WIDEBAND REPEATER ADDENDUM
PART NO. 090-0004-958

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Transcrypt International, Inc. designs and manufactures two-way radio equipment to serve a wide variety of communications needs. Transcrypt International Inc. produces EFJohnson® brand equipment for the mobile telephone and land mobile radio services which include business, industrial, government, public safety, and personal users.

LAND MOBILE PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from your product supplier or from the Transcrypt International, Inc., 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. Phone (507) 835-6222.

WARNING

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by Transcrypt International, Inc. could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

DO NOT allow the antenna to come close to or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

DO NOT operate the radio near electrical blasting caps or in an explosive atmosphere.

DO NOT operate the radio unless all the radio frequency connectors are secure and any open connectors are properly terminated.

DO NOT allow children to operate transmitter equipped radio equipment.

SAFETY INFORMATION

Proper operation of this radio will result in user exposure below the Occupational Safety and Health Act and Federal Communication Commission limits.

The information in this document is subject to change without notice.

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SECTION 1   INTRODUCTION AND OPERATION

1.1 SCOPE OF MANUAL

This service manual addendum provides operation, programming and alignment information for the VIKING® VX Frequency Hopping LTR® Repeater, Part No. 090-0004-958. The information within this addendum details the differences between this model and a standard VIKING® VX LTR® Repeater, Part No. 242-2008-232. Section numbers in this addendum correspond to the same section in the full repeater manual.

1.2 REPEATER DESCRIPTION

The VIKING VX Frequency Hopping repeater is designed for operation in a Johnson LTR system. It operates on the 800 MHz channels from 851.0000-865.9875 MHz (repeater transmit) or FCC Channels 1-600. The repeater receive frequencies are 45 MHz below these frequencies (806.0000-820.9875 MHz). Channel spacing is 25 kHz and RF power output is adjustable from 25 to 75 watts.

This repeater is programmed with a laptop or personal computer using the repeater software, Part No. 023-9998-404.

1.3 ACCESSORIES

The Viking VX Frequncy Hopping LTR repeater is not compatible with the following accessories:

- LTR Modem.

- Viking Network Controller (VNC).

- Telephone Interconnect Card (TIC).

A standard computer modem can be configured to remotely program the repeater through the Public Switch Telephone Network (PSTN).

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SPECIFICATIONS

GENERAL[1]

Frequency Range	806-821 MHz Receive, 851-866 MHz Transmit
Dimensions	9.125" H x 17" W x 20.9" D
AC Voltage/Frequency	100-240V AC/50-60 Hz
AC Current	0.40A (Standby), 1.7A (25W), 2.8A (75W)
AC Input Power	45W (Standby), 199W (25W), 328W (75W)
DC Current at 26.5V DC	5.2A (25W), 9.8A (75W)
Number of Channels	Up to 19 (Synthesized, programmable)
Channel Spacing	25 kHz
Channel Resolution	12.5 kHz
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Duty Cycle	Continuous
FCC Type Acceptance	ATH2422008
FCC Compliance	Parts 15, 90

RECEIVER

12 dB SINAD	0.30 µV
20 dB Quieting	0.40 µV
Signal Displacement Bandwidth	±2 kHz
Adjacent Channel Rejection	-70 dB
Intermodulation Rejection	-70 dB
Spurious & Image Rejection	-80 dB
Image Rejection	-70 dB
Audio Squelch Sensitivity	12 dB SINAD
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 3% at 0.5W/16 ohms
Local Audio Power	0.5W/16 ohms
Audio Sensitivity	±1.5 kHz
Hum & Noise Ratio	-45 dB
Frequency Spread	15 MHz
Frequency Stability	±1 PPM -30°C to +60°C (-22°F to +140°F)
Modulation Acceptance BW	±7 kHz

TRANSMITTER

RF Power Out	75W (Default setting), 25W (Variable Set Point)
Spurious Emissions	-60 dBc
Harmonic Emissions	-60 dBc
Audio Deviation	±3.5 kHz
LTR Data Deviation	±1 kHz
CWID Deviation	±2 kHz
Repeat Deviation	±1.5 kHz
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 2%
Hum & Noise (TIA)	-45 dB
Frequency Spread	15 MHz
Frequency Stability	±1 PPM -30°C to +60°C (-22°F to +140°F)
Emission Designators	14K0F3E, 16K0F3E, 14K0F3D, 16K0F3D, 14K0F1D, 16K0F1D

1. These general specifications are intended for reference and are subject to change without notice. Contact the Systems Applications consultants for guaranteed or additional specifications.

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SECTION 3   SOFTWARE

3.1 INTRODUCTION

The Johnson Frequency Hopping Repeater Program on 3.5 inch disk, Part No. 023-9998-404, uses an IBM® personal computer to program the EEPROM Memory in the Main Processor Card (MPC). To lessen the chance of programming errors and simplify operation, the program uses yes/no questions or toggles through the available responses.

The computer is connected directly from the serial card to the MPC or via a modem. The interconnect cables for direct connection are shown in Figure 4-29. The DB-9 to 8-pin modular adapter is connected to the serial port of the computer and an interconnect cable connects the adapter to the MPC.

NOTE: These connections are for the IBM computer and may differ from an IBM compatible. In which case, consult the manuals for your computer for serial card outputs and connections.

3.1.1 HOW TO USE THIS MANUAL

This manual introduces the program and illustrates how to use the features. This manual is organized to easily find programming information with the Table of Contents, Index and Parameter Tables for the responses required for programming.

Graphic reproductions of the screens are shown for reference. Adjacent to the screens are tables to provide the parameters, available responses and a brief description of the parameter. It is not the intent of this manual to teach computer operation, but to allow the user to become familiar with the available screens and the responses without having to be at the computer.

3.1.2 GETTING STARTED

NOTE: Before starting you should already know how to start MS-DOS®, format and make backup copies of disks, copy and delete files, and run programs. If you are unfamiliar with any of these actions, refer to the MS-DOS manual for your computer for more information (see Section 5).

Follow the computer instructions for loading the disk. The MS-DOS Revision 2.0 or later operating system is needed to run the programs. The computer needs to have RS-232C capability, for example, the Serial Card in slot "COM1" or "COM2". Modems must be configured for "COM1" or "COM2" connections.

3.1.3 COMPUTER DESCRIPTION

The programming software is designed to run on an IBM PC or compatible computer that meet the following minimum requirements.

- One 3.5" high density disk drive.

- 640K of memory

- MS-DOS version 2.0 or higher

- One serial port

- Monochrome or color monitor and video card

Although the program uses color to highlight certain areas on the screen, a monochrome (black and white) monitor or LCD laptop also provide satisfactory operation. Most video formats such as EGA and VGA are supported. A serial port is required to connect the Repeater to the computer. This port is standard with most computers.

The cables from the Repeater to the computer are not included. With most computers, the adapter-to-computer cable is a standard DB-25 M-F cable, PN 023-5800-017, (the male connector plugs into the adapter). If your computer requires a male connector, a male-to-male cable is also available, PN 023-5800-016. The cable from the adapter to the Repeater has a modular-type 8-pin connector (see Figure 4-29).

3.1.4 EEPROM DATA STORAGE

The data programmed into the MPC is stored by an EEPROM Memory. Since this type of device is nonvolatile, data is stored indefinitely without the need for a constant power supply. A repeater can be removed from the site or even stored indefinitely with-

out affecting programming. Since EEPROM Memory is also reprogrammable, a new device is not needed if programming is changed.

3.1.5 COMMAND LINE OPTIONS

HELP

To show all options available from the command line type: /h or /?. Either '/' or '-' can be used. For example: scanpgmr /h

The options can be entered in any order. For example: scanpgmr /d /b /c

COM PORT

The Johnson programming software defaults to serial port COM1. However, if this port is already in use, the software can be reconfigured to use serial port COM2. To do this, use one of the following methods:

1. When running the compiled (.EXE) version, type /
    c2 on the command line after the program name.
    For example: scanpgmr /c2 or -c2

1. Select COM port from Utilities heading.

BAUD RATE

The software defaults to 9600 baud, however this rate can be changed. To do this from the command line, type /bxxxx (xxxx = baud rate).
For example: scanpgmr /b or -b

NOTE: When the baud rate is changed on the command line, the baud rate jumpers on J3 in the MPC must also be changed to the same baud rate (see Section 6.8.8 in the complete LTR Service Manual). Repeaters programmed via modem must be set to 9600 baud

DEMO MODE

To view the screens for Read Setup Parms and Write Setup Parms from the Transfer menu when a repeater is not connected to the computer this option is used. Normally these screens are not available without a repeater connected. To do this from the command line, type: /d or -d.
For example: scanpgmr /d

3.1.6 COLOR OR MONOCHROME OPERATION

The programming software utilizes color for a color monitor and video card. However, with LCD-type displays, this may make some information hard to read because the contrast is poor. To improve contrast, a monochrome mode can be selected in the display mode from Utilities heading.

3.2 REPEATER PROGRAM SOFTWARE

3.2.1 INSTALLING THE SOFTWARE

When you receive the programming software, make a backup copy and store the master in a safe place. Copy the distribution disks using DOS DISK-COPY command. For example, type:

DISKCOPY A: A: (single floppy drive)

or

DISKCOPY A: B: or C: (multi-drive systems).

If you have a hard disk drive, you may want to create one or more separate directories for transceiver programming and then transfer the program disk files to those directories. To create a new directory, use the MKDIR command. For example, to create directory RADIOPRG, type:

MKDIR \RADIOPRG.

Then to make the new directory the current directory, use the CHDIR command. For example, to change to the \RADIOPRG directory, type

CHDIR \RADIOPRG.

To copy all files from a floppy disk in drive A: to this directory, type:

COPY A:*.*

If you have a single floppy drive and no hard disk drive, you need to create programming disks. The reason for this is that there is not adequate space on the backup disk(s) for storing radio files. If your computer has dual floppy disk drives, the backup disk can be placed in one drive and then the radio files stored on a disk in the second drive.

To make a programming disk, format a blank disk using FORMAT B: or FORMAT B: /S (use "/S" if it must be a bootable disk). Then copy the required program file or files to the programming disk. To do this, type COPY A:(filename.ext) B:(filename.ext). For example, to copy the file scanpgm2.exe from drive A to drive B, type

COPY A:scanpgm2.exe B:scanpgm2.exe

This procedure works for either single or dual drive computers. Refer to your computer reference manual for more information on these DOS commands.

The programming software is shipped in a compressed format. The name of the compressed file is 2000pgm2.exe and it extracts the following files so the program can be used on a PC.

2000PGMR.LNF	2k
MODEM.CFG	1k
SCANPGMR.CFG	1k
SCANPGMR.EXE	478k
SCANPGMR.HLP	45k
TESTM8H.LNF	15k
TESTM8L.HLP	2k
TESTM8L.LNF	228k
TESTM9H.LNF	11k
TESTM9L.LNF	208k
TESTT8L.LNF	53k
TESTT9L.LNF	51k

The SCANPGM2.EXE file is self extracting which means that the files extract automatically when executed. To extract these files so the program can be used, first make the current directory the destination directory for these files. For example, to make it the \RADIOPRG directory on drive C: (if not the current directory), type C: (Return) and then CD \RADIO-PRG as just described. To make it the disk in drive B:, simply type B:. Then insert the program disk in drive A: and type A:SCANPGM2 (or B: SCANPRM2 if drive B: is being used). The program files are automatically extracted into the current directory or disk.

3.2.2 MINIMUM FREE MEMORY REQUIRED

Approximately 570K of free conventional memory is required to run this program (use the CHKSK or MEM command to display the amount of free memory). If you have at least 640K of memory and not

enough is available, there may be other programs that are also being loaded into conventional memory. Contact Customer Service for information on how these programs can be moved or disabled to make more space available.

3.3 REPEATER PROGRAMMER

When the program is loaded into the computer and executed, the menu shows the files available from the directory. The program is used to create, edit, transfer and receive the repeater and channel parameters described in Section 5.

IMPORTANT

The commands and displays referred to in this manual are for the IBM PC and may differ from IBM compatible. Refer to the computer's operating system manual for command explanations.

3.3.1 PROGRAM FILES

The files in the software directory are needed to run the program.

3.4 ALIGNMENT SOFTWARE

File Edit Transfer Hardware Test Utilities

PA
Receiver
Exciter
Full Rptr/Station
RNT Interface
Telephone Interface
VNC Interface
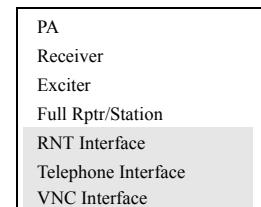
Figure 3-1   REPEATER TEST MENU

The software for the Johnson repeater programs the MPC to open and close the audio/data gates necessary for the alignment selected from the Test-Full Repeater menu. Under the menu heading Test are the alignment procedures for the PA (see Section 7.3), Receiver (see Section 7.1), Exciter (see Section 7.2) and overall Full Repeater (see Section 7.3) including the MAC card (see Figure 3-1).

*NOTE: Under the Setup Parameters, the Allow Hopping function must be set to **NO** and programmed into the repeater **before** entering Test Mode. If this is not done, the repeater will continue to change channels when the "Time-On-Channel" counter expires.*

Refer to Section 7 for Alignment Procedures as shown in the program, alignment points diagrams and test setup diagrams.

3.5 HELP F1

Help screens are available for most parameters and options in this program. Whenever a parameter or options clarification is needed, press F1 and if a help screen is available it will pop-up on the screen. Press Escape <ESC> to exit the pop-up screen.

HELP - F1

FILE
- Load
- Save
- Save As
- DOS Shell
- Quit   ALT X

EDIT
- Setup Parameters F4
- Select Repeater
- Alarm Configuration
- Repeater Type
- Delete Repeater

TRANSFER
- Read Setup Parms F5
- Write Setup Parms F6

HARDWARE
- HSDB Monitor
- RX/TX Data
- RF Data
- Revisions
- Mode Select

TEST
- PA
- Receiver
- Exciter
- Full Rptr/Station
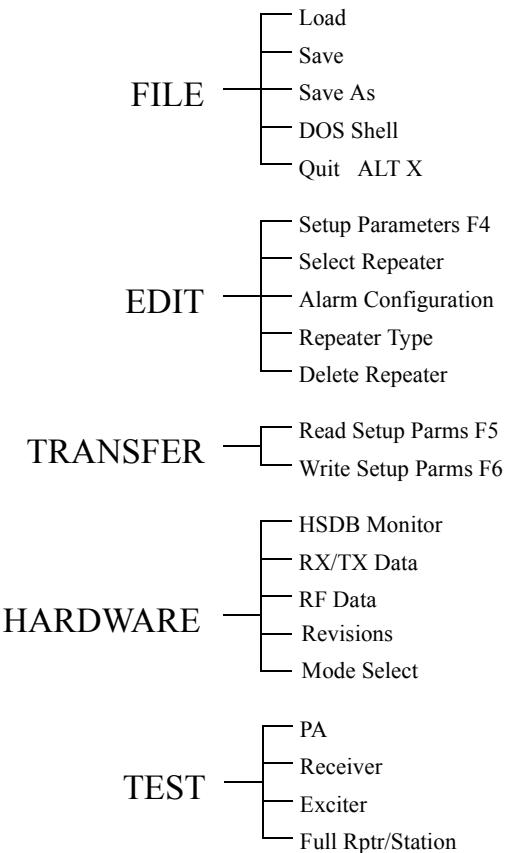
Figure 3-2   PROGRAMMING FLOWCHART

SECTION 4   PULL DOWN MENUS

4.1 MENU DISPLAYS

The menus available are listed at the top of the screen (see Figure 4-1). Move the cursor with the arrow keys to highlight the menu name. Press Enter to view the menu and the arrow keys to scroll through the menu. Call up the highlighted selection by pressing Enter.

