RL-903 900-MHz Receiver

USER MANUAL

PN 9110.00148 (old part number = 916-0903-001)

RELEASED

Specifications subject to change without notice

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1 GENERAL

1.1 Manual Scope

This manual presents the RL-903 900-MHz-range receiver. It contains information concerning the overall operation of the front end, IF board, VCO, and power supply. The optional tone board is treated in a separate manual.

Models in the series include:

- RL-903R, link repeater receiver, which passes the signal to a link transmitter
- RL-903XC, receiver for use by an external control device.

The above models may be narrowband, for 2.5-kHz-deviation systems, or wideband, for 5-kHz-deviation systems. Any of these combinations may have the line driver (LD) option, which provides a balanced output for telephone lines. The LD option may also be a separate model.

1.2 Applicable Documents

Other manuals, in addition to this manual, may be required for complete paging-site documentation. Refer to *Table 1-1* for a list of applicable documents, their part numbers, and a brief description of each.

Table 1-1 Applicable Documents

document	part number	description
RL-903	9110.00148	this manual
tone control board	915-0103-000	tone-control board for configurations which use a tone decoder inside the receiver, e.g., a link repeater receiver
transmitter controller (These are typical; others are possible.)	9110.00781	GL-C2000 transmitter controller v2.30
	IBPHASE3	QT-1000 (TXC) transmitter controller
	9110.00082	GL-C5012 transmitter controller
transmitter	various	paging transmitter or link repeater transmitter

1.3 Manual Sections

Refer to *Table 1-2.* This table lists the sections in this manual, and provides a brief description of the content of each section.

Table 1-2 Manual Sections

section	contents
1. General	contains scope and content of this entire manual and lists other applicable documents to supplement this manual
2. Specifications	contains overall and selected equipment specifications, and those not given in other equipment manuals
3. Description	contains overall physical and functional equipment descriptions
4. Installation & Setup	contains relevant equipment installation information and setup procedures
5. Operation	contains overall description of operator controls
6. Theory of Operation	contains overall block-diagram level theory of operation for equipment listed in *Paragraph 1.1* as it functions as a unit
7. Maintenance	contains necessary maintenance procedures which keep site operating within specified parameters
8. Checkout and Troubleshooting	contains information needed to checkout and troubleshoot overall equipment performance
9. Removal and Reinstallation	contains information needed to remove and reinstall the rack and equipment contained in it
10. Figures	contains related engineering drawings not found elsewhere
index	contains an alphabetized index of significant items

1.4 About Glenayre

Questions regarding the equipment or this manual should be directed to:

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1.4.1 Product Warranty Information

Glenayre warrants to the original purchaser that Glenayre products are free from defects in material or workmanship for a period of twelve months from the original invoice date, subject to the provisions herein. Glenayre will repair or replace at its option, FOB our factory, free of charge within one year from the date of shipment, any component, assembly or subassembly of our manufacture found to be defective under conditions of normal use. The unit, if repaired, will be returned to its original specifications. Failures caused by unauthorized modifications, *force majeure,* lightning, physical, environmental, or electrical damage including use with incompatible equipment are specifically excluded from this warranty. Glenayre disclaims any and all liability for loss or other damage whether direct, consequential or of any nature whatsoever, resulting from product failure.

This warranty is in lieu of all other warranties expressed or implied and covers only those items manufactured by Glenayre. Equipment supplied by, but not manufactured by Glenayre, is subject only to any warranty offered by the manufacturer of said equipment.

1.4.2 Service Warranty Information

Return of a defective item must be authorized by Glenayre prior to shipment. A Return Authorization number can be obtained from Glenayre Customer Service. When requesting a Return Authorization number, give the serial number of the unit. A description of the fault should accompany the unit on its return and the RA number must be shown on labels attached to the item(s). The cost of shipping to Glenayre is to be paid by the customer. Shipping from Glenayre will be prepaid by the customer, and shipped via surface mail. If express shipping is required, the unit will be shipped collect.

Any repair service performed by Glenayre under this limited warranty is warranted to be free from defects in material or workmanship for ninety days from the date of repair. All other terms of this limited warranty apply to the service warranty.

1.5 Reaulatorv-Authoritv Comoliance

1.5.1 FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

1.5.2 Industry Canada

This device complies with RSS-210 of Industry Canada. Operation is subject to the following two conditions:

this device may not cause interference, and
this device must accept any interference, including interference that may cause undesired operation of the device.

2 SPECIFICATIONS

Table 2-1, Specifications, lists the specifications of the receiver. All receiver tests were performed per the ANSI/EIA-603/1992 standard, "Land Mobile FM or **PM** Communications Equipment Measurement and Performance Standards," approved October 27, 1992, and dated February 1993.

Table 2-1 Specifications

characteristic (unit of measurement)	specification
frequency range (MHz)	922-960 (in special cases, to 902) in bands as follows: 900-920, 920-940, 940-960
modulation acceptance (kHz)	wideband, +/-7.0 narrowband, +/-5.0
sensitivity (uV for 12-dB SINAD)	wideband, 0.35, narrowband, 0.35
sensitivity (uV for 20 of quieting)	wideband, 0.5 narrowband, 0.5
channel spacing (kHz)	narrowband, 12.5 wideband, 25
adjacent-channel rejection (dB of rejection: wideband, 25 **kHz;** narrowband, 12.5 **kHz)**	wideband, -80 narrowband, -75
alternate-channel rejection (dB of rejection, wideband, 50 kHz; narrowband, 25 kHz)	wideband, -85 narrowband, -80
intermodulation (dB)	wideband, -80 narrowband, -75
spurious response (dB)	wideband, -100 narrowband, -100
maximum squelch sensitivity, **TIGHT** (carrier) squelch (dBm)	wideband, -65 narrowband, -65
minimum squelch sensitivity, **NORMAL** (noise) squelch (dBm)	wideband, -113 narrowband, -113
speaker output	
distortion (percent)	5 or better
hum and noise (3-kHz deviation with 1-kHz tone) (dB)	wideband, -40 narrowband, -40
output power (W)	1.5

