ZETRON

MODEL 48PB REPEATER MANAGER
TECHNICAL MANUAL

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MODEL 48PB REPEATER MANAGER
TECHNICAL 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.

(FCC) Federal Communication Commission Regulations

The following criteria MUST BE MET to comply with FCC rules:
(For 702-9183 Revision A and later.)

1. The FCC registration number of this device (EYB5Q5-15387-OT-T) and ringer equivalence number (0.4B) 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.

DOC COMPLIANCE

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.
Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100. An alphabetic suffix is also specific in the Load Number for the appropriate ringing type (A or B), if applicable. For example, " LN = 20 A " designates a Load Number of 20 and an "A" type ringer.

LOAD NUMBER __6A__ .

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TRADEMARKS

1. INTRODUCTION

GENERAL

The Model 48PB Repeater Manager is a microprocessor-based, general-purpose repeater panel with mobile radio-to-telephone interconnect. It is designed to provide low-cost, yet flexible operation as a full-featured repeater panel combined with a full-featured telephone patch with selective calling.

The Model 48PB, as well as a repeater panel, 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 information. The system data base can be downloaded and uploaded.

The compact size of the Model 48PB allows inconspicuous shelf mounting or it may be installed in a standard 19-inch equipment rack.

First time owners should finish reading this section and then read the sections on installation, programming, paging, and operation. Other information such as specifications, repair and schematic diagrams are found in sections seven through nine. The appendices contain information on serial communications between the Repeater Manager and computers, such as the IBM PC, Commodore 64 and Radio Shack Model 100.

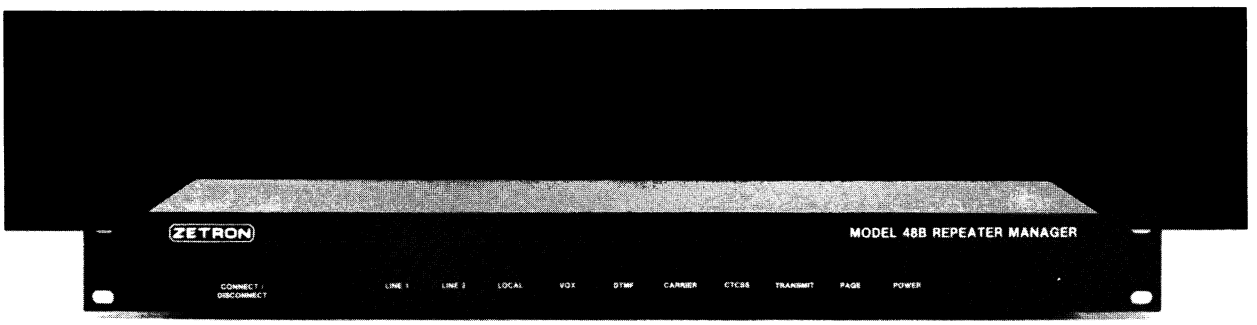


FIGURE 1-1: Model 48PB Repeater Manager

FEATURES

Repeater panel features:

* All 38 CTCSS tones standard.
* Sepatate regenerated CTCSS output.
* High pass filtered receive audio.
* Morse ID programmable.
* Courtesy tone.

Interconnect features:

* Supports full and half duplex mobile operation.
* Internal 300/1200 baud modem for remote computer or terminal programming.
* Complete paging encoder.
* Supports DTMF or pulse dial-out with programmable dialing rates.
* Programmable private access/disconnect codes from 1-8 digits.
* No cumbersome "DIP switches" to set.
* 4-digit first and second digit toll restrict.
* User selectable times for system variables, including call limit, line activity, VOX hold, COR delay, transmitter hold, number entry time-out, etc.
* Full COR channel monitoring for positive transmitter control.
* Mobile-to-Mobile paging encoder capability.
* User selectable auto-dial phone numbers with up to 10 entries.
* Four control relays allow control of devices from either the telephone or mobile.
* All tones (DTMF, etc.) are regenerated for error-free coding.
* 110/220 VAC at 50/60 Hz or 12-15 VDC operation.
* All features remotely programmable via phone.
* Two telephones lines provided plus line for local phone.
* Supports high speed (1200 baud) FFSK signaling.
* Includes 4-Wire E & M port for dispatch access.

2. SPECIFICATIONS

GENERAL

Power	100-130 VAC 60 Hz, 7 watts or 12-15 VDC, 700 mA.
Temperature	-10 to 65 degrees C.
Size	16W x 9D x 1.75H inches. 19-inch rack mount.
Weight	7 pounds.
Capacity Dispatch	38 CTCSS tones.

FFSK Signaling

Data rate	1200 Baud
Signaling Frequencies	1200/1800 Hz Frequency shift keying
Signaling Standard	MPT1327 data stream format

Decoder Specifications

Freq range	67 to 250.3 Hz.
Number of tones	38 EIA tones
Bandwidth	$\pm$1.5%
Hold time	0.1 to 3.0 sec. adjustable
Tone acquisition time	250 Ms.

Tone 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 cap-codes.
DTMF	1 to 7 digits.
Five/Six-Tone	EIA single or dual address.
CTCSS	38 standard EIA tones.

TELEPHONE INTERFACE

Connector	RJ11-C Modular Jack.
Mode	Full duplex operation, balanced hybrid.
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

RADIO INTERFACE

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

4-WIRE INTERFACE

Tx Audio	-30 to +6 dBm into 600 n
Rx Audio	-20 to +10 dBm into 600 n
E-Lead	Active Low input (Internally pulled to +9)
M-Lead	Relay closure to ground (output)

OTHER

Modem	300 baud Bell 103J or 1200 baud Bell 212.
Indicators	Line1, Line2, Local, VOX, DTMF, Carrier, CTCSS, Transmit, Page, Power.
Switches	Connect/Disconnect.
Station ID	Morse code, fixed 1200Hz frequency and selectable call sign.
Operating modes	Half-duplex and full-duplex.
Equipment types	Tone only pager, Tone + Voice pager, Talk-back pager, Mobile.
Prompt tones	Progress tones, error tones, and warning tones sent to phone or mobile.
Programming	Programmable via RS-232 or phone modem.
Data retention	Better than 5 years with power removed.
Secondary protection	High voltage varistors on phone lines and radio interface.

3. OPERATION

REPEATER PANEL OPERATION

The Model 48PB is a microprocessor based repeater controller. It interfaces directly with a radio system to provide repeat audio processing as well as a variety of functions as described below.

The Model 48PB recognizes special "access codes" requiring FFSK data bursts. No other qualifier for this access type is required, nor is specific data for any given user stored in the database.

This lack of specific knowledge of individual users is the key to allowing all mobile units to operate anywhere in the system while still preserving a reasonable degree of system security. Rather than residing in the Repeater Manager's database, user privileges are determined by the programmed configuration of the mobile controller.

When a valid tone and code is detected, the unit will regenerate the tone (when required) out the transmitter, and perform the necessary audio processing between the repeaters receiver and transmitter.

Impending repeater time-out warnings are indicated by double "beeps" occurring 15 seconds before the transmitter drops.

Courtesy Tone

A prompt or courtesy "beep" will be transmitted whenever a mobile unkeys.

Morse ID

Each Model 48PB may be assigned an eight character Morse code ID, that will be automatically sent when a mobile unkeys after a specified amount of time has expired.

INTERCONNECT OPERATION

The Model 48PB is designed to operate as a full-featured phone interconnect in full-duplex and/or half-duplex radio installations. The unit also provides the functions of both a dial access paging encoder and a mobile-to-mobile select call encoder, allowing a mix of equipment types in one system.
When operating half-duplex the telephone audio is muted whenever the mobile is transmitting, and if selected a privacy tone is transmitted. If full duplex is selected the privacy tone is not transmitted and the mobile's audio will be repeated out the transmitter.

When calling a mobile the Model 48PB issues a CTCSS tone only until the call is established so that other parties on the channel do not have to listen for the duration of the call.

Access to the system requires Access and Function codes as follows.

A F W X talk--- # where

A = DTMF password.

Function code (F)	(X) Required following digits.
0 Transmit access	none
1 CTCSS	1-38 (Desired Tone)
2 2-Tone Paging	3 digit cap code
3 DTMF select call	1-7 digit select-call code
4 FFSK	4 digit call code
5 5-Tone Paging	6 digit paging code
6 6-Tone Paging	7 digit paging code
7-9 Not used	

W = Wait for beep.
X = Required select-call/call code digits
Talk = Voice allowed on channel.
# = Call complete (Disconnect).

PHONE-TO-MOBILE w/MODEL 7

In phone-to-mobile communication, a caller accesses the Model 48PB by dialing the Model 48PB's phone number. The Model 48PB answers the call with a 400 ms beep 750 ms after the first ring. After the beep a caller may call a user by entering the unit Password + "4" + 4 digit call code. An FFSK page is then sent to all appropriate parties. If the called mobile is an individual the phone party will hear either a normal ring, a broken ring (channel busy) or a busy signal (unit is out of range). A CTCSS tone and the called ANI are required before an individual call is connected. If the call code is a group or all call two beeps will be heard and voice will be allowed on the channel for up to 45 seconds before a mobile is required to answer. If a call code is not entered after 10 seconds or the call is unanswered after 45 seconds the line is disconnected. In group call a CTCSS tone and any ANI is sufficient to answer. In all call only a CTCSS tone is required. The call will be disconnected if a mobile does not answer after 45 seconds or if the channel is busy for 60 seconds.

Answering a Call to a Mobile

A CTCSS tone and an appropriate ANI must be received by the calling Model 48PB for an answer to occur. The phone party will hear a single beep each time the mobile unkeys.

Phone-to-Mobile w/DTMF, 5/6-Tone or 2-Tone Decoder

Access to the Model 48PB for dial-access selective calling is identical to that for phone-to-mobile w/Model 7 communication. The Model 48PB answers the call as above. The caller may then place a call by entering a valid password + Function code + Select call code. The selective calling code for the called party will then be broadcast.

After the selective calling code is sent the phone party will hear any channel activity present and may issue a voice message if desired.

As above the call will be disconnected if a mobile does not answer after 45 seconds or if the channel is busy for 60 seconds.

Direct Transmitter access is similar to phone-to-mobile operation, however, no page occurs. The phone party is immediately allowed onto a quiet channel. (Function code "0", no select call code required). In this mode a CTCSS tone will be broadcast until COR becomes active (any mobile answers).

MOBILE-TO-PHONE ACCESS

Model 48PB Access

Model 7 (FFSK) access is automatic at keyup.

For DTMF access the user dials the repeater access code number and waits for a beep. He then completes the access by dialing a function code and any required call/paging/select call/speed dial numbers. The Function codes are given below:

Function code		Required following digits.
0	Transmitter	none
1	CTCSS	1-38 (Desired Tone)
2	2-Tone Paging	3 digit cap code
3	DTMF select call	1-7 digit select-call code
4	FFSK	4 digit call code
5	5-Tone Paging	6 digit paging code
6	6-Tone Paging	7 digit paging code
7	Speed Dial	Autodial number (0-9)
8	Line 2 Access	Telephone number
9	Line 1 Access	Telephone number

Phone Access Function Codes

Dialing

Mobile access to the telephone network is dependent upon the toll restriction assigned to the 48PB. If allowed, the mobile may immediately begin entering the phone number to be called. As DTMF/FFSK digits are received from the mobile, they are regenerated out the phone line as either DTMF or dial pulses. The unit will stop regenerating the digits and allow the mobile's audio through to the phone line when any one of the following conditions is met:

1) More than 5 seconds has elapsed between digits (DTMF time-out).
2) A DTMF "*" is received.
3) A minimum of 4 digits have been received and the mobile unkeys.

In addition to the normal dialing described above, the mobile users will have access to the Model 48PB's ten auto-dial (previously stored) phone numbers. After mobile access, the user selects an auto-dial number by entering a Function code of "7" followed by the desired auto-dial number ("0" through "9").

With the Model 7 auto-dial is accomplished simply by keying the mobile with the desired auto-dial number selected. Alternately, a 48PB may be restricted to using only the auto-dial numbers.

NOTE: Although Auto-dial numbers are not toll restricted only authorized parties can program them.

Toll Restriction

Each 48PB has a set of system defined toll restricts which defines 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 subject to toll restriction.

Disconnecting a Call

It is generally the mobile's responsibility to terminate the telephone connection. With the Model 7, this is accomplished automatically by hanging up the microphone or by pressing the '#' key. The DTMF mobile user should enter a long DTMF "#" (0.125 sec.) for disconnect. The telephone party may disconnect 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. Calls will also terminate if the 45 second mobile activity timer expires or if the call length exceeds the 3 minute 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. A 2nd dial tone (due to the telephone party hanging up) will also terminate the call. NOTE: The call limit timer can be reset.

In all cases, when a call is terminated, the unit will transmit five beeps (normal disconnect) or "bee-doos" (time-out disconnect) to indicate disconnect.

MOBILE-TO-MOBILE OPERATION

Mobile-to-FFSK Mobile/Dispatch

After receiving a valid repeater I.D. and function code from a DTMF mobile, the unit keys up the transmitter and issues a beep. The mobile must begin entering the call code of the mobile/dispatcher to be called before the 5 second DTMF time-out. If no number is entered, the unit will issue an error tone and drop the transmitter.

With the Model 7 mobile-to-mobile operation is accomplished simply by keying the mobile with the desired call code number selected.
After receiving the called mobile's code, the unit will issue the users FFSK call code, if the calling mobile does not unkey (automatic in the Model 7) the Model 48PB will cancel the call after 5 seconds. When the call is answered, the unit will issue a single prompt beep and commence repeater operation (described below) with a 20 second hold time. If a mobile does not answer in 45 seconds five beeps will be issued and the transmitter will be dropped.

Mobile-to-Mobile w/DTMF, 5-Tone, or 2-Tone decoder (also pagers)

After receiving a valid repeater I.D. and function code from a DTMF mobile, the unit keys up the transmitter and sends a beep. The mobile must enter the selective calling code of the mobile/pager to be called before the DTMF time-out [5 seconds]. If no number is entered, the unit will issue an error tone and drop the transmitter. The selective calling code for that user will then be broadcast. A prompt (2 beeps) will be issued after the code is sent and the Model 48PB will change to repeat mode.

With the Model 7 mobile-to-mobile/pager operation is accomplished by selecting the selective calling function (2-Tone, DTMF ...), keying the radio and entering the selective calling code at the beep. The call proceeds as above.

DISPATCH OPERATIONS

Dispatchers may operate either on a 4-wire audio link or as a mobile.

An FFSK or DTMF equipped dispatcher operating over the radio channel functions the same as other mobile operation above.

4-Wire Dispatch

An FFSK or DTMF equipped dispatcher operating over the 4-wire port operates like a mobile above with the following exceptions:

1). 4-Wire Port users do not have access to phone lines.
2). FFSK users must have their Model 7 set to 4-Wire mode.
3). DTMF users MUST dial a '*' before the repeater I.D. and access codes.

NOTE: Without a monitor receiver a 4-wire dispatcher has no way of knowing if co-channel repeaters are active.

The 4-Wire port may be used with the E & M signaling leads as a direct air instant dispatch port. Whenever the E-lead receives a connect signal the repeater will key up using the default transmit tone and remain on the air until the E-lead is dropped.

NOTE: If the repeater is on the air when the E-lead closes the current tone will be transmitted until the call-in-progress is cleared.

DTMF REPEATER OPERATION

The Model 48PB is set up to require an access code (Repeater Access Code + '1' + CTCSS Tone Number) from DTMF users to gain use of the repeater. A CTCSS tone (1-38) will be transmitted during the complete conversation. When a Model 7 user selects call codes 1-38 tone repeater access is established as above.

Repeater operation is ended if the repeater time-out timer ([3] minutes) expires, the [20] second hold timer expires, or the mobile sends its disconnect code. If operation is ended by hold timer expiration or disconnect code, the unit will issue five beeps to indicate repeater drop. If the repeater time-out timer expires, the error tone will be issued. Once the repeater drops, DTMF sign-on is again required to rekey the transmitter.

If a mobile wishes to send live DTMF over the air, the mobile must wait for the DTMF time-out [5 seconds] after access, without sending any DTMF. After the DTMF time-out the Model 48PB allows DTMF to pass from the receiver to the transmitter. The Model 48PB mutes any DTMF audio for the DTMF time-out after COR becomes valid. This is to prevent signaling 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.

For Model 7 users DTMF signaling may be generated at the repeater at any time during a transmission.

SENSE LINE INPUTS

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

Sense one is used to validate COR. This input is pulled high internally so if left open the COR validation polarity question should be answered yes, if answered no or if the input is pulled low the normal operation of COR is terminated.
Sense two 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 will flash.

Sense three can be used to send out a page. Sense three uses the page format and page code of user one.

Sense four is used as an input to control the 4-Wire E & M port.

