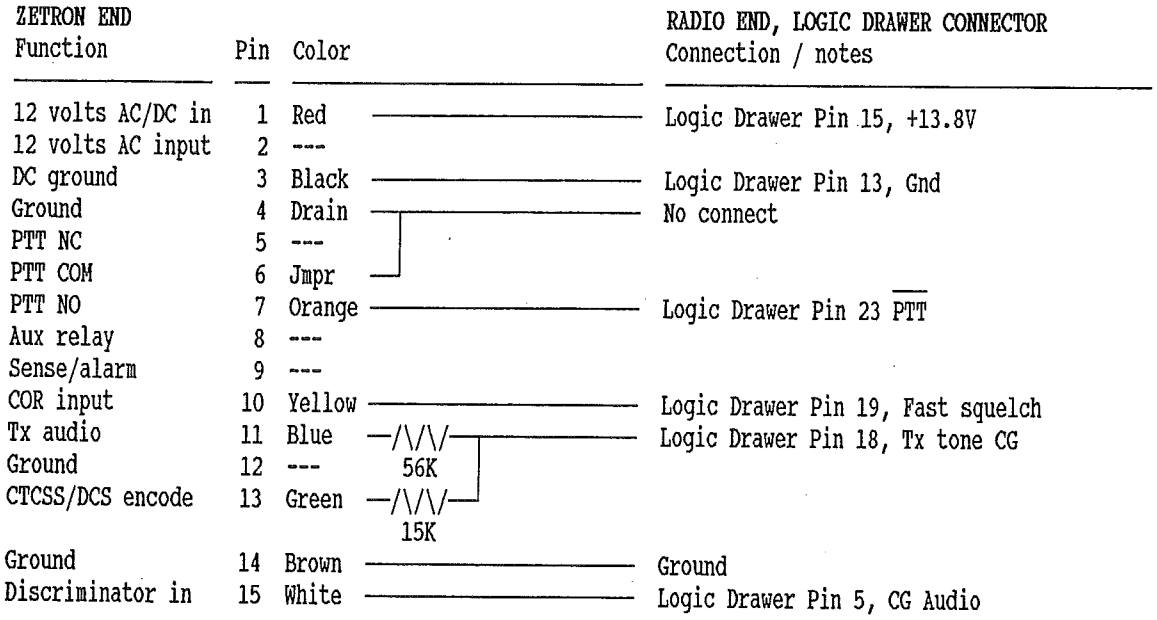
CR1010 CONFIGURATION:

1. Remove the brown wire from receiver going to the exciter transmit audio (Pin 1).

2. NOTE: This configuration uses the limiter and high-pass filter in the exciter. Since the Model 38-MAX has a high-pass filter to remove the CTCSS or digital coded squelch encode from the repeat audio, as well as the exciter, two high-pass filters in series may degrade the audio quality. The repeat audio quality may be improved by deleting (bypassing) the high-pass filter in either the Model 38-MAX or the exciter.

CONNECTION TO AN E.F. JOHNSON CR1010 REPEATER, ALTERNATE HOOKUP

For: Zetron Model 38-MAX
To: E.F. Johnson CR1010, alternate hookup
Using: 709-7112 Generic radio cable



CR1010 CONFIGURATION:

1. Remove the brown wire from receiver going to the exciter transmit audio (Pin 1).

2. Add a 10K ohm resistor across R123 in the exciter.

3. NOTE: This configuration does not use the deviation limiter in the exciter. It does provide a higher quality repeat audio quality than the hookup on the previous page.

CONNECTION TO AN E.F. JOHNSON VIKING UNIVERSAL STATION

For: Zetron Model 38-MAX
To: E.F. Johnson Viking Universal Station
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	J2-23, +15_ACC
12 volts AC input	2	---	
DC ground	3	Black	J2-21, Ground
Ground	4	Shield	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	J2-7, PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	J2-4, SQUELCH
Tx audio	11	Blue	J2-5, TX_AUDIO
Ground	12	---	
CTCSS/DCS encode	13	Green	J2-6, TX_DATA
Ground	14	Brown	J2-22, Ground
Discriminator in	15	White	J2-2, WB_DISC

RADIO CONFIGURATION:

1. The radio requires the Third Party Interface Card.

CONNECTION TO A KENWOOD TKR-720 / TKR-820 REPEATER

For: Zetron Model 38-MAX
To: Kenwood TKR-720 / TKR-820 repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Pin 7 SB
12 volts AC input	2	---	
DC ground	3	Black	Pin 11 Ground
Ground	4	Shield	No Connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Pin 8 PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 13 CO
Tx audio	11	Blue	Pin 5 L1
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 3 D1
Ground	14	Brown	Pin 6 SG
Discriminator in	15	White	Pin 4 DE
		PTT enable jumper	Pin 1 HK Pin 2 LG
		Speaker enable jumper	Pin 9 SI Pin 12 SO

RADIO MODIFICATIONS:

Note: These modifications may not apply to all versions of the TKR-radio. Refer to the Kenwood service manual and schematic diagram.

1. On the TX/RX Unit board, foil side:
   Cut the trace leading to CN3-8 (AFO). Add a jumper wire between CN3-8 and CN6-9 (DET). This corrects a foil error found in older Kenwood units.

   Cut the trace between CN7-1 (tone) and R68. This isolates the tone board injection point when the Zetron device keys the repeater.

2. On the Display Unit board, foil side:
   Remove J14, and add a jumper wire between CN8-4 (DE) and CN2-6 (det). This bypasses C22 on the display board for DCS decode capability.

3. Set the switches for:
   Takeover = Off / disabled
   Repeat = Off / full duplex transceiver
   Monitor = DC

CONNECTION TO A MIDLAND BASETECH REPEATER

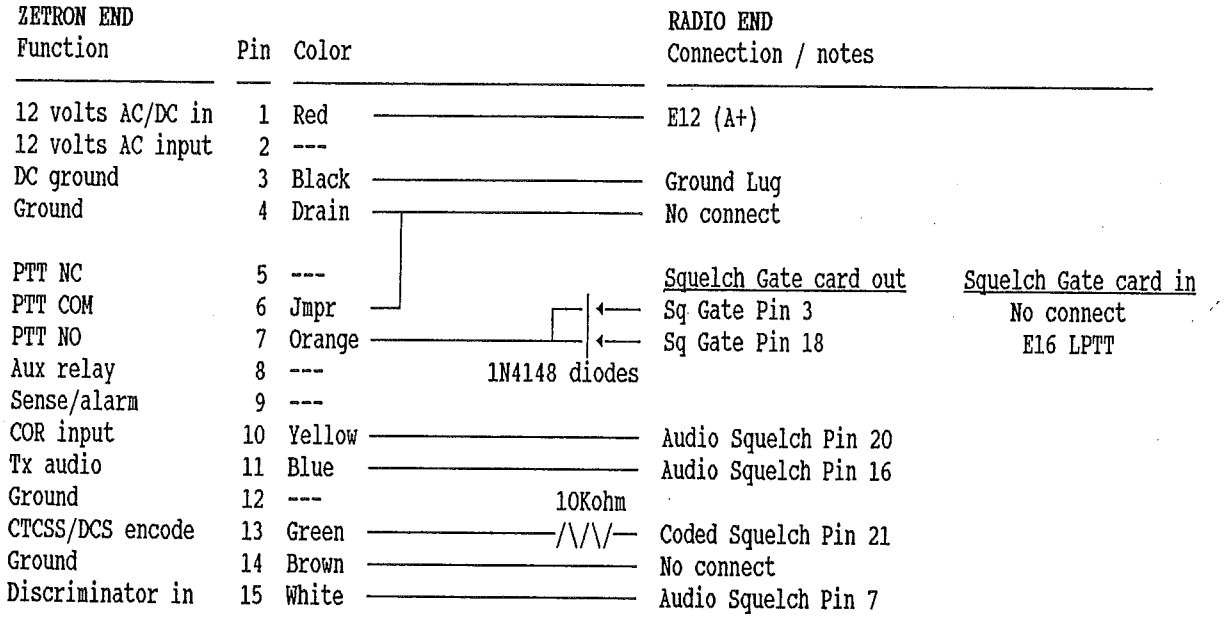
For: Zetron Model 38-MAX
To: Midland Basetech Repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END DB-9 connector Connection / notes
12 volts AC/DC in	1	Red	Pin 1, +12.6V
12 volts AC input	2	---	
DC ground	3	Black	Pin 3, Ground
Ground	4	Drain	No connection
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Pin 5, PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 6, COS
Tx audio	11	Blue	Pin 2, AF
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 9, TONE
Ground	14	Brown	No connection
Discriminator in	15	White	Pin 3, RX DISC

DPL polarity programming: Encode=Normal, Decode=Normal

CONNECTION TO A MOTOROLA MSR 2000 BASE/REPEATER

For: Zetron Model 38-MAX
To: Motorola MSR 2000 base/repeater
Using: 709-7112 Generic radio cable or
709-7105 MSR 2000 cable



MSR 2000 CONFIGURATION:

1. Remove all jumpers on the RF control chassis backplane except JU1, JU4, JU5 and JU9
2. Only R1 Audio and Station Control Modules are required, Squelch Gate is optional.
3. Changes to R1 Audio control card:
   Install JU1 and JU101, Remove JU2, JU103, JU104, JU105, CR2 and CR106.
4. Changes to Station Card:
   Install JU2 - JU8, remove JU9 - JU11.
5. Changes to Line Driver:
   Remove JU15 and CR3.
6. Changes to Squelch Gate card:
   Remove R74; make sure JU7 and JU12 are installed.

DPL polarity programming: Encode=Normal, Decode=Normal

CONNECTION TO A MOTOROLA GR300 REPEATER (or a pair of GM300 radios)

For: Zetron Model 38
To: Motorola GR300 repeater or a pair of GM300 mobiles

ZETRON END Function	Pin	Color	RECEIVE GM300
12 volts AC/DC in	1	Red	AUX Pin 13, Switched A+
DC ground	3	Black	AUX Pin 7, Ground
Ground	4	Shield	No connect
COR input	10	Yellow	AUX Pin 8, CSQ Detect
Discriminator in	15	White	AUX Pin 11, Disc audio
		Speaker enable jumper	AUX Pin 15, Internal speaker
			AUX Pin 16, External speaker

ZETRON END Function	Pin	Color	TRANSMIT GM300
Ground	4	Jmpr	
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	AUX Pin 3, Microphone PTT
Aux relay	8	---	
Sense/alarm	9	---	
Tx audio	11	Blue	AUX Pin 2, Microphone audio
Ground	12	Shield	No connect
CTCSS/DCS encode	13	Green	AUX Pin 5, Flat Tx audio
Ground	14	Black	AUX Pin 7, Ground
		Speaker enable jumper	AUX Pin 15, Internal speaker
			AUX Pin 16, External speaker

RADIO CONFIGURATION:

1. Set radio jumpers as follows:
   JU551 position A, flat/unmuted discriminator audio
   JU651 position A, tx audio gain selection
   JU701 position B, flat tx audio limiter bypass (16ch only)

2. Program both radio accessory connectors (with the RSS) as follows:

ACCESSORY CONNECTOR CONFIG

INT Accessory: None EXT Accessory: General I/O Custom: Y

PIN#	DESCRIPTION	DATA DIR	DEBOUNCE	ACT LEVEL
4	NULL 2	Output	No	High
6	NULL 1	Input	No	High
8	CSQ Detect	Output	No	Low
9	NULL 1	Input	No	High
12	NULL 1	Input	No	High
14	NULL 1	Input	Yes	Low

CONNECTION TO A MOTOROLA MSF 5000 ANALOG REPEATER

For: Zetron Model 38-MAX
To: Motorola MSF 5000 analog (older) repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	J800 Pins 1 and 2, or TB601 (A+) on pwr supply
12 volts AC input	2	---	
DC ground	3	Black	J800 Pins 7 and 8, or TB601 (gnd) on pwr supply
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	J801 Pin 14
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Test Point 6 (0.5v SQ, 2.9v US)
Tx audio	11	Blue	U834 Pin 13 (1vpp=3kHz)
Ground	12	---	both 33Kohm
CTCSS/DCS encode	13	Green	Wiper of R889 IDC pot (3vpp=0.75kHz)
Ground	14	Brown	No connect
Discriminator in	15	White	Test Point 3 (3kHz=1vpp)

MSF 5000 CONFIGURATION:

1. Make all connections to the Station Control Module PCB.
2. Set "AccDis" switch UP.

DPL polarity programming: Encode=Normal, Decode=Normal

CONNECTION TO A MOTOROLA MSF 5000 DIGITAL REPEATER

For: Zetron Model 38-MAX
To: Motorola MSF 5000 "digital capable" station
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	R8121, side closest to center of PCB
12 volts AC input	2	---	
DC ground	3	Black	TP2
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	SW800, pin closest to outside edge of PCB
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	U1552, pin 1
Tx audio	11	Blue	U814, pin 2
Ground	12	---	
CTCSS/DCS encode	13	Green	U831, pin 3
Ground	14	Brown	TP2
Discriminator in	15	White	Test point 3

/\/\/— both 33Kohm

MSF 5000 DIGITAL CAPABLE STATION CONFIGURATION:

1. Drill a cable access hole in the rear of the Station Control Module plastic housing, about mid point. Install a cable access hole grommet and strain relief.

