ZETRON

Model 37-MAX Repeater Pal
Installation Manual

Part No. 025-9376A

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

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QUICK! — GET ME ON THE AIR!

If this is your first Model 37-MAX Repeater Pal, your first questions probably are “What do I have to do to enable a tone?” and “Do I have to understand all the features just to make it work?” Here are the answers:

Before you can work with the Model 37-MAX, it must be installed. FOLLOW THE INSTALLATION INSTRUCTIONS (see Section 5). The installation should be accomplished by a qualified radio service technician. Then get your transceiver (set on the repeater's frequency and with touch-tone keypad) ready to enable some tones.

ACCESS THE PROGRAM MODE

To access the program mode, key up and press “12037”. A chirp should be heard coming back from the repeater (the chirp, or five beeps, is the “go-ahead” prompt tone). If the program mode is not accessed, check the Status LED on the front panel to see if it flashes with every key pressed.

PROGRAM MODE PROMPT TONES

During programming, the Model 37-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 that an error condition exists. A “chirp” or “bip bip bip bip bip” (five quick notes) indicates the proper completion of a command. A double “bip” indicates the panel is ready for additional digits to be entered to complete a command. When exiting the program mode, a “ringing” sound will be sent to verify the exit. If a key is not pressed within 60 seconds, the Model 37-MAX will exit the program mode automatically.

ENABLE A CTCSS TONE

A CTCSS tone may be enabled by pressing “111# nn#”, where “nn#” is the tone number from the User Numbers versus CTCSS Tones table in the Quick Reference section at the end of this manual.

PROGRAMMING EXAMPLE

Enable CTCSS tones 67.0, 100.0, 127.3, and 186.2:

1. Access the program mode. Press “12037”, then listen for the five beeps.

2. Enable the tones.
   for 67.0 Hz (tone 1), press 111# 1# (five beeps heard)
   for 100.0 Hz (tone13), press 111# 13# (five beeps heard)
   for 127.3 Hz (tone 20), press 111# 20# (five beeps heard)
   for 186.2 Hz (tone 36), press 111# 36# (five beeps heard)

3. Exit the program mode. Press 99#, then listen for the ringing sound to verify exiting.

4. Test the repeater!

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1. INTRODUCTION

OVERVIEW

The Zetron Model 37-MAX Repeater Pal is a high capacity, remotely programmable, community repeater controller. It provides individualized repeater service to up to 154 different customer groups using CTCSS tone and Digital Coded Squelch (DCS) signaling.

The Repeater Pal connects to a receiver and transmitter providing CTCSS/DCS decode, regenerated CTCSS/DCS encode, repeat audio processing, selectable system functions and per-user functions. It will convert any station capable of full duplex operation into a fully featured community repeater. The Repeater Pal is an ideal replacement for older tone panels, eliminating time consuming trips to remote repeater sites, as well as providing a high subscriber capacity growth path for the future.

The compact size of the Repeater Pal is ideal for low power repeater packages constructed from a pair of suitable mobile radios.

Complete CTCSS/DCS Coverage

The Repeater Pal has the capacity for supporting up to 154 separate user groups on a single channel, which is ideal for scan based trunking systems, roaming, or seasonal users.

The panel is equipped with ToneLock decoding, an exclusive Zetron feature that eliminates dropouts resulting from weak, fading signals or high modulation levels. The usable range of the repeater is not limited by the decode performance of the repeater tone panel when the Repeater Pal is in control.

The 37-MAX recognizes when a subscriber unkeys with a reverse burst, or the DCS turn-off code, and silently mutes the repeat audio path to prevent bursts of "squelch tail" noise from being repeated on the channel. The Repeater Pal also supports squelch tail elimination by dropping its encode a short time before dropping its carrier when the station is unkeyed. This ensures that listening radios mute without any annoying noise burst.

High quality audio processing circuits in the Repeater Pal are designed to make its repeater's audio quality rival the very best panels on the market.

Features You Expect in a Zetron Panel

Aside from providing the decode and encode performance of a larger tone panel, the Model 37-MAX has many of the other features of the "big guys" as well.

The Morse code Station ID feature is fully field programmable. The ID call sign can be up to eight characters in length. The panel can be set to wait for the next transmission to ID or to ID automatically whenever the ID interval timer reaches zero. The duration of the ID interval is also field programmable, as is the speed at which the ID is sent.

A Courtesy Beep, to inform listening mobiles that the speaker has definitely unkeyed, is available on a per tone/code basis. The pitch of the Courtesy beep is also programmable (on a system-wide basis) to either 500 Hz, 1000 Hz, or 1500 Hz.

The Reserved User feature helps to prevent the loss of tones or codes to co-channel operators during periods when they are temporarily not in everyday use. When a tone or code is programmed as 'reserved', the Repeater Pal will mute its repeat audio and transmit an alert tone on the channel.

The Cross Tone encoding feature expands the uses to which the panel can be put, allowing it to support applications that require the panel to encode a different tone or code than it received.

Programming and Control

In order to make it easy to install *and* easy to maintain, the Model 37-MAX is designed to be programmed over the radio channel using any mobile or handheld capable of manual DTMF encoding. If you wish to, you can use a Zetron Model 8B Repeater Programmer/Timekeeper attached to a control station or mobile radio.

This programming method was chosen for two very good reasons. First, because it doesn't require the installer or maintenance technicians to have special equipment in order to program the repeater; they can use equipment they already have. The second reason is that you don't have to be physically at the site in order to program the repeater. All the technician needs to be able to do is to drive far enough into the repeater's service area to be able to reliably hit the repeater while programming it. This can pay real dividends when a trip to the site is made difficult not just by distance but by accessibility as well.

Installation and Setup

Easy installation and setup procedures ensure that a technician can install a Model 37-MAX in nearly any repeater or duplex station. Only seven connections are required in typical installations, and interfacing assistance is available from Zetron. Section 5 includes application notes for some of the more popular repeaters, such as:

GE	MASTER III, MASTER II, Custom MVP, EXEC II, MASTER PRO
EF Johnson	Viking Universal Station, CR1010, CR1000
Kenwood	TKR720, TKR820
Midland	Basetech Repeater
Motorola	GR300/GR500, R100, MSF5000, MSR2000, MICOR
Standard	RPT10, RPT21, RPT30
Tait	T800 series, T300 series
Uniden	ARU-251

FEATURE SUMMARY

- Maximum capacity of 50 CTCSS and 104 DCS user groups
- ToneLock high performance decoding
- Remotely programmable using DTMF radio
- Database and validation for 154 users
- Regenerated CTCSS/DCS and cross tone encode
- Vacant tones and codes can be reserved
- Selectable transmitter hold time and courtesy tone per user
- Programmable repeater time-out to deal with “stuck mic” problems
- Programmable Morse code station ID
- Repeat audio processing
- Proper operation with reverse burst and DCS turnoff code for squelch tail elimination
- Applications notes and connection diagrams available for popular radios

USING THIS MANUAL

While this manual was not written to be read from cover-to-cover, it is highly recommended that you review Sections 3 and 5 before starting to work with the unit. Depending on your level of experience with Zetron’s other tone panels, you may want to review the Section 4 as well. This manual contains the following sections:

1. INTRODUCTION	Describes the Model 37-MAX, briefly lists its features and describes this manual.
2. SPECIFICATIONS	Lists the physical and electrical specifications of the Model 37-MAX.
3. OPERATION	Covers operation of the unit after it has been installed and the levels set. The general basics of using the repeater are covered.
4. INSTALLATION	Describes interfacing the Model 37-MAX to a generic station, and has applications notes for a number of popular radios.

5. PROGRAMMING	Provides background information on entering and exiting the program mode. It also provides in depth explanations of the programming commands and tables of tone frequencies and DPL codes showing their relationship to user numbers.
6. REPAIR	Contains low level hardware information such as parts lists, schematics, and component layout silkscreens.
APPENDIX A	Contains a programming log for recording the current system and user programming.
QUICK REFERENCE	Contains a list of all available programming commands.

2. SPECIFICATIONS

GENERAL SPECIFICATIONS

Power	11 to 16 volts DC, 100 mA nominal
Operating Temperature	0° to 60° Celsius
Size	5.5 in W × 6.25 in D × 1.4 in H
Weight	1.0 pound

RADIO INTERFACE SPECIFICATIONS

Connections	12 volt DC, ground, RX Discriminator Audio, TX Mic Audio, TX PTT, RX Carrier Detect, CTCSS/DCS Encode
PTT	FET pull to ground
Carrier Detector	External COR input with polarity and threshold adjustments
TX Audio	-40 to +6 dBm, Hi/Lo range selector, 1 kΩ output impedance
RX Audio	-40 to +10 dBm, Hi/Lo range selector, 25 kΩ input impedance
CTCSS/DCS encode	-40 to +3 dBm, Hi/Lo range selector, 600 Ω output impedance
CTCSS slope	Flat or de-emphasized output

ADDITIONAL SPECIFICATIONS

Indicators	Status, Carrier, Transmit, Power
Station ID	Morse Code, fixed 1200 Hz tone frequency, and programmable call sign
Programming	Via DTMF radio
Data Retention	Nonvolatile EEPROM

PROGRAMMABLE FUNCTIONS

General

Mode	Carrier repeat, or validated CTCSS/DCS users
Station ID	ID interval from 1 to 90 minutes, call sign programmable up to 8 characters, periodic ID or ID based on transmit activity
TX Time-out	1 to 9 minutes in 1-minute steps
TX Hold Time	0 to 9 seconds in 1-second steps

Alternate TX Hold Time	0 to 9 seconds in 1-second steps
Courtesy Tone Frequency	500 Hz, 1000 Hz, 1500 Hz selectable

User Specific

Number of Users	155 database entries. User numbers are from a cross-reference table based on CTCSS/DCS decode, 0 = Carrier repeat, 1 to 50 = CTCSS, 51 to 154 = DCS. Commands are available to program a single user, or globally for all users.
User Status	Disabled, enabled, or reserved. Reserved users will actuate the transmitter and generate the proper CTCSS/DCS for dispatch, but will not pass repeat audio. Valuable for no-pay customers.
Regenerated CTCSS/DCS	Selectable encode may be any CTCSS or DCS, programmable per user
TX Hold Time	Normal or Alternate transmit hold time selection
Tone-in-Tail	Enable or disable CTCSS/DCS encode during TX hold time
Courtesy Tone	Enable or disable

Installation Aids

DCS Polarity	Programmable data inverters for encode and decode
Program Mode Access	Five-digit DTMF password selectable
Clear	Resets unit to all factory default settings
TX Audio Test	Generates 1 kHz audio tone for transmit deviation adjustment
Repeat Audio Test	Enables carrier repeat operation to adjust RX audio for unity repeat gain
CTCSS Level Test	Keys transmitter with CTCSS tone to check encode level
CTCSS Pre-emphasis Test	Verifies that CTCSS encode frequency response is flat

3. OPERATION

OVERVIEW

This section explains the general operation of the Repeater Pal on a top level, “big picture” basis. The information presented here should be useful for evaluating a potential system installation, as primer before jumping into the Programming section for the first time, and for explaining system functions to users on the system.

This section starts out by explaining the relationship between the very often used term "user number" and the decoding of a particular CTCSS tone or DCS code. After discussing some additional user issues related to setting up a valid tone or code, the normal actions of the panel while in normal operation are covered. The last portion of this section covers the operation of system-wide timers and settings.

USERS VERSUS CTCSS/DCS DECODE

Since the Model 37-MAX is a multi-user repeater tone panel, it behaves as though it had a separate decode/encode module for each user group it supports. In reality, this is achieved using a single microprocessor controller and some very smart software to run it. The advantages of this software approach are:

- *higher capacity* than if we had built the panel using hardware modules. The Model 37-MAX can decode and encode all 50 CTCSS tones and 104 of the DCS codes.
- *flexibility of configuration* at a level that would be difficult to provide for even half as many users if physical switches or jumpers were required to configure user or system attributes
- *remote programming* is as easy as (in fact, works the same as) local programming, which means no more costly trips to the site just to alter a single user or system parameter

In order to reduce the number of commands used in programming and to bring some order to the process of setting up user groups, the Model 37-MAX uses the concept of a "user number" to program features related to a specific CTCSS tone or DCS code. There is a fixed relationship between a user number and the tone or code to be decoded. The user numbers 1 through 50 are used for CTCSS tones (see Table 3. OPERATION -1) and the users numbers 51 through 154 are used for DCS codes (see Table 3. OPERATION -2). The user number "0" is reserved for use with carrier squelch operations. For example, in Table 3. OPERATION -1, the user number 36 corresponds to the CTCSS tone frequency of 186.2 Hz. In Table 3. OPERATION -2, the user number 55 corresponds to the DCS code "032". These represent the tone and code that would be decoded if these two user numbers were enabled. Table 3. OPERATION -2 also shows an inverted code next to each of the primary DCS codes. Inverted codes are described in “DCS Polarity” later in this section.

