

**Z E T R O N**  
**MODEL 45 Z-PATCH**  
**INSTALLATION MANUAL**

**#025-9058G**

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# MODEL 45 Z-PATCH INSTALLATION MANUAL

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## **WARRANTY STATEMENT**

Zetron warrants that all equipment sold pursuant to any resultant agreement shall be free from defects in material and workmanship at the time of delivery. Such warranty shall extend from the time of delivery for One Year. Buyer must provide written notice to Zetron within this prescribed warranty period of any defect; if the defect is not the result of improper usage, service, maintenance, or installation and equipment has not been otherwise damaged or modified after delivery, Zetron shall either replace or repair the defective part or parts of equipment or replace the equipment or refund the purchase price at Zetron's option after return of such equipment by buyer to Zetron. Shipment to Zetron's facility shall be borne on account of buyer.

1. Consequential Damages: Zetron shall not be liable for any incidental or consequential damages incurred as a result of any defect in any equipment sold hereunder and Zetron's liability is specifically limited to its obligation described herein to repair or replace a defective part or parts covered by this warranty.

2. Exclusive Warranty: The warranty set forth herein is the only warranty, oral or written made by Zetron and is in lieu of and replaces all other warranties, expressed or implied, including the warranty of merchantability and the warranty of fitness for particular purpose.

## **FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS**

The following criteria **MUST BE MET** to comply with FCC rules:  
(For 702-9032 Revision E and later.)

1. The FCC registration number of this device (EYB5Q5-15387-OT-T) and ringer equivalence number (0.9B) **MUST BE REPORTED** to the telephone company.
2. This equipment complies with the requirements in Part 15 FCC rules for a "Class A" computing device. Operation of this device in a residential ("Class B") area **MAY CAUSE UNACCEPTABLE INTERFERENCE** to radio and television reception.
3. This device **MUST NOT** be installed on coin-operated or multi-party telephone lines.
4. If this unit malfunctions, the telephone company **MAY DISCONNECT SERVICE** temporarily. If disconnection is necessary, the telephone company **MUST ATTEMPT TO NOTIFY** the user in advance, if possible. If not, they must notify the user as soon as they are able.
5. Warranty repair work on this device **MUST BE DONE BY** Zetron, Inc. or an authorized Zetron repair station.

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**1. INTRODUCTION**

**General ..... 1-1**

**Features ..... 1-2**





### GENERAL

The Model 45 Z-Patch (Figure 1) is a microprocessor-based, general-purpose mobile radio-to-telephone interconnect. It is designed to provide low-cost, yet flexible operation as a full-featured telephone patch with selective calling and advanced airtime billing features.

The Model 45 is the interface device required between the telephone system and the radio system for interconnect. It provides two-way communications for mobiles and handheld radios and one-way signaling to pagers. A serial interface provides user-friendly, menu-driven programming of all system and user information. The system and user database can be downloaded and uploaded. Remote DTMF programming is also supported.

The compact size of the Model 45 allows inconspicuous shelf mounting or installation in a standard 19-inch equipment rack with the supplied rack-adaptor brackets.

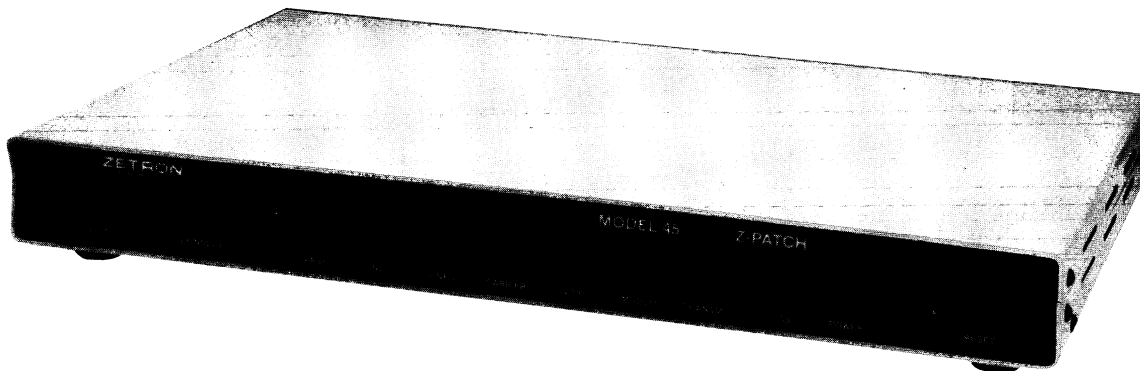


FIGURE 1: The Model 45 Z-Patch

First time owners should finish reading this section and then read the sections on installation, programming and operation. Owners with paging or billing options should also read appropriate options subsections. Other information such as specifications, repair and schematic diagrams are found in Sections 6 through 8. The Appendices contain information on serial communications between the Z-Patch and computers, such as the IBM PC, Commodore 64 and Radio Shack Model 100.

## SECTION 1 - INTRODUCTION

### FEATURES

A summary of Model 45 features is provided below.

- \* Supports full and half duplex as well as simplex VOX and sampling operation.
- \* Stock unit allows the system and user database to be uploaded and downloaded.
- \* Complete paging encoder options available.
- \* Supports DTMF or pulse dial-out with programmable dialing rates.
- \* 99 (or optionally 325) users
- \* Programmable private access/disconnect codes from 1-8 digits.
- \* Two sets of 4-digit first and second digit toll restrict.
- \* User selectable times for system variables, including call limit, line activity, VOX hold, COR delay, sampling rate and width, transmitter hold, number entry time-out, etc.
- \* Full COR/VOR channel monitoring for positive transmitter control.
- \* Seven different, user selectable ring-out sounds.
- \* Mobile-to-Mobile paging encoder capability.
- \* User selectable auto-dial phone numbers with up to 9 entries.
- \* Optional high-accuracy digital delay voice-operated transmitter control.
- \* Four control relays allow control of devices from either the telephone or mobile.
- \* All tones (DTMF, etc.) are regenerated for error-free coding.
- \* Dial click detector for rotary telephones.
- \* 110/220V AC at 50/60 Hz or 12-15V DC operation.
- \* All features remotely programmable via phone or mobile using special privileged DTMF access codes.
- \* No cumbersome "DIP switches" to set.
- \* Two telephones lines provided plus line for local phone.
- \* Optional real-time clock for detailed airtime billing.
- \* Optional internal 300/1200 baud modem for remote computer or terminal programming.
- \* Optional DID interface.
- \* Optional external dial click detector.

## **2. SPECIFICATIONS**



**SPECIFICATIONS**

Power	100-130V AC 60 Hz, 7 watts or 12-15V DC, 700 mA.
Temperature	0-65 degrees C.
Size	16W x 10.5D x 1.75H (inches). 19" rack brackets supplied.
Weight	7 pounds

<b>CAPACITY</b>	99 or 325 subscribers, up to 999-call detail records.
ANI Length	1 to 8 DTMF digits.
ANI Speed	Up to 14 digits per second.

**SIGNALING**

Freq range	67 to 3500 Hz.
Freq accuracy	0.1%
Freq stability	0.0005%
Distortion	2% nominal.
Two-Tone Sequential	Motorola/GE all tone groups, code plans, and capcodes. GE-MARC V and VE all tones.
DTMF	1 to 7 digits per subscriber.
2805	1 to 7 digits per subscriber.
Five/Six-Tone	EIA, ZVEI, CCIR single or dual address.
CTCSS	38 standard EIA tones.
Digital Squelch	All codes 000-777.

**TELEPHONE INTERFACE**

Connector	Two End to End (B1) phone lines, one Local Phone. RJ11-C Modular Jack.
Mode	Full duplex operation, hybrid with adjustable balance.
Call progress tones	Dial tone, ringing, interrupted ringing, busy, and reorder.
Dial tone detection	Single tone adjustable, preset to 440 Hz.
END TO END:	
FCC Registration	Number EYB5W5-15387-OT-T, Ringer Equivalence 0.9B
Incoming call	Ring detection on tip-ring pair or dry contact closure to ground. Programmable number of rings to answer.
Call answer	Off-Hook, tip-ring current draw or Darlington output (wet).
Call disconnect	Second dial tone for 2 seconds (440 Hz), busy tone (0.5 Hz, 50% duty cycle).
LOCAL PHONE:	
Incoming call	Loop start or dry contact closure, Immediate dial.
Call answer	Darlington output (wet).
Call disconnect	Local phone On-Hook
DID:	
FCC Registration	Number EYB5Q5-15386-OT-R, Ringer Equivalence 0.0B
Incoming call	Immediate Dial Loop start, or dry contact closure
Dial pulse detect	5 to 33 pulses per second
Loop start battery	-46 to -51 volts DC, 17 to 39mA limited
Call disconnect	Current loss (break) longer than 350ms

## SECTION 2 - SPECIFICATIONS

### RADIO INTERFACE

PTT	Two Form-C relay closures, 100 mA max.
COR	Noise detector, VOX detector or voltage change.
Tx audio	-30 to +6 dBm. 600 ohm or Hi-Z.
Rx audio	-30 to +10 dBm. 600 ohm or Hi-Z.
Discriminator	50 mV to 5 V P-P, 100K ohm.
Direct Modulation	CTCSS/Digital squelch, bipolar adjustable.
Control relays	4 each, Form-A relay closure.
Sense inputs	2 each, Form-A relay closures input.
Channel busy input	Closure input from secondary receiver COR.
COR validation input	Closure input from CTCSS decoder.

### GENERAL

Voice delay	0.15 to 0.85 seconds CVSD, w/Delay board.
Modem	300 baud Bell 103J or 1200 baud Bell 212.
Indicators	Page, Line1, Line2, Carrier, Vox, Data, Transmit, CTCSS, Power.
Switches	Disconnect, Connect and Reset.
Station ID	Morse code, fixed 1200Hz frequency and selectable call sign.
Operating modes	Simplex intelligent VOX, simplex intelligent sampling, half-duplex, and full-duplex.
Equipment types	Tone only pager, Tone+Voice pager, Talkback pager, Mobile.
Prompt tones	Progress tones, error tones, and warning tones sent to phone or mobile.
Programming	Programmable via DTMF phone, DTMF mobile, RS-232 or phone modem.
Data retention	Better than 5 years with power removed.
Real time clock	Battery backed for at least 5 years with no power.
Protection	High voltage varistors on phone lines and radio interface.

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**OPERATION**

The Model 45 is designed to operate as a full-featured phone interconnect in full-duplex, half-duplex and simplex radio installations. With the addition of one or more of the optional page formats, the unit also provides the functions of both a dial access paging encoder and a mobile-to-mobile paging encoder, allowing a mix of equipment types in one system.

**Duplex Installations**

When installed on a repeater (or full-duplex base station), the Model 45 provides audio path control for both full and half-duplex mobiles. In addition, the unit can be provided with a repeat audio option to handle no-tone (dispatch) or require ANI to access dispatch operations.

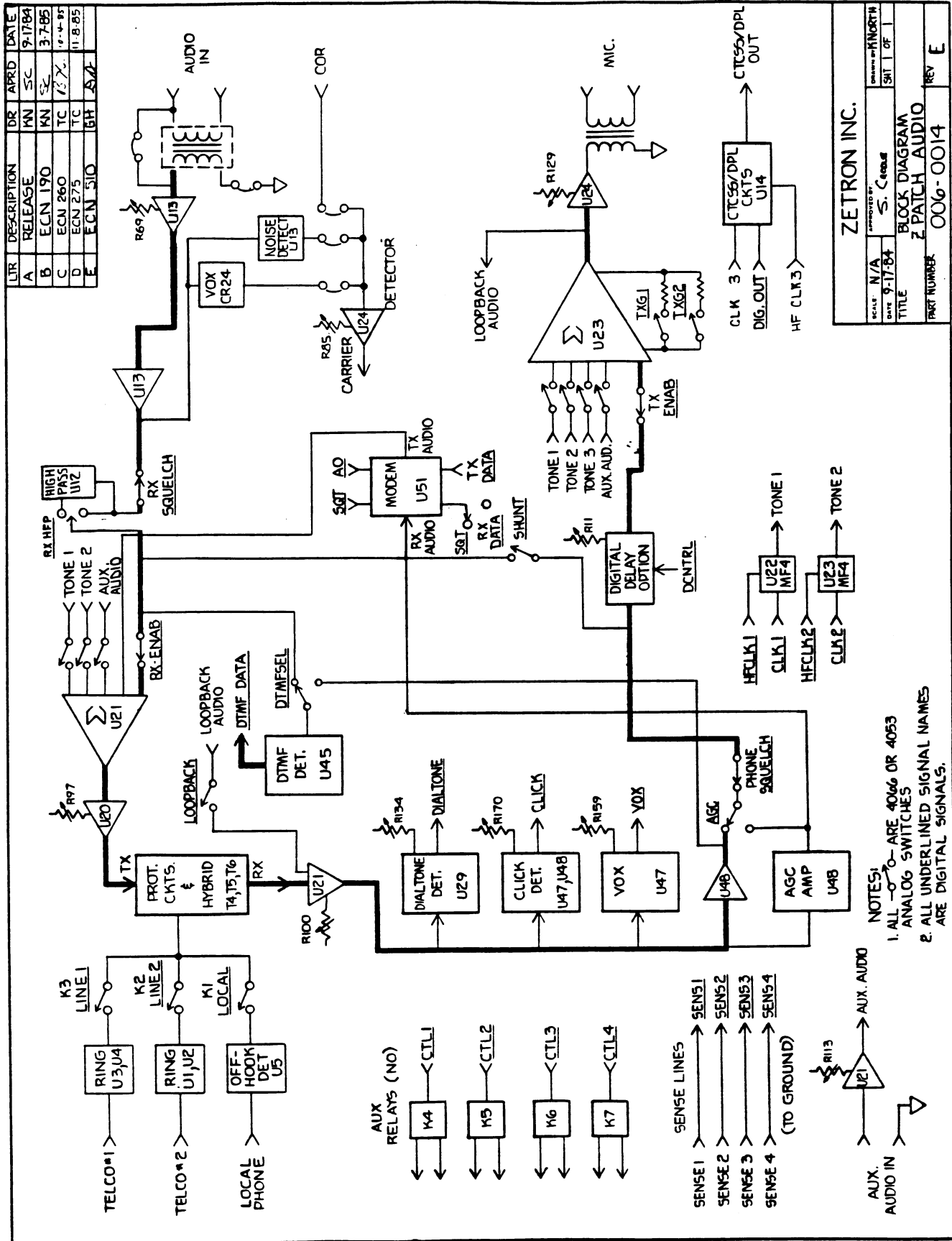
Each mobile user may be specified as either a full or half duplex user. When operating full-duplex in patch operation, the audio from the phone line is always output to the transmitter. When operating half-duplex without the repeater option, the telephone audio is muted whenever the mobile is transmitting, and if selected (per user) a privacy tone is transmitted. If the repeat audio option is installed, either the mobile's audio or the privacy tone is transmitted when the mobile is transmitting.

**Simplex Installations**

If installed in a simplex system, the Model 45 provides a unique combination of both VOX and sampling operation. Alternately, the unit can be programmed to operate as a pure VOX or sampling patch. VOX is the preferred mode of operation, unless the phone party has a high noise environment such that the VOX is triggered when there is no voice on the phone line, in which case sampling has to be used. When using VOX, the digital delay board option is recommended to prevent clipping of the initial syllable of speech when the phone party talks. The Model 45 uses a sophisticated combination of VOX and sampling in the VOX mode. If the phone party talks too long or background noise locks up the VOX detector (longer than the "into-sampling" time), the Model 45 automatically drops the transmitter and looks for mobile activity. If activity is detected, the conversation direction is switched, otherwise the transmitter is rekeyed and the phone party is still allowed to talk.

In simplex VOX operation, the transmitter is keyed when speech is detected from the phone. If there is no speech, the radio is allowed to revert to receive mode. If speech occurs again, the transmitter will be rekeyed, but if COR is seen, the radio will stay in receive mode until COR goes away. When COR goes away, the transmitter is keyed ("pre-key") and the phone line is examined again to determine if the transmitter should remain keyed. This pre-key is in anticipation of conversation turn-around, which helps eliminate the squelching of the phone party's first syllable. See Figure 2. for a diagram of typical VOX operation.

# SECTION 3 - OPERATION



Model 45 Operational Block Diagram

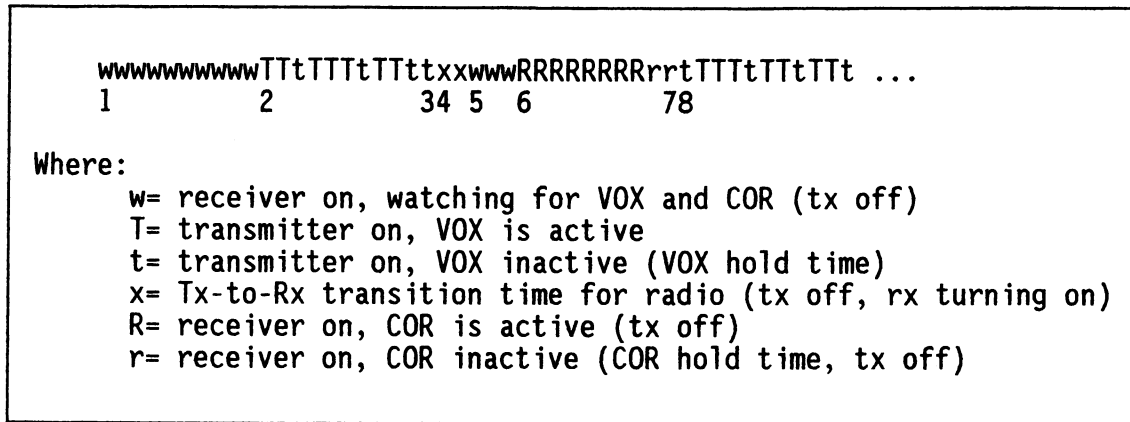


FIGURE 2: Typical VOX operation

Initially neither party is talking (1). The phone party speaks three words (2). The VOX hold time expires (3). The transmit to receive transition occurs (4). The Model 45 looks for COR and VOX (5). COR is seen when the mobile talks (6). The COR hold time expires (7). The transmitter is re-keyed (8).

If VOX is active for the programmed "into-sampling-time", the transmitter is periodically dropped (at the "sample rate") to check for COR. If COR is not detected, the transmitter is rekeyed, after the "sample width time" plus the "tx-to-rx time", and sampling continues. If COR is detected, the radio party talks and, after COR drops, the VOX mode is re-entered. The VOX mode is also re-entered if VOX activity stops. See Figure 3 for diagram of automatic sampling after VOX is active for the "into-sampling-time". The "sample rate" is how long the phone audio is transmitted and the "sample width" is how long the transmitter is dropped when testing for COR. Note that the "tx-to-rx" time is always added to the "sample width" time.

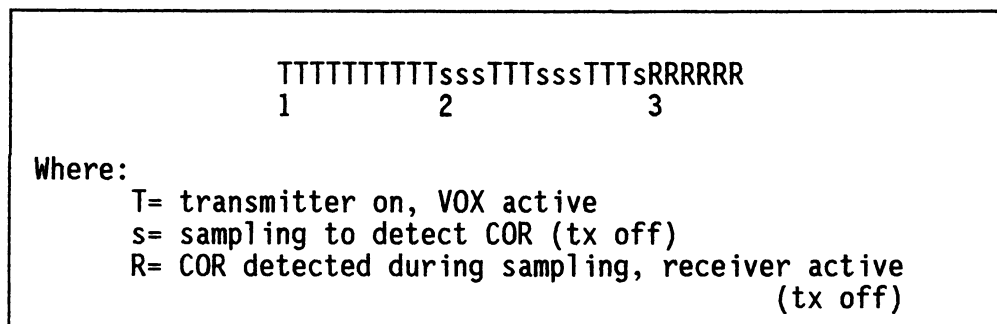


FIGURE 3: Typical auto-sampling after long VOX

The transmitter is keyed when VOX is active (1). After the "into sample time", sampling begins at the "sample rate" (2). Finally, COR is detected and the radio party talks (3). If pure VOX operation is required, the into-sample-time should be set to its maximum value. Alternatively, if pure sampling operation is desired, the into-sample-time should be set equal to the programmed sample rate.

## SECTION 3 - OPERATION

The unit operates with a separate set of programmed sample rates and widths during dial tone activity (before the mobile has completed dialing a phone number), and the into-sample-time does not apply. If dial tone sampling is desired, the sample rate should be set relatively fast (e.g. 1 second) and the sample width set to its minimum value. If VOX operation is desired, the sample rate should be set long (e.g. 4 sec) and the sample width should also be set long (e.g. 10 sec). This will force the unit to transmit 4 seconds of dial tone (after access), and then drop the transmitter to look for mobile activity. If the dial tone sample rate is set to 255 then dial tone will come up, with VOX, for the dial tone sample width. The transmitter will then be dropped and the unit will wait for dial in.

For optimum operation under VOX or sampling, three programmed values must be set: the tx-to-rx time of the station transceiver, the mobile's COR hold-time, and the mobile's tx-to-rx time. The station tx-to-rx time should be set to the minimum time that guarantees that the receiver's COR output is valid after unkeying its transmitter. The mobile tx-to-rx time delays the transition from a mobile unkey (and after the COR hold time) until the telephone party's audio is allowed through to the transmitter (the tx is keyed after the COR hold time expires), and the prompt beep is given to the phone party. Normally, the COR hold time needs to be set relatively short (e.g. 0.2 sec), as does the mobile tx-to-rx time (e.g. 0 to 0.1 sec).

### **Repeater Simplex Installations**

If the Model 45 is connected to a simplex base station operating through a repeater, a COR validation signal to the Model 45 should be derived from the COR from the receiver at the repeater.

This is normally accomplished by decoding a CTCSS tone which is encoded whenever the COR is on at the repeater receiver and using the tone decoder output for the COR validation input to the Model 45.

The COR from the base station radio is not adequate since the repeater transmitter stays keyed for its transmitter hold time and thus is not a true indicator of mobile activity.

VOX simplex is the only reliable mode of simplex operation when working through a repeater. Sampling simplex operation is not practical because the COR sampling time has to be unreasonably long to compensate for the CTCSS decode time (the "into-sampling" time should be set to its maximum).

### **PHONE-TO-MOBILE/PAGER ACCESS**

In phone-to-mobile/pager communication, a caller accesses the Model 45 simply by dialing the Z-Patch's phone number or by taking the local phone off-hook. Line 1 and line 2 of the Model 45 can be programmed for one of three telephone answering modes: answer/beep/ring-out, answer/dialtone/ring-out and no-answer/ring-out. The local phone may only be programmed for the answer/beep/ring-out or answer/dialtone/ring-out mode. In all modes if the caller does not put in a DTMF code the unit can be programmed to do an auto-call.

In answer/beep/ring-out mode, the Z-Patch answers the call with a 400ms beep 750 ms after a programmed number of rings (ring-until-answer). If the caller does not enter a code and the auto-call user number is set to '0', then the call will be disconnected. If the auto-call user number is from 1-99(325) normal ring-out occurs for the programmed number of rings (channel ring-outs). If a mobile answers, the call is connected. If the call is unanswered, the line is disconnected. Alternatively, a caller may call a specific user by entering the user's user number (or ANI) after the beep. If a user number is not entered before the Model 45 sends a ring to the caller, the call will be directed to the auto user number for the line receiving the call or disconnected if the auto call user number is '0'.

In answer/dialtone/ring-out mode, the operation is identical to answer/beep/ring-out except that the Model 45 answers the call with 2.5 seconds of dial tone, during or after which, a valid user number (or ANI) can be entered on the caller's phone. As above, ring-out begins and the call proceeds as above. If invalid or if the auto call user number is set to '0' an error tone is heard by the caller and the line is disconnected.

In no-answer/ring-out mode, ringing is detected on the phone line and after rings-until-answer, channel ring-out to the auto call user begins. If a mobile answers, the line is answered and the call is connected. If a mobile does not answer, the line is briefly answered to disconnect the call. This answer mode is not available for the local phone. If ringing on the phone line stops, after a brief inter-ringing time, ringing on the channel will stop. If the auto call user number is set to '0' or if the auto call user is disabled the answer mode will be forced to answer/dialtone/ring-out.

There are four modes of decode from the phone line. In all modes the Model 45 will decode DTMF, during dial or after tone or after the beep. Modes 0 and 3 are DTMF only. Mode 0 is the normal DTMF overdial operation. Mode 3 is for operation with an external dial click decoder. In mode 3, the quiet time after the beep or dial tone drops is extended to 15 seconds.

When using dial click decode, modes 1 or 2, the Model 45 will decode clicks on the phone line and turn them into digits. In mode 1 the phone party just enters the number, from a DTMF or pulse phone, they wish to dial. In mode 2 the telephone callers must first dial a '0', if from a pulse phone, before entering the user's number or access code. The leading '0' in mode 2 is only required from pulse phones. CAUTION: When the call is from a dial pulse phone the caller must first wait for dial tone from the unit to drop or after the beep before dialing. The local phone must always generate DTMF.

The type of ring-out is programmable for each user for one of seven ring-out styles: normal ringing, double ringing, triple ringing, ding-dong, singer, warbler or, optionally, repeat paging tones. These different ring-out styles are used so mobiles may easily determine who incoming calls are for if the unit does not have any of the paging tone options installed for selective calling, or if multiple users are on the same CTCSS tone.

After entering a valid user number (or ANI) in both the answer/ring-out and answer+access modes, the phone party will hear either a normal ring, or a broken ring. Broken rings indicate that the channel is busy, and that channel ring-out is not occurring.

### SECTION 3 - OPERATION

If the channel is quiet, the unit will key up the transmitter and issue the appropriate user's ring-out or page. The number of rings that occur on the channel is user selectable, from one of two system values. The phone party will continue to hear rings until disconnected or the mobile answers. The call will be disconnect after channel ring-outs occur or channel busy rings, whichever is greater.

If the channel is busy the caller will hear broken rings until channel busy rings for the line the call is on occurs, then the line will be disconnected. If the channel becomes quiet before channel busy rings occurs the unit will key up the transmitter and issue the appropriate users ring-out or page until channel ring-outs occur then the line will be disconnected.

If a mobile does not answer a call, the phone line will be placed back on-hook (or in the case of the no-answer/ring-out mode momentarily taken off-hook) disconnecting the phone party, after the programmed number of channel ring-outs or busy channel rings which ever is greater.

If the calling party hangs up and the unit detects dial tone it will discontinue the ring-out in the case of answer modes 0 and 1. In mode 2 the unit will discontinue ring-out if the ringing on the phone line stops.

#### **Answering a Call to a Mobile**

One of three call answer modes may be selected for each mobile: COR-to-answer, \*-to-answer, or ANI-to-answer (\*-to-answer = no). If a user is programmed with COR-to-answer, the mobile simply keys the mobile transmitter to answer an incoming call. Users programmed as \*-to-answer need only enter a long (0.8 sec) DTMF "\*". Users with \*-to-answer set to no, must enter their DTMF access code sequence. If ANI is required to answer, the mobiles answer sequence depends on the sign on mode. With Zetron sign on the answer code is \*+ANI, for RCC mode 1 is ANI+\*, for RCC mode 2 it is \*+ANI+\*. Note that the trailing '\*' can be any digit. If the courtesy tones are enabled for the user being called, the phone party will hear a single beep when the mobile answers and each time the mobile unkeys.

If a user is set up with ANI-to-answer, the supervisor's ANI will answer the call.

#### **Phone-to-Mobile/Pager Paging Access**

If the Model 45 has an optional paging format installed users may be selectively called. This allows the user to leave his radio squelched and not have to listen to all of the other calls on the channel and try to determine which ones are his. Paging to 'tone-only' and 'tone and voice' pagers may also be done.

Access to the Model 45 for dial-access paging is identical to that for phone-to-mobile communication. The Z-Patch answers the call using one of the methods described above. The page code for that user will then be broadcast.

After the page code is sent, operation is determined by the type of equipment specified, and the ring-out style, for the user. If a two-way mobile is called the unit will issue a ring-out or repeat the paging tones until the call is answered or disconnected.

If a tone-only pager is called, the phone party will hear a string of 5 beeps after completion of the page, and the phone line will be placed back on-hook.

If the equipment type is a tone+voice pager, the phone party will hear 2 prompt beeps after the page has been issued, indicating that the voice message may be given. After the programmed talk time (or if the phone party doesn't speak, 2 times the VOX hold time), 3 beeps will be issued, and the call will be disconnected.

If the equipment type is a talkback pager, operation is similar to tone+voice pager operation, however, after the page is issued the phone party will hear any channel activity present, allowing the "mobile" to reply to a voice message. Note that once a talkback page is in process, the call is only aborted by normal mobile disconnect procedures (see "Mobile-to-Mobile/Pager" section below).

Direct-air operation is similar to talkback pager operation, however, no page or channel ring-outs occur; the phone party is immediately allowed on to a quiet channel.

## DIAL CLICK

Dial click allows a phone party caller to overdial user numbers or access codes with a rotary dial (dial pulse) telephone. There are 2 modes of dial click decode, one that requires a 0, mode 2, to be dialed to calibrate the dial click decode software to the telephone, or mode 1 which does not require the calibrating '0'. After dialing the initial 0, the caller dials the user's number or user's code as without dial click. The leading '0' is not required from a DTMF phone.

When installing a unit with dial click, use the "DTMF" and "Click Detect" tests in the test menu to calibrate the Model 45. The "Click Detect" test will display "ON" or "OFF" when clicks are decoded or not. Adjust R170 so an "ON" indication is given for the entire duration of all digits 1-0. Next, use the DTMF test to display decoded dialed digits. If the click decode mode is set to 1, just dial digits from a dial pulse phone. Dial all digits 1-0 and verify they are correctly decoded. An "A" or "B" is displayed if the dialed number is decoded above or below the limit for a valid digit. If an "A" or "B" is displayed along with valid digits, decoding is okay. These errors are ignored during normal overdial and are presented in the test routine as an aid for adjustments. If the digits are not decoded properly, select dial click decode mode 2. When mode 2 is selected, a leading '0' is required to calibrate the software. After the line is picked up, dial a '0', then dial all digits from 1 to 0. See the Installation Section for more information on set up.

## SECTION 3 - OPERATION

### MOBILE-TO-PHONE ACCESS

A user is programmed to sign-on to the Model 45 using one of three formats: Zetron style, RCC style 1 or RCC style 2. Note that the sign on mode can affect the way a mobile answers a call, see above. Each method is discussed below.

Each user may be assigned line 1 or line 2 as the "default" phone line, with the other line being the user's "alternate" line. Access to the alternate line may be inhibited.

#### Tone/Code Drop Modes

When calling a mobile with more than one user on a tone or digital code it is some times desirable to only have the tone or code issued until the page is finished or until the mobile answers. Each user may be set up to have the tone/code for the duration of the call, drop after the page (or first ring), or drop after the mobile answers. If multiple users are on the same tone this would allow the other mobiles to resquelch and not have to listen to the duration of the call. See the user operation menu for more information.

#### Zetron-Style Sign-On

The Zetron-style sign-on format uses a leading DTMF digit to determine the type of access, see below. The following DTMF digits are used to determine the type of access a user wants:

- "\*" = Access user's default phone line.
- "0" = Access repeater (if allowed and option installed).
- "1" = Mobile-to-mobile access (if allowed).
- "2" = Access alternate phone line (if allowed).

After typing the DTMF digit to determine the type of access, the user must enter his programmed access code. When a user accesses either phone line, the line is taken off-hook, and the telephone audio is sent to the transmitter, allowing the mobile to hear dial tone (if present). The mobile may then enter the desired phone number. Mobile-to-mobile and repeater access are discussed below.

#### RCC-Style Sign-On

The RCC style 2 sign-on format uses the DTMF "\*" followed by the calling party's access code, followed by an additional DTMF steering digit which determines the type of access. The RCC steering digits are given below:

- "9" = Default phone line access.
- "8" = Alternate phone line access (if allowed).
- "7" = Mobile-to-mobile access (if allowed).
- "5" = Repeater access (if allowed and option installed).

RCC style 1 sign-on is the same as style 2, however, the leading DTMF "\*" is not used.



**Access Codes**

The access code portion of sign-on is allowed to be any sequence of DTMF digits, from one to eight digits in length including "\*", "#", and the "4th column" digits of "A", "B", "C", and "D". Since variable length codes are allowed, the system operator must be careful not to enter access codes that are subsets of other codes. For example, if a code of "12" is entered for user 1, and "123" is entered for user 2, user 2 will always sign-on as user 1, when using Zetron sign-on, since "\*12" will be validated before the final "3" is entered, and the "3" will be treated as the start of phone number dialing. For this reason the Model 45 looks for ANI conflicts. If an ANI conflict exists, the user will be prompted to enter another ANI code.

**Short Sign-On**

If enabled, mobiles can access the unit using the Zetron style steering digits (\*, 0, 1, 2). If a long digit (0.8 sec) is entered and no further digits are received for 1.5 seconds, the mobile is validated as user 1. Note that the same digits are used regardless of the sign-on mode chosen.

**Dialing**

After completing a valid mobile access, dial-out operation to the phone line is dependent upon the privileges assigned to the user. If allowed, the mobile may immediately begin entering the phone number to be called. As DTMF digits are received from the mobile, they are regenerated out the phone line in either DTMF, slow pulse or fast pulse. If DTMF dialing is selected, the regenerated digits will "follow" the mobile's transmitted digit duration.

If the mobile is designated as half-duplex, the unit will stop regenerating the digits and allow the mobiles audio through to the phone line when the mobile unkeys, and one of the following conditions is met:

- {1} The programmed DTMF time-out has been exceeded.
- {2} A DTMF "\*" is received.
- {3} A specified number of digits have been received.

If the mobile is designated as full-duplex, regeneration ceases upon condition {1} or {2} only (unkeying is not required, and has no effect).

In addition to the normal dialing described above, the mobile may be allowed to use the unit's nine auto-dial (previously stored) phone numbers. After mobile access, the user selects an auto-dial by entering a "\*", followed by the desired auto-dial number ("1" through "9"). Entering a "0" instead, will cause the unit to redial the last entered phone number.

Alternatively, a mobile user may not be allowed to do normal dialing, but instead may be restricted to only using the auto-dial numbers. If this mode is selected for the user, after sign-on, the mobile simply enters a "1" through "9" to choose the desired auto-dial number (the "\*" is not required or allowed). Caution: auto-dial numbers are not toll restricted.

Finally, a mobile may not be allowed to make any dialing selections at all; upon access, the unit may be set to immediately dial one of the nine auto-dial numbers.

## SECTION 3 - OPERATION

### Toll Restriction

Each user may be assigned to none or one of two sets of system defined toll restricts. Each set of restricts may define up to four restricted digits for both the first and second digits of a number to be dialed. The length of the number dialed may also be restricted. 911, 1-800 and the auto-dial numbers are not toll restricted, but last number redials are.