2. Make all connections to the Station Control Module PCB.

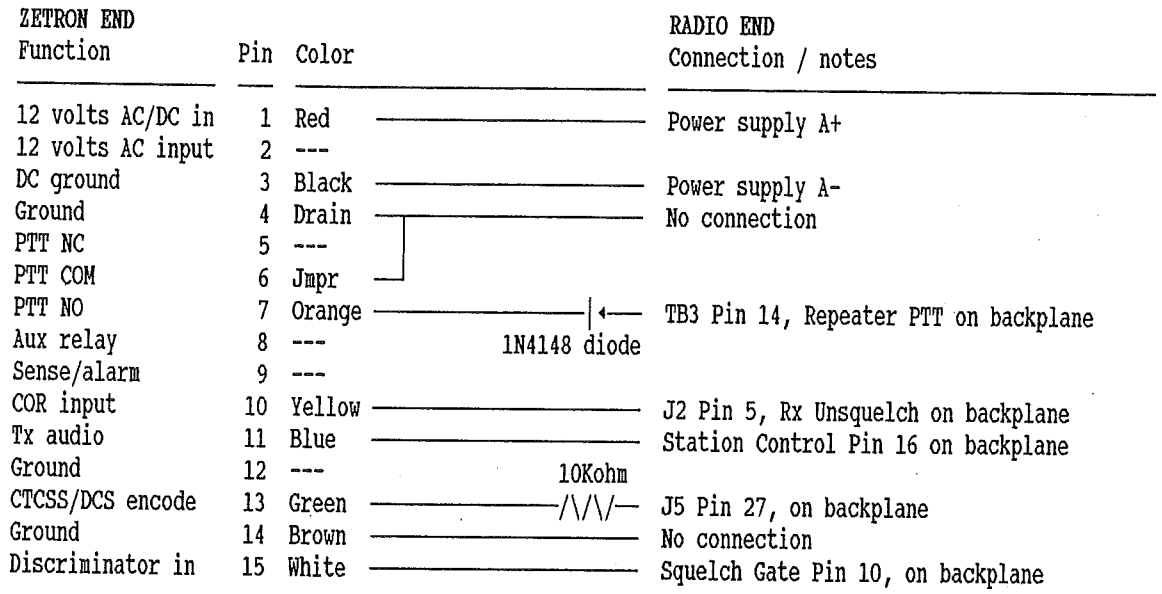
3. Set "AccDis" switch UP.

4. CAUTION! The front panel SQUELCH control (on the MSF) will set the CARRIER threshold for the Model 38-MAX.

DPL polarity programming: Encode=Normal, Decode=Normal

CONNECTION TO A MOTOROLA MICOR REPEATER

For: Zetron Model 38-MAX
To: Motorola Micor Repeater
Using: 709-7112 Generic radio cable



MICOR CONFIGURATION:

1. Remove all modules except Station Control and the Squelch Gate card. Remove PL/DPL encoder and decoder boards.
2. Modify the control modules as follows:
   a) Station Control: Jumper the "PL Disable" switch ON.
   b) Squelch Gate: Remove C17, in the exciter output line.
3. Modify Rx audio squelch board (TRN-6006A);
   Add jumper from U202 pin 10 to P903 pin 14.
4. Modify exciter board (TLE-1720A);
   Add jumper from IDC pot wiper to P902 pin 8, cut trace between P902 pin 8 and JU401.
5. Modify backplane board;
   Cut trace going to J2 pin 5, cut trace going to J5 pin 27.

DPL polarity programming: Encode=Invert, Decode=Normal

CONNECTION TO A MOTOROLA MCR-100 / RADIUS R-100

For: Zetron Model 38-MAX
To: Motorola MCR-100 / Radius R-100
Using: 709-7112 Generic radio cable, or 709-7109

ZETRON END Function	Pin	Color	RADIO END (DB-25P) Connection / notes
12 volts AC/DC in	1	Red	JAUX Pin 3, A+
12 volts AC input	2	---	
DC ground	3	Black	JAUX Pin 14, Desk set ground
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	JAUX Pin 4, PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	JAUX Pin 12, Audio Control
Tx audio	11	Blue	JAUX Pin 5, Audio from phone patch
Ground	12	---	
CTCSS/DCS encode	13	Green	JAUX Pin 23, uncommitted
Ground	14	Brown	JAUX Pin 6
Discriminator in	15	White	JAUX Pin 25, uncommitted

RADIO MODIFICATIONS:

1. Install a jumper from U601 pin 9 on the TX Command Board to JAUX Pin 23. This routes CTCSS/DCS modulation to the TX Command Board.

2. Install a jumper from U551A pin 4 on the RX Board to JAUX Pin 25. This routes unfiltered discriminator audio from the receiver to the JAUX connector.

3. Program the R-100 for carrier squelch operation and disable repeater operation using the RPTR Disable Switch on the RPT Control Board.

4. Order the R-100 with the DPL Option if DPL is to be used in the Model 38-MAX. If the R-100 is ordered as either the PL or carrier squelch model, several capacitors need to be changed in the receiver and transmitter. See the R-100 service manual for additional information concerning what capacitor values require changing.

5. Repeated audio from the Model 38-MAX will be heard in the local speaker if the Model 38-MAX transmit audio is connected to JAUX Pin 5. This is because audio appearing at pin 5 is distributed to several points in the R-100 Interface Board (including the local audio amp, the exciter board, and the line output) before being applied to the TX Command Board. If desired, transmitted voice modulation may be applied directly to the TX Command Board using the emitter of Q601.

CONNECTION TO A REPCO DIMENSION REPEATER

For: Zetron Model 38-MAX
To: Repco Dimension Repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Pin 8, CTCSS barrier strip (13.6 VDC)
12 volts AC input	2	---	
DC ground	3	Black	Pin 2, CTCSS barrier strip (GND)
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Pin 4, Tel barrier strip (KEY)
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 7, CTCSS barrier strip (COS), active low
Tx audio	11	Blue	Pin 4, CTCSS barrier strip (A IN)
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 3, CTCSS barrier strip (T IN)
Ground	14	Brown	No connect
Discriminator in	15	White	Pin 1, CTCSS barrier strip (DISC)

REPCO REPEATER CONFIGURATION:

1. Remove factory tone boards from card slots.

2. Set front panel switches as follows:
   TONE = off
   LOCAL/RPT = LOCAL

Note: Repeater is not capable of Digital Coded Squelch.

CONNECTION TO REGENCY/WILSON MICROCOMM REPEATERS

For: Zetron Model 38-MAX
To: Regency / Wilson Microcomm Repeaters
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	+12VDC, power supply in repeater
12 volts AC input	2	---	
DC ground	3	Black	DC Ground, power supply in repeater
Ground	4	Drain	No connection
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	PTT, C6 on control board
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	K9 or Pin 15 of IC20, SQ indication
Tx audio	11	Blue	U1 on control board
Ground	12	---	
CTCSS/DCS encode	13	Green	U2 on control board
Ground	14	Brown	No connection
Discriminator in	15	White	A0 on receiver shield, Rec Audio

MODIFICATIONS TO RADIO:

1. Remove jumper between A2 and A3 of P706 if present. This will break the repeat audio path if the station was configured for carrier squelch operation.

2. Remove any CTCSS tone decode boards if present.

3. Move jumper JU702 from P709 (transmit) to the NC (disable) position. This disables repeater PTT while still allowing local and M38-MAX generated PTT.

4. Move jumper JU718 from P707 (tone) to P708 (squelch). This configures the unit as a carrier squelch repeater.

5. A series resistor may be needed in the CTCSS and TX modulation encode lines if loading is noted. Values of 10K to 50K ohm are typical.

CONNECTION TO A STANDARD RPT10/RPT21

For: Zetron Model 38-MAX
To: Standard RPT10/RPT21
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Connection / notes
12 volts AC/DC in	1	Red	Multitone Pin 4, 13.8v
12 volts AC input	2	---	
DC ground	3	Black	Multitone Pin 5, Gnd
Ground	4	Drain	No connect
PTT NC	5	---	
PTT COM	6	Jmpr	
PTT NO	7	Orange	Multitone Pin 9, PTT
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Receiver Pin 7, COR
Tx audio	11	Blue	Control Pin 9, Mic Hi
Ground	12	---	
CTCSS/DCS encode	13	Green	Multitone Pin 3, Tone
Ground	14	Brown	Control Pin 6, Mic Lo
Discriminator in	15	White	Multitone Pin 2, Disc

CONFIGURATION NOTES:

1. Set the switch on the front of the repeater to "NON-RPT".

2. Set M38-MAX switch 5 (CTCSS de-emphasis) ON for RPT10, OFF for RPT21.

CONNECTION TO A TAIT T300 SERIES RADIO

For: Zetron Model 38-MAX
To: Tait T300 series base station
Direct plug in replacement for Tait T311 panel

ZETRON END Function	Pin	Color	RADIO END, 25 way "D" range female socket Connection / notes
12 volts AC/DC in	1	Red	Pin 8, +VE 12V
12 volts AC input	2	---	
DC ground	3	Grey	Pin 5, GROUND
Ground	4	Link	
PTT NC	5	---	
PTT COM	6	Link	
PTT NO	7	Yellow	Pin 10, TX KEY
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Purple	Pin 20, RX GATE, ** NOTE 2
Tx audio	11	Brown	Pin 7, TX AF
Ground	12	---	
CTCSS/DCS encode	13	White	Pin 2, CTCSS ENCODE
Ground	14	---	
Discriminator in	15	Blue	Pin 6, RX AF

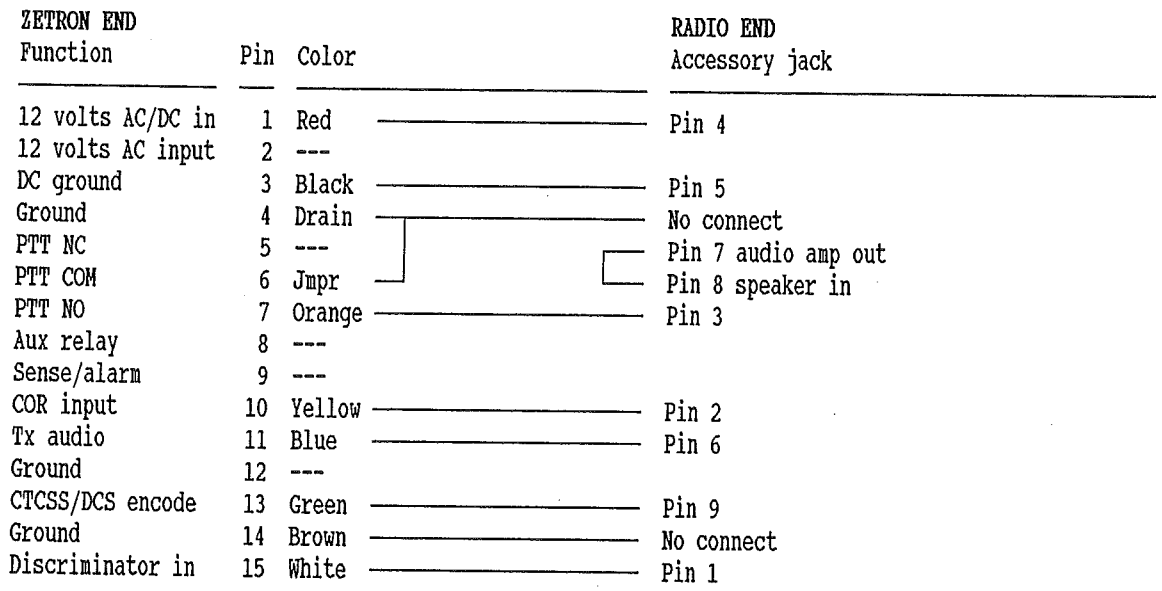
TAIT CONFIGURATION:

1. Links made on "D" range socket:
   - 1-4 Earth one side Rx 600 ohm
   - 1-3 Earth one side Tx 600 ohm
   - 1-5 Earth

2. Check the RX GATE lead goes to RX GATE on the Tait Base Station as on some models this lead may have been left disconnected.