CONTROL RELAYS

Four control relays are provided in the Model 48PB for external control: 2 for system level controls, relays 1 & 2 (J6 pin 8 and J2 pin 2), 1 user level control, relay 3 (J2 pin 4), and 1 for 4 Wire E & M port control (J2 pin 6). 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. Operation of the user relay is 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 that the above modes are system level selections. The relay is energized under one of the above sets of conditions.

FRONT PANEL INDICATORS

The Model 48PB has ten front panel indicator LEDs. Each indicator is discussed below.

LINE 1 On when line 1 is off-hook or ringing.
LINE 2 On when line 2 is off-hook or ringing.
LOCAL On when local phone is off-hook.
VOX On when phone audio is detected.
DTMF On when DTMF digits are detected.
CARRIER On when COR is detected.
CTCSS On when a sub-audible tone or Digital code is decoded.
TRANSMIT On when the transmitter is keyed.
PAGE On when a page is broadcast. Also blinks periodically to verify normal system operation.
POWER On when system power is applied.

FRONT PANEL CONTROLS

CONNECT/DISCONNECT:

When a line is not active connects the Model 48PB to the default phone line (factory set to line one). When a line is active Disconnects any call/access in process.

SMDR OPERATION

SMDR Print
When SMDR pring is enabled a detailed record of each transaction is sent out the serial port J1 to a printer or data recorder at the completion of the transaction.

Below is an example of the printout obtained when SMDR Print is enabled. If SMDR Storage is Enabled a complete printout can be obtained at any time by selecting 'List SMDR Storage' from the supervisor menu.

```
  DATE      TIME    USR  AIR-TIME TYPE      CALLED
-------- -------- ---- -------- ---- ----------------
09/01/89 03:09:00 4444 00:00:43  4W  Group 2222
09/01/89 13:10:00 9999 00:02:16  PL  User 1234
09/01/89 15:59:00 9999 00:00:42  P1  All 9999
09/01/89 16:07:00 9999 00:00:14  P2  User 1258 No Answ
09/01/89 16:09:00 4321 00:01:34  MM  User 1234
09/01/89 16:15:00 4321 00:02:21  M1  18005551212
09/01/89 18:49:00 1234 00:01:14  M2  12356874
** End of list **
```

Date and time are of call origination, USR is the FFSK ID# of the unit placing the call and Air-Time is the length of the call. A User ID of 9999 means that the Model 48PB is unable to determine originating ID (i.e. a DTMF or phone originated call).

TYPE shows origin and type of call. 4W is any call originated from the 4-Wire port. P{L/1/2} are phone calls from the Local Phone, Line 1 or Line 2. M{M/1/2} are calls from a mobile to another Mobile, to Phone Line 1, or to Phone Line 2.

CALLED shows the ID and call type (If a mobile is called, or the Phone number dialed if a phone line is used.

SMDR Internal Storage
The data above may be obtained one record at a time as they occur or as a complete table of calls downloaded by the command 'List SMDR Storage'. For the data to be downloaded both SMDR Print and SMDR Storage MUST be enabled.

4. PROGRAMMING WITH A CRT OR COMPUTER

INTRODUCTION

The Model 48PB contains many variables for the system. These variables are set by the system operator using the programming features of the Repeater Manager. The Model 48PB 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 48PB from a CRT or computer. DTMF programming (next section) is used mainly for small adjustments to the system "on-the-fly."

The system 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 done even without power applied.

The Model 48PB 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 48PB. One connection method is directly through the Model 48PB's serial port. This method is simple and quick, but it requires that the CRT and Model 48PB be within 100 feet of each other. Since this is not always possible, the Model 48PB's programming features may be accessed over the phone line and through its internal 300/1200 baud modem.

ACCESSING PROGRAMMING MODE BY DIRECT CONNECT

Before attempting to program the Model 48PB 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 48PB's serial port and configured with the proper communication protocol (4800 baud, 8 data bits, 1 stop bit, no parity), Model 48PB programming may begin. Press reset on the Model 48PB. A 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 48PB sign-on message and Top Menu selections (Figure 4). If the Repeater Manager does not respond, it may be processing a call or page. The Model 48PB must be idle before direct connect programming may commence. Instructions on actual programming are continued in "CRT Programming Menus and Commands." When programming is finished, be sure to EXIT PROGRAMMING or the Model 48PB will not detect subsequent call activity until the programming mode activity timer expires (5 min.).

300/1200-BAUD MODEM

The 300/1200-Baud modem that comes with the unit allows remote programming of the system and user programming remotely on the same phone line that is used for interconnect. The modem is factory defaulted to operate at 1200 baud and may be changed in the system misc. menu or may be changed via DTMF programming.

ACCESSING PROGRAMMING MODE VIA MODEM

The Model 48PB's programming may be accessed without any additional connections by using a standard phone line to the device, coupled with the unit's internal modem. This method is slightly more involved than the direct connect method because the Model 48PB 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 48PB. 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 48PB 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 00072). The program access code may be entered with a Hayes compatible modem by typing ATDT00072. The Model 48PB will issue modem tone, if the Model 48PB detects modem carrier signal and a RETURN is entered from the keyboard it will display the "Top Menu" (Figure 4). The unit will issue modem carrier for 20 seconds, after which it will go into DTMF programming (see "Programming via DTMF").

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 48PB to hang up the phone.

CRT PROGRAMMING MENUS

The Model 48PB'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 and supervisor programming, test functions, 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. This ensures subsequent calls will be processed. Since supervisor information is the simplest, it will be discussed first, followed by system programming. Before programming is discussed, a few general words about menus is in order.

```
Model 48PB   Ver:2.03
Copyright, 1989, ZETRON INC.

TOP MENU

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


Please select:
```

FIGURE 4-1: Model 48PB sign-on and "Top Menu"

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.

SUPERVISOR INFORMATION

Pressing "V" followed by the RETURN key eight the Top Menu, displays four supervisor variables (Figure 4-2). Select one of the variables to be changed. For example to change the program mode ANI to 787123, press A, type 787123 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 48PB 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.

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) = 00072
R. ANI for system relays = *1
B. Run modem at 300 baud = No
S. Reset system programming = No
D. Reset Dispatch Programming = No
I. Clear SMDR Storage = No
G. Clear all Group Calls = No
L. List system programming = No

Please select:
```

FIGURE 4-2: Supervisor programming

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

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. ("System Relay 1" is Control Relay 1, and "System Relay 2" is Control Relay 2.). See operation section--Control Relays.

RUN MODEM at 300 BAUD--If set to yes the modem will operate at 300 baud, if set to no the modem will operate at 1200 baud. This item may be changed while programming the unit via direct connected, modem, or DTMF.

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

RESET DISPATCH PROGRAMMING--If a "Y" is entered, the units dispatch user programming is reset to factory defaults. Caution: When the dispatch user programming is reset, the accumulated airtime for dispatch users is also cleared. The accumulated airtime can also be cleared in the accounting menu; clear tone/code dispatch accumulated.

Clear SMDR Storage--If selected and answered yes you will be asked "are you sure" if this is answered "Y" the SMDR memory will be cleared.

Clear all Group Calls--Clears the Group Call numbers from the FFSK operating section. This Must be done any time the memory chips (U5 or U6) are replaced.

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. If your terminal program allows you to capture the screen to a file you can save the system programming in a file on disk and print it.

PROGRAMMING SYSTEM INFORMATION

Pressing "S" followed by RETURN from the top menu, display's the System Menu (Figure 4-3). From this menu, eight system-related programming options are available, discussed below.

```
SYSTEM MENU

C. COR              A. ACCESS
R. REPEATER         I. STATION I.D.
D. AUTODIALS        V. TOLL RESTRICT
T. TELCO CONTROL    G. GROUP NUMBERS

Please select:
```

FIGURE 4-3: System Programming Menu

COR PRPGRAMMING

Pressing "C" followed by RETURN from the System Programming Menu will display four variables which effect COR operation (Figure 4-4) described in detail below.

```
COR MENU

Q. Quiet time (*100ms) = 30
M. Mob Tx-to-Rx time (*100ms) = 2
A. Mob act time (*sec) = 45
B. Channel busy active high = No

Please select:
```

FIGURE 4-4: COR programming information

HOLD TIME--the hold time determines how long the COR signal must be inactive before the Model 48PB is sure that the mobile is not transmitting. 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. This time delays the turn around time from receive to transmit and should normally be set to '0'.

QUIET TIME--the quiet time is the amount of time the radio channel must remain quiet (no COR) before the Model 48PB 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, are issued. Note: 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.

MOBILE ACT TIME--the mobile activity time determines how long a land- line may transmit without mobile intervention. 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.

CHANNEL BUSY--the unit is also provided with an auxiliary channel busy input (SENSE 2) for use with a monitor receiver. When this input is active the COR LED will flash. 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). Alternately, a "Y" indicates active high channel busy on the input. Note that the channel busy input is pulled high internal to the model 48PB. If the channel busy input is not being used set it to active low and leave the input open. Caution: If this input is active (the COR LED is flashing) 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 4-5), discussed below.

```
ACCESS MENU

T. Telco Password = 099
N. Repeater Number = 99
X. Repeater access Tx tone = 1
R. Repeater access Rx tone = 0
F. Full duplex mobiles = Yes
P. Privacy = No
D. DTMF timeout (*100ms) = 50
M. Min. regenerated digits = 4

Please select:
```

FIGURE 4-5: Access programming information

TELCO PASSWORD--DTMF characters required to be entered by the phone caller to gain access to the interconnect.

REPEATER NUMBER--Two digit number required by the Model 48PB to distinguish between co-channel repeaters. Must be sent as part of all over the air access to the repeater.

REPEATER ACCESS TX TONE--CTCSS tone number sent from repeater when tone is present.

REPEATER ACCESS RX TONE--CTCSS tone number required by repeater manager for access to functions.

FULL DUPLEX MOBILES--If 'yes' the COR signal is not used to mute the phone to mobile audio, therefore privacy tones and the mobile tx-to-rx timer will not apply. If the mobile does unkey the courtesy tone will be issued. Note that on a half-duplex mobile the Tx audio is muted when COR is active, but the repeat audio is not muted. (See Privacy)

PRIVACY--If 'yes' a fast busy signal is transmitted when the mobile is keyed-up. If the system is set for full duplex mobiles (above) the privacy tone is disabled. IF THE SYSTEM IS SETUP AS HALF-DUPLEX THE MOBILE'S AUDIO IS REPEATED UNLESS PRIVACY IS ON.

DTMF TIME-OUT--this is the maximum amount of time the Repeater Manager will wait 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 also affects sign on. If COR drops for 2 seconds or longer between sign-on digits, sign-on will have to be restarted.

MINIMUM REGENERATED DIGITS--this is the minimum number of digits the Model 48PB accepts from a dialing mobile before deciding that dial-in is complete, if the mobile unkeys. 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.

REPEATER PROGRAMMING

Pressing "R" followed by RETURN from the System Programming Menu will display eleven repeater oriented variables (Figure 4-6), discussed below.

```
REPEATER MENU

H. Repeater hold time (*100ms) = 30
S. CTCSS hold time (*100ms) = 8
T. Timeout (*min) = 3
D. Keyup delay (*25ms) = 60
I. Hog Idle Time (*sec) = 5
L. Hog Limit Time (*min) = 5
P. Hog Penalty Time (*10sec) = 30
R. Dispatch ID Rate (*min) = 15
C. CTCSS for Dispatch = Yes
O. Courtesy Tone = Yes
M. Stuck Mic ID = No

Please select:
```

FIGURE 4-6: Repeater programming information

REPEATER HOLD TIME--the amount of time the unit will keep the transmitter keyed after the mobile unkeys during dispatch.

CTCSS HOLD TIME--The amount of time that the mobiles tone must be gone before the unit will squelch the mobiles audio (with carrier present).

TIMEOUT--the maximum amount of time the repeater may remain in transmit mode during normal dispatch operations. During ANI dispatch, or on a mobile-to-mobile call, the call limit timer for the originator is used.

KEY-UP 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. This time is also used on mobile to mobile paging, between tone/code transmission and paging tones.

HOG IDLE TIME--The amount of time that a user must remain inactive to reset his conversation timer (hog limit timer).

HOG LIMIT TIME--The amount of time a dispatch user can continuously use the repeater, without allowing another mobile access or without unkeying for the idle time.

HOG PENALTY TIME--If a mobile exceeds the Hog Limit time, the repeater manager will not allow that tone/code to access the repeater until the Hog Penalty time has expired.

DISPATCH ID RATE--This timer controls how often a dispatch users Morse code ID will be sent, if its tone is detected. This is not the same as the system Morse ID.

CTCSS FOR DISPATCH--if 'yes', a mobile must encode a CTCSS tone or Digital code (that is enabled in the user dispatch menus) to gain repeater access by just keying up. If 'no', simply keying-up will key up the repeater. If 'yes', an ANI user may gain access to the repeater by entering the proper access code.

COURTESY TONE--if 'yes', a courtesy tone is issued when a mobile un-keys if CTCSS for dispatch is 'no'. If CTCSS for dispatch is 'yes', the courtesy tone setting for the tone/code user is used, as set in the user dispatch menu. If the user gains access with an ANI code the courtesy tone setting for the originating user is used in the user operation menu.

STUCK MIC ID--If yes, a 3-digit DTMF number every 15 seconds indicates the dispatch user number if a repeater timeout occurs.

STATION ID PROGRAMMING

Pressing "I" followed by RETURN from the System Programming Menu will display three station ID oriented variables (Figure 4-7), discussed below. The station ID frequency is fixed at 1200 Hz.

```
STATION ID MENU

M. Mode = 1
I. Interval (*min) = 15
S. Call sign (chrs) =

Please select:
```

FIGURE 4-7: 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.

AUTO-DIALS PROGRAMMING

Pressing "D" followed by RETURN from the System Programming Menu will display the ten auto-dial numbers (Figure 4-8).

```
AUTO-DIAL MENU

0.  (chrs) =
1.  (chrs) =
2.  (chrs) =
3.  (chrs) =
4.  (chrs) =
5.  (chrs) =
6.  (chrs) =
7.  (chrs) =
8.  (chrs) =
9.  (chrs) =

Please select:
```

FIGURE 4-8: Auto-dial information programming

AUTO-DIAL NUMBERS--ten 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 three toll restrict oriented variables (Figure 4-9). Each variable is discussed in detail below.

```
TOLL RESTRICT MENU

1. Max toll digits 1 = 15
2. 1st digit restrict (chrs) =
3. 2nd digit restrict (chrs) =

Please select:
```

FIGURE 4-9: Toll Restrict information programming

MAX TOLL DIGITS--this variable contains the maximum number of digits a mobile may dial for a phone number.

DIGIT RESTRICT--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. The numbers 911, 1-800-nnn-nnnn, and the auto-dial however, are never restricted. The digits that are restricted for 1st digit are independent of the 2nd digit restrict. Therefore a 4 for 1st digit and a 1 for 2nd digit will both restrict 411 access but any number that begins with a 4 will also be restricted. When entering the digits they must be entered without any spaces or other characters between them. The digit toll restriction is done after the 3rd digit is dialed.

TELCO CONTROL PROGRAMMING

Pressing "T" followed by RETURN from the System Programming Menu displays five telco control oriented variables (Figure 4-10), discussed below.

```
TELCO CONTROL MENU

1. Call limit timer-1 (*min) = 3
0. Delay before dial-out (*100ms) = 20
D. Disconnect on 2nd Dial Tone = Yes
M. Dial-out mode = 0
V. Override Dispatch = No
D. Channel busy rings = 4

Please select:
```

FIGURE 4-10: Telco control information programming

CALL LIMIT TIMER--this variable restricts the maximum length of a call. This timer affects, phone to mobile and mobile to phone. This timer will also limit the time of a mobile to mobile call and will limit repeater time. This timer is disabled for the duration of the call in progress if the DTMF digits '123' are entered anytime during a conversation.

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. If DTMF dialout is selected, then dialing will occur at the rate selected until the dialing has caught up with the mobile, then the dialout will follow the mobiles dialing. If the mobile unkeys, and waits for dial tone, this timer is not used.

DISCONNECT ON 2ND DIAL TONE--if 'yes', the Repeater Manager will disconnect a call after 2 seconds of dial tone, once 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 48PB dials a mobile originated call's phone number during regeneration.

0 = slow DTMF (5 digits/sec)
1 = fast DTMF (10 digits/sec)
2 = slow Pulse (10 pulses/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 call out to the user. This overrides the quiet timer.

CHANNEL BUSY RINGS--this variable determines the number of rings that may occur before the Repeater Manager disconnects when the channel is busy. The calling party hears broken rings. If the channel becomes free before channel busy rings occur then channel access is allowed.

GROUP NUMBER PROGRAMMING

Pressing "G" followed by RETURN from the System Programming Menu displays the GROUP MENU.