### Disconnecting a Call

At the completion of a phone call, it is generally the mobile's responsibility to terminate the patch operation. Three disconnect modes are available: "#" to disconnect, "#"+ANI to disconnect or ANI to disconnect. The requirement for the leading "#", when ANI is required to disconnect, is a system question. If "#" to disconnect is selected for a user, the mobile enters a long DTMF "#" (0.125 sec.). If "#"+ANI for disconnect is required, the mobile enters a "#", followed by his ANI code. If just ANI to disconnect is selected the mobile just enters his ANI code. Therefore if the system question '#+ANI to disconnect' is set to yes, all users that are set up to disconnect with ANI require the leading "#". The telephone party may disconnect any calls whenever the mobile is not keyed up by entering a long DTMF "#" (0.5 sec).

If a "#" is detected during the dialing sequence (before the unit has stopped regenerating digits), the call is immediately terminated. Note that a long digit is not required, nor is the ANI required.

Calls will also terminate if the mobile activity timer expires or if the call length exceeds the user's call limit timer. Impending mobile activity time-outs are indicated by single beeps transmitted 12, 9, 6, and 3 seconds before disconnect, while call limit time-outs are indicated by double beeps 15, 12, 9, 6, and 3 seconds before disconnect. In simplex systems, the unit drops the transmitter after a mobile activity time-out for an additional 10 seconds before disconnecting the call. If enabled, a 2nd dial tone (due to the telephone party hanging up) will also terminate the call.

If the users are programmed with ANI to disconnect, the ANI code of the supervisor can always disconnect the call.

### MOBILE-TO-MOBILE/PAGER OPERATION

After entering a valid mobile-to-mobile access code, the unit keys up the transmitter and issues a dial tone. In duplex systems the dial tone lasts 6 seconds. The mobile must dial before the duration of the DTMF time-out after the dial tone has dropped. In simplex systems the dial tone will last the dial tone sample rate, then the transmitter will be dropped. After the transmitter is dropped the Z-Patch will wait for the DTMF time-out for the mobile to enter the access code for the other mobile. At any time during the dial tone in duplex systems (or after the transmitter has dropped in simplex), the mobile may enter the user number of the mobile to be called (or ANI if selected). The unit will drop the dial tone upon receipt of the first digit in duplex systems. If an invalid user number (or ANI) is entered, or if no number is entered, the unit will issue an error tone and drop the transmitter.

After receiving the called mobile's code, the unit will begin ring-out, in the same manner as for phone-to-mobile calls. Ring-out may be terminated by either mobile's disconnect codes, or may be answered (which also terminates ring-out) by entering their sign-on codes. If the repeat audio option is installed and the call is answered, the unit will issue a single prompt beep and drop into repeater operation (described below) with a long (25-second) hold time. At the end of ring-out, if the call is not answered or terminated or answered in units without repeat audio or if the system is simplex, five beeps will be issued and the transmitter will be dropped.

When placing a mobile-to-pager call, operation differs depending on pager type. If a talkback or tone+voice pager is called, a prompt issues after the page (2 beeps for talkback, 1 for tone+voice). If the repeat option is installed, the unit drops into repeat; otherwise, the unit drops the transmitter and operation is complete. If a tone-only pager is called, the operation is completed immediately after the page is issued, and the transmitter is dropped.

### REPEATER DISPATCH OPERATION

Two forms of repeater operation may be selected; ANI-for-dispatch or carrier controlled dispatch. If ANI-for-dispatch is selected, the mobile must enter a valid access code to enable the dispatch function, the repeat audio is turned off until a valid code is entered. If carrier controlled dispatch is selected, the unit will key the transmitter whenever COR (mobile) activity is detected.

Dispatch operation is regulated by the dispatch hold timer and the dispatch time-out timer. The unit will hold the transmitter active for the duration of the hold time, if mobile activity is not present. If the transmitter remains keyed for the duration of the dispatch time-out timer, an error tone is issued and the transmitter is forced to drop until mobile activity ceases, at which point it may be rekeyed. Impending dispatch time-out is indicated by single beeps at 15, 12, 9, 6, seconds before time-out.

ANI-for-dispatch operation is ended if either of the above timers expires, if the mobile's call limit timer expires, or if the mobile sends its disconnect code. Call limit time-out operation is the same as for phone calls. If operation is ended by hold timer expiration or disconnect code, the unit issues five beeps to indicate repeater drop. If either the call limit or dispatch time-out timers expire, the error tone will be issued. Once the repeater drops, ANI sign-on is required to rekey the transmitter.

If a mobile wishes to send live DTMF over the air, the mobile must first key up for the DTMF timeout without sending any DTMF. After the DTMF timeout has passed the Z-Patch allows DTMF to pass from the receiver to the transmitter. The Z-Patch mutes any DTMF audio for the DTMF timeout of valid COR. This is to prevent ANI codes from being sent out over the channel which could set off another mobile's decoder. This also adds security to the system by not allowing mobiles to hear each other sign on to the system.

## SECTION 3 - OPERATION

### SENSE LINE INPUTS

There are four sense inputs. Two can be used to page a user number and two are used for transmitter control.

Sense one, J1 pin 4, is used to validate COR. This input is pulled high internally so if left open the COR validation polarity question should be answered yes. See Section 9, Connections and Jumpers for more information.

Sense two, J1 pin 5, is used to monitor the transmit channel activity, Channel Busy. This input is also pulled high and if left open the Channel busy question should be answered no. When this input is active, the COR LED flashes and access from a mobile or telephone is not possible. If the Model 45 doesn't have the repeat audio option, the channel busy input is ignored upon mobile access. See Section 9 for more information.

Sense three and four, J1 Pin 6 and 7 respectively, can be used to send out a page, and/or a tone/code. Sense three uses the page format and page code of user one and sense four uses user two. See Section 9, Connections and Jumpers for more information.

### CONTROL RELAYS

Four control relays are provided in the Model 45 for external control: 2 for system level controls, relays 1 & 2 (J2-3&17 and J2-4&16) and 2 for user level controls, relays 3 & 4 (J2-1&15 and J2-2&14). System relay access may be done from a phone or a mobile. The system relays are controlled by entering the system relay access code in place of a normal access ANI (or user number). The unit will respond with four prompt beeps, after which two digits are entered, with the first digit controlling relay 1 and the second digit controlling relay 2. If a "0" is entered, the appropriate relay is turned off; if a "1" is entered, the relay is turned on, if a "2" is entered the relay is left unchanged. When accessing from the phone side just enter the system relay access code, when accessing from a mobile a leading '\*' is required in sign on modes 0 and 2. In sign on modes 1 and 2 a trailing digit is required. So when accessing the system relays from the mobile, access is as follows: \*+ANI code with Zetron sign-on mode, ANI+\* with RCC mode 1 or \*+ANI+\* with RCC mode 2. Note that the trailing '\*' can be any digit.

Operation of the two user relays is independently controlled, with each being set to one of the following modes:

- Mode 0: ON at mobile originate....OFF at disconnect
- Mode 1: ON at mobile answer.....OFF at disconnect
- Mode 2: ON at telco access.....OFF at mobile answer
- Mode 3: ON at telco access.....OFF at disconnect
- Mode 4: ON at telco access  
or mobile originate....OFF at disconnect

Note: the above modes are system level selections, while under each user, each of the relays may be enabled or disabled. If disabled, the appropriate relay will not be energized when that user accesses the system. If enabled, the relay is energized under one of the above sets of conditions.

**FRONT PANEL INDICATORS**

The Z-Patch has nine front panel indicator LEDs (Figure 1). Eight of the indicators have an associated number as well as description. Each indicator is discussed below.

1-PAGE	On when a page is broadcast. Also blinks periodically to verify normal system operation.
2-LINE 1	On when line 1 is off-hook or ringing.
3-LINE 2	On when line 2 is off-hook or ringing.
4-CARRIER	On when COR is detected; flash when channel busy detected.
5-VOX	On when phone audio is detected.
6-DATA	On when DTMF digits are detected.
7-TRANSMIT	On when the transmitter is keyed.
8-CTCSS	On when a sub-audible (CTCSS) tone is encoded.
POWER	On when system power is applied.

All indicators are lit when the system is being reset.

**FRONT PANEL CONTROLS**

RESET	Resets the Model 45 to power-up conditions.
CONNECT	Connects the Model 45 to the phone line specified for user one (factory set to line one). CONNECT is also used with RESET to reset the system programming (but not user programming) to the factory defaults. To reset system programming, press and hold RESET, press and hold CONNECT, release RESET. When all LEDs light, release CONNECT.
DISCONNECT	Disconnects any call/access in process.



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### INTRODUCTION

The Model 45 contains many variables for the entire system and for each user. These variables are set by the system operator using the programming features of the Z-Patch. The Model 45 is programmed in one of two ways; from a CRT or computer, or by DTMF from a phone or mobile. Since CRT programming is the much preferred method, it will be discussed first. This section of the manual covers programming the Model 45 from a CRT or computer. DTMF programming (next section) is used mainly for small adjustments to the system "on-the-fly."

The system and user database is contained in low power RAM which is plugged into a smart socket which has a battery in it. This allows the unit to retain the programming even without power applied. Once the unit is programmed and operating the database may be downloaded to your PC using the ZCOM software which can be ordered from Zetron. This feature allows you to download the database from one unit and upload it to another unit or if the unit ever needs to be reprogrammed, all you have to do is upload it.

The Model 45 may be programmed from a CRT or computer, functioning as a "dumb terminal." Once this method of programming is chosen, there are two ways to connect the CRT (or computer) to the Model 45. One connection method is directly through the Model 45's serial port. This method is simple and quick, but it requires that the CRT and Model 45 be within 100 feet of each other. Since this is not always possible, the Model 45's programming features may be accessed over the phone line and through its (optional) internal, 300/1200 baud modem.

### ACCESSING PROGRAMMING MODE USING DIRECT CONNECT

Before attempting to program the Model 45 with a directly connected CRT or computer, follow the cabling instructions found in the installation section. If a computer is being used, its dumb terminal emulator program must be running (see also Appendices 1-3). When the CRT or computer is properly connected to the Model 45's serial port and configured with the proper communication protocol (4800 baud, 8 data bits, 1 stop bit, no parity), Model 45 programming may begin. Press reset on the Model 45. A power-on message should appear on your screen, (see below). If not, check all of your connections. You may have to connect DTR (data terminal ready) to DSR (data set ready) and CTS (clear to send) to RTS (ready to send) on the connector that goes to your CRT/computer.

Press the RETURN key on your CRT or computer to "bring-up" and display the Model 45 sign-on message and Top Menu selections (Figure 4). If the Z-Patch does not respond, it may be processing a call or page. The Model 45 must be idle before direct connect programming may commence. Instructions on actual programming are continued in "CRT Programming Menus and Commands" in section 3. When programming is finished, be sure to EXIT PROGRAMMING or the Model 45 will not detect subsequent call activity until the programming mode activity timer expires (5 min).

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

### ACCESSING PROGRAMMING MODE VIA MODEM (Option)

The Model 45's programming may be accessed without any additional connections by using a standard phone line to the device, coupled with the unit's optional installed internal modem. This method is slightly more involved than the direct connect method because the Model 45 must know that you want to do CRT programming and not DTMF programming or place an actual call or page. The steps for accessing CRT programming over a phone line are outlined below.

1. SET UP YOUR COMPUTER OR CRT. Your computer or CRT must have a modem and be running a terminal emulation program that will send data to the modem and over the phone lines. Start your terminal emulator and set the correct communication protocol.
2. CALL THE MODEL 45. You may do this either by dialing the number on your phone and then switching the modem to that line, or if you have a Hayes (compatible) modem, you may instruct the modem to dial the number for you, like this:

ATDT123-4567; RETURN

The AT gets the modem's Attention, the D is for Dial and the T is for Touch-Tone dialing. The number comes next and may contain hyphens or parentheses which are ignored or commas which insert delays. Finally, press the RETURN key to dial the number entered.

3. ENTER THE PROGRAMMING ACCESS CODE. After the Model 45 is called, it will answer the line after a predetermined number of rings. After the prompt tone, enter the program access code using DTMF (factory set to 00098). The program access code may be entered with a Hayes compatible modem by typing ATDT00098. The Model 45 will issue modem carrier for about 20 seconds, after which it will go into DTMF programming (see "Programming via DTMF"). If the Model 45 detects modem carrier before the time-out, the "Top Menu" (Figure 4) will be displayed if a RETURN is entered from the keyboard. Note that answer mode 2 does not answer the line and allow you to over dial, so programming access is not possible.
4. PROGRAM THE DEVICE. See "CRT Programming Menus and Commands."
5. EXIT PROGRAMMING MODE. Press E from the "Top Menu" to exit programming mode. Failure to do this may result in non-recognition of subsequent call activity for the programming activity time. From a Hayes compatible modem, typing ATH followed by RETURN hangs up the phone. Detection of dial tone, loss of carrier or detection of a break will cause the Model 45 to hang up the phone.

```
Model 45   Ver:4.00
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LOG ON MESSAGE

TOP MENU

S. SYSTEM          U. USERS
V. SUPERVISOR      A. ACCOUNTING
T. TEST            O. OPTIONS
E. EXIT

Please select:
```

FIGURE 4: Model 45 sign-on and "Top Menu" for programming

### CRT PROGRAMMING MENUS AND COMMANDS

The Model 45's CRT programming is accomplished through a hierarchy of menus. The first and most general menu is the "Top Menu". From the Top Menu, the operator may access system, user and supervisor programming as well as access accounting information, test functions, list installed options and exit the programming mode. To select any menu option, simply type the letter which appears to the left of the option description. When entering data, a "Y" or "N" may be entered for yes/no or enable/disable questions. The letter pressed may be upper or lower case. For example, when programming is complete, press "E" or "e" to exit programming. This ensures that all subsequent calls will be processed. Since the supervisor information is the simplest, it will be discussed first, followed by system and user programming. Before programming proper is discussed, a few words about menus in general is in order.

### USING MENUS

When menu options are selected (by pressing the corresponding letter), the menu name is displayed. To view the list of that menu's options, press the RETURN key. This method is employed to speed programming once the operator is familiar with the menu options. To return to the Top Menu from a lower level menu, type an exclamation mark "!". To return to the previous menu, type a period ".". Pressing the period while entering data returns to the top of the current menu after accepting the data. Pressing RETURN while entering data, accepts the current data and displays the next item in the menu. Pressing the RETURN without entering in any data will leave the selection unchanged and advanced to the next menu selection.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

### PROGRAMMING SUPERVISOR INFORMATION

Pressing "V" followed by the RETURN key from the Top Menu, displays seven supervisor variables (Figure 5). To change a supervisor variable, type the letter (A, N, S, U, I, M or L) corresponding to the variable to be changed. For example to change the program mode ANI to 00123, press A, type 00123 and press the RETURN key. Be extremely careful not to set the program mode access code to a valid user number or ANI code or subset thereof, if you do the Model 45 will prompt you with the message ANI conflict. While entering a variable, press the BACKSPACE key to back up and correct mistakes. After the RETURN key is pressed, you are prompted to enter the supervisor user number. Enter the new number and press RETURN or just press RETURN to leave the current setting unchanged and skip the next entry.

When displaying system programming, the scrolling of the menus may be stopped with Control S (^S). Enter Control Q (^Q) to restart the listing.

Press M to enter the Logon message. This message will appear before the top menu when you first access the system.

To exit the menu, simply type a ! to return to the top menu, or type a period to return to the previous menu (in this case the top menu) if you are currently at the top of the supervisor menu.

```
Select: V

SUPERVISOR MENU

A. Program mode ANI (chrs) = 00098
N. Supervisor user number = 0
S. Reset system programming = No
U. Reset user programming = No
I. Clear SMDR storage = No
M. Logon message =
L. List system programming = No

Please select:
```

FIGURE 5: Supervisor programming

**PROGRAM MODE ANI**--the code is used to gain access to DTMF programming from a mobile, or DTMF or modem programming from a telephone. The first three digits of the code cannot be in the range of 001 to 325.

**SUPERVISOR USER NUMBER**--specifies privileged supervisor user. The supervisor can answer any call (telephone-to-mobile or mobile-to-mobile) and disconnect any call in progress (telephone, mobile-to-mobile, or repeat) using the specified connect and disconnect codes.

**RESET SYSTEM PROGRAMMING**--if a "Y" is entered, the units system programming is reset to the factory defaults.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

**RESET USER PROGRAMMING**--if a "Y" is entered, the unit's user programming is reset to the factory defaults. Caution: When the user programming is reset the accumulated call data is also cleared. The accumulated call data can also be cleared in the accounting menu, clear accumulated.

**CLEAR SMDR STORAGE (option)**--with the internal SMDR storage option, a "Y" will clear all SMDR call transaction entries. This command does not clear the accumulated storage.

**LOGON MESSAGE**--The message entered here will appear in the logon message above the TOP MENU.

**LIST SYSTEM PROGRAMMING**--if a "Y" is entered, all of the system programming menus will be listed with their programmed values. A control S (^S) will stop the scrolling and a control Q (^Q) will start it again.

### PROGRAMMING SYSTEM INFORMATION

Pressing "S" followed by RETURN from the top menu, displays the System Menu (Figure 6). From this menu, 13 system-related programming options are available as discussed below.

SYSTEM MENU	
C. COR	A. ACCESS
H. DISPATCH	P. PAGING
I. STATION ID	D. AUTODIALS
V. TOLL RESTRICT	T. TELCO CONTROL
1. LINE 1	2. LINE 2
L. LOCAL PHONE	S. SIMPLEX
M. MISCELLANEOUS	
Please select:	

FIGURE 6: System Programming Menu

#### COR Programming

Pressing "C" followed by RETURN from the System Programming Menu will display seven variables which affect COR operation (Figure 7). Press the letter (P, H, Q, M, A, V, or B) of the variable to change, or press P to step through all settings. Enter the desired value noting the required units and press RETURN to implement the change. Each variable is described in detail below.

COR MENU

P. Polarity active high = No  
H. Hold time (\*100ms) = 2  
Q. Quiet time (\*100ms) = 30  
M. Mob Tx-to-Rx time (\*100ms) = 2  
A. Mob act time (\*sec) = 30  
V. COR validation active high = Yes  
B. Channel busy active high = No

Please select:

FIGURE 7: COR programming information

**POLARITY**--this variable determines whether the COR input to the Model 45 is active on a high or low signal (threshold adjustable from 0 to 4V DC in hardware). Enter an "N" for an active low COR signal or a "Y" for an active high COR signal.

**HOLD TIME**--the hold time determines how long the COR signal must be inactive before the Model 45 is sure that the mobile is not transmitting. This time eliminates "picket-fencing" with mobiles. Enter the value for COR hold time from 0 to 50. This value is then multiplied by 100 milliseconds to obtain the actual COR hold time.

**QUIET TIME**--the quiet time is the amount of time the radio channel must remain quiet (no COR) before the Model 45 issues ring-outs over the air on a phone to mobile call. Note that this time delay is not used on a mobile to mobile call.

**MOBILE TX-TO-RX**--this is the amount of time the mobile requires to change from transmit to receive mode. After this time expires the courtesy tones, if enabled, will be issued. Note that the mobile's audio is muted during this time. If the mobile is set up as full-duplex this timer has no effect, the phone to mobile audio is never muted. When operating in the simplex mode, this timer value must be less than the VOX hold time in the simplex menu.

**MOBILE ACT TIME**--the mobile activity time determines how long a land-line may transmit without mobile intervention. The FCC regulations set this time at 30 seconds for Part 90 operation. The transmitter is automatically dropped if this time expires. Warning beeps are issued at 12, 9, 6 and 3 seconds before the transmitter is dropped.

**COR VALIDATION**--the unit is provided with an auxiliary "sense" line input (SENSE1) to allow the connection of an external validation signal (e.g. the output of a CTCSS tone decoder). If "N" is entered, an active low level signal is required for the unit to validate the COR input. Alternately, if a "Y" is entered, an active high level is required to validate COR. Note that the COR validation input is always pulled high internal to the Model 45. So if COR Validation is not being used set it to active high and leave the input open. If needed JP13 puts a 1K-ohm pull-up to +5V on this line.

CHANNEL BUSY--the unit is also provided with an auxiliary channel busy input (SENSE 2) for use with a monitor receiver. If "N" is entered, the input must go high for the programmed quiet time (described above) before the unit will ring-out on the channel (active low channel busy). Alternatively, a "Y" indicates active high channel busy on the input. Note that the channel busy input is pulled high internal to the Model 45. So if the channel busy input is not being used set it to active low and leave the input open. If needed JP14 puts a 1K ohm pull-up to +5V on this line. Caution: if the COR LED is flashing, this input is active and access from a mobile will be impossible.

### Access Programming

Pressing "A" followed by RETURN from the System Programming Menu will display eight access oriented variables (Figure 8) as discussed below.

```

ACCESS MENU

S. Sign-on mode = 0
1. User 1 short sign-on = Yes
D. DTMF timeout (*100ms) = 50
R. Min. regenerated digits = 7
U. Phone-to-mobile use ANI = No
M. Mobile-to-mobile use ANI = No
P. #+ANI to disconnect = Yes
A. Direct page ANI (chars) = *2
C. Dial click decode mode = 0
N. Enable wild ANI = No

Please select:

```

FIGURE 8: Access programming information

SIGN-ON MODE--selects Zetron (0), RCC style (1), or RCC style 2 (2) sign-on modes, with steering digits and formats as follows:

Zetron (0): "\*" + Access Code = default phone line access  
 "0" + Access Code = repeater access  
 "1" + Access Code = mobile-to-mobile access  
 "2" + Access Code = alternate phone line access

RCC 1 (1): Access Code + "9" = default phone line access  
 Access Code + "5" = repeater access  
 Access Code + "7" = mobile-to-mobile access  
 Access Code + "8" = alternate phone line access

RCC 2 (2): "\*" + Access Code + "9" = default phone line access  
 "\*" + Access Code + "5" = repeater access  
 "\*" + Access Code + "7" = mobile-to-mobile access  
 "\*" + Access Code + "8" = alternate phone line access

USER 1 SHORT SIGN-ON--"Yes" allows mobiles to sign on as user 1 using a long (0.8 sec) single digit. The Zetron style sign-on steering digits ("\*", "0", "1", "2") are used regardless of the sign-on mode selected.

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**DTMF TIMEOUT**--this is the maximum amount of time the Z-Patch waits between DTMF digits from the mobile, when dialing a phone number, before dropping out of digit regeneration. A DTMF "\*" from the mobile will also cause the unit to drop out of regeneration, see also minimum regenerated digits. This timer does not affect sign-on, it is a fixed 2 seconds between digits.

**MINIMUM REGENERATED DIGITS**--this is the minimum number of digits the Model 45 accepts from a dialing half-duplex mobile before deciding that dial-in is complete. The minimum number of regenerated digits is not used as a toll restrict, but is an indication that regeneration should be terminated and the mobile's audio should be passed to the phone line. Regeneration will, however, not cease until the mobile unkeys, the DTMF time-out occurs or the mobile keys a DTMF "\*". Note that a full-duplex mobile has to key the DTMF "\*" or time-out, since he does not normally unkey.

**TELCO USE ANI**--if 'yes', a landline caller must enter the called mobile's ANI code rather than user number before ring-outs are issued.

**MOB-MOB USE ANI**--if 'yes', a mobile caller must enter the called mobile's ANI code rather than the user number before ring-outs.

**#+ANI to DISCONNECT**--This question only applies when a user is not allowed to disconnect a call with just a "#" (# to disconnect = No, in user programming). If "#" to disconnect is set to no for the user and #+ANI to Disconnect is set to yes, the mobile is required to enter "#" + ANI code to disconnect a call. If #+ANI to disconnect is set to no the user must enter ANI code to disconnect. If the user is set up with # to disconnect, user programming, this question does not affect sign-off. See user programming for more disconnecting information.

**DIRECT PAGE ANI (option)**--enter an up to 8-digit code. If this code is entered by a calling telco party, they may then enter a GE-MARC page code. See GE-MARC discussion in the Options Section. Caution: for this option to work properly user 1 must be programmed as a two-way mobile with the GE-MARC paging format. The first three digits of this code cannot be in the range of 001 to 325.

**DIAL CLICK DECODE MODE**--Dial click may be enabled by setting this question to a 1 or 2. If dial click is not being used, set this question to '0'. In mode one the Model 45 decodes clicks from the phone line using timing from a standard phone, or the value of the timing in nonvolatile memory. See the installation section. If this does not work, mode 2 will require a leading '0' to calibrate the software. Mode 2 only requires the leading '0' from the dial pulse phones, the DTMF phones just enter the access code. Mode 3 is for use with an external dial click decoder. When mode 3 is used the normal dial click functions of the Model 45 will be disabled and the pause before disconnect or auto call is extended to 15 seconds. The external decoder is enabled with the output at J1 pin 21 after the beep or after dial tone drops. When mode '0' is selected the nonvolatile memory is initialized to the timing of a standard phone.



**Dispatch Programming (option)**

Pressing "H" followed by RETURN from the System Programming Menu will display four dispatch oriented variables (Figure 9), discussed below.

<p>DISPATCH MENU</p> <p>H. Hold time (*100ms) = 30 T. Timeout (*min) = 3 A. ANI for dispatch = Yes C. Courtesy tone = Yes R. Repeat audio = No</p> <p>Please select:</p>
--

FIGURE 9: Dispatch programming information

**HOLD TIME**--the amount of time the unit will keep the transmitter keyed after the mobile unkeys. Note that on a mobile to mobile call the hold time is forced to 25 seconds.

**TIMEOUT**--the maximum amount of time the repeater may remain in transmit mode.

**ANI FOR DISPATCH**--if 'yes', a mobile must enter their ANI code with the proper steering digit to gain repeater access. If 'no', simply keying up will key up the repeater (dispatch mode).

**COURTESY TONE**--if 'yes', a courtesy tone is issued when a mobile unkeys if ANI for dispatch is 'no'. If ANI for dispatch is 'yes', the courtesy tone setting for the originating user is used.

**REPEAT AUDIO**--if 'yes', the Model 45 will repeat the audio during a mobile-to-mobile call and continue to repeat the audio for the duration of the call. This is used if the operator of the system wants to keep track of the time for all mobile-to-mobile calls. If Repeat Audio is set to 'no', the M45 will page the mobile being called and ring out until the called mobile answers. After the mobile answers, the M45 will drop out of the call allowing the repeater to repeat the audio. Mobile-to-phone and phone-to-mobile calls are not affected by this question.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

### Paging Programming

Pressing "P" followed by RETURN from the System Programming Menu will display five paging oriented variables (Figure 10). Each variable is discussed in detail below.

<p>PAGING MENU</p> <p>D. Keyup delay (*25ms) = 40</p> <p>1. DTMF timing #1 (*25ms) = 3</p> <p>2. DTMF timing #2 (*25ms) = 8</p> <p>R. RTX enable = No</p> <p>T. Talk time (*sec) = 5</p> <p>G. Number of GMarc channels = 4</p> <p>Please select:</p>
---

FIGURE 10: Paging information programming

**KEYUP DELAY**--the delay the unit inserts between the time it keys up the transmitter and issues the paging tones. Note that the CTCSS tones come up at the same time the transmitter is keyed.

**DTMF TIMING**--two variables for setting the timing of DTMF digits for DTMF paging. One of these two variables is selected in a user's page format programming. This timing sets the digit on time and the interdigit timing.

**RTX ENABLE**--if 'yes', the Model 45 will send a collect tone (DTMF D) for 2.5 seconds prior to sending the DTMF page. This collect tone is used by the RTX compatible mobile decoders to lock onto the channel while scanning and wait for the page. This will also change the hangup tones sent by the Model 45 from the beeps to a DTMF A. This hangup tone is used to mute the RTX compatible decoder board after a call has been completed. (This format is only used with the DTMF option.)

**TALK TIME**--the maximum amount of time allowed for voice messages during tone-and-voice paging. If the phone party is silent for twice the VOX hold time (in the simplex menu), the talk time is prematurely terminated and the call is ended.

**NUMBER OF GMARC CHANNELS (option)**--enter the number of channels being used in the GMarc system that the unit is installed with. This number determines the timing of the collect tone, first tone sent, in 2/4 tone paging. The collect tone equals the number of channels X 90ms + 90ms.

### Station ID Programming

Pressing "I" followed by RETURN from the System Programming Menu will display three station ID oriented variables (Figure 11), discussed below. The station ID frequency is fixed at 1200Hz.

STATION ID MENU
M. Mode = 0
I. Interval (*min) = 15
S. Call sign (chrs) =
Please select:

FIGURE 11: Station ID information programming

MODE--determines how the Station ID will be broadcast.

- 0= Not broadcast.
- 1= Broadcast at end of call if ID interval has expired.
- 2= Broadcast at expiration of ID interval and quiet channel. If the interval expires during a call, the ID is broadcast at call's end.
- 3= Broadcast when channel is quiet, after ID interval and channel activity.

INTERVAL--the amount of time between broadcasts of the station ID.

CALL SIGN--the ID which is broadcast in Morse code. Up to 10 alphanumeric digits may be entered.

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### Auto-Dial Programming

Pressing "D" followed by RETURN from the System Programming Menu will display the nine auto-dial numbers (Figure 12).

AUTODIAL MENU	
1.	(chrs) =
2.	(chrs) =
3.	(chrs) =
4.	(chrs) =
5.	(chrs) =
6.	(chrs) =
7.	(chrs) =
8.	(chrs) =
9.	(chrs) =
Please select:	

FIGURE 12: Auto-dial information programming

AUTO-DIAL NUMBERS--nine numbers of up to 16 digits may be entered for each auto-dial. A "D" between two digits will cause a 5-second delay in dialing between those two digits unless the VOX is active for 2 seconds. Caution: the numbers cannot contain any spaces or characters other than D between digits.

### Toll Restrict Programming

Pressing "V" followed by RETURN from the System Programming Menu will display six toll restrict oriented variables (Figure 13). Each variable is discussed in detail below.

TOLL RESTRICT MENU	
1.	Max toll digits 1 = 15
2.	1st digit restrict 1 (chrs) =
3.	2nd digit restrict 1 (chrs) =
4.	Max toll digits 2 = 15
5.	1st digit restrict 2 (chrs) =
6.	2nd digit restrict 2 (chrs) =
Please select:	

FIGURE 13: Toll Restrict information programming

MAX TOLL DIGITS--these variables contain the maximum number of digits a mobile may dial for a phone number. Two variables are provided for greater flexibility. Each user's programming selects no toll restricts or one of these sets, 1 or 2. Note that Max Toll Digits and 1st and 2nd digit restrict are selected together.

**DIGIT RESTRICT**--Two sets of digit restrictions are allowed; each set allows selection of up to four first digits to restrict and selection of up to four second digits to restrict. Entering a space will clear any previously entered digits. Each user's programming selects no toll restriction, restriction set 1, or restriction set 2. Note that when selecting digit restrict 1 or 2 that this also selects max. toll digits 1 or 2. The numbers 911, 1-800-nnn-nnnn, and the auto-dial numbers are never restricted, but the last number redial is toll restricted. Also, if Toll Mode 2 is selected in the user programming, the numbers 411 and 555 are restricted all the time. When entering the digits they must be entered without any spaces or other characters between them. If less than 4 digits are entered during dialing, the call will be restricted when the DTMF timeout expires.

### **Telco Control Programming**

Pressing "T" followed by RETURN from the System Programming Menu displays eight telco control oriented variables (Figure 14), discussed below.

<p><b>TELCO CONTROL MENU</b></p> <ol style="list-style-type: none"> <li>1. Call limit timer-1 (*min) = 3</li> <li>2. Call limit timer-2 (*min) = 15</li> <li>3. Channel ring-outs-1 = 5</li> <li>4. Channel ring-outs-2 = 5</li> <li>0. Delay before dialout (*100ms) = 20</li> <li>D. Disconnect on 2nd DialTone = Yes</li> <li>M. Dialout mode = 0</li> <li>V. Override dispatch = No</li> <li>B. Broken ring for busy = No</li> <li>P. Hookflash PTT count = 0</li> <li>R. Regenerate DTMF after PTT hookflash = No</li> </ol> <p>Please select:</p>
---

FIGURE 14: Telco control information programming

**CALL LIMIT TIMER**--these two variables restrict the maximum length of a call. Each user's programming selects no time-out or one of these two limits. This timer affects phone to mobile and mobile to phone. This timer will also limit the time of a mobile to mobile call if the repeat audio option is installed. This timer will limit repeater time if the repeat audio option is installed and ANI for dispatch is yes.

**CHANNEL RING-OUTS**--these variables control how many AIR ring-outs are issued for an incoming landline call. Each user's programming selects one limit.

**DELAY BEFORE DIAL-OUT**--minimum time between phone line off-hook and start of dial, if the mobile does not unkey after entering the access code. This value must be greater than the amount of time it takes for the telephone company to issue dial tone after coming off-hook.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

DISCONNECT ON 2ND DIAL TONE--if 'yes', the Z-Patch disconnects a call after 2 seconds of dial tone returned after the unit has dropped out of DTMF regeneration (2nd dial tone) or 5 busy signal cycles (after dialing phone no.). Note that this function is not intended to be used for toll restriction.

DIAL-OUT MODE--this variable determines how the Model 45 dials a mobile originated call's phone number during regeneration.

0= slow DTMF (5 digits/sec)    2= slow Pulse (10 pulses/sec)  
1= fast DTMF (10 digits/sec)    3= fast Pulse (14 pulses/sec)

OVERRIDE DISPATCH--if 'yes', incoming calls from any phone line will issue a warning tone over the air if the channel is busy, then it will key the transmitter and call out to the user. This overrides the quiet timer. Note that you should disable the repeat audio in your repeater when the Model 45 keys the transmitter, if you have the repeat audio option in the Model 45 the audio will be muted by the Model 45.

BROKEN RING FOR BUSY--if 'no', the Model 45 will send a true busy signal to the phone party when a busy channel is detected after the phone party has overdialed the correct user number. If this question is 'yes' the Model 45 will send the usual broken ringing at this time.

HOOKFLASH PTT COUNT--this is the number of PTT's that must occur for the Model 45 to do a hookflash. A '0' entered here enables the DTMF hookflash mode. In DTMF mode, if the mobile enters a DTMF digit '1', the Model 45 will do a hookflash and go back to the regeneration mode. This allows the mobile to dial a number after the hookflash. If the mobile enters a DTMF digit '2', the Model 45 will do the hookflash and return to the conversation mode. This allows the mobile to answer a call-waiting call and begin talking after the hookflash. The minimum number of PTT's for a hookflash is 3 and the maximum number is 9. If you try to program a 1 or 2 here, the Model 45 will convert it to a 3. The timing for a PTT hookflash is critical. The PTT cannot be held for more than one second and cannot be released for more than one second to accomplish the hookflash.