CONNECTION TO A UNIDEN ARU 251 REPEATER

For: Zetron Model 38-MAX
To: Uniden ARU 251 repeater ***(THIS IS NOT FOR ARU 251K)***
Using: 709-7112 Generic radio cable



ZETRON END Function	Pin	Color	RADIO END Accessory jack
12 volts AC/DC in	1	Red	Pin 4
12 volts AC input	2	---	
DC ground	3	Black	Pin 5
Ground	4	Drain	No connect
PTT NC	5	---	Pin 7 audio amp out
PTT COM	6	Jmpr	Pin 8 speaker in
PTT NO	7	Orange	Pin 3
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 2
Tx audio	11	Blue	Pin 6
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 9
Ground	14	Brown	No connect
Discriminator in	15	White	Pin 1

RADIO CONFIGURATION:

1. Disconnect the tone encode lead from the exciter at FT18 on the exciter case (leave wire disconnected).

2. Attach a wire from FT18 on the exciter case to pin 9 of the accessory jack. This provides CTCSS encode from the tone panel to the transmitter.

3. Set the control board switch to "Carrier Squelch" position.

4. Set the front panel switches to: LOCAL and MONITOR.

NOTE: This radio is not capable of DCS encode.

CONNECTION TO A UNIDEN ARU 251 "K" REPEATER

For: Zetron Model 38-MAX
To: Uniden ARU 251 "K" repeater
Using: 709-7112 Generic radio cable

ZETRON END Function	Pin	Color	RADIO END Accessory jack
12 volts AC/DC in	1	Red	Pin 6
12 volts AC input	2	---	
DC ground	3	Black	Pin 8
Ground	4	Drain	No connect
PTT NC	5	---	Pin 4 audio amp out
PTT COM	6	Jmpr	Pin 5 speaker in
PTT NO	7	Orange	Pin 1
Aux relay	8	---	
Sense/alarm	9	---	
COR input	10	Yellow	Pin 2
Tx audio	11	Blue	Pin 7
Ground	12	---	
CTCSS/DCS encode	13	Green	Pin 9
Ground	14	Brown	Pin 8
Discriminator in	15	White	Pin 3

RADIO CONFIGURATION:

1. Disconnect the tone encode lead from the exciter at FT18 on the exciter case (leave wire disconnected).

2. Attach a wire from FT18 on the exciter case to pin 9 of the accessory jack. This provides CTCSS encode from the tone panel to the transmitter.

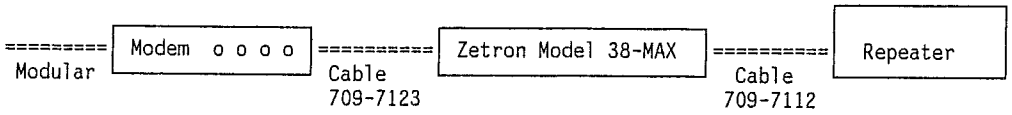
3. Set the control board switch to "Carrier Squelch" position.

4. Set the front panel switches to: LOCAL and MONITOR.

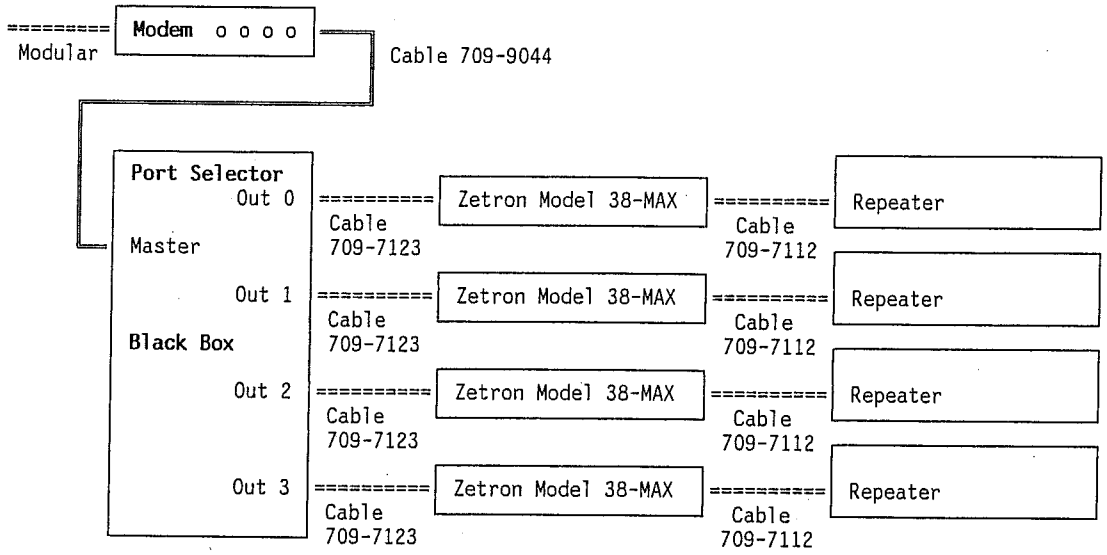
NOTE: This radio is not capable of DCS encode.

PROGRAMMING CONNECTIONS

Single Model 38-MAX with Modem Programming



Multiple Model 38-MAXs with Modem Programming



* * * * * * * * * * * * * * * C A U T I O N * * * * * * * * * * * * * * *

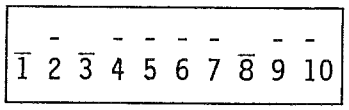
ZCU may or may not support auto download with various switching devices.

* *

Modem Cable (709-7123) Diagram

MODEM END (DB25P) Pin	Function	Color	ZETRON END (DB9P) Pin	Function
2	Transmit data	Orange	3	Transmit
3	Receive data	Yellow	4	Receive
7	Ground	Green	5	Ground
8	Carrier detect	Red	2	Not used
20	Data terminal ready	Brown	1	Not used

Hayes SmartModem 1200 Configuration Switch
When using a Hayes auto-answer modem, the switches are usually set as follows:



1 = Ignore DTR
2 = Result code words
3 = Result codes displayed
4 = Characters echoed in command state
5 = Auto-answer enabled
6 = Carrier detect reflects actual result
7 = Telco jack RJ11
8 = Command recognition enabled
9 = Communication standard at 1200 bps, Bell 212A
10 = Response to DTR

Typical Connection to a Computer or Video Terminal

M38-MAX DB-9	Function	Connection	Terminal PC DB-25	Terminal AT DB-9
3	Tx data	To terminal "Rx data"	3	2
4	Rx data	From terminal "Tx data"	2	3
5	Ground	Ground	7	5
n/a	No connect	RTS, jumper to CTS	4	7
n/a	No connect	CTS, jumper to RTS	5	8
n/a	No connect	DSR, jumper to DTR	6	6
n/a	No connect	DTR, jumper to DSR	20	4

* * * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * *

Be sure to jumper RTS to CTS, and DSR to DTR!

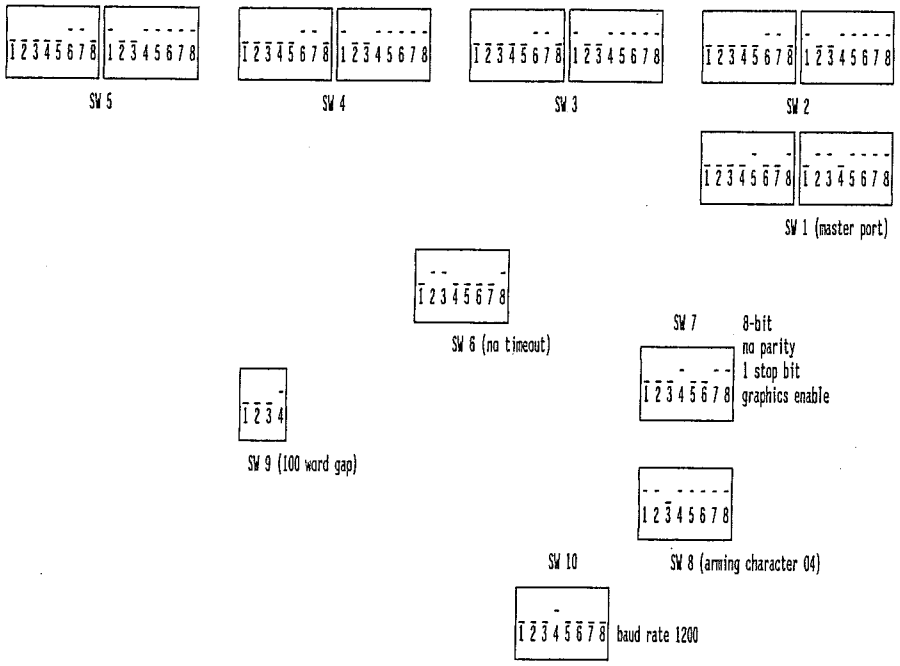
* *

Only three wires are required between the Model 38-MAX and the computer or terminal.

The following pre-wired cables for popular computers and terminals are available from Zetron:

Part #	Description
709-7027	RS-232 interface cable, DB-25P (terminal compatible)
709-9030	RS-232 interface cable, DB-25S (PC compatible)
709-7144	RS-232 interface cable, DB-9S (PC AT compatible)

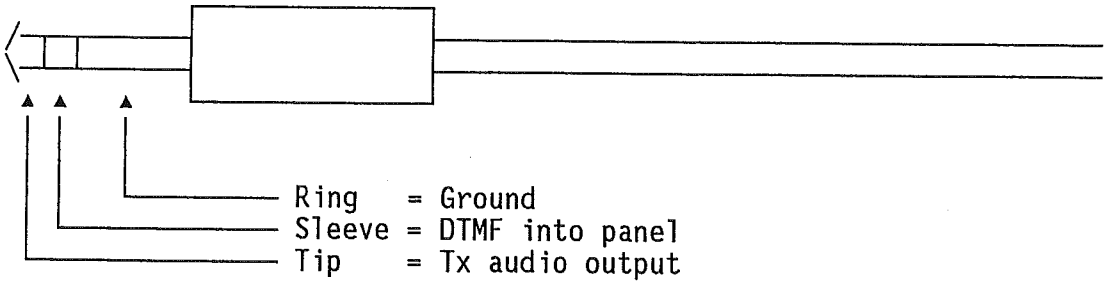
Black Box Code Operated Switch Settings
These switch settings apply for COS-4P or COS-8P units with serial number 8020187 and higher. Set front panel switch to "Graphics", arming character is "Control D" (04 hex), baud rate is 1200.