```
GROUP NUMBERS MENU (A-B:C)

G. Group Range = A-B
E. Group Enabled = NO

Please select:
```

FIGURE 4-11: Group Number Programming

GROUP RANGE--This variable selects a range of groups to program.

GROUP ENABLED--This variable shows whether the first group in any range of groups is enabled or disabled. To enable or disable a range of groups this question MUST be answered Yes or No (Y/N). Hitting Return leaves all groups as they were.

PROGRAMMING USER INFORMATION

Pressing "U" followed by RETURN from the Top Menu will display the User Programming Menu (Figure 4-12). This menu provides a method for programming user information. The dispatch menu works with one user(CTCSS tone) at a time to program unique information. Programming options are discussed below.

```
USERS MENU

T. Tone Dispatch
L. List

Please select:
```

FIGURE 4-12: User Programming Information

User Numbers

The tone dispatch menu allows programming of the 38 CTCSS tone dispatch users.

User Tone Dispatch

Entering a "T" from the User Programming Menu will display the User Tone Dispatch menu (figure 4-13). The current user is displayed in parentheses after the menu name, and any changes made will only change that users parameters. If a comma is entered while in the tone dispatch menu, the current user number will be incremented by one. If a comma is entered after data (rather than a return), the data will be stored, and the same menu item will be displayed but for the next user.

```
TONE DISPATCH MENU

U. Current User = 1
E. Enabled = Yes
R. Reserved = No
X. Tx tone/code =1
T. Tone in tail = Yes
V. Privacy = No
O. Courtesy tone = Yes
H. Hog Mode = No
M. Morse ID (chrs) =

Please select:
```

FIGURE 4-13: Repeater programming information

The user number in the tone dispatch menu corresponds to a subaudible receive tone number (1-38). For example, if user 2 is enabled, subaudible tone 2 (71.9 Hz) is enabled for tone dispatch operation on the repeater. See the appendix for the cross reference from/to numbers to tone frequencies.

Current User--The number entered selects the user number (receive tone number) to be displayed and programmed in the menu.

Enabled--If yes, corresponding receive tone number is enabled for dispatch.

Reserved--If yes, whenever the corresponding tone is received by the unit, a fast busy will be issued out the transmitter to prevent use of the channel. Note that the tone should not be "ENABLED".

TX tone/code--Specifies the output tone/code that is to be transmitted when the corresponding receive tone is detected. See the appendix for cross reference, tone to frequency.

Tone in tail--If yes, the output tone/code will continue to be sent for the duration of the repeater hold time (assuming another mobile doesn't key up, see privacy below), after the mobile unkeys.

Privacy--If yes, another tone/code cannot gain access to the repeater until the transmitter has been allowed to drop. Normally, tone in tail should be enabled if privacy is enabled, so that other mobiles know that the channel is busy.

Courtesy tone--If yes, a courtesy tone is issued whenever the mobile unkeys. If CTCSS for dispatch is set to NO, (COR dispatch), then the system courtesy tone enables or disables the courtesy tone.

Hog mode--If yes, a mobile is subject to the Hog Mode timers entered in the System Repeater Menu.

Morse ID (chrs)--Enter the ID for the user (up to 10 characters). To clear an entry, enter a space, followed by a return. Note the ID rate is set in the Repeater Menu (Dispatch ID Rate) and it is not the same as the Station ID.

PROGRAMMING ACCOUNTING INFORMATION

Pressing "A" from the top menu will display eight SMDR variables and--in parentheses--the number of SMDR records stored in the unit (Figure 4-14). This menu lets you control the storage and printing of airtime records as well as set the date and time of the Model 48PB'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 then 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
C. Set clock (mm/dd/yy hh:mm:ss) =
O. List SMDR storage = No
S. Clear SMDR storage = No
U. User range = 1
4. List tone dispatch accumulated = No
3. Clear tone dispatch accumulated = No

Please select:
```

FIGURE 4-14: Accounting programming information

SMDR PRINT MODE--this menu item determines whether the SMDR information is sent out the serial port at the end of each transaction. Enter '1' to send the SMDR data to the serial port to be printer at the end of each call or '0' to suppress printing. This option does not print any of the dispatch use, it only prints the use of the system by users that gain access by FFSK, DTMF or Phone Line.

INTERNAL SMDR STORAGE--this menu item determines whether the SMDR information is internally stored at the end of each transaction. This is the same data that will go out the serial port. Enter 'Y' to store the data at the end of each call or 'N' to suppress internal storage. As with the print option, dispatch use is not stored with this option.

SET CLOCK--use this function to set the Model 48PB'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.

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

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

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

LIST TONE DISPATCH ACCUMULATED --enter a 'Y' to list the accumulated airtime for the tone dispatch users in hours:minutes: seconds (99 hours max.) as specified under User Range, above. Note: Even if the tone user is disabled, time will still be accumulated. This can be used to track the use of tones on co-channel systems.

CLEAR TONE DISPATCH ACCUMULATED --enter a 'Y' to clear the tone dispatch users accumulated airtime for the users specified under User Range above.

TESTING THE UNIT

Pressing "T" followed by RETURN from the Top Menu will display the Test Menu (Figure 4-12). Twelve tests are displayed.

```
TEST MENU

A. Tone 1 frequency (*10 Hz) = 54
B. Tone 2 frequency (*10 Hz) = 10
1. Single tone (=Telco:1, Tx:2) = 0
2. Dual tone (=Telco:1, Tx:2) = 0
3. CTCSS tone/Digital code (=Tone) = 0
4. Emphasis (=Telco:1, Tx:2) = 0
H. Hybrid adjust (=Off, On) = No
D. DTMF/click detect (=Telco:1, RX:2) = 0
C. COR detect = No
S. Sense line states = No
T. CTCSS decode test = No
M. Memory test = No

Please select:
```

FIGURE 4-15: Test menu

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 350 to 1000 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 TONE TEST--select 3 for the CTCSS (sub-audible) tone test. Enter the tone number 1-38 to start the test. The tone is sent out the CTCSS output line (J6-13). The tone is generated for 10 seconds, after which the test ends.

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 for access 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 Y 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 potentiometers (AR6 and AR7) for minimum deviation on the channel. Press any key to end the test. This test is not allowed when access is via modem.

DTMF/FFSK DETECT TEST--select D for DTMF tests. This test displays decoded DTMF from a mobile or phone. In FFSK equipped units this test will display the contents of any received FFSK data burst. Enter a 1 to start the test from telco, 2 from the receiver. 3 is a loop around FFSK test that will test the FFSK operation in a full duplex mode. 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.

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.

CTCSS DECODE--Select "T" to display the CTCSS tone currently being received by the unit. The test will display 1-38 for tone numbers. If no tone, a zero will be shown. Press "Y" and a return to start the test; press any key to end the test.

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. "OK" is displayed if all memory is good. "FAIL" is displayed if the system RAM (U5 or U6) is bad. The Model 48PB may still operate if defective memory is detected but the memory should be replaced as soon as possible or unpredictable operation may occur.

5. PROGRAMMING VIA DTMF

INTRODUCTION

Although it is not suggested that major system or user programming be accomplished via DTMF, it is often useful to use DTMF programming for fine tuning system parameters. DTMF programming may be accomplished over-the-air from a mobile or from a DTMF telephone from line 1, line 2 or the local phone. Note also that the baud rate for the serial port may only be changed via DTMF.

Most programming functions available through menu programming are also available with DTMF programming.

DTMF PROGRAMMING 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.

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 48 phone number. When the Repeater Manager answers the phone, enter the programming access code. The Model 48 will issue modem tone, if after 20 seconds the Model 48 does not detect modem tone an eight-note tone is sounded to verify the DTMF programming mode has been entered.

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-doos.

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-doos.

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.

DTMF programming commands are classified as system commands (Hog timer, Hold times etc.), and user commands (ANI, tone dispatch, digital dispatch etc.). User commands affect a specific user, which must first be selected via one of the three user number selection commands: 30 for ANI users, 119 for tone dispatch users or 135 for digital dispatch users. Note: Once the current user has been selected, tone or digital, the same function codes are used. To enable a digital dispatch user, select the user with function code 135, then select function code 21, same as if enabling a tone user, to enable the user.

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.

TESTS FROM DTMF

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, Sense line states, and CTCSS decode.

DTMF PROGRAMMING EXAMPLES

These examples assume the Model 48's phone number has been dialed and the Repeater Manager 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 "00072", Program mode access code (After Modem tone drops hear 8-tone signal).

2) Setting auto-dial number one to 8206363:

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

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

   Enter "8206363", the number. (hear three beeps)

3) Exiting DTMF programming:

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

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

6. PAGING

INTRODUCTION

The Model 48PB is capable of generating a variety of paging tones including two-tone, five/six-tone, and DTMF. The use of each paging option is discussed below.

Two-Tone Paging

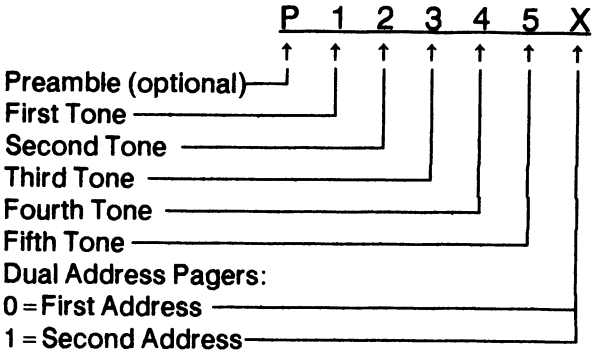
Two-tone paging is fixed to Motorola code plan L and is entered as three-digit pager codes.

DTMF Selective Calling

DTMF selective calling is accomplished by sending a string of one to seven DTMF digits. The digits are sent with 150 msec tone 50 msec gap.

Five/Six-Tone Paging

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



EXAMPLE--pager cap-code 8-84325:
1st address ... Page-code = 8843250

EXAMPLE--pager cap-code 53421:
2nd address ... Page-code = 534211

7. INSTALLATION

INSTALLATION WARNING

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

Installation of the Repeater Manager 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.

The performance of the Model 48PB is totally dependent upon careful setup and adjustment of the various signals in the Repeater Manager.

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 7-1 provides a graphic presentation of a typical Model 48PB-to-transmitter/receiver connection.

INSTALLATION PROCEDURE

Chassis Ground
A chassis ground should be connected between the Repeater Manager and the radio receiver. The Model 48PB ground is available at J6 Pins 3, 4, 12, and 14.

Power Supply
Locate the 12 VDC supply for the repeater receiver/transmitter. With a VOM, measure the DC voltage. It must be between 10.5 and 15 Volts, and capable of at least 700 milliamps of current. When using a DC supply the positive (+) connection must be to J6 terminal 1 and negative (-) to J6 terminal 3. If proper DC voltage is not available, the 12 VAC wall transformer supplied with the Repeater Manager should be used. When using the wall transformer connections should be made to J6 terminals 1 & 2. The Model 48PB is internally fused with a 1-ampere slo-blow fuse. Verify that the POWER LED lights when power is applied.

Set Factory Defaults
The units system database may be reset to the factory defaults by using the following procedure:

1) Turn off system power
2) Install JP19
3) Turn on system power
4) When several LEDs come on remove JP19.

The front panel POWER indicator should be on, and the PAGE indicator should blink every 5 seconds.

Local Telephone
Connect a DTMF (touch-tone) telephone to the jack marked LOCAL. Pick up the phone and verify that dial tone is present for about two seconds, then dial "00072". A high pitched tone will be heard for about 20 seconds, then a program mode greeting tone sequence will be sent. This indicates proper access to the DTMF program mode. Simply hang up the phone to exit DTMF programming.

TYPICAL CONNECTIONS

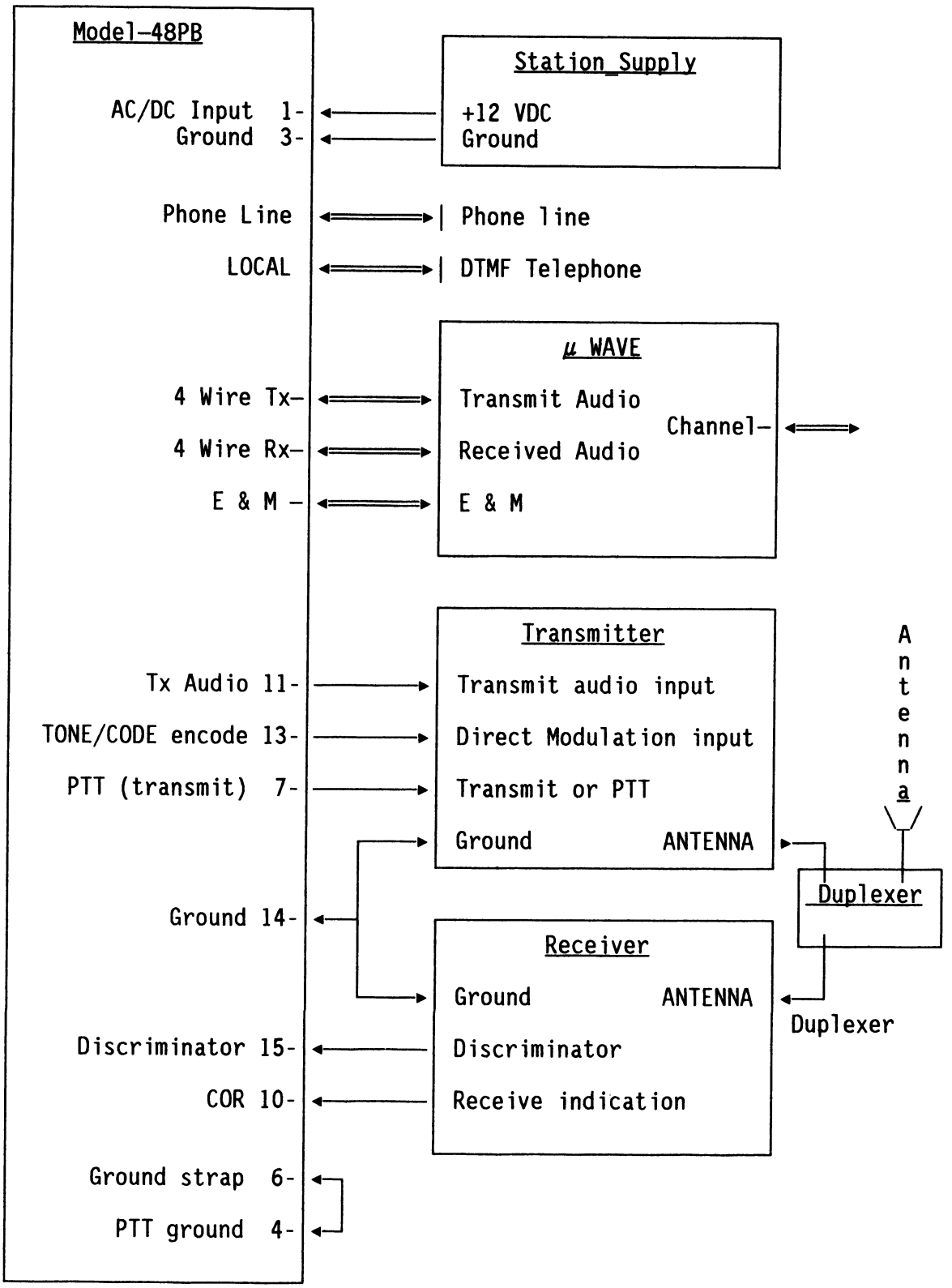


FIGURE 7-1: Typical Model 48PB Installation

RECEIVER CONNECTIONS

COR Input

The Repeater Manager requires a signal from the receiver to indicate when the mobile is transmitting. This signal is usually derived from the receiver squelch, and is called Carrier-Operated-Relay or similar names. What the Repeater Manager needs is either a relay-contact closure between J6 Pin-10 and Ground, or a signal applied to Pin-10 that changes level during carrier, and no carrier conditions. When the COR signal is connected, be sure jumper JP14 is in position B. COR must have an active output which will pull low with a midpoint between 0 and 4.0 volts DC. Active COR polarity may be changed by changing JP15 from position A to position B. COR threshold may be set using AR12 with the threshold voltage being measured at TP6.

Verify proper COR operation by supplying then removing a signal on the receiver RF channel. The CARRIER LED should light when a signal is being received. If the lamp doesn't change, adjust the COR threshold pot(AR12). If the polarity is backwards (CARRIER is lit when no carrier is present), change the orientation of JP15.

Note that when COR polarity is set to active high, the CARRIER led will be on if the COR input is left unconnected.

Discriminator Input

Connect discriminator audio to J6 Pin-15 using shielded cable or coax. You may also connect the input to Volume Squelch High, as long as the subaudible tones are not filtered before this point. The braid is connected to J6 Pin-14. The input impedance is 50K ohms. A signal of at least 50 mV P-P is required for proper operation. The signal may be as high as 5 V P-P. Install jumper JP8 in position A for CTCSS only operation or position B for CDCSS (DPL) or combined CTCSS/CDCSS operations. Install JP9 in position B for signals less than 500 mV P-P or in position A for signals greater than 500 mV P-P.