4.2 FILE MENU

This menu manipulates new or existing files into directories and saves files to be called up at another time.

File Edit Transfer Hardware Test Utilities

Load
Save
Save As

Print Config
DOS Shell
About...
Quit   ALT X

Figure 4-1   FILE MENU

Load File
Dir c:\example\file\load
File *.qx

file1.qx   ..\
                  tmp\

Ok   Cancel

Figure 4-2   LOAD FILE
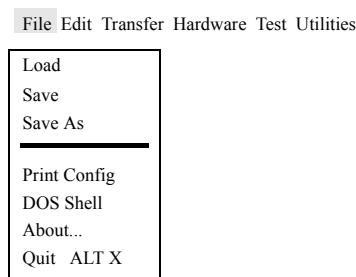
4.2.1 LOAD

Load reads information from a stored file. The program requests the filename to be loaded into the buffer. The filename from a disk can be entered in the highlighted area. Then move the cursor down with the arrow key and highlight "Ok" and press Enter. To select an existing file, use the arrow keys to move down the menu list and press Enter when the high-lighted filename is the file to load.

4.2.2 SAVE

This saves the edited version of an existing file loaded in the buffer under the same filename in the directory and deletes the old file. It loads a new file created in the Edit menu into the directory.

4.2.3 SAVE AS

This saves the edited version of an existing file loaded in the buffer under a new filename or gives a new file created in the Edit menu a filename.

Save File
Dir c:\example\file\load
File *.qx

test.qx   ..\
                  tmp\

Ok   Cancel

Figure 4-3   SAVE FILE

```
                                              ┌── Repeater Number
                                              ├── Channel Number
                                              ├── TELCO Network Type
                                              ├── Area
                                              ├── Stand-alone
                                              ├── CWID Time
                                              ├── CWID Message
                                              ├── Local Mic ID
                                              ├── Test Mode ID
                                              ├── Paging
                                              ├── RF Power Level
                                              ├── Power Source
                                              └── Data Modem
                ┌── Setup Parameters F4 ──────┐
                ├── Select Repeater ───────────── Default
                ├── Alarm Configuration          Repeater Number
   EDIT ────────┤── Repeater Type             ┌── Input Alarms ──────── Input Type Selection
                ├── Delete Repeater           ├── Output Alarms ─────── Output Type Selection
                ├── Telephone Access Parameters└── Cross Reference ───── Alarm Cross Reference Selection
                ├── Telephone Interface       ┌── Repeater Type ──┐    ┌── Multi-Net
                └── TIC Calibration Data       ├── Frequency Band  │    ├── LTR
                                              ├── Power Level     │    └── Universal Station
                                              └── IAC Type        │    ┌── 800 MHz
                                                                  │    ├── 800 MHz (-12.5 kHz)
                                                                  │    └── 900 MHz
                                                                  │    ┌── 75W
                                                                  │    └── 175W
                                                                  │    ┌── 8 I/O IAC
                                                                  └────└── 4 I/O IAC
```

Figure 4-4   EDIT PROGRAMMING FLOWCHART

4.2.4 PRINT REPEATER CONFIGURATION

Select the destination for the configurations.
Printer - Prints to printer connected to PC.
File - Writes printable test to selected filename.

Select which repeater data will be printed.

All Repeaters - Prints the data for all valid
             repeaters.
Single Repeater - Prints the data for the entered
             repeater number.

NOTE: A list of valid repeaters can be seen under the Edit-Select Repeater menu selection.

4.2.5 DOS SHELL

DOS shell temporarily suspends the program and returns to DOS. Directories and other DOS commands can be performed. To return to the program from DOS, type EXIT and press Enter.

4.2.6 QUIT (ALT X)

Quit exits the repeater program and returns to DOS. Save all files before exiting the repeater program.

4.3 EDIT

File **Edit** Transfer Hardware Test Utilities

```
┌─────────────────────────────────┐
│  Setup Parameters  F4            │
│  Select Rptr                     │
│  Alarm Config                    │
│  Repeater Type                   │
│  Delete Rptr                     │
│  Telephone Access Parms          │
│  Telephone Interface             │
│  TIC Calibration Data            │
└─────────────────────────────────┘
```

Figure 4-5   EDIT MENU

This menu is used to create new files and set or change the repeater operating parameters. The filename for the repeaters in this file is shown in the lower left corner of the screen.

4.3.1 SETUP PARAMETERS

This programs the scanning repeater and options of each repeater at a site. Table 5-1 lists the parameters that are set by this screen (see Figures 5-1 and 5-2) and gives a brief description of each.

NOTE: The parameters are shown in the lower left of the pop-up screen for reference.

FIRST PAGE SETUP PARAMETERS

TIME-ON-CHANNEL

This is the time in seconds that a scanning repeater is on a programmed channel. The time is set based on the number of repeaters and channels programmed. The default value ensures that all channels are serviced every 30 minutes. If a time that is less than maximum is desired, the time on channel can be changed to a new value.

*NOTE: This can only be done as the **last** parameter to be changed on the screen, then F2 to the next screen.*

Any other changes to repeater numbers or channel numbers reloads the maximum default. This value can be set from 30 seconds to 1800 seconds in 30 second increments.

FORCE CWID

This value, in seconds, sets the guaranteed time to transmit all CWID or idle messages of all repeater channels programmed. The default value of 1650 seconds guarantees that for 19 programmed channels, each channel has the idle message (no CWID programmed) or programmed CWID sent within a 30 minute time. This value prevents "locked up" channels from stopping the frequency hopping repeater on that channel.

If a repeater becomes "locked" on a channel, the Force CWID time drops the call and proceeds to the next repeater and CWID (if programmed) or idle message (if no CWID is programmed) until all repeater channels have been serviced.

The default time of 1650 seconds (26 minutes) is the maximum time that a channel can be locked up before the call is dropped and the scanning continues. There is about 4 minutes of overhead to scan through the remaining 18 channels. To guarantee that the repeater will CWID or idle message all channels in a time less than 30 minutes, enter a value that is less than 1650 seconds.

ALLOW HOPPING

Select YES for standard hopping repeater operation. Select NO (must be programmed into the repeater) to stop the hopping function. This allows the receiver and exciter to be tested without the channel changing frequency. The first repeater in the setup list generally is the default channel in the test screens. The current repeater number and channel number can be found at the bottom of the SCANPGMR screen.

*NOTE: Return the Allow Hopping selection to **YES** and program the repeater when done testing.*

REPEATER NUMBER

Nineteen repeater numbers can be set for scanning. The default is Repeaters 2 through 20. This repeater number is used for communication to the master "Home" repeater via the High Speed Data Bus (HSDB). Any subscriber units using this system cannot use any of the included repeater numbers for a Home repeater. All subscriber units must be "Homed" on the fixed frequency repeater.

CHANNEL NUMBER

Each repeater number to be scanned must have a channel number. Enter the channel number (FCC Channels 1 to 600) for the corresponding repeater number. Enter a 0 (zero) for any unused repeaters.

NOTE: Repeater program channel numbers 1-599 increment in 25 kHz steps. See Appendix A of the full repeater service manual for correct operating frequency.

CWID MESSAGE

Enter the CWID message to be transmitted for the channel. If left blank, the channel only has LTR idle messages transmitted.

FCC regulations require that the station call letters be transmitted periodically on the lowest-frequency repeater in the system and disabled on all the others. Morse code is used to encode these letters/numbers for continuous-wave (CW) transmission (15 characters/numbers UPPER CASE).

SECOND PAGE SETUP PARAMETERS

REPEATER NUMBER

Displays information from First Repeater in the list on the previous page.

CHANNEL NUMBER

Displays information from First Repeater in the list on the previous page.

TELCO NETWORK TYPE

Not available on scanning repeaters.

AREA

This is the same as the area bit used when programming the mobiles. This bit is usually "0" (zero). This is a global command. All repeaters in the scan list use the same area bit.

SYNC REPEATER

None is used for LTR system repeaters.

STAND ALONE

Not a user selectable function on scanning repeaters.

ID VALIDATOR (Not Applicable)

CWID TIME

Displays information from First Repeater in the list on the previous page.

CWID MESSAGE

Displays information from First Repeater in the list on the previous page.

LOCAL MIC ID

The local microphone connected to the MAC jack is assigned a Group ID for transmitting when the local microphone PTT is active. This allows the repeater to operate as a Base Station.

TEST MODE ID

This is the Group ID transmitted when the Repeater is in Test Mode. Mobiles with the same Group ID can communicate with the Repeater in Test Mode.

RF POWER LEVEL

This is the default power level. Enter the power level for transmit power. This is the power level for all channels in the repeater list.

NOTE: This is not the actual power out level. Other factors must be considered for true power out.

POWER SOURCE

This indicates the primary power source for the Repeater (AC/DC). If AC is selected and Battery Backup is installed, the transmitter goes to half rated power (max.) when AC fails. If DC is selected and AC fails, power output is unchanged.

PAGING (Not Available)

DATA MODEM (Not Available)

4.3.2 SELECT REPEATER

Select the repeater number to be programmed or edited from the pop-up menu (see Figure 4-6). Move the cursor with the arrow keys to highlight the repeater number and press Enter.

A frequency Hopping Repeater can assume the identity of any of the programmed repeater numbers. If a repeater is being programmed from scratch the repeater number is the first repeater in the Repeater Number / Channel Number list.

NOTE: If the file to be viewed is a saved file from multiple "Transfer, Read" commands of a scanning repeater, there may be several repeaters listed in the "Select Repeater" list. Any of the listed repeaters can be used as long as the data is valid (see Section 4.4.2).

```
┌ Repeater List ──────────┐
│ default                 │
│ Rptr 1                  │
│ -------                 │
│ -------                 │
│ -------                 │
│ Rptr 20                 │
└─────────────────────────┘
```
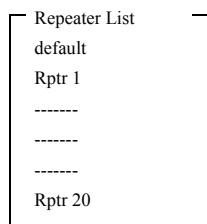
Figure 4-6   REPEATER LIST

4.3.3 ALARM CONFIGURATION

This programs the input alarm (see Figure 4-8) and output alarm (see Figure 4-9) configurations and provides a cross reference screen.

```
┌ Select Which Alarms To Edit ──────┐
│                                   │
│  Input Alarms                     │
│                                   │
│  Output Alarms                    │
│                                   │
│  Cross Reference                  │
│                                   │
└───────────────────────────────────┘
```
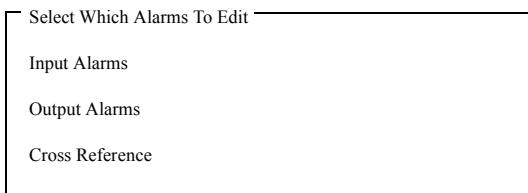
Figure 4-7   ALARM CONFIGURATION

Use the arrow keys to move down the list. Use the Space bar to toggle through the parameters: Disabled, Active Low, Active High, for each alarm.

INPUT ALARMS

There are four input alarms that can be activated by external devices (see Section 6-10). These inputs can be disabled, energized or de-energized. Alarms 3 and 4 can also be analog input.

If the input is disabled, the input alarm line is inactive. When energized and current flow is detected, the alarm is activated. When de-energized and no current flow is detected, the alarm is activated. Analog inputs provide a detection of an analog input out of limit condition. Select the Low and High Limit pair to trip an Analog Input Alarm. The High Limit must be greater in value than the Low Limit (0.0V-5.0V in 0.1V steps).

```
┌────── Input Alarm Configuration ──────────┐
│                                           │
│  Input Type Selection          Description│
│                                           │
│ Alarm 1 Input Type: Energized    Door 1 open
│ Alarm 2 Input Type: De-Energized Door 2 open
│ Alarm 3 Input Type: Analog       Fuel Tank 1/2
│ Alarm 4 Input Type: Analog       Fuel Tank 1/4
│ Low  Limit Voltage (Input3):  1.6  Volts  │
│ High Limit Voltage (Input3):  2.5  Volts  │
│ Low  Limit Voltage (Input4):  0    Volts  │
│ High Limit Voltage (Input4):  1.5  Volts  │
│                                           │
└ Spacebar ─────────────────────────────────┘
```

Figure 4-8   INPUT ALARMS

OUTPUT TYPE SELECTION

Select the operation of the Output Alarm. The available types are:

Active Open - An active alarm opens (no contact) the output lines.

Active Closed - An active alarm closes (contact) the output lines.

```
┌────── Output Alarm Configuration ─────────┐
│                                           │
│  Output Type Selection    Description  Tx ID
│                                           │
│ Alarm 1 Output Type: Active Open   DOOR OPEN    15
│ Alarm 2 Output Type: Active Open   FUEL 1/2     120
│ Alarm 3 Output Type: Active Open   FUEL 1/4     120
│ Alarm 4 Output Type: Active Closed RF HALF POWER 0
│                                           │
│                                           │
│          Alarm Tx Rate:    0              │
│             Press F2 to Accept            │
└ Spacebar ─────────────────────────────────┘
```

Figure 4-9   OUTPUT ALARMS

ALARM DESCRIPTION

This is a text string (up to 15 characters) to describe the alarm. This test string is sent via Morse code if the alarm input is programmed with a Tx ID and an output is selected in the cross reference menu (see Figure 4-10).

TRANSMIT ID

Each of the 8-alarm outputs can be assigned a Group ID from 1-225. The default setting is 0 (zero) for disabled. This Group ID and the Repeater number identify an alarm that is active. This ID can be programmed into a transceiver so that when the alarm is active, the alarm description is received in Morse code.

ALARM TRANSMIT RATE

This sets the time interval for transmitting the alarm message in Morse code. If more than one alarm is active, this is the inter-alarm time.

CROSS REFERENCE

The cross reference screen selects the output alarm that is activated by each input alarm. There are up to 48 alarms (0-47), 8 external input alarms and 40 internal alarms (see Table 1-2). There are eight output alarms. An alarm condition on any input can cause an output alarm. This screen configures which input alarm activates an output alarm.