Front Panel Program Connector
To use the front panel "Program" connector, a DTMF encoder must be provided that can generate DTMF tones between 0.5 and 2.0 volts peak-to-peak. The connector is a three wire interface (miniature stereo type) that provides the following signals:

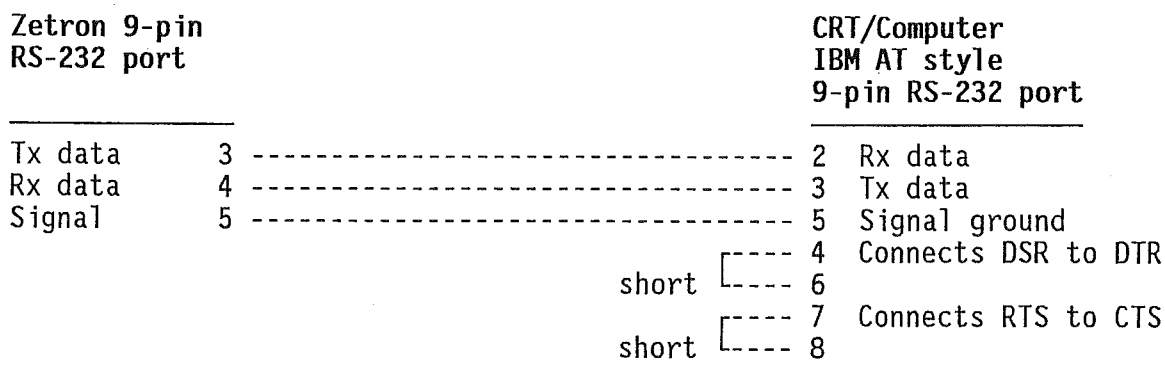
1. Signal Ground
2. DTMF receive audio
3. Repeater Panel transmit audio output

The miniature stereo Program connector is wired as follows:

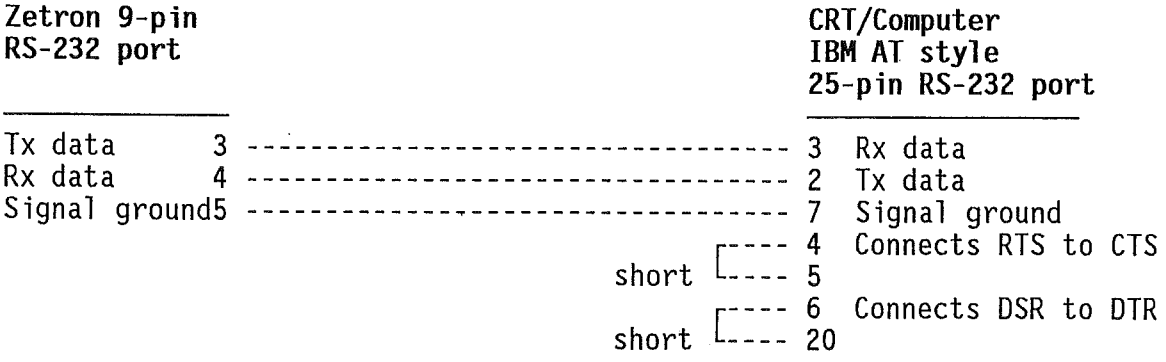


An amplifier may be used on the Tx audio output to hear the prompt tones generated by the Model 38-MAX during programming. Note: While the stereo plug is installed in the Program connector, DTMF on the radio channel will not reach the DTMF decoder in the Model 38-MAX.

9-9 Pin Cable Diagram
A direct connection cable diagram for connecting a Zetron device to a CRT/computer that has a DB-9 pin RS-232 port is shown below.



9-25 Pin Cable Diagram
A direct connection cable diagram for connecting a Zetron device to a CRT/computer that has a DB-25 pin RS-232 port is shown below.



* * * * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * * * *

These cable diagrams are correct for most computers. If RS-232 communication is not successful, consult your computer manual for the RS-232 pin-out description.

* *

INSTALLING A NEW PROM

IMPORTANT!

The EPROM label has the last four digits of a serial number written on it. This must match the last four digits of the panel it is to be installed in.

IMPORTANT!

The software is contained in an IC (Integrated Circuit) called an EPROM (Erasable Programmable Read Only Memory). The EPROM contains the software program that controls the operation of the Model 38-MAX.

This device is delicate and sensitive to static electricity. When handling it, be sure to keep your fingers in contact with the chassis sheet metal to keep yourself grounded. Only remove the IC from the static protective shipping material when ready for installation. To install the new EPROM IC, do the following:

1. Turn off the power.
2. Remove the cover.
3. Remove the old EPROM from the board.
4. Look at the old EPROM carefully. There is an orientation notch on the end.
5. Install the new EPROM in the socket with the orientation notches aligned with the notches in the socket.
6. Now take some time to look carefully at all of the pins of the chip. Make sure that the pins are aligned in the socket and are fully inserted, not bent out, and not bent under. If the unit is powered on without proper EPROM connection, the user programmable memory (database) may be cleared.
7. Read any attached rework instructions for your hardware version.
8. Turn on the power and make sure that the display indicates normal.
9. Replace the cover.
10. Return the old EPROM to Zetron in the protective shipping material in which the new EPROM was shipped.

6. REPAIR

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DCS tips 6-2

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6. REPAIR

IN CASE OF DIFFICULTY...

In case of installation difficulty, call Zetron Model 38-MAX Applications Engineering Department at (206) 820-6363. Engineers are available. Please have the serial number of the unit and/or the Zetron Order number. If the call is made from the installation site by the installer or radio technician, the problem can usually be solved over the phone.

If a problem develops after a unit has been in service for some time, call the Zetron Model 38-MAX Service Department at (206) 820-6363. If the call is made from the installation site by a radio technician, the problem can usually be solved over the phone.

Service Notes

1. If a 400-Hz beep is heard just prior to the transmitter being unkeyed, the Model 38-MAX is reporting a problem. Use the "Setup menu" (see Section 4) to find the source of the problem.

2. When the unit is reset or powered on, an automatic memory test will be executed. If greater than 15 memory errors are detected, the unit will reset all of its memory to the default settings.

3. If the unit gets "locked-up" possibly due to lightening, a DTMF key may be held for greater than 15 seconds to reset the unit. This removes the requirement to go to the repeater site to reset the unit.

4. If the audio does not sound proper, perform an audio sweep test by generating an audio signal on the RF input of the repeater (of known deviation), and monitor the repeater output deviation. The deviation should be fairly flat from 300 to 2800 Hz.

5. When using the internal noise detector for COR, if the COR polarity switch seems backwards, the audio input from the receiver does not have enough high frequency content for the noise detector to operate. It is usually caused by a capacitor or some low pass filtering of the actual discriminator signal. An alternate connection point must be found in the receiver for either audio, or a receiver generated COR signal must be connected.

6. The "Carrier" LED MUST follow carrier activity on the channel. If it is always off, the Model 38-MAX will not detect CTCSS tones.

7. If a 2000 Hz beep tone is heard just prior to the transmitter unkeying, the Model 38-MAX is indicating that the site alarm input is active (or grounded).

8. If DCS decode seems sluggish or exhibits poor sensitivity, verify that jumper JP3 is in the "B" position.

DCS TIPS

When using DCS decode with CTCSS, the digital squelch tail elimination sequence sent by a mobile is approximately 134 Hz. This is close to the CTCSS frequencies 131.8 and 136.8. It is not a good idea to set mobiles on these tones.

When setting the DCS codes in the Model 38-MAX for the first time, use this procedure:

1. Use a mobile with a known DCS code.

2. Use the DCS encode test mode in the Model 38-MAX to generate the DCS code that the mobile is set to. If the mobile does not unsquelch, use the Model 38-MAX DCS encode invert selection. The mobile should unsquelch on either the normal or inverted code.

3. Do not set the deviation of the transmitter with a DCS code. The DCS code may result in an inaccurate reading on a deviation meter. Use a CTCSS tone for adjustment purposes.

4. To set the DCS decode number, pick a user number in the DCS range, above 50. Enable the user and set the DCS decode number. Key up the mobile and verify that the Model 38-MAX recognizes the mobile. If the mobile is not decoded, try inverting the Model 38-MAX receive polarity.

5. Once a single mobile is working through the Model 38-MAX, additional mobiles may be added.

THEORY OF OPERATION

The design of the Model 38-MAX Repeater Tone Panel is microprocessor based, resulting in a software intensive product whose operation can change minimally or radically by updating the instructions stored in memory. The microprocessor controls the relay, LED's, audio path, and peripheral chips such as the timer. It is also especially good at performing the high speed data management necessary to perform tone/digital decoding simultaneously with RS-232 CRT terminal interface.

Microprocessor Operation

To ensure an orderly power on sequence to the microprocessor U12, and its peripheral devices, the active low Reset signal is not brought up until the 12 volt supply has stabilized; the zener diode CR1, R2, R3 and U3F accomplish this task. The delayed reset also gives crystal Y2 time to stabilize. An additional reset input comes from the long DTMF reset circuit CR16, C54, R68, R69, U3E, and CR3. This circuit is a fail save device to allow the system operator to reset the unit by keying a DTMF digit for greater than 12 seconds. The Reset duration is controlled by R3 and C5.

Memory is functionally divided into three sections: Program memory, Operating memory, and protected Database memory. Program memory resides in erasable programmable read only memory EPROM U14/U16 and stores the actual operating instruction that make the Model 38-MAX act like a Repeater Tone Panel. Operating memory is provided by static read/write memory (RAM U15). The Model 38-MAX performs computations and maintains data buffer in this area. Database memory includes all the User and System programming values, and airtime counts. All of this information must be retained regardless of how often the unit loses power. To do this, the Model 38-MAX stores it in a low power static read/write memory that plugs into a socket with a battery (U15). Thus, the protected memory chip has its own private power supply with a 10 year lifespan.

A peripheral timer/counter, U17 are available to the microprocessor. The counter chip contains three timers with are used for tone generation and internal timing functions.

The microprocessor is able to directly control 8 I/O lines that interface to its Port 1 register on pins 13 thru 20. These carry information from the DTMF encoder/decoder chip, the relays, the Noise detector and squelch, and the LEDs.

Power Supply

Full wave bridge and filtering is normally used to smooth the 9-12 VAC from the wall transformer, or supply additional filtering of 12 VDC input. The 12 volts is available as an unregulated supply for the relays and LED's. The main +5 VDC supply is regulated by VR1, a +8 VDC supply is regulated by VR2 for audio circuits, R8, R9, and C14 produce a bias supply for audio circuits.

Serial Communications
A feature of the microprocessor is that it contains an internal UART for asynchronous data transfer. The UART receives data through pin 11 of the microprocessor but first it is level shifted to 0 to 5 volt levels by U1. Transmitted data leaves through pin 12 of U4 then gets level shifted by U10 to standard RS-232 levels. The internal programming supports the XON/XOFF protocol. All standard baud rates are generated by the timer IC U17 pin 6 connected to the microprocessor bit clock input pin 10.

CTCSS/Digital Decoding
Unsquelched discriminator receiver audio passes thru gain stage U7 then gets low pass filtered by U22A and U22B. This removes the voice component from the audio. U21 makes up a zero crossing detector which feeds a digital signal into the microprocessor. The actual decoding of the CTCSS tones and Digital codes is done inside the microprocessor using Zetron proprietary digital signal processing techniques.

DTMF Decoding
The mobile audio is passed thru gain stage U7A, then is hi-pass filtered by U10 to remove the CTCSS/Digital encode frequencies. U23A is a low pass filter to remove high frequency noise from weak signals. Finally the signal is presented to the DTMF encoder/decoder chip U5. For front panel programming via DTMF, connector J6 will break the mobile audio path to the DTMF decoder while a plug is inserted.

CTCSS Encoding
Two signals are used for CTCSS generation. One is a clock frequency at the exact CTCSS rate from the microprocessor, and the other is a clock frequency at 64 times the CTCSS rate from the timer module. These signals are fed into a low pass filter U6, then sent out gain stage U7B to the transmitter. Since most transmitters will output higher deviation of higher frequencies (pre-emphasis), the filter C22 is switch selectable to de-emphasize the signal before being presented to the transmitter.

Digital Encoding
For generating Digital Squelch signals, the microprocessor will send the digital code out its pin 9. Data inversion is done inside the microprocessor if required. The timer module U5 will produce a high frequency clock signal that is fed into the low pass filter U18. Operation is very similar to CTCSS encoding described above.

DTMF Encoding
To generate a DTMF tone on the radio channel, the microprocessor controls the DTMF encoder/decoder IC U5 to generate a tone. The DTMF audio is passed through a filter (C44, R59) and summed at the transmit audio junction.