Table 3. OPERATION -1. User Numbers versus CTCSS Tones

User #	Tone	Motorola Reed Code	User #	Tone	Motorola Reed Code	User #	Tone	Motorola Reed Code
0	Carrier Repeat		**17**	114.8	2A	**34**	179.9	6B
1	67.0	XZ	**18**	118.8	2B	**35**	183.5	J5
2	69.4	WZ	**19**	123.0	3Z	**36**	186.2	7Z
3	71.9	XA	**20**	127.3	3A	**37**	189.9	J6
4	74.4	WA	**21**	131.8	3B	**38**	192.8	7A
5	77.0	XB	**22**	136.5	4Z	**39**	196.6	J7
6	79.7	WB	**23**	141.3	4A	**40**	199.5	J8
7	82.5	YZ	**24**	146.2	4B	**41**	203.5	M1
8	85.4	YA	**25**	151.4	5Z	**42**	206.5	8Z
9	88.5	YB	**26**	156.7	5A	**43**	210.7	M2
10	91.5	ZZ	**27**	159.8	J1	**44**	218.1	M3
11	94.8	ZA	**28**	162.2	5B	**45**	225.7	M4
12	97.4	ZB	**29**	165.5	J2	**46**	229.1	9Z
13	100.0	1Z	**30**	167.9	6Z	**47**	233.6	M5
14	103.5	1A	**31**	171.3	J3	**48**	241.8	M6
15	107.2	1B	**32**	173.8	6A	**49**	250.3	M7
16	110.9	2Z	**33**	177.3	J4	**50**	254.1	J9

USER OPERATION ISSUES

A short list of topics related to the setup and configuring of the users needs to be covered before discussing normal tone panel operations.

Disabled Users

The default condition for all users is disabled. The 37-MAX will still be able to decode these tones and codes, but it will not react to them in any way. If a user has been previously enabled and programmed, the user can be disabled without altering any of that programming. If the same user is enabled again at a later time, it will not need to be programmed again to restore its operational configuration.

Enabled Users

To place a tone or code in service (or in the Reserved mode), the user number that corresponds to the desired tone or code must be enabled. The other attributes and parameters of a user's programming can be set or altered, even if that user is not currently enabled, however, the user must be enabled for any of that programming to take effect.

Table 3. OPERATION -2. User Numbers versus DCS Codes

User #	DCS Code	Invert.	User #	DCS Code	Invert.	User #	DCS Code	Invert.	User #	DCS Code	Invert.
51	023	047	**77**	152	115	**103**	311	664	**129**	466	662
52	025	244	**78**	155	731	**104**	315	423	**130**	503	162
53	026	464	**79**	156	265	**105**	325	526	**131**	506	073
54	031	627	**80**	162	503	**106**	331	465	**132**	516	432
55	032	051	**81**	165	251	**107**	332	455	**133**	523	246
56	036	172	**82**	172	036	**108**	343	532	**134**	526	325
57	043	445	**83**	174	074	**109**	346	612	**135**	532	343
58	047	023	**84**	205	263	**110**	351	243	**136**	546	132
59	051	032	**85**	212	356	**111**	356	212	**137**	565	703
60	053	452	**86**	223	134	**112**	364	131	**138**	606	631
61	054	413	**87**	225	122	**113**	365	125	**139**	612	346
62	065	271	**88**	226	411	**114**	371	734	**140**	624	632
63	071	306	**89**	243	351	**115**	411	226	**141**	627	031
64	072	245	**90**	244	025	**116**	412	143	**142**	631	606
65	073	506	**91**	245	072	**117**	413	054	**143**	632	624
66	074	174	**92**	246	523	**118**	423	315	**144**	654	743
67	114	712	**93**	251	165	**119**	431	723	**145**	662	466
68	115	152	**94**	252	426	**120**	432	516	**146**	664	311
69	116	754	**95**	255	446	**121**	445	043	**147**	703	565
70	122	225	**96**	261	732	**122**	446	255	**148**	712	114
71	125	365	**97**	263	205	**123**	452	053	**149**	723	431
72	131	364	**98**	265	156	**124**	454	266	**150**	731	155
73	132	546	**99**	266	454	**125**	455	332	**151**	732	261
74	134	223	**100**	271	065	**126**	462	252	**152**	734	371
75	143	412	**101**	274	145	**127**	464	026	**153**	743	654
76	145	274	**102**	306	071	**128**	465	331	**154**	754	116

Carrier Only Repeat

While the whole point of a "tone panel" is to control repeater operation based on the tone or code being decoded, the Model 37-MAX can also be programmed to repeat on just carrier (sometimes called "carrier controlled repeat", "carrier squelch", or an "open repeater"). When this mode of operation is enabled, the 37-MAX will allow any user to bring up the repeater, regardless of any encode. Users with CTCSS or DCS encode will be treated as the Carrier Repeat user if this mode is enabled.

The user number "0" has been designated as the Carrier Repeat user. This allows all of the standard user-programmable features for carrier repeat, such as enable/disable, CTCSS or DCS encoding, reserve mode.

Reserved Users

There will be times when a tone or code stops being used on a regular basis, due to the nature of how the user group assigned to it does business. This idleness places that tone or code at

risk of being taken over by another local co-channel repeater system in a busy market, rendering it unavailable whenever the original user wants to resume using "their tone".

To help prevent this problem, the 37-MAX provides a feature called the Reserve mode. When an ENABLED user is placed in this mode, the panel will still key upon decoding that tone or code, but it will not pass audio. Instead, the 37-MAX will transmit a beep tone to indicate to anyone monitoring the channel that a reserved tone is in use. The panel will still encode the proper CTCSS tone or DCS code for this user.

Disabling a user number will prevent that user from operating in Reserve mode. Temporary or seasonal users that the system operator plans to use in the future should always be reserved, not simply disabled, whenever they enter a period of idleness.

Tone Translation

The fixed relationship in the Model 37-MAX is between the user number and the CTCSS tone or DCS code that is *decoded*. The default is for the panel to encode the same tone or code that is decoded for a user, however, this relationship can be altered in programming. Each user may be programmed to encode any CTCSS tone or DCS code, or to not encode at all.

NORMAL OPERATION

The items in this subsection cover how the panel behaves while operating in its normal mode. The actions of the Model 37-MAX will be determined by both which features have been enabled in programming and what signals are coming to it from the receiver.

Carrier is Detected

Whenever the 37-MAX receives a carrier detect signal from the receive radio, it will first check to see if the panel is programmed for Carrier Repeat operation (user number "0" is enabled). If Carrier Repeat is enabled, then the 37-MAX will key the transmitter and unmute the repeat audio path. If an encode tone or code has been programmed for the "0" user number, it will be encoded. If the Carrier Repeat function has not been enabled, then the Repeater Pal will not take any actions until it checks for decode of a CTCSS tone or a DCS code.

Valid Tone or Code is Detected

After responding to the carrier detect signal from the receiver and determining that it is not enabled to do Carrier Repeat, the Model 37-MAX will start its decode software routines to determine if there is a CTCSS tone or DCS code in the receive signal. Once the panel determines which tone or code is present, it looks in its user database to see if that tone or code is enabled. If the tone or code is not enabled the panel ignores it. If the tone or code is enabled, the panel checks whether or not it is Reserved. If the Reserved mode is not enabled for that user, then the 37-MAX will key the transmitter, start encoding the programmed tone or code for that user, and unmute the repeat audio path. The 37-MAX will remain in this

condition for as long as it continues to receive a carrier indication and the tone or code that it first decoded.

Repeater Hold Time

In order to reduce wear on the equipment and not clip out important parts of the messages sent between users, the 37-MAX does not normally unkey immediately after the transmitting radio user does. It keeps its own transmitter keyed for a short time in anticipation of another radio in the same user group responding to the transmission that just ended. The duration of this repeater hold time is set under system programming and the 37-MAX actually provides two timers, a normal and an alternate. Which timer is used by a particular user is set under user programming. The default values for these timers are Normal = 2 seconds and Alternate = 3 seconds. Both of these timers can be set anywhere from zero to nine seconds, in whole second increments.

Encode During Repeater Hold Time

Since the tone or code that is encoded by the panel during a radio user's transmission is generated in the panel, it can be maintained independently during the repeater hold time. Normally, the encode is dropped when the radio user unkeys to provide those units monitoring the transmitter frequency of the repeater with a positive indication that the user unkeyed, even though the repeater's carrier is still up. There are, however, valid operating reasons for maintaining the encode for the entire repeater hold time. A common one would be to support the use of radios that had a "busy-channel-lock-out" feature enabled in them. This would both prevent new tones from interrupting conversations in progress, and require that the originating tone or code continue during the hold time so that the radios in the correct group could key up to respond. Whether or not the encoding continues during the repeater hold time is programmable on a per-user basis.

Transmitting Morse Code Station ID

When a valid user has keyed up, the 37-MAX will check the Station ID Interval Timer to see if the programmed interval has elapsed since the last ID. If it has, then the 37-MAX will transmit the call sign programmed in Morse code at 30% of full channel deviation (so that the radio users can continue to talk over the ID). This call sign can be up to eight characters long. There are a number of parameters controlling the ID transmission that can be altered in the field to suit the needs / licensing of the system, they are:

ID Interval = The period of the ID Interval timer can be programmed from one to 90 minutes (in whole minutes), with the default being 15 minutes.

ID Mode = The 37-MAX can be set to not ID at all, to ID only when the timer has expired and there has been recent activity on the repeater, or to ID automatically whenever the timer expires regardless of whether there has been any recent activity or not. The default is to ID based on repeater activity. The 37-MAX will fail to ID if there is no call sign programmed into the unit (the default is the call sign is blank), even if one of the two ID modes has been selected.

Morse Code Transmission Speed = The 37-MAX defaults to transmitting its Morse code characters at 22 words per minute, however, it can be set to transmit them at only 11 words per minute.

In order to program the actual call sign into the 37-MAX, all of the characters are converted into pairs of DTMF numbers using the table provided “Station ID Call Sign” in Section 4. They can then be entered into the nonvolatile memory of the tone panel while in the programming mode. The default condition for the call sign memory is blank, and returning it to a blank condition will stop the panel from transmitting its ID, even if the rest of the ID programming is left in an enabled state.

Reserved Mode Users

If the tone or code decoded by the 37-MAX during a transmission belongs to a user that has been placed in the Reserved mode, then the panel mutes the repeat audio path and transmits a covering beep tone to let anyone monitoring the channel know that a reserved user has been brought up. When the transmitting radio user unkeys, the 37-MAX will send out a tone to let that user know about the reserved status as well.

Courtesy Tone

Even when the users involved are experienced users (and especially if one or more are novice users), there can be a good deal of airtime wasted with both parties to a conversation waiting because they were all uncertain whether the speaker has actually unkeyed and is waiting for a response. The Courtesy Beep feature was developed to help reduce this problem. If it is enabled for the user group in question, then, when the 37-MAX senses that the transmitting radio user has unkeyed, it will transmit a short beep tone right after it mutes the repeat audio path to provide listeners with an audible indication that the user who was speaking has unkeyed.

Because this feature tends to be one that users either really like a lot, or can't stand at all, it defaults to being disabled, and it can be enabled on a per-user basis.

Under system programming, the technician can set the pitch of the beep tone used for the Courtesy beep. The default is 1000 Hz, with alternate choices of 500 Hz or 1500 Hz. There is only one pitch selection available, so all courtesy tone users will hear the same one.

SYSTEM OPERATION ISSUES

This subsection covers some features that affect the operation of the 37-MAX on a system-wide basis.

Repeater Time-out Timer

Whenever the panel keys up its own transmitter, it starts a timer to keep track of how long the transmitter has been keyed. If carrier with a valid tone or code has kept the repeater keyed long enough for the Repeater Time-out Timer to reach its limit, then the 37-MAX will unkey the transmitter and remain unkeyed until the receive signal stops. Once the offending carrier

signal has stopped, the panel will function again normally the next time carrier with a valid tone or code is received. As the timer nears its limit, the panel will start transmitting warning tones to indicate that it is about to drop the transmitter.

This timer is not intended as a way to limit users from getting long winded. The Repeater Time-out timer is intended to help protect the repeater transmitter equipment in case of a "stuck mic" accident. This is particularly important for repeaters that use lower power radios which are not designed or rated for continuous-duty operation.

DCS Polarity

If you look at Table 3. OPERATION -2, you will notice that each of the three-digit DCS codes has an 'inverted' code next to it. The number in the inverted column is the valid DCS code number that would be decoded if you took the original code in the first column and inverted it, that is, changed all the zeros to ones and vice-versa.

The reason this is of interest to a technician working with the Model 37-MAX (or another repeater controller) is because most analog amplifier stages are also signal inverters, and any time that a signal carrying the DCS encoding passes through a stage all of the data bits in the DCS code get flipped upside down, i.e. inverted. If there is an odd number of stages between the encoder and the decoder, the decoder will see the inverted code and fail to provide a valid decode output. This problem can arise going in either direction, the panel can fail to decode the DCS sent by the radio user, or the radios in the fleet can fail to decode the signal from the repeater.

One way to handle this problem, once the technician has determined which is failing, the encode or the decode, is to look through Table 3. OPERATION -2 and enable the user number that has the necessary code in its Inverted column, or use the tone translation command to set the enabled user's encode to the necessary inversion. This is not a good solution if the system is supporting very many DCS users.