Adjust the receiver audio level by supplying a full quieting 1 kHz audio tone with 3 kHz deviation on the receiver frequency. Adjust the Rx audio pot (AR3) until the voltage at test point (TP1) is roughly 1.0 V P-P (0.35 VRMS).

NOTE: This is a preliminary adjustment and will be set more precisely when repeat audio level is set.

Verify DTMF decoding from the mobile with a mobile or service monitor with DTMF encode capability. Verify the DATA LED lights with each digit.

CTCSS Decode

Supply a CTCSS tone on the receiver RF frequency. Verify that the CARRIER and CTCSS LED's come on. The tone will have to be enabled before the Model 48PB will key the transmitter.

TRANSMITTER CONNECTIONS

Transmitter PTT
For most transmitters, a contact closure to ground will cause the transmitter to key up. For this configuration, connect a wire from pin 7 of J6 (PTT Normally Open) to the PTT input of the transmitter, then jumper J6 pin 6 (PTT Common) to J6 Pin 6 (Ground). A ground should be connected from the Model 48PB to the transmitter.

The TR-relay will be closed whenever the Repeater Manager desires to transmit. The relay is form-C (SPDT). J6 Pins 5, 6, and 7 are NC, Common, and NO respectively.

Verify proper PTT operation by pressing the CONNECT/DISCONNECT button on the front panel. The transmitter should key, press the CONNECT/DISCONNECT button again to unkey.

Transmit Audio
Connect J6 pin 11 to the Mic input of the transmitter using shielded cable. Connect the braid to pin 12. The output level is adjustable from 50 mV P-P to 5.0 V P-P. Install JP6 in position A (HI) for desired output greater than 500 mV P-P or position B (LO) for desired output less than 500 mV P-P.

The transmitter deviation must be set for proper operation of the system. AR1 sets the deviation. To send out a test tone to set this level, access the DTMF programming mode as above (00072). Select a test tone frequency (usually 1 kHz) by entering the function code "102*" then the frequency divided by 10 followed by the "#" (100# = 1kHz). Then send the tone out the transmitter by entering the function code "98*", followed by the function argument "2#". This will cause the transmitter to be keyed up and generate the desired frequency. Adjust AR1 for 4 kHz deviation. To end the test, simply press the "#" key.

CTCSS Encode

Connect the direct mod input of the transmitter to connector J6 pin 13 using shielded cable. Connect the braid to J6 pin 12 (ground).

To set the CTCSS modulation level, access the program mode as above (00072), then enter "115* 18#". This will cause the transmitter to key with 123.0 Hz CTCSS encoded. Adjust AR11 for 750 Hz deviation on the channel. Check the upper and lower tones for proper deviation by pressing "115* 1#" for 67Hz, and "115* 38#" for 250.3 Hz. To unkey the transmitter press the "#" key.

To test digital encoding, press "115*" then a number from the digital squelch code look-up table in the APPENDICES section PLUS (+) 39 (digital code 023 = 115* 40#). If the code is found to be inverted on the channel, it may be corrected by using the command "132*" then a "0#" for normal polarity, or "1#" for inverted polarity. Press the "#" key to unkey the transmitter, or just hang up the phone.

When using digital squelch decode with CTCSS, the digital squelch tail elimination sequence can interfere with tone users 20 (131.8 Hz) and 21 (136.8 Hz). Since the off code for digital squelch is 134 Hz. which is in between tone users 20 and 21, it is advisable not to use either of these tones on mixed CTCSS/CDCSS systems.

Repeat Audio Level
The repeat audio level is affected by the receiver audio gain and the Tx gain. The Tx level should be set for proper test tone deviation only, and should <u>not</u> be used for repeat level or phone level control.

To verify or set the repeat audio level set the Model 48PB for carrier controlled repeat (no CTCSS required) by accessing the program mode (00072) and entering "56* 0#" (enable carrier repeat). Supply a test signal on the receiver frequency with an audio tone of known deviation. Set the repeat level for the same deviation using the RX audio level pot (AR3). Disable carrier repeat by pressing "56* 1#", then hang up the local phone.

NOTE: One method of supplying a test tone of known deviation without a duplex service monitor is to encode a tone using a DTMF radio and pressing the 1 and 4 keys simultaneously. This should provide a single audio tone. Measure the deviation of this tone with the service monitor, then switch to the repeater output frequency.

PHONE LINE CONNECTIONS

The Repeater Manager is designed to operate with standard "end-to-end" lines, such as those normally used in the home.

End-to-End Lines
The Repeater Manager connects to standard phone lines via RJ-11 modular jacks. Plug the phone line into "PHONE 1" if there is only one line to be installed, or into both jacks if there are two. The Repeater Manager also interfaces with PBX or other phone systems, if they are plug compatible with 2500 series Touch-Tone phones. To use the Repeater Manager in a PBX system, you must be able to enter DTMF over-dial from extension to extension. The "CONNECT/DISCONNECT" button on the front panel selects the default line.

Local Phone
Any standard 2500 series "Touch-Tone" telephone is appropriate for use as a local phone. Simply plug it into the phone jack marked LOCAL. The local phone jack is an installation aid.

NOTE: Local phone audio level may be different than phone lines 1 or 2.

Dial Tone Detector Adjustment
The dial tone detector is factory preset to 440 Hz. and in most systems should not have to be reset.

Connect a phone line to the line input. Press and release CONNECT/ DISCONNECT on the front panel. While LINE 1 is lit, adjust the DIAL TONE FREQUENCY pot (AR10) to the center of the range for which the DIAL TONE LED (DS1) is lit. The Repeater Manager will disconnect after detecting dial tone for a short period of time, so the test may have to be repeated a number of times. Precise setting of this detector is important to insure the Repeater Manager will disconnect on dial tone. If the dial tone is not precise (frequency stable), adjustment may be impossible. If so set the pot to as close to the dial tone frequency as possible.

OPTIONAL CONNECTIONS

Transmitter Inhibit via Monitor Receiver
J2 pin 8 (Sense 2) allows connection to a logic signal or contact closure from a repeater output frequency monitor receiver to prevent keyup or ring-out during co-channel usage. The Model 48PB will indicate co-channel transmitter inhibit by flashing the COR LED. See Operation and Programming.

Control Relays
Three relays are available for site control: Control 1 and control 2 are "system" relays and control 3 is a "user" relay. See the operation and programming sections for relay operation. All control relay outputs supply a closure to ground.

NOTE: Some control relays and/or sense inputs may be committed for special system functions (i.e. The 4-Wire E & M port uses Sense 4 and Control 4)

FINAL CHECKS BEFORE LEAVING THE SITE

1. Have a helper call the Model 48PB from a remote DTMF phone and verify proper access to the program mode.
2. If the modem is to be used, have someone call the unit and access modem programming. Verify errors are not present during modem communication.
3. Verify the program mode can be accessed over the radio channel, or better yet, place a call through the Model 48PB.

COMPUTER CONNECTIONS

The computer/CRT port on the Model 48PB 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 (J1) on the Repeater Manager: 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.

The Model 48PB 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 Repeater Manager receives an "XOFF" code (Control S), the data output will pause until a "XON" code (Control Q) is received. When the Model 48PB is powered on or reset, a header message is sent out the serial port. This may help when installing or debugging serial communication. See appendices 1-3 for more information on terminal emulation and serial connections between the Model 48PB and the Radio Shack Model 100 and Commodore 64.

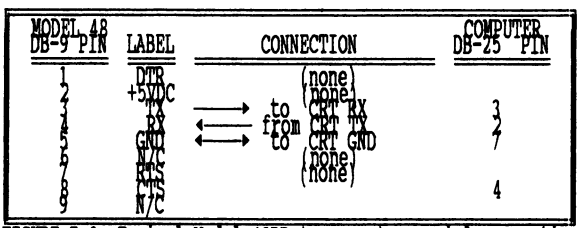


FIGURE 7-2: Typical Model 48PB-to-computer serial connections.

CONNECT YOUR COMPUTER OR CRT to the serial connector J1 (DB9). The Model 48PB serial port is preset for 4800 baud. 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 48PB sign-on message and "Top-menu". Appendix A1 tells how to use the ZETRON supplied terminal emulator DT on an IBM PC (or compatible). Appendix A2 tells how to use a Radio Shack Model 100 computer for communications and Appendix A3 tells how to use 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 48PB's local phone jack.

b. Pick up the hand-set and enter "00072". The unit will issue its DTMF programming prompt tune (if the modem option is installed, 20 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.

SPECIFIC MODEL 48PB-TO-RADIO CABLING

The following notes and diagrams have been compiled to help ease the installation of the Zetron Model 48PB. 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.

Generic

If your radio is equipped with repeat audio it must be removed or disabled.

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 AR12 from 0 to 4.0v DC. There is a 100K internal pull up in the unit which holds the input to 12.0V 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 single ended. The output level is adjustable from 50 mV P-P to 5.0 V P-P. Install JP6 in position A (HI) for desired output greater than 500 mV P-P or position B (LO) for desired output less than 500 mV P-P. To set the transmitter deviation use the single tone test in the Test Menu and adjust AR1.

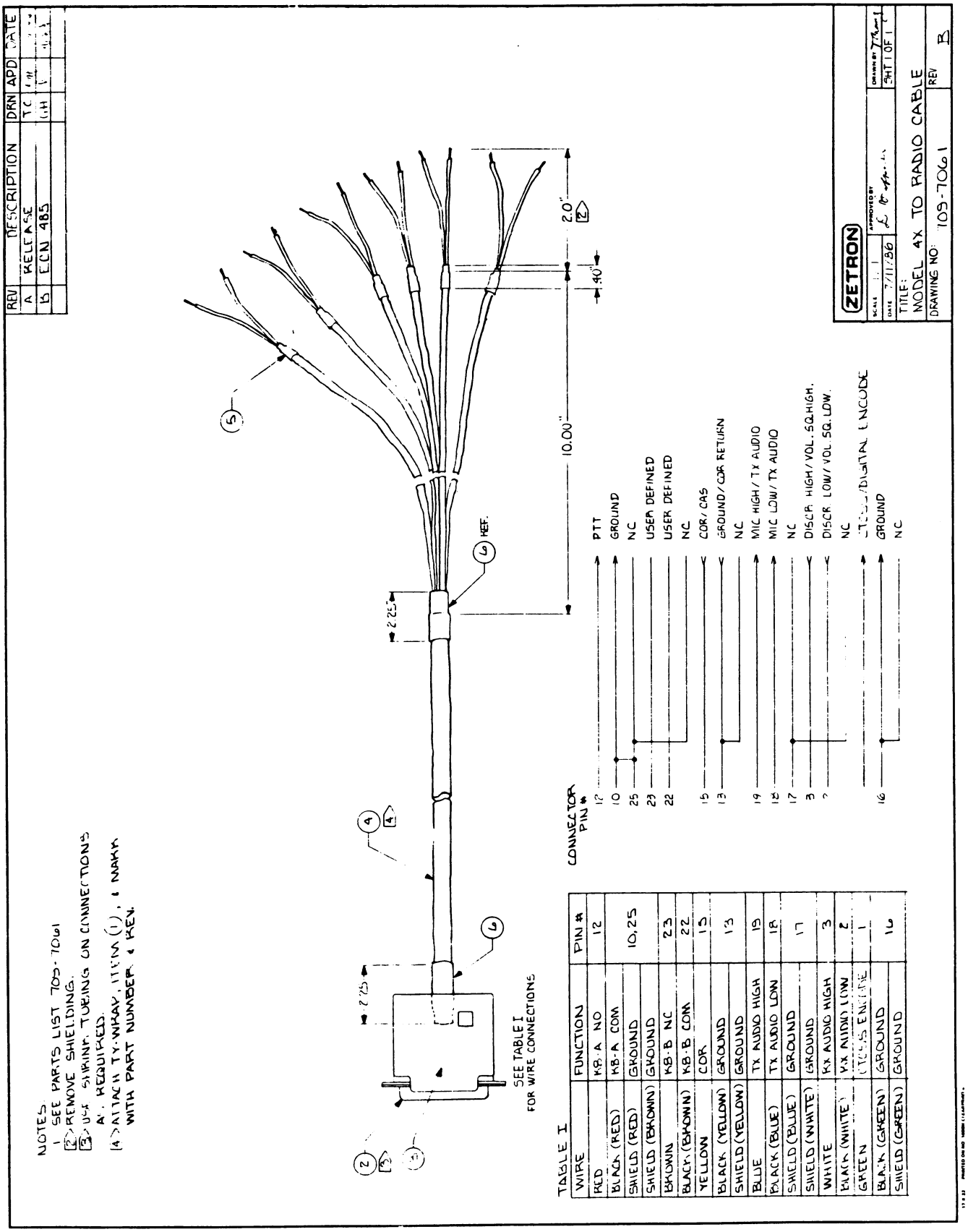
The RX audio from the radio must be unsquelched discriminator (unfiltered) audio. Adjust AR3 for proper receive levels.

The CTCSS encode always comes out on connector J6 pin 13. The level of the CTCSS at this pin is adjustable with AR11.

NOTE: When using digital squelch decode with CTCSS, the digital squelch tail elimination sequence can interfere with tone users 20 (131.8 Hz) and 21 (136.8 Hz). Since the off code for digital squelch is 134 Hz. which is in between tone users 20 and 21, it is advisable not to use either of these tones.

MODEL 47 Radio Interface Cable Connector Pin Numbers and Color Codes (J6)

Pin #	Color	Function
1	n/c	9-12 VAC or +12 VDC
2	n/c	9-12 VAC
3	n/c	Power Ground
4	n/c	Shield of Blk/Red Ground
5	n/c	PTT N.C.
6	Black (Red) & Shield (to pin 4)	PTT Common
7	Red	PTT N.O.
8	n/c	Control 1
9	n/c	Sense 1
10	Yellow	COR
11	Blue	Transmit Audio
12	Black(Blue) Black(Yellow)+Shields	Ground
13	Green	Subaudible tone/code out
14	Black(White) Black(Green)+Shields	Ground
15	White	Receive Audio


REV | DESCRIPTION | DRN | APD | DATE
A | RELEASE | TC
B | ECN 485
NOTES
1. SEE PARTS 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
2.25
10.00"
2.0"
.40"
REF.
CONNECTOR PIN #
PTT
GROUND
NC
USER DEFINED
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
NC
GROUND
NC
TABLE I
WIRE | FUNCTION | PIN #
RED | KB-A NO | 12
BLACK (RED) | KB-A COM | 10,25
SHIELD (RED) | GROUND
SHIELD (BROWN) | GROUND | 23
BROWN | KB-B NC | 22
BLACK (BROWN) | KB-B COM | 15
YELLOW | COR | 13
BLACK (YELLOW) | GROUND
SHIELD (YELLOW) | GROUND | 19
BLUE | TX AUDIO HIGH | 18
BLACK (BLUE) | TX AUDIO LOW | 17
SHIELD (BLUE) | GROUND
SHIELD (WHITE) | GROUND | 3
WHITE | RX AUDIO HIGH | 2
BLACK (WHITE) | RX AUDIO LOW
GREEN | DISCRIMINATOR | 1
BLACK (GREEN) | GROUND | 16
SHIELD (GREEN) | GROUND
ZETRON
SCALE 1:1
DATE 7/11/86
APPROVED BY
DRAWN BY TMH
SHT 1 OF 1
TITLE: MODEL 4X TO RADIO CABLE
DRAWING NO: 109-7061
REV B

INSTALLING NEW EPROMS

Most changes to the Model 48PB are made only to the controlling software. Whenever a change is made to the Repeater Manager, 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.

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 pins of each IC. Make sure pins are aligned in the sockets, fully inserted and not bent out or under.
7. Turn on power to the Repeater Manager 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.

8. REPAIR

IN CASE OF DIFFICULTY

In case of installation difficulty, call the Zetron Model 48PB 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 48PB 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 over night, retested and shipped the next day.

FAULT IDENTIFICATION

PROBLEM	POSSIBLE CAUSE(S)
No answer on any line, 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 (K5) defective.
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 a 0.1uF to 0.47uF, 100V capacitor from pin 1 to pin 2 of U9, for line 1, or U8 for line 2.
Modem programming doesn't work.	a. Modem or CRT wrong baud rate. b. Poor quality phone line audio. Listen to audio; if snaps or crackles are heard, the modem may be unusable. c. M48PB phone line (hybrid) balance poor d. Audio gain TO or FROM the phone line set too high or too low.