REGENERATE DTMF AFTER PTT HOOKFLASH--if 'yes', the Model 45 will go back to the regeneration mode after the PTT hookflash. A 'no' here will return the mobile to the conversation mode after the hookflash. You will need to decide which mode is best suited for your application if you are using the PTT hookflash. This question is not used for a DTMF hookflash.

**Line 1 and 2 Programming**

Line 1 and 2 programming are identical except that line 2 has an override mode; only line 2 is discussed. Pressing "2" (1) followed by RETURN from the System Programming Menu will display five line 2 ( four line 1) oriented variables (Figure 15), discussed below.

```

LINE 2 MENU

A. Rings until answer = 1
D. Channel busy rings = 6
M. Answer Mode = 0
U. Auto call user = 1
P. Priority override = No    (line 2 menu only)

Please select:

```

FIGURE 15: Line 2 (1) information programming

**RINGS UNTIL ANSWER**--this variable determines the number of rings the Model 45 must receive from a land-line before it determines that a call on that line needs to be processed. Caution: Rings until answer must be less than channel busy rings.

**CHANNEL BUSY RINGS**--this variable determines the number of rings that may occur before the Z-Patch disconnects when the channel is busy. The calling party hears broken rings. If the channel becomes free before channel busy rings occur then channel ring-outs will occur. On an idle channel if channel busy rings is greater than channel ring-outs then the phone will hear channel busy number of rings while the channel will still only get channel ring-outs. Caution: The caller will only hear channel busy rings, since this variable includes the rings until answer, if the channel is busy.

**ANSWER MODE**--this variable determines one of three Telco answer modes.

0= Answer/beep/Ring-out

Line is answered with a 400ms beep 750ms after Rings-Until-Answer, the Model 45 will then wait for the caller to enter a user number (or ANI), if the code is valid ring-outs will be sent out over the channel if the channel is clear. If the caller does not enter a number before the line times out, the Model 45 will disconnect if the auto call user number is '0', or the auto call user is disabled. If the auto call user number is not '0' then it will ring-out on the channel as above. If the channel is clear, the calling party will hear normal ringing. If the channel is in use, the calling party will hear broken ringing and the line will be disconnected after channel busy rings occur. If the channel is clear and if a mobile does not answer, the call is disconnected after channel ring-outs, if channel busy rings is less than channel ring-outs. If channel busy rings is greater than channel ring-outs the channel will receive channel ring-outs and the phone will receive channel busy rings. The minimum number of channel ring-outs and rings to the phone will be channel ring-outs if the channel is idle.

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### 1= Answer/Dialtone/Ring-out

The line is answered after Rings-Until-Answer and a two-second dial tone is issued. During or within 5 seconds after the dial tone drops, the calling party may enter a valid user number (or ANI code if telco-use-ANI is required). When the access code is verified, the call proceeds as if in ANSWER/BEEP/RING-OUT mode above. If an invalid user number or code is entered, the call is disconnected. If a code or user number is not entered and the auto call user number is '0' then the call will be disconnected. If the auto call user number is not '0' then that user will be called if not disabled.

### 2= No-Answer/Ring-out

A call and ring-outs are issued over the channel after Rings-Until-Answer occur to the auto call user. The phone line is not taken off-hook until a mobile answers. If a mobile does not answer before channel busy rings, or channel ring-outs expire, the line is answered briefly to disconnect the call.

AUTO CALL USER--allows a user number to be the default recipient of an incoming call. If set to '0' the call will disconnect after the line time out. If set to a valid user then the auto call will occur after the line times out, if the caller does not enter a number.

PRIORITY OVERRIDE--if 'yes', an incoming call on line 2 will issue a warning tone and cancel any operations currently in progress. This allows the new call on line 2 to be processed. This item only applies and is only displayed in the line 2 menu.

### Local Phone Programming

Pressing "L" followed by RETURN from the System Programming Menu will display three local phone oriented variables. These variables are identical to the last three variables for line 1 programming. The only difference is that the local phone is limited to answer modes 0 and 1.



**Simplex Programming**

Pressing "S" followed by RETURN from the System Programming Menu will display eight simplex oriented variables (Figure 16). Each variable is discussed in detail below. Variables indicated with (\*) are only used in simplex systems.

<p><b>SIMPLEX MENU</b></p> <p>X. Simplex operation = No</p> <p>V. VOX hold time (*100ms) = 7</p> <p>D. Dial tone sample rate (*100ms) = 10</p> <p>S. Dial tone sample width (*100ms) = 1</p> <p>I. Into sample time (*100ms) = 50</p> <p>R. Sample rate (*100ms) = 20</p> <p>W. Sample width (*10ms) = 1</p> <p>T. Tx-To-Rx time (*10ms) = 3</p> <p>Please select:</p>
--

FIGURE 16: Simplex information programming

**SIMPLEX OPERATION**--this variable indicates whether the Z-Patch is operating on a simplex base or on a full-duplex base, or repeater. If answered yes the Z-Patch will operate in the simplex mode.

**VOX HOLD TIME**--the time between a gap in the telephone VOX signal and the Model 45's determination that the phone party is no longer talking. This time should be longer than inter-syllable gaps but short enough to allow normal conversation turn-around. When calling a tone-and-voice pager, the talk time will be prematurely terminated if the phone party is silent for twice the hold time, simplex or full-duplex. If using a VOX delay board, be sure to set the VOX hold time greater than the VOX delay to avoid premature transmitter drop. When operating simplex, this value must be greater than the mobile tx-to-rx time in the COR menu.

**DIAL TONE SAMPLE RATE (\*)**--this time is how long the Z-Patch samples or allows phone audio to go out the transmitter during DTMF regeneration. Dial tone sampling only occurs when the mobile is not keyed and the VOX is active (dial tone present).

**DIAL TONE SAMPLE WIDTH (\*)**--this is the amount of time the Model 45 looks for mobile activity during a single sample. The amount of time the transmitter is dropped is equal to the sample width plus the tx-to-rx time. Once COR becomes valid the unit will not start sampling again until COR drops and VOX is active. Sampling only occurs when the mobile is not keyed and the VOX is active. Once DTMF regeneration is complete dial tone sampling is no longer used. If this value is set to the maximum, dial tone will only be heard once for the dial tone sample rate time.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

INTO SAMPLE TIME (\*)--this is the amount of time the telephone VOX detector must be continuously active, no COR activity, before the Z-Patch will drop out of VOX simplex and begin simplex sampling. If this value is set to 255 the unit will never go into sampling. Once COR is seen or the VOX becomes idle the unit will drop back into VOX simplex operation.

SAMPLE RATE (\*)--the sample rate is how often, after the Z-Patch has started simplex sampling, the Z-Patch samples the mobile channel for COR, this is how long the phone audio is allowed to go out the transmitter when the VOX is active. Note that once COR becomes valid and drops the Z-Patch will go back into simplex VOX. If the VOX becomes inactive the Z-Patch will also revert back into simplex VOX.

SAMPLE WIDTH (\*)--this is the amount of time the transmitter is unkeyed and the channel is tested for COR activity. Simplex sampling only occurs if the VOX is continuously active for the into sample time and COR is not active. If the VOX goes idle or COR becomes active the Z-Patch reverts to VOX simplex.

TX-TO-RX TIME (\*)--this is the time delay between the Z-Patch dropping the transmitter and the start of sampling (testing for a valid COR signal). This delay should be slightly longer than the time needed to change the transmitter from transmit to receive. The Z-Patch will not consider the COR signal to be valid until this time has expired after dropping the transmitter.

### Miscellaneous Programming

Pressing "M" followed by RETURN from the System Programming Menu will display ten miscellaneous variables (Figure 17). Each variable is discussed in detail below.

#### MISCELLANEOUS MENU

D. Courtesy tone duration (\*25ms) = 3  
F. Courtesy tone frequency (\*10Hz) = 54  
A. Automatic gain (AGC) on = No  
H. High pass filter on = No  
S. CTCSS add-in = No  
R. ANI for system relays (chrs) = \*1  
1. User relay 1 mode = 0  
2. User relay 2 mode = 0  
B. Run modem at 300 baud = No  
I. Invert digital = No

Please select:

FIGURE 17: Miscellaneous information programming

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COURTESY TONE DURATION--this is the duration of the courtesy tones and warning tones to the phone and mobile.

COURTESY TONE FREQUENCY--this is the frequency of the courtesy tones and warning tones to the phone and mobile. This value does not affect the Morse ID, it is fixed at 1200Hz.

AUTOMATIC GAIN (AGC)--if 'yes', the incoming phone line audio will be routed through an automatic gain control (AGC) circuit to maintain a consistent volume level. The AGC is turned off when a full-duplex mobile access's the system, this is to prevent the mobiles own audio from feeding back at to high of a level.

HIGH PASS FILTER--if 'yes', the Rx audio routes through a high pass filter circuit which removes CTCSS (subaudible) tones from the audio.

CTCSS ADD-IN--if 'yes', the CTCSS tones will be summed in with the normal transmit audio, the CTCSS will also be at Pin 1 of J1. If 'no', the CTCSS tones are available only on J1, pin 1. Caution: You cannot use CTCSS add-in when encoding a digital code.

ANI for SYSTEM RELAYS--this access code is entered from either a mobile or telephone to allow changes to be made to the system relays. Note that when accessing the system relays from a mobile a valid steering digit must also be entered before or after the access code, depending upon the sign-on mode; e.g., if Zetron-style sign-on is in effect, and the relay access code is "\*1", a "\*\*\*1" must be entered. The first three digits of this code can't be in the range of 001 to 325. ("System Relay 1" is Control Relay 1, and "System Relay 2" is Control Relay 2.). After the prompt, enter a '0' to turn the relay off, a '1' to turn the relay on, or a '2' to not change the relay. Two digits must be entered.

USER RELAY MODES--selects the corresponding user relays operation:

- 0 = ON at mobile originate, OFF at disconnect
  - 1 = ON at mobile answer, OFF at disconnect
  - 2 = ON at telco access, OFF at mobile answer
  - 3 = ON at telco access, OFF at disconnect
  - 4 = ON at telco access or mobile originate, OFF at disconnect
- ("User Relay 1" is Control Relay 3, and "User Relay 2" is Control Relay 4.)

RUN MODEM at 300 BAUD--this menu item will only appear if the 300/1200-baud modem option is installed. If set to yes the modem will operate at 300 baud, if set to no the modem will operate at 1200 baud.

INVERT DIGITAL--If set to 'yes' the digital encode output will be inverted. See the appendix, Digital Squelch codes, for more information.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

### PROGRAMMING USER INFORMATION

Pressing "U" followed by RETURN from the Top Menu will display the User Programming Menu (Figure 18). This menu provides two methods for programming user information. The access and operation menus or common menus allow a group of user's access, telco and equipment variables to be entered and changed. The specific menu works with one user at a time to program information unique to each user. The individual user programming options are discussed below.

When entering user information, typing a comma increments the current user number by 1.

USERS MENU	
A. ACCESS	O. OPERATION
S. SPECIFIC	L. LIST
Please select:	

FIGURE 18: User programming menu

#### Access User Programming

Pressing "A" followed by RETURN from the User Programming Menu will display the User Access Menu (Figure 19). In all both common menus, the user range or user to be effected is displayed in parentheses just after the menu name. If a range is selected then the parameters of the user being displayed will be on the right side of the colon ":", (range:user). If the user number being displayed is not within the range then its parameters will not be changed. When a parameter is changed it only affects the users in the range.

USER ACCESS MENU(1)
U. User range = 1
E. User enabled = Yes
M. Mobile-to-phone = Yes
P. Phone-to-mobile = Yes
B. Mobile-to-mobile = Yes
T. Dispatch = Yes
C. COR to answer = No
S. * to answer = Yes
D. # to disconnect = No
F. Fast ANI required = No
L. Line select = No
2. Line 2 default = No
A. Autodial mode = 0
Please select:

FIGURE 19: User access menu

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

USER RANGE--this variable defines a single user or range of users to be affected by changes in the user common menus (access and operation). Enter a single user by typing U followed by the number of the user to select followed by RETURN. Enter a range of users by pressing U followed by the beginning user number, followed by a hyphen, followed by the ending user number and terminated with RETURN. For example, to enter a range of users one to 99, press U, enter 1-99 and press RETURN. When a range of users is selected, the range is displayed as f-l:c, where f= first user number, l= last user number and c= current user number, whose variables are displayed. The current user number may be outside the range, in which case, any changes made would not be reflected in the viewed data. Note that typing a comma will increment the current user number (c).

USER ENABLED--if 'yes', this user may access the Model 45 or receive calls through the Model 45 as allowed below.

MOBILE-TO-PHONE--if 'yes', this user may make mobile originated phone calls.

PHONE-TO-MOBILE--if 'yes', this user may receive calls from the landline.

MOBILE-TO-MOBILE--if 'yes', this user may place a call from his mobile to another mobile.

DISPATCH (option)--if 'yes', this user may access the repeater when ANI for dispatch is required (system programming).

COR-to-ANSWER--if 'yes', an incoming call to this user will be answered by a mobile keying up, any valid COR signal, this answer mode overrides "\*" to Answer.

\*-to-ANSWER--if 'yes', the user may answer incoming calls by simply pressing a long DTMF "\*". Note that if COR to answer is set to yes this question has no affect on the way the mobile answers. If 'no' the user must answer with their ANI code. When using Zetron sign-on the user enters \*+ANI to answer, with RCC mode 1 the user enters their ANI+\*, and with RCC mode 2 the user must enter \*+ANI+\*. Note that the trailing '\*' can be any digit.

#-to-DISCONNECT--if 'yes', the user may disconnect a call by simply pressing a 125ms DTMF "#". If 'no', the user must enter their ANI code to disconnect. If #+ANI to disconnect is enabled, in system programming, and # to disconnect is set to no, then the user disconnects with a "#" followed by their ANI code. (see #+ANI to disconnect in System access programming).

FAST ANI REQUIRED--if 'yes', the mobile must enter their ANI code to access, answer or disconnect at a minimum rate of 5 digits per second. This item does not affect access from the telephone.

LINE SELECT--if 'yes', user may determine which phone line to use for outgoing calls. If 'no', all outgoing calls are made on user's default line (see below). Line selection is controlled by sign-on mode.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

LINE 2 DEFAULT--if 'yes', the user's default line is switched to line 2 rather than line 1. (e.g. a "\*" ZETRON sign-on places the call on line 2 and a "2" places a call on line 1). Note that the connect button will connect to the default line for user 1.

AUTO-DIAL MODE--this variable selects the user's access to the nine auto-dial numbers, normal dialing and last number redial. The four auto-dial modes are shown below. With mode '0' the user can only dial numbers manually. With modes '1-9', when the user accesses the system the number they are assigned to is automatically dialed. With mode '14' the user can access all of the auto-dial numbers, can do manual dialing and can do a last number redial. With mode '14' the auto dials are accessed by entering a '\*' then a digit from 1 to 9, for the number they want auto-dialed, or a 0 for last number redial, after they receive dial tone. With mode '15' the user can only access the auto-dial numbers, they cannot do any manual dialing. Access is done by just entering the auto-dial number after they receive dial tone.

Caution: the auto-dial numbers are not toll restricted, but last number redial is.

- 0 = Autodial access and last number redial is not allowed.
- 1-9= Forced automatic dialing of the indicated auto-dial number upon mobile access.
- 14= Access to all auto-dial numbers, normal dialing and last number redial.
- 15= Access to all auto-dial numbers only (normal dialing not allowed).

**User Operation Programming**

Pressing "0" followed by RETURN from the User Programming Menu will display the User Operation Menu (Figure 20). The user range and user enabled items in this menu are identical to that of the User Access Menu and are not discussed in detail here. All other User Operation Menu items are discussed in detail below.

```

USER OPERATION MENU(1)

U. User range = 1
E. User enabled = Yes
Q. Equipment type = 0
N. Number of ring-outs mode = 1
S. Ring-out style = 0
O. Courtesy tone = Yes
X. Full-duplex mobile = No
P. Privacy = No
M. Call timer mode = 1
T. Toll mode = 0
D. DTMF thru = No
F. Page format = 0
C. CTCSS/Digital drop mode = 0
1. Enable relay 1 = No
2. Enable relay 2 = No
H. Enable hookflash = No

Please select:

```

FIGURE 20: User operation menu

EQUIPMENT TYPE--this variable determines the type of equipment this user will be using to receive calls. The choices of equipment type are described below.

- |                       |                            |
|-----------------------|----------------------------|
| 0 = Mobile.           | 3 = Tone-only pager.       |
| 1 = Talk-back pager.  | 4 = Direct channel access. |
| 2 = Tone+Voice pager. |                            |

Equipment type 4 will dump the caller on air, if the channel is idle, after issuing a beep.

Note that if any equipment type other than mobile is selected, the mobile-to-phone privilege is automatically set to "no". If desired, it must be re-enabled. This item only affects how the unit is called from a mobile or the phone line.

NUMBER of RING-OUTS MODE--this variable determines which of the two system variables, channel ring-outs-1 or channel ring-outs-2, will be assigned to a user. The channel ring-outs determine the number of ring-outs that will occur on the channel before the transmitter is dropped.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

RING-OUT STYLE--this variable provides one of seven different and distinctive ring-out styles for a mobile. Each style is described below.

- |                          |                         |
|--------------------------|-------------------------|
| 0 = Normal ring.         | 4 = Singer type ring.   |
| 1 = Double ring.         | 5 = Warbler type ring.  |
| 2 = Triple ring.         | 6 = Normal ringing.     |
| 3 = Ding-Dong type ring. | 7 = Repeat pager tones. |

Note that if the user is not setup with a paging format and code that normal rings will occur if repeat pager tones is selected.

COURTESY TONE--if 'yes', a tone will be issued to the phone line when the mobile unkeys. If ANI for dispatch (option) is required, a courtesy tone will also be issued out the transmitter when a mobile unkeys. The courtesy tone is sent after the COR hold time plus the tx-to-rx time. (see dispatch menu in system programming).

FULL-DUPLEX MOBILE--if 'yes' this user operates as a full-duplex mobile. The COR signal is not used to mute the TX audio, therefore the phone party will never get courtesy tones, privacy tones and the mobile tx-to-rx timer will not apply. The phone AGC is also turned off. Note that on a half-duplex mobile the TX audio is muted when COR is active and during the COR hold time plus the mobile tx-to-rx time.

PRIVACY--if 'yes', a fast busy signal is sent out the transmitter when the mobile is keyed-up. Privacy is only used on half-duplex mobiles, if the mobile is setup for full-duplex, above, the privacy tone is disabled.

CALL TIMER MODE--this variable selects one of the two call timers for the user. A zero applies no time restriction to the user, a one selects call timer 1 and a two selects call timer 2.

TOLL MODE--this variable assigns one of the two toll restrict digit and number length sets to a user. A zero applies no toll restricts, a one selects toll restrict digit/length set 1 and a two uses set 2.

DTMF THRU--if 'yes', the mobile may DTMF dial directly to the phone line after the Model 45 stops regenerating DTMF. If 'no', extra DTMF digits are inserted after any mobile DTMF digits are entered preventing useful number dialing. Caution: if DTMF thru is allowed a mobile can dial a toll restricted number if dial tone is returned after the called party disconnects the call.

PAGE FORMAT (option)--the user's paging format, chosen from the list below. The given paging option must also be installed.

- |                              |                           |
|------------------------------|---------------------------|
| 0 = No paging for this user. | 4 = Two-tone paging.      |
| 1 = DTMF paging timing 1.    | 5 = Five/six-tone paging. |
| 2 = DTMF paging timing 2.    | 6 = GMarc paging.         |
| 3 = 2805 paging.             |                           |



## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

CTCSS/DIGITAL DROP MODE (option)--if set to '0' the subaudible tone (CTCSS) or digital code will be transmitted for the duration of the call. If mode '1' is selected the tone/code is dropped after the paging tones are sent, or after the first ring-out if the user is not set up with paging tones, in mobile ring-out. If set to mode '2' the tone/code is dropped after the mobile answers the call. If mode '1' or mode '2' are selected the tone/code will not be sent out when the mobile signs on to the system.

ENABLE RELAY 1/2--controls whether the two user relays, 1 or 2, are enabled for use as setup in system programming. If yes the relay(s) will operate per the mode selected, if no the relay(s) will not operate. See system programming for operation modes. User relay 1 is K5 and the N/O contacts come out on J2 pins 1 & 15, user relay 2 is K7 and the N/O contacts come out on J2 pins 2 & 14.

ENABLE HOOKFLASH-- if 'yes', this user may do a hookflash as described in the System Telco Menu.

### User Specific Programming

Pressing "S" from the User Programming Menu will display the User Specific Menu (Figure 21). The current user is displayed in parentheses after the menu name, this is the user that is being programmed. The current users parameters are displayed and are changed when an item in this menu is changed. This is the same user number as the current user in the user common (access and operation) menus.

Note that items changed on the user specific menu only affect one user, not a block of users as in the common menus.

If a comma is entered while in the user specific menu, the current user number is incremented by one. If a comma is entered after data, the data is entered and the current user number is incremented while staying on the same menu item.

#### USER SPECIFIC MENU(1)

U. Current user = 1  
E. User enabled = Yes  
A. ANI code (chrs) = D  
F. Page format = 0  
P. Page code (chrs) =  
C. Tx tone/code = 0

Please Select:

FIGURE 21: User specific menu

CURRENT USER--this variable selects the user that is affected by changes made by specific user programming. The current user is displayed in parentheses just after the menu name and is the same current user as in the common menus.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

USER ENABLED--if 'yes', this user may access the Model 45 (duplicated in the other user menus).

ANI--the ANI code for the user, from one to eight characters. When entering ANI codes if the Model 45 detects another ANI that is the same or a subset it will display "ANI conflict" and a new ANI will have to be entered. If you continue to have problems check all ANI codes with the user list command and list system. A space will reset the ANI back to a 'D'.

PAGE FORMAT (option)--same as page format in the user operation menu. CAUTION: When a different page format is entered, the page code is automatically cleared (below).

PAGE CODE (option)--the page code, if applicable, defines the DTMF or tone code that is sent over the air. Each code depends on the page format, as shown in the Options section.

TX TONE/CODE (option)--this variable specifies the subaudible (CTCSS) tone or the digital code for the user. The CTCSS tone is selected from 1 to 38, or zero for none. The digital code is selected from 1 to 104. To enter a digital code a 'D' must preset the number. See the Appendix Section for tone frequencies vs. tone numbers and the digital codes vs. numbers.

**User Lists**

Pressing "L" from the User Programming Menu will display user lists. First, press U and enter the range of users to list (i.e.1-20) and press RETURN. Finally, enter "Y" and RETURN to list the user's programming. First the user number will be displayed on the left, to the right will be the user programming, A - X, followed by the ANI for the user, the CTCSS tone, the paging format and finally the page code. A typical user list is shown in figure 22. To save space, the user programming information is displayed in a compact format of 24 characters. The programming associated with each character (labeled from A to X from the left) is given below. The user list may be paused is needed by entering a control S (^S). Once paused it may be started again by entering a control Q (^Q). If you wish to abort the display enter a control C (^C).

```

Model 45 (Station ID) 09/23/87 08:00:24
Usr      Programming      ANI      Tone  Type      Page
--- ABCDEFGHIJKLMNOPQRSTUVWXYZ -----
  1 nnYnn10nnn1nnnnYYYYY00>nn 001      0 *NONE*
** End of list **

```

Figure 22: User List

Definition of programming characters:

- |                      |                             |
|----------------------|-----------------------------|
| A. Privacy           | B. Enable user              |
| C. * to answer       | D. # to disconnect          |
| E. DTMF thru         | F. Number of ring-outs mode |
| G. Ring-out style    | H. CTCSS drop mode          |
| I. Fast ANI required | J. Full-duplex mobile       |
| K. Call timer mode   | L. Line 2 default           |
| M. Enable relay 1    | N. Enable relay 2           |
| O. COR to answer     | P. Mobile-to-phone          |
| Q. Phone-to-mobile   | R. Mobile-to-mobile         |
| S. Dispatch          | T. Courtesy tone            |
| U. Toll mode         | V. Equipment type           |
| W. Auto-dial mode    | X. Line select              |
| Y. Enable hookflash  |                             |

If a programming variable is enabled or allowed, a "Y" is printed, otherwise a "N" is printed. Variables with a range have a number printed. The auto-dial mode variables are displayed as follows: 0 is no access to auto-dials or last number redial; 1-9 is access only to the auto-dial specified, 1-9; ? is access only to the auto-dials 1-9; > is access to normal dial-out and all of the auto-dials. While the list is output, the following keyboard commands are available:

```

cntrl C - aborts list
cntrl S - pauses list
cntrl Q - restarts a paused list

```

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

### PROGRAMMING ACCOUNTING INFORMATION

Pressing "A" from the top menu will display nine SMDR variables and the number of SMDR records stored in the unit will be displayed in parentheses (Figure 23). This menu lets you control the storage and printing of airtime billing records as well as set the date and time of the Model 45's internal clock/calendar. If the internal buffer overflows then the message 'lost records', with the number of lost records will be displayed. If the number of records stored is less than 999 then you may have a memory problem and you should perform a memory test. See the test menu.

```
ACCOUNTING MENU (0 recs)

P. SMDR print mode = 0
I. Internal SMDR storage = Yes
M. Minimum call time (*sec) = 0
C. Set clock (mm/dd/yy hh:mm:ss) = 07/04/87 13:13:13
O. List SMDR storage = No
S. Clear SMDR storage = No
R. User range = 1
2. List accumulated = No
1. Clear accumulated = No

Please select:
```

FIGURE 23: Accounting menu

**SMDR PRINT MODE (option)**--this menu item determines whether the SMDR information is sent out the serial port at the end of each transaction, and the format of the output. Enter '1' to send the SMDR data to the serial port to be printer at the end of each call in the pretty print format, a '2' for the FP-10 format or '0' to suppress printing. This mode selection also affects the SMDR list below. See the options section for more information on the format.

**INTERNAL SMDR STORAGE (option)**--this menu item determines whether the SMDR information is internally stored at the end of each transaction. This is the same data that goes out the serial port. Enter 'Y' to store data at end of each call or 'N' to suppress internal storage.

**MINIMUM CALL TIME**--this is the minimum duration a call must reach before the call is printed or stored.

**SET CLOCK**--use this function to set the Model 45's internal clock and calendar. Enter the date and time as mm/dd/yy hh:mm:ss, including the slashes, spaces and colons. Use 24 hour time when entering the hours.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

LIST SMDR STORAGE--enter 'Y' to print all internally stored detailed (SMDR) billing records. While the list is output, the following keyboard commands are available:

cntrl C - aborts list  
cntrl S - pauses list  
cntrl Q - restarts a paused list

The output format is determined by the SMDR print mode. See options section for more information on the format.

CLEAR SMDR STORAGE--enter 'Y' to clear the internally stored detailed (SMDR) billing records (does not clear accumulated).

USER RANGE--enter the range of users (low-high) to be included in the listing or clearing of accumulated billing information.

LIST ACCUMULATED--enter a 'Y' to list the accumulated billing information for the users specified with the USER RANGE command. The maximum time is 18 hours and the maximum hit count is 999 per user.

CLEAR ACCUMULATED--enter a 'Y' to clear the accumulated billing information for the users specified with the USER RANGE command above (does not clear detailed).

### LISTING OPTIONS

Press 0 from the Top Menu to list the options installed in your Model 45.

### PROGRAMMING TEST MODES

Pressing "T" followed by RETURN from the Top Menu will display the Test Menu (Figure 24). Ten tests are displayed.

#### TEST MENU

A. Tone 1 frequency (\*10 Hz) = 54  
B. Tone 2 frequency (\*10 Hz) = 60  
1. Single tone (=Telco:1, Tx:2) = 0  
2. Dual tone (=Telco:1, Tx:2) = 0  
3. CTCSS/Digital encode = 0  
4. Emphasis (=Telco:1, Tx:2) = 0  
H. Hybrid adjust = No  
D. DTMF/Click detect (=Telco:1, RX:2) = 0  
C. COR detect = No  
K. Click calibrate = No  
S. Sense line states = No  
M. Memory = No

Please select:

FIGURE 24: Test menu

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

**TONE FREQUENCIES**--select A or B to enter the tones used for the single and dual tone tests. Tone 1 is used for the single tone test. Tones 1 and 2 are used for the dual tone test. A range of 200 to 2500 Hz may be entered for the test tones.

**SINGLE AND DUAL TONE TESTS**--select 1 or 2 for single or dual tone tests. Next, enter 1 to send the tones to the telephone or 2 to send the tones out the transmitter. Press any key to end the test. Telephone line test are not allowed when programming via modem.

**CTCSS/DIGITAL ENCODE TEST**--select 3 for the CTCSS (subaudible) tone or digital encode test. Enter the tone number 1-38, or Digital number D1-D104 to start the test. The CTCSS tone/Digital code is sent out the CTCSS output line (J1-1). If CTCSS add-in is set to yes (system misc. menu) the tone is also sent out the transmit audio output, pins 18 and 19 of J1. The tone/code is generated for 10 seconds, after which the test ends. Caution: You cannot use CTCSS add-in when encoding a digital code.

**EMPHASIS TESTS**--select 4 for the EMPHASIS test. This test outputs a sequence of three tones of increasing frequency. The frequencies are 312, 624 and 1246 Hz each lasting 1.1 seconds. The sequence is followed by 3 seconds of quiet, after which the sequence is repeated. Enter a 1 for telephone output, or a 2 for transmitter output. Press any key to stop test. Telephone line tests are not allowed when access is via modem.

**HYBRID ADJUST**--select H for the hybrid adjust test. This test offers a simple way of balancing the telephone hybrid circuit. This test issues a single tone (test frequency 1) out a telephone line and feeds received telephone audio to the transmitter. Press 1 to start the test. When the test begins, the ringing phone line is answered--if no lines are ringing, line 1 is answered. Have a friend call the patch and remain quiet. Start the test. Adjust the phone balance potentiometer (R98) for minimum deviation on the channel. Press any key to end the test. This test is not allowed when access is via modem.

**DTMF/CLICK DETECT TEST**--select D for DTMF tests. This test displays decoded DTMF from a mobile or phone and displays converted dial click digits from the phone. Enter a 1 to start the test from telco, 2 from the receiver. Note that clicks are only decoded from the telco. Press any key to end the test. If from telco, the test automatically answers the ringing phone line, or answers line 1 if neither of the lines are ringing. This test is not allowed when access is via modem. See the installation section for more information.

**COR DETECT TEST**--select C for the COR test. This test displays the COR state (OFF, HLD [hold], or ON). When COR is detected, the displayed state is ON. When COR goes away after being ON, the HLD state is displayed for the COR hold time. After the COR hold time, OFF is displayed. Press Y to start the test, press any key to end the test.

## SECTION 4 - PROGRAMMING WITH A CRT OR COMPUTER

CLICK CALIBRATE--select K for the dial click calibrate test. This displays the state of the dial click detection circuit. This test automatically answers the ringing phone line, or line 1 if neither line is ringing. Press Y to start the test, press any key to end the test. Have a friend call the patch. Start the test. Have the friend dial a sequence of 0's. Adjust the click sensitivity potentiometer (R170) so the state is ON for the duration of the 0 and does not flicker off (about mid-range). This test is not allowed when access is via modem. See the installation section for more information on setting up the click adjustments.

SENSE LINE STATES--Select S to display the current state of the sense line inputs. Entering a Y will display the state (HI for high, LO for low) of the four sense lines 1-4. Once the states are displayed the test is ended.

MEMORY TEST--Select "M" to do a memory test. When the test is complete, a message is displayed depending on the results of the test and the options installed. "OK" is displayed if all memory is good. "FAIL" is displayed if the system RAM (U58) is bad. If the SMDR internal storage option is installed "BAD:0", "BAD:1", "BAD:2", or "BAD:3" is displayed if one of four the SMDR memory banks is bad. "BAD:SMDR" is displayed if the entire SMDR memory board is bad or not installed. The Model 45 may still operate if defective memory is detected but the memory should be replaced as soon as possible or unpredictable operation may occur. This test may also be done via modem.

### SAVING THE DATABASE

Now that you have finished programming the system and user database you can now download the database to your computer if you have purchased the ZCOM software from Zetron. This function allows you to save what you have done and upload it to another terminal or upload it to the same device, if the database gets altered by a lightning storm or by a sever power disruption. The database in the Model 45 is backed up by an internal battery and will hold the programming through normal power outages. Caution: The accumulated air time is part of the user database, so when downloaded and re-uploaded the accumulated time will also be uploaded.





## **5. PROGRAMMING VIA DTMF**

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## INTRODUCTION

Although it is not suggested that major system or user programming be accomplished via DTMF, it is often useful to have such a feature. DTMF programming is adequate for fine tuning system parameters, enabling or disabling users or changing user parameters. DTMF programming may be done over-the-air from a mobile or from a DTMF telephone from line 1, line 2 or the local phone. Note: the baud rate may only be changed via DTMF.

Almost all programming functions available through menu programming are also available with DTMF programming. One exception is that only one user may be programmed at a time, rather than a range of users (current user).

## DTMF PROGRAMMING ACCESS OVER-THE-AIR

Since DTMF programming from a mobile uses the mobile channel, a method is incorporated to enter the programming mode, rather than to make a phone or mobile-to-mobile call. To enter the DTMF programming mode from a mobile, enter the programming access code rather than a user access code. An eight-note tone is sounded to verify the DTMF programming mode has been entered.

The exact method to enter into the programming mode depends on the sign-on mode. With Zetron sign-on it is \*+the access code, RCC mode 1 it is the access code+\*, and with RCC mode 2 it is \*+the access code+\*. Note that the trailing "\*" can be any digit.

## DTMF PROGRAMMING OVER A TELEPHONE LINE

As with entering the DTMF programming mode from a mobile, a method is required to enter the programming mode from a phone line. Enter the DTMF programming mode from a phone line by dialing the Model 45 phone number. When the Z-Patch answers the phone, enter the programming access code. An eight-note tone is sounded to verify the DTMF programming mode has been entered. If the unit has the modem option installed, 10 seconds of modem carrier will be issued first.

## ENTERING DTMF PROGRAMMING COMMANDS

All DTMF programming is accomplished by entering a programming function code, which selects one of the programming variables. All programming functions with corresponding DTMF function codes, menu paths, argument ranges and values are summarized on the programming reference sheet.

Once in DTMF programming mode, a function code is selected by entering the function code on the DTMF keypad followed by a DTMF "\*". Entry of a valid function code is acknowledged with two quick beep tones. Entry of an invalid function code is signaled by two bee-does.

After a valid function code is selected, enter the function argument (value) followed by a DTMF "#". Entry of a valid function argument is acknowledged with three quick beep tones. Entry of an invalid function argument is signaled by two bee-does.

## SECTION 5 - PROGRAMMING VIA DTMF

Functions that program digit sequences (e.g. access codes) are entered in a somewhat different manner. Enter the function code as normal. Next enter the LENGTH of the sequence to enter followed by a DTMF "#" -- three beeps are heard. Finally enter the string -- three beeps are heard after the correct number of digits have been entered.