Table 2-1 Specifications ***(continued)***

characteristic (unit of measurement)	specification
audio response, 3(X) to 3000 Hz (dB)	-1, +8, from nominal 750-usec deemphasis curve
flat audio output	
max distortion at 1 **kHz,** 2/3 modulation (percent)	wideband, 1.5 narrowband, 2.5
hum and noise (dB to 3 kHz)	wideband, -50 narrowband, -50
frequency response (dB with respect to 1000 Hz)	wideband, +/-1 narrowband, +/-1
phase linearity (max degrees of deviation from RL-900	wideband, +/-10 narrowband, +/-10
line driver	
output level (dBm)	-15 to +5 (normally 0 dBm)
max frequency response variation from 1000 Hz (dB)	wideband, +/-0.5 narrowband, +/-0.5
input power	10.6 to 29 Vdc at less than 2 A, 3 A peak
operating temperature range (degrees centigrade)	-30 to +60
storage temperature (degrees centi-grade)	-40 to +85
relative humidity, noncondensing	5 to 95 percent
altitude (ft)	to 10,000 (3050 m)
chassis dimensions	3.5 in (9 cm) high x 19 in (48 cm) wide x 8 in (20.3 cm) deep. excluding front and rear pro-jections
chassis weight	5.7 lb (2.6 kg)
FCC ID	BFL RL-903

Table 2-1 Specifications (continued)

characteristic (unit of measurement)	specification
tone board (optional, not used in determining above specifications)	
keytone notch filter	
center frequency (Hz)	2875 or user-selectable
notch depth (dB) below full modulation	25
-1-dB bandwidth at 2875 Hz (Hz)	2835 to 2915
keytone decoder	
frequency (Hz)	2875 or user-selectable
sensitivity (dB)	32 below +1- 3 kHz deviation or better
turn-on time (ms)	200
hold time (ms)	100

3 DESCRIPTION

3.1 Introduction

The receiver may be used in three types of applications or in various combinations:

- link repeater receiver for link transmitter (R).
- link receiver with external control (XC) for paging transmitter.

Additionally, in combination with any of these, it may be used as a monitor receiver with line driver (LD) suitable for telephone lines.

3.2 Physical Description

The receiver is normally mounted in a standard rack and requires two rack units. *Table 2-1* includes physical characteristics. These are the main assemblies:

- RF board
- IF board
- VCO assembly/synthesizer board
- power supply/audio amplifier (PS/A)
- interface board attached to the rear of the chassis (not used in some configurations).

Additional components may need to be installed in order to enable the line driver output.

For views of the receiver, refer to *Figure 3-1, Receiver Isometric Front View*, *Figure 3-2, Receiver Rear View*, and ***Figure 3-3, Top View of Internal Assemblies.*** An optional tone-control board may be used and is mounted on the IF board.

3.3 Simplified Block-Diagram Description

Refer to ***Figure 3-4, Receiver Functional*** *Diagram*. The RL-903 is a self-contained receiver capable of covering the range of paging and link frequencies between 922 MHz and 960 MHz. Channel spacing is 12.5 or 25 kHz. The radio has a synthesized local oscillator. The receive frequency is set in 6.25-kHz steps by a selection of DIP switches. The electronic tuning range is approximately one MHz before manual (coarse) oscillator retuning is required.

The 900-MHz signal enters at the rear of the chassis and is routed to the RF assembly, where it is amplified and mixed to produce a 45-MHz IF signal.

An internal or external reference oscillator furnishes the reference for the synthesizer. The VCO output is routed to mixer Ul on the RF assembly. For a description of the synthesizer and VCO, refer to *Paragraph 6.3, Synthesizer and VCO Block-Diagram Description.*

IF amplifiers Q5 and Q6 amplify the first IF signal and make up any losses caused by the insertion loss of the IF filters. FM detector chip U2 is the second mixer and quadrature detector for the receiver. Its output includes the recovered audio and a signal-strength indicator which are passed to the audio and squelch circuitry.

The audio_dc signal is dc-coupled all the way from the quadrature detector to J1. The audio_ac signal is filtered to produce standard transmitter audio. This signal may be routed through the optional tone board to produce a logic indication if a control tone is detected and to optionally notch out the control tone to a transmitter (tone is normally not notched). For a discussion of the tone board, refer to its manual. See *Table 1-1.*

An external delay device or other type of audio processor may be spliced into the audio path, depending on jumper settings. See *Table 7-7,* ***IF Board Controls and Indicators.***

The received-signal-strength indicator is a dc voltage which gives a relative indication of the signal strength.

The R tone-controlled link receiver reserves a segment of the audio passband (normally a narrow band centered on 2875 Hz) for control purposes. The presence of a tone at that frequency causes the keyline to the transmitter to become active. The R receiver can be set up to notch the control tone out of the audio passband, but the R receiver normally passes the control tone, along with the rest of the audio passband.

Refer also to the system theory of operation of the associated transmitter for additional discussion. Refer to the tone-control manual (see *Table 1-1* for part number) for a discussion of the operation of the tone board.

Some systems require more extensive control than that offered by tone keying. In such cases, an external device uses the receiver audio and squelch status to control the associated transmitter. Refer to the control device's manual for additional discussion.

An external 600-ohm, balanced output may be used for sending remotely monitored audio over telephone lines. This feature may be used at the same time as the previously mentioned features. Additional components may need to be installed on the RF board in order for this feature to be enabled.

The received-signal-strength indicator (RSSI) is a dc voltage which gives a relative indication of the signal strength.

There are two types of squelch which may be used:

- noise squelch (NORMAL) for normal reception and
- carrier squelch (TIGHT) for reception in areas of high RF density.

The power supply uses switching techniques to provide a stable output voltage despite wide variations in the input. The board also provides the audio amplifier for the chassis-mounted speaker.