The Model 37-MAX offers a simple fix for this problem. Since the decode/encode inversion is the result of the physical design of the radio hardware and the tone panel's interface to them, if any of the DCS codes are inverted, then they will all be inverted. The 37-MAX has two complementary sets of commands in its system programming that will independently configure the DCS decoding and encoding done by the panel to be either 'normal' or 'inverted'.

Repeater Knock-down and Setup

There are any number of reasonable scenarios where a system operator might want to temporarily take a repeater out of service, that is, force it to be idle. One way to do this would be to enter the programming mode and force all programming back to the factory default values. This method carries the high price of requiring the technician to completely reprogram the 37-MAX in order to return it to service.

Fortunately, the Model 37-MAX has a Repeater Knock-down and a Repeater Setup command. If the technician uses the Knock-down command and then exits the programming mode, the panel will retain all of its programming, but it will not function and service the valid radio users until the technician enters and exits the programming mode again, or the main power is cycled. The Setup command is supplied so that the 37-MAX can be enabled again after certain types of testing or so the Knock-down command can be canceled while still in the programming mode.

4. PROGRAMMING

OVERVIEW

This section covers the field programming of the Model 37-MAX. Since the Repeater Pal can only be programmed using DTMF commands over the radio, this means that the basic installation and level adjustments must already have been made before programming can done.

The process of getting into and out of the programming mode is covered first, then the specific commands are discussed in detail. The commands have been grouped according to their general purpose: User, System, and Diagnostic.

PROGRAM MODE ACCESS

The programming mode can be accessed by entering the Program Mode Access Code over the radio. The default value for the Program Mode Access Code is "12037", but it can be changed to any other 5-digit code. The Model 37-MAX will respond to decoding a valid access code by transmitting a "go-ahead" tone consisting of five short beeps. This same prompt is used throughout the programming process to indicate that the panel is ready to accept the next programming command.

If the access code decoded by the 37-MAX is invalid, then the panel will ignore the attempt.

Manually Resetting the Access Code

There are a number of ways in which the Program Mode Access Code in use can be rendered useless; you change it, don't write the new one down and forget what it is, someone else changes it and either won't or can't tell you what they changed it to, etc. In this situation, the panel's programming must be manually reset to factory defaults in order to use the default access code. This is also a good argument for keeping a complete and current record of the panel's programming so that it can be restored as quickly as possible.

The procedure for manually resetting Model 37-MAX programming to factory defaults is as follows:

1. Turn off power to the 37-MAX.
2. Press and hold the Disable button while power is restored to the Model 37-MAX.
3. Continue to hold the Disable button in and watch the Status LED on the front of the unit. The Status LED will light for the first 2 seconds, then it will be off continuously for about 10 seconds.
4. After 10 seconds, the LED will start to flash, indicating that the 37-MAX has completed resetting all its programming to defaults. Release the Disable button.

ENTERING A PROGRAM COMMAND

To enter a programming command, a DTMF number is entered followed by the "#" key. Once the "#" has been entered, the Model 37-MAX will respond either with the 5-beep "go-ahead" prompt to indicate the command was accepted, or the high-low "error tone" sequence to indicate that an invalid command sequence was received.

Some commands will require additional numbers be entered, as in the case of a CTCSS tone, or the station ID call sign. When it receives a command of this type, the 37-MAX will respond with two quick beeps to indicate that it is waiting for the additional data to be entered. In most cases, the data will be followed by a "#", just as the command numbers are.

The Model 37-MAX accepts its commands and updates its database in "real time". That is, it changes the parameters recorded in its memory as each command is completed. The programming mode can be exited at any time and the panel will "remember" any and all changes made up to that point.

The commands should all be entered one at a time, do not try to string several commands together in a single transmission. Always unkey and wait for the go-ahead prompt or the error tones before making the next command entry. If the next command is not received within 60 seconds of the last command, the 37-MAX will exit the programming mode and return itself to the normal, idle condition.

CLEARING PROGRAMMED SETTINGS

The Model 37-MAX offers no method of viewing the programmed settings (there is no RS-232 port for CRT or printer). Therefore, it is very important to be careful during programming and to keep track of all programming entries made.

If the state of an individual parameter is not known for certain, then it must be programmed again with the condition or value desired for that parameter. If there are a number of parameters that are not known, it will probably be easier to reset the entire database of the unit back to factory defaults and start over again. If the program mode can still be accessed, this can be done by using command "391#". If not, then use the manual method described in "Manually Resetting the Access Code" at the beginning of this section.

EXITING THE PROGRAM MODE

When a programming session is completed, the programming mode is exited by entering "99#". The 37-MAX will transmit a prompt that sounds like the ringing of an electronic telephone, and then return to its normal, idle state.

If the Model 37-MAX receives no new commands for a period of 60 seconds, it will exit the program mode and return to the normal idle state on its own.

USER PROGRAMMING COMMANDS

The following commands are used to configure the operation and privileges of individual users on the repeater. Where the variable “uu” appears, it represents the user number associated with a particular receive CTCSS tone or DPL code. This can be a two or three digit entry, no leading zero is required for numbers under 100. A listing of the relationship between user numbers and tones or codes can be found in Tables 3-1 and 3-2. The user number "999" may be used with most of the following commands to globally program all users at once.

Enable and Disable a User

In order to enable service to a particular tone or code in the Model 37-MAX, the user number associated with that tone or code must be enabled. The two commands shown here are used with the appropriate user number to start or suspend service. By default, all users are disabled and must be individually enabled to provide service. The user number "999" may *not* be used to globally enable or disable users. The user number "00" is used to turn on and off Carrier Squelch repeater operation.

110# uu# Disable User Number “uu” (default)
111# uu# Enable User Number “uu”

Tone Translation

In the Model 37-MAX, there is a fixed relationship between any given user number and the tone or code that will be decoded when that user is enabled. By default, a user will encode the same tone or code that it decodes, but this is not a fixed relationship. The encode output of any user can be programmed for another tone or code using the command shown here. The command requires that the user affected be specified first (uu), followed by the user number of the new tone or code to be encoded (ee). Setting the variable “ee” to zero will produce a Carrier Squelch output, 1 to 50 for a CTCSS tone, and 51 to 154 to chose a DCS code.

122# uu# ee# Tone Translation (default, encode is the same as decode)

Tone-In-Tail

In many repeater systems, the controller drops the encode of the CTCSS tone or DCS code when the radio user that was transmitting unkeys. This provides a convenient way for persons and equipment monitoring the repeater transmitter to know when the mobile has unkeyed, even though the repeater transmitter is still keyed. There are other types of system configurations though, that require the encode to continue for the entire transmitter hold time (commonly referred to as the repeater “tail”) for proper operation. The two commands shown here are used to configure the 37-MAX for whichever mode of operation fits the system it is installed in. The default setting of this parameter is for no encode during the transmit hold time.

120# uu# Encode Disabled During TX-Hold for User “uu” (default)
121# uu# Encode Enabled During TX-Hold for User “uu”

TX-Hold Time Selection

The Model 37-MAX has two transmitter hold timers available, a normal and an alternate timer. The values of these timers are set under System programming. The commands shown here are used to select which timer is used whenever a particular tone or code has brought the repeater up. The default setting for all users is to use the Normal TX-Hold Timer.

123# uu# Use Normal TX-Hold Timer for User “uu” (default)
124# uu# Use Alternate TX-Hold Timer for User “uu”

Reserved Mode

Placing a user into the Reserve mode will cause the panel to mute the repeat audio path whenever that user’s tone or code is received. The repeater will still get keyed and the proper tone or code will be transmitted, but no voice audio will pass. The default condition is that no users are reserved.

130# uu# Reserve Mode Disabled for User “uu” (default)
131# uu# Reserve Mode Enabled for User “uu”

Courtesy Tone

The Courtesy Tone is a beep prompt transmitted by the 37-MAX every time it detects that the mobile which was transmitting has unkeyed. This provides a positive indication to the listener that the transmitting mobile has finished their last transmission, as opposed to just pausing a moment. The pitch (frequency) of the Courtesy tone is set in System programming. These commands enable or disable the feature for individual users. The default setting for all users is disabled.

150# uu# Courtesy Tone Disabled for User “uu” (default)
151# uu# Courtesy Tone Enabled for User “uu”

Exit the Program Mode

Returns the Model 37-MAX to the normal operating mode.

99# Exit Program Mode

SYSTEM PROGRAMMING COMMANDS

The following commands are used to configure the operation of the Model 37-MAX on a system wide basis. Those commands that require the entry of additional data will be followed by a variable “nn”, where the number of n’s indicates the number of digits expected.

TX-Hold Time Duration

These commands set the duration of the two transmit hold timers available in the 37-MAX. Which timer gets used by a particular user is set under User programming, the default being for all users to use the normal timer. The timers are programmed in whole second increments, with the normal timer defaulting to 2 seconds and the alternate timer to 3 seconds.

210# n#	Sets Normal TX-Hold Timer (0 to 9 seconds, default = 2)
211# n#	Sets Alternate TX-Hold Timer (0 to 9 seconds, default = 3)

Repeater Time-out Timer (Stuck Mic)

This command determines the maximum time that the 37-MAX will keep the repeater transmitter continuously keyed. This timer acts as a form of protection for the transmitter equipment in the case of a "stuck mic" situation where a mobile (or any other set of conditions) keeps the receiver continuously unsquelched for a very long period of time. The timer is programmed in increments of whole minutes. The default setting is three minutes.

220# n#	Repeater Time-out Timer (1 to 9 minutes, default = 3)

Station ID Parameters

These commands are used to configure how and when the Morse code Station ID occurs, if this feature of the Model 37-MAX is being used (the default condition is ID with activity enabled). The panel can be set to only ID when the timer has expired and there has been some activity on the channel either during the timer period or since it timed out. The alternative mode is for the panel to go ahead and ID whenever the timer expires, whether or not the channel has had any recent activity. The timer period is programmed in increments of whole minutes, and defaults to 15 minutes. The speed at which the Morse characters are transmitted defaults to 22 words per minute, but it can be halved down to 11 words per minute.

230#	Station ID Disabled
232#	Station ID Only After Channel Activity (default)
233#	Station ID At Regular Intervals
235# nn#	Set Station ID Interval (1 to 90 minutes, default = 15)
273#	Station ID Sent at 22 words per minute
274#	Station ID Sent at 11 words per minute

Station ID Call Sign

The Model 37-MAX supports station ID call signs up to eight characters long. Since the call sign can include letters as well as numbers, and the tone panel can only be programmed using DTMF, the call sign must be converted into a sequence of DTMF pairs in order to be entered into the 37-MAX. The relationship between numbers/letters, Morse Code characters, and the two-digit DTMF pairs used to represent them when programming a 37-MAX are all set forth in Table 4. PROGRAMMING -1. The default is for no call sign to be in memory. The following example will help to clarify the process, the call sign used is WNCR414 :

DTMF entered:	272#	19	26	32	27	04	01	04	#
Function:	Command	W	N	C	R	4	1	4	End

To clear a call sign from memory, enter the command with no digits after it. 272# #

272# nn nn ... # Enter Station ID Call Sign (default is blank)

Table 4. PROGRAMMING -1. Morse Code ID Cross-Reference

Digits	#	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	– • – –
#	END		16	M	– –	20	Z	– – • •

Courtesy Tone Frequency

This command sets the frequency of the beep used to make the Courtesy Tone, when a user has that feature enabled. The default frequency is 1000 Hz.

244# Set Courtesy Tone Frequency to 500 Hz
245# Set Courtesy Tone Frequency to 1000 Hz (default)
246# Set Courtesy Tone Frequency to 1500Hz

Program Mode Access Code

The Program Mode Access code is always a 5-digit sequence. The default setting for this code is "12037". When it is used, it is entered all by itself, without prefixes or terminators. This command allows system operators to change the Program Mode Access code in the field to protect their systems against unauthorized changes by persons who know the factory default code.

290# nnnnn# Set Program Mode Access Code to "nnnnn"

CAUTION:

Whenever this command is used, great care should be taken that it is executed correctly and the new access code should be recorded in a secure place. The reason for this is, if the

operator does not enter the digits of the new code correctly or forgets what they are before using the code again, then there is no way to get back into the program mode again except to force the panel to its default settings. This will also require that you reprogram the rest of the unit's memory as well.

DCS Encode Polarity

This command allows the service technician to invert the polarity of the DCS encode in software. This may be necessary to make the transmitted data stream look correct for the decoders in the mobiles using the system.

215# DCS Encode set to Normal Polarity (default)
216# DCS Encode set to Inverted Polarity

DCS Decode Polarity

This command allows the service technician to invert the polarity of the DCS decode in software. This may be necessary to make the received data stream from the mobiles using the system look correct for the decoder in the Model 37-MAX.

217# DCS Decode set to Normal Polarity (default)
218# DCS Decode set to Inverted Polarity

Exit the Program Mode

Returns the Model 37-MAX to the normal operating mode.

99# Exit Program Mode

DIAGNOSTIC PROGRAMMING COMMANDS

The following commands will be used during the initial installation to set levels and verify correct operation. They can also be used at any time to assist in trouble-shooting any problems with the normal operation of the repeater.