Beep Tone Encoding
Progress tones (Morse ID, warning beeps, etc..) are generated by timer chip U17. The square wave output is filtered by R63, C46, and C45, then summed at the transmit audio junction.

Squelch/Repeat Audio
The repeat audio is passed through the input gain stage, the audio hi-pass to remove the CTCSS/Digital encode, and finally to the squelch gate. The microprocessor controls the squelch via U19E level translator. The repeat audio is summed at the transmit audio junction, then passes thru U9A output buffer amp to the transmitter audio input. A filter is provided to de-emphasize the repeat audio via switch 1-4.

COR Input
When using external COR input, R26 and C28 provide input protection and R27 is an optional pullup to +5V. The signal then is presented to U11A and compared against the level set by the threshold pot R12. Device U11 and switch 1-7 provide COR polarity selection. The COR logic signal is presented to the microprocessor input port pin 19.

Noise Detector
When external COR is not possible, the internal noise detector may be used. The unsquelched discriminator audio is hi-pass filtered by U9B then rectified by CR8. The output then charges C20 with the high frequency component of the signal, and is compared against the squelch threshold pot R12. Switch 1-6 selects internal or external COR detection.

MODEL 38-MAX REPEATER TONE PANEL (702-9540B)
Parts List

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMPONENT REF.	MFG.PART NO.
1.	1	101-0010	1	R7	
2.	3	101-0047	47	R21 30 31	
3.	1	101-0061	330	R93	
4.	3	101-0066	510	R22 23 55	
5.	2	101-0068	620	R25 59	
6.	6	101-0071	820	R8 89-92 94	
7.	2	101-0073	1K	R24 36	
8.	1	101-0074	1.2K	R58	
9.	2	101-0081	2.2K	R46 48	
10.	3	101-0085	3.3K	R33 77 78	
11.	11	101-0089	4.7K	R2 9 29 40 41 50 51 57 64 65 66	
12.	1	101-0091	5.6K	R53	
13.	16	101-0097	10K	R4 5 10 16 17 20 26 27 35 37 42 43 47 61 63 96	
14.	1	101-0101	15K	R39	
15.	3	101-0103	18K	R18 85 100	
16.	7	101-0105	22K	R49 80 81 86 97 98 99	
17.	1	101-0107	27K	R60	
18.	5	101-0113	47K	R32 52 56 84 95	
19.	3	101-0115	56K	R19 44 45	
20.	1	101-0117	68K	R87	
21.	6	101-0121	100K	R38 62 69 76 82 88	
22.	1	101-0123	120K	R83	
23.	1	101-0133	330K	R79	
24.	4	101-0145	1M	R3 6 67 68	
25.	1	105-0001	VARISTOR 250V AC	RV1	
26.	1	107-0005	5K POT 1T RA	R14	
27.	3	107-0015	50K POT 1T RA	R11 12 13	
28.	1	119-0008	10Kx7 R-SIP	RP1	
29.	2	150-0024	24pF/D	C50 51	
30.	1	151-0047	470pF/TS	C16	
31.	1	151-0120	.01/TS	C44	
32.	1	151-0100	.033/TS	C23	
33.	2	151-0199	.47/50V/P	C5 22	
34.	10	152-0012	.1/50V/P	C18 26 35-37 56 57 59 64 70	
35.	2	152-0040	4.7/50V/P	C17 19	
36.	19	152-0085	.01/50V/P	C7 9 12 25 32 40 43 45-47 49 52 53 61 63 65 66 68 69	
37.	11	152-0089	.001/50V/P	C21 27-29 33 34 38 39 48 60 62	
38.	3	152-0250	.047/50V/P	C30 41 42	
39.	1	154-0025	1/35V/T	C20	
40.	3	154-0100	10/16V/T	C10 54 58	
41.	8	155-0052	10/35V/A	C1 C2 **(NOTE 1)** C3 C4 11 13 15 24	
42.	3	155-0080	100/25V/A	C14 31 71	
43.	1	155-0140	3300/25V/A	C67	

MODEL 38-MAX REPEATER TONE PANEL (702-9540B)
Parts List (Continued)

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMPONENT REF.	MFG.PART NO.
44.	3	210-0001	#4 NUT	XVR1,XJ5	
45.	2	220-0102	440x3/8	XJ5	
46.	1	220-0103	440x1/2"	XVR1	
47.	5	305-0001	FERRITE BEAD W/LEAD	E1-5	
48.	5	311-0011	LED RED FLUSH	DS1-5	
49.	1	311-0012	LED GREEN FLUSH	DS6	
50.	1	316-0004	TONE FILTER	U6	MF4CN-50
51.	1	316-1232	RS232 DRIVER	U1	RS232
52.	2	316-0353	OP-AMP,DUAL BIFFET	U7 9	LF353
53.	5	316-0358	OP-AMP, DUAL	U10 11 21-23	LM358N
54.	1	316-7805	REG. +5V 1.5A	VR1	LM340T-5
55.	1	316-7808	REG. +8V	VR2	LM78L08CZ
56.	1	321-2090	DTMF XCVR	U5	20C90
57.	1	321-8256	32K x 8 RAM	U15	HPD43256-15L
58.	1	321-6304	MICROPROCESSOR	U12	6803U4CP
59.	1	322-2764	8Kx8 EPROM	U16 **(NOTE 6)**	TMS27C64JL
60.	1	322-7256	32Kx8 EPROM CMOS	U14 **(NOTE 6)**	AM27C256-200DC
61.	1	323-4053	3PDT SWITCH	U8	MC144053
62.	1	327-4139	DUAL 2-4 DECODER	U4	74ACT139
63.	1	324-7400	QUAD NAND	U2	74HC00
64.	1	324-7414	HEX SCHMIDT	U3	74HC14
65.	1	325-4373	OCTAL LATCH	U13	74HCT373
66.	1	340-2003	RELAY DRIVER	U19	ULN2003
67.	4	340-3904	NPN-40V/200MA	Q2 3 4 5	2N3904
68.	4	342-0001	SILICON 1A 100V	CR9-12	1N4002
69.	2	342-0103	DIODE	CR5 6	
70.	7	342-3009	SILICON	CR3 4 7 8 16	1N4148
71.	2	343-3017	1/2W, 6.2V	CR1 15	1N5234B
72.	1	371-0008	SW OCTAL DIP	SW1	
73.	1	376-0737	7.37MHz XTAL	Y2	
74.	1	376-0358	3.58 MHZ XTAL	Y1	
75.	1	380-0030	RELAY DPDT	K2	
76.	1	381-0010	HEATSINK	XVR1	
77.	1	401-0021	CONNECTOR DB9	J5	
78.	1	401-0034	3 CON STEREO JACK	J6	
79.	2	401-0042	DB LOCK SCREWS	XJ5	
80.	3	401-0052	STAKE PINS	JP3 (3 EA)	
81.	1	401-0059	15 POS R/A HEADER	TB1	
82.	1	402-3040	MINI JUMPER	JP3 (POS A)	

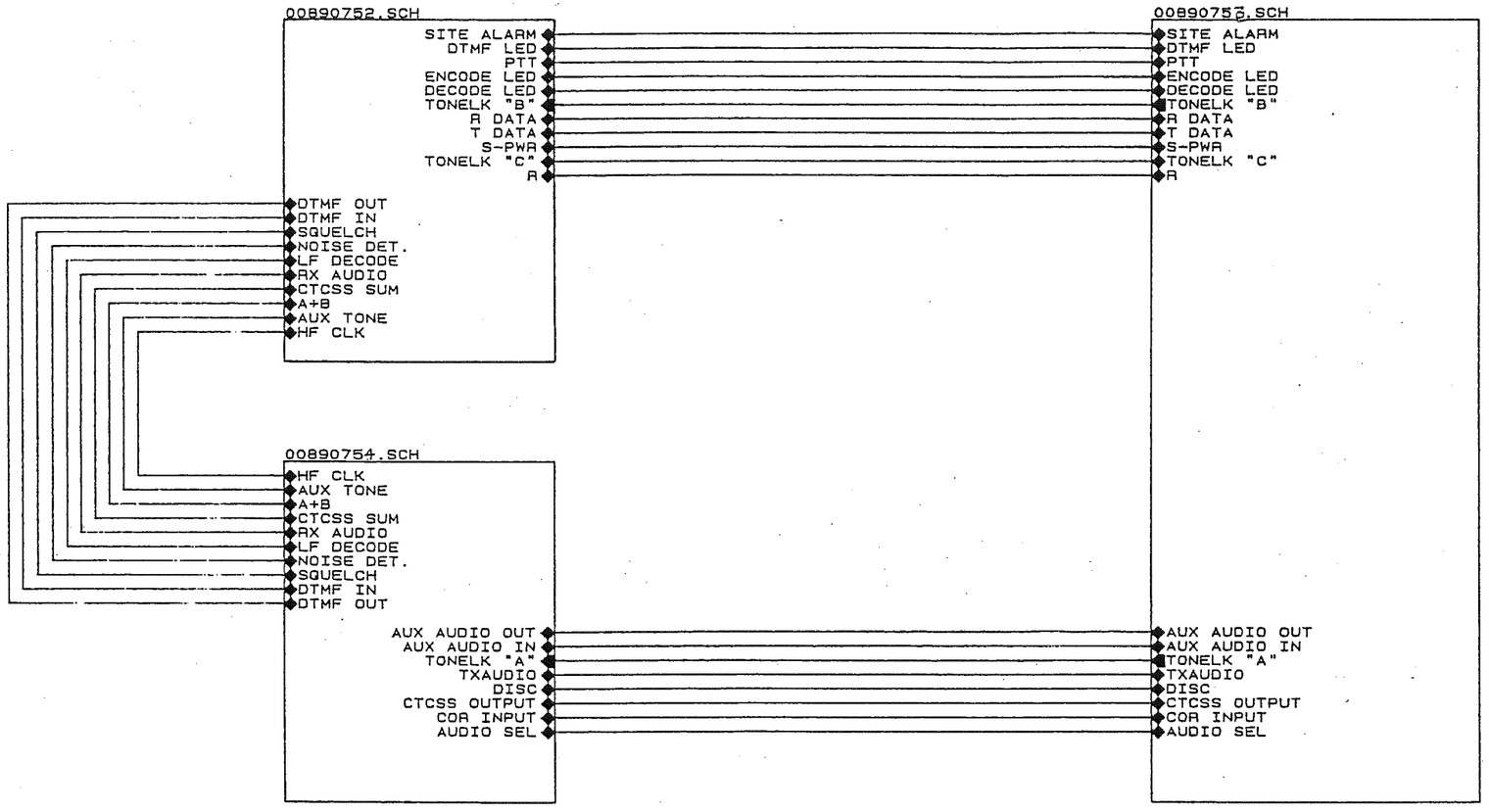
MODEL 38-MAX REPEATER TONE PANEL (702-9540B)
Parts List (Continued)

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMPONENT REF.	MFG.PART NO.
83.	8	407-0008	SKT, 8 PIN DIP	U6 7 9-11 21-23	
84.	2	407-0014	SKT, 14 PIN DIP	U2 3	
85.	4	407-0016	SKT, 16 PIN DIP	U1 4 8 19	
86.	1	407-0020	SKT, 20 PIN DIP	U13	
87.	1	407-0022	SKT, 22 PIN DIP	U5	
88.	3	407-0028	SKT, 28 PIN DIP	U14 15 16	
89.	1	407-0040	SKT, 40 PIN DIP	U12	
90.	1	408-0001	WIRE JUMPER	JP6B	
91.	1	410-9075F.1	PCB		
92.	1	416-1214	SMART SOCKET	U15	
93.	2	416-1576	FUSE 1A AGC	F1 2	
94.	4	416-3040	FUSE CLIP	XF1 2	
95.	6	417-0010	LED R/A	XDS1-6	
96.	1	561-0001	THERMAL COMPOUND	XVR1	
97.	1	702-9541A	M38-MAX DAUGHTER BD	XU17	

NOT INSTALLED:
C6 8 55
CR2 13 14
J1-4
JP2 4 5 7
K1
Q1
R1 15 28 54 70-75
U18 20

NOTES: Notes are for production use only.