### EXITING DTMF PROGRAMMING MODE

DTMF function code zero provides a method of exiting the programming mode. Exit DTMF programming by selecting function code 0 (enter 0\*). Select function argument zero - exit programming mode (enter 0#). A successful programming mode exit is acknowledged by sounding a series of two beep tones of three quick tones each. If the station ID mode is one or two, the station ID is sent after exiting the program mode.

### DTMF PROGRAMMING ERRORS

If a "bee-doo" is heard when a "\*" or "#" is entered at the end of a command string, then the command contained invalid data and no changes will have been made to the function parameter. A valid parameter is changed as soon as the "#" is entered NOT when the program mode is exited.

If an undesired function code is entered, pressing the "\*" twice will abort the command and allow a new function code to be selected. If an undesired parameter is entered, pressing "\*" instead of "#" will abort the command. If undesired but valid data are entered, the function must be reprogrammed with the desired data.

**DTMF PROGRAMMING EXAMPLES**

These examples assume the Model 45's phone number has been dialed and the Z-Patch has answered the phone line and is issuing dial tone. Refer to the programming reference sheet at the rear of the manual for the DTMF commands used below.

- 1) Access DTMF programming:  
(Assuming the factory default)

Enter "00098", Program mode access code  
(hear 8-tone signal, may have to wait for modem to drop).

- 2) Setting the Courtesy tone Frequency to 800 Hz:

Enter "15\*", Courtesy tone frequency function code.  
(hear two beeps)

Enter "80#", Courtesy tone frequency function argument.  
(hear three higher-pitched beeps)

- 3) Setting auto-dial number one to 6441300:

Enter "153\*", Auto-dial number on function code.  
(hear two beeps)

Enter "7#", Auto-dial number length.  
(the length -- hear three beeps)

Enter "6441300", the number.  
(hear three beeps)

- 4) Enabling user number 99:

Enter "30\*", User number function code.  
(hear two beeps)

Enter "99#", User number function argument.  
(select user 99 -- hear three beeps)

Enter "82\*", User enabled function code.  
(hear two beeps)

Enter "1#", User enabled function argument.  
(enable user 99 -- hear three beeps)

- 5) Exiting DTMF programming:

Enter "0\*", System function code.  
(hear two beeps)

Enter "0#", Exit programming function argument.  
(hear two-five beep sequences)

## SECTION 5 - PROGRAMMING VIA DTMF

### TESTS FROM DTMF PROGRAMMING

Tests are started by entering an argument of 1 or 2 (depends on test and desired output). The following tests are not available from DTMF: DTMF, COR, DIAL CLICK, and Sense line states.

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## INTRODUCTION

This section covers the options that may be installed in the Model 45. The available options are: paging tones, subaudible encode, repeat audio, extended users and billing. The options currently installed in a Model 45 are displayed by pressing '0' from the Top Menu in CRT programming. Installation of one or more of these options affect Model 45 operation and programming. Specifics of each option is discussed in detail below.

## PAGING OPTION

The Model 45 is capable of generating a variety of paging tones including two-tone, five/six-tone, GE GMarc, 2805, and DTMF. Installing any paging option will enable programming of paging variables such as page format and page code for each user. The use of each paging option is discussed below.

### Two-Tone Paging Option

The Z-Patch contains a table of all commonly encountered tones used in two-tone sequential paging. The call code which the Z-Patch requires for paging a given user is derived from the tables which are found in Appendix A4. A page code is created as a 5-digit number which is entered as the page code for each two-tone pager. A page code has the format:

PAGE-CODE: T G1 G2 T1 T2

The first digit of the page code is selected from the timing table in Appendix A4.1 and depends only on the actual type of two-tone encoding desired. This number is referred to as T.

The second through fifth digits must be selected from the tone-group table in Appendix A4.2 and are in the form: G1-G2-T1-T2, where G1 and T1 are numbers for Group-1 and Tone-1 respectively. Look up the specific frequencies that the pager requires in the table. Write down the column number in which the first frequency appears. This is G1. Look across at the row number on the left side of the row where your first frequency appears. This is T1. Now repeat the process for your second frequency. This second procedure yields G2 and T2. Write down the five-digit number in the order T, G1, G2, T1, T2.

EXAMPLE--given a Motorola tone-only pager, which requires 855.5 Hz as the first tone, and 313.0 as the second tone. The timing table of A4.1 gives a value of 2 for "Motorola Tone only" timing, therefore, T=2.

Looking up 855.5 Hz in the tone-group table of A4.2, we find it is listed in column 5, thus G1 is 5. 855.5 Hz is also in the row marked 8, therefore, T1 is 8.

Using a similar process with 313.0 Hz, we find that G2 (Mot 3) should be 3, and T2 is 4.

Now we have all the digits: T=2, G1=5, T1=8, G2=3, T2=4

## SECTION 6 - OPTIONS

Finally, write them down in the order: T G1 G2 T1 T2. For this example the pager code is 25384.

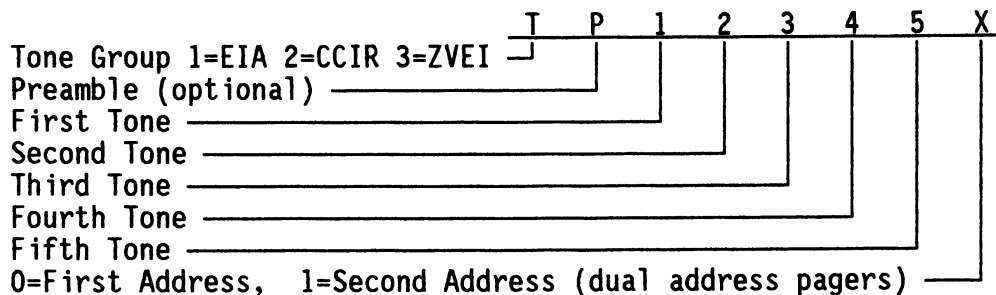
As a final double check, the last two digits of the actual cap-code on the pager should match the last two digits of the page code as entered into the Z-Patch (doesn't have to match user number).

NOTE ON "TONE NUMBER A" IN THE FIRST TONE-GROUP TABLE--this is the diagonal tone for the tone group. If the decoders/pagers don't have group call and the decoder's capcode ends in the same two digits, then the diagonal tone is entered for one of the two tones. For most pagers the diagonal tone is entered for the first tone sent (tone A).

NOTE ON GROUP CALL--for decoders/pagers with group call, a tone is sent for the group call time ("Grp" in timing table) to activate the decoders/pagers in the group. To activate group call in the Z-Patch, enter the first tone and group for both tones and groups in the page code. (Example: T G1 G2 T1 T2 if G1=G2 and T1=T2).

### Five/Six-Tone Paging Option

Seven- or eight-digit pager codes for five-tone paging are entered as follows: (seven digits=no preamble, eight digits=preamble)



EXAMPLE--pager capcode 8-84325, EIA tones:

1st address ... Page code = 18843250

EXAMPLE--pager capcode 53421, ZVEI tones:

2nd address ... Page code = 3534211

### 2805 Paging Option

2805 paging is accomplished by sending a 2805-Hz tone which is modulated by one to seven digits. The format is a 800-msec front porch, followed by the digit-modulated tones at 60 msec on, 40 msec off, followed by a back porch of 4 sec.

**DTMF Paging Option**

DTMF paging is accomplished by sending a string of one to seven DTMF digits. The digits may be sent using one of two timers which may be from 50 msec to 2 sec. DTMF timer 1 and 2 are set in the paging menu and the actual timer is selected in user programming.

**SUBAUDIBLE (CTCSS) ENCODE OPTION**

The subaudible (CTCSS) encode option allows units to be programmed to encode a CTCSS tone (1 of 38) when transmitting. If this option is not installed, no menu selections dealing with this option are displayed. See Appendix 6 for tone numbers.

**GMARC PAGING OPTION**

The Zetron Model 45 Z-Patch with the GMarc paging option can be added to a GMarc V repeater to allow interconnect between a mobile and a phone line. The Model 45 is connected to one channel of the system, preferably the last channel to be used for repeat audio. Calls to and from GMarc VE mobiles via the GMarc V repeater are also possible, with the addition of an SRM board to the repeater to handle the handshake with the mobile when it initiates a call.

The unit can also be used to provide mobiles with the capability to alert other mobiles with different GMarc codes using the Model 45's mobile-to-mobile features.

It is possible to add Model 45s on more than one channel, preferably having all of the units on the same listed directory number with the phone company CO automatically searching for the next free Model 45. The problem that arises is that if a mobile is already busy on another patch, or with a dispatch call, the Model 45 will still attempt to alert the unit.

If the GMarc paging option is installed, the user 2 relay will be used exclusively for the GMarc page. This relay will key when the 2nd, 3rd, and 4th tone of a 4-tone page is being sent out. This is used to disable the busy tone so as not to false 2-tone mobiles on the same system. The relay contacts should be used to disable the busy tone when they are energized. This relay will ignore normal programming if you have GMarc paging installed in your Model 45. The user 1 relay will act as normal.

## SECTION 6 - OPTIONS

The user's page code is entered as a four- or eight-digit code, with each pair of digits corresponding to one of the following GMarc tones:

Tone	Code	Tone	Code	Tone	Code
604.2	01	1041.2	13	1795.6	25
631.5	02	1089.0	14	1877.5	26
662.3	03	1140.2	15	2051.6	27
693.0	04	1191.4	16	2143.8	28
727.1	05	1246.0	17	2239.4	29
761.3	06	1304.0	18	2341.8	30
795.4	07	1362.1	19	2447.6	31
832.9	08	1423.5	20	2556.9	32
870.5	09	1488.4	21	2672.9	33
911.5	10	1556.7	22	2792.4	34
952.4	11	1628.3	23	2918.7	35
996.8	12	1717.1	24		

The first tone of a page is issued for 90ms + 90ms x number of channels (see paging menu). If only two tones have been specified, the second tone is issued for 450 ms. If four tones have been specified, the 2nd, 3rd, and 4th tones are issued for 180 ms each.

An additional system ANI (Direct Page ANI under the System-Access menu) has been added to provide capability for direct pages to specific mobiles that are not entered into the user database. Operation is as follows:

- 1) Enter the Direct Page ANI from the phone.
- 2) Wait for the prompt beeps.
- 3) Enter either a four- or eight-digit sequence corresponding to the desired page frequencies, as above. If an eight-digit sequence is entered, operation will immediately continue. If a four-digit sequence is entered, the unit will wait the programmed DTMF time-out before continuing (alternatively, a DTMF "#" may be entered to avoid waiting the time-out. From a dial-pulse phone, the time-out will have to be used.

Note that for the above to work correctly, the default user for the phone line (factory default to user 1) used must be set up as a mobile with GMarc page format, and must be enabled.

### EXTENDED USER OPTION

The extended user option incorporates a larger internal memory for user database storage. User numbers are from 001 to 325.

### SMDR PRINT OPTION

The SMDR print option provides the unit with a clock and the ability to output a detailed record of each transaction out the J3 Serial I/O connector, at the completion of the call (see the Installation Section for baud rate selection). The data is sent to a line printer or data recorder (customer supplied). The output contains information formatted in one of two ways, depending upon the SMDR print mode selection. In mode 1 the

output will be formatted for a line printer (pretty print) with headings for each data field (see the example below). In mode 2, the output is formatted for SMDR (Station Message Detail Record), (see below). This format can be interpreted by customer supplied equipment to sort and total each user's access. SMDR format is commonly used by PABX equipment in hotels to tally up room charges. The SMDR output emulates the Dimension FP-10 format. In mode 1 the output will display a maximum time of 18 hours while in mode 2 the output will only display a maximum of 9 hours.

#### FP-10 Format

When the SMDR print mode 2 is selected the output to the printer and the output to the screen, when doing an SMDR list, will be in the FP-10 format. The format output is shown below.

The following is a list of the line codes, column 18, which will be displayed depending on the access to the system:

- A = Mobile to Phone on line 1.
- B = Mobile to Phone on line 2.
- 0 = Phone to Mobile on local phone. (DID if installed).
- 1 = Phone to Mobile on line 1.
- 2 = Phone to Mobile on line 2.
- R = Repeater access.
- M = Mobile to Mobile.
- C = Manual Connect.

The following is a list of the condition codes, column 16, which will be displayed depending on what happens to the call:

- A = Call completed successfully.
- B = Called mobile did not answer.
- C = Call disconnected by line 2 override.
- D = Illegal access.
- Z = Internal SMDR overflow, detailed billing record only.

#### SMDR Format (Station Message Detail Record) ("Dimension" FP-4, 7, 10)

Each standard SMDR record is 63 characters long. The Month/Day output is printed on a line by itself. It is the ONLY record which begins in column 0. The month/day is only printed once per day. See SMDR pretty print for detailed explanation of each call. The Month/Day detail is shown below:

Column #	Width	Description
0	2	Month (1-12)
2	1	space
3	2	Day (1-31)
5	53	spaces
58	1	Carriage Return
59	1	Line Feed
60	3	Nulls (0's)

## SECTION 6 - OPTIONS

The time the call was placed is the start of the normal SMDR record.  
Normal SMDR record detail is shown below, FP-10 (print mode 2):

Column #	Width	Description
0	3	spaces
3	2	Hour (00-23)
5	1	:
6	2	Minute (00-59)
8	1	space
9	1	Duration Hours (0-9)
10	1	:
11	2	Duration Minutes (00-59)
13	1	.
14	1	Duration Tenths-of-Min (0-9)
15	1	space
16	1	Condition Code
17	1	space
18	3	Line Code
21	1	space
22	3	Route Advance (unused)
25	1	space
26	18	Phone Number Dialed
44	3	spaces
47	4	Calling Number
51	2	spaces
53	5	Account Code (unused)
58	1	Carriage-Return
59	1	Line-Feed
60	3	Nulls (0's)

### Printout Examples

See the Pretty print section for details on each call.

SMDR Output, with FP-10 format =

15 Record(s)

10 09

11:38	0:00.1	D 1		0011
11:39	0:00.7	B 1		0001
14:20	0:00.1	A C		0001
14:24	0:00.1	D 1		0004
14:40	0:00.7	A 1		0001
14:41	0:00.7	A A	6441300	0001
14:43	0:00.6	B M	002	0001
14:44	0:00.9	A M	002	0001
14:45	0:06.3	A 1		0001
14:52	0:00.4	A 1		0001
14:53	0:00.2	B 1		0001

**Pretty Print**

The pretty print is obtained by selecting SMDR print mode 1. Below are some examples of the printout. This is the form the unit will display, if the internal SMDR storage option is installed, when an output is requested or what will be displayed on the printer. The header line is printed every 62 lines and with added spaces the header should be printed once per page. The date and time are set in the internal clock of the Model 45. "USR" is the user that originated the call or received the call. "AIR-TIME" is the amount of time the transmitter was keyed, including the ring-out. "CALLED" is the column that contains information about the call; 'No Answ' is displayed if the call was not answered; if blank, the call was answered; 'User' (number) is the number of the user called on a mobile to mobile call. If the mobile did not answer, 'No Answ' will follow to the right. If 'Err' is displayed the number the mobile tried to dial was toll restricted or the user being called was invalid or restricted. The list of calls below is the same as the calls listed in the FP-10 printout. Under "TYPE", the first letter is who originated the call, the second letter or number is the line that was used or in the case of a mobile to mobile call it will be "MM".

The following is a list of codes displayed under TYPE:

P = Phone, 0 = Local Phone Line, 1 = Phone Line 1, 2 = Phone Line 2,  
M = Mobile, C = Manual Connect.

Pretty Print =

Model 45 (Station ID) 10/09/87 14:54:36

DATE	TIME	USR	AIR-TIME	TYPE	CALLED
10/09/87	11:38:00	011	00:00:09	P1	Err
10/09/87	11:39:00	001	00:00:46	P1	No Answ
10/09/87	14:20:00	001	00:00:11	C	
10/09/87	14:24:00	004	00:00:09	P1	Err
10/09/87	14:40:00	001	00:00:42	P1	
10/09/87	14:41:00	001	00:00:42	M1	6441300
10/09/87	14:43:00	001	00:00:37	MM	User 002 No Answ
10/09/87	14:44:00	001	00:00:59	MM	User 002
10/09/87	14:45:00	001	00:06:18	P1	
10/09/87	14:52:00	001	00:00:24	P1	
10/09/87	14:53:00	001	00:00:16	P1	No Answ

1. Phone line 1 to user 011, user disabled.
2. Phone line 1 to user 001, mobile did not answer.
3. The connect button was depressed.
4. Phone line 1 to user 004, user disabled.
5. Phone line 1 to user 001, mobile answered.
6. Mobile user 001 to phone line 1, dialed number.
7. Mobile user 001 to mobile user 002, mobile did not answer.
8. Mobile user 001 to mobile user 002, mobile answered.
9. Phone line 1 to user 001, call limit time-out.
10. Phone line 1 to user 001, dial tone disconnect after answer.
11. Phone line 1 to user 001, dial tone disconnect before answer.

## SECTION 6 - OPTIONS

### **SMDR INTERNAL STORAGE OPTION**

This option provides the unit with the capability to store up to 999 transactions. The call information is stored in battery-backed memory insuring preservation of data even if power is lost. The detailed records may be viewed via programming menus. The Model 45 is accessed by the CAS either directly or over a phone line using the Model 45's internal modem. The internal billing records stored in the Model 45 are downloaded by the CAS and stored on disk.

The Model 45's system and user programming data may be downloaded and stored on disk. In the event of Model 45 failure (such as lightning strike) the system and user programming is reloaded into the Model 45 and the system is back on-line without having to manually reprogram.

Model 45s without internal storage don't store detailed call records, but they do store accumulated call records (one per user). For each user, a record of accumulated call time and number of calls is recorded. This information can be downloaded and used for billing. However, no time of day rate variations are used, nor can toll calls be tracked. The CAS will download and upload system and user program data for a Model 45 of any configuration.

### **300/1200-BAUD MODEM OPTION**

The 300/1200 baud modem for the Model 45 allows modem communication at 300 or 1200 baud. This option is strongly recommended for remote systems. With a CRT, program the "run modem" at 300 baud question in the system misc. menu, for the baud rate desired. This baud rate does not affect the normal operation of the serial, RS-232, port. With the modem you may also remotely do tests of the system.



**VOICE PROMPT OPTION**

The following is a list of the voice prompts and how they work. Message numbers one and two have a maximum length of 7.5 seconds. All other messages have a maximum length of 3.7 seconds.

1. **Message One** is the **"Welcome"** message. This message comes on after the phone line is answered and before the beep or dial tone prompt is sent. DTMF can be entered during the voice message. This is for experienced users who don't want to listen to the whole message. When the first DTMF digit is received, the voice message will stop. Dial click detection is not enabled until after the voice message so anyone using a rotary telephone will need to wait until after the voice message to begin dialing. If the message is not recorded the beep or dialtone prompt will be sent immediately.
2. **Message Two** is the **"Your call cannot be completed at this time"** message. This message comes on if the mobile does not answer the call or the channel is busy and the channel busy ring occurs. The line is disconnected after this message is sent out to the calling party. If this message is not recorded a reorder tone (fast busy) will be sent to the calling party.
3. **Message Three** is the **"Thank You"** message. This message comes on after a valid ANI or user number has been entered by the calling party. If this message is not recorded the M45 will go directly to ringing.
4. **Message Four** is the **"This user is no longer in service"** message. This message comes on if the ANI or user number dialed in is correct but the user has been disabled in the User Programming section of the M45. If this message is not recorded the M45 will issue reorder tone (fast busy), then disconnect the call.
5. **Message Five** is the **"The number you dialed is invalid"** message. This message comes on if the number dialed is not a valid ANI or User number (one that has not been programmed into the unit). If this message is not recorded the M45 will issue reorder tone (fast busy), then disconnect the call.
6. **Message Six** is the **"At the prompt, please speak your voice message"** message and is used for Tone & Voice or Talkback paging. This message is sent before the caller is put on the air to leave a voice message. If this message is not recorded a beep will be sent to indicate when the calling party should begin speaking.

The Voice Prompt Access Code is defaulted to \*3 when the M45 System Programming is reset to factory defaults. This access code can be programmed in the System Miscellaneous Menu in version 6.2 software or later. It can also be programmed using the DTMF command 171. The access code can be one to eight digits long. To program a code of \*235 via DTMF first enter the DTMF Programming Access Code (00098). If a modem is installed in the M45 wait for the modem carrier tone to stop and the DTMF programming prompt to be sent. Enter 171\* 4# \*235. The 171\* is the DTMF command, 4# is the total number of digits in the Access Code and \*235 is the new Access Code. For an access code of 987654, enter 171\* 6# 987654 etc.

## SECTION 6 - OPTIONS

### Voice Prompt Commands

The following commands are used to program the voice prompts:

0	for	Erase
2	for	Play
9	for	Record
*	for	Stop recording message
##	for	Hang up phone line

The following prompts are heard during the recording:

**Two Ding-Dongs:** This prompt is sent when you first enter the programming mode.

**Fast Busy Tone:** This prompt is sent if you wait to long between recording. The M45 hangs up the line after this prompt.

**Three Ding-Dongs:** This prompt is sent after an invalid command or message number.

**Six Beeps:** This prompt is sent at the beginning of recording a message.

**Eight Beeps:** This prompt is sent to indicate a message is being erased.

**One Ding-Dong:** This prompt is sent after a message has been erased or the maximum length of the message has been recorded.

### Programming a Voice Message

The Voice Prompt Messages can be recorded by using the Local Phone Line or by calling the unit on one of it's end to end lines (Line 1 or 2) hooked to a regular phone line. To use the Local line, connect a DTMF phone into the Jack marked Local and pick up the handset. When you hear the prompt, enter the Voice Prompt Access Code (\*3). To use the end to end lines, dial the number that the M45 is hooked to as if placing an over dial call or programming the unit. When you hear the prompt enter the Voice Prompt Access Code as before (\*3). After entering the Access Code you will hear the go ahead prompt (Two Ding-dongs). To record a message enter "9" followed by the message number you want to record (1 for the first message, 2 for the second etc.). After the Six Beeps, speak the message into the phone handset. If the message is shorter than 7.5 seconds for the first two messages or 3.7 seconds for messages 3 thru 6, enter a DTMF \* to stop the recording. To listen to the message you just recorded enter 2 plus the message number you just recorded. 21 for the first message, 22 for the second message etc. All the other messages can then be recorded by entering the message number after the record command. Message 2 would be 92, message 3 would be 93 etc. To erase a message, enter 0 plus the message number to be erased. 01 for message 1, 02 for message 2 etc. You will hear eight beeps to indicate the message is being erased.

**Example: Recording Message One with a Welcome Message**

Plug telephone into Local Jack. Pick up handset and listen for dial tone. Enter \*3 and listen for Two Ding-Dongs. Enter 91 and listen for Six Beeps. Speak message into the phone in a normal speaking voice. Enter a DTMF \* right after the message to stop the recording process. Enter 21 to listen to the message you just recorded. If you don't like the message enter 91 to record over it and then enter 21 to play it again. Repeat this procedure for all the messages. If you'd like to erase message 1 so the beep prompt or dial tone prompt is sent immediately after the M45 answers, enter 01.



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## **INSTALLATION WARNING**

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, this device may cause interference to radio communications.

Installation of the Z-Patch should be accomplished by experienced radio and paging system personnel. Specialized knowledge in telephone systems is also important to ensure a smooth interface when connecting with the Telco network.

## **GENERAL**

Connections to the transmitter and receiver are grouped on a detachable 25 pin connector on the rear of the Z-Patch for ease of installation. The power connector is also located on the rear and is also detachable. The Model 45 includes installation test modes accessible with a Touch-Tone phone plugged into the local phone jack to aid in installation. **CAUTION:** If the M45 is set up for a DID Convertor, R8 may have been removed or changed, disabling the local phone jack. R8 should be 220 Ohms for testing, and then changed back the way it was before for proper operation of the DID.

## **REQUIRED TEST EQUIPMENT**

1. Radio transceiver w/DTMF encode capability
2. CRT or display terminal
3. VOM (Volt/Ohm meter)
4. Service monitor
5. Oscilloscope
6. Local DTMF (Touch-Tone) Phone

Figure 25 provides a graphic presentation of a typical Model 45-to-transmitter/receiver connection.

## SECTION 7 - INSTALLATION

### TYPICAL CONNECTIONS

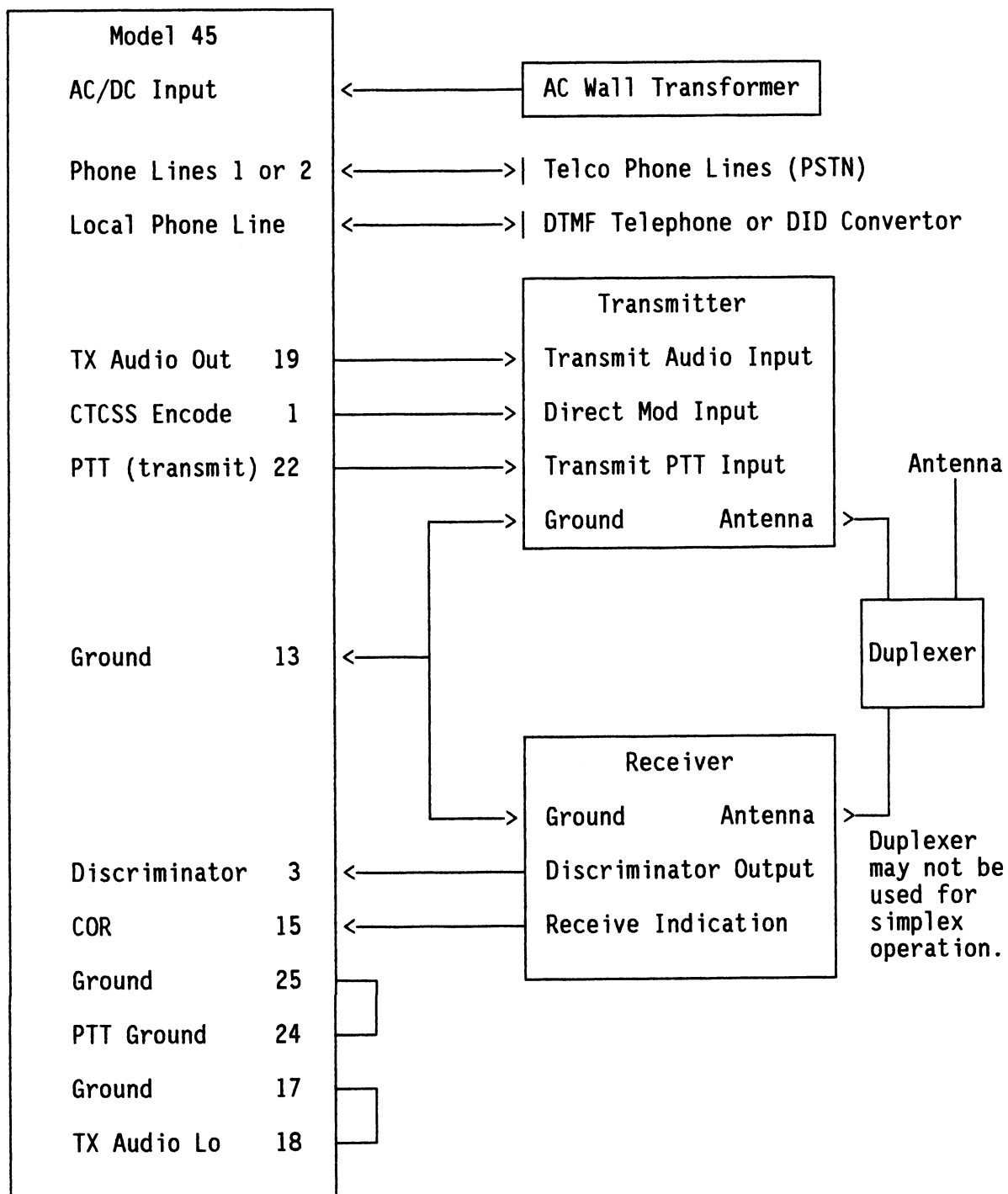


FIGURE 25: Typical Model 45 Installation



## MODEL 45 Cable Connector Pin Numbers and descriptions

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	

1 - CTCSS/DPL ENCODE	14 - COR COMMON
2 - RX AUDIO LOW	15 - COR INPUT
3 - RX AUDIO HIGH	16 - GROUND
4 - SENSE - 1	17 - GROUND
5 - SENSE - 2	18 - TX AUDIO COM
6 - SENSE - 3	19 - TX AUDIO OUTPUT
7 - SENSE - 4	20 - NOT USED
8 - NOT USED	21 - NOT USED
9 - NOT USED	22 - TX PTT-A-COM
10 - TX PTT-B-COM	23 - TX PTT-A-NC
11 - TX PTT-B-NC	24 - TX PTT-A-NO
12 - TX PTT-B-NO	25 - GROUND
13 - GROUND	

**INSTALLATION PROCEDURE**

1. Locate the 25 Pin Male connector from the accessory bag included with the M45.
2. GROUND CONNECTION: Connect a chassis ground wire from pin 13 to the chassis ground of the transceiver.
3. TRANSMITTER PTT: For most transmitters, a contact closure to ground will cause the transmitter to key up. For this configuration, connect a wire from pin 22 (Tx PTT COM) to the PTT input of the transmitter. Next install a wire jumper between pins 24 and 25 (PTT NO and Gnd). In some cases, the transmitter needs to see a voltage to key up. If this is the case, put the voltage needed to pin 24 instead of a ground.
4. TRANSMITTER AUDIO OUTPUT: Connect pin 19 (TX Audio Out) to the mic or line input of the transmitter. Shielded cable must be used for this connection. Connect the braid to pin 18 (Tx Audio Com). Jumper JP12 determines the impedance of the TX Output. (A=600 Ohm and B=High)
5. CTCSS OPTION: If the M45 has the CTCSS Encode Option installed, connect Pin 1 (CTCSS OUTPUT) to the direct modulation input of the transmitter. This wire should be shielded with the braid tied to any ground pin on the M45.

## SECTION 7 - INSTALLATION

6. **DISCRIMINATOR INPUT:** Connect pin 3 (RX Audio In) to the receiver discriminator output. Speaker audio may be used for this input, but disc. audio is recommended. Shielded cable is required for disc. audio but not for speaker audio. The shield braid should be connected to pin 2 (RX Audio Com). Jumpers JP9, JP10 and JP11 determine the impedance of the RX Audio Input.

IMPEDANCE	JP9	JP10	JP11
600 Ohm Balanced	A	B	A
1600 Ohm Balanced	A	A	A
High Impedance	B	A	B

7. **COR INPUT:** The M45 Z-Patch requires a signal from the receiver to indicate when the mobile is transmitting. This signal is usually derived from the receiver squelch circuit, and is called Carrier-Operated-Relay (COR) or similar names such as RUS, CAS, or COS. A good COR signal is critical if using the M45 for simplex operation and must give a COR indication upon immediate reception of a signal. This will help shorten the sample width needed to indicate mobile activity. The Z-Patch needs a relay-contact closure between Pin 15 and ground, or a signal applied to Pin 15 that changes from low voltage to high OR high voltage to low when receiving a signal. Verify proper COR operation by supplying, then removing a signal on the receiver RF frequency. The CARRIER LED should light when a signal is being received. If the LED operation is backwards, off during receive and on with no signal, change the COR polarity in the SYSTEM COR MENU described in the Programming with a Computer section of this manual. This can also be changed using DTMF Programming Function Code 1, as described in the Programming via DTMF section. If the LED doesn't change, adjust COR Threshold Pot (R85) until a change takes place.

8. **POWER SUPPLY:**

**AC POWER:** The M45 is normally powered by a 12V AC UL-approved wall transformer. The current requirements are approximately 700 mA with all relays in use, and 400 ma with no relays in use. Any 12V AC transformer may be used, regardless whether the source voltage is 115V AC or 230V AC, 50 or 60 Hz. The Z Patch is fused with a 1-ampere slo-blow fuse. AC power connection is made to the POWER connector at the left edge of the Model 45's rear panel.

**DC POWER:** The Z-Patch may be externally powered with a DC power supply which is capable of supplying 12 to 15 volts at approximately 700 mA with no more than 1% ripple and noise. If the DC supply is less than 13 volts, put in jumper JP18, located next to the AC/DC power jack on the rear panel. Do not supply the Z-Patch with any supply which cannot provide at least 12.0 volts, as the internal regulators will start to drop out of regulation at approximately 11.8 volts. DC power connection is made as indicated to the POWER connection at the left edge of the M45's rear panel.

## RESETTING TO FACTORY DEFAULTS

The M45's system database may be reset to the factory defaults by using the following procedure:

- 1) Press and hold the reset button on the front panel. All the LEDs should light up.
- 2) While holding the reset button, press and hold the connect button. All the LEDs should stay on.
- 3) Continue to hold the connect button and let up on the reset. The LEDs should go off at this time.
- 4) After approximately 3 seconds, all the LEDs should come back on. When this happens, release the connect button.

The front panel POWER indicator should be on and the PAGE indicator should blink every 5 seconds. This only resets the System programming and does not reset the User programming or the SMDR storage. The System and User programming can be reset using the Supervisor Menu described in the Programming with a CRT or Computer Section of this manual.

## LOCAL TELEPHONE

Connect a DTMF (Touch-Tone) telephone to the jack marked LOCAL. Pick up the handset and verify that dial tone is present for about 2 seconds. If no dial tone is heard, check to see if R8 has been removed or changed. R8 is normally a 220 Ohm resistor but may be removed for DAPT-1000 DID operation or changed to a 2.2K ohm resistor for the Model 50 DID convertor. If this is the case, change R8 back to 220 Ohms to install the M45 and also for testing, then change it back to it's previous condition. After hearing dial tone, dial "00098". If the modem option is installed, a high pitched tone will be heard for about 20 seconds followed by the programming mode greeting tone sequence. The programming tones will be heard immediately if the modem option is not installed. This sequence indicates proper access to the DTMF program mode. Simply hang up the phone to exit the programming mode. This phone will be used for various test procedures during the alignment of the M45.

**DID OPTION:** The local telephone line is also used for the DID Convertor Option. Hookup for the DID is explained in the DID Convertor Manual.