Repeater Knockdown and Setup

The Model 37-MAX can be disabled and then enabled again (without losing any of its programming) by using the Disable button on its front panel. These commands allow the technician to do the same thing remotely using DTMF commands. Once the Repeater Knockdown command has been used, the 37-MAX will remain idle until the Program Mode is entered again, or the Disable button on the front panel is used. The panel can be re-enabled during the same programming session by using the Repeater Setup command.

300#	Repeater Knockdown
301#	Repeater Setup

Reset Programming to Factory Default

This command will erase the programmable parameters held in non-volatile memory and then write in the factory default values. This command can be used to "zero-out" a unit that is in some unknown condition, so that programming it can proceed from a known, defined state.

391#	Reset all Programming to Factory Default Values

TX Audio Test

This command is used to set the transmit deviation for audible tones and voice coming from the Model 37-MAX. When this command is entered, the panel will key the transmitter and put out a 1 kHz sine wave. The technician should adjust the transmit level control in the 37-MAX (R3) until the transmitter is modulated at 60% of full channel deviation (e.g. for 3 kHz deviation on a channel licensed for 5 kHz maximum deviation). To terminate the test, send a "#" to the panel. This test is *not* used to set the repeat audio level.

392#	Transmit Audio Test

TX Audio Pre-Emphasis Test

This test is used to determine the pre-emphasis slope of the repeater transmitter. When this command is entered, the 37-MAX will key the transmitter and generate a sine wave. The frequency of the sine wave will change every time a DTMF digit is received by the panel, cycling through 400 Hz, 1000 Hz, 2000 Hz, and then starting over again. The test is terminated by sending a "#" to the panel.

393#	Transmit Audio Pre-Emphasis Test

Repeat Audio Test

This test is used to set the receive audio level and frequency response to produce a flat, unity-gain output from the repeater during normal operations. When this command is entered, the 37-MAX will key the transmitter, open the repeat audio path, and then remain that way until the test is terminated. The technician will then transmit a signal of known level to the repeater and adjust the receive level and de-emphasis jumpers until a unity gain output is achieved on the transmitter. The test is terminated by sending a "#" to the panel.

394# Repeat Audio Test

CTCSS Encode Test

This test is used to set the encode deviation level for the CTCSS/DCS encode. When this command is used, the panel will key the transmitter and encode a 136.5 Hz CTCSS tone. The technician should adjust the encode level for 15% of full channel deviation (e.g. for 750 Hz deviation on a channel licensed for 5 kHz maximum deviation). The test is terminated by sending a "#" to the panel.

395# CTCSS Encode Test

CTCSS Frequency Response Test

This test is used to determine how flat the encode deviation level is across the entire range of CTCSS tone frequencies. A reasonably flat output level is necessary for reliable operation of the decoders in the mobiles on the system. When this command is used, the 37-MAX will key the transmitter and start encoding a CTCSS tone. Every time a DTMF digit is received, the panel will switch to encoding the next DTMF tone in the list (67.0 Hz, 136.5 Hz, 250.3 Hz). The test is terminated by sending a "#" to the panel.

396# CTCSS Frequency Response Test

DCS Encode Test

This test is used to verify the correct polarity and deviation level for the DCS encode. When this command is used, the panel will key the transmitter and encode DCS code "023". If the code "047" is decoded on your service monitor, then the DCS Polarity must be changed using the command 216# or 215#. The test is terminated by sending a "#" to the panel.

397# DCS Encode Test

Exit the Program Mode

Returns the Model 37-MAX to the normal operating mode.

99# Exit Program Mode

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 37-MAX should only be attempted by qualified radio service personnel.

GENERAL

Connections to the transmitter, receiver, and power supply are grouped on a detachable connector on the rear of the unit for ease of installation. The Model 37-MAX includes installation test modes to aid in installation. Adjustments can be made from the rear of the Model 37-MAX, though the top cover will need to be removed during the initial installation to allow the technician to check and set the positions of various jumpers.

The "Installation Procedure" in the beginning of this section is generic in nature. The "Radio Specific Application Notes," at the end of this section, will aid the technician considerably in connecting the Model 37-MAX to the radios to which they apply.

EQUIPMENT REQUIRED FOR INSTALLATION

Equipment *required* for the installation includes :

Communications Service Monitor
DTMF capable mobile radio or handheld transceiver
Soldering iron, and solder
Shielded Audio Cable
Hookup Wire
Volt meter (preferably one with DC, AC-rms, and dBm scales)
Crimping tool for adding the Model 37-MAX connector pins to the hook-up wire

Additional *recommended* equipment:

Oscilloscope

INSTALLATION PROCEDURE

The following procedure is generic in nature. If used by itself, the technician must supply equipment specific information concerning the proper points at which to make connections for the radio(s) and power supply used. Radio specific application notes are available at the end of this section of the manual, which supply connection information for some of the more popular repeater stations.

Note

PLEASE REVIEW THE *ENTIRE* INSTALLATION PROCEDURE BEFORE STARTING TO MAKE CONNECTIONS.

1. Power Supply: Locate and verify the voltage of the power supply for the radio receiver and transmitter. With a voltmeter, set to a DC scale, confirm that the voltage is between 10.5 and 15.0 volts. Connect the positive supply lead to J1/pin-1 (+12VDC) of the Model 37-MAX, and the power supply ground lead to J1/pin-2 (GND). DO NOT crimp the connector onto the ground lead until step #2.

2. Ground Connection: Connect a wire from J1/pin-2 (GND) of the Model 37-MAX to the chassis ground of the transmitter/receiver.

3. Transmitter PTT: Connect a wire from J1/pin-7 (PTT) of the Model 37-MAX to the PTT input of the transmitter. This output is an 'open-drain' FET that pulls to ground when PTT is activated.

4. Transmitter Audio Output: Connect a shielded cable from J1/pin-5 (TX AUD) of the Model 37-MAX to the microphone input of the transmitter. Connect the shield braid to J1/pin-6 (GND) of the Model 37-MAX, and leave it unconnected on the radio end.

5. Discriminator Input: Connect J1/pin-3 (DISC) of the Model 37-MAX to the discriminator output of the receiver. Shielded cable must be used for this connection. Connect the shield braid to J1/pin-4 (GND) of the Model 37-MAX, and leave it unconnected on the receiver end.

NOTE:

Unfiltered, unsquelched discriminator audio must be used for proper operation of the CTCSS / DCS decoder circuits in the Model 37-MAX.

6. CTCSS Encode: Connect J1/pin-10 (TONE OUT) of the Model 37-MAX to the direct modulation input of the transmitter. Shielded cable must be used for this connection. Connect the shield braid to J1/pin-8 (GND) of the Model 37-MAX.

7. COR Input: Connect J1/pin-9 (COR) to a carrier indication point in the receiver. The signal available at this point must be between 0 and 11.5 volts DC, and it must change value by at least one volt between the carrier and no-carrier conditions.

TESTS AND ADJUSTMENTS

These tests and adjustments will need to be done after the Model 37-MAX has been installed on the repeater and prior to programming the system and placing it in service. The tests need to be done in order to ensure reliable operation and optimum audio quality on the system. If this is the first time this test has ever been run on this system, remove the top cover of the unit before starting, to provide access to the jumpers inside.

1. Carrier Detect: After completing the connection of the Model 37-MAX to the repeater, apply power to both units. Supply and then remove a 6 dB SINAD quieting signal to the receiver and adjust the potentiometer R35 (EXT COR) until the Carrier LED tracks the presence of carrier and goes off when the signal is removed. If the Carrier LED operates 'backwards', then locate the jumper JP5 (COR POLL) and rotate its jumpers a quarter turn. Readjust R35 as necessary. If necessary, adjust the squelch control on the receiver to cause the receiver to unsquelch reliably for the test signal. When this step is completed, the receiver's squelch control will set the threshold for both the receiver and the Model 37-MAX.

2. Initial Receiver Audio Level: Using a DTMF equipped mobile radio or portable set to the repeater's receive frequency, transmit all of the DTMF tones. Adjust the potentiometer R2 (RX LVL) so that the Status LED blinks after each digit. If necessary, change the position of JP3(RX).

3. Access Program Mode: Set the service monitor to receive on the repeater's transmit frequency and connect it either to the transmitter output or a suitable antenna. Using the DTMF equipped radio from step one, enter the program mode access code. It is initially set to "12037". Once the program mode has been accessed, the 37-MAX will key the transmitter and send a five-beep "go-ahead" prompt.

4. Transmit Audio Level: Enter the DTMF command "392#". The panel will respond by keying the transmitter and sending a 1 kHz test tone. Adjust the potentiometer R3 (TX LVL) for 60% of full channel deviation (example: ± 3 kHz deviation on a channel licensed for 5 kHz). If it is difficult or impossible to reach this level, try moving jumper JP4 (TX) to the other position and try again. When finished adjusting the transmit level, enter a DTMF "#" to exit the transmit audio test.

5. Repeat Audio Level: Move the jumper JP3 (RX) to position 'A'. Supply a full quieting signal with a test tone of known deviation on the receiver's frequency. Enter "394#" to start the repeat audio test, the 37-MAX will key the transmitter and open its repeat audio path. Adjust the potentiometer R2 (RX LVL, *not* R3 - TX LVL) for unity gain through the repeater, that is, the transmitter deviation equals the known deviation of the signal being supplied to the receiver. If unity gain can not be achieved with JP3 (RX) in the 'A'

position, move it to 'B' and try again. Once the level has been set, supply a signal on the receive channel with test tones of 500 Hz, 1000 Hz, and 1500 Hz while monitoring the transmit frequency. The deviation should remain reasonably flat for all three tones. If not, move jumper JP6 to the other position and readjust the receive level (R2) if necessary. Enter a DTMF "#" to exit this test.

NOTE:

If using a DTMF digit as the test tone, do not hold the digit continuously for more than eight seconds, or a RESET will occur. If the signal is not being repeated, check that the receiver is supplying audio to the Model 37-MAX. Some duplex capable radios disable their receivers while transmitting. If this is the case, the radio will need to be modified before continuing.

6. Encode Output Level: To set the encode level, enter the DTMF command "395#". The Model 37-MAX will key the transmitter and encode a 136.5 Hz CTCSS tone. Adjust the potentiometer R1 to set the encode level at 15% of full channel deviation (example: that is ± 750 Hz deviation on a channel licensed for 5 kHz maximum). If it is difficult to achieve this deviation, move the jumper JP2 (LO/HI) to the opposite position and try again. Enter a DTMF "#" to exit this test.

7. CTCSS Pre-Emphasis Test: Enter the DTMF command "396#" to start the CTCSS pre-emphasis test. After that, each time a DTMF digit is received, the panel will change to encoding a new CTCSS tone. The three tones that it will cycle through are 67.0 Hz, 136.5 Hz, and 250.3 Hz, then it loops back again. The deviation levels of all three tones should be close to the same. If they are not, switch the position of jumper JP1, repeat step six, and then repeat this test. It is important to the proper operation of the repeater that there not be more than a few hundred Hertz difference in the encode deviation between the highest and lowest tones. Enter a DTMF "#" to exit from this test.

8. DCS Encode Polarity: Enter the DTMF command "397#" to start the DCS encode of "023". Verify that the code "023" is being transmitted. If code "047" is being decoded instead, then the DCS Encode polarity must be changed using either command "216#" or "215#". Verify that the encode is being sent at approximately 15% of full channel deviation. Enter a DTMF "#" to exit from this test.

9. Exit The Program Mode: Enter the DTMF command "99#" to exit the program mode and return the Model 37-MAX to normal operation. Replace the top cover and mount the Model 37-MAX in the repeater.

ALTERNATE TEST AND ADJUSTMENT PROCEDURE

There is another way to set up the Model 37-MAX on a new radio system that does not require having a radio with a DTMF encoder. Cycling the Model 37-MAX through the various test modes is accomplished using the Disable button on the front of the unit.

1. Complete the installation of the Model 37-MAX to the radio(s). Configure the Communications Service Monitor to display the deviation of the signal it receives on the repeater's transmit frequency.

2. Cycle power on the Model 37-MAX while holding the Disable button down. Continue holding the button for at least two seconds until the Status LED turns on. Release the button after the Status LED turns on to begin the Alternate Test Procedure.

3. The following test sequence will advance each time the Disable button is pressed. To exit this mode at the end of the procedure, turn off power to the tone panel. If power is not cycled, the 37-MAX will return to the normal operating mode on its own, 30 minutes after the test mode was entered.

   Key the transmitter and output a 1 kHz tone.
   Output a 136.5 Hz CTCSS tone, no audible tone.
   Output a 67.0 Hz CTCSS tone, no audible tone.
   Output a 250.3 Hz CTCSS tone, no audible tone.
   Output DCS code "023", no audible tone.
   Enable Repeat Audio Mode, no tones from the 37-MAX.

4. Transmit Audio Level: Set the deviation level of the 1 kHz tone being transmitted by the tone panel to 60% of full channel deviation (example: ± 3 kHz deviation on a channel licensed for 5 kHz maximum). The gross level of this signal can be set using JP4 (TX), and the final level adjustment is done using R3 (TX LVL).