NOTE: More than one alarm condition can have the same output alarm (see Figure 4-10).

```
         Alarm Cross Reference Selection

 Select which Output Alarm is activated by each Input Alarm.


 0. None    8. None    16. None   24. None   32. None   40. None
 1. 1       9. None    17. None   25. None   33. 4      41. None
 2. 1      10. None    18. None   26. None   34. None   42. None
 3. 2      11. None    19. None   27. None   35. None   43. None
 4. 3      12. None    20. None   28. None   36. None   44. None
 5. None   13. None    21. None   29. None   37. None   45. None
 6. None   14. None    22. None   30. None   38. None   46. None
 7. None   15. None    23. None   31. None   39. None   47. None

                  Press F2 to Accept
```

Figure 4-10   ALARM CROSS REFERENCE

4.3.4 REPEATER TYPE

This screen (see Figure 4-11) selects the repeater type (LTR signaling protocol and features):

Frequency Band   800 MHz
                             800 MHz [-12.5 kHz]
                             900 MHz
Power Level   75W
                             175W
IAC Type   4 I/O IAC
                             8 I/O IAC

```
            Repeater Type Selection

           Select the Repeater Type
                     LTR
          Freq Band: 800 MHz
          Power Level:  75W
          IAC Type:   4 I/O IAC
               Press F2 to Accept
    Select Signaling Method (Spacebar)
```
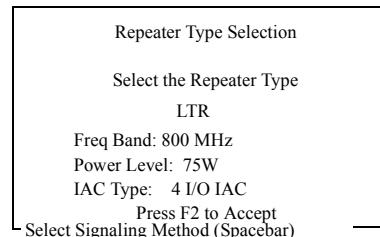
Figure 4-11   REPEATER TYPE

4.3.5 DELETE REPEATER

```
 Select Rptr To Delete
  Rptr 1
```
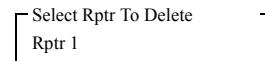
Figure 4-12   DELETE REPEATER

4.3.6 TELEPHONE PARAMETERS

Refer to the Telephone Interface Card manual, Part No. 004-2000-370, for information on the Telephone Access Parameters, Telephone Interface and TIC Calibration Data.

4.4 TRANSFER

```
File  Edit  Transfer  Hardware  Test  Utilities

        Read Setup Parms  F5
        Write Setup Parms  F6
        Read TIC Calibration Data
        Write TIC Calibration Data
```
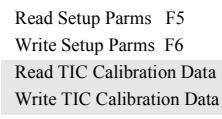
**Figure 4-13   TRANSFER MENU**
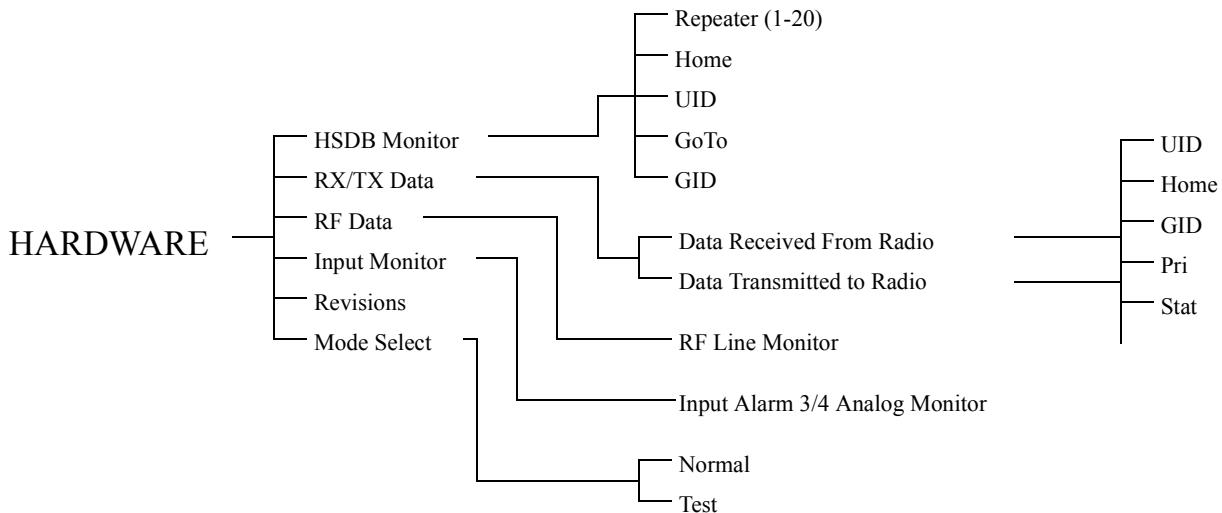
Figure 4-14   HARDWARE PROGRAMMING FLOWCHART

4.4.1 WRITE SETUP PARAMETERS

    This command sends the contents of a file to the repeater and programs the EEPROM memory in the Main Processor Card (MPC).

```
+------------------------------+
|                              |
|     Program Rptr 1           |
|                              |
| Ok              Cancel       |
|                              |
+------------------------------+
```
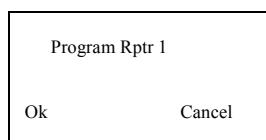
Figure 4-15   WRITE SETUP PARAMETERS

```
+----   Programming Setup Parameters   ----+
|                                          |
|             Count = 1                    |
|                                          |
+------------------------------------------+
```
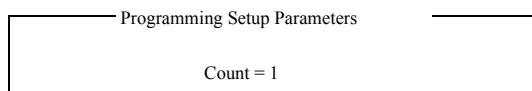
Figure 4-16   PROGRAM WRITE SETUP

4.4.2 READ SETUP PARAMETERS

    This command reads the contents of the EEPROM memory of a repeater and loads it into a buffer. The contents of the buffer is then displayed to show the programming of the repeater.

    If the contents of a Frequency Hopping Repeater are read and the repeater changes identity (i.e. scans to a new Repeater Number/channel), the contents of the EDIT SETUP screen may contain invalid data. This is generally represented by a -1 in any of the Repeater Number, Channel Number fields. If this happens, read the setup parameters again until valid data is observed.

```
+------------------------------+
|                              |
|   Read Setup Parms?          |
|                              |
| Ok              Cancel       |
|                              |
+------------------------------+
```
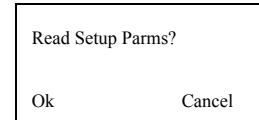
Figure 4-17   READ SETUP PARAMETERS

```
+----   Reading Setup Parameters   ----+
|                                      |
|     Attempting access to Repeater    |
|                                      |
+--------------------------------------+
```
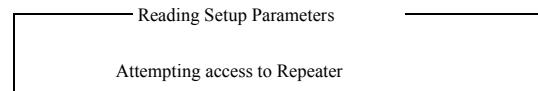
Figure 4-18   READING SETUP

4.5 HARDWARE

File Edit Transfer Hardware Test Utilities

| HSDB Monitor |
| --- |
| Rx/Tx Data |
| RF Data |
| Input Monitor |
| Revisions |
| Mode Select |
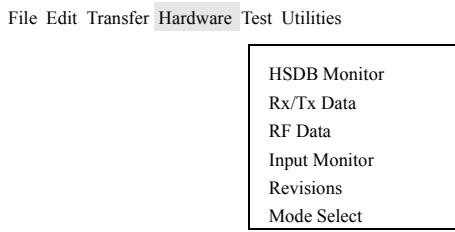
Figure 4-19   HARDWARE MENU

4.5.1 HSDB MONITOR

High Speed Data Bus (HSDB) connects all repeaters at a site and continually sends updates on the status of each repeater. This information screen provides a list of all repeaters at the site (1 to 20).   If a repeater is not sending data, IDLE is next to the repeater number. The data sent by the repeater is used to determine the Home, GID and UID of destination (mobile) users to receive the call placed by the originator.

The Home column refers to the Home repeater number of the originator, therefore the Repeater number and the Home number may not be the same number. The UID is the Unique ID used to identify the originator of special calls.   The GID column refers to the Group ID of the talk group of the originator (236=UID Call, 237 Telco call). The GoTo column shows the repeater channel all destination users switch to so they receive the call.

Rptr   Home   UID   GoTo   GID

Figure 4-20   HSDB MONITOR

4.5.2 RECEIVE/TRANSMIT DATA

This is an information screen used at the repeater site while the computer (laptop) is connected to the MPC in the repeater being monitored. This information is contained in the receive data stream exchanged between the repeater and the destination user (mobile) and the data content of the repeater transmit data stream. The message contains data received from the destination and data sent to the mobile by the repeater. The repeater receives the destination's: Unique ID, Home Repeater Number, Group ID, Priority, Status and Time Stamp. The information sent to the destination in the update message from the repeater includes: Unique ID of originator, Home Repeater Number, Group ID, GoTo Channel Number, Free Channel Number and Priority of the current repeater. The time stamp is included because messages are sent continually and this provides a reference for when a data exchange took place.

NOTE: This screen is only valid during the time the repeater is not "hopping". If the display is showing activity and then stops, the repeater has changed identities and reset the communication port. To start the display again, exit out of the screen and re-enter.

UID Home GID Pri Stat Time

Figure 4-21   MOBILE TRAFFIC MONITOR

4.5.3 RF DATA

The A/D Monitor Screen shows the state of the lines (see Figure 4-22). These lines are monitored by the A to D converter in the IAC. The normal values for each line are defined as follows.

Synthesizer Lock Lines	Yes or No
Forward Power (LP)	25-75 Watts
Forward Power (HP)	75-175 Watts
Reflected Power	0-6 Watts
Final Out (ratio)	approx equal
Chassis Temp	27°C-55°C
Wideband Audio Output	approx 200
LO Injection	approx 200
RSSI	20-150
Fan Current	100-200, 0
Fan	On or Off
Power Supply Temp	22°C-45°C
Battery Voltage	21V-28V

Values with no label are the actual A to D reading. To calculate the voltage on the line, divide the value by 51. Example: Value $\div$ 51 = Volts. Any variation from the above values may indicate a problem in that area. Values on this screen are relative measurements only.

NOTE: This screen is only valid during the time the repeater is not hopping. If the display is showing activity and then stops, the repeater has changed identities and reset the communication port. To start the display again, exit out of the screen and re-enter.

C A U T I O N

While in the test mode the repeater is "busy", therefore it is important to place the repeater in Normal mode when the test mode is no longer required.

```
                     RF Line Monitor

    Synthesizer Lock Lines          Receive Parameters

Exciter Synthesizer:     Yes    Wideband Audio Output:    0
Receive Synthesizer:     Yes    LO Injection:          0
Exciter High Stability:  No     RSSI:                  0
Receive High Stability:  No

      Transmit Parameters           System Parameters
        (Not Calibrated)        Fan 1 Current:        0
                                Fan 2 Current:        0
Forward Power:        0 Watts   Fan On:             Off
Reflected Power:      0 Watts   Chassis Temp:         0 C
Final Output 1/2:  0/ 0 ratio   Power Supply Temp:    0 C
Final Output 3/4:  0/ 0 ratio   Battery Voltage:      0 Volts
```

Figure 4-22   RF LINE MONITOR

4.5.4 REVISION/VERSION

The Revision/Version is displayed for the repeater modules in this screen. The format is R.V (revision.version) for all modules. The MPC information also includes the release date of the software and the serial number of the repeater. The HSDB version in Figure 4.3.1 is for J4, pins 5/6 connected in the MPC and Figure 4-24 is the version for J4, pins 3/4 connected in the MPC.

4.5.5 MODE SELECT

The Mode Select screen places the repeater either in the Normal mode or the Test mode. In the Normal mode the repeater operates as a normal repeater.

In the Test mode the repeater transmits a test word. This test word is the Test Mode ID setup in the Setup Parameters (see Section 4.3.1).

```
              Repeater Version Display


              Repeater Number:  1


    HSDB: 2.1d  MAC: 1.09  TIC: 0.00


    MPC or TPI: 2.05  02/13/97  11
    Serial Number:  1234567891234567
```

Figure 4-23   REVISION/VERSION

```
              Repeater Version Display


              Repeater Number:  1


    HSDB: 50.02  MAC: 1.09  TIC: 0.00


    MPC or TPI: 2.05  02/13/97  11
    Serial Number:  1234567891234567
```

Figure 4-24   REVISION/VERSION

Frequency Adjust
Power Output Adjust

All Receive Tests
TCXO Frequency Adjust
Audio Distortion
Hum & Noise Measurement
SINAD Measurement
Squelch Adjust
Data Level Adjust
Local Speaker/Mic
Desense Check
Miscellaneous Tests

PA
Receiver
Exciter
TEST ——— Full Rptr/Station

All Test
Repeater Setup
Transmitter Tests
Receiver Tests
Transmit Audio/Data
Voter Audio Adjust
Audio/Data Adjust
Repeater Operation

All Transmit Tests
Audio Deviation Limit
Repeat Audio Level
Data Level Adjust
Audio/Data Deviation
CWID Level Check
Local Speaker/Mic
Tx Hum & Noise Ratio
Transmit Audio Distortion
LTR Modem

All Audio/Data Tests
Voice Audio From Repeater
Voice Audio To Repeater
FSK Data To Rptr (Separate Path)
FSK Data To Rptr (Over Voice Path)
FSK Data From RNT (Separate Path)
FSK Data From Rptr (Over Voice Path)
RS-232 Setup

All Operational Tests
New HSDB Test
Old HSDB Test
Handshake Test
Alarm Test
Spurious Check

Figure 4-25   TEST PROGRAMMING FLOWCHART

4.6 TEST

File Edit Transfer Hardware Test Utilities

PA
Receiver
Exciter
Full Rptr/Station
RNT Interface
Telephone Interface
VNC Interface

Figure 4-26   TEST MENU

4.6.1 POWER AMPLIFIER

Refer to the complete Service Manual.

4.6.2 RECEIVER

This menu selection walks through the alignment of the receiver on the computer screen. Refer to Section 7.1 for the Receiver alignment in this manual and Figure 7-1 for an alignment points diagram and Figure 7-8 of the Receiver.

4.6.3 EXCITER

This menu selection walks through the alignment of the Exciter on the computer screen. Refer to Section 7.2 for the Exciter alignment and Figure 7-2 for an alignment points diagram and Figure 7-9 for a test setup of the Exciter.

4.6.4 FULL REPEATER

This menu selection walks through the alignment of the entire repeater. The Receiver and Exciter portions are performance tests and adjustments. The Audio and Data portions are level adjustments for the Main Audio Card (MAC). Refer to Figure 7-16 for an alignment points diagram for the MAC.