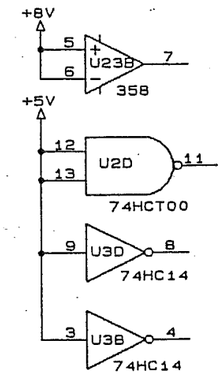
REV	DESCRIPTION	DRN	APV	DATE
A	RELEASE	KM	JC	7/26/93
A.1	REDLINE	KM	JC	8-12-94
B	HCN 2633	KN	GH	9-20-94



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
3. ALL POTENTIOMETERS ARE 1 TURN.

UNUSED PARTS:



LEGEND:

+	OPTION, INSTALL PER CUSTOMER ORDER.
^	INSTALLED ON HIGHER ASSEMBLY.
*	NOT INSTALLED.
———X———	CUT TRACE.
- - - - - - - - - -	JUMPER WIRE.

ZETRON, INC.

12335 134TH COURT N.E.
REDMOND, WASHINGTON, 98052-2433

Title: M38 - MAX REPEATER PANEL

Size	Document Number	REV
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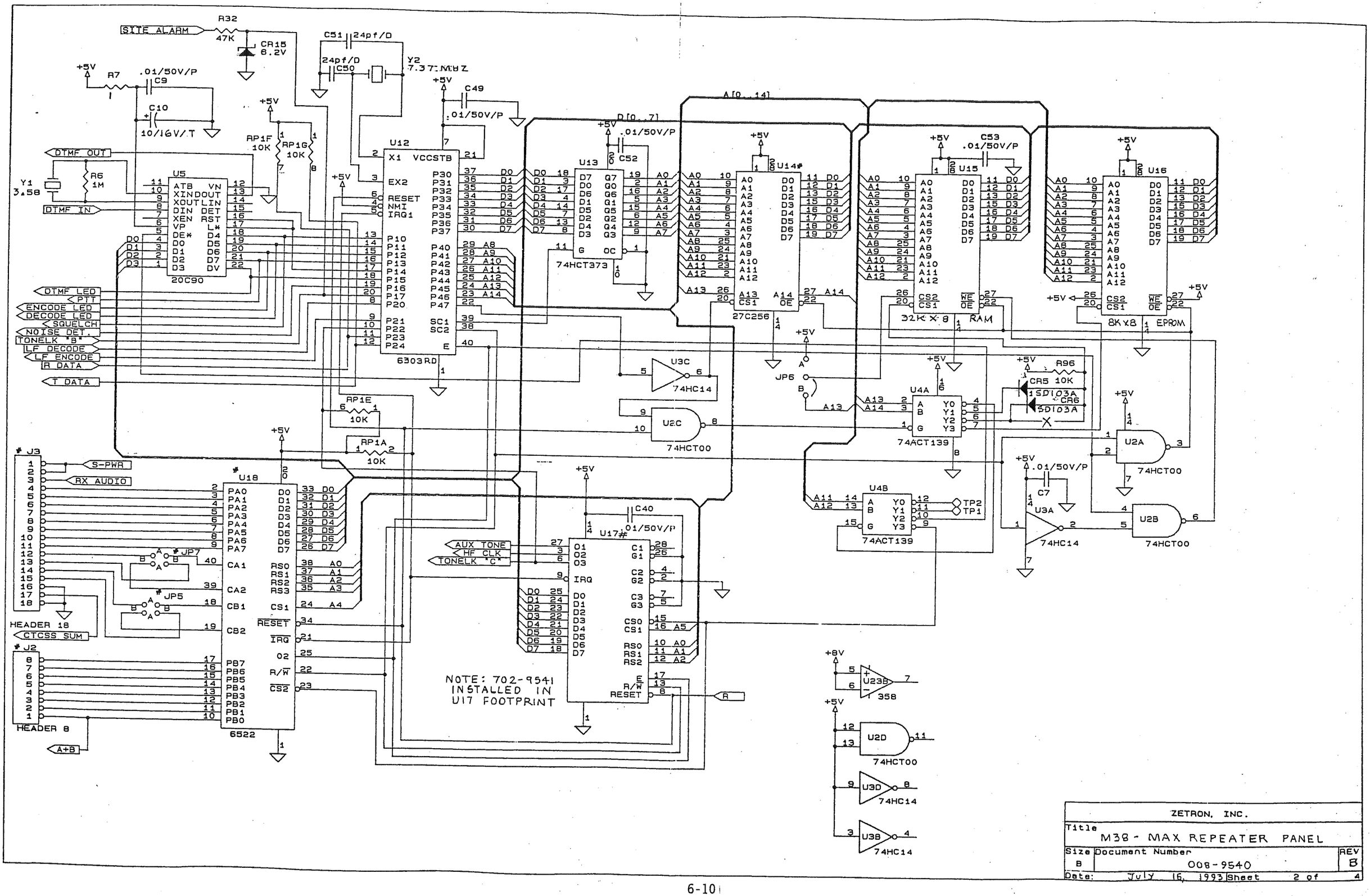
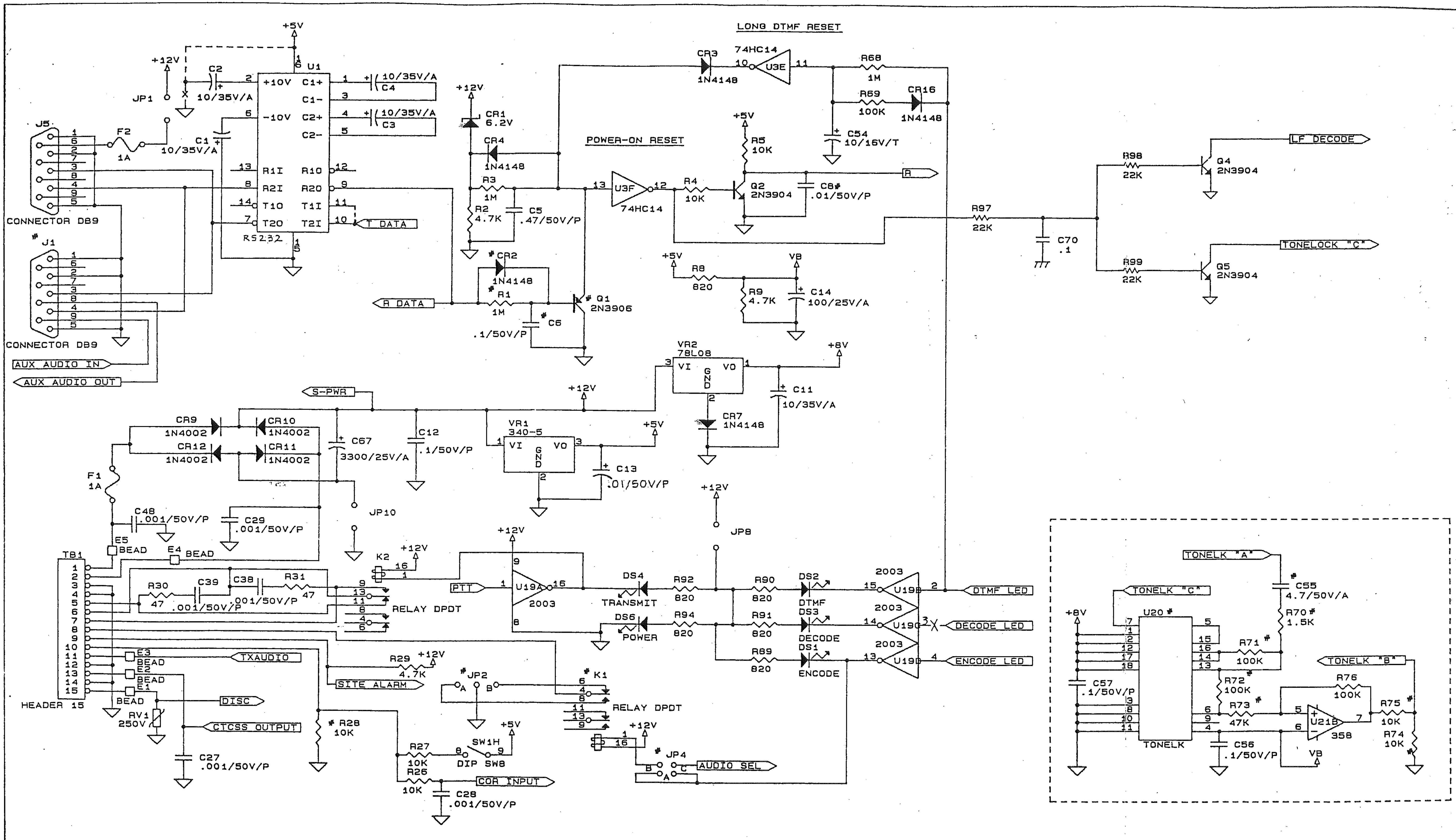


ZETRON, INC.		
Title: M38 - MAX REPEATER PANEL		
Size: B	Document Number: 008-9540	REV: B
Date: July 16, 1993	Sheet 2 of 4	


LONG DTMF RESET
POWER-ON RESET
CONNECTOR DB9
J5
J1
F2 1A
F1 1A
JP1
U1 RS232
+10V C1+ C1- -10V C2+ C2-
R1I R1O R2I R2O T1O T1I T2O T2I
C1 10/35V/A
C2 10/35V/A
C3 10/35V/A
C4 10/35V/A
T DATA
R DATA
CR1 6.2V
CR2 1N4148
CR3 1N4148
CR4 1N4148
CR16 1N4148
74HC14
U3E
U3F
R68 1M
R69 100K
C54 10/16V/T
R5 10K
R4 10K
Q2 2N3904
C8 .01/50V/P
R1 1M
R2 4.7K
R3 1M
C5 .47/50V/P
C6 .1/50V/P
Q1 2N3906
R8 820
R9 4.7K
C14 100/25V/A
R97 22K
C70 .1
R98 22K
R99 22K
Q4 2N3904
Q5 2N3904
LF DECODE
TONELOCK "C"
AUX AUDIO IN
AUX AUDIO OUT
S-PWR
VR2 78L08
VI GND VO
C11 10/35V/A
CR7 1N4148
+8V
CR9 1N4002
CR10 1N4002
CR11 1N4002
CR12 1N4002
C67 3300/25V/A
C12 .1/50V/P
VR1 340-5
C13 .01/50V/P
JP10
JP8
C48 .001/50V/P
C29 .001/50V/P
E5 BEAD
E4 BEAD
TB1
HEADER 15
R30 47
C39 .001/50V/P
C38 .001/50V/P
R31 47
RELAY DPDT
K2
PTT
U19A 2003
DS4 TRANSMIT
DS6 POWER
R92 820
R94 820
R90 820
R91 820
R89 820
DS2 DTMF
DS3 DECODE
DS1 ENCODE
U19B
U19C
U19D
DTMF LED
DECODE LED
ENCODE LED
E3 BEAD
E2 BEAD
E1 BEAD
TXAUDIO
SITE ALARM
R29 4.7K
DISC
RV1 250V
CTCSS OUTPUT
C27 .001/50V/P
R28 10K
JP2
K1
RELAY DPDT
R27 10K
R26 10K
SW1H DIP SW8
COR INPUT
C28 .001/50V/P
JP4
AUDIO SEL
TONELK "A"
TONELK "C"
TONELK "B"
C55 4.7/50V/A
R70 1.5K
U20 TONELK
C57 .1/50V/P
R71 100K
R72 100K
R73 47K
R76 100K
R75 10K
R74 10K
U21B 358
C56 .1/50V/P
VB