5. Encode Output Level: Press the Disable button once to start the 136.5 Hz encode. Set the encode deviation level for 15% of full channel deviation (example: for 750 Hz of deviation on a channel licensed for 5 kHz maximum deviation). The gross level can be set by moving JP2 (LO/HI) and the final level is set using R1. Check the position of JP1, it should be in the 'B' position. The only time JP1 would be moved to the 'A' position is if the repeater was doing CTCSS encode only on a phase modulated transmitter.

6. Encode Pre-Emphasis Test: Press the Disable button once to change the encode frequency to 67.0 Hz and check that the encode deviation remains close to what it was set at in step five. Press the Disable button again to change the encode frequency to 250.3 Hz and check the encode deviation again to confirm that it has remained reasonably constant. It is important to the proper operation of the repeater that there not be more than a few hundred Hertz difference in the encode deviation between the highest and lowest tones. If necessary, move JP1 to the 'A' position and start the encode level setting in step five over

again (cycle the Disable button as necessary to get the encode frequency back to 136.5 Hz).

7. DCS Encode Polarity: After completing step six satisfactorily, press the Disable button once to start the DCS encode of "023". Verify that the code "023" is being transmitted. If code "047" is being sent instead, then the DCS Encode polarity must be changed using either command "216#" or "215#". Verify that the encode is being sent at approximately 15% of full channel deviation.

8. Carrier Detect: Press the Disable button once to enable the Repeat Audio mode. Supply and remove a full quieting signal in the receiver frequency and adjust R35 (EXT COR) as necessary to get the Carrier LED to track the presence of receive signal. If the LED appears to be operating 'backwards', locate JP5 (COR POLL) and rotate the two jumpers there a quarter turn. Then, readjust R35 as necessary.

NOTE:

Some duplex radios disable their carrier indication output while transmitting. If this is the case with radio being used, the receiver must be modified to supply carrier detection regardless of the transmitter's condition.

9. Repeat Audio Level: Supply a full quieting signal with a test tone of known deviation on the receive frequency of the repeater. Adjust R2 (RX LVL, *not R3 TX LVL*) for unity gain through the repeater. This means that the deviation measured on the transmit frequency during this test should be the same as the known deviation of the signal being supplied on the receive frequency. If unity gain cannot be reached using R2 (or is reached only with the potentiometer 'pegged'), try moving jumper JP3 to the opposite position, and then run the test again.

   Once the level has been set, supply a signal on the receive channel with test tones of 500 Hz, 1000 Hz, and 1500 Hz while monitoring the transmit frequency. The deviation should remain reasonably flat for all three tones. If not, move jumper JP6 to the other position and readjust the receive level (R2) if necessary.

NOTE:

If using a DTMF digit as the test tone, do not hold the digit continuously for more than eight seconds, or a RESET will occur. If the signal is not being repeated, check that the receiver is supplying audio to the Model 37-MAX. Some duplex capable radios disable their receivers while transmitting. If this is the case, the radio will need to be modified before continuing.

10. This completes the Alternate Test Procedure. Cycle power on the Model 37-MAX to return it to normal operation.

RADIO SPECIFIC APPLICATION NOTES

This subsection contains applications notes with connection information specific to some of the more popular repeater stations used with Zetron tone panels. Most of these notes were written assuming that Zetron's Generic Radio Cable (part # 709-7179) was used to do the interface, however, the same information will still be very useful to any technician that is making up a cable on site. The repeaters covered here are:

GE	MASTER III, MASTER II, Custom MVP, EXEC II, MASTER PRO
EF Johnson	Viking Universal Station, CR1010, CR1000
Kenwood	TKR720, TKR820
Midland	Basetech Repeater
Motorola	GR300/GR500, R100, MSF5000, MSR2000, MICOR
Standard	RPT10, RPT21, RPT30
Tait	T800 series, T300 series
Uniden	ARU-251

Connection to a GE Master III Base/Repeater

For: Zetron Model 37-MAX
To: GE Master III Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	P5.1 (A+ / DC Power)
Ground	2	BLACK	P2.2, P2.3, P4.2 (Power Ground)
Discriminator Input	3	WHITE	P2.5 (Demodulated Audio)
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	P5.8 (Repeat Audio)
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	P2.13 (Repeat PTT In)
Ground	8	BROWN	
COR Input	9	YELLOW	P3.5 (CAS)
CTCSS/DCS Encode	10	GREEN	P3.14 (CTCSS Encode)

MASTER III Configuration

The connectors for P2, P3, P4, and P5 are located on the Master III backplane.

1. Cut the printed circuit foil at JP-1 on the T/R Shelf's backplane (19d902948).

2. 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).
   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
   g. No CCT or DODT Timers (set to 0)
   h. Remote Control optional

3. Set the repeat and CTCSS modulation levels by adjusting the Zetron unit (See “Tests and Adjustments” earlier in this section.

Connection to a GE Master II Base/Repeater

For: Zetron Model 37-MAX
To: GE Master II Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Station supply +12 volts DC
Ground	2	BLACK	Station supply ground
Discriminator Input	3	WHITE	J606 on IF/Audio/Squelch board
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	J933, pin 6 on old control board, or P2, pin 4 on new IDA board
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	J931, pin 14 (Local PTT)
Ground	8	BROWN	J933, pin 2 (CG Low)
COR Input	9	YELLOW	J932, pin18 (CAS)
CTCSS/DCS Encode	10	GREEN	J933, pin 3, (CG Hi)

GE Master II Configuration

Two versions of the GE Master II 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 for the TX Audio. On the later models, TX Audio is connected to the "Battery Alarm Audio" point. Follow these steps:

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

2. Discriminator audio may be connected to Volume Squelch Hi (J932, pin 3).

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

Connection to a GE Custom MVP

For: Zetron Model 37-MAX
To: GE Custom MVP
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Inside front panel, S701 (switch side)
Ground	2	BLACK	Chassis ground
Discriminator Input	3	WHITE	IF detector board, junction of R606, R608, C622
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Exciter board, P902, pin 4 (Mic Hi)
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	System Audio Squelch board, J911 (PTT)
Ground	8	BROWN	Exciter board, P902, pin 5 (Mic Lo)
COR Input	9	YELLOW	System audio squelch, J912 (CAS)
CTCSS/DCS Encode	10	GREEN	Exciter board, P902, pin 9 (CG Hi)

GE MVP Configuration

Follow these steps:

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

2. Install a jumper between J904 pin 2 (RX OSC Control) and J904 pin 1 (10 volt regulator) on the System Audio Squelch board (SAS board). This provides a source of switched 10 volt to the receiver oscillator at all times.

Connection to a GE EXEC II Base

For: Zetron Model 37-MAX
To: GE EXEC II Base
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	H20 (A+)
Ground	2	BLACK	Chassis ground
Discriminator Input	3	WHITE	J907, pin 8 (Vol Hi)
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	H36 (Tone Hi)
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	J907, pin 10 (PTT)
Ground	8	BROWN	Ground trace
COR Input	9	YELLOW	J913, pin 4 (CAS)
CTCSS/DCS Encode	10	GREEN	J907, pin 6 (CG Hi)

GE EXEC II Configuration

To modify the radio for full-duplex (repeater) operation, follow these steps:

1. Remove Q905 and Q908 on the System Audio Squelch board (SAS board).
2. Install a wire jumper from the Q908 emitter solder pad to the Q908 collector solder pad.
3. Care should be taken not to damage the transmitter PA due to continuous duty operation.

Connection to a GE Master PRO

For: Zetron Model 37-MAX
To: GE Master PRO
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	TB501 Pin-8 or Pin-9, +12.6 V
Ground	2	BLACK	TB501 Pin-11 or Pin-12, Ground
Discriminator Input	3	WHITE	TB502 Pin-2, AUD CPLR HI
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	J902 Pin-2, MIKE HI, (mic connector)
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	TB502 Pin-10, XMIT
Ground	8	BROWN	
COR Input	9	YELLOW	TB502 Pin-16, COS FEED
CTCSS/DCS Encode	10	GREEN	P101 Pin-10, Tone Encoder In (transmitter)

GE MASTER PRO Installation Notes

1. Connect the transmit audio directly to the microphone connector.
2. Verify the transmitter is equipped with the Channel Guard Encode option.
3. Disable any channel guard decode in the receiver, or connect TB502 Pin-11 (CG MON) to ground.

Connection to an EF Johnson Viking Universal Station

For: Zetron Model 37-MAX
To: EF Johnson Viking Universal Station
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	J2-23, +15_ACC
Ground	2	BLACK	J2-21, Ground
Discriminator Input	3	WHITE	J2-2, WB_DISC
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	J2-5, TX_AUDIO
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	J2-7, PTT
Ground	8	BROWN	
COR Input	9	YELLOW	J2-4, SQUELCH
CTCSS/DCS Encode	10	GREEN	J2-6, TX_DATA

EF Johnson Viking Universal Station Configuration

1. The radio requires the Third Party Interface Card in order to install the Model 37-MAX.

Connection to an EF Johnson CR1010

For: Zetron Model 37-MAX
To: EF Johnson CR1010
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Logic Drawer, pin-15, +13.8 V
Ground	2	BLACK	Logic Drawer, pin-13, Ground
Discriminator Input	3	WHITE	Logic Drawer, pin-5, CG Audio
Ground	4	BRAID	No connection
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Logic Drawer, pin-23, $\overline{PTT}$
Ground	8	BROWN	Ground
COR Input	9	YELLOW	Logic Drawer, pin-19, fast squelch
TX Audio Output	5	BLUE + 56 kΩ	Logic Drawer, pin-18, TX Tone CG
CTCSS/DCS Encode	10	GREEN + 15 kΩ	Logic Drawer, pin-18, TX Tone CG

CR1010 Configuration

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

2. Add a 10 kΩ resistor across R123 in the exciter.

3. Add a 56 kΩ resistor to the radio end of the blue TX audio wire, and a 15 kΩ to the radio end of the green CTCSS/DCS encode wire. The other end of both resistors are tied to the TX Tone CG input on the Logic drawer (pin-18).

NOTE: This configuration does not use the deviation limiter in the exciter. It does provide a higher quality repeat audio than the alternate hookup that follows this.

Connection to an EF Johnson CR1010 (Alternate Hookup)

For: Zetron Model 37-MAX
To: EF Johnson CR1010
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Logic Drawer, pin-15, +13.8 v
Ground	2	BLACK	Logic Drawer, pin-13, Ground
Discriminator Input	3	WHITE	Logic Drawer, pin-5
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Exciter drawer, pin-1, TX Audio
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Logic Drawer, pin-23, $\overline{PTT}$
Ground	8	BROWN	Ground
COR Input	9	YELLOW	Logic Drawer, pin-19, Fast Squelch
CTCSS/DCS Encode	10	GREEN	Logic Drawer, pin-18, TX Tone CG

CR1010 Configuration (Alternate Hookup)

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

NOTE: This configuration uses the limiter and the high-pass filter in the exciter of the CR1010. Since the Model 37-MAX also has a high-pass filter to remove the CTCSS/DCS encode from the repeat audio, the two high-pass filters in series may degrade the quality of the repeat audio. The repeat audio quality may be improved by deleting (bypassing) either the high-pass filter in the Model 37-MAX or the exciter of the CR1010.

To delete the high-pass filter in the Model 37-MAX, lift one end of R43, then add a wire jumper across C34, and another wire jumper across C35.

Connection to an EF Johnson CR1000

For: Zetron Model 37-MAX
To: EF Johnson CR1000
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Level Adjust Card, pin-21
Ground	2	BLACK	Level Adjust Card, pin-24
Discriminator Input	3	WHITE	Level Adjust Card, pin-11
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Level Adjust Card, pin-18
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Level Adjust Card, pin-19
Ground	8	BROWN	Ground
COR Input	9	YELLOW	Level Adjust Card, pin-12
CTCSS/DCS Encode	10	GREEN	Level Adjust Card, pin-22

CR1000 Configuration

Follow these steps:

1. In the receiver, remove the wire from J211, and connect it to U201 pin-6. This provides unfiltered receive audio to the Model 37.

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

3. Set the Repeat switches to: Access = Tone, Repeat = Off

Connection to a Kenwood TKR720 / TKR820

For: Zetron Model 37-MAX
To: Kenwood TKR720 / TKR820
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Pin-7, SB
Ground	2	BLACK	Pin-6 and Pin-11, Ground
Discriminator Input	3	WHITE	Pin-4, DE
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Pin-5, L1
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Pin-8, PTT
Ground	8	BROWN	No connection
COR Input	9	YELLOW	Pin-13, CO
CTCSS/DCS Encode	10	GREEN	Pin3, D1

TKR720 / TKR820 Configuration

For all TKR repeaters:

1. Make up two wire jumpers to install on the radio's auxiliary plug. Place one from pin-1 (HK) to pin-2 (LG), this is the PTT Enable jumper. Place the second from pin-9 (SI) to pin-12 (SO), this is the Speaker Enable jumper.

2. Set the repeater's front panel switches to: TAKEOVER = Off / Disabled, REPEAT = Off / Full Duplex Transceiver, Monitor = DC

NOTE: The following modifications do not apply to all versions of the TKR-repeaters, only the earlier versions. Refer to the Kenwood service manual and schematic diagrams.