MODEL 48PB CONTROL BOARD SPARE PARTS LIST (951-9045A)

ITEM	QTY	ZETRON P/N	DESCRIPTION	MANUFACTURER PART #
1.	2	105-0001	VARISTOR 250V AC	V250LA20
2.	2	106-0047	4.7 OHM 1/2W 5% FUSIBLE	BW1/2F-4.7OHM5%B
3.	1	107-0500	500 OHM TRIMPOT 1 TURN	3386P-1-501
4.	1	107-0501	5K POT 1 TURN	3386P-1-502
5.	1	107-0502	50K POT 1 TURN	3386P-1-503
6.	1	107-3085	10K POT 1 TURN	3386P-1-103
7.	4	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
8.	2	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
9.	1	152-0089	.001 UF 50V +-5% POLYESTER	ECQBIH102JZ
10.	1	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
11.	2	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
12.	2	155-0077	100UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1EU101
13.	1	155-0090	1000 UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECE-A1EU102
14.	1	155-0140	3300 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECEB1EU332
15.	2	210-0001	440 KEPT NUT	
16.	2	250-0104	440X1/2 W/STUD	
17.	1	305-1540	LO SIZE/COST PHONE HYBRID XFMR	671-1540
18.	1	311-0011	LED RED FLUSH	TLSR-5201
19.	1	311-1001	OPTO ISOLATOR, BI-POLAR	H11AA1
20.	1	316-0004	TONE FILTER	MF4CN-50
21.	1	316-0232	RS232 DRIVER	MAX 232
22.	2	316-0358	OP-AMP, DUAL	LM358N
23.	1	316-0567	PLL, TONE DECODER	LM567
24.	1	316-7805	REGULATOR, +5V 1.5A	LM340T-5
25.	1	321-0202	DTMF DECODER	SSI-202P
26.	1	321-6264	8K X 8 RAM	HM6264 LP-1
27.	1	321-6811	UP-HC MOS	MOT68HC11A0FN
28.	1	321-6840	PTM	MC6840
29.	1	323-4053	3PDT SWITCH	MC144053
30.	1	323-4066	QUAD ANALOG SWITCH	MC14066B
31.	1	324-4138	DECODER 1 OF 8	MCH74HC138
32.	1	324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
33.	1	324-4373	OCTAL LATCH	MC74HC373
34.	1	324-7400	QUAD NAND	MC74HC00
35.	1	324-7414	HEX SCHMIDT	74HC14
36.	1	340-2003	RELAY DRIVER 50V/.5A	ULN2003
37.	1	340-3821	JFET N-CHAN Vp=-2.5V	MPF3821
38.	2	340-3904	NPN 40V/200MA	2N3904
39.	1	340-3906	PNP 40V/200MA	2N3906
40.	1	340-5460	JFETP-CHAN	2N5460
41.	2	342-3009	SILICON	1N4148
42.	2	342-3011	SILICON 1A 1000V	1N4007
43.	1	343-3030	1W 6.2V +-5%	1N4735A
44.	1	343-3035	1W 12V +-5%	1N4742A
45.	1	376-0004	4.000 MHZ HC 18 CASE	SKO-DS400A
46.	1	376-0358	3.58 MHZ HC 18 CASE	SKO-DS357
47.	1	380-0001	SPDT 12V	MZ-12HG
48.	1	380-0030	DPDT 12V COIL MINI	DS2E-M-DC12V
49.	2	402-3040	MINI JUMPER	
50.	2	416-1202	FUSE AGC 2A	AGC 2A

MODEL 48PB CONTROL BOARD PARTS LIST (702-9183-3B)

= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSEMBLY
+ = OPTION INSTALLED PER CUSTOMER ORDER

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	1	R58	101-0013	2.2 OHM 1/4W 5% CARBON FILM	
2	4	R35,R36,R37,R190	101-0047	47 OHM 1/4W 5% CARBON FILM	
3	4	R61,R107,R120,R136	101-0049	100 OHM 1/4W 5% CARBON FILM	
4	10	R125,R152,R153,R154,R155, R160,R163,R164,R168,R189	101-0057	220 OHM 1/4W 5% CARBON FILM	
5	1	R76	101-0059	270 OHM 1/4W 5% CARBON FILM	
6	4	R77,R92,R106,R188	101-0065	470 OHM 1/4W 5% CARBON FILM	
7	10	R2,R22,R28,R34,R39,R40, R57,R104,R117,R186	101-0066	510 OHM 1/4W 5% CARBON FILM	
8	14	R41,R43,R55,R78,R80,R95#, R108,R121,R141,R144,R156, R157,R161,R165,R187	101-0073	1K 1/4W 5% CARBON FILM	
9	5	R102#,R105,R110,R112, R134,R176	101-0075	1.5K 1/4W 5% CARBON FILM	
10	12	R23,R26,R45,R60,R71,R93, R118,R137,R138,R158,R159, R172	101-0081	2.2K 1/4W 5% CARBON FILM	
11	3	R59,R99#,R113,R169	101-0085	3.3K 1/4W 5% CARBON FILM	
12	1	R177	101-0087	3.9K 1/4W 5% CARBON FILM	
13	8	R3,R13,R16,R52,R53,R70, R131,R174	101-0089	4.7K 1/4W 5% CARBON FILM	
14	2	R114,R171	101-0091	5.6K 1/4W 5% CARBON FILM	
15	1	R100#,R139	101-0094	7.5K 1/4W 5% CARBON FILM	
16	12	R1,RX1,R19,R20,R21,R67, R75,R89,R91,R116,R151, R191	101-0097	10K 1/4W 5% CARBON FILM	
17	4	R130,R132,R133,R184	101-0099	12K 1/4W 5% CARBON FILM	
18	3	R65,R97#,R115,R166	101-0101	15K 1/4W 5% CARBON FILM	
19	8	R24,R25,R54,R69,R85,R87, R122,R148	101-0105	22K 1/4W 5% CARBON FILM	
20	7	R62,R63,R119,R123,R124, R126,R129	101-0109	33K 1/4W 5% CARBON FILM	
21	4	R47,R49,R50,R111	101-0111	39K 1/4W 5% CARBON FILM	
22	20	R5,R6,R7,R8,R9,R10,R31, R32,R42,R44,R73,R145, R146,R150,R162,R178,R180, R181,R183,R185	101-0113	47K 1/4W 5% CARBON FILM	
23	3	R74,R109,R135	101-0115	56K 1/4W 5% CARBON FILM	
24	4	R46,R48,R51,R84	101-0117	68K 1/4W 5% CARBON FILM	
25	1	R103	101-0119	82K 1/4W 5% CARBON FILM	
26	10	R14,R18,R29,R30,R64,R72, R128,R149,R173,R182	101-0121	100K 1/4W 5% CARBON FILM	
27	1	R167	101-0123	120K 1/4W 5% CARBON FILM	
28	1	R83	101-0129	220K 1/4W 5% CARBON FILM	
29	4	R68,R81,R90,R142	101-0131	270K 1/4W 5% CARBON FILM	

MODEL 48PB CONTROL BOARD PARTS LIST (702-9183-3B) cont'd

Item	Quantity	Reference	Part	Description	Mfg.Part No.
30	5	R4,R88,R170,R175,R179	101-0145	1M 1/4W 5% CARBON FILM	
31	1	R147	101-0150	2.7M 1/4W 5% CARBON FILM	
32	1	R86	101-0160	10M 1/4W 5% CARBON FILM	
33	1	R56	103-0175	75 OHM 2W 5%	RD-200BJ75
34	4	RV1,RV2,RV3,RV4	105-0001	VARISTOR 250V AC	V250LA20
35	4	R11,R12,R15,R17	106-0047	4.7 OHM 1/2W 5% FUSIBLE	BW1/2F-4.7OHM5%B
36	1	R27	106-0115	15 OHM 1/2W 5% FUSIBLE	BW1/2F-15OHM5%B
37	1	AR2	107-0500	500 OHM TRIMPOT 1 TURN	3386P-1-501
38	4	AR1,AR5,AR6,AR9	107-0501	5K POT 1 TURN	3386P-1-502
39	5	AR3,AR7,AR10,AR11,AR12	107-0502	50K POT 1 TURN	3386P-1-503
40	2	AR4,AR8 *NOTE 3	107-3085	10K POT 1 TURN	3386P-1-103
41	4	C52,C53,C56,C57	150-0024	24 PF 1KV +-10% CERAMIC DISC	GG-240K
42	1	C50,C80	150-0033	33 PF 1KV +-10% CERAMIC DISC	GH-330K
43	2	C42,C63	151-0047	470 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C471K
44	3	C76,C83,C91	151-0199	.47 UF 50V +-5% POLYESTER	ECQVIH474JZ
45	27	C1,C6,C11,C15,C17,C28, C29,C30,C31,C48,C49,C51, C54,C55,C62,C66,C67,C81, C84,C86,C89,C92,C93,C97, C98,C103,C104	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
46	2	C12,C13	152-0021	.47 UF 250V +-10% POLYESTER	713A1KK474PK251SM
47	1	C35	152-0030	2.2 UF 250V +-10% POLYESTER	ECQ-E2225KS
48	2	C18,C19	152-0040	4.7 UF 50V NON-POLAR ELECTROLYTIC	EHN-4.7M50BA
49	2	C45,C61	152-0080	.22 UF 50V	ECQ-VIH224JZ
50	12	C22,C23,C24,C27,C34,C39, C40,C44,C88,C94,C100, C101	152-0085	.01 UF 50V +- 5% POLYESTER	ECQ-V1H103JZ
51	11	C16,C20,C21,C32,C33,C41, C46,C47,C64,C73,C87	152-0089	.001 UF 50V +-5% POLYESTER	ECQBIH102JZ
52	4	C58,C72,C82,C90	152-0250	.047 UF 50V POLYESTER	ECQ-VIH473JZ
53	4	C7,C96,C99,C105	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
54	2	C8,C95	154-0100	10 UF 16V TANTALUM	ECS-FICE106K
55	7	C9,C25,C26,C36,C43,C71, C75	155-0012	2.2 UF 100V +50-10% RADIAL ALUMINUM ELECTROLYTIC	ECEA2AV2R2S
56	11	C2,C3,C4,C5,C10,C59,C68, C69,C70,C79,C102	155-0052	10 UF 35V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1VU100
57	6	C37,C60,C65,C74,C77,C78	155-0077	100UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECEA1EU101
58	1	C38	155-0090	1000 UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	ECE-A1EU102
59	1	C14	155-0120	2200 UF 25V +-20% AXIAL ALUMINUM ELECTROLYTIC	ECE-B1EU222
60	1	C85 *NOTE 4	155-0140	3300 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECEB1EU332
61	2	E1,E2	305-0007	BEAD FERRITE PLZ	56-590-65-3
62	2	T1,T2	305-0600	600:600 OHM AUDIO	MR671-0064
63	1	T3	305-1540	LO SIZE/COST PHONE HYBRID XFMR	671-1540
64	10	DS1,DS2,DS3,DS4,DS5,DS6, DS7,DS8,DS9,DS10	311-0011	LED RED FLUSH	TLSR-5201
65	1	DS11	311-0012	LED GREEN FLUSH	TLSG-5201
66	3	U8,U9,U19	311-1001	OPTO ISOLATOR, BI-POLAR	H11AA1
67	3	U16,U17,U18	316-0004	TONE FILTER	MF4CN-50
68	1	U7	316-0232	RS232 DRIVER	MAX 232

MODEL 48PB CONTROL BOARD PARTS LIST (702-9183-3B) cont'd

Item	Quantity	Reference	Part	Description	Mfg.Part No.
69	11	U20,U21,U22,U29,U31,U32, U33,U37,U38,U39,U40	316-0358	OP-AMP, DUAL	LM358N
70	1	U30	316-0567	PLL, TONE DECODER	LM567
71	1	VR1	316-7805	REGULATOR, +5V 1.5A	LM340T-5
72	1	U27	321-0202	DTMF DECODER	SSI-202P
73	0	U6^	321-6264	8K X 8 RAM	HM6264 LP-1
74	1	U23 *NOTE 5	321-6811	UP-HC MOS	MOT68HC11A0FN
75	2	U1,U2	321-6840	PTM	MC6840
76	0	U5^	321-8256	32K X 8 RAM LP	HPD43256-15L
77	0	U3^,U4^	322-7256	32Kx8 CMOS EPROM	MBM27C256-25
78	0	U28^	323-0212	MODEM 1200 BAUD	UA212AT-DC
79	1	U36	323-4053	3PDT SWITCH	MC144053
80	1	U35	323-4066	QUAD ANALOG SWITCH	MC14066B
81	2	U11,U12	324-4138	DECODER 1 OF 8	MCH74HC138
82	3	U15,U25,U26	324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
83	2	U24,U34	324-4373	OCTAL LATCH	MC74HC373
84	1	U10	324-7400	QUAD NAND	MC74HC00
85	1	U13	324-7414	HEX SCHMIDT	74HC14
86	1	U14	340-2003	RELAY DRIVER 50V/.5A	ULN2003
87	1	Q4 *NOTE 6	340-3821	JFET N-CHAN Vp=-2.5V	MPF3821
88	7	Q1,Q5,Q6,Q7,Q8,Q9,Q11	340-3904	NPN 40V/200MA	2N3904
89	2	Q2,Q3	340-3906	PNP 40V/200MA	2N3906
90	1	Q10	340-5460	JFETP-CHAN	2N5460
91	9	CR1,CR6,CR7,CR8,CR9,CR11, CR12,CR20,CR22	342-3009	SILICON .50 SP	1N4148
92	4	CR13,CR14,CR15,CR16	342-3011	SILICON 1A 1000V .50 SP	1N4007
93	7	CR2,CR3,CR4,CR5,CR10, CR18,CR21	343-3030	1W 6.2V +-5% .50 SP	1N4735A
94	2	CR17,CR19	343-3035	1W 12V +-5% .50 SP	1N4742A
95	1	SW1	371-0005	SINGLE KEY RA PWB MOUNT	L21217-2-MV-02-G
96	1	Y1	376-0004	4.000 MHZ HC 18 CASE	SKO-DS400A
97	1	Y3	376-0358	3.58 MHZ HC 18 CASE	SKO-DS357
98	1	Y2	376-3686	3.6864 MHZ HC18 CASE	368S
99	4	K1,K2,K3,K4	380-0001	SPDT 12V	MZ-12HG
100	3	K5,K6,K7	380-0030	DPDT 12V COIL MINI	DS2E-M-DC12V
101	1	J1	401-0021	DB9 S	DEP-9S-CA
102	1	J6	401-0059	15 POS R/A HEADER	6923.6
103	1	J2	401-0086	12-POS R/A HEADER	1116.6
104	1	J7	401-0129	6 POS RA HEADER	1122.6
105	1	J8	401-6001	10-POS FEMALE	09-52-3103
106	1	J12	401-6005	6-POS FEMALE	09-52-3063
107	1	J10	401-6006	6-POS MALE	09-64-1061
108	3	J3,J4,J5	401-7000	6-POS TELCO JACK	66011-002
109	1	JP1#,JP2#,JP3#,JP4#,JP5#, JP7#,JP10#,JP18#,JP19, JP23#	403-0002	2 OF 401-0052	
110	11	JP6,JP8,JP9,JP11,JP12, JP13,JP16,JP17,JP20,JP21, JP22,JP24#	403-0003	3 OF 401-0052	

MODEL 48PB CONTROL BOARD PARTS LIST (702-9183-3B) cont'd

Item	Quantity	Reference	Part	Description	Mfg.Part No.
111	1	J11	403-0010	10 OF 401-0052	
112	1	J9	403-0018	18 OF 401-0052	
113	1	JP15	403-0202	4 OF 401-0052 [2X2]	
114	1	JP14	403-0203	6 OF 401-0052 [2x3]	
115	4	TP1,TP2,TP3#,TP4#,TP5, TP6	406-0001	1 OF 401-0108	
116	1	F1	416-1202	FUSE AGC 2A	AGC 2A
117	6	XVR1,XJ1,STANDOFFS	210-0001	440 KEPT NUT	
118	3	XVR1,XJ1	220-0102	440X3/8 PAN PHILLIPS	
119	3	STANDOFFS	250-0104	440X1/2 W/STUD	
120	1	XVR1	381-0010	HEATSINK TO-220	
121	1	XJ1	401-0042	DB LOCK SCREWS	
122	14	XJP6,XJP8,XJP9,XJP11, XJP12,XJP13,XJP14, XJP15(2),XJP16,XJP17, XJP20,XJP21,XJP22 (POS. A)	402-3040	MINI JUMPER	
123	3	XU6,XU9,XU19	407-0006	6-PIN DIP SOCKET	
124	13	XU16,XU17,XU18,XU20,XU21, XU22,XU29,XU30,XU31,XU32, XU33,XU37,XU38,XU39,XU40	407-0008	8-PIN DIP SOCKET	
125	3	XU10,XU13,XU35	407-0014	14-PIN DIP SOCKET	
126	8	XU7,XU11,XU12,XU14,XU15, XU25,XU6,XU36	407-0016	16-PIN DIP SOCKET	
127	1	XU27	407-0018	18-PIN DIP SOCKET	
128	2	XU24,XU34	407-0020	20-PIN DIP SOCKET	
129	7	XU1,XU2,XU3,XU4,XU5,XU6, XU28	407-0028	28-PIN DIP SOCKET	
130	1	XU23	407-0052	52-PIN HC11 SOCKET	
131	1	PCB	410-9183B	M4XB CONTROL BOARD	
132	2	XF1	416-3040	FUSE CLIPS	
133	10	XDS2,XDS3,XDS4,XDS5,XDS6, XDS7,XDS8,XDS9,XDS10,XDS11	417-0010	LED MOUNT R/A	

NOTES:

1. USE SPARE RESISTOR WIRE.
2. INSERT FROM CIRCUIT SIDE WITH LONG LEADS ON TOP SIDE. SOLDER COMPONENT SIDE. CUT LEADS CLOSE TO PLASTIC BASE.
3. AT AR4 (SOLDER SIDE) CUT WIPER TRACE, WIRE JUMPER TO OTHER LEG OF AR4.
4. CUT TRACE (COMPONENT SIDE) BETWEEN C85 AND R141. ON SOLDER SIDE WIRE JUMPER R141 TO C84 (GND).
5. ON COMPONENT SIDE CUT (2) TRACES - U23 PINS 43 AND 44, (CUT AT FEEDTHRU). ON SOLDER SIDE ADD JUMPER WIRES TO REVERSE.
6. ON SOLDER SIDE CUT TRACE BETWEEN Q4 (DRAIN) AND FEEDTHRU. ADD RX1 (ITEM 16) ACROSS CUT TRACE.