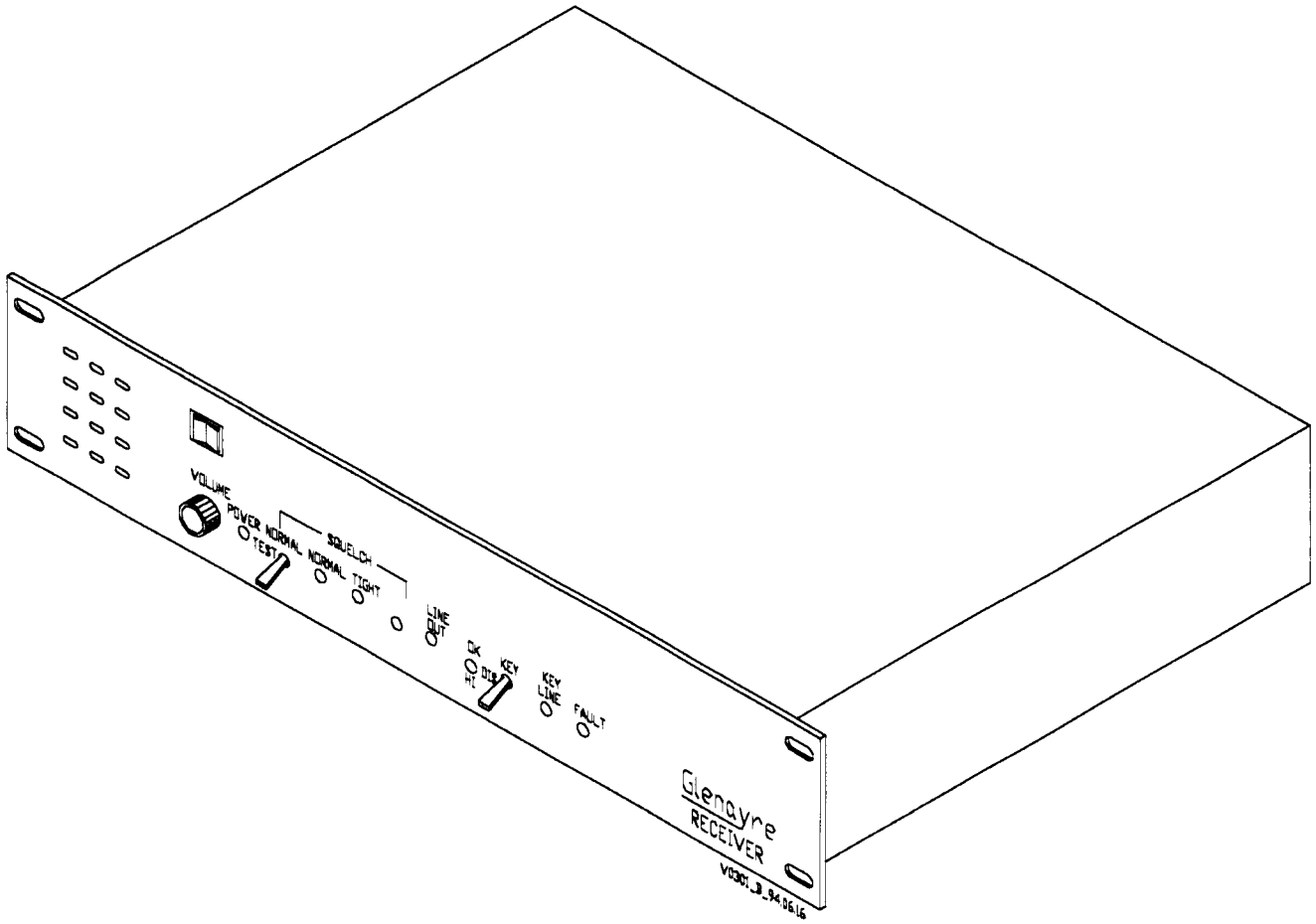

Figure 3-1 Receiver Isometric Front View

	TB1	TB2	TB3
1	GROUND	DC AUDIO	KEY
2	DC IN	AC AUDIO	SQUELCH IND
3		GROUND	GROUND
4		TO EXT DELAY	FAULT IND
5		FROM EXT DELAY	RSSI IND
6		GROUND	GROUND
7		LINE OUT +	INTERLOCK
8		LINE OUT –	INTERLOCK