4.7 UTILITIES

File Edit Transfer Hardware Test Utilities

COM Port
Display Mode
Alarm Display
User Level
Hang-Up Modem
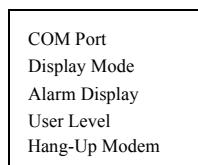
Figure 4-27   UTILITIES MENU

Dial Method: Tone   (√) COM 1
Baud rate: 9600   ( ) COM 2
Modem. . .
hangup: +++ATH
(F3,F4) Setup:ATV0M1&D0S58=2
name: Telebit WorldBlazer
(F7) Modem list src: Standard Modems
Enter Phone # to call for remote access.
(Leave Blank for Direct Connect)
Phone #:
F2 to Accept (& Dial)

Figure 4-28   COM PORT SELECTION

TO MPC
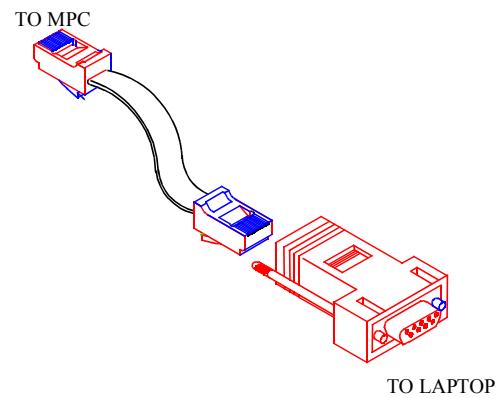
TO LAPTOP

Figure 4-29   LAPTOP INTERCONNECT CABLE

4.7.1 COM PORT

This is the COM port used to send and receive data from the Repeater MPC. An interface cable connects the Repeater to the computer (see Figure 4-29). This screen also selects the data baud rate.

MODEM

Repeater Modem

Repeaters equipped with a modem must be configured with the following guidelines:

- Result codes must be sent as digits, also called Terse mode or Terse response.
- Flow control must be disabled.
- Modem must ignore DTR signal.
- Modem will not excape.
- Serial port BAUD rate must be set to 9600 bps.
- Configuration must be saved to modem.

The Multi-Tech Multimodem model MT1932ZDX currently used in repeaters must have the following configuration changes from a factory default setting.

V0   Result codes sent as digits
&#3   Flow control disabled
&D0   Modem ignores DTR signal
%E0   Modem won't escape
$SB9600   Set serial port to 9600 bps
&W0   Store current settings in NVRAM; load them at power-on or following the ATZ command instead of loading the factory defaults in ROM.

To change the Multi-Tech modem factory defaults and save them to NVRAM, sned the following command using the terminal program.

ATV0&E3&D0%E0$SB9600&W0

Programming and other information onthe Multi-Tech modems can be found on the Internet at: http://www.multitech.com.

Computer Modem

The modem that is to be used at the computer for repeater communications through the phone lines has the following guidelines for setup.

1. Result codes must be sent as digits, also called Terse mode or Terse response.
1. Flow control must be disabled.
1. Modem must ignore DTR signal.
1. Modem must be configured for COM1 or COM2 serial port connection.

The SCANPGMR has seven modems setup strings to choose from. The available list can be reviewed by pressing F3 or F4 (forward/backward). If the selection of available modem setup strings does not work with the modem available, a used defined setup string can be entered and stored. To enter your own modem setup string, press F7. This selects the user configurable modem.cfg file. At the setup:command line, type in the commands that your modem must use to function properly (the command line must have the AT first). After the command is typed in, select the name: line and type in the modem name.

Select F2 and the response "Save the changed Modem Setup to file? modem.cfg" is displayed. Select yes to save the modem setup. To retrieve this modem setup, select F7 to access the user modem.dfg file and F3/F4 to the desired modem setup string.

The following table lists the setup changes that are different from the factory defaults for modems used at the computer. These setup changes are included within the SCANPGMR software.

Table 4-1   SETUP CHANGES

Modem	AT Command
Multi-Tech MT1932ZDA external	ATV0&E3&D0
Telebit Worldblazer T3SA external	ATV0M1&D0S58=2
Hayes ACCURA 144 external	ATV0&D0&K0
Megahertz XJ2288 PCMCIA	ATV0&D0&K0
Megahertz XJ2288i PCMCIA	ATV0&D0&H0
Motorola Montana PCMCIA	ATV0&D0&K0
Gateway 2000 TelePath 14.4 PCMCIA	ATV0&D0&K0

Phone Number

Enter the phone number of the repeater modem and press F2 to dial. Leave this location blank if a repeater is to be connected to a local COM port.

4.7.2 DISPLAY MODE

This screen allows the color mode to be selected for color monitors. When using a laptop, monochrome is recommended for better resolution.

Select Color Mode Desired

(•) Color   ( ) Monochrome

Spacebar to Select
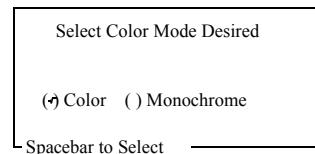
Figure 4-30   COLOR MODE SELECTION

4.7.3 USER LEVEL

There are two levels to choose from, Novice and Advanced. The Novice uses prompts in the Edit-Parameters screens when Escape or F2 keys are pressed that ask "are you sure" before the task is executed. The Advanced selection performs the task without asking the question.

4.7.4 HANG-UP MODEM

This selection hangs up the phone connection when remotely connected to a repeater through a modem.

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SECTION 5 REPEATER PROGRAMMING

5.1 CREATING A NEW FILE

An example will be used to show the programming for a new file created for Site 1.

NOTE: At any point in the programming sequence, if F1 is selected, a help screen appears to explain the menu selection highlighted at that point.

5.1.1 SELECT REPEATER TO EDIT

A repeater is selected to program. When no file exists with programmed repeaters, the default is selected and edited.

● Highlight EDIT, press Enter.

● Highlight SELECT REPEATER, press Enter.

● Default is the only repeater in this list, press Enter.

● Highlight EDIT, press Enter.

● Highlight SETUP PARAMETERS, press Enter.

● The FIRST Setup Parameters screen appears (see Figure). Fill in the parameters for this repeater. A brief description of the parameters is in Table 5-1. Full descriptions are in Section 4.3.1.

● Select parameters, press F2 to accept.

● The SECOND Setup Parameters Screen appears (see Figure 5-2). Fill in the global parameters for this repeater. The values entered on this screen are used for all repeater numbers programmed on the previous screen. A brief description of the parameters is in Table 5-1. Full descriptions are in Section 4.3.1.

● Select parameters, Press F2 to accept.

● Highlight EDIT, press Enter.

● Highlight ALARM CONFIGURATION and press Enter, if alarms are to be configured.

● Program the Alarms to be configured (see Section 4.3.3), press F2 to accept.

● Highlight FILES, press Enter.

● Highlight SAVE, press Enter.

● Type in a valid DOS filename. For this example site1.dat is used.

● The file consists of default and repeater one under the filename of site1.dat.

5.2 ADDING A REPEATER TO A FILE

Because a Frequency Hopping Repeater changes personality with each change in Repeater Number and Channel Number, it is not recommended that any files saved to disk contain more than one Repeater Number.

NOTE: If a file to be saved is generated by reading the contents of a Frequency Hopping Repeater, the number of repeaters listed could be up to 19. Each of the 19 repeaters would have the same information. This is the result of reading the parameters at different times while the repeater is hopping. The parameters that are read are what the repeater is at the time of the download. When the repeater changes channels and repeater number, a new Repeater Number is listed in the EDIT : SELECT REPEATER menu.

```
 File  Edit  Transfer  Hardware  Test  Utilities                    <F1> - Help            09:17:09

         Rptr
         num     Chan     CWID Msg          Time on Channel(secs)   94
                                            Force CWID secs   1560
    1       2      101     CHAN101
    2       3      102     CHAN102             Allow Hopping   Yes
    3       4      103     CHAN103
    4       5      104     CHAN104
    5       6      105     CHAN105             19 Channels selected
    6       7      106     CHAN106
    7       8      107     CHAN107             94 secs max time on
    8       9      108     CHAN108                  channel!
    9      10      109     CHAN109
   10      11      110     CHAN110
   11      12      111     CHAN111
   12      13      112     CHAN112             <- CWID Fields are
   13      14      113     CHAN113                transmitted if
   14      15      114     CHAN114                left Non-Blank!!
   15      16      115     CHAN115
   16      17      116     CHAN116
   17      18      117     CHAN117
   18      19      118     CHAN118
   19      20      119     CHAN119             Press F2 to Accept
```

Figure 5-1   FIRST SCREEN CHANNEL SETUP PARAMETERS

Table 5-1   FIRST SCREEN SETUP PARAMETERS

Parameter	Response	Description
Time-On-Channel	30-1800 seconds	Time in seconds that a repeater is on a channel. 94 seconds is the default for 19 channels.
Forced CWID	1560 (default)	Guaranteed time to service all programmed Repeater/Channel Numbers.
Allow Hopping	Yes = Hopping mode No = Tune up mode	Select if the repeater is hopping (default) or ready for tune-up.
Repeater Number	1-20 (19 selections)	Up to 19 Repeater Number can be setup for hopping. Default Repeater Numbers 2 to 20.
Channel Number	1-600	Up to 19 Channel Numbers can be setup for hopping.

```
┌─────────────────────────────────────────────────────────────┐
│              LTR Repeater Setup Parameters Edit               │
│      *   Rptr num. Channel and CWID Msg are for 1st selected rptr │
│                                                               │
│     *Repeater Number:  2          Telco Network Type:  None   │
│     *Channel Number:  101         Area:                0      │
│                                                               │
│                                                               │
│      Sync Repeater:     No        CWID Time:           1      │
│      Stand Alone:       No        *CWID Message:       CHAN101 │
│      ID Validator:      N/A                                   │
│                                                               │
│                                                               │
│      Local MIC ID:      253       RF Power Level:      75     │
│      Test Mode ID:      254        Power Source:       AC     │
│                                                               │
│                                                               │
│      Paging:            No        Data Modem:          No     │
│                                                               │
│                         Press F2 to Accept                    │
└─ Repeater Home (1-20) ────────────────────────────────────────┘
```

Figure 5-2   SECOND SCREEN REPEATER SETUP PARAMETERS

Table 5-2   SECOND SCREEN REPEATER SETUP PARAMETERS

Parameter	Response	Description
Repeater Number	See First Screen	Home Repeater number of the first repeater listed on the First Screen.
Channel Number	See First Screen	Channel Number of the first repeater listed on the First Screen.
Telco Network Type	None	Not available on Hopping Repeates.
Area	0, 1	Same as value of the Area bit in the mobiles.
Sync Repeater	No	Not used.
Stand Alone	No	Not selectable on Hopping Repeaters.
ID Validator	No	Not used.
CWID Time	1	Not selectable on Hopping Repeaters.
CWID Message	See First Screen	CWID message of the first repeater listed on the First Screen.
Local MIC ID	0 = disabled (default) 1-250, 253	Group ID transmitted when the local microphone PTT is active.
Test Mode ID	0 = disabled 1-250, 254 (default)	Group ID transmitted when the Repeater is in the Test Mode.
RF Power Level	25-75, 75-175	Transmit power level in watts for all channels in the list on the First Screen.
Power Source	AC or DC	The type of primary power source for the Repeater.
Paging	No	Not available.
Data Modem	No	Not available.

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SECTION 7   ALIGNMENT AND TEST PROCEDURES

FOR RECEIVERS AND EXCITERS MODIFIED FOR
WIDEBAND OPERATION (CHANNELS 1 TO 600).

7.1 RECEIVER ALIGNMENT

C R I T I C A L   A D J U S T M E N T

The TCXO must be adjusted within 5 minutes of turning the AC power on to the repeater. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

Refer to Figure 7-1 for component locations. Refer to Figure 7-8 for equipment needed and setup diagram.

7.1.1 PRE-TEST

L201, L202, L203, L204, L205, L206, L223 and L224 are factory set and should not be adjusted.

7.1.2 VOLTAGE MEASUREMENTS

Apply power to the Receiver by plugging the 20-pin cable from the RF Interface Board into J201 (see Figure 7-1).

Measure the voltages at the following pins.

U206, pin 1 - +12V DC ±0.4V
U207, pin 1 - +12V DC ±0.4V
U208, pin 1 - +6V DC ±0.2V
R309/R310 junction - +3.5V DC ±0.1V

7.1.3 VCO CONTROL LINE VOLTAGE/TCXO FREQUENCY ADJUSTMENT AND INJECTION LEVEL TEST

1. The software programs the synthesizers to **Channel 600** for this adjustment.

2. Tune the VCO helical L220 for +7.5V DC ±0.05V on U209, pin 6 or TP2.

NOTE: The Channel Number, Channel Frequency and Synthesizer Frequency appear at the bottom of the screen.

3. Place a pick-up loop (sniffer) or RF probe connected to a frequency counter near L210.

4. Set Y201 (TCXO) for the Injection Frequency ±50 Hz (Inj Freq = chnl 600 freq - 52.95 MHz).

5. Record the voltage on J201, pin 13 _____.

6. The software programs the synthesizer for **Receive Channel 1**.

7. The voltage on TP2 should be > 2V.

8. Record the voltage on J201, pin 13 _____.

7.1.4 RECEIVER ADJUSTMENTS

1. The software programs the synthesizers to **Channel 1** for this adjustment.

2. L201, L202, L203, L204, L205, L206, L223 and L224 are factory set and should not be adjusted.

3. Set the generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz deviation (1000 µV at the generator with 20 dB pad gives 100 µV at the receive antenna).