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 transmitter.
2. On the Display Unit board, foil side: Remove R14, and add a jumper wire between CN8-4 (DE) and CN2-6 (DET). This bypasses C22 on the Display Unit board for DCS decode capability.

Connections to a Midland Basetech Repeater

For: Zetron Model 37-MAX
To: Midland Basetech Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Pin-1, +12.6 V
Ground	2	BLACK	Pin-8, Ground
Discriminator Input	3	WHITE	Pin-3, RX Disc
Ground	4	BRAID	No Connection
TX Audio Output	5	BLUE	Pin-2, AF
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Pin-5, PTT
Ground	8	BROWN	No connection
COR Input	9	YELLOW	Pin-6, COS
CTCSS/DCS Encode	10	GREEN	Pin-9, Tone

Connections to a Motorola GR300/GR500 Repeater Station

For: Zetron Model 37-MAX
To: Motorola GR300/GR500 Repeater Station
Using: 709-7394

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
			RECEIVE RADIO
+12 volts DC	1	RED	AUX pin 13, Switched A+
Ground	2	BLACK	AUX pin 7, Ground
Discriminator Input	3	WHITE	AUX pin 11, Disc. Audio
Ground	4	BRAID	No connection
Ground (spare)	6	BROWN	AUX pin 9, Emergency Alert
COR Input	9	YELLOW	AUX pin 8, CSQ Detect
			TRANSMIT RADIO
Ground	2	BLACK	AUX pin 7, Ground
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	AUX pin 2, MIC Audio
PTT Output	7	ORANGE	AUX pin 3, MIC PTT
Ground	8	BROWN	AUX pin 9, Emergency Alert
CTCSS/DCS Encode	10	GREEN	AUX pin 5, Flat TX Audio

Radius GM300 Radio Configuration

1. On both Accessory Connectors, a black wire jumper connects pins 15 (Internal Speaker) and 16 (External Speaker). This enables the Internal Speaker in the radios.
2. Set the Radius GM300 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 (16 channel radios only)
3. Use the RSS software to program accessory connectors on both radios as shown:

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	Low
8	CSQ Detect	Output	No	Low
9	NULL 1	Input	No	High
12	NULL 1	Input	No	Low
14	NULL 1	Input	No	Low

Connections to a Motorola R100 Repeater Station

For: Zetron Model 37-MAX
To: Motorola R100 Repeater Station
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	JAUX, pin-3, A+
Ground	2	BLACK	JAUX, pin-14, Desk Set Ground
Discriminator Input	3	WHITE	JAUX, pin-25, uncommitted
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	JAUX, pin-5, Audio from Phone Patch
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	JAUX, pin-4, PTT
Ground	8	BROWN	JAUX, pin-6,
COR Input	9	YELLOW	JAUX, pin-12, Audio Control
CTCSS/DCS Encode	10	GREEN	JAUX, pin-23, uncommitted

Radius R-100 Configuration

1. Install a jumper from U601 pin-9 on the TX Command Board to JAUX pin-23 (an unused pin). This routes CTCSS/DCS modulation from the 37-MAX to the TX Command board.
2. Install a jumper from U551A pin-4 on the RX Command Board to JAUX pin-25. This routes unfiltered discriminator audio from the receiver to the 37-MAX.
3. Program the R-100 for carrier squelch operation and disable repeater operation using the RPTR Disable Switch on the RPT Control Board.
4. If the R-100 was not ordered with the DPL Option (i.e. it was ordered for PL only or Carrier Squelch operation), then there are several capacitors which need to be changed in the receiver and transmitter to support DPL operation with the Model 37-MAX. Consult the R-100 service manual for additional information concerning what capacitor values require changing.
5. Repeated audio from the Model 37-MAX will be heard in the local speaker of the R-100 if the 37-MAX's TX audio is connected to JAUX pin-5. This is because the audio at pin-5 goes to several points in the R-100 (Local Audio Amp, Exciter Board, and the Line Output) as well as the TX Command board. If desired, the repeat audio can be applied directly to the TX Command board at the emitter of Q601.

Connections to a Motorola MSF5000 Analog Base/Repeater

For: Zetron Model 37-MAX
To: Motorola MSF5000 Analog Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	J800 Pin-1 & Pin-2, TB601 (A+) on Power Supply
Ground	2	BLACK	J800 Pin-7 & Pin-8, or TB601 (GND) on Power Supply
Discriminator Input	3	WHITE	Test Point 3 (3 kHz = 1Vpp)
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE + 33 kΩ	U834 Pin-13 (1 Vpp = 3 kHz)
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	J801 Pin-14
Ground	8	BROWN	
COR Input	9	YELLOW	Test Point 6 (0.5 V SQ. , 2.9 V UnSQ.)
CTCSS/DCS Encode	10	GREEN + 33 kΩ	Wiper of R889 IDC pot (3 Vpp = 0.75 kHz)

Motorola MSF-5000 (Analog) Configuration

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

Connections to a Motorola MSF5000 Digital Base/Repeater

For: Zetron Model 37-MAX
To: Motorola MSF5000 Digital Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	R8121, the side closest to the center of the PCB
Ground	2	BLACK	TP2
Discriminator Input	3	WHITE	Test Point 3
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE + 33 kΩ	U814, pin 2
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	SW800, the pin closest to the outside edge of the PCB
Ground	8	BROWN	
COR Input	9	YELLOW	U1552, pin 1
CTCSS/DCS Encode	10	GREEN + 33 kΩ	U831, pin 3

Motorola MSF-5000 (Digital Capable) Station Configuration

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

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

3. Set the "AccDis" switch to the up position.

CAUTION!

The front panel SQUELCH control (on the MSF) will now set the carrier detect threshold for both the radio and the Zetron panel.

Connections to a Motorola MSR2000 Base/Repeater

For: Zetron Model 37-MAX
To: Motorola MSR2000 Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	E12 (A+)
Ground	2	BLACK	Ground Lug
Discriminator Input	3	WHITE	Audio Squelch, pin-7
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Audio Squelch, pin-16
Ground (spare)	6	N/C	
PTT Output	7	ORANGE + two 1N4148 diodes	Cathodes (banded ends) of both diodes joined to Orange wire, anodes (unbanded) connected to Squelch Gate pin-3 and Squelch Gate pin-18
Ground	8	BROWN	No connection
COR Input	9	YELLOW	Audio Squelch, pin-20
CTCSS/DCS Encode	10	GREEN + 10 kΩ	Resistor goes on radio end, connects to Coded Squelch, pin-21

Motorola MSR-2000 Base / Repeater Configuration

1. Remove all jumpers on the RF control chassis backplane except JU1, JU4, JU5, and JU9.

2. Only the R1 Audio and Station Control modules are required. Make the following changes to the control cards:

   R1 Audio: Install JU1 and JU101. Remove JU2, JU103, JU104, JU105, CR2, and CR106
   Station Card: Install JU2 through JU8. Remove JU9 through JU11.
   Line Driver: Remove JU15 and CR3.

Connections to a Motorola MICOR Base/Repeater

For: Zetron Model 37-MAX
To: Motorola MICOR Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Power Supply A+
Ground	2	BLACK	Power Supply A-
Discriminator Input	3	WHITE	Squelch Gate, pin-10
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Station Control, pim-16
Ground (spare)	6	N/C	
PTT Output	7	ORANGE + 1N4148	Cathode (banded) end connects to wire, anode to TB3, pin-14
Ground	8	BROWN	No connection
COR Input	9	YELLOW	J2, pin-5 (RX Unsquelch)
CTCSS/DCS Encode	10	GREEN + 10 kΩ	Resistor goes on radio end, connects to J5, pin-27

Motorola MICOR Connection

1. Remove all modules except Station Control and the Squelch Gate card.

2. Modify the control modules as follows:
   a. Station Control: Jumper the "PL Disable" switch ON.
   b. Station Gate: Remove C17, in the exciter output line.

3. Modify RX Audio Squelch board (TRN-6006A) by adding a jumper from U202 pin 10 to P903 pin 14.

4. Modify Exciter board (TLE-1720A) by adding a jumper from the IDC pot wiper to P902 pin 8, and cut the trace between P902 pin 8 andJU401.

5. Modify the backplane board (TRN-6421A) by cutting the trace going to J2 pin 5, and cutting the trace going to J5 pin 27.

Connections to a Standard RPT10/RPT21

For: Zetron Model 37-MAX
To: Standard RPT10/RPT21
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Multitone, pin 4, +13.8 V
Ground	2	BLACK	Multitone, pin 5, Ground
Discriminator Input	3	WHITE	Multitone, pin 2, DISC
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Control, pin 9, MIC HI
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Multitone, pin 9, PTT
Ground	8	BROWN	Control, pin 6, MIC LO
COR Input	9	YELLOW	Receiver, pin 7, COR
CTCSS/DCS Encode	10	GREEN	Multitone, pin 3, Tone

Standard RPT10 / RPT21 Configuration

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

Connections to a Standard RPT30

For: Zetron Model 37-MAX
To: Standard RPT30
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	pin 11, +13.8 VDC supply
Ground	2	BLACK	pin 12, Supply Ground, and pin 4, TX Line-IN Ground
Discriminator Input	3	WHITE	pin 10, Processed Audio Out
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	pin 3, TX Line-IN
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	pin 9, TX Key Line
Ground	8	BROWN	pin 4, TX Line-IN Ground
COR Input	9	YELLOW	pin 8, Squelch Output
CTCSS/DCS Encode	10	GREEN	pin 6, CTCSS Input

Standard RPT30 Configuration

1. Set the squelch on the RPT30 for proper Carrier LED indication on the 37-MAX.
2. Set VR202 in the Transmit module for no repeater hold time. Use the Carrier switch on the front panel of the Transmit module to test the transmitter.
3. Extend the Transmit module's time-out timer to maximum.
4. Set the Receiver module's jumpers to pass unfiltered discriminator audio to pin 10 of the RPT30's connector, Processed Audio Out.

Connections to a Tait T800 series Base/Repeater

For: Zetron Model 37-MAX
To: Tait T800 series Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	TB1-13, +13.8V
Ground	2	BLACK	TB1-8, TX LINE (ground)
Discriminator Input	3	WHITE	TB2-11 RX AUDIO
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	TB1-5, TX LINE
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	TB1-12, TX KEY
Ground	8	BROWN	TB1-8, (ground)
COR Input	9	YELLOW	TB1-11, RX GATE
CTCSS/DCS Encode	10	GREEN	TB2-9, CTCSS

Tait T800 Configuration

1. Make up four wire jumpers and place them between the following pairs of contacts on TB1 of the T800: TB1-14 (-VE) to TB1-10 (SP-), TB1-10 to TB1-8, TB1-2 to TB1-3 (RX LINE CT), and TB1-6 to TB1-7 (TX LINE CT).

2. Move the Violet wire from TB2-9 to TB2-11. The Violet wire (RX Audio 2) is flat receive audio, separated out to TB2-11.

3. Disable the transmitter time-out timer by removing R257 (near IC202 on the bottom of the PCB).

Connections to a Tait T300 series Base/Repeater

For: Zetron Model 37-MAX
To: Tait T300 series Base/Repeater
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Pin 8, +VE 12V
Ground	2	BLACK	Pin 5, Ground
Discriminator Input	3	WHITE	Pin 6, RX AF
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Pin 7, TX AF
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Pin 10, TX Key
Ground	8	BROWN	No connection
COR Input	9	YELLOW	Pin 20, RX GATE, see Note 2
CTCSS/DCS Encode	10	GREEN	Pin 2, CTCSS ENCODE

Tait T300 Configuration Notes

1. All connections are made to the radio on 25-pin D-connector. Additional jumper to be made at the D-connector are:

   pin 1 to pin 4 = Earth to one side RX 600Ω
   pin 1 to pin 3 = Earth to one side TX 600Ω
   pin 1 to pin 5 = Earth

2. Check that the RX GATE lead goes to the RX GATE connection on the Tait Base Station you are using. This lead has been left unconnected on some models.

Connections to a Uniden ARU-251 Repeater

For: Zetron Model 37-MAX
To: Uniden ARU-251 *(This is NOT for the ARU-251K)*
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Pin 4
Ground	2	BLACK	Pin 5
Discriminator Input	3	WHITE	Pin 1
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Pin 6
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Pin 3
Ground	8	BROWN	No connection
COR Input	9	YELLOW	Pin 2
CTCSS/DCS Encode	10	GREEN	Pin 9

Uniden ARU-251 Configuration

1. At the radio's accessory jack, install a jumper wire between pin 7 and pin 8 (Audio Amp Out to Speaker In).

2. Disconnect the Tone Encode lead from the Exciter at FT18 on the Exciter case, and leave the wire disconnected.

3. Attach a wire from FT18 on the Exciter case to pin 9 of the accessory jack. This provides a path for CTCSS encode from the panel to the transmitter exciter.