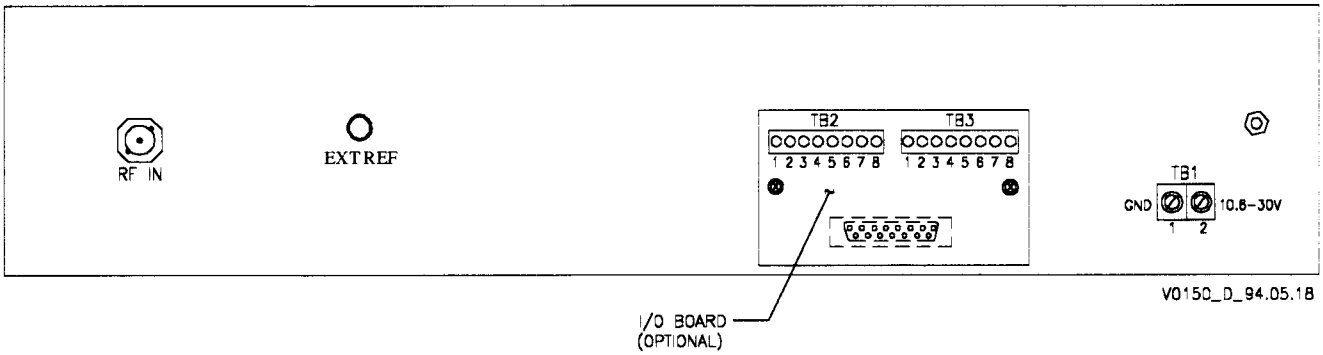

Figure 3-2 Receiver Rear View

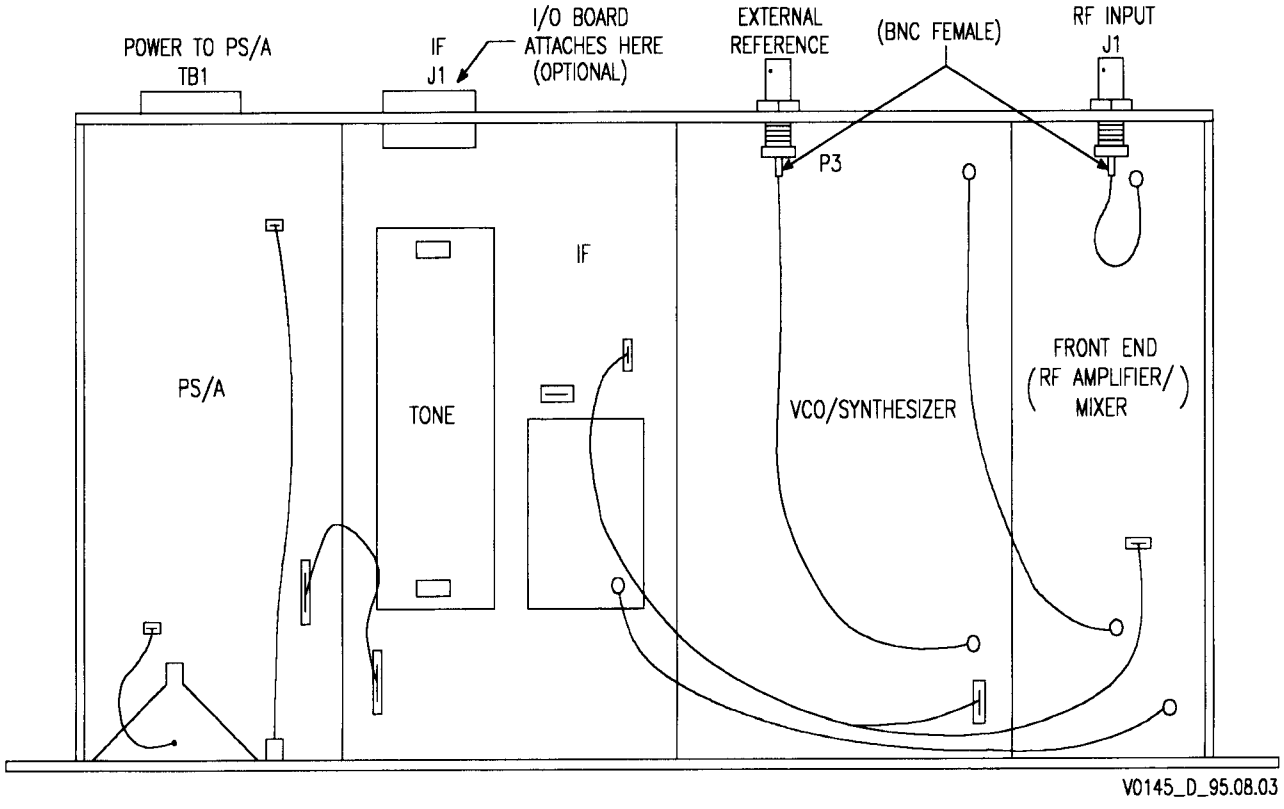

Figure 3-3 Top View of Internal Assemblies

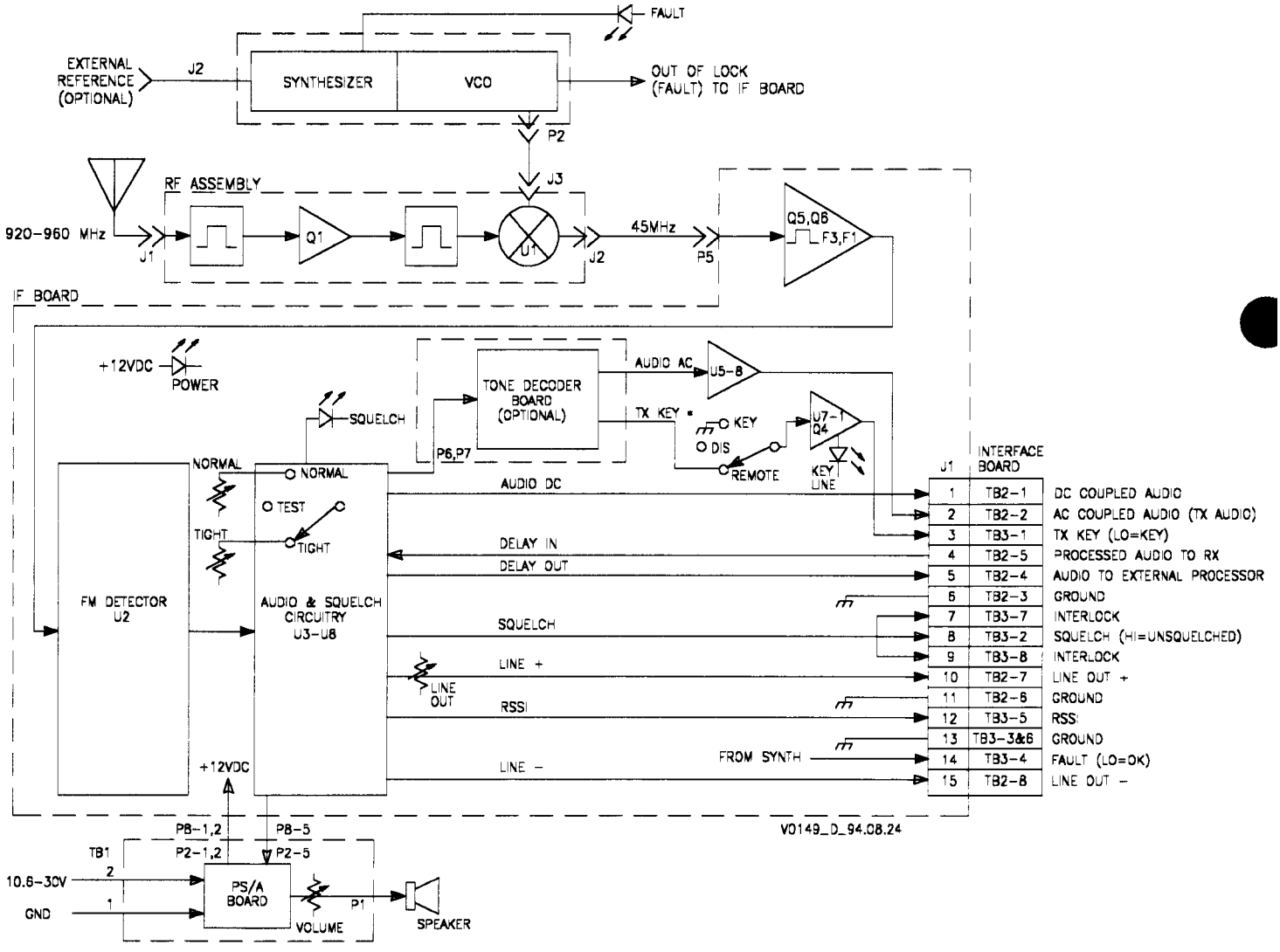

Figure 3-4 Receiver Functional Diagram

4 INSTALLATION AND SETUP

This manual contains setup information for the receiver. For a broader view of setup, refer to the system manual.