## SECTION 7 - INSTALLATION

### TESTS AND ADJUSTMENTS

1. PTT: Verify proper PTT operation by pressing the CONNECT button on the front panel. The transmitter should key up at this time. If not, check the wiring between the M45 and the transmitter. Press the DISCONNECT button to unkey the transmitter.
2. TRANSMIT AUDIO: The transmitter deviation must be set for proper operation of the system. First, using an external mike on the transmitter, set the deviation for a maximum of 5kHz using the Deviation Pot in the radio as described in the radio's manual. Next, using the phone plugged into the local phone jack, enter the DTMF programming mode by picking up the handset and dialing "00098". Select a test tone frequency (usually 1 kHz) by entering the function code "102\*", then the frequency divided by 10 followed by a "#" (100# = 1kHz). Send the tone out the transmitter by entering the function code "98\*", followed by "2#" for TxToneOn (98\* 2#). This will cause the transmitter to key up and generate the desired frequency. Adjust R129 for 3 kHz deviation. To end the test, simply press the "#" key.
3. CTCSS ENCODE OPTION: To set the CTCSS modulation level, access the programming mode as above, then enter "115\* 18#". This will cause the transmitter to key up with the tone 123.0 Hz encoded. Adjust R91 for 750Hz deviation on the channel. Check the lower and upper tone for proper deviation by pressing "115\* 1#" for 67.0 Hz and "115\* 38# for 250.3 Hz. To unkey the transmitter press the "#" key. This should also adjust the digital encode output for the correct deviation provided your transmitter is set up to handle DCS. You can check the DCS deviation by pressing "115\*" and "D1# thru D104#" to encode the 104 digital codes described in the code table in the Appendix. "115\* D1#" = Digital code 025, "115\* D104#" = Digital code 754 etc.
4. DISCRIMINATOR INPUT: Adjust the receiver audio level by supplying a full quieting signal to the receiver. This signal should have a 1kHz tone at 3kHz deviation. Adjust R69 for 1.5 volts P-P at TP 3 measured with an oscilloscope. Verify DTMF decoding with a handheld or service monitor with DTMF encoding capability. The Data LED should light with each digit. The M45 has De-emphasis and Pre-emphasis capacitors (CX3 and CX4) in the DTMF decoder circuit that can be changed to compensate for DTMF twist problems that may occur should you have DTMF decoding problems. The high and low tones of the DTMF should be entering the DTMF decoder (U45) at about the same level if the twist is set correctly.

5. **REPEAT AUDIO ADJUSTMENT:** The M45 can be used as a carrier operated repeater manager by programming the ANI for Dispatch in the System Dispatch Menu to no. The M45 will then key up the transmitter and repeat the audio upon receiving a signal from a mobile. If this is to be used, the Repeat audio must be adjusted. To accomplish this, program the ANI for Dispatch to no via a computer or enter the DTMF programming Mode and enter "56\* 0#". Then, using the handheld with DTMF encoding capability and a service monitor, adjust the repeat audio via R69. First, measure the DTMF out of the handheld with the service monitor. It should be about 3kHz deviation. Next, while monitoring the repeater TX frequency, key the handheld and send the same DTMF number you measured earlier. Adjust R69 in the M45 for the same deviation you measured with the handheld. 3kHz in = 3kHz out.
  
6. **TELEPHONE ADJUSTMENTS:** The M45 Telco output level (R97) is factory set for proper DTMF regeneration levels into the phone line and does not need adjusting. The Telco input level (R100) is also adjusted at the factory but may be adjusted to compensate for low telco levels if needed. The Telco Hybrid must be adjusted for proper operation of full duplex users or proper modem operation. The Hybrid Balance should be adjusted after the M45 is installed at the site and the correct phone line is hooked up to the patch. If using both line inputs on the M45, only one needs to be adjusted, preferably the line that gets the most use. Call the phone patch from another line and enter the DTMF programming mode when the over dial prompt is heard. Set the Hybrid tone to 1000 Hz by entering "102\* 100#" as before. Enter "106\* 1#" to turn on the Hybrid tone. The transmitter should key up and the tone should be heard on the TX frequency. The tone will be on for 8 seconds and off for 2 seconds. While the tone is on, adjust R98 for a null while monitoring to the transmitter frequency. The tone should actually seem to go away completely. When this happens, the Hybrid is adjusted properly. To exit the Hybrid mode, wait for the pause in the tone and enter "#" from the phone. You can also press the RESET button to exit the Programming Mode.
  
7. **DIAL TONE DETECTOR ADJUST:** The dial tone detector is factory preset to 440 Hz and in most systems should not need to be adjusted. R134 is used to adjust the frequency of the detect circuit. Pin 8 of U29 should drop to 0 volts upon detection of any dial tone and can be used to adjust R134 if needed. While monitoring pin 8, push the Connect button on the front panel with a phone line installed in Line 1. The M45 will bring line 1 off hook and transmit Dial Tone. Pin 8 of U29 should be low at this time. If not, adjust R134 until it goes low. This test may need to be repeated as the M45 will disconnect when proper Dial Tone is detected.
  
8. **VOX DETECTOR ADJUST:** The VOX detector is factory set and should not need adjusting. R159 is the control for the VOX detect circuit and should be adjusted to give a VOX indication when voice or noise is present on the phone line.

## SECTION 7 - INSTALLATION

9. **DIAL CLICK ADJUSTMENTS:** If you are using the dial click detector you will need to set up the detect circuit. You will need to have a CRT or computer directly connected to the serial port for the set up. The following steps should get you close. Minor variations in the adjustments will occur due to the fact that dial click detection is detecting noise clicks on the phone line. **CAUTION:** Before you can do any tests you must first set the Dial Click Decode Mode to 1 or 2. If not, the click calibrate message will always say "Clicks are OFF". The modes are described in the Programming with a CRT or Computer section of this manual.
1. Go to the test menu and select the Click calibrate test. The M45 will take line 1 off hook or the line that is ringing.
  2. Dial pulse the digit '0'; the message " Clicks are ON" should be displayed for the duration of the digits. If not, adjust R170. Make sure that the message "Clicks are OFF" is displayed at the end of each digit.
  3. Next select the DTMF/Click detect test, from the telco. The unit will take line 1 or the line that is ringing off hook. The message will display DTMF: then the decoded digit. This test is good for decode testing dial clicks or DTMF.
  4. The letters "A" or "B" may be displayed and can be ignored. If Mode 1 is selected, dial digits from the dial pulse phone. If the unit does not decode properly, adjust R170 as needed. If that does not work select Mode 2 and start this test over and continue from this point. Dial a "0" from your pulse phone. The first "0" will calibrate the software to the phone you are dialing on. This feature allows phones with different dialing characteristics to have a chance of working. Dial another "0". The proper digit should be displayed on the CRT. Then dial other digits and verify that they are decoded properly. Also try this test from several different phones and number prefixes. Make final adjustments as needed for all the phones to work. If an "A" or "B" is displayed along with the proper digit the adjustment should be okay. The "A" and "B" is just an indication that an invalid pulse was detected and will not affect the normal operation of the dial click decode.

### FINAL CHECKS BEFORE LEAVING THE SITE

1. Have a helper call the Model 45 from a remote DTMF phone and verify proper access to the program mode. This checks proper phone decode.
2. If the M45 has the modem option, have someone call the unit and access the modem programming. Verify errors are not present during modem communication.
3. Verify that the program mode can be accessed over the radio channel, or better yet, place a call through the Model 45.

## OPTIONAL CONNECTIONS

1. COR VALIDATION: Sense line 1 (J1 Pin 4) allows connection to a logic signal or contact closure from a tone decoder to validate the COR input signal. This option allows only the users with the correct CTCSS tone or DCS to use the system. The sense line is programmed in the SYSTEM COR MENU under COR Validation Active High. If this is set to yes, the signal needs to be ground or low with no signal and open with a tone present. If the COR Validation is set to no, the signal needs to be grounded upon reception of the proper tone. The jumper JP 13 should be installed when using sense line 1. If nothing is connected to the sense line 1 input the COR Validation must be set to yes. This is the factory default setting.
2. TRANSMITTER INHIBIT VIA MONITOR RECEIVER: Sense line 2 (J1 Pin 5) allows connection to a logic signal or contact closure from a repeater output frequency monitor receiver to prevent key-up or ring-out during co-channel usage. The M45 will indicate co-channel transmitter inhibit by flashing the COR LED. This is also programmed in the SYSTEM COR MENU and is called Channel Busy Active High. If this is set to yes, the sense line needs to be grounded when no signal is received and open or high upon reception of a proper signal from the monitor receiver. If the Channel Busy is set to no, the sense line needs to be grounded upon reception of the proper signal and open or high with no signal. Jumper JP 14 should be installed when using sense line 2. If the sense line 2 is not being used the Channel Busy must be set to no. This is the factory default setting.
3. SENSE LINES 3 AND 4: J1 Pins 6 and 7 are the sense lines 3 and 4 and are used to page user 1 when sense line 3 is grounded or user 2 when sense line 4 is grounded. Jumper JP 15 needs to be in for sense line 3 and JP 16 needs to be in for sense line 4. The paging formats for users 1 and 2 are programmed in the User Specific Menu.
4. CONTROL RELAYS: The M45 has four relays for sight control. There are two system relays and two user relays. The system relays normally open contacts are available on J2 pins 3, & 17 for relay 1 and J2 pins 4, & 16 for relay 2. The user relays NO contacts are available on J2 pins 1, & 15 for user 1 relay and J2 pins 2, 14 for user 2 relay. The operation and programming of these relays are explained in the operation and programming sections of this manual.
5. VOX DELAY BOARD (for simplex operation): The VOX Delay Board is factory installed and should not need adjusting. If the option is ordered after the Model 45 an installation instruction sheet will accompany the board. The delay board plugs into P1 in the Model 45 and is held in place by two screws included with the board. Jumper JP30 should be in the B position with the VOX Delay Board installed. R11 on the delay board adjusts the delay of the voice from the telco to the transmitter and should be adjusted to the minimum value needed to guarantee that none of the telephone audio is lost due to transmitter key-up delays.

## SECTION 7 - INSTALLATION

### SPECIFIC MODEL 45-TO-RADIO CABLING

The following notes and diagrams have been compiled to help ease the installation of the Zetron Model 45. These notes should be used along with the remainder of this section.

Zetron neither warrants nor assumes any liability for the use of or the accuracy of these notes and diagrams but every effort has been made to insure their accuracy and fitness for the purpose intended.

The connection notes for the Zetron generic cable should be read in addition to the radio specific connection notes and the manual for the radio being used. Please check the radio manual for any changes the manufacturer may have made.

The generic cable and cables for the radios included in the following notes may be purchased from Zetron.

#### MODEL 45 Cable Connector Pin Numbers and Color Codes

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	

1 Green	14 nc
2 Black (White)	15 Yellow
3 White	16 Black (Green) & Shield
4 nc	17 Shields of Blu/Blk & Wht/Blk
5 nc	18 Black (Blue)
6 nc	19 Blue
7 nc	20 nc
8 nc	21 nc
9 nc	22 Black (Brown)
10 Black (Red) & Shield (to pin 25)	23 Brown
11 nc	24 nc
12 Red	25 Shield of Brn/Blk (to pin 10)
13 Black (Yellow) & Shield	



**Generic**

Check the position of Jumpers JP9, JP10, JP11 and JP12 per the manual and your installation.

If your radio is equipped with repeat audio, you may want to use the auxiliary contacts of the PTT relay, K8A, in the Model 45 to defeat it when interconnected to the phone line. This allows the privacy mode to operate properly. If you have a M45 with the repeat audio option installed you will need to remove the repeat audio from your radio then K8A can be used for another purpose. K8 is active whenever the unit keys up the transmitter, K8B is used for PTT.

It is recommended that you use the COR signal from your radio. COR sense may be set to positive or negative in the system programming (COR Menu). The low voltage level of the COR signal must be below 4.0V DC. The detection level is adjustable by R85 from 0 to 4.0V DC. There is an internal pull up in the unit which holds the input to 4.0V DC. If the COR is set to positive, the COR LED will not go out until the input is pulled low.

The TX audio is transformer coupled and has a high and a low output impedance which is selectable by JP12. Also note that both sides of the output must be connected. For single ended installations, ground Tx Audio low at the transmitter. To set the transmitter deviation use the single tone test in the Test Menu and adjust R129.

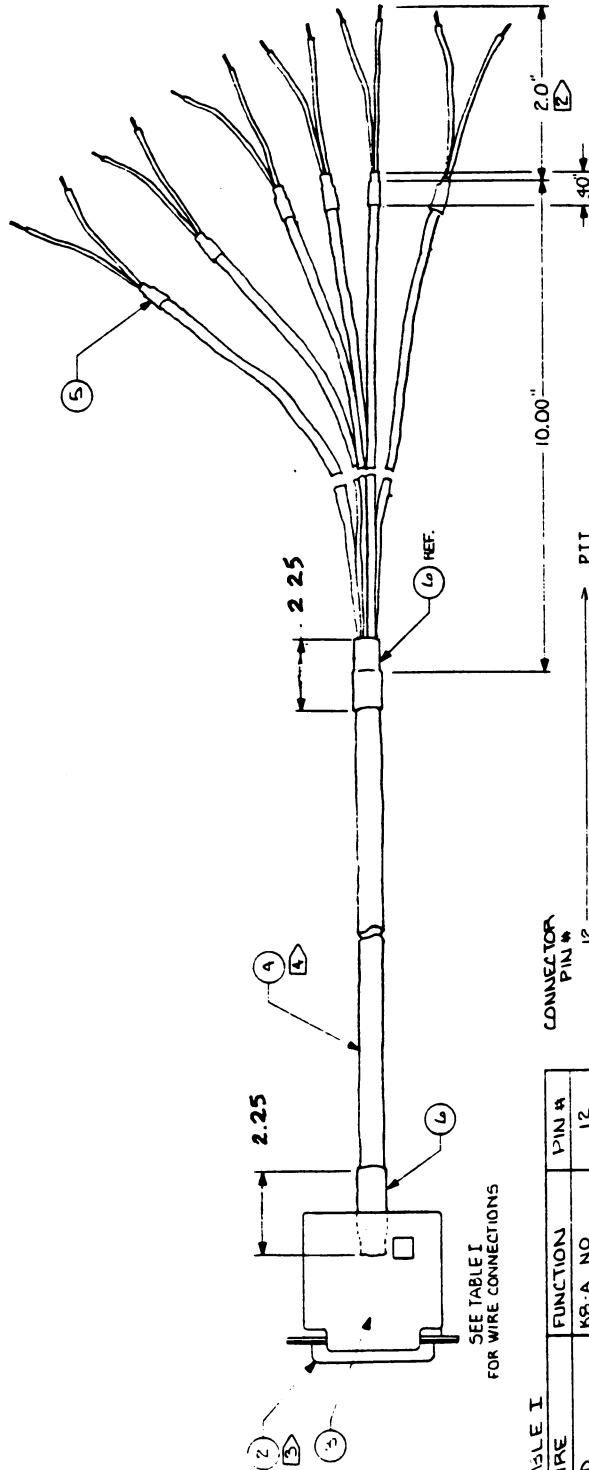
The RX audio input configuration and impedance are selectable with JP9, JP10 and JP11. The RX audio from the radio can be unsquelched or squelched audio. Adjust R69 for proper receive levels.

The CTCSS encode always comes out pin 1 of J1 but can also be set up so that the signal is added into the audio path by answering 'yes' to the 'Enable CTCSS Tx Sum' question (System Miscellaneous Menu ). The level of the CTCSS, at pin 1 of J1, is adjustable by R91. The level of the CTCSS signal when 'summed in' is not adjustable. The output goes above and below ground and is an op-amp output. Be sure not to directly couple this output to an input that has a DC voltage on it. Put a capacitor in series if needed. If the radio has a polarized capacitor in it, check the polarity, since reverse biasing it will cause the signal to be distorted. On units before hardware rev 'H' a nonpolar 4.7 $\mu$ F 16V capacitor may need to be tied from pin 1 of J1 to ground. On rev 'H' boards or later, C46 and C48 may need changing -- depending on your installation -- to provide a flat response to all 38 subaudible tones.

# SECTION 7 - INSTALLATION

REV	DESCRIPTION	DATE
A	RELEASE	TC 2/8
B	ECN 985	10/20/00

- NOTES:
1. SEE PART'S LIST 705-7061
  2. REMOVE SHIELDING.
  3. USE SHRINK TUBING ON CONNECTIONS AS REQUIRED.
  4. ATTACH TY-WRAP, ITEM ①, & MARK WITH PART NUMBER & REV.



SEE TABLE I  
FOR WIRE CONNECTIONS

WIRE	FUNCTION	PIN #
RED	KB-A NO	12
BLACK (RED)	KB-A COM	10, 25
SHIELD (RED)	GROUND	23
SHIELD (BROWN)	GROUND	22
BROWN	KB-B NC	15
BLACK (BROWN)	KB-B COM	13
YELLOW	COR	19
BLACK (YELLOW)	GROUND	18
SHIELD (YELLOW)	GROUND	17
BLUE	TX AUDIO HIGH	3
BLACK (BLUE)	TX AUDIO LOW	2
SHIELD (BLUE)	GROUND	1
SHIELD (WHITE)	GROUND	16
WHITE	RX AUDIO HIGH	
BLACK (WHITE)	RX AUDIO LOW	
GREEN	CTCSS ENCODE	
BLACK (GREEN)	GROUND	
SHIELD (GREEN)	GROUND	

CONNECTOR  
PIN #

PTT	GROUND	NC	USER DEFINED	NC	COR/CAS	GROUND/COR RETURN	NC	MIC HIGH/TX AUDIO	MIC LOW/TX AUDIO	NC	DISCR. HIGH/VOL. SQ. HIGH	DISCR. LOW/VOL. SQ. LOW	NC	CTCSS/DIGITAL ENCODE	GROUND	NC
12	10	25	23	22	15	13	19	18	17	3	2	1	16			

**ZETRON**

SCALE	1/1	DATE	7/11/80	APPROVED BY	J. B. Smith	DRAWN BY	J. B. Smith
TITLE: MODEL 4X TO RADIO CABLE							REV. 3
DRAWING NO. 105-7061							

## GE Master II

## JUMPERS

-----  
JP9 B Position.  
JP10 B Position.  
JP11 B Position.  
JP12 See notes.

Set COR Positive.

- \* If the Radio has the Repeater option use the Brown/Black pair to disable it. Open the connection to J933-6 when the M45 keys the radio and connect the Blue/Black pair to J933-6 & J933-5 and put JP-12 in the A position.
- \*\* Use RUS if the Radio has CG. Connect the Yellow/Black pair to J931-18 & J931-1 and remove jumper H16 - H17 on the 10V Reg. card.
- \*\*\* When using CTCSS encode on units before hardware rev 'H' you will need to put a nonpolar 4.7 $\mu$ F capacitor from Pin 1 of J1 to ground. The CTCSS level is adjustable in the radio by R105.

If you have a M45 with the repeat audio option you should remove the repeater boards.

R608 in the radio will adjust the rec. audio level.

R104 in the radio will adjust the Tx audio level.

# SECTION 7 - INSTALLATION

REV	DESCRIPTION	DATE
A	RELEASE	KC

## NOTES

- 1 SEE PARTS LIST 709-7056
- 2 ATTACH TY WRAP ITEM ①, AND MARK WITH PART NUMBER & REVISION
- 3 CUT SHRINK TUBING IN HALF
- 4 TIN WIRE ENDS
- 5 CUT ALL SHIELD TO END OF SHRINK TUBING

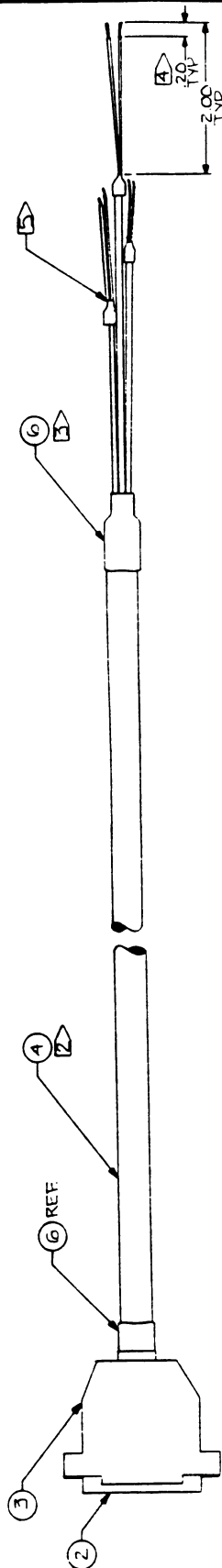


TABLE I

25-PIN DB	COLOR	LENGTH
12	RED	4.5"
10, 25	BLACK	
10, 25	SHIELD	
23	BROWN	
22	BLACK	12"
10, 25	SHIELD	
15	YELLOW	
13	BLACK	6.5"
13	SHIELD	
19	BLUE	
18	BLACK	12"
17	SHIELD	
3	WHITE	
2	BLACK	6.5"
17	SHIELD	
1	GREEN	
16	BLACK	12"
16	SHIELD	

FUNCTION	M45	GE
PTT	12	J931-14
GROUND	10	J931-1
GROUND	25	NC
KB-NC	23	USER DEFINED
KB-COM	22	USER DEFINED
GROUND	15	NC
CLK	13	J932-18 CAS
GROUND	13	J932-4
GROUND	19	NC
TX AUDIO HIGH	19	J931-12 JPIZB POSITION
TX AUDIO LOW	18	J931-11 IN 15145
GROUND	17	NC
RX AUDIO HIGH	3	J932-3 VOL 5A HIGH
RX AUDIO LOW	2	J932-4 VOL 5A LOW
GROUND	1	NC
CTCSS ENCODE 1	17	J933-3
GROUND	16	J933-2
GROUND	16	NC

**ZETRON**

SCALE: 1:1	DATE: 12-18-86	DESIGNED BY: J. J. J. J.	SHIT 101
TITLE: MODEL 4X TO			
GE MASTER II STATION			
DATE: 12-18-86	709-7056	REV: 13	

**GE Master-Pro****JUMPERS**

-----  
JP9    B Position  
JP10   A Position  
JP11   B Position  
JP12   B Position

Set COR to Positive.

Connect the DB25 connector to the M45 J1 connector. Connect the wire ends to the terminal strips and to the mike jack and the transmitter jack as needed.

SECTION 7 - INSTALLATION

REV	DESCRIPTION	DRN	APPROV	DATE
A	RELEASE	KC	/	

- NOTES:
- SEE PARTS LIST 709-7055A.
  - ATTACH TY WRAP ITEM ①, AND MARK WITH PART NUMBER & REVISION.
  - CUT ALL SHIELD TO END OF SHRINK TUBING.
  - TIN WIRE ENDS.

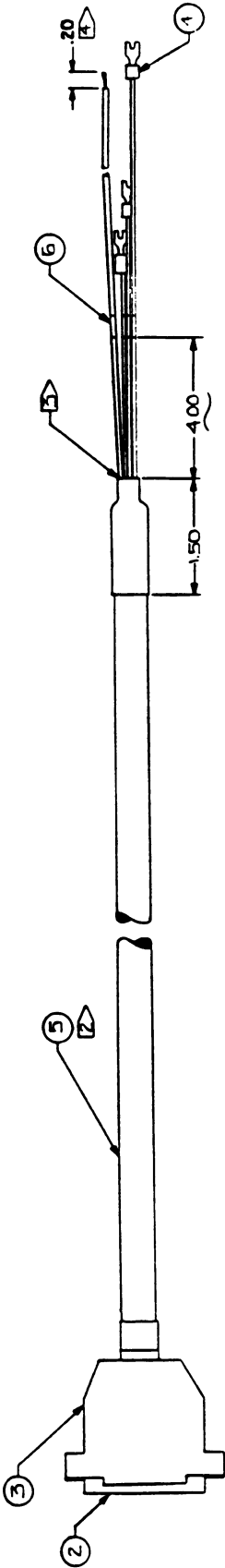


TABLE I			GE	
25-PIN DB	COLOR	LENGTH	M45	GE
12	RED	9.5	12	TB502-10
10.25	BLACK		10	TB501-12
10.25	SHIELD		25	
23	BROWN	19.0	23	USER DEFINED
22	BLACK	④	22	USER DEFINED
10.25	SHIELD			NC
15	YELLOW		15	TB502-16
13	BLACK	13.75	13	TB501-12
13	SHIELD			
19	BLUE	19.0	19	J902-2
18.17	BLACK	④	18	J902-1
18.17	SHIELD			
3	WHITE	7.0	3	TB502-2
2	BLACK		2	TB502-1
18.17	SHIELD			
1	GREEN	19.0	1	PI01-10
16	BLACK	④	16	PI01-13
16	SHIELD			

(ZETRON)

DATE	12-19-86	DESIGNED BY	SHY/10/10/10	REVISION	1
TITLE	MODEL 45 Z PATCH TO GE MASTER PRO	DRAWING NO	709-7055	REV	A

**Standard FX60 Series Base Station****JUMPERS**

JP9 B Position  
 JP10 A Position  
 JP11 B Position  
 JP12 B Position

Set COR Positive.

TX Audio is adjustable in the radio via RM01 and RQ04.

TX to RX for simplex operation is about 200ms.

M45/J1 Pin#			Radio Connections
-----			-----
		red	
PTT	12	-----	JR14
		black	
Ground	10	-----	JR10
		shield	
Ground	25	-----	No Connection
		brown	
K8-N/C	23	-----	User defined
		black	
K8-Com	22	-----	User defined
		shield	
Ground		-----	No Connection
		yellow	
Cor	15	-----	JR07
		black	
Ground	13	-----	No Connection
		shield	
Ground		-----	No Connection
		blue	
TX Audio High	19	-----	JP03
		black	
TX Audio Low	18	-----	JP04
		shield	
Ground	17	-----	No Connection
		white	
RX Audio High	3	-----	JR04
		black	
RX Audio Low	2	-----	JR10
		shield	
Ground		-----	No Connection
		green	
CTCSS Encode	1	-----	JP09
		black	
Ground	16	-----	JP04
		shield	
Ground		-----	No Connection

## SECTION 7 - INSTALLATION

### Fujitsu Ten FTM15-3092L

#### JUMPERS

-----  
JP9 B Position  
JP10 B Position  
JP11 B Position  
JP12 B Position

The Model 45 must be set up in the simplex mode.

Note that both sides of the output must be connected. To set the transmitter deviation use the single tone test in the test mode and adjust R129.

Adjust R69 for proper receive levels.

The level of the CTCSS coming out of the Model 45 is adjustable by R91. You can use CTCSS selective calling if you disable the TX CTCSS function in the radio.

#### CONNECTIONS INSIDE RADIO

-----  
\* S0501 pin 6 to ground.  
\* S0501 pin 1 to P0502 pin 6.  
\* IC408 pin 4, pickup from feedthru  
between IC413 and S0402, to S0501 pin 8.



## SECTION 7 - INSTALLATION

M45/J1 Pin#			Radio Connections
-----			-----
PTT	12	red	S0501 Pin 3
Ground	10	black	S0501 Pin Case
Ground	25	shield	No Connection
K8A-N/C	23	brown	Not Used
K8A-Com	22	black	Not Used
Ground		shield	No Connection
Cor	15	yellow	S0501 Pin 8
Ground	13	black	No Connection
Ground		shield	No Connection
X Audio High	19	blue	S0501 Pin 2
TX Audio Low	18	black	S0501 Pin 6
Ground	17	shield	No Connection
RX Audio High	3	white	S0501 Pin 1
RX Audio Low	2	black	S0501 Pin 6
Ground		shield	No Connection
CTCSS Encode	1	green	S0501 Pin 4
Ground	16	black	No Connection
Ground		shield	No Connection

## SECTION 7 - INSTALLATION

### Standard RP70 Series Repeater

#### JUMPERS

-----  
JP9 B Position  
JP10 A Position  
JP11 B Position  
JP12 B Position

Set COR to Positive.

- \* A 1  $\mu$ F capacitor has to be added in series with the TX Audio line '+' side to Pin 2 of Q234. Pull one side of R14, in the M45, up and put a 1 $\mu$ F capacitor in series, the + side to the radio. JP12 must be in B position or out.
- \* A 510-ohm resistor may need to be added across R129 pins 1 & 2 (pins 8 & 9 of U14) in the Model 45, if the transmit audio from the Model 45 is too high. The audio is adjustable via R428 inside the radio.
- \* R15 should be changed to 10K ohms if CTCSS encode from the Model 45 is being used.

When using CTCSS encode from the Model 45, the connections can be made to different points in the radio. Pin 4 of JG10 or JG11, pin 1 for ground, may be used, but the tone button for the tone connector on the front of the radio must be released before the tone will be transmitted. The tone may be injected at the junction of R282 and C251, a point on the circuit board should be available, or the tone may be injected at the junction of R276, R281, R305 and C251. Connection is made to R305.

# SECTION 7 - INSTALLATION

M45/J1 Pin#			Radio Connections
PTT	12	red	PTT on Remote Conn
Ground	10	black	Ground on Remote Conn
Ground	25	shield	No Connection
K8-N/C	23	brown	Use to control Repeat
K8-Com	22	black	Audio on Remote Conn
Ground		shield	No Connection
Cor	15	yellow	in 13 of Q119
Ground	13	black	Ground or No Connection
Ground		shield	No Connection
TX Audio High	19	blue	*Pin 2 of Q234
TX Audio Low	18	black	Ground/Pin 7 of Q231
Ground	17	shield	No Connection
RX Audio High	3	white	Pin 14 of Q237
RX Audio Low	2	black	Ground/Pin 11 of Q237
Ground		shield	No Connection
CTCSS Encode	1	green	See notes
Ground	16	black	Ground or No Connection
Ground		shield	No Connection

## SECTION 7 - INSTALLATION

### COMPUTER OR CRT CONNECTIONS

The computer/CRT port on the Model 45 is compatible with RS-232C signals and uses an asynchronous ASCII serial communications protocol. The unit sends and expects to receive data with 8 data bits, no parity, and 1 stop bit. Typically, only three wires need to be connected from your computer or CRT to the Serial I/O connector (J3) on the Z-Patch: Pin-3 (Txdata), Pin-4 (Rxdata), and Pin-5 (GND) (Figure 26). If your hardware requires signals on the DSR, DTR or CARRIER DETECT pins, they must be tied high or low, depending on the requirements of your hardware -- consult the manual for your specific hardware for more information.

When the Model 45 is powered on or reset, a message is sent out the serial port. This may be helpful when installing or debugging serial communication. See appendices 1-3 for more information on terminal emulation and serial connections between the Model 45 and the Radio Shack Model 100 and Commodore 64.

MODEL 45 DB-9 PIN	LABEL	CONNECTION	COMPUTER DB-25 PIN
=====	=====	=====	=====
1	DTR	(none)	
2	+5VDC	(none)	
3	TX	-----> to CRT RX	3
4	RX	<----- from CRT TX	2
5	GND	<-----> to CRT GND	7
6	N/C	(none)	
7	RTS	(none)	
8	CTS		4
9	PRINT		

FIGURE 26: Typical Model 45-to-computer serial connections.

#### XON/XOFF Protocol

The Model 45 follows the "XOFF/XON" protocol. This is a flow control sequence that prevents information from flowing too rapidly for the display device (printer/terminal) to receive. If the Z-Patch receives an "XOFF" code (Control S), the data output will pause until an "XON" code (Control Q) is received.

## Serial Communications

CONNECT YOUR COMPUTER OR CRT to the serial connector J3 as discussed in "Computer or CRT Connections," Section 7. The Model 45 serial port is preset at the factory for 4800 baud communications with 8 data bits, 1 stop bit and no parity. Configure your computer or CRT similarly. If you are using a CRT (dumb terminal) this is all that needs to be done for serial communications. If you are using an IBM PC (or compatible), start your terminal emulation program and set it for 4800 baud, 8 data bits, 1 start bit and no parity. Press RETURN to "bring-up" the Model 45 sign-on message and "Top-menu". Appendix A1 provides information on using the ZETRON supplied terminal emulator DT. Appendix A2 tells how to use a Radio Shack Model 100 computer for communications and Appendix A3 provides information on using a Commodore 64 computer.

If required, the baud rate may be changed to 300, 600, 1200, 2400 or 4800 baud using DTMF programming via the local phone as follows:

- a. Plug a standard DTMF telephone into the Model 45's local phone jack.
- b. Pick up the hand-set and enter "00098". The unit will issue its DTMF programming prompt tune (if the modem option is installed, 10 seconds of modem carrier will be issued first).
- c. Enter "78\* ". The unit will issue 2 beeps.
- d. Enter one of these:

0# for 300 baud  
 1# for 1200 baud  
 2# for 2400 baud  
 3# for 4800 baud  
 4# for 600 baud

- after which the unit will issue 3 beeps.
- e. Enter "0\*0#" and hang up the hand-set.

## Reset User Programming and Call Accounting

ENTER A "V" FOLLOWED BY A "RETURN", from the top menu, to select the supervisor menu. Enter a "U", followed by a "Y", followed by a RETURN. This will set the user programming to the factory defaults. This will also reset the accumulated call data.

If your unit is equipped with the internal detailed call accounting option, an additional menu item for "clear internal storage" will appear. Enter a "Y" followed by a RETURN.

The accumulated call data may be cleared independent of resetting the user programming. To clear the accumulated airtime memory (all units), enter a "!", followed by an "A" and a "U". Enter "1-99" for a 99-user system, or "1-325" for a unit provided with the extended user option, and press RETURN. Press RETURN again to display the "clear accumulated" prompt. Enter a "Y" and press RETURN.

Exit programming by typing a "!" followed by an "E". The unit should issue its sign-off message.

## SECTION 7 - INSTALLATION

### INSTALLING NEW EPROMS

Most changes to the Model 45 are made only to the controlling software. Whenever a change is made to the Z-Patch, a new EPROM IC containing the operating software for the unit must be installed. ICs are delicate and sensitive to static. When handling them, be sure to remain grounded by maintaining contact with the chassis sheet metal. Only remove the ICs from the static protective shipping material when ready for installation. The following steps outline the EPROM installation procedure. When upgrading hardware for B version software, refer to Section 6 - Repairing and Updating.

1. TURN OFF THE POWER, or remove power connector at rear.
2. Remove the top cover.
3. Remove the old EPROM(s) from the board.
4. Carefully note the orientation notch on the end of the old EPROM(s).
5. Install the new IC(s) in the designated sockets with the orientation notches aligned with the notches in the sockets.
6. Carefully examine all of the pins of each IC. Make sure that the pins are aligned in the sockets, fully inserted and not bent out or under.
7. Turn on power to the Z-Patch and make sure that the front panel gives a normal display. If all LEDs are on, there is a problem.
8. Replace the top cover of the unit.
9. Return the old EPROM(s) to Zetron in the protective shipping material in which the new EPROMs were shipped.

### UPGRADING TO THE SMDR PRINT OUT

When adding the SMDR printer option the EPROM(S) will need to be changed and a smart clock socket will have to be installed in U57, under the database RAM. You will have to remove the RAM from the battery socket in U57 and place it in the smart clock socket. Caution: this will destroy all of your system and user programming, you must first download the database and any call accumulation you want to keep. Plug the smart clock into U57 and the RAM, removed from the old socket, into the smart clock socket. The new socket contains the battery to retain all programming.

Power up the unit and reset the system programming as in RESET SYSTEM PROGRAMMING, using the reset and connect buttons on the Model 45. Then upload the database.