MODEL 4XB FFSK CARD PARTS LIST (702-9196A)

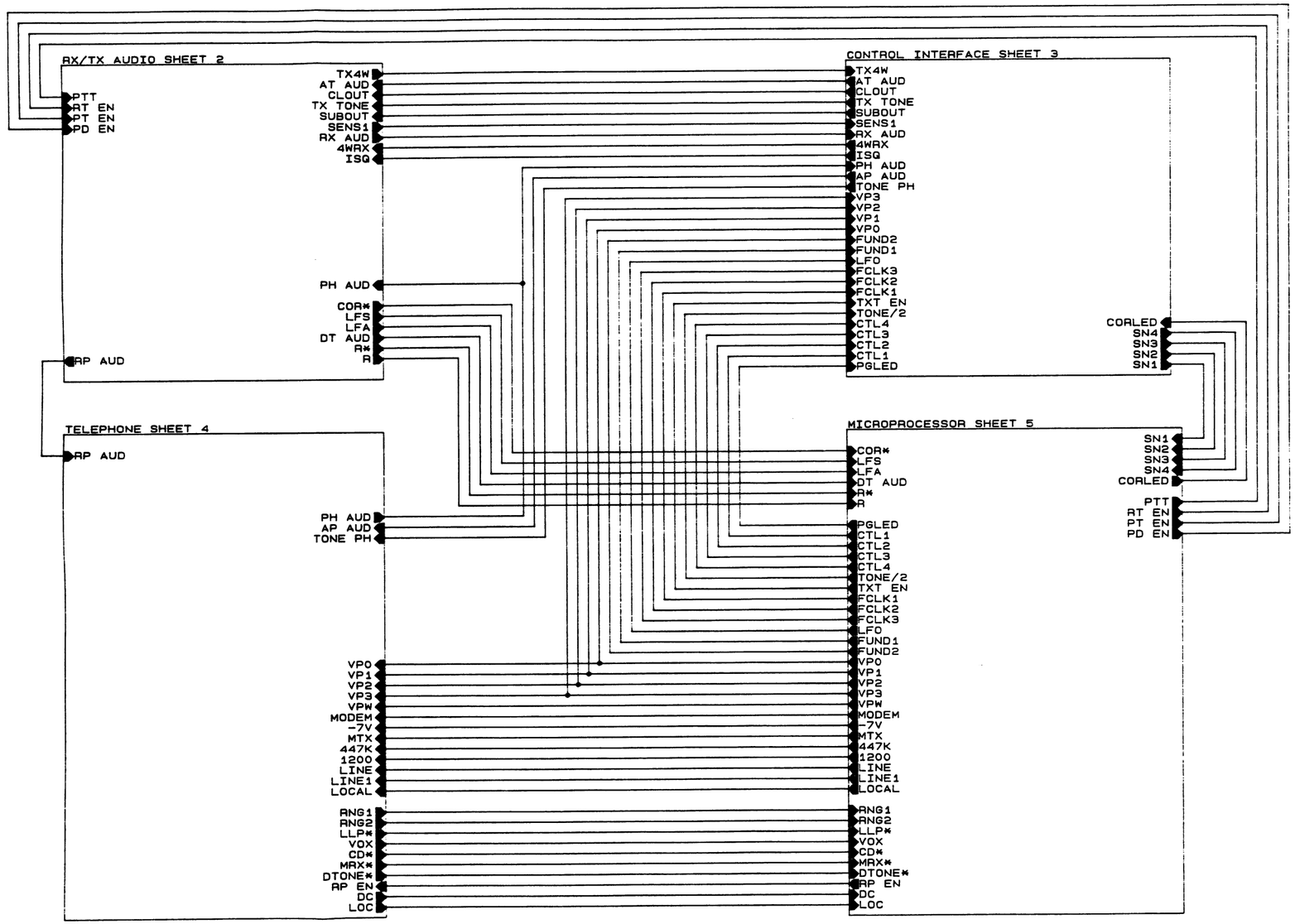
Item	Quantity	Reference		Part	Description	Mfg.Part No.
1	1	R15		101-0066	510 OHM 1/4W 5% CARBON FILM	
2	1	R17		101-0081	2.2K 1/4W 5% CARBON FILM	
3	1	R18		101-0085	3.3K 1/4W 5% CARBON FILM	
4	4	R22,R5,R12,R21		101-0089	4.7K 1/4W 5% CARBON FILM	
5	1	R14		101-0094	7.5K 1/4W 5% CARBON FILM	
6	1	R16		101-0097	10K 1/4W 5% CARBON FILM	
7	1	R4		101-0107	27K 1/4W 5% CARBON FILM	
8	6	R6,R7,R11,R13,R19,R20		101-0117	68K 1/4W 5% CARBON FILM	
9	4	R3,R8,R9,R10		101-0121	100K 1/4W 5% CARBON FILM	
10	1	R1		101-0138	510K 1/4W 5% CARBON FILM	
11	1	R2		101-0145	1M 1/4W 5% CARBON FILM	
12	2	C4,C3		150-0024	24 PF 1KV +-10% CERAMIC DISC	GG-240K
13	8	C9,C2,C7,C8,C12,C13,C14, C15		152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ
14	2	C5,C6		155-0010	1 UF 50V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECE-B1HV010
15	3	C11,C1,C10		155-0050	10 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	ECE-B1EV100S
16	2	U6,U7		316-0358	OP-AMP, DUAL	LM358N
17	1	U4		321-0429	FFSK MODEM 24 DIP	
18	1	U5		323-4066	QUAD ANALOG SWITCH	MC14066B
19	1	U3		324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
20	1	U1		325-7404	HEX INVERTER	74HCT04P
21	1	U2		325-7432	QUAD OR GATE	MM74HCT32
22	1	Y1		376-4032	4.032 MHZ HC-18 CASE	CTS MP043
23	1	JP1		403-0003	3 OF 401-0052	
24	1	J1	*NOTE 1	407-0108	SKT, 8 PIN SIP	65780-044
25	2	J2,J3	*NOTE 1	407-0110	SKT, 10 PIN SIP	65780-046
26	1	XJP1		402-3040	MINI JUMPER	
27	2	XU6,XU7		407-0008	SKT, 8 PIN DIP	
28	3	XU1,XU2,XU5		407-0014	SKT, 14 PIN DIP	
29	1	XU3		407-0016	SKT, 16 PIN DIP	
30	1	XU4		407-0024	SKT, 24 PIN DIP	
31	1	PCB		410-9196A	PCB, M4X FFSK CARD	

NOTES:

1. TO BE MOUNTED ON SOLDER SIDE OF BOARD.

MODEL 48PB CONTROL BOARD SCHEMATIC (008-9183-3B) SHT 1/5

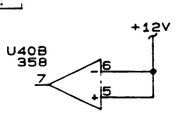
REV	DESCRIPTION	DRN	AP.	DATE
A	RELEASE	TW		
B	ECN 612	DW		04/28/89



NOTES:

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

UNUSED PARTS:



LEGEND:

*	NOT INSTALLED
___X___	CUT TRACE
_____	JUMPER WIRE

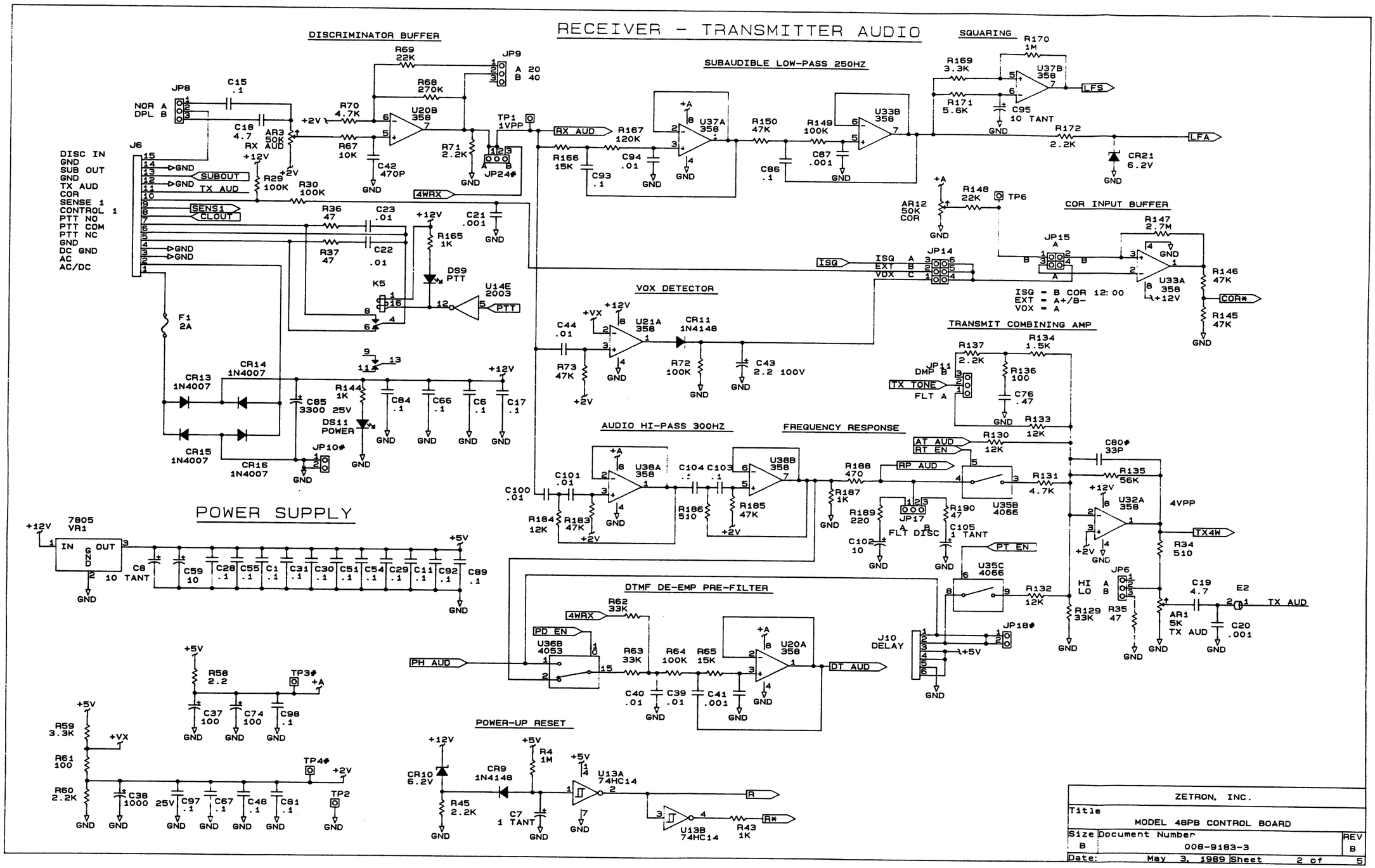
ZETRON, INC.
12335 134TH COURT N.E.
REDMOND, WASHINGTON, 98052-2433