4. Tune Z213 for 2V ±0.05V on TP4.

5. Tune R264 for 387 mV RMS, ±5 mV RMS, on TP4.

6. Repeat Steps 3 and 4.

7. Measure the distortion on TP4.

8. Tune L207, L209, L211 and L225 for minimum distortion <5%, (typically <3%).

9. Repeat Step 8 then Steps 4, 5 and 6.

7.1.5 AUDIO DISTORTION

1. The software initially programs the synthesizers to **Channel 300** for this measurement.

2. Plug a 16 ohm load at J101 or J104 on the MAC (Main Audio Card).

3. Connect a distortion analyzer to the 16 ohm load.

4. Measure the distortion of the receive audio at J101 or J104 on the MAC with the local volume control set to 2.8V RMS.

5. The reading should be less than 3% (typically less than 1%).

6. Measure receive sensitivity at J101 or J104 on the MAC.

7. The reading should be less than 0.35 µV (typically 0.25 µV).

8. The software programs the synthesizer for **Receive Channel 1**.

9. Receive sensitivity should be less than 0.35 µV (typically less than 0.30 µV).

10. The software programs the synthesizer for **Receive Channel 600**.

11. Receive sensitivity should be less than 0.35 µV (typically less than 0.30 µV).
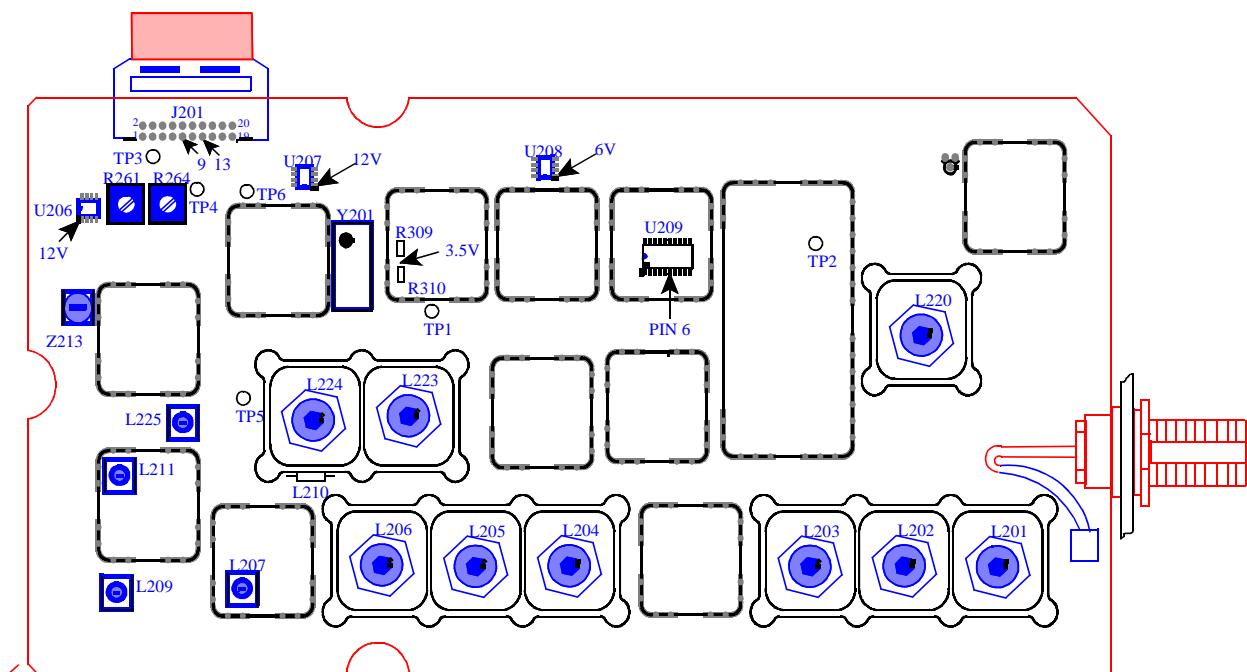
Figure 7-1   RECEIVER ALIGNMENT POINTS

7.2 EXCITER ALIGNMENT

C R I T I C A L   A D J U S T M E N T

The TCXO must be adjusted within 5 minutes of turning the AC power on to the repeater. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

Refer to Figure 7-2 for component locations. Refer to Figure 7-9 for equipment needed and setup diagram.

NOTE: Some adjustments will be made using the cursor "Up"/"Dn" or "PgUp"/"PgDn" keys.

W A R N I N G

SAFETY MEASURES ARE DISABLED IN TEST MODE. ALARMS ARE ACTIVE. HOWEVER, FEATURES SUCH AS THERMAL SHUTDOWN IN THE PA ARE DISABLED.

7.2.1 PRETEST

1. Set TCXO modulation adjust R425 fully counter-clockwise.

2. Connect the power meter to J402.

7.2.2 VOLTAGE MEASUREMENTS

Apply power to the Exciter by plugging the 20-pin cable from the RF Interface Board into J401.

Measure the voltages at the following pins.

U406, pin 1 - +12V DC ±0.4V
U405, pin 1 - +5V DC ±0.2V
U402, pin 1 - +3.5V DC ±0.1V
U404, pin 7 - +3.5V DC ±0.1V

7.2.3 VCO CONTROL LINE VOLTAGE ADJUST-MENT

1. The software programs the synthesizers to **Channel 600** for this adjustment.

2. Press the space bar to key the Exciter.

3. Tune VCO helical L404 for 7.5V ±0.05V on U403, pin 6.

4. Measure the Power Output of the Exciter at J402. Reading should be +15 dBm ±0.5 dB.

5. Press the space bar to unkey the Exciter.

7.2.4 VCO/SYNTHESIZER LOCK TEST

1. The software programs the synthesizer for **Channel 1**.

2. Press the space bar to key the Exciter.

3. The voltage on U403, pin 6 should be > 2.0V. Power output should be +15 dBm ±0.5 dB.

4. Measure the power output of the Exciter at J402. Reading should be +15 dBm ±0.5 dB.

5. Press the space bar to unkey the Exciter.

7.2.5 TCXO FREQUENCY ADJUST

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. Connect a 10 dB pad and frequency counter to J402.

3. Press the space bar to key the Exciter.

4. Tune TCXO Y401 for the **Transmit Channel 300** Frequency, ± 50 Hz.

5. Press the space bar to unkey the Exciter.

7.2.6 TRANSMIT MODULATION ADJUST

1. The programmer will lock the synthesizers to **Channel 300** for this adjustment.

1. Connect a 10 dB pad and modulation analyzer to J402.

2. Press the "FM" and "3 kHz LPF" switches of the modulation analyzer.

3. Inject a 1 kHz sine wave at 400 mV RMS into P100, pin 32 on the MAC.

4. Adjust U149 with "Up/Dn" and "PgUp/PgDn" keys for 707 mV RMS on P100, pin 29. This waveform should be a "clean" sine wave.

NOTE: This test changes the Tx audio deviation limit. To correct the limit, perform adjustment per Section 7.3.5.

5. Press the space bar to key the Exciter.

6. Set R446 for ±3 kHz deviation.

7. Press the space bar to unkey the Exciter.

8. Adjust U151 with "Up/Dn" and "PgUp/PgDn" keys for a 2V P-P square wave on P100, pin 29.

   NOTE: This test changes the Tx audio deviation limit. To correct the limit, perform adjustment per Section 7.3.5.

9. Press the space bar to key the Exciter.

10. Set R425 for "best" square wave as observed on the modulation analyzer output to the oscilloscope.

NOTE: Ensure that the oscilloscope is "DC" coupled and the Modulation Analyzer has the 3 kHz LPF switch set but NOT the 300 Hz HPF and 50 Hz HPF switches set.

11. Press the space bar to unkey the Exciter.

12. Connect a 10 dB pad and modulation analyzer to J402.

13. Press the "FM" and 3 kHz LPF switches of the modulation analyzer.

14. Inject a 1 kHz sine wave with a level of 400 mV RMS into P100, pin 32.

15. Adjust U149 for 707 mV RMS on P100, pin 29. This waveform should be a clean sine wave.

16. Press the spacebar to key the Exciter.

17. Set R446 for ±3 kHz deviation (very little adjustment should be needed).

18. Press the spacebar to unkey the Exciter.
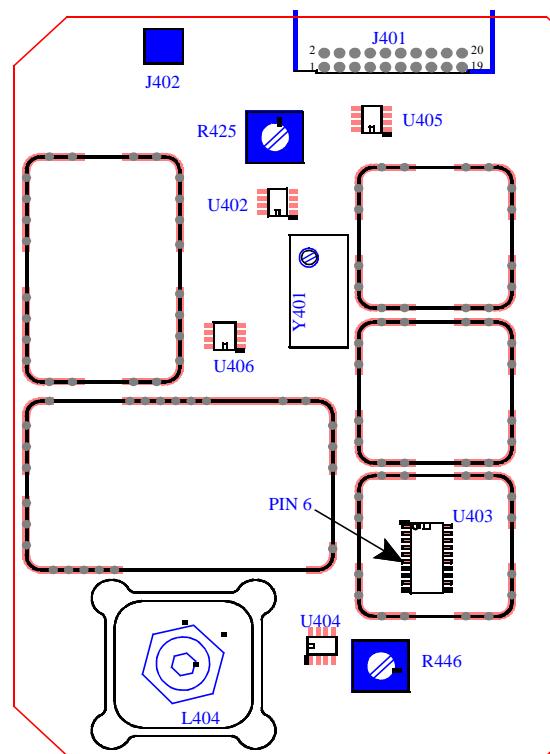
Figure 7-2   EXCITER ALIGNMENT POINTS
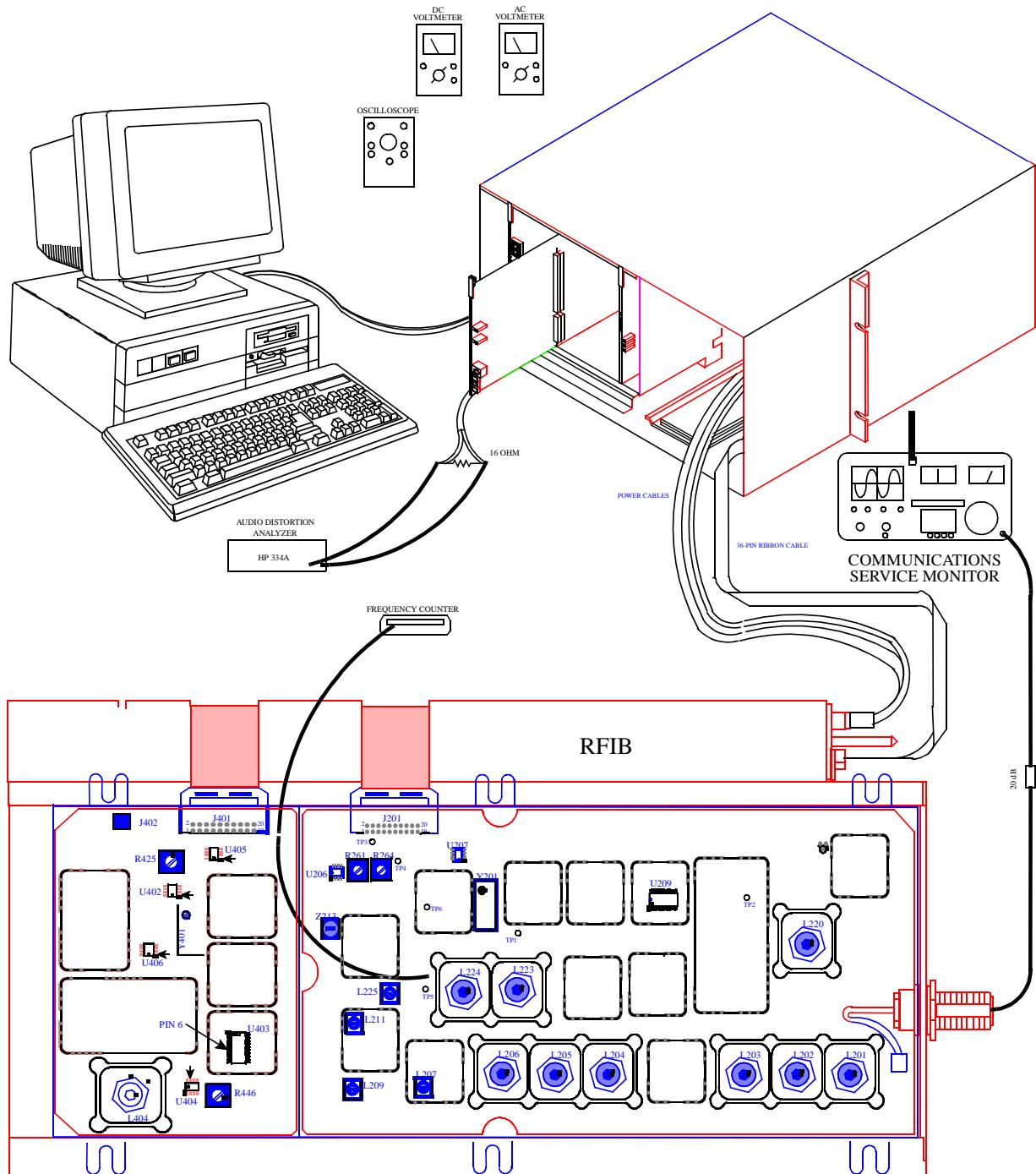
Figure 7-8   RECEIVER TEST SETUP
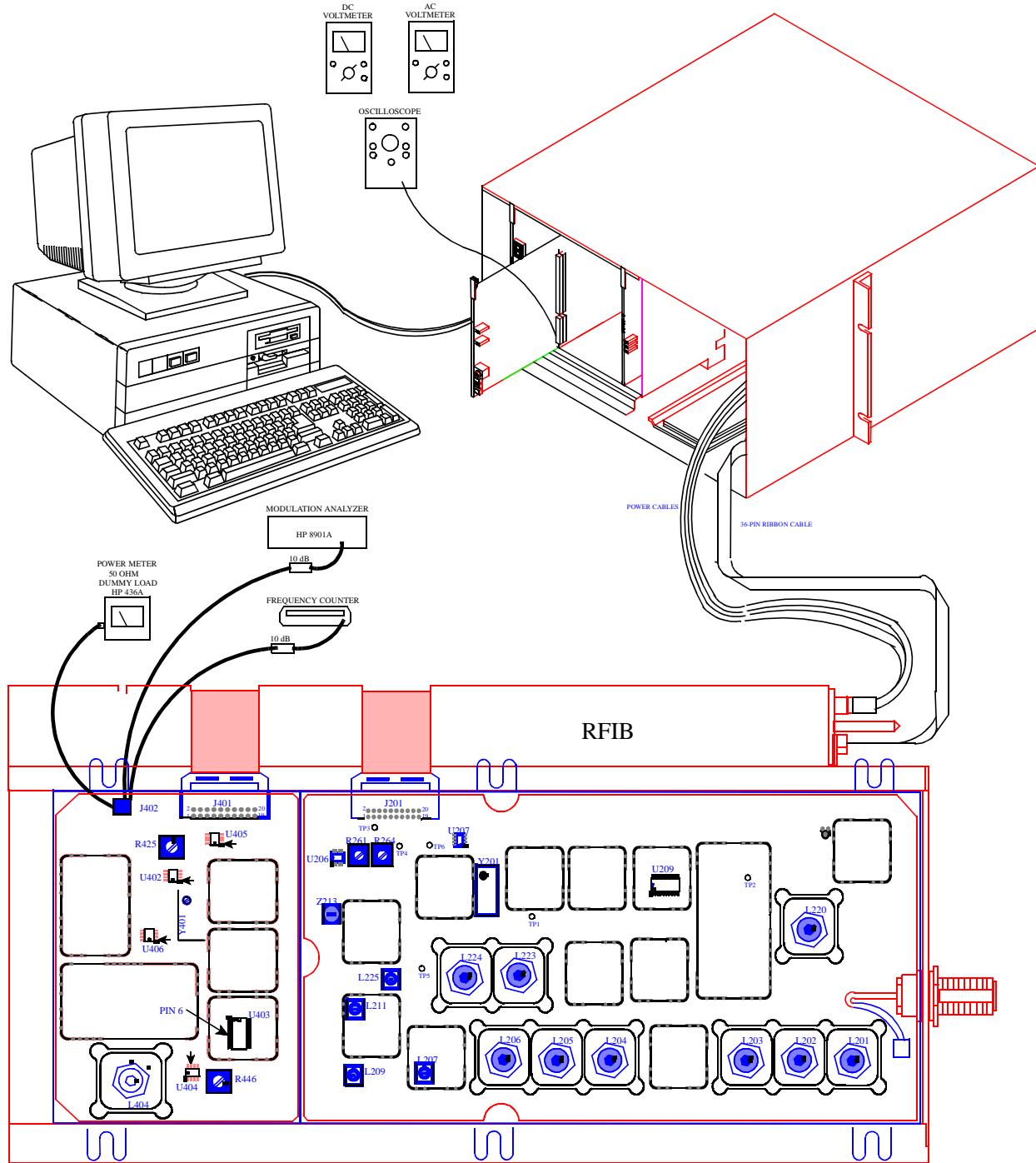
Figure 7-9   EXCITER TEST SETUP

7.3 FULL REPEATER ALIGNMENT

7.3.1 PERFORMANCE TEST PROGRAM

1. Select the TEST - FULL REPEATER - ALL TEST and press Enter.

7.3.2 REPEATER SETUP

The Summit QX repeater has been pretested at the factory, therefore only performance tests are required to check the repeater. Refer to test setup diagrams for equipment and cabling diagram.