ZETRON, INC.	
Title: M38-MAX REPEATER PANEL	
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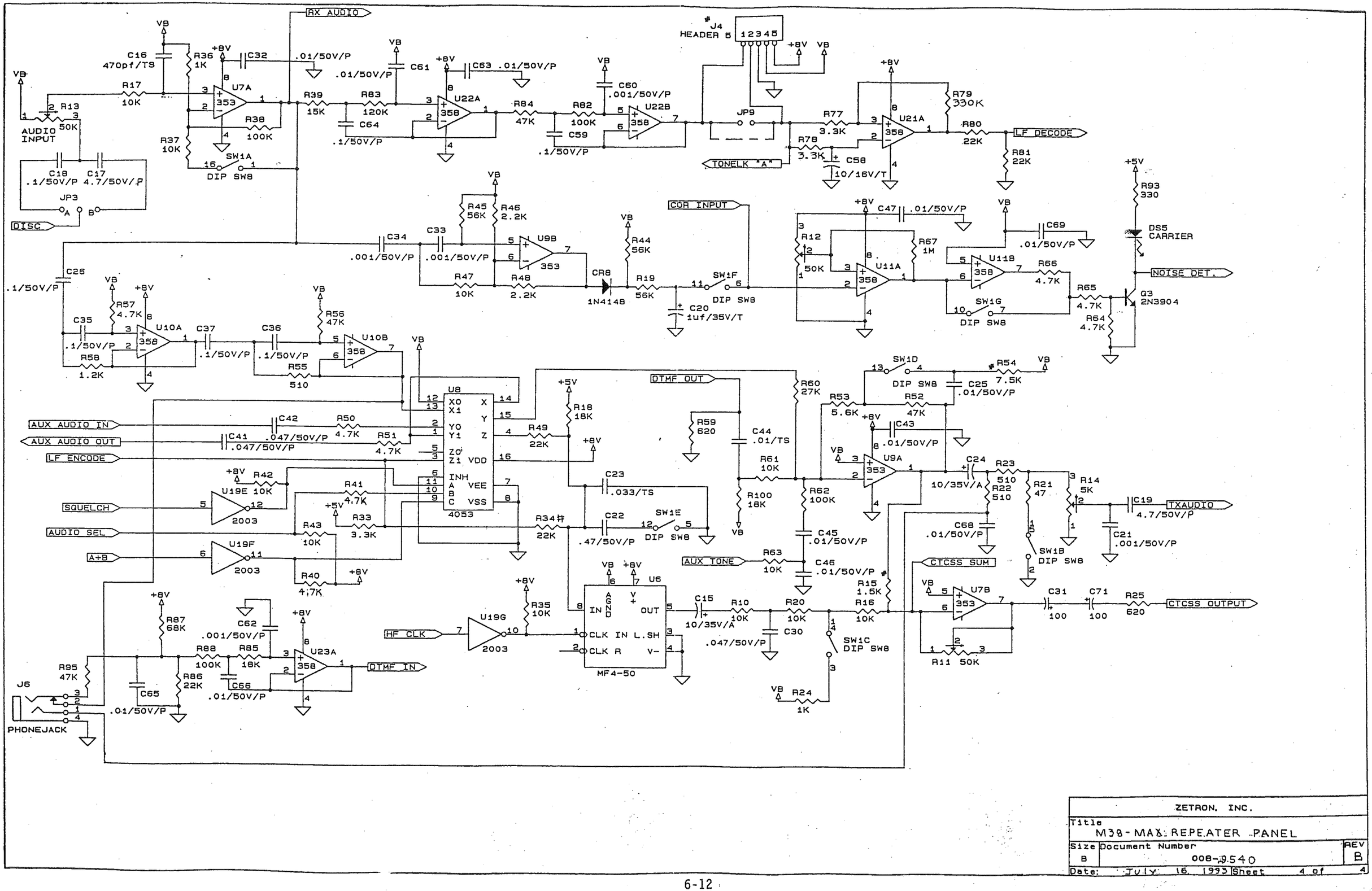

ZETRON, INC.

Title: M38-MAX REPEATER PANEL

Size	Document Number	REV
B	008-9540	B

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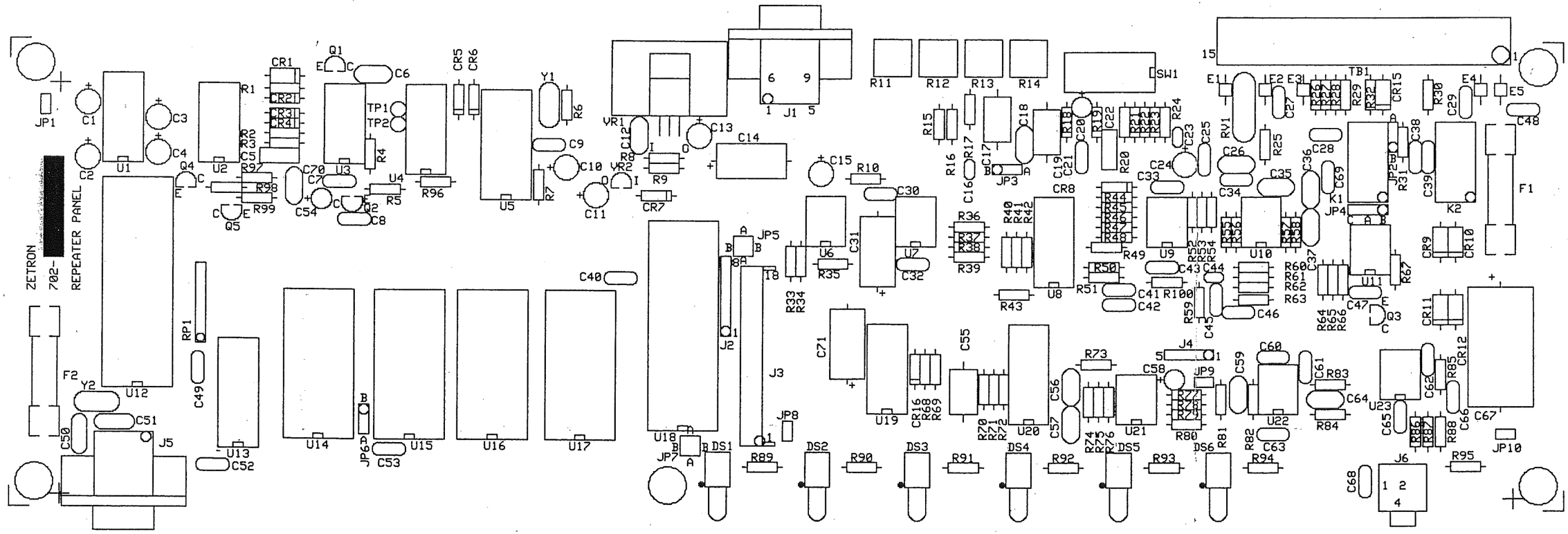
ZETRON
702-
REPEATER PANEL
JP1
C1
C2
C3
C4
U1
U2
R1
CR1
CR2
CR3
CR4
Q1
C6
TP1
TP2
R4
U3
C7
C54
C8
U4
R5
R96
CR5
CR6
U5
Y1
R6
C9
C10
C11
R7
VR1
C12
C13
C14
R9
CR7
J1
R11
R12
R13
R14
SW1
R15
R16
R17
C16
C17
JP3
C18
C19
C20
C21
R18
R19
C22
R20
R21
R22
R23
R24
C23
C25
C24
C33
C26
C34
C35
C36
C28
C69
JP4
JP2
R31
C38
C39
K2
F1
C48
15
1
E1
E2
E3
TB1
R29
R32
CR15
R30
E4
E5
C29
RV1
R25
C27
C30
C31
C32
U6
R35
R10
C15
R33
R34
JP5
A
B
J2
J3
C40
U14
U15
U16
U17
JP6
C53
RP1
C49
U13
C52
F2
Y2
U12
C51
C50
J5
R36
R37
R38
R39
R40
R41
R42
CR8
U8
R43
R44
R45
R46
R47
R48
R49
U9
R50
R51
C41
C42
C43
C44
R52
R53
R54
R100
C45
R59
C46
U10
R60
R61
R62
R63
C37
U11
C47
Q3
R64
R65
R66
R67
CR9
CR10
CR11
CR12
R85
C66
C67
JP10
J6
1 2
4
R95
C68
C71
U19
CR16
R68
R69
C55
R70
R71
R72
U20
C56
C57
R73
R74
R75
R76
C58
U21
J4
5
1
JP9
R80
R81
C59
C60
C61
R83
C64
R84
U22
R82
C63
R94
C62
U23
C65
R86
R87
R88
DS1
DS2
DS3
DS4
DS5
DS6
R89
R90
R91
R92
R93
JP7
JP8
U18
U7
R33
R34

7. QUICK REFERENCE AND PROGRAMMING LOG SHEETS

DTMF programming 7-1
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Progress tones 7-1
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DCS users 7–8

Table of 104 commonly used DCS codes 7-13

Normal/inverted DCS codes 7-14

7. QUICK REFERENCE AND PROGRAMMING LOG SHEETS

DTMF PROGRAMMING

Summary

1. Numbers may be entered with or without leading zeros (1 may be entered as 00001 or 1).
2. All commands are ended with the "#" key.
3. The "*" key may be used as a clear entry key.
4. In the list of user commands, where "uuu" is indicated, a user number from 1 to 160 may be entered. To program all users, enter 999.
5. Program mode has a 1.5 minute "no-digits heard" automatic exit feature.
6. The default program mode access code is 12038#.
7. When a DTMF type remote unit is specified, possibly a Zetron Model 8 (system command 227, 1-3), the current setting of a command will be displayed.
8. To leave a setting as it is when prompted, press the "#" key.

Progress Tones

These tones are heard during program mode.

Sound	Meaning
Chirp (7-beeps)	Ready for a command.
Warble (dee-doo-dee-doo)	Invalid command or out of range data.
Ringing (electronic)	Leaving program mode, return to normal operation.
500 Hz, Low Bip-Bip	Current setting is zero, disabled, or off.
2 KHz, High Bip-Bip	Current setting is one, enabled, or on.
1 KHz, Bip-Bip	Current setting is not zero or one.
DTMF tones	Settings or airtime data sent to remote unit.

User Commands
These commands provide values for functions available on a per-user basis.

DTMF command	Per-user main items (uuu = 999 = change all users)
110# nnn# n#	Enable/disable user number "nnn" (1=on, 0=off)
112# nnn# nnn#	DCS decode, 000-777
113# uuu# n#	Airtime accumulation and decode for disabled DCS users (on/off)
120# uuu# n#	CTCSS/DCS encode during tx-hold, on/off
122# uuu# nnnn#	CTCSS/DCS encode, 0=off 1-50=CTCSS 1000-1777=DCS
123# uuu# nnn#	Transmit hold time, 0-25.0 sec
130# uuu# n#	Reserve mode on/off, disables repeat audio
140# uuu# n#	Anti-barge-in on/off, no new users until tx-hold
150# uuu# n#	Courtesy beep tone, on/off
152# uuu# n	Last user DTMF ID, on/off
160# nnn# nn# nn#..	Morse code station ID, up to 8 characters
161# nnn#	Playback a users ID, verify call sign
170# uuu# n#	DTMF commands on/off
180# uuu# n#	Aux relay enable/disable (if installed)
99#	Exit DTMF program mode

DTMF command	Per-user airtime items
1501# uuu# n#	Prepay mode on/off, counts airtime up or down
1510# uuu# nn#	Hog mode conversation limit time, 0.1-25.0 minutes
1521# nnn#	List minutes:seconds
1522# nnn#	List hours:minutes
1523# nnn#	List hours
1530# nnn#	Clear a users airtime
1531# nnn#	Add n hours to users airtime, for prepay
3501#	List all airtime counts, hold * to stop
3502# 25327#	Clear all airtime counts
99#	Exit DTMF program mode

Tone-to-User Number Default Conversions

User	Decode	User	Decode	User	Decode	User	Decode
1	67.0	41	203.5	81	d 165	121	d 445
2	69.4	42	206.5	82	d 172	122	d 446
3	71.9	43	210.7	83	d 174	123	d 452
4	74.4	44	218.1	84	d 205	124	d 454
5	77.0	45	225.7	85	d 212	125	d 455
6	79.7	46	229.1	86	d 223	126	d 462
7	82.5	47	233.6	87	d 225	127	d 464
8	85.4	48	241.8	88	d 226	128	d 465
9	88.5	49	250.3	89	d 243	129	d 466
10	91.5	50	254.1	90	d 244	130	d 503
11	94.8	51	d 023	91	d 245	131	d 506
12	97.4	52	d 025	92	d 246	132	d 516
13	100.0	53	d 026	93	d 251	133	d 523
14	103.5	54	d 031	94	d 252	134	d 526
15	107.2	55	d 032	95	d 255	135	d 532
16	110.9	56	d 036	96	d 261	136	d 546
17	114.8	57	d 043	97	d 263	137	d 565
18	118.8	58	d 047	98	d 265	138	d 606
19	123.0	59	d 051	99	d 266	139	d 612
20	127.3	60	d 053	100	d 271	140	d 624
21	131.8	61	d 054	101	d 274	141	d 627
22	136.5	62	d 065	102	d 306	142	d 631
23	141.3	63	d 071	103	d 311	143	d 632
24	146.2	64	d 072	104	d 315	144	d 654
25	151.4	65	d 073	105	d 325	145	d 662
26	156.7	66	d 074	106	d 331	146	d 664
27	159.8	67	d 114	107	d 332	147	d 703
28	162.2	68	d 115	108	d 343	148	d 712
29	165.5	69	d 116	109	d 346	149	d 723
30	167.9	70	d 122	110	d 351	150	d 731
31	171.3	71	d 125	111	d 356	151	d 732
32	173.8	72	d 131	112	d 364	152	d 734
33	177.3	73	d 132	113	d 365	153	d 743
34	179.9	74	d 134	114	d 371	154	d 754
35	183.5	75	d 143	115	d 411	155	d 000
36	186.2	76	d 145	116	d 412	156	d 000
37	189.9	77	d 152	117	d 413	157	d 000
38	192.8	78	d 155	118	d 423	158	d 000
39	196.6	79	d 156	119	d 431	159	d 000
40	199.5	80	d 162	120	d 432	160	d 000

System Commands and Programming Log

These commands are for items that relate to overall system operation.