### UPGRADING TO THE SMDR INTERNAL STORAGE

When upgrading to the SMDR internal storage option you must first do the upgrade to the SMDR print out. Next install the SMDR memory in U59. Power up the unit and reset the system programming. Then upload the database and continue. Note if the SMDR internal storage option is installed in the EPROM(s) but the board is not installed or if there is a memory error, the memory test will give an error message.

**UPGRADING 99-USER SYSTEMS TO 325-USER SYSTEMS**

Upgrade to a 325-user system from a 99-user system by simply changing the PROM as outlined above. The user programming for the first 99 users is still intact. Caution: the over dial from the phone will now be 3-digit, 001 to 325.





## 8. REPAIR

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**IN CASE OF DIFFICULTY**

In case of installation difficulty, call the Zetron Model 45 Applications Engineering Department at (206) 820-6363. Engineers are available. Please have the serial number of the unit and/or the Zetron Order number. If the call is made from the installation site by the installer or radio technician, the problem can usually be solved over the phone.

If a problem develops after a unit has been in service for some time, check the fault identification list below to isolate the problem. If help is required, call the Zetron Model 45 Service Department at (206) 820-6363. If the call is made from the installation site by a radio technician, and a spare parts kit is on hand, the problem can usually be solved over the phone. If requested, units returned to Zetron (if received before 11:00am) can be serviced and returned the same day. In the case of units that have been hit by lightning, the unit will be powered up overnight, retested and shipped the next day.

**FAULT IDENTIFICATION**

PROBLEM	POSSIBLE CAUSE(S)
No answer on any line, but RING light works.	Relays, relay driver IC.
1000 Hz test tone off frequency. Transmit led works, but doesn't key the transmitter.	Y1 xtal off frequency. TR relay defective. K8
Difficult for mobiles to perform connect.	Gain from receiver wrong, Pre or De-emphasis needed. Power supply voltage to low.
Wrong numbers dialed from mobiles	Same as above, level to phone wrong
Answers phone line & issues dial tone, but doesn't respond to DTMF.	Level from phone wrong, hybrid line balance wrong, Pre or De-emphasis needed from phone line.
Phone party hears unsquelched audio (hiss) when mobile is not talking.	COR not working while transmitter is on.
Dial pulse dialing across tip and ring cause unit to detect ringing.	a. Change dial pulse phone to DTMF dial. b. Connect in parallel, a 100k resistor and a 0.1 $\mu$ F to 0.47 $\mu$ F 100V capacitor, from pin 5 to pin 7 of U3, for line 1, or U1 for line 2.

## SECTION 8 - REPAIR

Modem programming doesn't work

- a. Modem option not installed, wrong baud rate on CRT
- b. Poor quality phone line audio.  
Listen to audio; if snaps or crackles are heard, the modem may be unusable.
- c. M45 phone line (hybrid) balance poor.
- d. Audio gain TO or FROM the phone line too high or too low. The levels are set at the factory, but may need to be adjusted slightly in some cases. If the computer gives a "no carrier" indication, the gain TO the phone line may be low.

If the Model 45 drops into DTMF programming then the level to the 45 is not high enough, adjust R100 or hybrid balance. If the 45 does not drop into DTMF programming the level to your modem may not be high enough, adjust R97. Note the R100 adjust all the phone line levels to the 45 and transmitter and R97 adjust all of the levels to the phone line, dial tone, courtesy tones and the mobiles audio.

## ZETRON MODEL 4X M150 MAIN BOARD SPARE PARTS KIT 70 USER (951-9026G)

ITEM	QTY	ZETRON P/N	DESCRIPTION	MFR. PART #
1.	2	105-0001	VARISTOR	V250A15A
2.	1	107-0501	5K POT 1T	
3.	2	107-0502	50K POT 1T	
4.	1	107-3085	10K POT 1T	
5.	2	150-0110	.01 CER DISC	
6.	4	151-0180	.1 CER TS	
7.	1	152-0030	2.2 250V POLY	
8.	2	154-0100	10 16V TANT	
9.	1	155-0050	10 25V ELECT	
10.	1	155-0055	22 25V ELECT	
11.	1	155-0080	100 25V ELECT	
12.	1	155-0141	3300 16V TUB	
13.	1	305-0003	AUDIO 600 OHM	TM-016
14.	1	305-0004	2T04 WIRE HYBRID	671-0256
15.	1	305-2600	600:600 OHM AUD	
16.	1	311-0008	OPTO ISOLATOR	4N26
17.	1	311-0010	LED RED	
18.	1	314-4373	OCTAL LATCH TS	74LS373
19.	1	314-7400	QUAD NAND	74LS00
20.	1	314-7402	QUAD 2 INPUT NOR	74LS02
21.	1	314-7404	HEX INVERTER	74LS04
22.	1	316-0004	TONE FILTER	MC4CN-50
23.	1	316-0353	OP-AMP, DUAL BIFET	LF353P
24.	1	316-3403	OP-AMP, QUAD	MC3403P
25.	1	316-0358	OP-AMP, DUAL	LM358P
26.	1	316-0567	PLL, TONE DECODER	LM567
27.	1	316-7660	VOLTAGE CONVERTER	ICL7660CPA
28.	1	316-7805	REG +5V 1.5A	LM340T-5
29.	1	316-7840	REGULATOR, 5W REG	78S40
30.	1	321-0202	DTMF DECODER	SSI-202P
31.	2	321-6264	8K RAM	HM6264ALP-15
32.	1	321-6803	MICROPROCESSOR	MC6803P
33.	1	321-6822	PIA OPEN COLL OUTP	MC6822
34.	1	321-6840	PTM	MC6840
35.	1	323-1520	RING DET	TCM1520
36.	1	323-4049	HEX BUFFER INV	MC14049B
37.	1	323-4053	3PDT SWITCH	MC144053
38.	1	323-4066	QUAD ANALOG SWITCH	MC14066B
39.	1	323-4093	QUAD NAND SCHMITT	MC14093B
40.	1	323-4099	8 BIT LATCH	MC14099B
41.	1	323-4503	HEX BUFFER	MC14503
42.	1	323-4906	HEX LEVEL SHIFT	74C906
43.	1	323-9532	MODEM	TMS99532
44.	1	324-4138	DECODER 1 OF 8	74HC138
45.	1	324-7420	GATE	74HC20
46.	1	340-0008	HEX FET	P8P08
47.	1	340-0014	HEX NPN	MPSA14
48.	1	340-2003	DRIVER ARRAY	ULN2003
49.	1	340-3904	NPN GEN	2N3904
50.	1	340-3906	PNP GEN	2N3906
51.	1	340-5460	FET	2N5460

# SECTION 8 - REPAIR

## ZETRON MODEL 4X M150 MAIN BOARD SPARE PARTS KIT 70 USER (951-90266) cont'd

ITEM	QTY	ZETRON P/N	DESCRIPTION	MFR. PART #
52.	1	342-0001	SILICON 1A 100V	1N4002
53.	1	342-3008	GERMANIUM	1N100
54.	2	342-3009	SILICON	1N4148
55.	1	342-5822	SILICON HC	1N5822
56.	1	343-3029	1W 5.1V	1N4733A
57.	1	343-3035	1W 12V	1N4742A
58.	1	376-0245	2.4576 MHZ	
59.	1	376-0358	3.58 MHZ	
60.	1	376-4032	4.032 MHZ	
61.	1	380-0001	SPDT 12V	
62.	1	380-0030	DPDT 12V	
63.	1	416-1214	SOCKET W/BATTERY 8K DS1214	
64.	2	416-1576	FUSE AGC 1 A	

## MODEL 45 Z-PATCH PARTS LIST (702-9032V)

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMP. REF.	MFR. PART #
1.	5	101-0025	10 OHM 1/4W 5%	R34 54 64 70 121	
2.	1	101-0033	22 OHM	R202	
3.	1	101-0049	100 OHM	R47	
4.	1	101-0057	220 OHM	R8	
5.	2	101-0061	330 OHM	R51 52	
6.	4	101-0065	470 OHM	R48 119 185 187	
6.5	1	101-0066	510 OHM	R63	
7.	5	101-0068	620 OHM	R10 15 59-61	
8.	1	101-0069	680 OHM	R74	
9.	11	101-0073	1K	R11 25 26 38 39 45 58 87 126 198 207	
10.	1	101-0074	1.2K	R57	
11.	4	101-0081	2.2K	R2 5 49 161	
12.	1	101-0083	2.7K	R146	
13.	4	101-0085	3.3K	R44 46 73 135	
14.	2	101-0087	3.9K	R145 189	
15.	7	101-0089	4.7K	R1 6 35 56 78 182 200	
16.	3	101-0090	5.1K	R105 130 138	
17.	1	101-0091	5.6K	R190	
18.	53	101-0097	10K	R14 16 31-33 43 72 80 84 86 88-90 92-96 108 109 115 116 120 122 123-125 127 131 133 136 139 140 143 144 147 148 154 158 165 181 183 186 191 192 197 199 201 204-206 208 209	
19.	2	101-0099	12K	R141 156	
19.5	1	101-0101	15K	R110	
20.	1	101-0103	18K	R149	
21.	1	101-0104	20K	R153	
22.	4	101-0105	22K	R29 37 157 X2	
23.	3	101-0106	24K	R104 172 179	
24.	1	101-0107	27K	R79	
25.	4	101-0108	30K	R111 112 151 152	
26.	2	101-0109	33K	R81 99	
27.	19	101-0113	47K	R3 4 7 13 21-24 62 65 66 75 106 107 114 155 160 169	
28.	2	101-0115	56K	R82 83	
29.	12	101-0121	100K	R68 71 76 128 137 166 167 173 176 178 180 X1	
30.	1	101-0125	150K	R174	
31.	1	101-0129	220K	R150	
32.	5	101-0137	470K	R17-20 164	
33.	1	101-0141	680K	R177	
34.	6	101-0145	1M	R118 162 163 168 175 203	
35.	3	101-0160	10M	R55 67 77	
36.	1	103-0010	.1 OHM 1W	R53	
37.	6	105-0001	VARISTOR	RV1-6	
38.	2	107-0501	5K POT 1T	R98 134	
39.	9	107-0502	50K POT 1T	R69 85 91 97 100 113 129 159 170	
40.	1	107-3085	10K POT 1T	R36	

# SECTION 8 - REPAIR

## MODEL 45 Z-PATCH PARTS LIST (702-9032V) cont'd

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMP. REF.	MFR. PART #
41.	1	119-0004	1Kx7 R-PAK	RP1	
42.	2	119-0006	10Kx9 R-PAK	RP2 3	
43.	1	119-0008	10Kx7 R-PAK	RP4	
44.	5	150-0024	24 PF CER DISC	C58 73 74 97 98	
45.	18	150-0110	.01 CER DISC	C15 18 24 50-56 68 70 71 75 84 99 101 111	
46.	4	151-0020	.001 CER TS	C6 43 44 78	
47.	3	151-0027	270 PF CER TS	C21 40 90	
48.	1	151-0090	.0033 CER TS	C93	
49.	2	151-0100	.033 UF 50V TS	C96 107	
50.	5	151-0120	.01 CER TS	C41 45 102 106 X6	
51.	2	151-0130	.047 CER TS	C46 60	
52.	19	151-0180	.1 CER TS	C16 28 31 32-35 37 38 49 67 79 80 88 91 92 95 110 X3	
53.	7	151-0199	.47 CER TS	C61 65 66 76 85 108 X5	
54.	2	152-0021	.47 250V POLY	C1 2	
55.	1	152-0030	2.2 250V POLY	C57	
56.	1	152-0040	4.7 UF 50V POLY	C7	
57.	4	154-0025	1.0 35V TANT	C36 39 63 81	
58.	21	154-0100	10 16V TANT	C5 10 11 13 23 25 30 47 59 62 64 69 72 77 86 87 89 94 100 103 109	
59.	1	155-0010	1.0 50V ALUM	C83	
60.	1	155-0014	4.7 50V ALUM	C48 82	
61.	5	155-0050	10 25V ALUM	C3 4 22 104 105	
62.	3	155-0055	22 25V ALUM	C9 17 29	
63.	1	155-0080	100 25V ALUM	C19	
64.	3	155-0141	3300 16V ALUM TUB	C14 26 27	
65.	8	210-0001	440 NUT	XJ1-3 XQ9 XVR1	
66.	1	220-0102	440 X 3/8 SCREW	XVR1	
67.	7	220-0106	440 X 5/16 SCREW	XJ1-3 XQ9	
68.	2	234-0007	INSUL. WASHER	XQ9 XVR1	
69.	2	236-0001	NICA WASHER	XQ9 XVR1	
70.	2	305-0003	AUDIO 600 OHM	T1 2	
71.	2	305-0004	2T04 WIRE HYBRID	T5 6	
72.	5	305-0007	BEADS FERRITE	E1-4 6 NOTE 1	
73.	1	305-0023	500MH INDUCTOR 1A	T3	
74.	1	305-2600	600:600 OHM AUD	T4	
75.	3	311-0008	OPTO ISOLATOR	U2 4 5	4N26
76.	9	311-0010	LED RED	DS1-9	
77.	2	314-7400	QUAD NAND	U19 41	74LS00
78.	3	314-7402	QUAD 2 INPUT NOR	U43 62 64 NOTE 2	74LS02
79.	1	314-7404	HEX INVERTER	U42	74LS04
80.	4	316-0004	TONE FILTER	U22 23 30 34	NF4CN-50
81.	2	316-0353	OP-AMP, DUAL BIFET	U14 20	LF353P
82.	6	316-3403	OP-AMP, QUAD	U12 13 21 24 47 48	MC3403P
83.	1	316-0567	PLL, TONE DECODER	U29	LM567
84.	2	316-7660	VOLTAGE CONVERTER	U9 65	ICL7660CPA
85.	1	316-7805	REG +5V 1.5A	VR1	LM340T-5
86.	1	316-7840	REGULATOR, 5W REG	U11	78S40



## MODEL 45 Z-PATCH PARTS LIST (702-9032V) cont'd

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMP. REF.	MFR. PART #
87.	1	321-0202	DTMF DECODER	U45	SSI-202P
88.	2	321-6264	8Kx8 RAM	U57 59	HM6264LP-15
89.	1	321-6803	MICROPROCESSOR	U46	MC6803P
90.	1	321-6820	PIA	U26	MC6821
91.	2	321-6840	PTM	U27 28	MC6840
92.	1	323-0212	MODEM 1200 BAUD	U51	UA212A
93.	2	323-1520	RING DET	U1 3	TCM1520
94.	1	323-4049	HEX BUFFER INV	U15	MC14049B
95.	2	323-4053	3PDT SWITCH	U33 50	MC14053
96.	4	323-4066	QUAD ANALOG SWITCH	U25 32 35 49	MC14066B
97.	1	323-4093	QUAD NAND SCHMITT	U53	MC14093B
98.	4	323-4099	8 BIT LATCH	U16 39 40 52	MC14099B
99.	1	323-4503	HEX BUFFER	U17	MC14503
100.	5	323-4906	HEX LEVEL SHIFT	U18 31 36-38	74C906
101.	2	324-4138	DECODER 1 OF 8	U44 60	74HC138
102.	1	324-7420	GATE	U61	74HC20
103.	1	325-4373	OCTAL LATCH	U54	74HCT373
104.	1	325-4374	OCTAL DFF REG TS	U63	74HCT374
105.	1	340-0008	HEX FET	Q9	P8P08
106.	2	340-0014	HEX NPN	Q1 11	MPSA14
107.	1	340-2003	DRIVER ARRAY	U8	ULN2003
108.	5	340-3904	NPN GEN	Q2 5 8 14 15	2N3904
109.	1	340-3906	PNP GEN	Q7	2N3906
110.	2	340-5460		Q4 10	2N5460
111.	5	342-0001	SILICON 1A 100V	CR9 16-19	1N4002
112.	4	342-3008	GERMANIUM	CR22 24 25 29	1N100
113.	20	342-3009	SILICON	CR1-8 10-12 27 28 30-32 34-36 41	1N4148
114.	1	342-5822	SILICON HC	CR13	1N5822
115.	3	343-3029	1W 5.1V	CR15 20 26	1N4733A
115.5	1	343-3030	1W 6.2V	CR33	1N4735A
116.	3	371-0005	SINGLE KEY RA	SW1-3	
117.	1	376-0004	4.0000 MHZ	Y1	
118.	1	376-0358	3.58 MHZ	Y3	
119.	1	376-3686	3.6864 MHZ	Y2	
120.	4	380-0001	SPDT 12V	K4-7	
121.	4	380-0030	DPDT 12V	K1-3 8	
122.	1	381-0003	HEATSINK	XVR1	
123.	1	401-0013	DC PWR CONN F	J8	
124.	1	401-0021	DB9 S	J3	
125.	1	401-0023	DB25 M	J2	
126.	1	401-0024	DB25 P	J1	
127.	1	401-0034	3 CON STEREO JACK	J7	
128.	82	401-0052	STAKE PINS	TP1-10 (1 EA) XJP1-8 13-20 27 31-33 (2 EA) XJP9-12 21-24 30 35 (3 EA)	
129.	1	401-6006	6-POS MALE	P1	
130.	3	401-7000	6-POS TELCO JACK	J4-6	

## SECTION 8 - REPAIR

### MODEL 45 Z-PATCH PARTS LIST (702-9032V) cont'd

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMP. REF.	MFR. PART #
131.	12	402-3040	MINI JUMPER	JP17 25 (IN) JP9 11 12 22 23 30 (POS A) JP10 21 24 35 (POS B)	
132.	3	407-0006	SKT 6 PIN DIP	XU2 4 5	
133.	11	407-0008	SKT 8 PIN DIP	XU1 3 9 14 20 22 23 29 30 34 65	
134.	23	407-0014	SKT 14 PIN DIP	XU12 13 18 19 21 24 25 31 32 35-38 41-43 47-49 53 61 62 64	
135.	12	407-0016	SKT 16 PIN DIP	XU8 11 15-17 33 39 40 44 50 52 60	
136.	1	407-0018	SKT 18 PIN DIP	XU45	
137.	2	407-0020	SKT 20 PIN DIP	XU54 63	
138.	8	407-0028	SKT 28 PIN DIP	XU27 28 51 55-59	
139.	2	407-0040	SKT 40 PIN DIP	XU26 46	
140.	3	408-0001	JUMPER WIRE	JP28 29 34	
141.	1	410-9032E	PCB BARE	ZETRON	
142.	1	416-1213	28 PIN SKT/BAT	XU57	
143.	1	416-1577	1A FUSE SLO-BLO	F1	
144.	2	416-3040	FUSE CLIP	XF1	
145.	9	417-0010	LED MOUNT	XDS1-9	
146.	.1	561-0001	THERMAL GREASE	XQ9 XVR1	

DO NOT INSTALL:

C8 12 20 42 X1 X2 X4

R12 27 28 30 40-42 50

CR14

Q3 6

U6 7 10

NOTES:

1. USE SPARE WIRE
2. ON COMPONENT SIDE CUT TRACE BETWEEN U62 PINS 8 & 9.

## ZETRON MODEL 4X VOX DELAY PARTS LIST (702-9031H)

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	4	R4,R8,R9,R12	101-0073	1K 1/4W 5% CARBON FILM	
2	5	R3,R7,R11,R14,R15	101-0085	3.3K 1/4W 5% CARBON FILM	
3	1	R1	101-0097	10K 1/4W 5% CARBON FILM	
4	2	R2,R18	101-0105	22K 1/4W 5% CARBON FILM	
5	1	R13	101-0113	47K 1/4W 5% CARBON FILM	
6	2	R6,R17	101-0121	100K 1/4W 5% CARBON FILM	
7	2	R5,R16	101-0160	10M 1/4W 5% CARBON FILM	
8	1	R10	107-0502	50K POT 1 TURN	3386P-1-503
9	1	C8	151-0010	100 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C101K
10	1	C6	151-0020	.001 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C102K
11	1	C10	151-0027	270 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C271K
12	4	C3,C5,C11,C13	151-0130	.047 UF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW20C473M
13	6	C1,C2,C4,C7,C9,C12	151-0180	.1 UF 50V +-10% CERAMIC, UNSTABLE	AVXSR205E104MAA
14	2	U6,U7	316-0004	TONE FILTER	MF4CN-50
15	1	U4	321-0256	256K DRAM	P21256-100
16	2	U5,U12	323-3418	CVSD VOICE DIG	MC3418CP
17	2	U3,U10	323-4019	MUX	MC14019
18	1	U8	323-4047	MONOSTABLE MULTIVIBRATOR	CD4047BE
19	1	U11	323-4049	HEX BUFFER INV	MC14049B
20	1	U1	323-4053	3PDT SWITCH	MC144053
21	2	U2,U9	323-4520	COUNTER	MC14520
22	1	J1 (NOTE 1)	401-6005	6-POS FEMALE	09-52-3063
23	2	XU6 7	407-0008	8-PIN DIP SOCKET	
24	1	XU8	407-0014	14-PIN DIP SOCKET	
25	9	XU1-5 9-12	407-0016	16-PIN DIP SOCKET	
26	1	PCB	410-9031D	VOX DELAY BOARD	

## NOTES:

1. CUT OFF TAB NEAR PIN 1 OF J1.

## SECTION 8 - REPAIR

### ZETRON MODEL 4X SMDR MEMORY BOARD PARTS LIST (702-9128B.1)

ITEM	QTY	ZETRON P/N	DESCRIPTION	COMPONENT REF.	MFG.PART NO
1	2	101-0097	10K 1/4W 5% CARBON FILM	R1 2	V22ZA3
2	3	151-0180	.1 UF 50V TS	C1 2 3	AVXSR205E104MAA
3	1	314-7400	QUAD NAND	U2	74LS00
4	1	314-7402	QUAD 2 INPUT NOR	U1	74LS02
5	1	321-8256	32KX8 RAM LP	U5	HPD43256-15L
6	1	325-4374	OCTAL DFF REG TS	U3	74HCT374
7	28	402-0032	14 PIN STRIP	P1 (NOTE 1)	TS-132-T-AA
8	2	402-0014	SKT, 14 PIN DIP	XU1 2	
9	1	402-0020	SKT, 20 PIN DIP	XU3	
10	1	407-0028	SKT, 28 PIN DIP	XP1 (NOTE 2)	
11	1	407-0108	SKT, 8 PIN SIP	P2	
12	1	410-9128A	PCB	PCB	
13	1	416-1214	28 PIN SKT/BAT 8K/32K	XU5	DS1213C

DO NOT INSTALL: U4

#### NOTES:

1. PINS INSTALLED INTO BOARD FROM SOLDER SIDE, SOLDER LARGER DIAMETER PINS INTO THE BOARD.
2. PROTECT PINS WITH FOAM.

SECTION 8 - REPAIR

ZETRON MODEL 4X 1200 BAUD MODEM BOARD PARTS LIST (702-9109C)

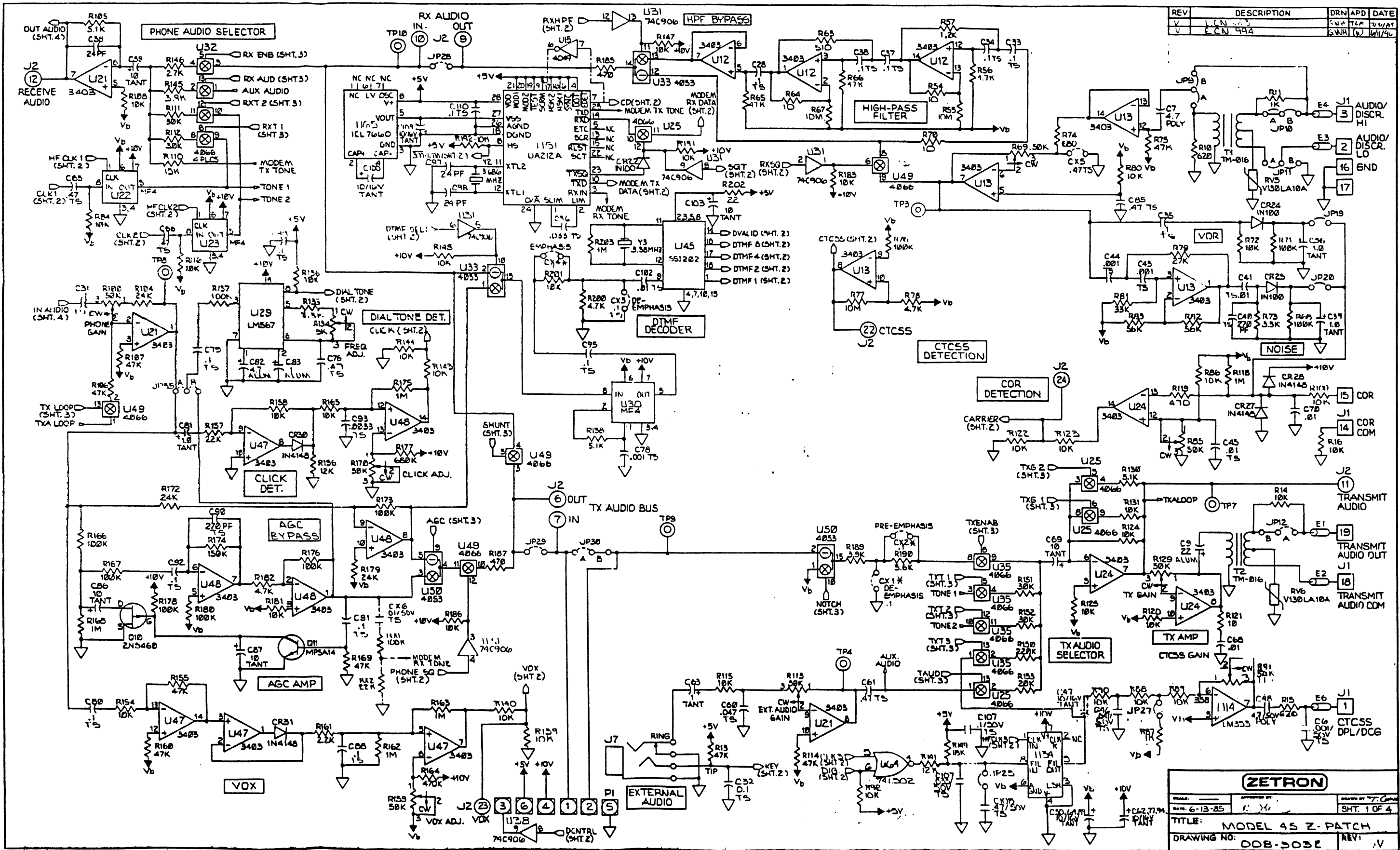
ITEM	QTY	ZETRON P/N	DESCRIPTION	COMP.REF	MFR. PART NO.
1.	1	101-0094	7.5K 5%	R1	
2.	2	150-0024	24PF DISC	C2 3	
3.	1	151-0100	.033UF 50V TS	C4	
4.	1	151-0180	.1UF 50V TS	CX1 NOTE 1	
5.	2	154-0100	10UF 16V TANT	C1 5	
6.	1	316-7660	VOLTAGE CONVERTER	U2	1CL7660CPA
7.	1	323-0212	MODEM 1200 BAUD	U1 NOTES 3&4	UA212A
8.	1	376-3686	3.6864 MHZ HC18 CASE	Y1	
9.	18	402-0032	.025x.159 STRAIGHT PIN	P1 NOTE 2&4	
10.	1	407-0008	SKT, 08 PIN DIP	XU2	
11.	1	407-0028	SKT, 28 PIN DIP	XU1	
12.	2	408-0001	WIRE JUMPER	JP1 POS A	
				JP2 POS C	
13.	1	410-9109A	PCB-BARE		
14.	1	431-0006	FOOT, BUMPON		

NOTES:

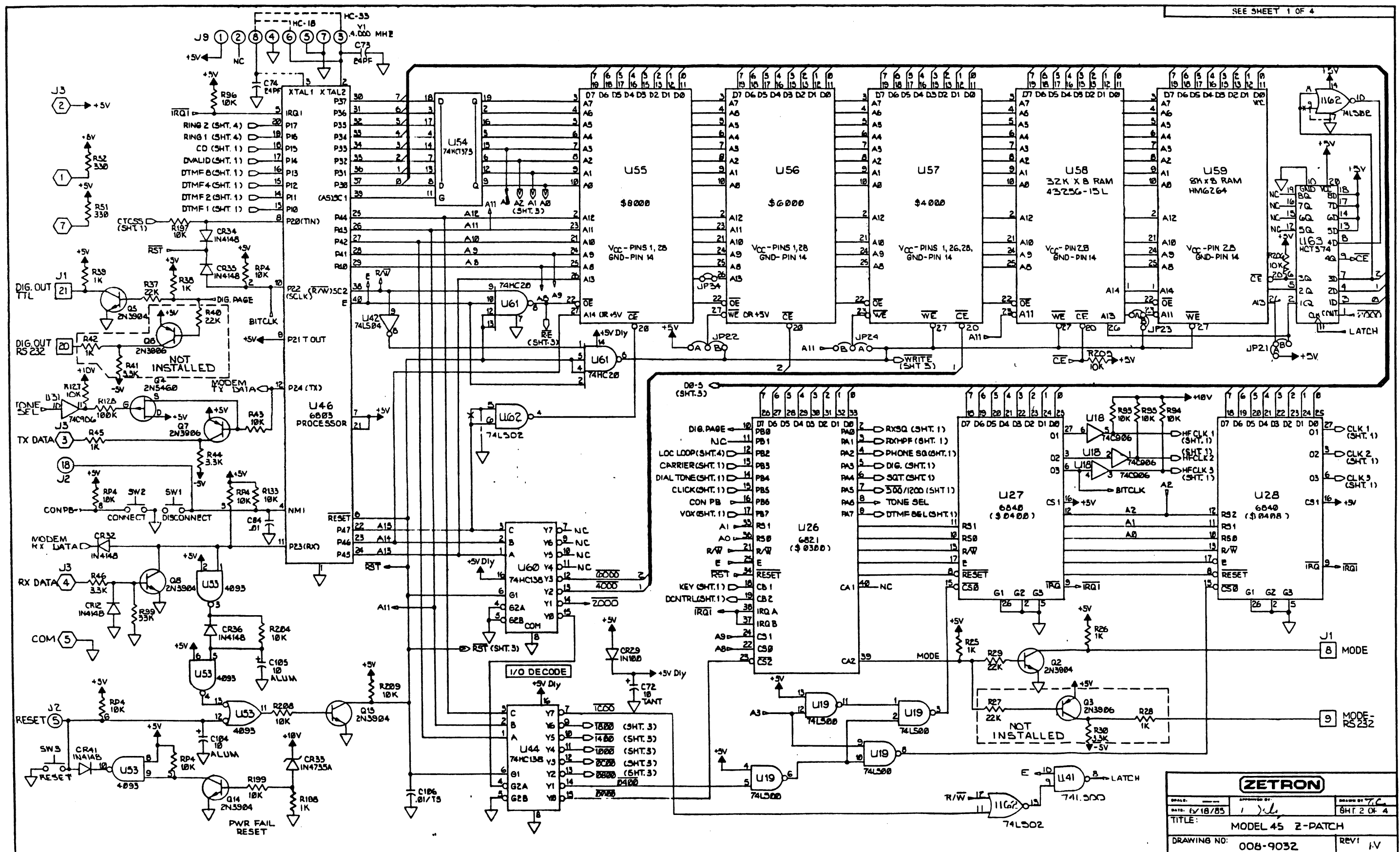
- 1. INSTALL CX1 BETWEEN U1-18 (GND) & U1-20 (+5V).
- 2. BREAK ITEM 9 INTO 2 ROWS OF 9 PINS, INSTALL LARGER DIAMETER PINS INTO SOLDER SIDE OF BOARD AT P1 THEN SOLDER.
- 3. INSTALL A REWORK WIRE BETWEEN P1 PIN 17 AND U1 PIN 23.
- 4. CUT TRACE TO U1-9 (+5V).
- 5. JUMPER FROM U1-9 TO P1-6.