Turn on the IAC repeater power supply switch (S508) or engage the locking lever (see Figure 7-18).

The operating code has been programmed at the factory. The parameters are programmed into the MPC. If these parameters have changed or are incorrect, exit this test and reprogram the repeater.

It may be necessary to remove the RF assembly from the chassis and connect via extension cables for some of the tests or adjustments.

NOTE: All audio generators and audio voltmeters are unbalanced unless specifically stated otherwise.

7.3.3 TRANSMITTER TEST/ADJUSTMENTS

Transmit Mode

1. The software programs the synthesizers for **Channel 300** for these adjustments and measurements.

2. Press the space bar to key the repeater.

3. The IAC Transmit LED should turn on to indicate the repeater is transmitting (see Figure 7-18).

4. Press the space bar to unkey the repeater.

Transmit TCXO Frequency Adjustment

C R I T I C A L   A D J U S T M E N T

The TCXO must be adjusted within 5 minutes of turning the AC power on to the repeater. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

5. Press the space bar to key the repeater.

6. Check the frequency of the transmitted signal. The frequency should be ±50 Hz of the channel frequency.

7. Adjust the frequency with Y401 (TCXO) on the Exciter (see Section 7.2.5).

8. Press the space bar to unkey the repeater.

Transmitter Output Power Adjustment

1. Press the space bar to key the repeater.

2. Check the transmit output power. The power can be adjusted from the computer using the cursor Up/Dn and PgUp/PgDn keys. The test equipment should be calibrated for ±2W.

3. Press the space bar to unkey the repeater.

7.3.4 RECEIVER TESTS/ADJUSTMENT

NOTE: If this is a voting repeater, it is not equipped with a receiver.

Receiver TCXO Frequency Adjustment

C R I T I C A L   A D J U S T M E N T

The TCXO must be adjusted within 5 minutes of turning the AC power on to the repeater. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

1. The software programs the synthesizers for **Channel 300** for these adjustments and measurements.

2. Check the receiver injection frequency by using a "sniffer" pickup loop, or RF probe connected to a suitable frequency counter placed near L210 in the Receiver (see Section 7.1.4).

3. Adjust Y201 (TCXO) on the Receiver to within ±50 Hz of the channel frequency.

Receiver Audio Distortion Measurement

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz deviation.

2. Insert test cables into J100/J103 on the MAC and connect to an AC voltmeter.

3. Adjust R237 for 0 dBm (775 mV RMS).

4. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

5. Adjust R236 for 2.8V RMS and measure the distortion. Distortion should be < 3%.

Receiver Hum and Noise Measurement

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Remove modulation from the RF generator. The measured level must be ≤ -45 dB.

Receiver SINAD Measurement

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Re-adjust RF level for 12 dB SINAD.
   12 dB SINAD reading should be ≤ 0.35 µV.

Receiver Squelch Adjustment

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Set the RF generator output for 5 dB SINAD.

5. Adjust R234 on the MAC so the Receiver just squelches.

6. Increase the RF generator output until the Receiver unsquelches. Reading should be ≤ 10 dB SINAD.

Receiver Data Level Adjustment

1. Adjust the RF generator for 100 µV into the receiver with a 100 Hz tone at ±1 kHz.

2. Insert test cables into J100/J103 on the MAC and connect to an AC voltmeter.

3. Adjust R235 to achieve 340 mV RMS.

Local Speaker/Microphone Check

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz.

2. Plug a Speaker/Microphone into J101/J102 of the MAC.

3. Adjust R236 until the 1 kHz tone is heard.

Receiver Desense Check

1. Adjust the RF generator for 100 µV into the receiver with a 1 kHz tone at ±3 kHz.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Re-adjust the RF generator output for 12 dB SINAD.

5. Press the space bar to key the transmitter.

6. SINAD should not degrade more than 1 dB or to no less than 11 dB SINAD.

7. Press the space bar to unkey the transmitter.

Receiver Miscellaneous Tests (Optional)

Several additional tests may be performed on the Repeater Receiver as listed below:

1. Signal Displacement Bandwidth

2. Adjacent Channel Rejection

3. Offset Channel Selectivity

4. Intermodulation Rejection

5. Spurious Rejection

6. Audio Response

7. Audio Sensitivity

Perform the Test desired using the appropriate RF Generators, modulation frequencies, levels, RS-232 levels and test probes following the latest TIA document measurement procedures.

7.3.5 TRANSMIT AUDIO/DATA LEVEL ADJUST-MENTS

NOTE: All audio generators and audio voltmeters are unbalanced unless specifically stated otherwise.

Audio Deviation Limit Adjustment

1. The software programs the synthesizers to **Channel 1** for this adjustment.

2. Apply a 1 kHz tone at -3 dBm (548 mV RMS) to P100, pin 32 of the MAC.

3. Insert test cables into J100/J103 and connect to an AC voltmeter.

4. Press the space bar to key the transmitter.

5. Adjust R305 for 0 dBm (775 mV RMS).

6. Press the space bar to unkey the transmitter.

7. Apply a 1 kHz tone at +7 dBm (1.73V RMS) to P100, pin 32 of the MAC. (Set modulation analyzer LPF to 3 kHz.)

8. Press the space bar to key the transmitter.

9. Adjust U149 with the PgUp/PgDn and CurUp/CurDn keys to set the maximum allowed deviation at ±3.5 kHz (±200 Hz) (±2.5 kHz for NPSPAC).

10. Press the space bar to unkey the transmitter.

11. Remove the signal from P100, pin 32.

Repeat Audio Level Adjustment

NOTE: Audio Deviation Limit Adjustment must be completed before this test.

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. Adjust the RF generator for 100 μV into the receiver with a 1 kHz tone at ±1.5 kHz dev. (±1.2 kHz for NPSPAC). Be sure the Modulation Analyzer LPF switch is set to 3 kHz.

3. Press the space bar to key the transmitter.

4. Adjust R237 on the MAC to achieve ±1.5 kHz (±100 Hz) transmit deviation (±1.2 kHz for NPSPAC). Be sure the Modulation Analyzer LPF switch is set to 3 kHz.

5. Press the space bar to unkey the transmitter.

6. Connect an AC voltmeter to J103 and P100, pin 31 (RX_VOICE).

7. Adjust R238 for -3 dBm (548 mV RMS).

8. Remove the RF generator from the Receiver.

Data Level Adjustment

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. Set modulation analyzer LPF switch to 3 kHz. Press the space bar to key the transmitter.

3. Adjust U151 with the PgUp/PgDn and CurUp/CurDn keys to achieve ±1 kHz (±100 Hz) transmit deviation.

4. Press the space bar to unkey the transmitter.

ALIGNMENT AND TEST PROCEDURES

Audio/Data Deviation Check

1. The software programs the synthesizers to **Channel 1** for this adjustment.

2. Apply a 1 kHz tone at +7 dBm (1.73V RMS) to P100, pin 32 of the MAC. Set modulation analyzer LPF to 3 kHz.

3. Press the space bar to key the transmitter.

4. Measured deviation should be ±4.5 kHz (±200 Hz) (±3.5 kHz NPSPAC).

5. Press the space bar to unkey the transmitter.

6. Disconnect all cables.

CWID Level Check

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. Set modulation analyzer LPF switch to 3 kHz. Press the space bar to key the transmitter.

3. Deviation should be 1.5 kHz to 2.5 kHz.

4. Press the space bar to unkey the transmitter.

Local Speaker/Microphone Check

1. Plug a Speaker/Microphone into J101/J102 of the MAC. Set modulation analyzer LPF switch to 3 kHz.

2. Press the microphone PTT and say "four" loudly into the microphone.

3. Deviation should be ±3 to ±3.5 kHz (±2 to ±2.5 kHz for NPSPAC).

4. Release the microphone PTT.

5. Press the space bar to unkey the transmitter.

Transmitter Hum and Noise Ratio (Optional)

NOTE: An HP8901A modulation analyzer is required for this test.

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. On the modulation analyzer press:
    300 Hz HPF
    3000 Hz LPF
    FM
    Pre-Display
    750 µS
    Avg RMS Cal
    .44
    dB

3. Press the space bar to key the transmitter and measure the Hum and Noise Ratio. The reading should be < -45 dB.

4. Press the space bar to unkey the transmitter.

Transmit Audio Distortion

1. The software programs the synthesizers to **Channel 300** for this adjustment.

2. On the modulation analyzer select:
    FM
    50 Hz
    15 kHz

3. Apply -11.7 dBm at 1 kHz to P100, pin 32 of the MAC.

4. Press the space bar to key the transmitter.

5. Adjust audio level to produce ±1 kHz dev.

6. On the modulation analyzer select:

    300 Hz
    3 kHz
    750 µs de-emphasis

7. Distortion should be < 2 kHz.

7.3.6 VOTER AUDIO LEVEL ADJUSTMENT

NOTE: Use an unbalanced audio voltmeter.

1. Inject a 1 kHz tone at -12 dBm (194 mV RMS) into J2, pin 17. This tone represents ±1.5 kHz deviation in the Voter Receiver.

2. Adjust R233 for a level of -6 dBm (387 mV RMS) at J100/J103 on the MAC.

### 7.3.7 REPEATER OPERATION

New HSDB Test
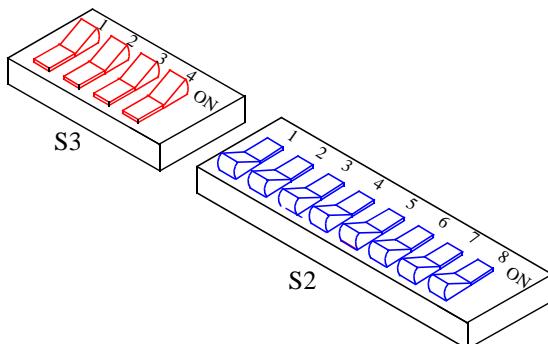
Figure 7-10   NEW HSDB SWITCH SETTINGS

1. Switch settings on the MPC for RS-485 (new style) operation are shown in Figure 7-17.

2. Verify that the repeater is programmed for "Stand Alone" mode in Setup Parameters-F4 (see Section 4.3.1).

3. The repeater is now in Normal Operation mode. Verify by the MPC front panel indicators that no HSDB alarms have occurred (Alarm Number 10) see Table 1-2.

Old HSDB Test
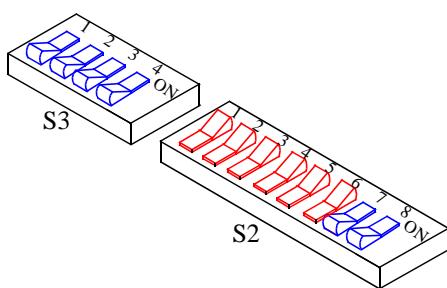
Figure 7-11   OLD HSDB SWITCH SETTINGS

1. Switch settings on the MPC for single-ended 5V (old style) operation are shown in Figure 7-11. S002 Sections 1-6 Off; 7, 8 On. S003 all sections On.

2. Verify that the repeater is programmed for "Stand Alone" mode in Setup Parameters-F4 (see Section 4.3.1).

3. The repeater is now in Normal Operation mode. Verify by the MPC front panel indicators that no HSDB alarms have occurred (Alarm Number 10) see Table 1-2.

Handshake Test

1. Program a Multi-Net, portable or mobile for the following parameters.

   Multi-Net
   Home Repeater - Same as repeater number.
   System Key - Same as repeater.
   Status Channel - Same as repeater channel.
   Home Channel - Same as repeater channel.
   Encode ID - 1
   Decode ID - 1
   UID - 1
   Site - 1

2. The repeater is in Normal Operation mode.

3. Key the radio several times on the programmed System/Group. Access should occur every time. (Proper Tx/Rx antenna connections are assumed.)