4.1 Precautions and Hazards

Caution

PC boards within this assembly use static-sensitive components. Follow IC-handling precautions.

4.2 Test Equipment and Tools Required

Most internal adjustment can be performed with the receiver chassis pulled forward and with the lid removed.

The receiver's RF and l.o. sections should not need realignment unless poor operation is indicated or if the receive frequency has been changed by more than one MHz. *Table 4-1, Test Equipment Required,* shows required test equipment for setup. Common hand tools are also required.

Table 4-1 Test Equipment Required

	item	characteristic
	service monitor	to 1 GHz, IFR model 1200S or equivalent
	frequency counter	to 1 GHz
	digital voltmeter	Beckman model 330 or equivalent
	audio distortion analyzer	capable of measuring audio distortion to 3000 Hz, Sinadder or equivalent
	power supply	+12 Vdc at 3 A
	(optional) spectrum analyzer	capable of displaying up to 1 GHz
	(optional) RF millivoltmeter	capable of reading 0 dBm at 1 GHz
	QPN 263-0305-002	receiver I/O board for accessing I/O signals
	slotted alignment tool	Johanson 8777

4.3 Component and Adjustment Locations

Figure 3-3, *Top* ***View of Internal Assemblies,*** shows the locations of pc boards.

4.4 Installation

4.4.1 Inspection

Refer to the system manual for inspection information.

4.4.2 Power Requirement

The receiver, when used as a component of a paging site, draws its power from system wiring.

4.4.3 Input/Output Connections

Figure 3-2, Receiver Rear View, shows the locations of rear-mounted I/O connectors, and *Table 4-2, I/O Connections,* lists I-o connectors and describes their functions.

Normally the receiver is delivered as part of an entire paging system and has already been installed in a rack, with all connections already made, except for connections to equipment that was not installed in the rack before shipment. If I/O connections are required, refer to the system-interconnect diagram and other instructions in the system manual.

4.4.4 Internal Test Points, Switches, and Jumpers

Refer to *Figure 7-4, RF Assembly - Adjustments. Table 7-6, RF Board Controls,* lists RF board controls.

Refer to *Figure 7-1, Synthesizer Controls and Indicators. Table 7-1, VCO Controls and Indicators, lists* VCO/synthesizer controls and indicators.

Refer to *Figure 7-5, IF Board Controls and Indicators. Table 7-7, IF Board Controls and Indicators,* lists IF board controls and indicators.

Refer to *Figure 7-6, PS/A Board Controls and Indicators. Table 7-8, PS/A Board Controls,* lists PS/A board controls.

Tone board adjustments are discussed in the tone board manual (see *Table 1-1* for part number).There are no indicators on the tone board.

4.5 Ultimate Disposition

Caution

This equipment may contain hazardous materials. Check with the local EPA or other environmental authority before disposing of this equipment.

Table 4-2 I/O Connections

connection	board label	label on I/O schematic	I/O assembly connection	note
PS/A board				
TB 1-2	10.6-30V			positive input to receiver
TB1-1	GND			negative return to power supply
IF board				
J1-1	AUDIO_DC	DC AUDIO	TB2-1	U6-1 output through 1000-ohms
J1-2	AUDIO_AC	AC AUDIO	TB2-2	U5-8 output (tx audio)
J1-6	ground	GROUND	TB2-3	chassis ground
J1-5	DELAY_OUT	TO EXT DELAY	TB2-4	connects to input of external delay
J1-4	DELAY_IN	FROM EXT DELAY	TB2-5	connects to output of external delay
J1-11	ground	GROUND	TB2-6	chassis ground
J1-10	LINE+	LINE OUT+	TB2-7	optional 600-ohm balanced output +
J1-15	LINE-	LINE OUT-	TB2-8	optional 600-ohm balanced output -
J1-3	TXKEY*	KEY	TB3-1	optional keyline output, LO = key
J1-8	SQUELCH	SQUELCH	TB3-2	HI = unsquelched
J1-13	ground	GROUND	TB3-3	chassis ground
J1-14	FAULT	FAULT IND	TB3-4	fault (out of lock) output, LO = okay
J1-12	RSSI	RSSI IND	TB3-5	see text
		GROUND	TB 3-6	chassis ground
J1-7	interlock	INTERLOCK	TB3-7	internally jumpered together
J1-9	interlock	INTERLOCK	TB3-8	internally jumpered together
RF Assembly				
J1	RF input	RF IN		RF-board J1 is attached to rear-panel female BNC receptacle via a short cable.
synthesizer assembly				
P3	external reference input	EXT REF		P3 on synthesizer is attached to rear-panel BNC receptacle by short cable.
ground stud				Attach to common cabinet ground.

Table 4-3 Internal Connections among Assemblies

connection #1	label #1	label #2	connection #2	note
IF board	**IF board**	**VCO assembly**	**VCO assembly**	
P3-1,2	+12V	+12V	P1-1, -2	power to VCO
P3-3 thru -7	ground	GROUND	P1-3	ground
P3-8	LOCK_DETECT	OUT-OF-LOCK	P1-8	fault input to IF board
	RF assembly			
J3			P2 (cable)	1.o. injection to first mixer
	IF board	**RF assembly**		
P3-1, -2	+12V	+12V	P1-1	power to RF board
P3-3 thru -7	ground	GROUND	P1-2	
P5	45-MHz input	IF OUTPUT	J2	IF connection from RF assembly
	IF board	**tone board**		optional, J5 front, J4 rear
P6-1	from_tone	audio_out	J2-1	tone audio output
P6-2	ground	ground	J2-2	ground
P6-3	keytone*	keytone*	J2-3	keytone detected = LO
P6-4	ground	ground	J2-4	ground
P6-5	voting_tone	voting_tone	J2-5	n/u
P6-6	ground	n/c	J2-6	ground
P6-7, 8	n/c	n/c	J2-7,-8	
P7-1, 2	+12v	+12	J1-1, -2	12 Vdc
P7-3	ground	ground	J1-3	ground
P7-4	to_tone	audio_in	J 1-4	tone audio input
P7-5	ground	ground	J1-5	
P7-6, 7, 8	n/c	n/c	J1-6, 7, 8	
	IF board	**PS/A board**		
P8-1, 2	+12v	+12v to receiver	P2-1, -2	12-Vdc source for RF board
P8-3, 4	ground	ground	P2-3, -4	ground
P8-5	speaker_audio	speaker audio	P2-5	connects to speaker amplifier
P8-7	n/c	disable	P2-7	