4. Set the Control Board switch to the Carrier Squelch position.

5. Set the Front Panel switches to Local and Monitor.

Connections to a Uniden ARU-251K Repeater

For: Zetron Model 37-MAX
To: Uniden ARU-251K
Using: 709-7179 Generic Radio Cable

37-MAX End Function	J1 pin#	Wire Color	Radio End Connection/Notes
+12 volts DC	1	RED	Pin 6
Ground	2	BLACK	Pin 8
Discriminator Input	3	WHITE	Pin 8
Ground	4	BRAID	No connection
TX Audio Output	5	BLUE	Pin 7
Ground (spare)	6	N/C	
PTT Output	7	ORANGE	Pin 1
Ground	8	BROWN	Pin 8
COR Input	9	YELLOW	Pin 2
CTCSS/DCS Encode	10	GREEN	Pin 9

Uniden ARU-251K Configuration

1. Install a wire jumper on the accessory jack between pin 4 and pin 5 (Audio Amp Out to Speaker In).

2. Disconnect the Tone Encode lead from the Exciter at FT18 on the Exciter case, leave the wire disconnected.

3. Attach a wire from FT18 on the Exciter case to pin 9 on the accessory connector. This provides a path for the CTCSS encode from the tone panel to the transmitter exciter.

4. Set the Control Board switch to Carrier Squelch position.

5. Set the Front Panel switches to Local and Monitor.

6. REPAIR

IN CASE OF DIFFICULTY

In case of difficulty, call Zetron at (206) 820-6363 and ask for Model 37-MAX technical support. Please have the serial number of the unit and/or the Zetron "Order Number" available when you call. 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, the service technicians should call Zetron just as they would for a new installation. Zetron's Applications engineers will happy to help figure out what has changed about the system.

The parts lists for the Model 37-MAX are included in this section to aid in the evaluation, installation, or repair of the unit.

Service Notes

1. If a programmed value is out of range for the parameter in question, the default value will be used instead.

2. If the unit gets "locked-up" due a lightning hit or power line spike, a microprocessor reset can be performed by sending any valid DTMF digit continuously for more than 20 seconds. This removes the need to drive to the site to reset the unit.

3. If the audio does not sound correct, perform an audio sweep test by generating an audio signal (of known deviation) on the repeater receive frequency, and monitor the deviation on the repeater transmit frequency. As the frequency of the test is changed, the transmit deviation should be fairly flat from 300 Hz to 2500 Hz. If the deviation changes by more than a few hundred hertz, try moving jumper JP6 in the Model 37-MAX to flatten the response.

4. The Carrier LED must follow carrier activity on the channel. If it is always off, the Model 37-MAX will not detect CTCSS tones. If it is always on, the Model 37-MAX will usually time out.

The Model 37-MAX is a microprocessor controlled device, which means that the operation can change depending on the software the microprocessor is running. The processor controls the audio repeat path, PTT, Status LED, and CTCSS decode.

MODEL 37-MAX REPEATER PAL ASSEMBLY

Reference: Part No. 901-9486

ITEM	QTY	PART NO.	DESCRIPTION	REFERENCE
1.	1	025-9376	M37-MAX MANUAL	
2.	4	220-0199	632x1/4 BLK PAN PHILLIPS	CASE
3.	4	221-0108	440X1/4 PAN HD PHIL, SEM	PCB TO BOTTOM
4.	1	265-0001	TY-WRAP STD	
5.	1	265-0003	STRAIN RELIEF	
6.	1	401-0201	10 PIN x .156 HOUSING	
7.	10	402-0012	CON PINS TRIFURCON	BAG (2X3)
8.	1	415-9094	DECAL, PART 15 FCC/PN/SN	BOTTOM CENTER
9.	1	415-9523	TOP COVER	
10.	1	415-9524-4	BOTTOM CASE, FIN	
11.	4	431-0006	RUBBER FEET	
12.	1	601-0801 V1.0	M37-MAX SOFTWARE	U7
13.	1	702-9808	M37-MAX PCB	

MODEL 37-MAX REPEATER PAL (702-9808A)

Parts List

LEGEND:

= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	PART REFERENCE
1	0	R45#	101-0015	3.3 OHM 1/4W 5% CARBON FILM	
2	1	R67	101-0025	10 OHM 1/4W 5% CARBON FILM	
3	1	R23	101-0033	22 OHM 1/4W 5% CARBON FILM	
4	2	R38,R60	101-0047	47 OHM 1/4W 5% CARBON FILM	
5	1	R44	101-0049	100 OHM 1/4W 5% CARBON FILM	
6	5	R61,R64,R72,R73,R74	101-0057	220 OHM 1/4W 5% CARBON FILM	
7	0	R50#	101-0059	270 OHM 1/4W 5% CARBON FILM	
8	1	R65	101-0061	330 OHM 1/4W 5% CARBON FILM	
9	2	R15,R16,R47#	101-0065	470 OHM 1/4W 5% CARBON FILM	
10	2	R8,R39	101-0066	510 OHM 1/4W 5% CARBON FILM	
11	7	R6,R10,R14,R19,R51,R62, R75	101-0073	1.OK 1/4W 5% CARBON FIIM	
12	1	R43	101-0083	2.7K 1/4W 5% CARBON FIIM	
13	1	R29	101-0085	3.3K 1/4W 5% CARBON FIIM	
14	1	R22	101-0089	4.7K 1/4W 5% CARBON FIIM	
15	0	R56#	101-0091	5.6K 1/4W 5% CARBON FIIM	
16	3	R17,R18,R59	101-0092	6.2K 1/4W 5% CARBON FIIM	
17	1	R5	101-0094	7.5K 1/4W 5% CARBON FIIM	
18	6	R13,R24,R63,R66,R68,R79	101-0097	10K 1/4W 5% CARBON FIIM	
19	1	R52	101-0103	18K 1/4W 5% CARBON FIIM	
20	2	R21,R32,R46#,R48#,R49#	101-0105	22K 1/4W 5% CARBON FIIM	
21	1	R11	101-0109	33K 1/4W 5% CARBON FIIM	
22	2	R7,R55#,R57	101-0113	47K 1/4W 5% CARBON FIIM	
23	1	R9	101-0114	51K 1/4W 5% CARBON FIIM	
24	2	R41,R36	101-0117	68K 1/4W 5% CARBON FIIM	
25	1	R40	101-0119	82K 1/4W 5% CARBON FIIM	
26	12	R26,R27,R30,R31,R34,R37, R53,R70,R71,R76,R77,R80	101-0121	100K 1/4W 5% CARBON FIIM	
27	1	R58	101-0123	120K 1/4W 5% CARBON FIIM	
28	1	R25	101-0129	220K 1/4W 5% CARBON FIIM	
29	2	R4,R20	101-0131	270K 1/4W 5% CARBON FIIM	
30	3	R28,R54,R69	101-0145	1.0M 1/4W 5% CARBON FIIM	
31	1	R78	101-0149	1.5M 1/4W 5% CARBON FIIM	
32	1	R33	101-0150	2.7M 1/4W 5% CARBON FIIM	
33	1	R3	107-0003	2K POT 1 TURN R/A	
34	2	R1,R2	107-0015	50K POT 1 TURN R/A	

MODEL 37-MAX REPEATER PAL (702-9808A)

Parts List (Continued)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	PART REFERENCE
35	0	R42#	107-0202	2K POT 1 TURN	
36	1	R35	107-0502	50K POT 1 TURN	
37	2	RP2,RP1	119-0021	R/2R 100K/200K 10 PIN SIP	
38	5	C6,C12,C13,C14,C15	150-0096	1000 PF 1KV +-10% CERAMIC DISC Y5P	
39	2	C26,C3	151-0047	470PF 100V/200V +-5% CERAMIC NPO	
40	8	C16,C18,C27,C29,C36,C38, C40,C41	151-0180	.1UF 50V +-20% CERAMIC Z5U	
41	1	C1	151-0199	.47UF 50V +-5%, POLYESTER	
42	1	C22	152-0012	.1 UF 50V +-5% POLYESTER	
43	1	C10	152-0033	3.3UF 50V +-20% NON-POLAR ELECTROLYTIC, RADIAL	
44	1	C7	152-0047	47UF 25V 20% NON-POLAR ELECTROLYTIC	
45	1	C11	152-0050	10 UF 100V 20% NON-POLAR ELECTROLYTIC, RADIAL	
46	2	C31,C24	152-0080	.22 UF 50V +-5% POLYESTER	
47	4	C4,C9,C34,C35	152-0085	.01 UF 50V +- 5% POLYESTER	
48	1	C5	152-0088	.0047UF 50V +-5% POLYESTER	
49	3	C21,C23,C25,C43#,C44#	152-0089	.001 UF 50V +-5% POLYESTER	
50	2	C8,C20	152-0130	.033 UF 50V 5% POLYESTER	
51	1	C2,C42#	152-0250	.047 UF 50V 5% POLYESTER	
52	1	C32,C30#	154-0025	1 UF 35V TANTALUM +- 10%	
53	6	C17,C33,C37,C39,C45,C46	154-0100	10 UF 16V TANTALUM +-10%	
54	2	C19,C28	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	
55	4	E1,E2,E3,E4	305-0001	FERRITE BEADS W/ LEADS	
56	3	DS1,DS2,DS3	311-0011	LED RED FLUSH	
57	1	DS4	311-0012	LED GREEN FLUSH	
58	5	U1,U2,U3,U4,U5,U6#	316-0358	OP-AMP, DUAL BIPOLAR	358
59	1	VR1	316-7805	REGULATOR, +5V 1.5A	7805
60	1	U11	321-0204	DIMF RECEIVER	75T204
61	1	U7 **NOTE 3**	321-6806	IC, 8 BIT CMOS OTP 40 PIN DIP (68HC705A)	ASIC 009
62	1	U8	322-9366	4K EEPROM EXT. TEMP	93C66
63	1	U10	323-4053	ANALOG SWITCH, TRIPLE SPDT	4053
64	1	U9	324-7414	IC, HEX SCHMIDT, MOTOROLA THRESHOLDS	74HC14
65	2	Q2,Q1	340-3904	NPN 40V/200MA, TO92	2N3904
66	1	Q3	340-7000	XSTR, MOSFET, N-CHANNEL TO-92 60V/0.2A, 5 OHMS	2N7000
67	3	CR1#,CR4,CR5,CR6	342-3009	DIODE, SILICON 100V 250MW	1N4148
68	1	CR2	343-3100	ZENER, 8.2V 1W +-5%	1N4738A
69	1	CR3	343-3110	ZENER, 20V 1W +-5%	1N4747A
70	1	SW1 **NOTE 2**	371-0024	SPST RA PWB MNT MOM PB	
71	1	Y1 **NOTE 1**	376-0358	XTAL, 3.579545MHZ HC-49 CL=18PF	3.58MHZ
72	1	J1	401-0202	10 PIN X .156 R/A CONN	
73	5	JP1,JP2,JP3,JP4,JP6,JP7#	403-0003	3 OF 401-0052	
74	0	P1#	403-0004	4 OF 401-0052	

MODEL 37-MAX REPEATER PAL (702-9808A)

Parts List (Continued)

ITEM	QTY	COMPONENT REFERENCE	PART NO.	DESCRIPTION	PART REFERENCE
75	1	JP5	403-0202	4 OF 401-0052 [2X2]	
76	1	F1	416-1576	FUSE AGC 1 A FAST-BLOW	1A
77	7	XJP1,2,3,4,6 (POS A) XJP5 (2EA) (POS A)	402-3040	MINI JUMPER	
78	7	XU1,XU2,XU3,XU4,XU5,XU6 XU8	407-0008	SKT, 08 PIN DIP	
79	2	XU9,XU11	407-0014	SKT, 14 PIN DIP	
80	1	XU10	407-0016	SKT, 16 PIN DIP	
81	1	XU7	407-0040	SKT, 40 PIN DIP	
82	1	XJP7 (POS B)	408-0001	WIRE JUMPER	
83	1	PCB	410-9384C	PCB, M37 CONTROL BOARD	
84	2	XF1	416-3040	FUSE CLIPS	
85	4	XDS1,XDS2,XDS3,XDS4	417-0010	LED MOUNT RA	

NOTES: Notes are for production use only.

MODEL 37-MAX REPEATER PAL (702-9808A)

Schematic

1/3

2/3

3/3

MODEL 37-MAX REPEATER PAL (702-9808A)

Silkscreen

AAPPENDIX A. PROGRAMMING LOG

OVERVIEW

This appendix is provided as an aid to proper record keeping for the Repeater Pal's programming. The pages in this appendix can be copied and used as log sheets to record the programming done when a system is initially set up, or at any time the programming is changed. The programmable features are divided into System Programming items and User programming items.

Throughout the System programming forms, the default value for the parameter, if there is one, will be shown in bold letters.