Alarm Test

1. The repeater is now in Normal Operation mode.

2. Verify by the MPC front panel indicators that no alarms have occurred (see Table 1-2).
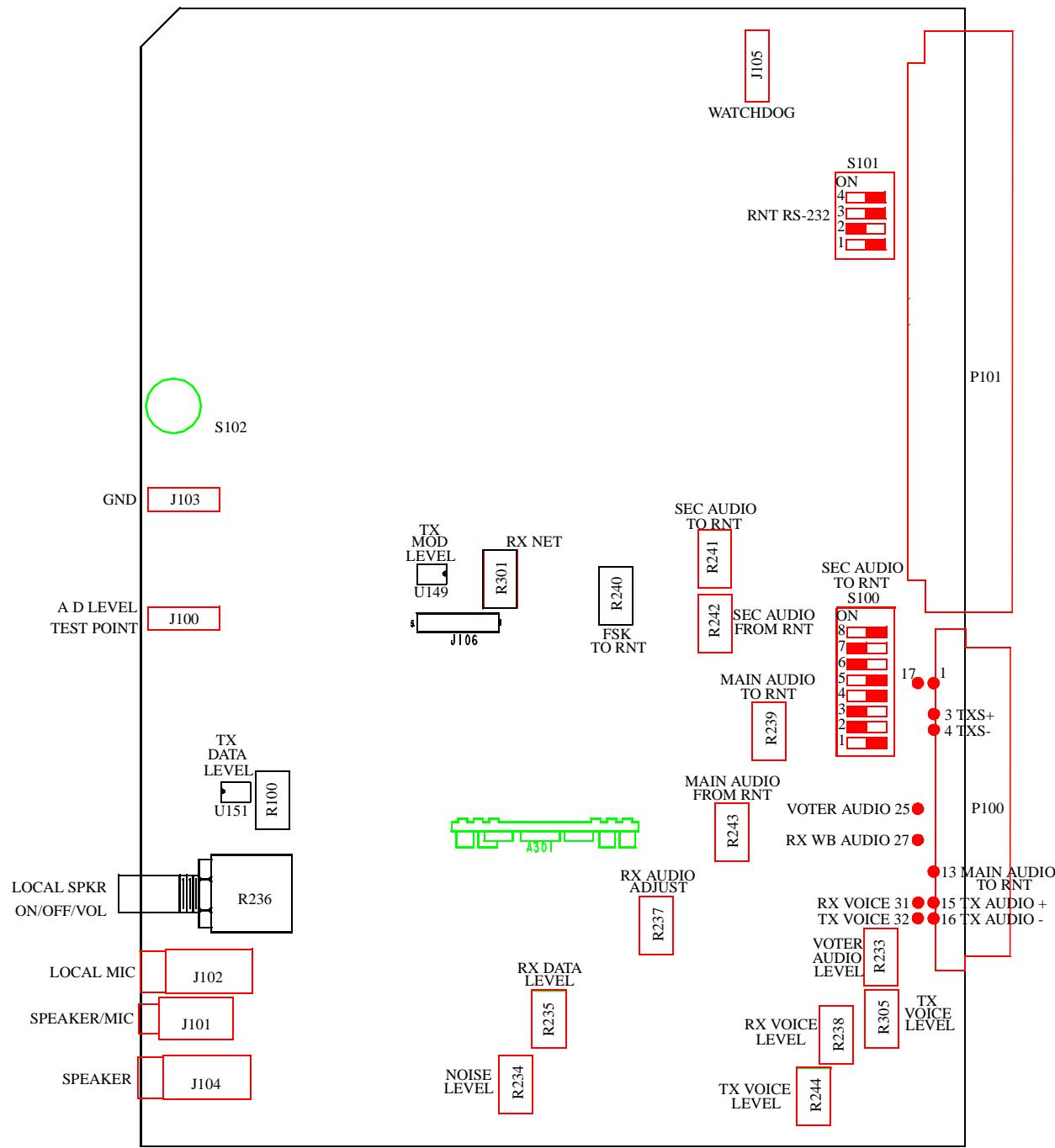
**Figure 7-16 MAC ALIGNMENT POINTS**
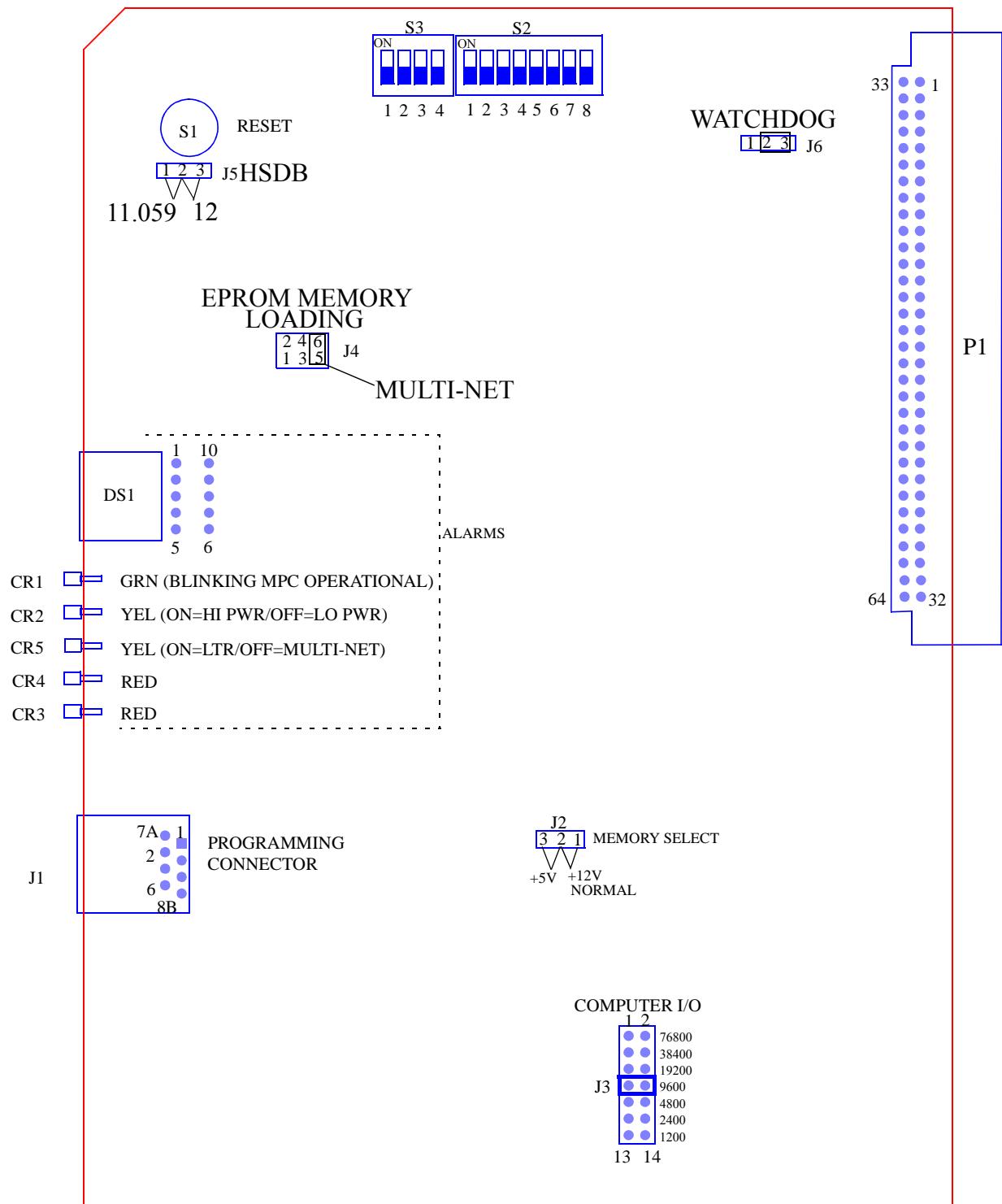
Figure 7-17   MAIN PROCESSOR CARD ALIGNMENT POINTS
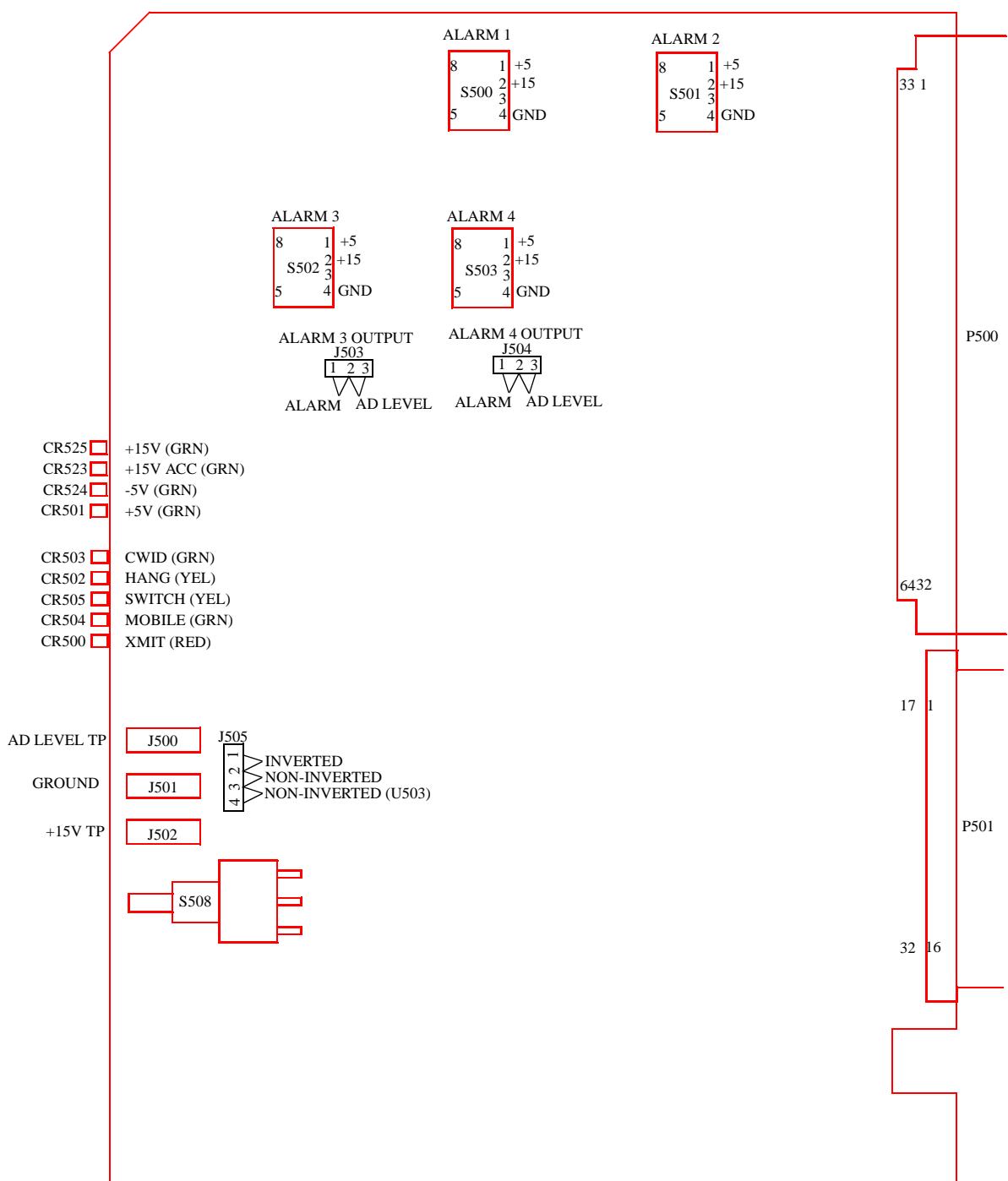
Figure 7-18   INTERFACE ALARM CARD ALIGNMENT POINTS

SECTION 9   PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
800 MHz WIDEBAND RECEIVE VCO		
PART NO. 090-0004-962		
C 803	1 pF 150V chip	510-3656-109
C 804	3.9 pF 150V chip	510-3656-399
C 807	27 pF ±5% NPO 0805 chip	510-3601-270
C 808	27 pF ±5% NPO 0805 chip	510-3601-270
C 809	15 µF 20V SMD tantalum	510-2626-150
C 810	27 pF ±5% NPO 0805 chip	510-3601-270
C 811	27 pF ±5% NPO 0805 chip	510-3601-270
C 812	4.7 pF 150V chip	510-3656-479
C 813	6.8 pF 150V chip	510-3656-689
C 814	27 pF ±5% NPO 0805 chip	510-3601-270
CR802	Varactor BB535 SOD-323	523-5005-022
CR803	Varactor BB535 SOD-323	523-5005-022
L 803	0.039 µH SMD inductor	542-9001-397
L 804	0.039 µH SMD inductor	542-9001-397
L 805	0.039 µH SMD inductor	542-9001-397
L 806	82 nH ±10% SMD 0805	542-9003-827
PC800	PC board	035-2008-820
Q 801	Si NPN gen purp sw/amp	576-0001-300
Q 802	NPN 85633 SOT-23	576-0003-636
R 801	10 ohm ±5% 0805 chip	569-0105-100
R 802	3.6k ohm ±5% 0805 chip	569-0105-362
R 803	10 ohm ±5% 0805 chip	569-0105-100
R 804	3.6k ohm ±5% 0805 chip	569-0105-362
R 805	5.1k ohm ±5% 0805 chip	569-0105-512
R 806	6.2k ohm ±5% 0805 chip	569-0105-622
R 807	180 ohm ±5% 1206 SMD	569-0115-181

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
800 MHz WIDEBAND TRANSMIT VCO		
PART NO. 090-0004-963		
C 802	0.3 pF ±0.1% high Q SMD	510-3656-039
C 803	1 pF 150V chip	510-3656-109
C 804	3.9 pF 150V chip	510-3656-399
C 807	27 pF ±5% NPO 0805 chip	510-3601-270
C 808	27 pF ±5% NPO 0805 chip	510-3601-270
C 809	15 µF 20V SMD tantalum	510-2626-150
C 810	27 pF ±5% NPO 0805 chip	510-3601-270
C 811	27 pF ±5% NPO 0805 chip	510-3601-270
C 812	4.7 pF 150V chip	510-3656-479
C 813	6.8 pF 150V chip	510-3656-689
C 814	27 pF ±5% NPO 0805 chip	510-3601-270
C 815	0.3 pF ±0.1% high Q SMD	510-3656-039
CR801	Varactor BB535 SOD-323	523-5005-022
CR802	Varactor BB535 SOD-323	523-5005-022
CR803	Varactor BB535 SOD-323	523-5005-022
L 803	0.039 µH SMD inductor	542-9001-397
L 804	0.039 µH SMD inductor	542-9001-397
L 805	0.039 µH SMD inductor	542-9001-397
L 806	82 nH ±10% SMD 0805	542-9003-827
PC800	PC board	035-2008-820
Q 801	Si NPN gen purp sw/amp	576-0001-300
Q 802	NPN 85633 SOT-23	576-0003-636
R 801	10 ohm ±5% 0805 chip	569-0105-100
R 802	3.6k ohm ±5% 0805 chip	569-0105-362
R 803	10 ohm ±5% 0805 chip	569-0105-100
R 804	3.6k ohm ±5% 0805 chip	569-0105-362
R 805	5.1k ohm ±5% 0805 chip	569-0105-512
R 806	6.2k ohm ±5% 0805 chip	569-0105-622
R 807	180 ohm ±5% 1206 SMD	569-0115-181
R 814	10k ohm ±5% 0805 chip	569-0105-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	800 MHz WIDEBAND RECEIVER	
	Part No. 090-0004-960	
	(only the differences from 023-2008-200 are shown)	
CH200	3 cavity front end 800 MHz	015-0901-038
CH201	3 cavity front end 800 MHz	015-0901-038
CH202	3 cavity front end 800 MHz	015-0901-038
L 210	22 AWG coil	597-0271-022
L 212	22 AWG coil	597-0271-022
L 221	22 AWG coil	597-0271-022
L 226	22 AWG coil	597-0271-022
L 227	22 AWG coil	597-0271-022
L 228	22 AWG coil	597-0271-022