Table 4-3 Internal Connections among Assemblies (continued)

connection #1	label #1	label #2	connection #2	note
P8-8	de-emph	de-emphasis	P2-8	
J1		--	--	see I/O table
	chassis	**PS/A board**		
SW 1		S W 1		connection to front-panel on/off switch
		P1		connection to front-panel speaker, P1-1=hot, P1-2=ground

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5 OPERATION

5.1 Front-Panel Controls and indicators

Figure 5-1, Front-Panel Controls and Indicators, shows the locations of operator controls and indicators. *Table 5-1, Front-Panel Controls and Indicators,* describes their functions.

5.2 Operating Instructions

The receiver operates in an unattended manner during normal system operation. Refer to the system manual and the maintenance section of this manual for maintenance action, including setup.

Table 5-1 Front-Panel Controls and Indicators

control or indicator	function
(PS/A board)	
SW1	| - on 0 - off
VOLUME R27	adjusts front-panel speaker level
(IF board)	
POWER D21 (green)	on indicator
SQUELCH S2	selects noise squelch, test (open), or carrier squelch **NORMAL -** noise squelch TEST - open squelch **TIGHT** -carrier squelch
TIGHT SQUELCH R81	(4-turn pot) adjusts carrier-squelch threshold level
NORMAL SQUELCH R80	(4-turn pot) adjusts noise-squelch threshold level
SQUELCH D14 (green)	indicates unsquelched when lit
LINE OUT R57	(optional 4-turn pot) adjusts level of line audio option at J2-10, -15
LINE OK HI D15 (red, green)	green - optional line output J2-10, -15 (TB2-7, -8) at or above 0 dBm red - line output too high (+2 dBm) (see *Paragraph 7.7)*
REMOTE/ DIS/ KEY S1	**REMOTE -** allows remote keying DIS - disables remote keying **KEY -** keys output line locally
KEYLINE D11 (green)	when lit, indicates TXKEY line J2-3 (TB3-1) is active
(synthesizer/VCO)	
FAULT D1 (red)	when lit, indicates synthesizer fault; fault output J1-14 (TB3-4 active (HI) at same time

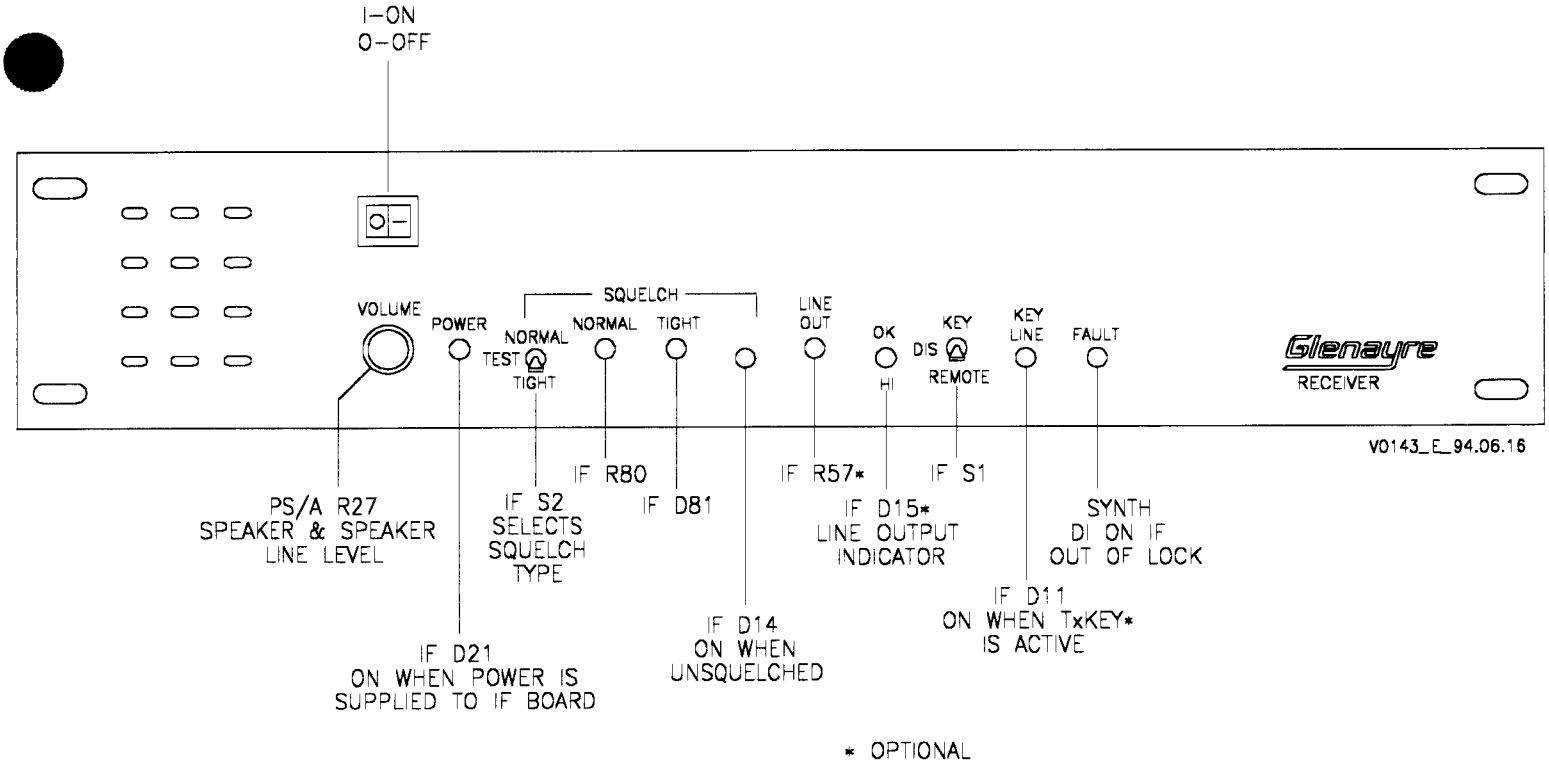


Figure 5-1 Front-Panel Controls and Indicators

6 THEORY OF OPERATION

The dual-conversion, synthesized, narrowband FM receiver covers 922 to 960 **MHz. The** optional tone board provides tone decoding and keying logic. The optional line driver circuit supplies receiver audio to telephone lines.