Title: MODEL 48PB CONTROL BOARD

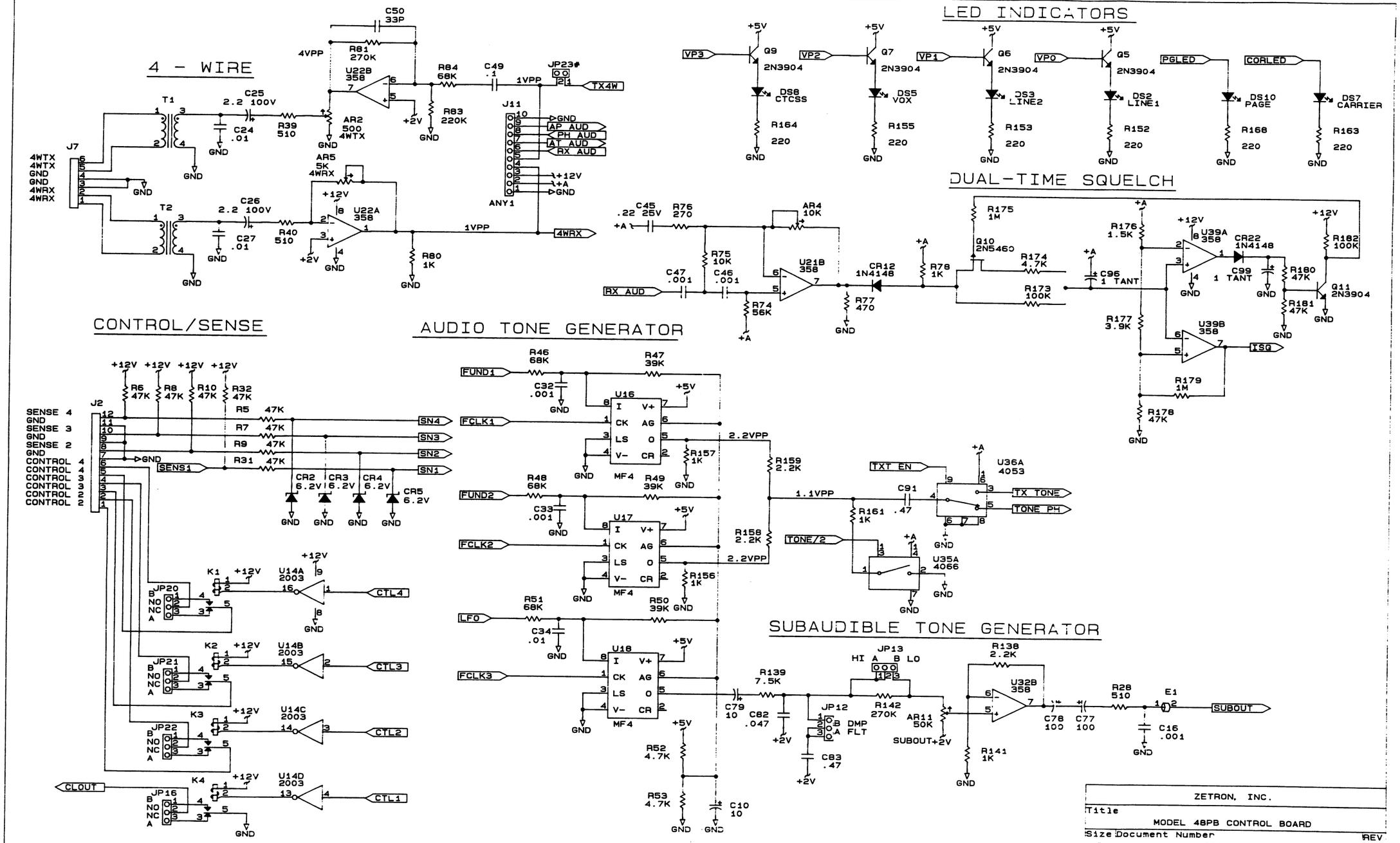
Size	Document Number	REV
B	008-9183-3	B

Date: May 3, 1989 Sheet 1 of 5

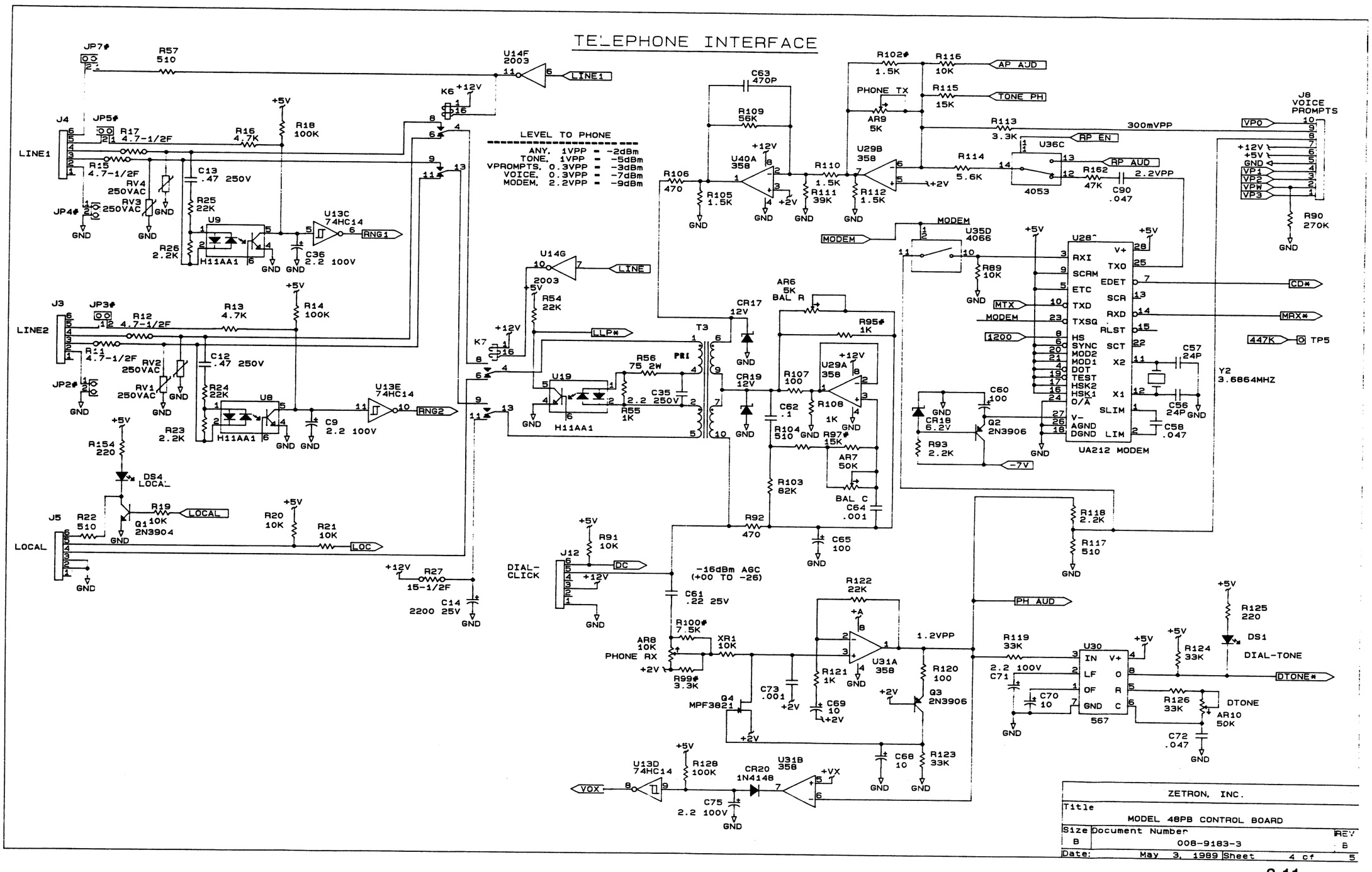
MODEL 48PB CONTROL BOARD SCHEMATIC (008-9183-3B) SHT 2/5



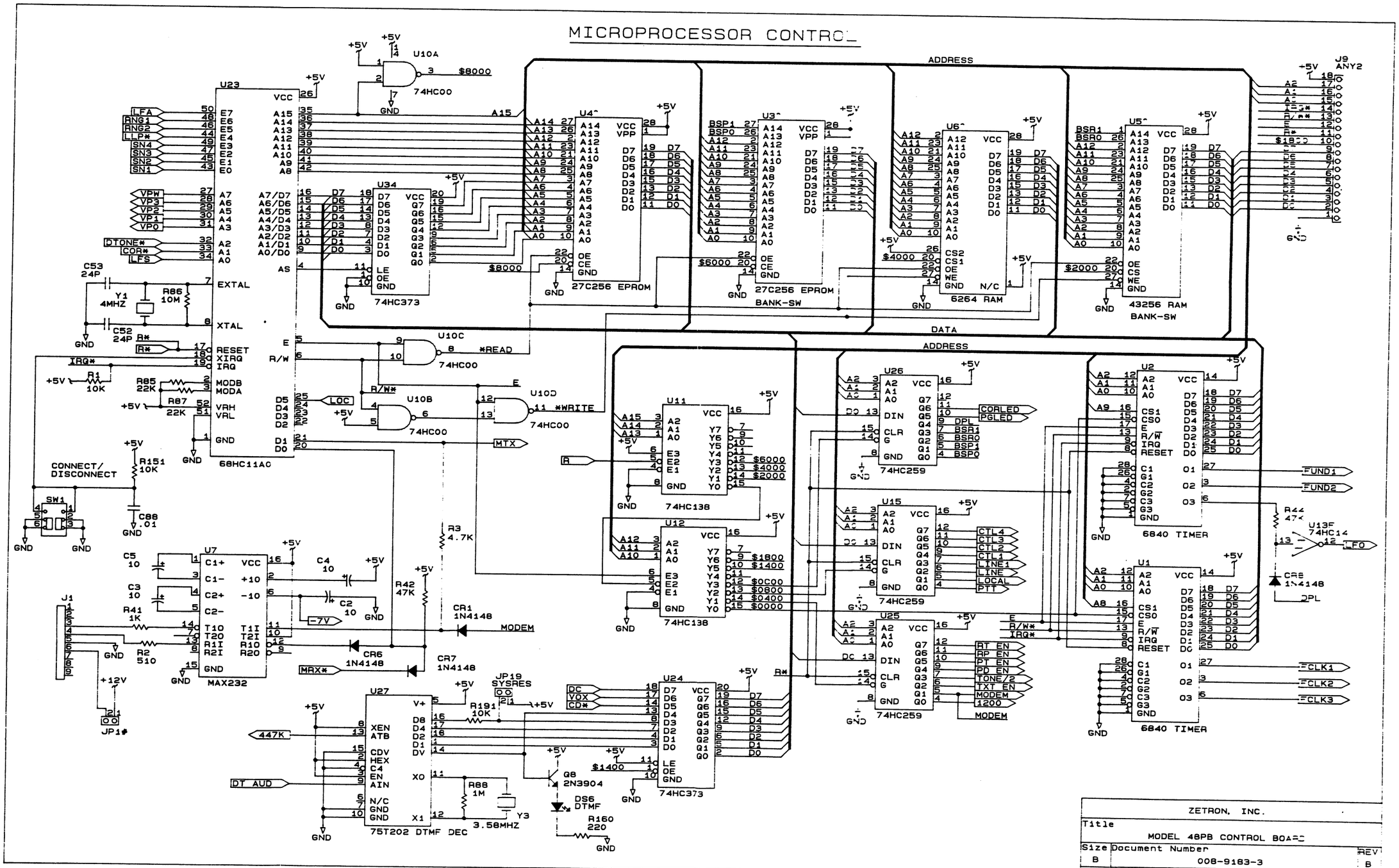
MODEL 48PB CONTROL BOARD SCHEMATIC (008-9183-3B) SHT 3/5



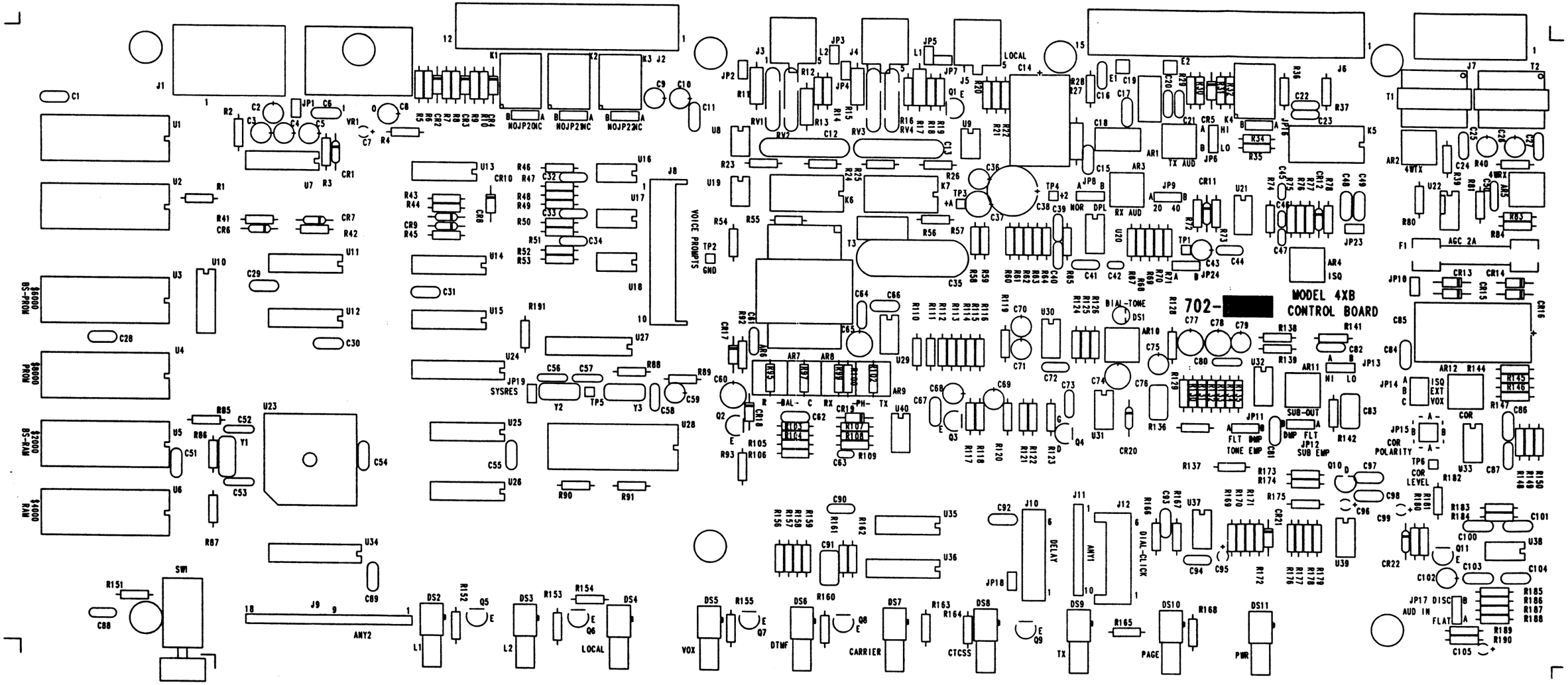
MODEL 48PB CONTROL BOARD SCHEMATIC (008-9183-3B) SHT 4/5



MODEL 48PB CONTROL BOARD SCHEMATIC (008-9183-3B) SHT 5/5

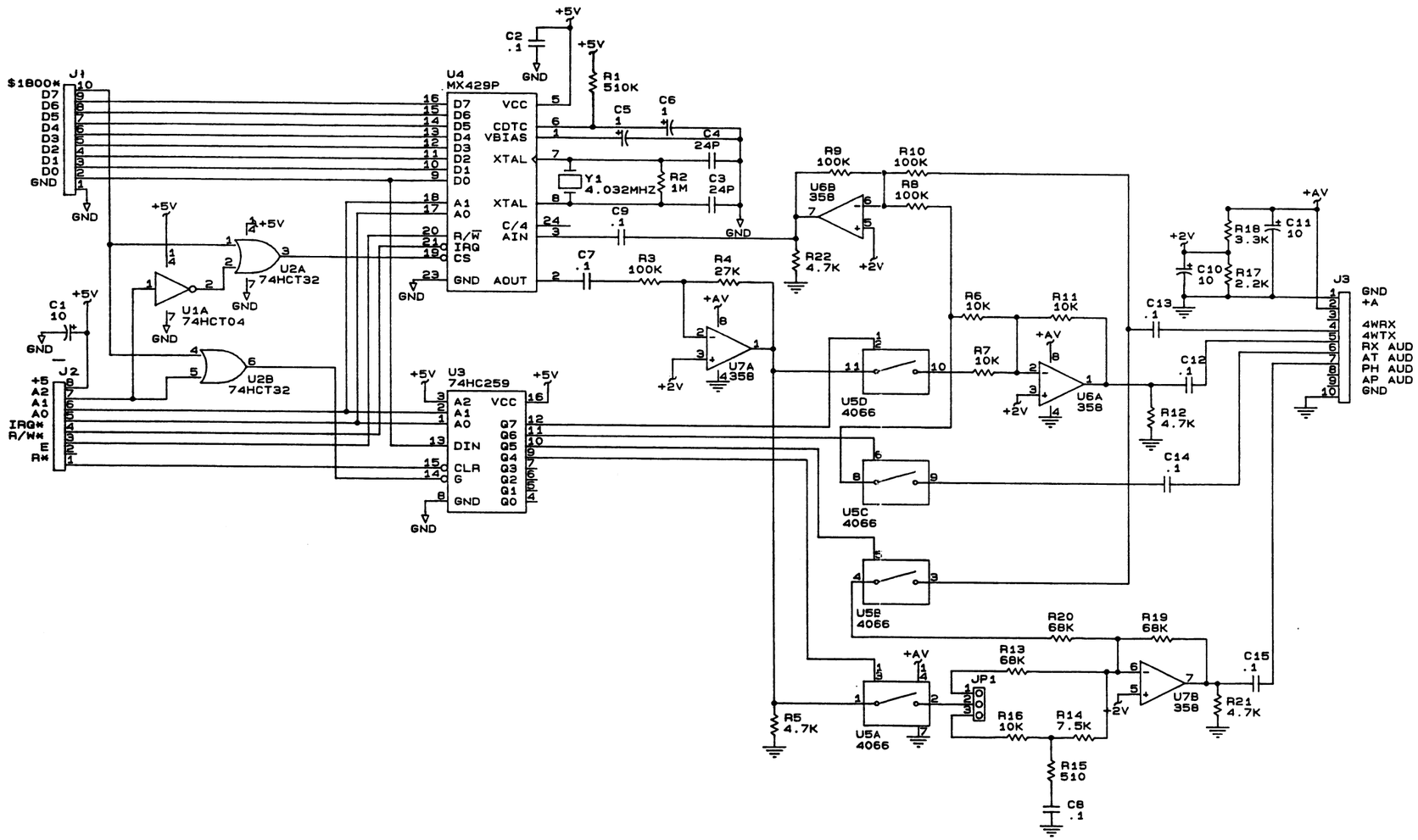


MODEL 48PB CONTROL BOARD SILKSCREEN (702-9183-3B)



MODEL 4X FFSK CARD SCHEMATIC (008-9196AY)

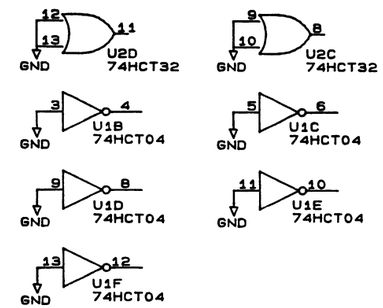
REV.	DESCRIPTION	DN	AP	DATE
AY	PROTOTYPE	DGW		12/02/88



NOTES: UNLESS OTHERWISE SPECIFIED

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

UNUSED PARTS:



LEGEND

*	NOT INSTALLED
X	CUT TRACE
- - - - - - - - - - - - - -	JUMPER WIRE

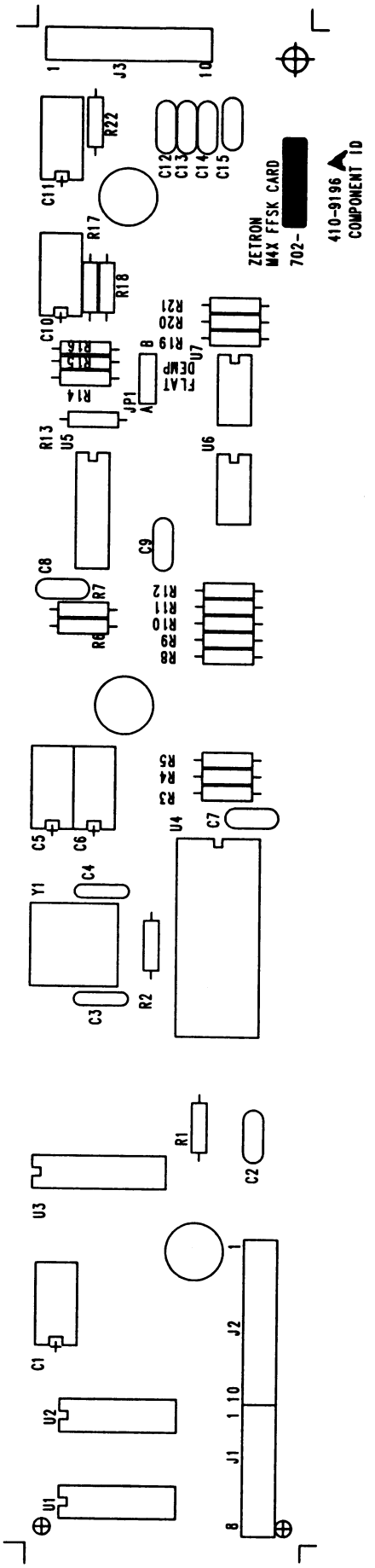
ZETRON INC.
2930 RICHARDS RD. S.E.
BELLEVUE, WA 98005-4479

Title: M4X FFSK CARD

Size	Document Number	REV
B	008-9196	AY

Date: December 27, 1988 Sheet 1 of 1

MODEL 4X FFSK CARD SILKSCREEN (702-9196A)



9. CONNECTIONS AND JUMPERS

INTRODUCTION

This section includes the connections to the Model 48PB's three input/output ports, jumper functions and descriptions, and block diagrams.