WO803 WO804 WO806
CNTRL IN GND RF OUT

WO801
MOD IN

WO809
GND

WO802
TO RESONATOR TAP

R804

+ C806

C805

L804

L806

CR802

CR803

C804

R806

R805

Q802
B   C   E

C803

C812

C813

L805

R803

C811

C814

R807

C809
+

R802

R801

B   Q801   C
E

C808

C807

C810

L803

+12V
WO805

GND
WO807

GND
WO808
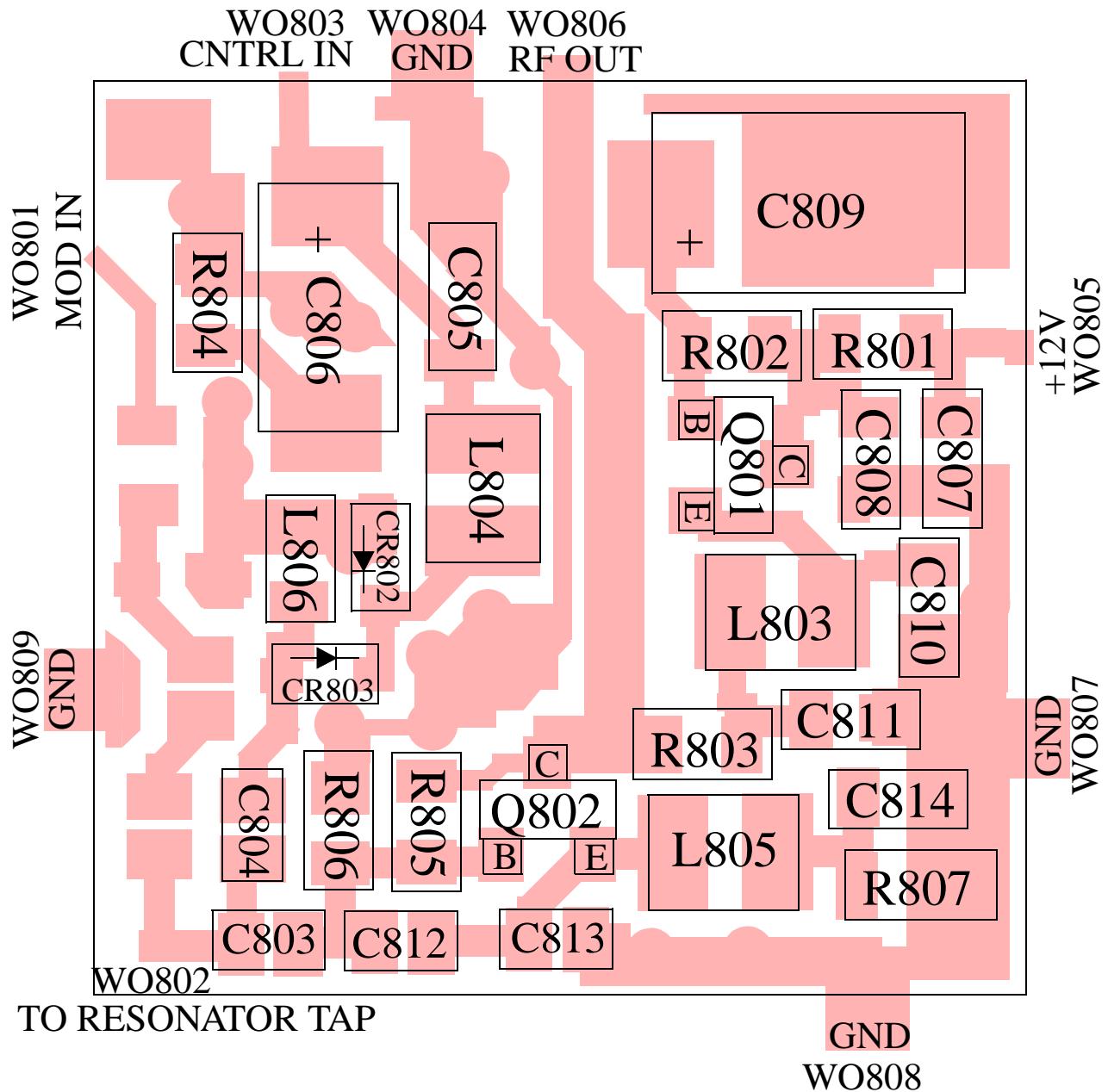
Figure 10-12   RECEIVE VCO COMPONENT LAYOUT
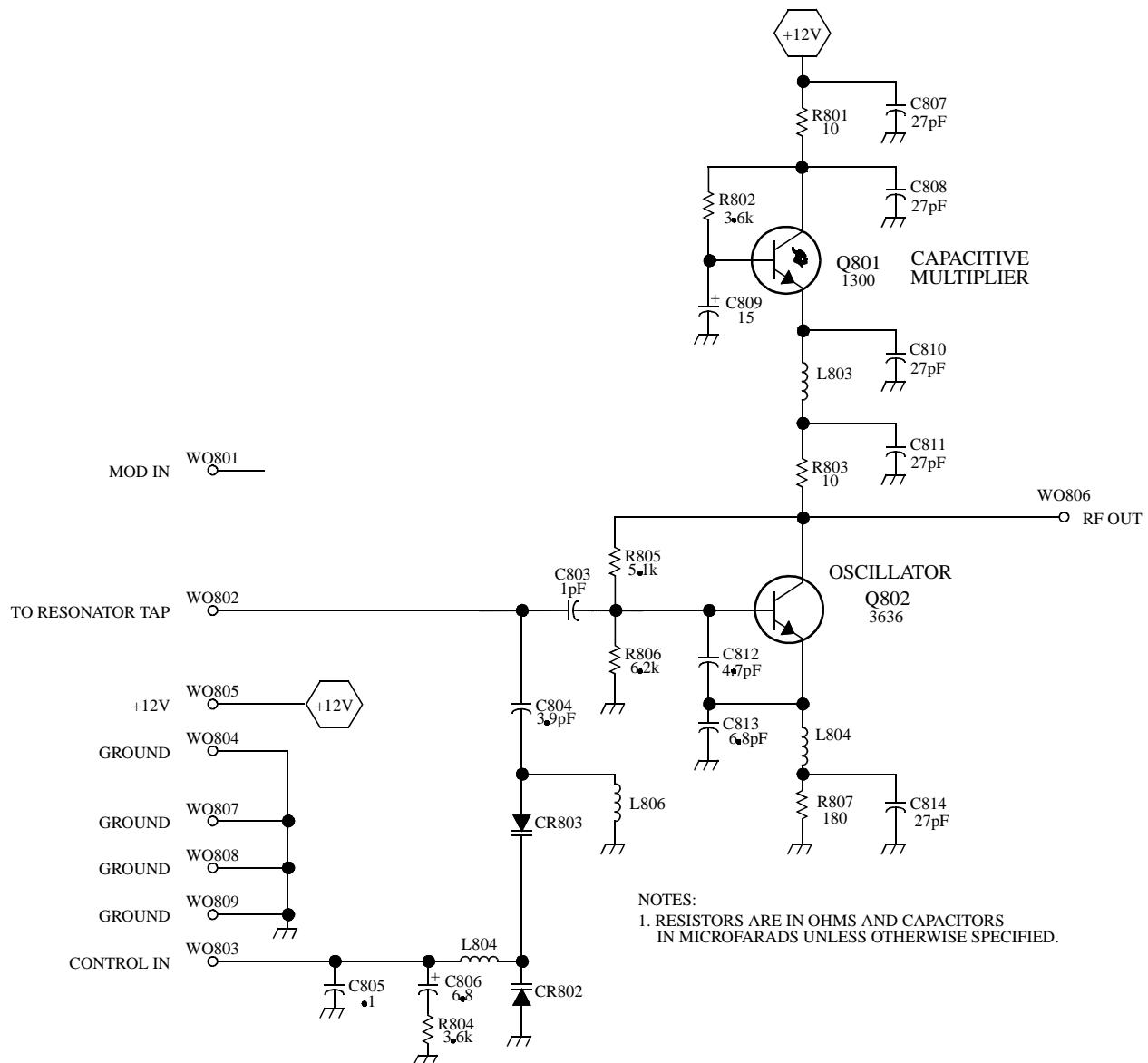
**Figure 10-13   RECEIVE VCO SCHEMATIC**
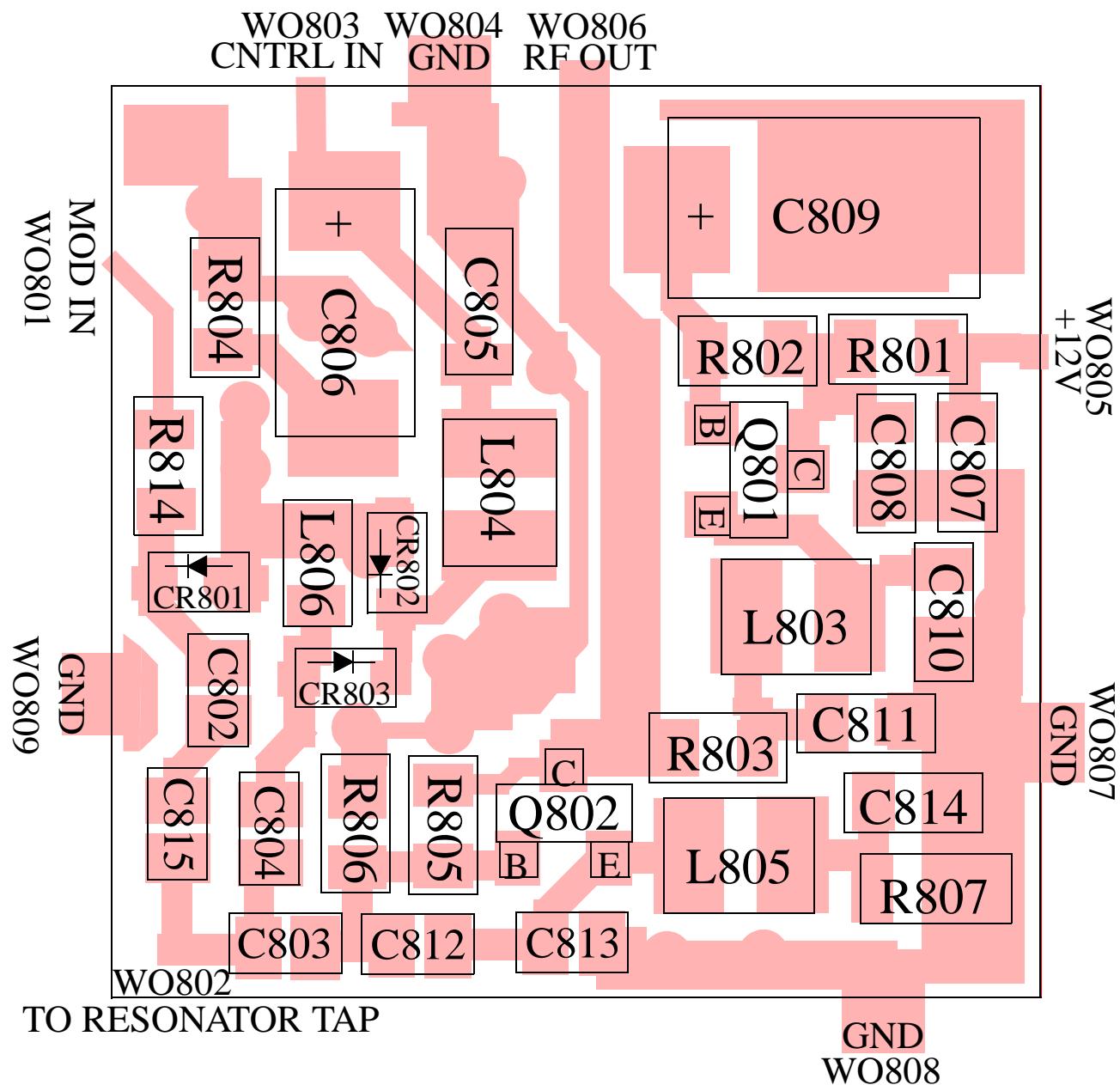
Figure 10-16   TRANMIT VCO COMPONENT LAYOUT
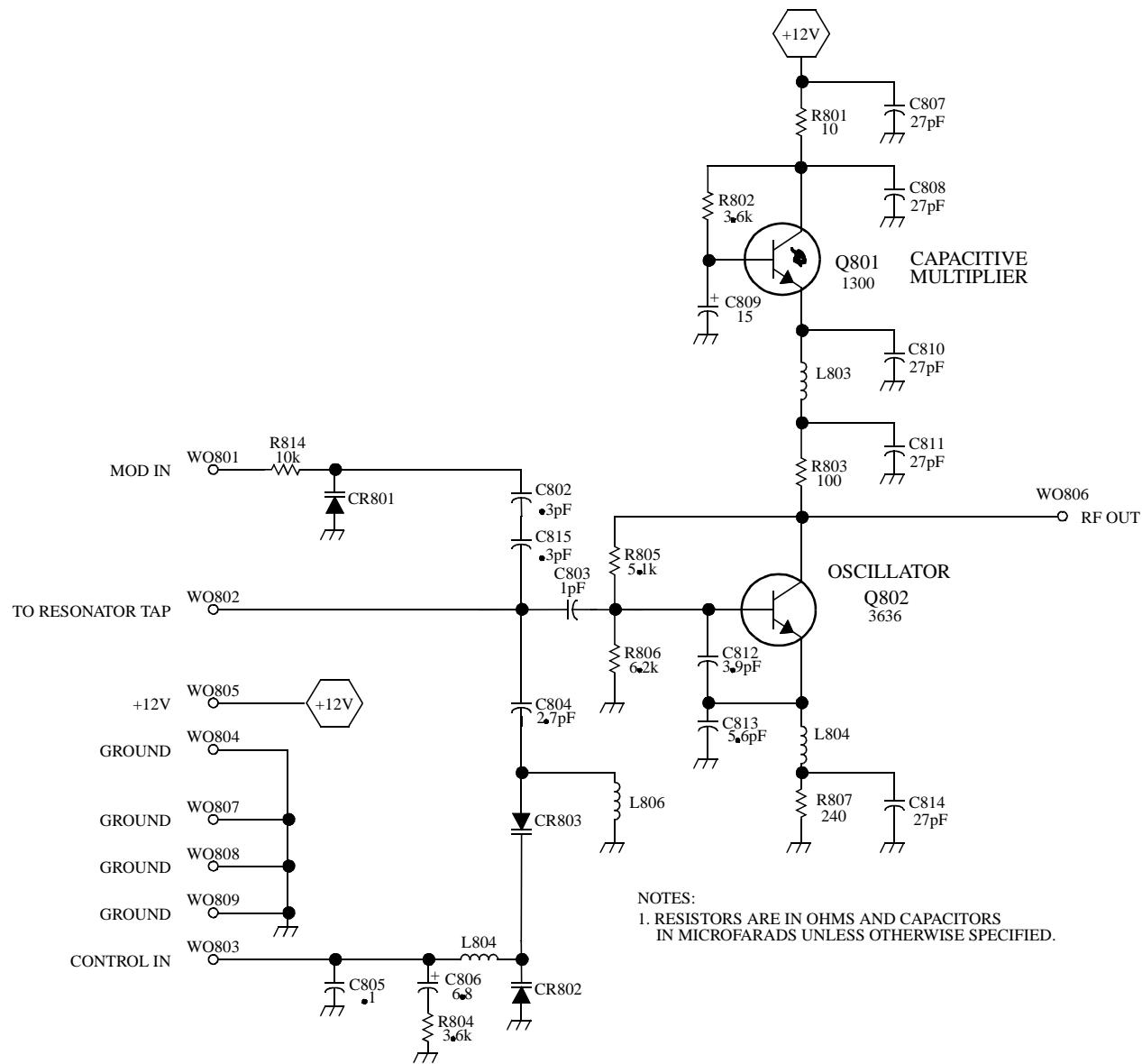
Figure 10-17   TRANSMIT VCO SCHEMATIC