Table 4-3, Internal Connections among Assemblies, shows the interconnections among assemblies.

6.1 PS/A Board

Figure 7-6, PS/A ***Board Controls and Indicators,*** shows a view of the pc board.

6.1.1 Power Supply

Table 2-1, Specifications, lists the electrical requirement for input power. Refer to *Figure 10-5, PS/A Board Schematic.* Unregulated power entering from TB1-2 is fused by pc-board-mounted F1 and is controlled by front-panel-mounted SW1. Switch converter U1 and associated components provided filtered, regulated power (approximately 15.1 Vdc) to the input of linear voltage regulator U2, which supplies twelve volts to the rest of the unit.

6.1.2 Audio Amplifier

Op-amps in U4 amplify and deemphasize the audio supplied to speaker driver U3. Front-panel VOLUME control R27 controls the speaker level.

6.2 RF Amplifier/First Mixer

Figure 7-4, RF Assembly - Adjustments, shows a view of the assembly. Refer to *Figure 10-3, Front End Schematic.* The RF input is at rear-mounted BNC connector J1 on the left of the back of the chassis, as viewed from the rear. The desired signal is passed by helical filters L2, L3, L4, L7, L8, and L9 and is amplified by Q1 while undesired signals are attenuated. The RF output is matched by L10 to one input of mixer U1. The l.o. signal from the synthesizer arrives at SMB receptacle J3 and is passed to the second input of mixer U1. The output of mixer U1 is a 45-MHz IF signal which exits the RF board at J2. Receptacle J4 is used with a network analyzer in the factory for tuning the front end.

6.3 Synthesizer and VCO Block-Diagram Description

Figure 7-1, Synthesizer Controls and Indicators, shows a view of the pc board. The synthesizer tunes in 6.25-kHz steps to accommodate the channel spacing of 12.5 or 25 kHz. Refer to *Figure 6-1, Synthesizer Functional Diagram* and *Figure 10-4, VCO Board Schematic.*

6.3.1 VCO

The VCO oscillates at the first l.o. injection frequency. The active element in the circuit is Q6, whose output is fed to buffer Q5 through a two-dB pad for isolation. The output of **Q5** goes to the front end assembly for use as the local oscillator signal for the mixer and to U12 for use by the synthesizer to maintain phase lock. Capacitor C46 centers the VCO control voltage at TP1.

6.3.2 PLL Synthesizer

A portion of PLL U8 compares the phase difference between the internally divided frequencies which are fed to it from the reference oscillator and the VCO. The phase difference causes an error voltage which feeds back to keep the VCO frequency phase-locked. The feedback signal is passed through a low-pass filter to suppress 6.25-kHz components and is fed to VCO varactor D2 for fine (electronic) frequency adjustment and is also fed, via buffer U13A, to TP1 for alignment purposes.

6.3.3 Reference Oscillators

On-board reference oscillator U11 or an external high-stability reference can be used, depending on the setting of JR1. Oscillator Ull operates at 12.8 MHz. The external oscillator may be 10 or 12.8 MHz, depending on JR3. Refer to *Table 7-1, VCO Controls and Indicators.*

6.3.4 Programming Logic

Astable multivibrators U7A and U7B are triggered if an out-of-lock or reset condition exists. Multivibrator U7-12 resets four-bit BCD counters U1 and U2 while multivibrator U7-4 starts clock U6 to trigger the counters. The counter output is input to GAL IC U3, which is programmed to provide the reference-divider sixteen-bit data and serially clock it into synthesizer U8, through the clock and data outputs. An enable pulse is outputted from the GAL to latch the reference-divider data. A control bit and the two most-significant bits of the programmable divider for channel selector are also clocked in after the enable pulse. The data which is latched into registers U4 and U5 from user-programmable DIP switches Si and S2 is essentially shifted through GAL U3 to synthesizer U10 to provide the final sixteen bits for the programmable divider. The enable line is then reactivated to latch in the data.

When the synthesizer is out of lock, red FAULT LED D2 is lit, and U9-1 goes LO to provide a lockout* status report for the board. The status signal appears at P1-8 and to IF board P3-8, where it becomes the LOCK_DETECT signal. On the IF board the LOCK_DETECT signal is inverted and appears at rear IF-board connector J1-14 (TB3-4) as the FAULT output (HI=out of lock).