DTMF command	System programmable items	units	lo	hi	default	SETTING
201# nnn#	Carrier repeat user number	user#	0	160	0	
202# nnn#	First transmit hold time	.1 sec	1	250	20	
203# nn#	Anti-kerchunk time	.1 sec	0	50	0	
204# n#	Tailbip enable	on/off	0	1	0	
205# nnnn#	Courtesy tone frequency	freq	400	4000	1000	
206# n#	Stuck mic timeout time	minutes	0	9	3	
207# n#	Stuck mic timeout DTMF ID	on/off	0	1	0	
208# nn#	ID interval	minutes	1	99	15	
209# nnnn#	ID frequency	freq	400	2000	1200	
210# nn#	ID speed, words/minute	WPM	4	25	22	
211# n#	ID periodic enable	on/off	0	1	0	
212# nnn#	ID system user	user#	0	160	0	
213# nn#	Hog mode idle time	seconds	1	99	5	
214# nnn#	Hog mode penalty time	10 sec	1	999	30	
215# nnn#	Hog mode dynamic minimum	.1 min	5	250	10	
216# nnn#	Hog mode dynamic maximum	.1 min	8	250	100	
217# n#	Accumulate airtime w/tx-hold	on/off	0	1	0	
218# nnnn#	Remote PTT CTCSS/DCS	CTCSS/DCS	0	1777	0	
219# nnnn#	Site alarm CTCSS/DCS	CTCSS/DCS	0	1777	0	
220# n#	Site alarm at power up	on/off	0	1	0	
221# nnnnn#	Program mode access code	number	1000	32000	12038	
222# nnn#	Program mode access user	user#	0	160	0	
223# n#	Program mode access alarm	on/off	0	1	0	
224# nn#	Program mode access delay	seconds	0	30	0	
225# n#	Radio DTMF hold time	seconds	0	3	0	
226# n#	RS-232 port baud rate	150-9600	1	7	4	
227# n#	Remote unit, ID-DTMF-RDU-DI16	select	0	3	0	
228# n#	Serial tone output	on/off	0	1	0	
229# n#	DCS encode invert	on/off	0	1	0	
230# n#	DCS decode invert	on/off	0	1	0	
231# n#	DCS acquire bit errors	bits - 1	1	4	2	
232# nnn#	CTCSS turnoff delay	millisec	1	250	75	
233# nn#	CTCSS hold time	.1 sec	0	25	0	
234# n#	DTMF interdigit timeout	seconds	1	9	4	
235# n#	Slower CTCSS decode	on/off	0	1	0	
236# n#	Courtesy tone type	sounds	1	7	2	
270# cc..	Site alarm DTMF digits		up to 8 digits			
99#	Exit DTMF program mode					

Diagnostic and Setup Commands
Diagnostic and Setup Commands aid the installer in system setup.

DTMF command	System setup / diagnostics
300#	Repeater disable
302#	PTT Off (will key up during commands)
303#	Squelch repeat audio
304#	Unsquelch repeat audio when carrier is active
305# nnnn#	Encode CTCSS/DCS 0=off, 1-50=CTCSS, 1000 1777=DCS
306#	Encode CTCSS sweep
307# nnnn#	LF encode, 50.0-300.0 Hz.
308# nnnn#	Generate an audio tone 400-3000 Hz. End with *
309# 25327#	Reset unit to factory defaults
310# nn#	Encode a DTMF digit, 0-15, 99=off
311#	Send the site alarm
360#	List the number of enabled users
361#	List the enabled user numbers
362#	List the number of program mode accesses
363#	List the number of resets
364#	List the number of power fails
365#	List the number of users with data errors
366#	List the users with data errors
367#	List the system diagnostic status
368#	Clear the reset/power fail/access counters
99#	Exit DTMF program mode

USER PROGRAMMING LOG

User	Rx-tone	Tx-tone	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
1	67.0													
2	69.4													
3	71.9													
4	74.4													
5	77.0													
6	79.7													
7	82.5													
8	85.4													
9	88.5													
10	91.5													
11	94.8													
12	97.4													
13	100.0													
14	103.5													
15	107.2													
16	110.9													
17	114.8													
18	118.8													
19	123.0													
20	127.3													
21	131.8													
22	136.5													
23	141.3													
24	146.2													
25	151.4													

User	Rx-tone	Tx-tone	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
26	156.7													
27	159.8													
28	162.3													
29	165.5													
30	167.9													
31	171.3													
32	173.8													
33	177.3													
34	179.9													
35	183.5													
36	186.2													
37	189.9													
38	192.8													
39	196.6													
40	199.5													
41	203.5													
42	206.5													
43	210.7													
44	218.1													
45	225.7													
46	229.1													
47	233.6													
48	241.8													
49	250.3													
50	254.1													

DCS Users

User	Rx-code	Tx-code	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
51														
52														
53														
54														
55														
56														
57														
58														
59														
60														
61														
62														
63														
64														
65														
66														
67														
68														
69														
70														
71														
72														
73														
74														
75														

User	Rx-code	Tx-code	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
76														
77														
78														
79														
80														
81														
82														
83														
84														
85														
86														
87														
88														
89														
90														
91														
92														
93														
94														
95														
96														
97														
98														
99														
100														

User	Rx-code	Tx-code	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
101														
102														
103														
104														
105														
106														
107														
108														
109														
110														
111														
112														
113														
114														
115														
116														
117														
118														
119														
120														
121														
122														
123														
124														
125														

User	Rx-code	Tx-code	See Note 1 O	S	P	R	L	Q	D	A	X	Hog-limit	Tx-hold	Station Id
126														
127														
128														
129														
130														
131														
132														
133														
134														
135														
136														
137														
138														
139														
140														
141														
142														
143														
144														
145														
146														
147														
148														
149														
150														

User	Rx-code	Tx-code	See Note 1: O S P R L Q D A X	Hog-limit	Tx-hold	Station Id
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						

NOTE 1: "O S P R L Q D A X" column on/off setting description;
- O = Enable/disable (On/Off)
- S = Tx tone/code Squelch during tx hold
- P = Privacy mode
- R = Reserve user mode
- L = Last user DTMF ID
- Q = Queuing beep (Queue)
- D = DTMF functions enable
- A = Prepay Airtime mode.
- X = Aux relay

TABLE OF 104 COMMONLY USED DCS CODES

Code	Binary data	Hex
023	111011000111000000010011	640E37
025	110101101111000000010101	540F6B
026	110010111011000000010110	340DD3
031	101000111111000000011001	4C0FC5
032	101111101011000000011010	2C0D7D
036	000101111110100000011110	3C0BE8
043	101101101101000000100011	620B6D
047	000111111011000000100111	720DF8
051	111110010101000000101001	4A0A9F
053	011010101011000000101011	6A0D56
054	110111101001000000101100	1A097B
065	101110100011000000110101	560C5D
071	110011110011000000111001	4E0CF3
072	110100100111000000111010	2E0E4B
073	010111001101000000111011	6E0B3A
074	111010001111000000111100	1E0F17
114	011010111101000001001100	190BD6
115	111001010111000001001101	590EA7
116	111110000011000001001110	390C1F
122	101110110101000001010010	250ADD
125	000011110111000001010101	550EF0
131	011110100111000001011001	4D0E5E
132	011001110011000001011010	2D0CE6
134	010111011011000001011100	1D0DBA
143	011011110101000001100011	630AF6
145	010101011101000001100101	530BAA
152	001111011001000001101010	2B09BC
155	100010011011000001101101	5B0D91
156	100101001111000001101110	3B0F29
162	110101111001000001110010	2709EB
165	011000111011000001110101	570DC6
172	000010111111000001111010	2F0FD0
174	001100010111000001111100	1F0E8C
205	110111010011000100000101	508CBB
212	101101010111000100001010	288EAD
223	110100011101000100010011	648B8B
225	111010110101000100010101	548AD7
226	111101100001000100010110	34886F
243	100010110111000101000011	628ED1
244	001111110101000101000100	128AFC
245	101100011111000101000101	528F8D
246	101011001011000101000110	328D35
251	110001001111000101010001	4A8F23
252	110110011011000101010010	2A8D9B
255	011011011001000101011101	5A89B6
261	001011101111000101100001	468F74
263	101111010001000101100011	6688BD
265	100001111001000101101101	5689E1
266	100110101101000101101110	368B59
271	111100101001000101111001	4E894F
274	110101010101000101111100	1E8AAB
306	000110011111100011000110	318F98
311	011100011011000110010010	498D8E
315	110110001101000110011101	598B1B
325	001100101101000110101010	558B4C
331	010001111101000110110010	4D8BE2
332	010110101001000110110010	2D895A
343	010100101111000111000011	638F4A
346	011101010011000111001110	338CAE
351	000111010111000111010010	4B8EB8
356	101010010101000111011110	3B8A95
364	110100001011000111101000	178D0B
365	010111100001000111101010	57887A
371	001010110001000111111001	4F88D4
411	111011101101001000010010	484B77
412	111100111001001000010100	2849CF
413	011111010011001000010110	684CBE
423	100101110011001000100110	644CE9
431	110110001011001000110010	4C4D1B
432	110001011111001000110100	2C4FA3
445	111101110001001001001010	5248EF
446	111010100101001001001100	324A57
452	100111110101001001010100	2A4AF9
454	101001011101001001011000	1A4BA5
455	001010110111001001011010	5A4ED4
462	011101010101001001100100	264AAE
464	010011111101001001101000	164BF2
465	110000010111001001101010	564E83
466	110111000011001001101100	364C3B
503	011110001101001010000110	614B1E
506	010111110001001010001100	3148FA
516	100000110111001010011100	394EC1
523	010011101011001010100110	654D72
526	011010010111001010101100	354E96
532	000111000111001010110100	2D4E38
546	001100111101001011001100	334BCC
565	000110001111001011101010	574F18
606	101110110011001100000110	30CCDD
612	110011100011001100010100	28CC73
624	000111101011001100101000	14CD78
627	000000111111001100101110	74CFC0
631	111001010001001100110010	4CC8A7
632	111110000101001100110100	2CCA1F
654	100110000111001101011000	1ACE19
662	010010001111001101100100	26CF12
664	011100100111001101101000	16CE4E
703	010001010111001111000011	61CEA2
712	000101111011001110010100	29CDE8
723	011100110001001110100110	65C8CE
731	001111001001001110110010	4DC93C
732	001000011101001110110100	2DCB84
734	000110110101001110111000	1DCAD8
743	001010011011001111000110	63CD94
754	010000011111001111011000	1BCF82

NORMAL/INVERTED DCS CODES

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