SECTION 8 - REPAIR

REV. V SCHEMATIC (008-9032V) SHT 1/4

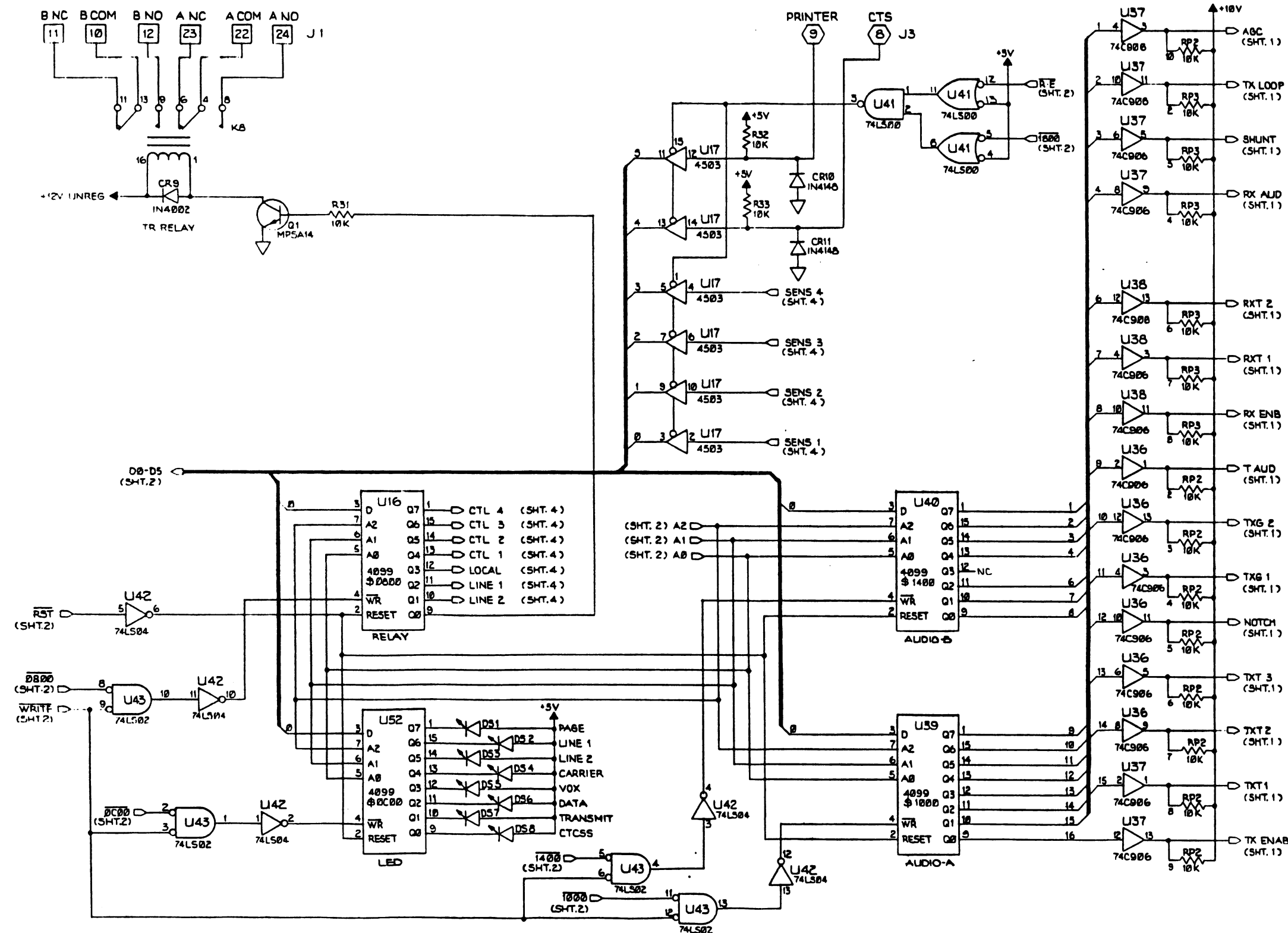


## REV. V SCHEMATIC (008-9032V) SHT 2/4



## SECTION 8 - REPAIR

REV. V SCHEMATIC (008-9032V) SHT 3/4

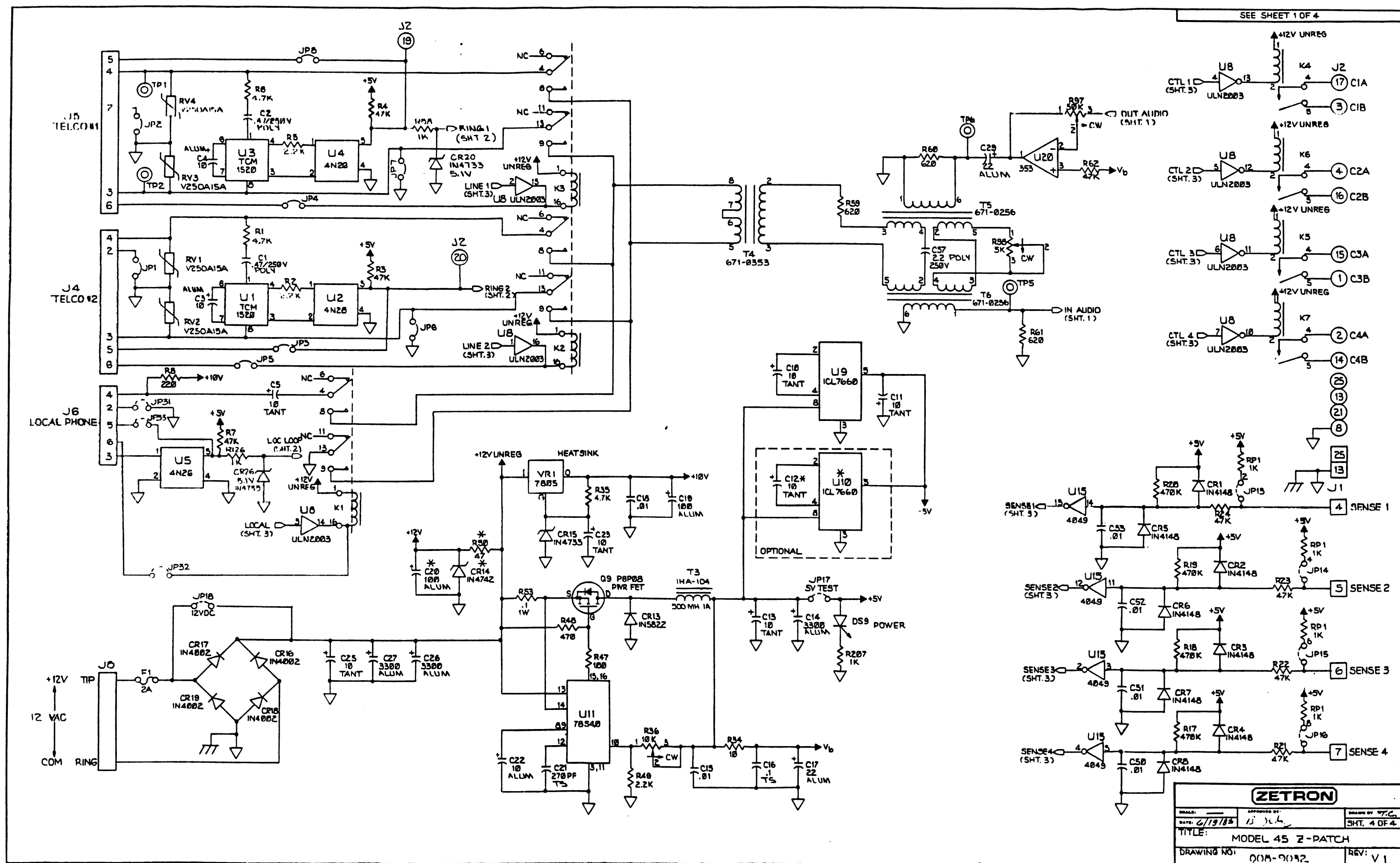


SEE SHEET 1 OF 4

- NOTES: UNLESS OTHERWISE SPECIFIED  
 1 ALL RESISTORS ARE IN OHMS, 1/4W, 5%  
 2 ALL CAPACITORS ARE IN MICROFARADS  
 3 BYPASS CAPACITORS (.01, .05V-GND) / (.1, .15V-GND)  
 4 ALL CAPACITORS ARE DISC.  
 5 LAST REF DES. USED:  
 C111, C141, C142, D57, E6, J7, J733, P2, Q15,  
 R208, R214, R215, R216, R217, R218, R219, R220, R221,  
 R222, R223, R224, R225, R226, R227, R228, R229, R230,  
 R231, R232, R233, R234, R235, R236, R237, R238, R239, R240,  
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 R1821, R182

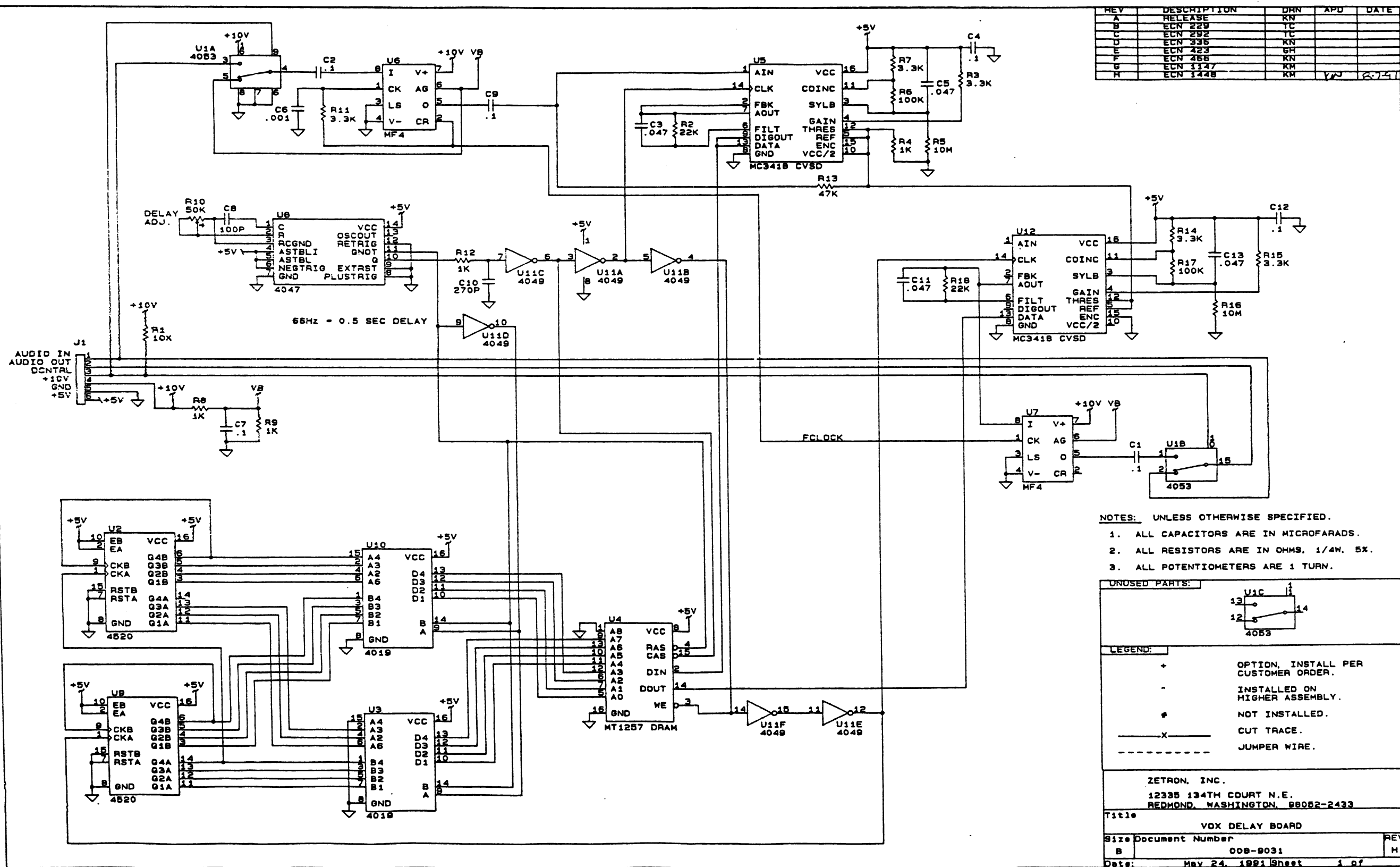


REV. V SCHEMATIC (008-9032V) SHT 4/4

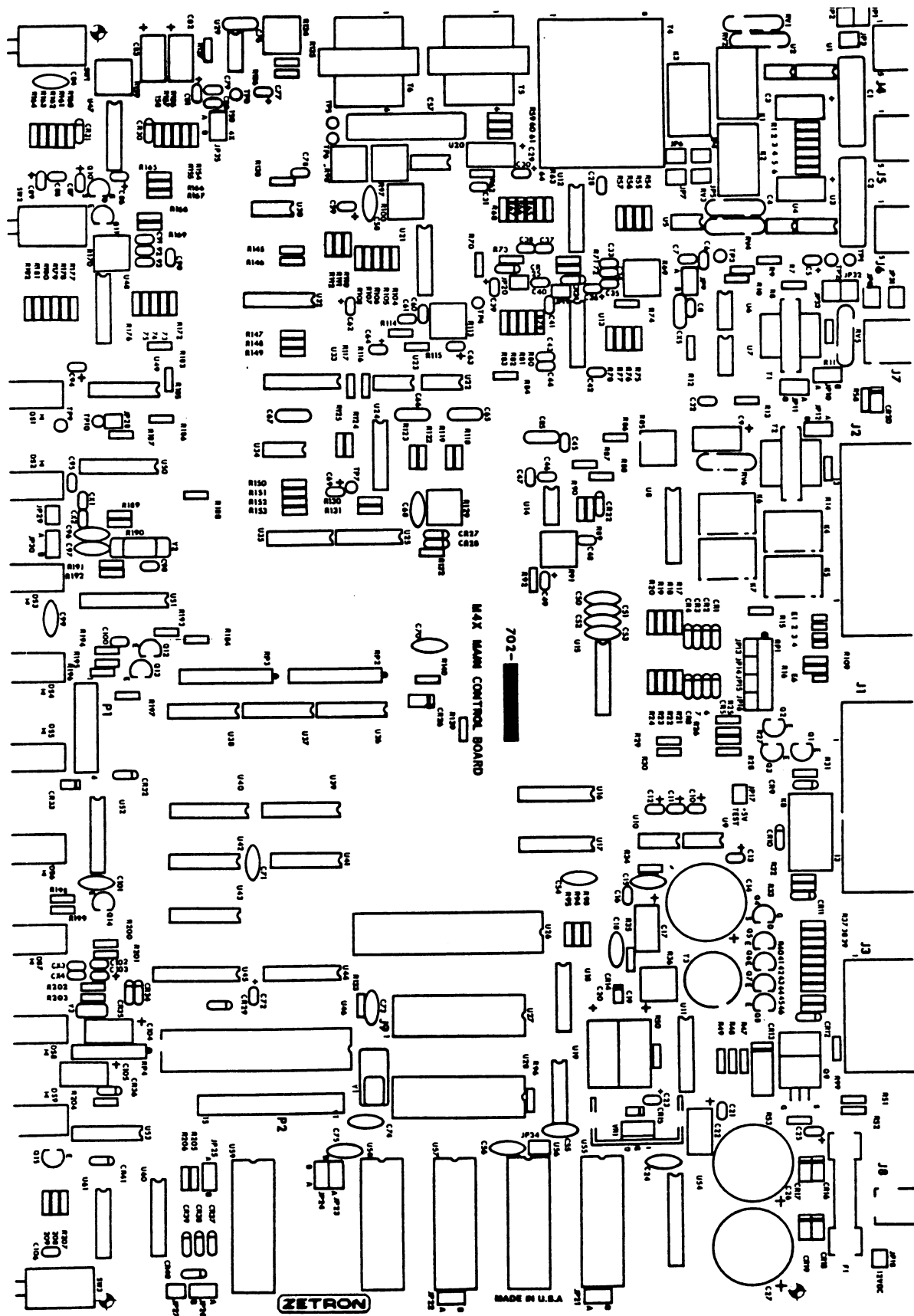


# SECTION 8 - REPAIR

## MODEL 4X VOX DELAY SCHEMATIC (008-9031H)

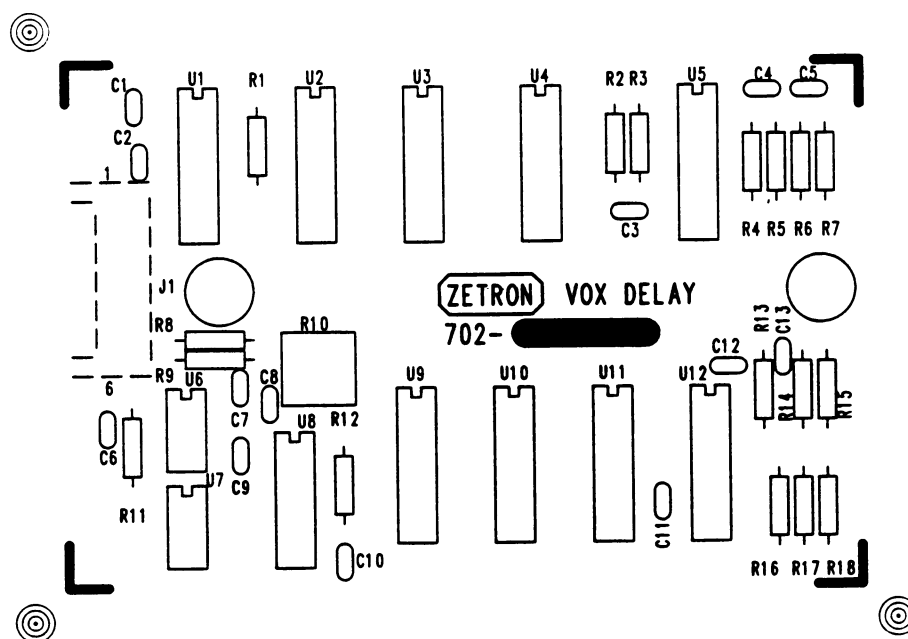


## Z-PATCH SILKSCREEN (702-9032V)



# SECTION 8 - REPAIR

## MODEL 4X VOX DELAY SILKSCREEN (702-9031H)



## 9. CONNECTIONS AND JUMPERS

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**INTRODUCTION**

This section includes the connections to the Model 45's three input/output ports, jumper functions and descriptions, and block diagrams.

**PRIMARY CONNECTIONS (to J1)**

Type: AMP-206584 or eq. 25-pin "Subminiature-D" (female)

**1 - CTCSS/Digital Squelch Output**

The CTCSS (subaudible) or Digital Squelch output for direct modulation of the transmitter. The signal is symmetrical around ground, and may be adjusted for swings from 50 mV to 5 V P-P.

**2 - Audio In / Discriminator Lo.**

The return pin for pin 3. This pin is connected to chassis-ground, or half of the input audio transformer.

**3 - Audio In / Discriminator Hi.**

This is the audio input to the Z-Patch from the receiver's discriminator. It has an input impedance greater than 100K ohms. It is sensitive to discriminator levels on the order of 10 mV P-P. The input impedance may be changed to 600 or 1600 ohms as needed, for speaker audio or volume squelch high.

**4 - Sense-1**

External Sense Line 1. This line is used for the COR validation input. This input may be set for active high or active low operation. See system COR menu. This input is internally pulled high so setting COR validation to active high and leaving the input open will cause the normal COR input to be validated. If the COR validation input is pulled low it would cause the COR input to be invalidated. The COR and COR validation inputs must both be valid before mobile operation will occur. If a lower impedance pull-up is needed install JP13.

**5 - Sense-2**

External Sense Line 2. This line is used for the Channel busy input. This input may be set for active high or active low operation. See the system COR menu. This input is internally pulled high so setting Channel busy to active low and leaving the input open will cause the channel to look idle. If this input is pulled low then the Z-Patch will not allow any calls from the land line to go out because the channel will look busy. This input may be used on a monitor receiver to test for channel activity on the transmit channel or as a busy inhibit. If a lower impedance pull up is needed install JP14. Caution: if this input is active, the COR LED will be flashing and access from a mobile or telephone will be impossible. If the Model 45 doesn't have the repeat audio option, the channel busy input will be ignored upon mobile access.

## SECTION 9 - CONNECTIONS AND JUMPERS

### 6 - Sense-3

This line and the other Sense Line are designed for closure to ground for activation. The closure may be by transistor, logic gate, or relay contact. If using a relay contact, extra current (12 ma.) may be supplied for contact cleanliness by putting in jumpers JP-15 and JP-16 for Sense Lines 3 and 4 respectively. Logic gates and transistors must sink only 100 microamperes. When this input is pulled low it will do a page out with user one's page format and page code. User 1 must be setup with a valid page format and page code. The page will be sent 3 times.

### 7 - Sense-4

This line is the same as sense-3 except that it sends a page out with user two's page format and page code.

### 8 - Digital Mode

Not used.

### 9 - Digital Mode RS-232

Not used.

### 10 - TR Relay B Common

Pins 10 through 12 are the TR (Transmit/Receive) relay connections. The contacts will take 150V DC at 500 mA max. There are two sets of DPDT contacts, A and B.

### 11 - TR Relay B NC

### 12 - TR Relay B NO

### 13 - Ground - Chassis ground.

### 14 - COR Common Return for COR.

This pin is tied to ground through a 10K-ohm resistor.

### 15 - COR

Carrier-Operated-Relay. (Also known as CAS, Carrier-Active-Signal, and CAR, Carrier-Activated-Relay.) This pin is activated by (a) closing it to ground with a contact closure, (b) pulling it to ground or to pin 14 with a transistor or logic gate. It may also be activated by supplying it with a signal that goes from some positive voltage to a lesser voltage or ground or vice-versa. In all cases the "direction" of the signal when the Rx detects a carrier is not important, as the sense of the signal may be changed in the Z-Patch software. Caution: the COR signal must swing around 0 and +4V, adjustable via R85.

### 16 - Ground

### 17 - Ground

### 18 - Transmit Audio Common

The return for pin 19. It is isolated from the Z-Patch ground. This pin must be tied to ground if a single ended input is used.



## SECTION 9 - CONNECTIONS AND JUMPERS

### 19 - Transmit Audio Out

Audio to Transmitter. Often, this signal is connected to the "MIC" input of the transmitter. This output is through a 600-ohm transformer, and has a high-impedance jumper option (JP-12). It is adjustable from 50 mV to 5 V P-P.

### 20 - Digital Out RS-232

Not used.

### 21 - Digital Out TTL

Not used.

### 22 - TR Relay A Common

Pins 22 through 24 are the TR (Transmit/Receive) relay connections. The contacts will take 150V DC at 500 mA max. There are two sets of DPDT contacts, A and B.

### 23 - TR Relay A NC

### 24 - TR Relay A NO

### 25 - Ground

## SECTION 9 - CONNECTIONS AND JUMPERS

### AUXILIARY CONNECTIONS (to J2)

Type: AMP-206604 or eq. 25-pin "Subminiature-D" (male)

**1 - Relay 3 Com**

The four Auxiliary relays are Form-A NO contacts, which will carry 150 VAC/VDC at 100 mA maximum.

**2 - Relay 4 Com**

**3 - Relay 1 Com**

**4 - Relay 2 Com**

**5 - RESET**

If this pin is grounded momentarily the Z-Patch will completely reset, just as if power had just been applied, or the reset button depressed. This pin may be used to remotely restart the Z-Patch in the unlikely event that it "hangs" due to a lightning strike nearby, etc..

**6 - Tx Audio Bus Out**

This pin, and pin 7, are in series with the internal Transmitter Audio Bus. By cutting the circuit foil at JP-29, any number of auxiliary devices may be inserted into the transmitter audio bus. The nominal level is 0dBm, or approximately 2 V P-P. The audio is sent out this pin, and should be received back in on pin 7.

**7 - Tx Audio Bus In**

**8 - Chassis Ground**

**9 - Rx Audio Bus Out**

This is the output of the internal Receiver Audio Bus. Its corresponding input pin is pin 10. Its nominal level is 0dBm.

**10 - Rx Audio Bus In**

**11 - Transmit Audio**

A 1 V P-P. audio signal which is the same as Transmitter Audio for use in recording, etc. This level is not affected by R129.

**12 - Receive Audio**

This pin has a 1 V P-P audio signal which is usually the audio as received from the Receiver. If CTCSS is present in the Receiver audio, it will be filtered out of this signal. This signal represents the audio going to the phone, and will contain dialing signals, etc. as they occur from time-to-time in addition to receiver audio. This level is not affected by R97.

**13 - Chassis Ground.**

**14 - Relay 4 N.O.**

**15 - Relay 3 N.O.**

**16 - Relay 2 N.O.**

**17 - Relay 1 N.O.**

**18 - Non-Maskable-Interrupt**

Produces a software-reset if grounded momentarily. Same as pushing front panel DISCONNECT.

**19 - Ring1 (input or output)**

This is a CMOS logic level which goes to ground when a ringing voltage is present on Phone Line 1. Otherwise, it is at +5 V.

**20 - Ring2 (input or output)**

Ringing Logic level for Phone Line 2. Electrically the same as Ring1.

**21 - Ground**

**22 - CTCSS (subaudible) Zero-Crossing Input**

Not used.

**23 - VOX Indicator**

This pin will go to 10V when the Z-Patch has active VOX. Otherwise it will be at 0V. It will only drive 1 CMOS load (100 microamperes).

**24 - Carrier Indicator**

This pin will go to 10V when the Z-Patch has active Carrier (COR). Otherwise it will be at 0V. It will only drive 1 CMOS load (100 microamperes).

**25 - Ground**

## SECTION 9 - CONNECTIONS AND JUMPERS

### SERIAL CONNECTIONS

Type: AMP-207084 or eq. 9-pin "Subminiature-D" (female)

**1 - DTR (Data-Terminal-Ready)**

This pin is tied to regulated +5V DC through a 330-ohm resistor.

**2 - +5V DC**

This pin is tied to the +5V DC regulated supply, and can supply up to 100 mA to an external device.

**3 - TDATA (Transmitted-Data)**

This pin is the RS-232 data FROM the Z-Patch. It swings from -5V (mark) to +5V (space) through a 1K-ohm resistor.

**4 - RDATA (Received-Data)**

This pin is the RS-232 data TO the Z-Patch. It should swing from -5V (mark) to +5V (space) through no less than a 3K-ohm resistor. It may swing through  $\pm 25V$  max.

**5 - Ground**

All signals refer to this pin for ground. It is physically connected to the metal chassis of the Z-Patch, and all internal logic and audio signals refer to this same potential.

**6 - Not Used.**

**7 - RTS (Request-To-Send)**

This pin is tied to regulated +5V DC through a 330-ohm resistor.

**8 - CTS (Clear-To-Send)**

Not used.

**9 - PRINTER**

This input is not used see SMDR print mode.

## DEFAULT JUMPER SETTINGS

JUMPER SET	FUNCTION	OPTIONS
JP- 1	out Phone line jumpers	In= L2 pin 2= ground
2	out " " "	In= L1 pin 2= ground
3	out " " "	In= L2 pin 5= ring detector
4	out " " "	In= L1 pin 6= line select relay
5	out " " "	In= L2 pin 6= line select relay
6	out " " "	In= L2 pin 3= ground (ring)
7	out " " "	In= L1 pin 3= ground (ring)
8	out " " "	In= L1 pin 5= ring detector
9	B Rx Audio Input	A= 600 ohm B= 100K
10	A Rx Audio Input	A= 1.6K B= 600 ohm
JP-11	B Rx Audio Input	A= 600 ohm B= Hi-Z
12	A Tx Audio output	A= 600 ohm B= 10K
13	out Sense Line 1	In= 1K pull-up
14	out Sense Line 2	In= 1K pull-up
15	out Sense Line 3	In= 1K pull-up
16	out Sense Line 4	In= 1K pull-up
17	in +5 volt power	In= +5 supply enable
18	out +12V DC operation	In= DC supply Out= 1V AC
19	out COR VOX detector	In= COR= VOX
20	out COR Noise detector	In= COR= Noise detector
JP-21	A U59 size	A= 16K x 8 B= 32K x 8
22	A U56 type	A= ROM B= RAM
23	A U59 size	A= 2k x 8 B= 8K x 8/16K x 8
24	B U57 size	A= 2K x 8 B= 8K x 8
25	out Tone/code de-emph	In= De-emphasis Out= No de-emphasis
26	Not used	
27	out Tone/code level	In= Low level Out= High level
28	in Rx audio patching	In= normal Out= external source
29	in Tx audio patching	In= normal Out= external source
30	A Dig. Voice Delay	A= no delay B= delay line in
31	out Phone line jumper	In= local phone ground
32	out " " "	In= local phone line select relay
33	out " " "	In= local phone ring detector
34	in U56 size	Out= 8K x 8 In= 16K x 8
35	B Dialtone detect	A= No AGC B= From AGC amp.

## RECEIVER JUMPERS

Rx Audio: (discriminator) JP-9 : B  
 JP-10: A  
 JP-11: B

COR:

COR/CAS Signal from Rx: JP-19: OUT  
 JP-20: OUT

Noise Detector Activated: JP-19: OUT  
 JP-20: IN

Remove CX5 when using the noise detector.

## SECTION 9 - CONNECTIONS AND JUMPERS

### MEMORY JUMPERS

JUMPER	POSITION	IC REFERENCE
JP-21	A/B	U59= 6264/43256
JP-22	A/B	U56= ROM-2764/RAM-6264
JP-23	A/B	U59= 43256/6116
JP-24	A/B	U57= 6116/6264

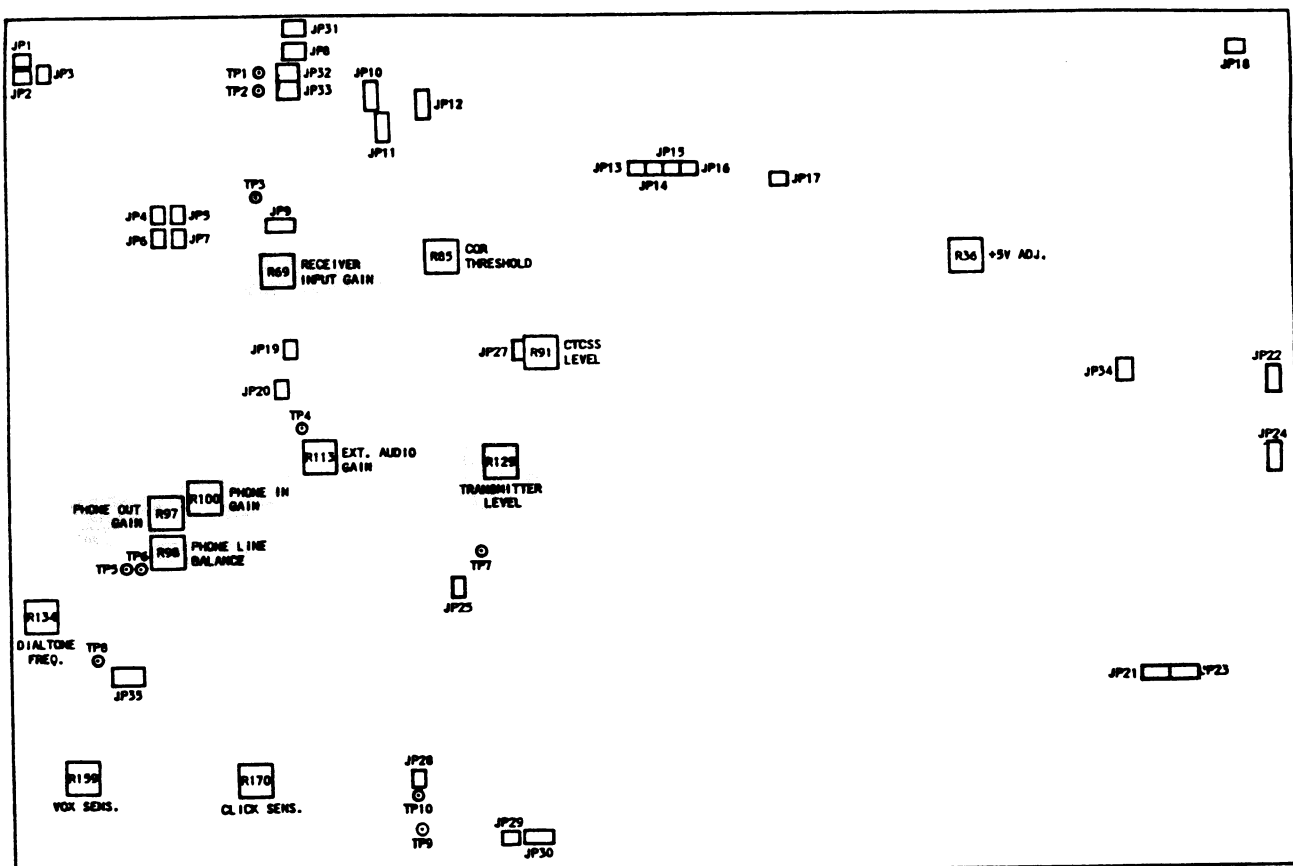
Default settings:

U NUMBER/TYPE	JUMPERS	MEMORY SIZE
U55= 27256	None	40K
U56= 2764	JP-22: A	

### RAM JUMPERS

Default settings:

U NUMBER/TYPE	JUMPERS	MEMORY SIZE	ADDRESS
U58 = 43256	None	32K	2000-3FFF
U59 = 6264	JP-21: A	8K	2000-3FFF
	JP-23: A		
43256	JP-21: B	32K	2000-3FFF
	JP-23: A		

**PINOUT/ADJUST LABEL (415-9106)**

**J1 - TRANSMITTER CONTROL**

Pin	Signal Name
1	CTCSS/DPL/DCG
2	RX AUDIO LO
3	RX AUDIO HI
4	SENSE-1
5	SENSE-2
6	SENSE-3
7	SENSE-4
8	DIGITAL MODE
9	DIGITAL MODE RS232
10	TR-B-COM
11	TR-B-NC
12	TR-B-NO
13	GND
14	COR COMMON
15	COR
16	GND
17	GND
18	XMITTER AUDIO COM
19	XMITTER AUDIO OUT
20	DIGITAL OUT RS232
21	DIGITAL OUT
22	TR-A-COM
23	TR-A-NC
24	TR-A-NO
25	GND

**J2 - AUXILIARY I/O**

Pin	Signal Name
1	RELAY 3 COM
2	RELAY 4 COM
3	RELAY 1 COM
4	RELAY 2 COM
5	RESET-
6	TX AUDIO BUS OUT
7	TX AUDIO BUS IN
8	GND
9	RX AUDIO BUS OUT
10	RX AUDIO BUS IN
11	TRANSMIT AUDIO
12	RECEIVE AUDIO
13	GND
14	RELAY 4 NO
15	RELAY 3 NO
16	RELAY 2 NO
17	RELAY 1 NO
18	DISCONNECT-
19	RING 1-
20	RING 2-
21	GND
22	CTCSS+
23	VOX+
24	CARRIER+
25	GND

## J3

Pin	Signal Name
1	DATA TERM RDY
2	+5VDC
3	TXDATA
4	RDATA
5	GND
6	-
7	REQUEST TO SEND
8	CLEAR TO SEND
9	PRINTER-

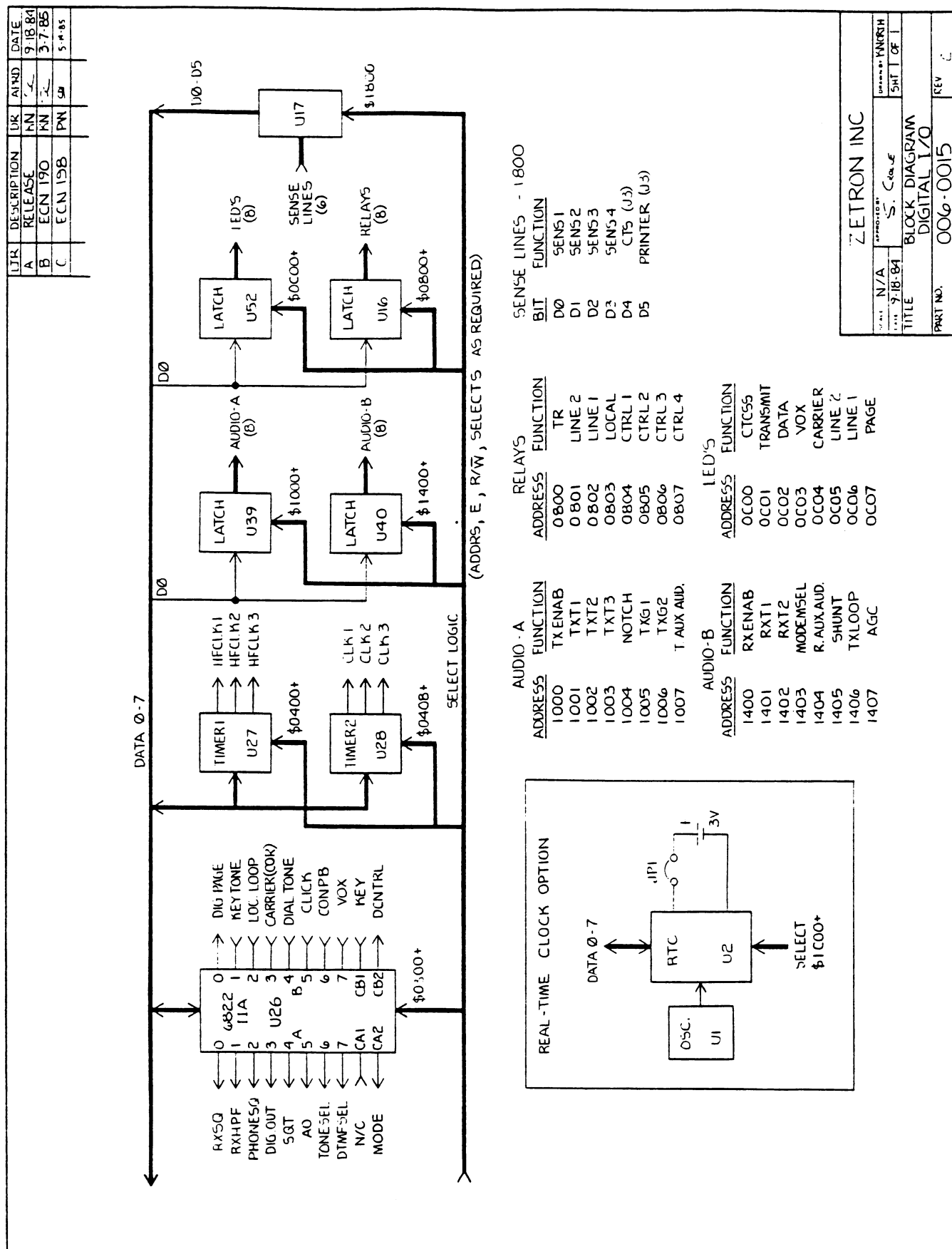
TP-	Test Point
1	TIP
2	RING
3	RX AUDIO
4	EXT AUDIO AFTER GAIN
5	FROM PHONE AUDIO
6	TO PHONE AUDIO
7	TX AUDIO
8	FROM PHONE AFTER GAIN
9	TX AUDIO BUS
10	RX AUDIO BUS

### Z-PATCH AUDIO BLOCK DIAGRAM (006-0014E)





### DIGITAL I/O BLOCK DIAGRAM (006-0015)



### Z-PATCH PROCESSOR BLOCK DIAGRAM (006-0016)



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## USING THE DT TERMINAL EMULATOR

An IBM PC (or compatible) may be used to program the Z-Patch. The computer must contain an RS-232 serial interface in order to function as a "dumb terminal". The only connections required between the Model 45 and the computer running "DT" are: Ground, Tx-data, and Rx-data (as described in "Computer or CRT Connections," section 7). The baud rate is defaulted to 300 baud from the factory when programming with a modem. If the 1200 baud modem option is installed, the default baud rate is 1200. If you want to change it back to 300 baud you can change the modem baud rate in the system miscellaneous menu, run modem at 300 baud. Set to Yes for 300 baud.