PRIMARY CONNECTIONS (to J6)

Type: Weidmuller SL12 Male
Mating connector BL12

1 - AC/DC Input
Power input. +10.5 to +15 VDC or 12 VAC input.

2 - AC Input
When AC power is used the other side of AC power is hooked here.

3 - Power Ground
When DC power is used the negative side (ground) should be hooked here.

4 - Ground

5 - TR Relay NC
Pins 5 through 7 are the TR (Transmit/ Receive) relay connections. The contacts will take 150 VDC at 500 mA max.

6 - TR Relay Common

7 - TR Relay NO

8 - Control 1
System Relay #1 output - Dry contact - NO or NC contact set by JP16.

9 - 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. Note: This input is not normally used.

10 - 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 using JP15. Caution: the COR signal must cross a voltage between 0 and +4V, adjustable via AR12.

11 - Transmit Audio Out
Audio to Transmitter. Often, this signal is connected to the "MIC" input of the transmitter. It is adjustable from 50 mV to 5 V P-P.

12 - Transmit Audio Common
The return for pin 11. Ground.

13 - CTCSS/Digital Squelch Output
The CTCSS (sub-audible) or Digital Squelch output for direct modulation of the Transmitter. The signal is capacitively coupled and may be adjusted for swings from 50 mV to 5 V P-P.

14 - Audio In / Discriminator Lo.
The return pin for pin 15. This pin is connected to chassis-ground.

15 - Audio In / Discriminator Hi.
This is the audio input to the REPEATER MANAGER from the Receiver's discriminator. It has an input impedance greater than 50 kΩ. It is sensitive to discriminator levels on the order of 50 mV P-P. Ensure the output from the receiver has the tone/code information.

AUXILIARY CONNECTIONS (to J2)

Type: Weidmuller SL15 (#6923.6) Male
Mating connector BL15 (#12604.6)

1 - Control 2 Common

2 - Control 2 N.O. or N.C. via JP22
System Relay #2 output.

3 - Control 3 Common

4 - Control 3 N.O. or N.C. via JP21
User Relay #1 output. Not used in Model 47 Commander's Net

5 - Control 4 Common
For 4-Wire port E & M operation connect to pin 7 (ground).

6 - Control 4 (E-Lead)
4-Wire E & M trunk port E-Lead**(to trunk)**. Output is open for idle trunk, shorted to ground to seize trunk.

7 - Ground

8 - 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. When this input is active the COR LED will flash. If this input is pulled low then the RADIO CHANNEL MANAGER will not allow any calls from the land line to go out because the channel will look busy. This input also will inhibit dispatch, Mobile to phone and Mobile to mobile operation. This input may be used on a monitor receiver to test for channel activity on the transmit channel or as a busy inhibit.

9 - Ground

10 - Sense #3
NOT USED

11 - Ground

12 - Sense-4 (M-Lead)
4-Wire E & M trunk port M-Lead**(from trunk)**. Input should be grounded (or open) for trunk idle condition, and battery (-48V nominal) when the switch has seized the trunk.

4-WIRE PORT CONNECTIONS (to J7)

Type: Weidmuller SL6 (# 1122.6) Male
Mating connector BL6 (# 12595.6)

1 - 4-Wire Receive
With pin 2 forms a 600Ω balanced audio input.

2 - 4-Wire Receive
With pin 1 forms a 600Ω balanced audio input.

3 - Ground

4 - Ground

5 - 4-Wire Transmit
With pin 6 forms a 600Ω balanced audio output.

6 - 4-Wire Transmit
With pin 5 forms a 600Ω balanced audio output.

SERIAL CONNECTIONS (to J1)

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

1 - Not Used

2 - Not Used

3 - TXDATA (Transmitted-Data)
This pin is the RS-232 data FROM the Repeater Manager. It swings from -5V (mark) to +5V (space) through a 1 kΩ resistor.

4 - RXDATA (Received-Data)
This pin is the RS-232 data TO the Repeater Manager. It should swing from -5V (mark) to +5V (space) through no less than a 3 kΩ resistor. It may swing through ±25V max.

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

6 - +12 Volts
If JP1 is installed +12 VDC will be supplied to this pin.

7 - Not Used

8 - Not Used

9 - Not Used

DEFAULT JUMPER SETTINGS

JUMPER	SET	FUNCTION	OPTIONS
JP- 1	out	RS-232 Power	In = +12 Volts to J1 Pin 6
JP- 2	out	Phone line jumper	In = L2 pin 2 = ground
JP- 3	out	Phone line jumper	In = L2 pin 5 = ring detector
JP- 4	out	Phone line jumper	In = L1 pin 2 = ground
JP- 5	out	Phone line jumper	In = L1 pin 5 = ring detector
JP- 6	A	Tx Audio Hi/Lo	A = Hi B = Lo
JP- 7	out	L1 Answer OUT	In = L1 pin 6 ground = answered
JP- 8	A	Rx Tone NOR/DPL	A = CTCSS only B = CTCSS/CDCSS(DPL)
JP- 9	A	Rx Audio Gain	A = 20 dB B = 40 dB
JP-10		Supply Ground	Etched--Do not cut
JP-11	A	Tx Tone Filter	A = Flat B = De-emphasized
JP-12	A	Tx Subaud Filter	A = Flat B = De-emphasized
JP-13	A	Tx Subaud Hi/Lo	A = Hi B = Lo
JP-14	A	COR Mode	A = Internal Squelch B = Externally Supplied COR C = Voice operated (VOX)
JP-15	A	COR Polarity	A = Active Lo B = Active Hi
JP-16	B	Control 1 NO/NC	A = Normally Closed B = Normally Open
JP-17	A	Tx Audio Filter	A = Flat B = De-emphasized
JP-18		Delay	Etched
JP-19	out	System Reset	In = **Clears all system memory on power-up**
JP-20	B	Control 4 NO/NC	A = Normally Closed B = Normally Open
JP-21	B	Control 3 NO/NC	A = Normally Closed B = Normally Open
JP-22	B	Control 2 NO/NC	A = Normally Closed B = Normally Open

A. APPENDIX

USING THE DT TERMINAL EMULATOR

An IBM PC (or compatible) may be used to program the Repeater Manager. The computer must contain an RS-232 serial interface in order to function as a "dumb terminal". The only connections required between the Model 48PB 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 1200 baud from the factory when programming with a modem. 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 48PB. 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 48PB and back to the PC to be displayed. Characters sent from the Model 48PB are displayed. Pressing the RETURN key will "bring up" or display the Model 48PB "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
```

"DT" communication settings screen

SERIAL COMMUNICATIONS

If you have 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 M47 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 M48PB and your CRT/Computer.

2. Check that data is coming out of the M48PB, pin 12 of U46, and pin 3 of J3. The data will come out each time you hit the reset button on the M47.

3. Check your cable.

SERIAL COMMUNICATIONS/ RADIO SHACK MODEL 100

Direct Connection Cable Diagram

Model 48	Data Direction	Model 100
3 Txdata	⟹	3 Rxdata
4 Rxdata	⟸	2 Txdata
5 Ground	⟺	7 Ground

Terminal Emulation at 4800 Baud

A. Move the Cursor over the word TELCOM and press ENTER
B. Press STAT (F3 function key)
C. Type: 77i1e ENTER
D. Press TERM (F4 function key)

Procedure for Remote Access via Modem

A. The Model 47 must have 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: M7i1E ENTER
C. Dial the number of the Model 48PB from a DTMF phone.
D. When the line is answered, enter the program mode (see Section 3 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 47 phone line (hybrid) balance poor.
      c. Verify proper phone line connections. Gray to phone.

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

SERIAL COMMUNICATIONS WITH THE COMMODORE 64

Direct Connection Cable Diagram

Model 48	Data Direction	RS-232
3 Txdata	⟹	3 Rxdata
4 Rxdata	⟸	2 Txdata
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 48PB. 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 48PB Setup for use with the Commodore 64

The data rate at which the Model 48PB 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 Setup

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

```
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 IF A$<>""THEN PRINTCHR$(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 M48PB 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 48PB and taking the characters sent back from the Model 48PB and displaying them on the C-64 screen.

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

DIGITAL SQUELCH CODES

The following table is a list of the digital codes the Model 48PB decodes and encodes, note that the Model 48PB only decodes 22 codes for dispatch operation. When entering an encode number in the digital dispatch user menu, just enter the number of the code you wish to decode. In the user specific menu the digital number is preceded by the letter 'D' when entering an encode or decode code. When entering an encode code in the tone dispatch user menu the leading 'D' is required. When programming a digital code via DTMF programming, add 39 to the digital number (ie. digital code D1=40). Note that 'D0' and '0', both set the tone/code off.

Digital Number	Code	Inverted Code	Digital Number	Code	Inverted Code	Digital Number	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 48PB generates. The name of the tone(s), the timing and the frequency is listed.

Mobile/telco 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 on telco:
800Hz for 0.400 sec, 1 sec after the 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.

QUICK REFERENCE

System Items

1. 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.

2. Dialout Mode: 0 = Slow DTMF, 1 = Fast DTMF, 2 = Slow Pulse, 3 = Fast Pulse.

3. Toll Mode: 0 = No toll restricts; 1 = Restricted

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

P. PROGRAMMING REFERENCE

PROGRAMMING REFERENCE TABLE

DTMF	MENU	RANGE	DESCRIPTION
0	!E	0	Control function (0=Exit)
2	!SCH	0- 50	COR hold time **(0)** x100 (ms)
3	!SCQ	0-100	COR quiet time **(30)** x100 (ms)
4	!STO	5-100	Delay before dial-out **(20)** x100 (ms)
5	!SAM	1- 15	Minimum regenerated digits **(4)**
6	!SAD	30-250	DTMF time-out **(50)** x100 (ms)
7	!SCA	15-255	Mobile activity time **(45)** (sec)
8	!ST1	1- 60	Call limit timer-1 **(3)** (min)
11	!STB	1- 25	Channel busy rings **(11)**
18	!SCM	0- 20	Mobile Tx-to-Rx time **(2)** x100 (ms)
32	!SAP	0- 1	Privacy (**0=no**, 1=yes)
38	!VB	0- 1	Run modem at 300 baud (**0=No**, 1=Yes)
71	!SV1	1- 20	Max toll digits 1 **(15)**
77	!STD	0- 1	Disconnect on second dial tone (0=no, **1=yes**)
78		0- 3	Baud rate (No Menu)(0=300,1=1200,2=2400,3=4800,4=600)
79	!SRD	0-200	Key up delay **(40**x25ms)
94	!VS		Reset system programming (NOT DTMF PROGRAMMED)
98	!T1	**0**- 2	Single tone test (0=TonesOFF, 1=Telco ON, 2=TxToneON)
102	!TA	35-100	Tone 1 frequency **(54)** x10 Hz
103	!TB	35-100	Tone 2 frequency **(60)** x10 Hz
104	!T2	0- 2	Dual tone test (0=tones OFF, 1=telco ON, 2=tx tone ON)
105	!T4	0- 1	Emphasis test (0=tones OFF, 1=telco ON)
106	!TH	0- 1	Hybrid adjust (0=tones OFF, 1=telco ON)
108	!TD		DTMF tests (NOT DTMF PROGRAMMED)
109	!TC		COR tests (NOT DTMF PROGRAMMED)
110	!SCB	0- 1	Channel busy active high (**0=no**, 1=yes)
111	!SCV	0- 1	COR validation active high (0=no, **1=yes**)
115	!T3	1-143	CTCSS test (1-38=CTCSS, 40-143=Digital)
163	!SD1	0- 16	Auto-dial number 1 (digits)
↕	!SDn	0- 16	Auto-dial numbers 2-8 (digits)
171	!SD9	0- 16	Auto-dial number 9 (digits)
172	!SI	1- 10	Station ID (chars)
173	!SV2	1- 4	Toll restrict set 1 - 1st digits (digits)
174	!SV3	1- 4	Toll restrict set 1 - 2nd digits (digits)
177	!VA	1- 7	Program mode access code **(00072)** (digits)
180	!VR		ANI for system relays **(*1)** (chars)

NOTE: Program variable defaults appear in **BOLD** type.
Variables with no defaults have a 0 or null string value.
Variable left blank are not DTMF programmable.

MODEL 48PB MENU PROGRAMMING STRUCTURE

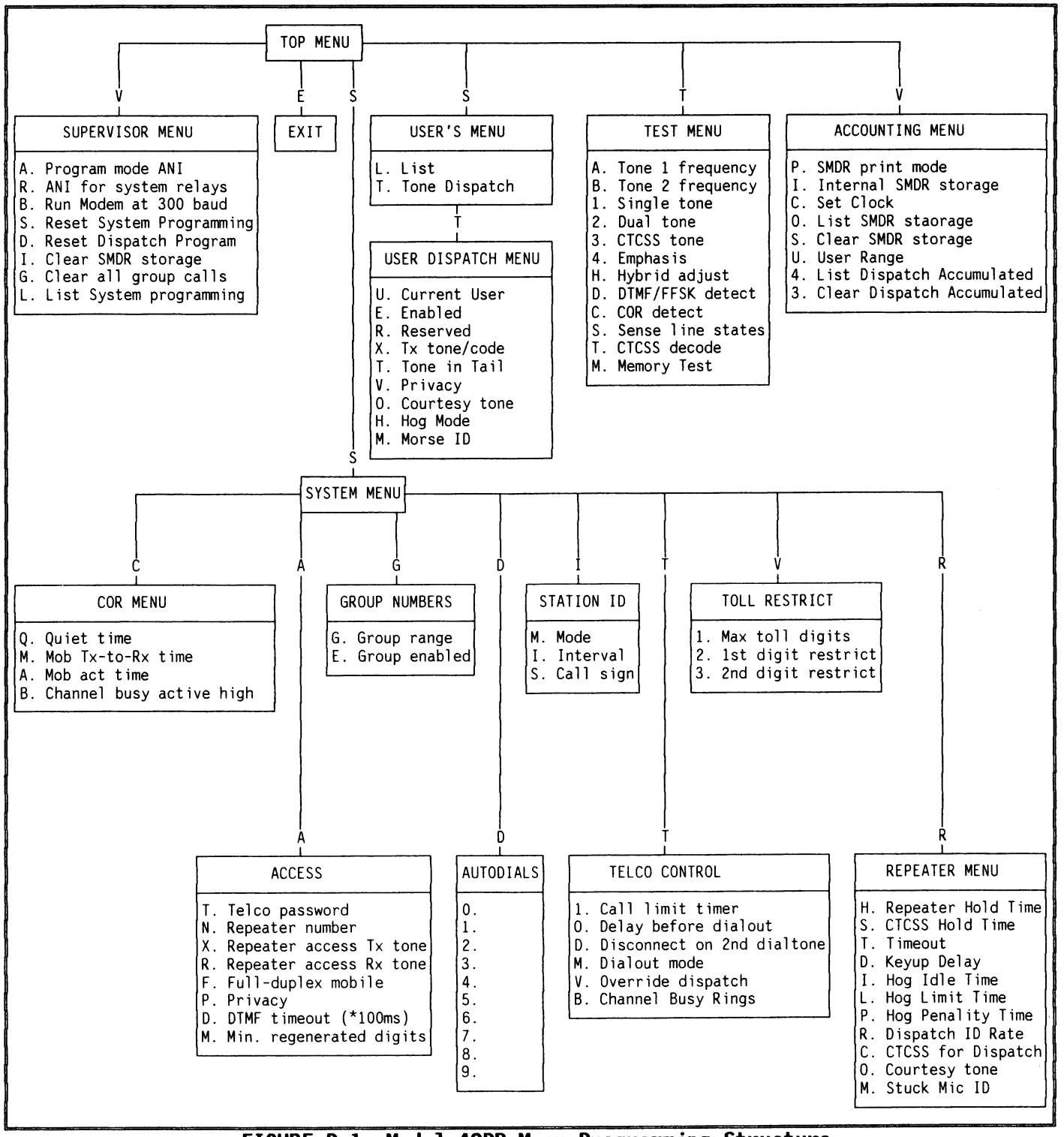


FIGURE P-1: Model 48PB Menu Programming Structure