SYSTEM PROGRAMMING

NORMAL TX-HOLD TIME (0 to 9 seconds, **2 seconds**)	210#, **2#** [_____]
ALTERNATE TX-HOLD TIME (0-to-9 seconds, **3 seconds**)	211#, **3#** [_____]
RPEATER TIME-OUT TIMER (1 to 9 minutes, **3 minutes**)	220#, **3#** [_____]
STATION ID DISABLED	230# [_____]
STATION ID ONLY AFTER CHANNEL ACTIVITY	**232#** [_____]
STATION ID AT REGULAR INTERVALS	233# [_____]
STATION ID INTERVAL (0-to-90 minutes, **15 minutes**)	235# [_____]#
STATION ID SENT AT 22 WORDS PER MINUTE	**273#** [_____]
STATION ID SENT AT 11 WORDS PER MINUTE	274# [_____]
STATION ID CALL SIGN	272# [_____]#
SET COURTESY TONE FREQUENCY TO 500 Hz	244# [____]
SET COURTESY TONE FREQUENCY TO 1000 Hz	**245#** [____]
SET COURTESY TONE FREQUENCY TO 1500 Hz	246# [____]
PROGRAM MODE ACCESS CODE (five digits, **12037**)	290# [_____]#
DCS ENCODE SET TO NORMAL POLARITY	**215#** [____]
DCS ENCODE SET TO INVERTED POLARITY	216# [____]
DCS DECODE SET TO NORMAL POLARITY	217# [____]
DCS DECODE SET TO INVERTED POLARITY	218# [____]

USER PROGRAMMING

USER #	Tone/Code	A	B	C	D	E	F	G	H
0	Carrier								
1	67.0 Hz								
2	69.4 Hz								
3	71.9 Hz								
4	74.4 Hz								
5	77.0 Hz								
6	79.7 Hz								
7	82.5 Hz								
8	85.4 Hz								
9	88.5 Hz								
10	91.5 Hz								
11	94.8 Hz								
12	97.4 Hz								
13	100.0 Hz								
14	103.5 Hz								
15	107.2 Hz								
16	110.9 Hz								
17	114.8 Hz								
18	118.8 Hz								
19	123.0 Hz								
20	127.3 Hz								
21	131.8 Hz								
22	136.5 Hz								
23	141.3 Hz								
24	146.2 Hz								
25	151.4 Hz								
26	156.7 Hz								
27	159.8 Hz								
28	162.2 Hz								
29	165.5 Hz								
30	167.9 Hz								
31	171.3 Hz								
32	173.8 Hz								
33	177.3 Hz								

A = User Enabled, **B** = Tone Translation, **C** = Encode during TX-Hold, **D** = No Encode During TX-Hold, **E** = Normal TX-Hold Time, **F** = Alternate TX-Hold Time, **G** = Reserve Mode, **H** = Courtesy Tone

USER #	Tone/Code	A	B	C	D	E	F	G	H
34	179.9 Hz								
35	183.5 Hz								
36	186.2 Hz								
37	189.9 Hz								
38	192.8 Hz								
39	196.6 Hz								
40	199.5 Hz								
41	203.5 Hz								
42	206.5 Hz								
43	210.7 Hz								
44	218.1 Hz								
45	225.7 Hz								
46	229.1 Hz								
47	233.6 Hz								
48	241.8 Hz								
49	250.3 Hz								
50	254.1 Hz								
51	023								
52	025								
53	026								
54	031								
55	032								
56	036								
57	043								
58	047								
59	051								
60	053								
61	054								
62	065								
63	071								
64	072								
65	073								
66	074								
67	114								

A = User Enabled, **B** = Tone Translation, **C** = Encode during TX-Hold, **D** = No Encode During TX-Hold, **E** = Normal TX-Hold Time, **F** = Alternate TX-Hold Time, **G** = Reserve Mode, **H** = Courtesy Tone

USER #	Tone/Code	A	B	C	D	E	F	G	H
68	115								
69	116								
70	122								
71	125								
72	131								
73	132								
74	134								
75	143								
76	145								
77	152								
78	155								
79	156								
80	162								
81	165								
82	172								
83	174								
84	205								
85	212								
86	223								
87	225								
88	226								
89	243								
90	244								
91	245								
92	246								
93	251								
94	252								
95	255								
96	261								
97	263								
98	265								
99	266								
100	271								
101	274								

A = User Enabled, **B** = Tone Translation, **C** = Encode during TX-Hold, **D** = No Encode During TX-Hold, **E** = Normal TX-Hold Time, **F** = Alternate TX-Hold Time, **G** = Reserve Mode, **H** = Courtesy Tone

USER #	Tone/Code	A	B	C	D	E	F	G	H
102	306								
103	311								
104	315								
105	325								
106	331								
107	332								
108	343								
109	346								
110	351								
111	356								
112	364								
113	365								
114	371								
115	411								
116	412								
117	413								
118	423								
119	431								
120	432								
121	445								
122	446								
123	452								
124	454								
125	455								
126	462								
127	464								
128	465								
129	466								
130	503								
131	506								
132	516								
133	523								
134	526								
135	532								

A = User Enabled, **B** = Tone Translation, **C** = Encode during TX-Hold, **D** = No Encode During TX-Hold, **E** = Normal TX-Hold Time, **F** = Alternate TX-Hold Time, **G** = Reserve Mode, **H** = Courtesy Tone

USER #	Tone/Code	A	B	C	D	E	F	G	H
136	546								
137	565								
138	606								
139	612								
140	624								
141	627								
142	631								
143	632								
144	654								
145	662								
146	664								
147	703								
148	712								
149	723								
150	731								
151	732								
152	734								
153	743								
154	754								

A = User Enabled, **B** = Tone Translation, **C** = Encode during TX-Hold, **D** = No Encode During TX-Hold, **E** = Normal TX-Hold Time, **F** = Alternate TX-Hold Time, **G** = Reserve Mode, **H** = Courtesy Tone

NOTES:

QUICK REFERENCE Error! Unknown switch argument.

OVERVIEW

This quick reference is provided as convenience for experienced technicians. Very little is explained here. If information provided here is not clear, refer to Section 4 for more complete descriptions.

PROGRAM MODE ACCESS

The programming mode can be accessed by entering the Program Mode Access Code over the radio. The default value for the Program Mode Access Code is "12037". The Model 37-MAX will respond to decoding a valid access code by transmitting a "go-ahead" tone consisting of five short beeps. If the access code decoded by the 37-MAX is invalid, then the panel will ignore the attempt.

ENTERING A PROGRAM COMMAND

To enter a programming command, a DTMF number is entered followed by the "#" key. Once the "#" has been entered, the Model 37-MAX will respond either with the 5-beep "go-ahead" prompt to indicate the command was accepted, or the high-low "error tone" sequence to indicate that an invalid command sequence was received.

Some commands will require additional numbers be entered. When it receives a command of this type, the 37-MAX will respond with two quick beeps to indicate that it is waiting for the additional data. In most cases, the data will be followed by a "#".

The Model 37-MAX accepts its commands and updates its database in "real time". The programming mode can be exited at any time and the panel will "remember" any and all changes made up to that point.

The commands should all be entered one at a time, do not try to string several commands together in a single transmission. If the next command is not received within 60 seconds of the last command, the 37-MAX will exit the programming mode and return itself to the normal, idle condition.

EXITING THE PROGRAM MODE

When a programming session is completed, the programming mode is exited by entering "99#". The 37-MAX will transmit a prompt that sounds like the ringing of an electronic telephone, and then return to its normal, idle state.

If the Model 37-MAX receives no new commands for a period of 60 seconds, it will exit the program mode and return to the normal idle state on its own.

USER PROGRAMMING COMMANDS

110# uu# Disable User Number “uu” (default)
111# uu# Enable User Number “uu”

122# uu# ee# Tone Translation (uu = user, ee = encode to use)
(default, encode is the same as decode)

120# uu# Encode Disabled During TX-Hold for User “uu” (default)
121# uu# Encode Enabled During TX-Hold for User “uu”

123# uu# Use Normal TX-Hold Timer for User “uu” (default)
124# uu# Use Alternate TX-Hold Timer for User “uu”

130# uu# Reserve Mode Disabled for User “uu” (default)
131# uu# Reserve Mode Enabled for User “uu”

150# uu# Courtesy Tone Disabled for User “uu” (default)
151# uu# Courtesy Tone Enabled for User “uu”

99# Exit Program Mode

User Numbers versus CTCSS Tones

User #	Tone	Motorola Reed Code	User #	Tone	Motorola Reed Code	User #	Tone	Motorola Reed Code
0	Carrier Repeat		**17**	114.8	2A	**34**	179.9	6B
1	67.0	XZ	**18**	118.8	2B	**35**	183.5	J5
2	69.4	WZ	**19**	123.0	3Z	**36**	186.2	7Z
3	71.9	XA	**20**	127.3	3A	**37**	189.9	J6
4	74.4	WA	**21**	131.8	3B	**38**	192.8	7A
5	77.0	XB	**22**	136.5	4Z	**39**	196.6	J7
6	79.7	WB	**23**	141.3	4A	**40**	199.5	J8
7	82.5	YZ	**24**	146.2	4B	**41**	203.5	M1
8	85.4	YA	**25**	151.4	5Z	**42**	206.5	8Z
9	88.5	YB	**26**	156.7	5A	**43**	210.7	M2
10	91.5	ZZ	**27**	159.8	J1	**44**	218.1	M3
11	94.8	ZA	**28**	162.2	5B	**45**	225.7	M4
12	97.4	ZB	**29**	165.5	J2	**46**	229.1	9Z
13	100.0	1Z	**30**	167.9	6Z	**47**	233.6	M5
14	103.5	1A	**31**	171.3	J3	**48**	241.8	M6
15	107.2	1B	**32**	173.8	6A	**49**	250.3	M7
16	110.9	2Z	**33**	177.3	J4	**50**	254.1	J9

User Numbers versus DCS Codes

User #	DCS Code	Invert.	User #	DCS Code	Invert.	User #	DCS Code	Invert.	User #	DCS Code	Invert.
51	023	047	**77**	152	115	**103**	311	664	**129**	466	662
52	025	244	**78**	155	731	**104**	315	423	**130**	503	162
53	026	464	**79**	156	265	**105**	325	526	**131**	506	073
54	031	627	**80**	162	503	**106**	331	465	**132**	516	432
55	032	051	**81**	165	251	**107**	332	455	**133**	523	246
56	036	172	**82**	172	036	**108**	343	532	**134**	526	325
57	043	445	**83**	174	074	**109**	346	612	**135**	532	343
58	047	023	**84**	205	263	**110**	351	243	**136**	546	132
59	051	032	**85**	212	356	**111**	356	212	**137**	565	703
60	053	452	**86**	223	134	**112**	364	131	**138**	606	631
61	054	413	**87**	225	122	**113**	365	125	**139**	612	346
62	065	271	**88**	226	411	**114**	371	734	**140**	624	632
63	071	306	**89**	243	351	**115**	411	226	**141**	627	031
64	072	245	**90**	244	025	**116**	412	143	**142**	631	606
65	073	506	**91**	245	072	**117**	413	054	**143**	632	624
66	074	174	**92**	246	523	**118**	423	315	**144**	654	743
67	114	712	**93**	251	165	**119**	431	723	**145**	662	466
68	115	152	**94**	252	426	**120**	432	516	**146**	664	311
69	116	754	**95**	255	446	**121**	445	043	**147**	703	565
70	122	225	**96**	261	732	**122**	446	255	**148**	712	114
71	125	365	**97**	263	205	**123**	452	053	**149**	723	431
72	131	364	**98**	265	156	**124**	454	266	**150**	731	155
73	132	546	**99**	266	454	**125**	455	332	**151**	732	261
74	134	223	**100**	271	065	**126**	462	252	**152**	734	371
75	143	412	**101**	274	145	**127**	464	026	**153**	743	654
76	145	274	**102**	306	071	**128**	465	331	**154**	754	116

SYSTEM PROGRAMMING COMMANDS

210# n# Sets Normal TX-Hold Timer (0 to 9 seconds, default = 2)
211# n# Sets Alternate TX-Hold Timer (0 to 9 seconds, default = 3)

220# n# Repeater Time-out Timer (1 to 9 minutes, default = 3)

230# Station ID Disabled
232# Station ID Only After Channel Activity (default)
233# Station ID At Regular Intervals
235# nn# Set Station ID Interval (1 to 90 minutes, default = 15)
273# Station ID Sent at 22 words per minute
274# Station ID Sent at 11 words per minute

272# nn nn ... # Enter Station ID Call Sign (default is blank, To clear a call sign from memory, enter the command with no digits after it. 272# #)

Digits	#	Code	Digits	Lette	Code	Digits	Lette	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	– • – –
#	END		16	M	– –	20	Z	– – • •

244# Set Courtesy Tone Frequency to 500 Hz
245# Set Courtesy Tone Frequency to 1000 Hz (default)
246# Set Courtesy Tone Frequency to 1500Hz

290# nnnnn# Set Program Mode Access Code to “nnnnn”

215# DCS Encode set to Normal Polarity (default)
216# DCS Encode set to Inverted Polarity

217# DCS Decode set to Normal Polarity (default)
218# DCS Decode set to Inverted Polarity

DIAGNOSTIC PROGRAMMING COMMANDS

300#	Repeater Knockdown
301#	Repeater Setup
391#	Reset all Programming to Factory Default Values
392#	Transmit Audio Test
393#	Transmit Audio Pre-Emphasis Test
394#	Repeat Audio Test
395#	CTCSS Encode Test
396#	CTCSS Frequency Response Test
397#	DCS Encode Test
99#	Exit Program Mode