Zetron offers a terminal emulator program that enables the computer to communicate with the Model 45. The program is named DT.COM and is provided on floppy diskette. If the disk with the program is in drive A:, "DT" is run by typing DT and pressing the RETURN or ENTER key. The program begins and displays the title and communication settings (Figure A1). Pressing a function key (F1-F7) will change the corresponding setting. Pressing the function key F10, will exit the program. Pressing the Home key will clear the screen and begin serial communications. Any key you type is then sent to the Model 45 and back to the PC to be displayed. Characters sent from the Model 45 are displayed. Pressing the RETURN key will "bring up" or display the Model 45 "Top Level" menu. To end communications and return to the "DT settings" screen, press the Home key again. The DT program only communicates with COM1:.

**ZETRON Terminal Emulator - Copyright 1985**  
**Part Number 611-0122 Version B**

4800 F1 to set BAUD RATE

8 F2 to set NUMBER OF BITS PER CHARACTER

1 F3 to set NUMBER OF STOP BITS PER CHARACTER

NONE F4 to set PARITY

ENABLED F5 to enable/disable XON-XOFF HANDSHAKING

DISABLED F6 to enable/disable RTS-CTS HANDSHAKE

FULL F7 to set FULL or HALF DUPLEX

Home to START TERMINAL EMULATION

F10 to EXIT

FIGURE A1: "DT" communication settings screen

## SECTION A - APPENDICES

### GENERAL SERIAL COMMUNICATIONS

If you have having problems determining which connections are correct the following information should help.

1. The DC voltage on the TX data signal from your CRT/Computer should be between -5V and -15V.
2. The DC voltage on the RX data signal from your CRT/Computer should be at ground.

If the initial message appears on your screen but nothing happens when you hit return do the following:

1. Tie DTR to DSR on the connector on your CRT/Computer.
2. Tie RTS to CTS on the connector on your CRT/Computer.

If you still do not get the top menu from the M45 check the following:

1. With a Scope measure the signal coming from your TX data. It should be sitting low and then, when you hit the return or enter key, you should see three pulses going high to +5V to +15V DC.
2. If the signal looks O.K. then look for the signal at pin 11 of U46. The signal at pin 11 should be sitting at +5V DC. then go low with the incoming signal.

If you do not get the initial message then do the following:

1. verify the baud rate and set up of the M45 and your CRT/Computer.
2. Check that data is coming out of the M45, pin 12 of U46, and pin 3 of J3. The data will come out each time you hit the reset button on the M45.
3. The TX data output of the M45 should be sitting between -3 and -5V DC. If not check the -5V regulator, U9.
4. Check your cable.

**SERIAL COMMUNICATIONS WITH THE RADIO SHACK MODEL 100****Direct Connection Cable Diagram**

Model 45	Data Direction	Model 100
-----	-----	-----
3 Txdata	----->	3 Rxdata
4 Rxdata	<-----	2 Txdata
5 Ground	<----->	7 Ground

**Initiating Terminal Emulation at 4800 Baud**

- A. Move the Cursor over the word TELCOM and press ENTER
- B. Press STAT (F3 function key)
- C. Type: 78N1E ENTER
- D. Press TERM (F4 function key)
- E. Press the "LABEL" key to turn on or off the status line for a larger display area.

**Procedure for Remote Access via Modem**

- A. The Model 45 must have the 300 baud internal modem option, or the 1200 baud modem option with the modem baud rate set to 300.
- B. Set the Model 100 computer for modem operation as follows:
  1. Move the Cursor over the word TELCOM and press ENTER
  2. Press STAT (F3 function key)
  3. Type: M8N1E ENTER
- C. Dial the number of the Model 45 from a DTMF phone.
- D. When the line is answered, enter the program mode (see section 3.2 for details).
- E. When the modem tone is heard, press TERM (F4) on the Model 100.
- F. Press the ENTER key, the sign-on menu should appear.
  1. If the menu fails to appear and the computer does not respond, press F8 to return to TELCOM mode.
  2. Fault identification for "garbaged" (wrong characters) sign-on display:
    - a. Poor quality phone line audio. Listen to the audio, if snap, crackle or pops are heard, the modem may be unusable.
    - b. Model 45 phone line (hybrid) balance poor. Use the adjustment procedure below.
    - c. Audio gain TO or FROM the phone line too high or too low. The levels are set at the factory, but may need to be adjusted slightly in some cases. If the computer gives a "no carrier" indication, the gain TO the phone line may be low. If the line drops after 10-20 sec., the phone IN level may be low.
    - d. Be sure RS-232 cable is disconnected from Model 100.
    - e. Verify proper phone line connections. Gray to phone.

NOTE: For detailed information, consult the Model 100 portable computer operation manual.

## SECTION A - APPENDICES

### SERIAL COMMUNICATIONS WITH THE COMMODORE 64

#### Direct Connection Cable Diagram

Model 45	Data Direction	RS-232 Interface
-----	-----	-----
3 Txdata	----->	3 Txdata
4 Rxdata	<-----	2 Rxdata
5 Ground	<----->	7 Ground

#### RS-232 Interface

An RS-232 interface is needed to convert the TTL levels of the Commodore's output port to the RS-232 level required by the RS-232 port in the Model 45. A suitable RS-232 interface is manufactured by Omnitronix Inc. of Mercer Island, WA.. If you are using the Omnitronix interface, set the DCE DTE switch in the DTE position. The other 3 switches on the Omnitronix board have no effect.

#### Model 45 Set-Up for use with the Commodore 64

The data rate at which the Model 45 communicates with the C-64 is 600 baud. To set the data rate to 600 baud, go into the DTMF programming mode and use function 78. Specify parameter 4 for 600 baud, (78\* 4#). Then exit DTMF programming, (0\* 0#).

#### Commodore 64 Set-Up

The C-64 requires a terminal emulation program to operate the RS-232 port. A BASIC language terminal emulation program is listed below which can be used with the C-64. Enter the program in accordance with the C-64 user's manual. If the program has previously been stored on a floppy disk or cassette tape, load the program using the following procedure.

Floppy disk, Type: LOAD"RS232.TERM",8  
Cassette tape, Type: LOAD"RS232.TERM"

Saving the program on a floppy disk or a cassette would be advisable in order not to have to enter the program every time the system is powered up.

To start the terminal emulation program, type RUN then press the RETURN key.



**Commodore 64 Terminal Emulation Program**

```

100 POKE 53281,0: POKE 53280,0
110 PRINT "*"
120 PRINT CHR$(14)
130 OPEN 1,2,0,CHR$(7)
180 DIM A%(255)
190 FOR X=0 TO 255
200 A%(X)=X:NEXT
210 FOR X=97 TO 122
220 A%(X)=X-32:NEXT
230 FOR X=65 TO 90
240 A%(X)=X+32:NEXT
270 GET#1,A$ : GET B$
280 IFA$<>"" THEN PRINTCHR$(A%(ASC(A$)));
290 IF B$<>"" THEN PRINT#1,B$;
300 GOTO 270

```

Note: In line 110, the "\*" is displayed as "heart" on the C-64 screen.

**Explanation of C-64 Terminal Emulator Program**

LINE(S)	PURPOSE
-----	-----
100	Set monitor colors.
110	Clear screen.
120	Change to character set 2, which is as close as the C-64 gets to standard ASCII characters.
130	Open RS-232 port for input and output.
180-240	Prepare to convert lower case letters to upper case letters and vice versa, this converts ASCII characters to C-64 character set 2.
270	Read RS-232 port into A\$, read C-64 keyboard into B\$.
280	If any character came into the RS-232 port print, it on the C-64 screen, after doing letter case conversion.
290	If any character was typed on the C-64 keyboard send it out the RS-232 port; upper and lower case treated the same by M45 so no conversion necessary.
300	Go back to 270, thus forever taking the keys typed on the C-64 and sending them out to the Model 45 and taking the characters sent back from the Model 45 and displaying them on the C-64 screen.

# SECTION A - APPENDICES

## TWO-TONE TIMING AND FREQUENCIES

### Two-Tone Sequential Timings (in seconds)

This is format #4.

T	1st	Gap	2nd	Grp	Timing Group
---	---	---	---	---	-----
1	1.0	0	3.0	8.0	(Mot/GE Tone & Voice)
2	0.4	0	0.8	8.0	(Mot Tone Only)
3	1.0	0	3.0	6.0	(NEC-B)
4	1.0	.25	3.0	6.0	(NEC-A)
5	1.0	0	1.0	4.0	(NEC-C)
6	0.4	0	0.8	4.0	(NEC-M)
7	0.5	0	0.5	3.0	(NEC-L)
8	0.4	0	0.4	3.0	(NEC-D)

### Two-Tone Tone Groups

TONE GROUPS							
Tone Number	Mot 1 1	Mot 2 2	Mot 3 3	Mot 4 4	Mot 5 5	Mot 6 6	Mot A 7
-----	-----	-----	-----	-----	-----	-----	-----
0	330.5	569.1	1092.4	321.7	553.9	1122.5	358.9
1	349.0	600.9	288.5	339.6	584.8	1153.4	398.1
2	368.5	634.5	296.5	358.6	617.4	1185.2	441.6
3	389.0	669.9	304.7	378.6	651.9	1217.8	489.8
4	410.8	707.3	313.0	399.8	688.3	1251.4	543.3
5	433.7	746.8	953.7	422.1	726.8	1285.8	602.6
6	457.9	788.5	979.9	445.7	767.4	1321.2	668.3
7	483.5	832.5	1006.9	470.5	810.2	1357.6	741.3
8	510.5	879.0	1034.7	496.8	855.5	1395.0	822.2
9	539.0	928.1	1063.2	524.6	903.2	1433.4	912.0
A	569.1	979.9	569.1	569.1	979.9	979.9	979.9

TONE GROUPS							
Tone Number	Mot B 8	Mot Z 9	GE A' A	GE B' B	GE C' C	Mot 10 D	Mot 11 E
-----	-----	-----	-----	-----	-----	-----	-----
0	371.5	346.0	682.5	652.5	667.5	1472.9	1930.2
1	412.1	384.6	592.5	607.5	712.5	1513.5	1989.0
2	457.1	426.6	757.5	787.5	772.5	1555.2	2043.8
3	507.0	473.2	802.5	832.5	817.5	1598.0	2094.5
4	562.3	524.8	847.5	877.5	862.5	1642.0	2155.6
5	623.7	582.1	892.5	922.5	907.5	1687.2	2212.2
6	691.8	645.7	937.5	967.5	952.5	1733.7	2271.7
7	767.4	716.1	547.5	517.5	532.5	1781.5	2334.6
8	851.1	794.3	727.5	562.5	577.5	1830.5	2401.0
9	944.1	881.0	637.5	697.5	622.5	1881.0	2468.2
A	979.9	979.9	742.5	742.5	742.5	none	none

## FIVE/SIX TONE TIMING AND FREQUENCIES

This is format #5.

	Tone Number	EIA	CCIR	ZVEI	
	-----	----	----	----	
	0	600	1981	2400	Tone Freq. in Hz
	1	741	1124	1060	
	2	882	1197	1160	
	3	1023	1275	1270	
	4	1164	1358	1400	
	5	1305	1446	1530	
	6	1446	1540	1670	
	7	1587	1640	1830	
	8	1728	1747	2000	
	9	1869	1860	2200	
2nd Addr	X	2010	2247	970	
Repeat	R	459	2110	2600	
	-----	----	----	----	
	Preamble	690	690	690	Tone Timing in msec
	Gap	65	65	65	
	Tone	33	100	100	
	X Tone	65	100	100	

## CTCSS TONES

Number	Frequency (Hz)	Number	Frequency (Hz)
-----	-----	-----	-----
01	67.0	20	131.8
02	71.9	21	136.8
03	74.4	22	141.3
04	77.0	23	146.2
05	79.7	24	151.4
06	82.5	25	156.7
07	85.4	26	162.3
08	88.5	27	167.9
09	91.5	28	173.8
10	94.8	29	179.9
11	97.4	30	186.2
12	100.0	31	192.8
13	103.5	32	203.5
14	107.2	33	210.7
15	110.9	34	218.1
16	114.8	35	225.7
17	118.8	36	233.6
18	123.0	37	241.8
19	127.3	38	250.3

## SECTION A - APPENDICES

### DIGITAL SQUELCH CODES

Digital squelch codes have been added and are included with the CTCSS option. The following table is a list of the digital codes the Model 45 encodes. The digital number is preceded by the letter 'D' when entering an encode code in the user specific menu (e.g. D1 for code 1). If a CTCSS tone is being encoded just enter a number from 1-38 as before, 0 for no encode. When programming a transmit tone/code from DTMF enter a number from 0 to 143, add 39 when entering a digital code (e.g. 40 for code 1). See the system miscellaneous menu for inverting the digital output. Note that 'D0' and '39' is the same as entering a '0'.=, which will turn the encode off.

Digital Number	Digital Code	Inverted Code	Digital Number	Digital Code	Inverted Code	Digital Number	Digital Code	Inverted Code
1	023	047	36	223	134	71	445	043
2	025	244	37	225	122	72	446	255
3	026	464	38	226	411	73	452	053
4	031	627	39	243	351	74	454	266
5	032	051	40	244	025	75	455	332
6	036	172	41	245	072	76	462	252
7	043	445	42	246	523	77	464	026
8	047	023	43	251	165	78	465	331
9	051	032	44	252	462	79	466	662
10	053	452	45	255	446	80	503	162
11	054	413	46	261	732	81	506	073
12	065	271	47	263	205	82	516	432
13	071	306	48	265	156	83	523	246
14	072	245	49	266	454	84	526	325
15	073	506	50	271	065	85	532	343
16	074	174	51	274	145	86	546	132
17	114	712	52	306	071	87	565	703
18	115	152	53	311	664	88	606	631
19	116	754	54	315	423	89	612	346
20	122	225	55	325	526	90	624	632
21	125	365	56	331	465	91	627	031
22	131	364	57	332	455	92	631	606
23	132	546	58	343	532	93	632	624
24	134	223	59	346	612	94	654	743
25	143	412	60	351	243	95	662	466
26	145	274	61	356	212	96	664	311
27	152	115	62	364	131	97	703	565
28	155	731	63	365	125	98	712	114
29	156	265	64	371	734	99	723	431
30	162	503	65	411	226	100	731	155
31	165	251	66	412	143	101	732	261
32	172	036	67	413	054	102	734	371
33	174	074	68	423	315	103	743	654
34	205	263	69	431	723	104	754	116
35	212	356	70	432	516			

**PROGRESS AND RING-OUT TONE DEFINITIONS**

The following is a list of all of the tones that the Model 45 generates. The name of the tone(s), the timing and the frequency is listed.

Tones to mobile or telco:

Mobile illegal access/error:

Repeat, 540Hz for 0.15 sec then 393Hz for 0.15 sec, five times.

Line 2 override:

Same as mobile illegal access/error.

Dial tone:

440Hz plus 350Hz.

Beep answer mode 1 on telco:

800 Hz for 0.400 sec, 1 sec after line is answered.

Normal busy:

Repeat, 471Hz plus 602Hz, 0.5 sec on, 0.5 sec off.

Fast busy:

Repeat, 432Hz plus 471Hz, 0.125 sec on, 0.125 sec off.

This tone is issued to telco before disconnect.

Normal ring:

Repeat, 432Hz plus 471Hz, 2 sec on, 4 sec off.

Broken ring:

Repeat, 432Hz plus 471Hz, 0.5 sec on, 0.5 sec off, 0.5 sec on, 4 sec off.

DTMF program mode access acknowledgment:

Repeat 2 times, 546Hz for 0.2 sec, then 590Hz for 0.2 sec, then 564Hz for 0.2 sec, then 466Hz for 0.2 sec then 0.025 sec off.

Ring-out styles to mobile:

Normal ring:

Repeat, 432Hz plus 471Hz, 2 sec on, 4 sec off.

Double ring:

Repeat, 432Hz plus 471Hz, 0.5 sec on, 0.5 sec off, 0.5 sec on, 4 sec off.

Triple ring:

Repeat, (repeat 3 times) 432Hz plus 471Hz, 0.4 sec on, 0.4 sec off, then 4 sec off.

Ding-dong ring:

Repeat, 550Hz plus 590 Hz, 1 sec on, then 400Hz plus 440Hz, 1 sec on then 4 sec off.

## SECTION A - APPENDICES

### Singer ring:

Repeat, 700Hz plus 708Hz, 2 sec on, 4 sec off.

### Warbler ring:

Repeat, 20 repetitions of (741Hz for 0.05 sec then 500Hz for 0.05 sec) then 4 sec off.

## DTMF MORSE CODE ID PROGRAMMING CHART

DESIRED CHARACTER	PROGRAMMING VALUE	DESIRED CHARACTER	PROGRAMMING VALUE
0	00	I	18
1	01	J	19
2	02	K	20
3	03	L	21
4	04	M	22
5	05	N	23
6	06	O	24
7	07	P	25
8	08	Q	26
9	09	R	27
A	10	S	28
B	11	T	29
C	12	U	30
D	13	V	31
E	14	W	32
F	15	X	33
G	16	Y	34
H	17	Z	35

## QUICK REFERENCE

## System Items

1. Sign-On Mode: 0=Zetron style, 1=RCC Mode 1, 2=RCC Mode 2.  
Zetron = \*+ANI, RCC 1 = ANI+steering digit, RCC 2 = \*+ANI+steering digit.
2. Station ID Mode: 0=Off; 1=End of call and timer; 2=End of timer and quiet channel; 3 = End of timer, quiet channel and after channel activity.
3. Dialout Mode: 0=Slow DTMF, 1=Fast DTMF, 2=Slow Pulse, 3=Fast Pulse.
4. Line 1, 2 and Local Answer Mode: 0=Answer Ring-out, this allows a user to be called if the caller does not overdial; 1=Answer/Access/Ring-out, the M45 returns dial tone; 2=No-Answer/Ring-out, the M45 does not answer the line until the mobile answers, not a valid mode for the local phone.
5. User Relay Mode: 0=On at mob. orig., OFF at Disconnect; 1=ON at mob. ans., OFF at mob. disconnect; 2=ON at telco Acc., OFF at mob. ans.; 3=ON at telco Acc., OFF at disconnect; 4=ON at telco Acc. or Mob. org., OFF at disconnect.
6. SMDR Print Mode: 0=No output to printer; 1=Output in Pretty print; 2=FP-10.
7. Dial click decode mode: 0=DTMF only; 1=DTMF/Click decode without the calibration digit '0'; 2=DTMF/Click decode with the calibration digit '0' from dial pulse phones; 3=DTMF only, for use with the external dial click decoder.

## User Items

1. Autodial Mode: 0=Manual dial only; 1-9=Number automatically dialed; 14=Manual and Autodials; 15=Autodials only.
2. Equipment Type: 0=Mobile; 1=Talk-back pager; 2=T+V pager; 3=T.O. pager; 4=Direct channel access.
3. Ringout Style: 0=Normal; 1=Double; 2=Triple; 3=Ding-Dong; 4=Singer; 5=Warbler; 6=Normal; 7=Repeat paging tones.
4. Call timer Mode: 0=No call limit; 1=Call limit timer 1; 2=Call limit timer 2.
5. Toll Mode: 0=No toll restricts; 1=Toll/length 1; 2=Toll/length 2.
6. Page Format: 0=none; 1=DTMF using timer 1; 2=DTMF using timer 2; 3=2805; 4=2-tone; 5=5/6 tone; 6=GMarc.





## **P. PROGRAMMING REFERENCE**

DTMF programming reference sheet .....	P-1
Model 45 menu programming structure .....	P-5



## DTMF PROGRAMMING REFERENCE SHEET

DTMF	MENU RANGE	DESCRIPTION	
<b>COR</b>			
1	!SCP 0-1	POLARITY ACTIVE HIGH (0)	(0=NO,1=YES)
2	!SCH 0-50	COR HOLD TIME (2)	X100(MS)
3	!SCQ 0-100	COR QUIET TIME (30)	X100(MS)
18	!SCM 0-20	MOBILE TX-TO-RX TIME (2)	X100(MS)
7	!SCA 15-255	MOBILE ACTIVITY TIME (30)	(SEC)
111	!SCV 0-1	COR VALIDATION ACTIVE HIGH (1)	(0=NO,1=YES)
110	!SCB 0-1	CHANNEL BUSY ACTIVE HIGH (0)	(0=NO,1=YES)
<b>SYSTEM ACCESS</b>			
67	!SAS 0-2	SIGN-ON MODE(0) (0=ZETRON, 1=RCC, 2=RCC W/LEAD *)	
76	!SAI 0-1	USER 1 SHORT SIGN-ON (1)	(0=NO,1=YES)
6	!SAD 30-250	DTMF TIME-OUT (50)	X100(MS)
5	!SAR 1-15	MINIMUM REGENERATED DIGITS (7)	
36	!SAU 0-1	PHONE-TO-MOBILE USE ANI (0)	(0=NO,1=YES)
64	!SAM 0-1	MOBILE-TO-MOBILE USE ANI(0)	(0=NO,1=YES)
32	!SAP 0-1	# + ANI TO DISCONNECT (1)	(0=NO,1=YES)
169	!SAA 1-8	DIRECT PAGE ANI (A)	(DIGITS)
113	!SAC	DIAL CLICK	
91	!SAW 0-1	ENABLE WILD ANI (0)	(0=NO,1=YES)
<b>DISPATCH</b>			
58	!SHH 0-255	DISPATCH HOLD TIME (30)	X100(MS)
57	!SHT 1-10	DISPATCH TIME-OUT TIME (3)	(MIN)
56	!SHA 0-1	ANI FOR DISPATCH? (1)	(0=NO,1=YES)
63	!SHC 0-1	DISPATCH COURTESY TONE (1)	(0=NO,1=YES)
142	!SHR 0-1	REPEAT AUDIO (1)	(0=NO,1=YES)
<b>PAGING</b>			
79	!SPD 0-200	KEYUP DELAY (40)	X25(MS)
43	!SP1 2-8	DTMF TIMING #1 (3)	X25(MS)
44	!SP2 2-8	DTMF TIMING #2 (8)	X25(MS)
143	!SPR 0-1	ENABLE RTX SIGNALING	(0=NO,1=YES)
65	!SPT 5-25	TALK TIME (5)	(SEC)
100	!SPG 1-20	NUMBER OF GMARC CHANNELS (4)	
<b>STATION I.D.</b>			
70	!SIM 0-4	STATION I.D. MODE (0) (0=NO,1=END+TIME,2=TIMED, 3=ACTIVITY+TIME,4=END OF EACH CALL)	
69	!SII 1-99	STATION I.D. INTERVAL (15)	(MIN)
162	!SIS 1-10	STATION I.D.	(CHARS)
<b>AUTODIALS</b>			
153	!SD1 0-16	AUTODIAL NUMBER 1	(DIGITS)
:	!SDn 0-16	AUTODIAL NUMBERS 2-8	(DIGITS)
161	!SD9 0-16	AUTODIAL NUMBER 9	(DIGITS)

# SECTION P - PROGRAMMING REFERENCE

DTMF	MENU	RANGE	DESCRIPTION
<hr/>			
<b>TOLL RESTRICTS</b>			
71	!SV1	1-30	MAX TOLL DIGITS SET 1 (15)
163	!SV2	1-4	TOLL RESTRICT SET 1 FIRST DIGITS (DIGITS)
164	!SV3	1-4	TOLL RESTRICT SET 1 SECOND DIGITS (DIGITS)
72	!SV4	1-30	MAX TOLL DIGITS SET 1 (15)
165	!SV5	1-4	TOLL RESTRICT SET 2 FIRST DIGITS (DIGITS)
166	!SV6	1-4	TOLL RESTRICT SET 2 SECOND DIGITS (DIGITS)
<b>LINE 1</b>			
9	!S1A	1-20	RINGS UNTIL ANSWER LINE 1 (1)
11	!S1D	1-25	CHANNEL BUSY RINGS LINE 1 (6)
12	!S1M	0-2	ANSWER MODE LINE 1 (0) (0=AnsRO,1=AnsAccRO, 2=NoAnsRO)
47	!S1U	1-99	AUTOCALL USER LINE 1 (1)
<b>LINE 2</b>			
50	!S2A	1-20	RINGS UNTIL ANSWER LINE 2 (1)
51	!S2D	1-25	CHANNEL BUSY RINGS LINE 2 (6)
52	!S2M	0-2	ANSWER MODE LINE 2 (0) (0=AnsRO,1=AnsAccRO, 2=NoAnsRO)
48	!S2U	1-99	AUTOCALL USER LINE 2 (1)
74	!S2P	0-1	LINE 2 PRIORITY OVERRIDE (0) (0=NO,1=YES)
<b>LOCAL PHONE</b>			
87	!SLD	1-25	CHANNEL BUSY RINGS LOCAL PHONE (6)
37	!SLM	0-1	ANSWER MODE LOCAL PHONE (1) (0=AnsRO,1=AnsAccRO)
49	!SLU	1-99	AUTOCALL USER LOCAL PHONE (1)
<b>TELCO CONTROL</b>			
8	!ST1	1-60	CALL LIMIT TIMER - 1 (3) (MIN)
17	!ST2	1-60	CALL LIMIT TIMER - 2 (15) (MIN)
10	!ST3	1-25	CHANNEL RING-OUTS - 1 (5)
42	!ST4	1-25	CHANNEL RING-OUTS - 2 (5)
4	!STO	5-100	DELAY BEFORE DIAL OUT (20) X100(MS)
77	!STD	0-1	DISCONNECT ON SECOND DIAL TONE (1) (0=NO,1=YES)
26	!STM	0-3	DIALOUT MODE (0) (0=sDTMF,1=fDTMF,3=sPULSE, 4=fPULSE)
75	!STV	0-1	OVERRIDE DISPATCH (0) (0=NO,1=YES)
145	!STP	0-9	HOOKFLASH PTT COUNT (0)
146	!STR	0-1	REGENERATE DTMF AFTER PTT HOOKFLASH (0=NO,1=YES)
<b>SIMPLEX</b>			
16	!SSX	0-1	SIMPLEX (0) (0=NO,1=YES)
20	!SSV	0-50	VOX HOLD TIME (7) X100(MS)
21	!SSD	10-50	DIAL TONE SAMPLE RATE (10) X100(MS)
22	!SSS	1-250	DIAL TONE SAMPLE WIDTH (1) X10(MS)
23	!SSI	10-255	INTO SAMPLE MODE TIME (50) X100(MS)
24	!SSR	10-50	SAMPLE RATE (20) X100(MS)
25	!SSW	1-10	SAMPLE WIDTH (2) X10(MS)
19	!SST	1-250	TX-TO-RX TIME (3) X10(MS)

# SECTION P - PROGRAMMING REFERENCE

DTMF MENU RANGE	DESCRIPTION
<b>MISCELLANEOUS</b>	
101 !SMD 1-10	COURTESY TONE DURATION (3) X25(MS)
15 !SMF 35-250	COURTESY TONE FREQUENCY (54) X10(HZ)
84 !SMA 0-1	AUTOMATIC GAIN ON (0) (0=NO,1=YES)
85 !SMH 0-1	HIGH PASS FILTER ON (0) (0=NO,1=YES)
86 !SMS 0-1	CTCSS ADD-IN (0) (0=NO,1=YES)
170 !SMR 1-8	ANI FOR SYSTEM RELAYS (*1) (CHARS)
27 !SM1 0-4	USER RELAY 1 MODE (0)
28 !SM2 0-4	USER RELAY 2 MODE (0)
38 !SMB 0-1	RUN MODEM AT 300 BAUD (0) (0=NO,1=YES)
120 !SMI 0-1	INVERT DIGITAL (0) (0=NO,1=YES)
141 !SME 0-1	DID DELAYED BILLING (0) (0=NO,1=YES)
171 !SMV 1-8	ANI FOR VOICE PROMPTS (*3) (CHARS)
<b>USER SPECIFIC</b>	
30 !USU 1-99(325)	USER NUMBER
82 !USE 0-1	USER ENABLE (0) (0=NO,1=YES)
150 !USA 1-8	USER ANI STRING (DIGITS)
41 !USF 0-6	PAGE FORMAT (0) (0=NONE, 1=ADTMF, 2=BDTMF, 3=2805, 4=2T, 5=5/6T, 6=GMARC)
151 !USP VAR	USER PAGING CODE
53 !USC 0-143	USER TONE/CODE
<b>USER ACCESS</b>	
59 !UAM 0-1	USER MOBILE-TO-PHONE (1) (0=NO,1=YES)
60 !UAP 0-1	USER PHONE-TO-MOBILE (1) (0=NO,1=YES)
61 !UAB 0-1	USER MOBILE-TO-MOBILE (1) (0=NO,1=YES)
62 !UAT 0-1	USER DISPATCH (1) (0=NO,1=YES)
55 !UAC 0-1	COR TO ANSWER (0) (0=NO,1=YES)
33 !UAS 0-1	USER * TO ANSWER (1) (0=NO,1=YES)
34 !UAD 0-1	USER # TO DISCONNECT (1) (0=NO,1=YES)
35 !UAF 0-1	USER FAST ANI REQUIRED (0) (0=NO,1=YES)
13 !UAL 0-1	USER LINE SELECT (1) (0=NO,1=YES)
80 !UA2 0-1	USER LINE 2 DEFAULT (0) (0=NO,1=YES)
68 !UAA 0-1	USER AUTO DIAL MODE (0) (0=NO,1-9=ONLY,14=ALL+, 15=ALL)
<b>USER OPERATION</b>	
66 !UOQ 0-4	USER EQUIPMENT TYPE (0) (0=MOB,1=T/B,2=T+V,3=TO, 4=DIRECT)
39 !UON 1-2	USER CHANNEL RINGOUTS
40 !UOS 0-7	USER RINGOUT STYLE
14 !UOO 0-1	USER COURTESY TONE (1) (0=NO,1=YES)
81 !UOX 0-1	USER FULL DUPLEX MOBILE (0) (0=NO,1=YES)
31 !UOP 0-1	USER PRIVACY (0) (0=NO,1=YES)
46 !UOM 0-2	USER CALL TIMER MODE (1)
73 !UOT 0-2	USER TOLL MODE (0)
45 !UOD 0-1	USER DTMF THRU (0) (0=NO,1=YES)
54 !UOC 0-2	CTCSS DROP AFTER PAGE (0) (0=ALWAYS,1=AFTER PAGE, 2=AFTER MOB. ANS.)
29 !UO1 0-1	USER ENABLE RELAY 1 (0) (0=NO,1=YES)
107 !UO2 0-1	USER ENABLE RELAY 2 (0) (0=NO,1=YES)
144 !UOH 0-1	ENABLE HOOKFLASH (0=NO,1=YES)

# SECTION P - PROGRAMMING REFERENCE

DTMF MENU RANGE	DESCRIPTION
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<b>SUPERVISOR</b>	
167 !VA 1-7	PROGRAM MODE ACCESS CODE (DIGITS)
83 !VN 0-99(325)	SUPERVISOR USER NUMBER
94 !VS (N/A)	RESET SYSTEM PROGRAMMING (NOT DTMF PROGRAMMABLE)
95 !VU (N/A)	RESET USER PROGRAMMING (NOT DTMF PROGRAMMABLE)
<b>TEST</b>	
102 !TA 20-250	TONE #1 FREQUENCY X10(HZ)
103 !TB 20-250	TONE #2 FREQUENCY X10(HZ)
98 !T1 0-2	SINGLE TONE TEST (0) (0=OFF,1=TELCO ON,2=TX ON)
104 !T2 0-2	DUAL TONE TEST (0) (0=OFF,1=TELCO ON,2=TX ON)
115 !T3 0-143	CTCSS TONE OUT (0) (0=TONE OFF,1-143=TX TONE)
105 !T4 0-1	EMPHASIS TEST (0) (0=NO,1=YES)
106 !TH 0-1	HYBRID ADJUST (0) (0=NO,1=YES)
<b>ACCOUNTING</b>	
88 !AP 0-1	SMDR OUTPUT TO PRINTER (1) (0=NO,1=YES)
89 !AI 0-1	INTERNAL SMDR STORAGE (1) (0=NO,1=YES)
90 !AM 0-180	MINIMUM CALL TIME (1) (SEC)
168 !AC 1-12	SET CLOCK/CALENDAR (DIGITS)
<b>NONMENU ITEMS</b>	
78 ! 0-4	SET BAUD RATE FOR RS-232 PORT (3) (0=300, 1=1200, 2=2400, 3=4800, 4=600)
0*0#	EXIT PROGRAMMING

## MODEL 45 MENU PROGRAMMING STRUCTURE