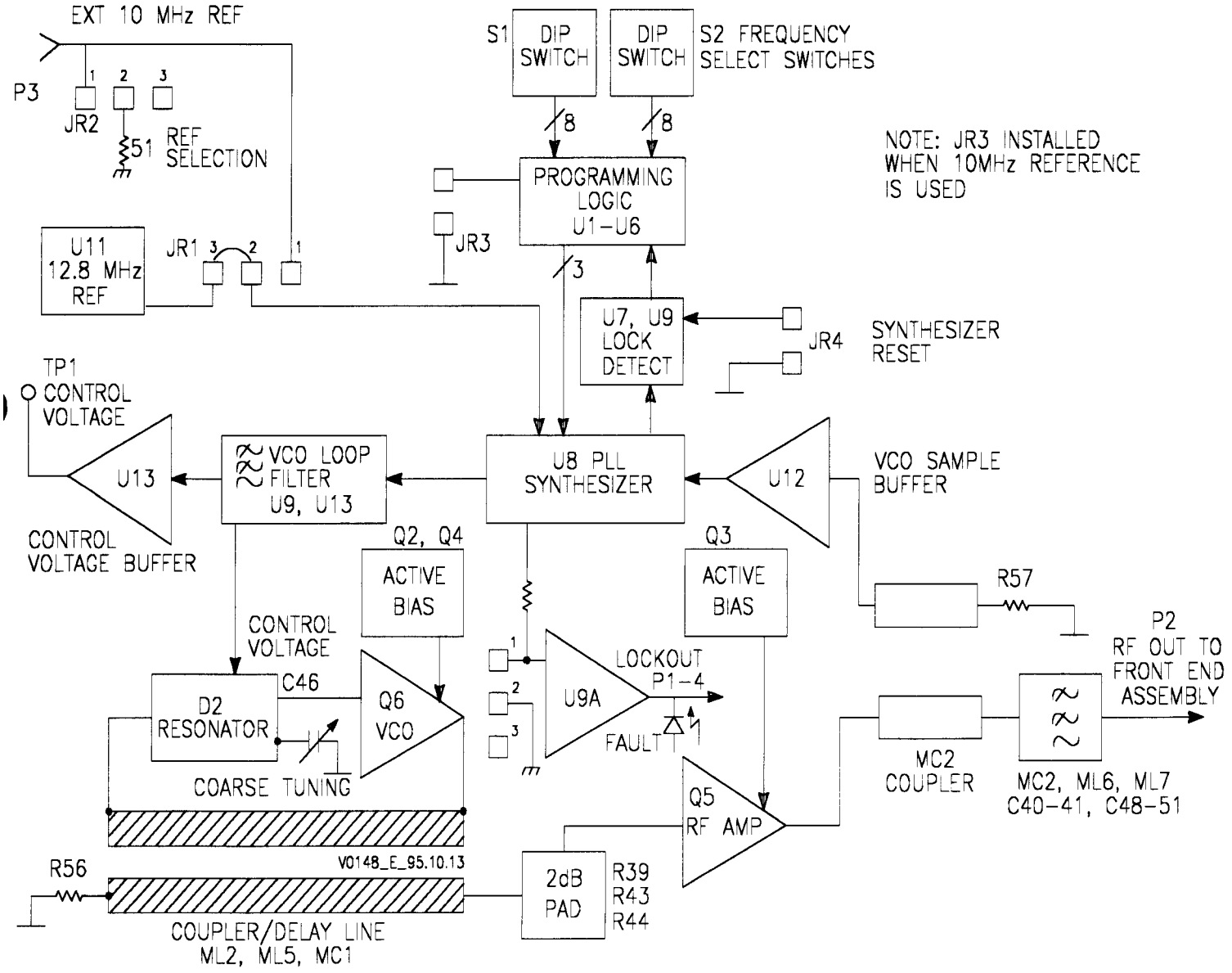


Figure 6-1 Synthesizer Functional Diagram

6.4 IF Board

Figure 7-5, IF ***Board Controls and Indicators,*** shows a view of the pc board. *Table 7-5, IF Board Controls and Indicators,* lists the signal-flow options which can be altered by changing the position of internal jumpers. Refer to *Figure 10-2, IF* ***Audio Board Schematic.***

6.4.1 IF Amplification and FM Detection

The 45-MHz IF signal from the front-end assembly is arrives at P5. Crystal filter F3 shapes the bandpass to accept the appropriate FM modulation, nominally +/-5 kHz or +/- 2.5 kHz, and to provide some adjacent-channel selectivity.

First IF amplifier buffers the signal between F3 and Fl. Second IF amplifier Q6 buffers the signal between F1 and U2, which provides mixing, IF amplification, limiting, and FM detection.

Ceramic filter F2, between the IF amplifier and limiter sections of U2, provides additional adjacent-channel selectivity. The FM detector section of U2 use 455-kHz quadrature coil L5 to produce audio at U2-9 and a received-signal-strength-indicator (RSSI) voltage at U2-13.

6.4.2 Audio Processing

Buffer U3-14 supplies audio to pot R51, which is used to set the audio level at audio_dc J1-1 (TB2-1) and audio_ac J1-2 (TB2-2). (Refer to *Paragraph 7.7* for adjustment.) Audio phase polarity is controlled by JR9 through JR12. Refer to *Table 7-7.* Buffers U6-8 and U6-7 provide additional filtering.

Audio may be routed to an external delay device and then returned, depending on the settings of jumpers. Audio may also be routed to the optional tone board, also depending on the settings of jumpers. Refer to *Table 7-7.* Audio output to the transmitter is present at rear-panel J1-2 (TB2-2).

The optional line driver circuit may be driven by either squelched or unsquelched audio, depending on the setting of jumpers. Refer to *Table 7-7* and *Paragraph 6.5.*

6.4.3 Squelch and RSSI

In order to provide reliable squelch in harsh RF environments there are two types of squelch. carrier squelch (TIGHT) squelch and (NORMAL) noise squelch. Carrier squelch is triggered by the signal strength, and noise squelch, the type of squelch common to most FM receivers, is triggered by the relative amount of high-audio-frequency intensity in the received signal.

Front-panel SQUELCH switch S2 selects the type of squelch used.

- When S2 is set to TIGHT, squelch is under the control of carrier squelch.
- When S2 is set to TEST, squelch is disabled, enabling the audio path.
- When S2 is set to NORMAL, only noise squelch is used to determine squelch status.

Green front-panel SQUELCH LED D14 lights whenever the receiver is unsquelched. Front-panel NORMAL SQUELCH control R80 adjusts the sensitivity of noise squelch. Front-panel TIGHT SQUELCH control R81 adjusts the sensitivity of carrier squelch. Refer to *Paragraph 7.7* for adjustment.

The RSSI signal from U2 goes to dc amplifier U6-1 and comparator U7-7. The **RSSI** voltage is available at rear-panel J1-12 (TB3-5) for external equipment.

6.4.4 Fault Reporting

A condition which causes the receiver's PLL circuitry to go out of lock, causes the lock-detect signal at P3-8 to go LO. The fault causes a HI at Q2-drain and rear-panel J1-14 (TB3-4) for reporting to external equipment. During a fault, D5 causes the receiver to be squelched.

6.4.5 Keying

The receiver must use the optional tone board for keying. Green front-panel KEY LINE LED D11 lights whenever the keyline is active. The front-panel key switch works as follows:

- S 1 set to REMOTE. A keytone* LO from the tone board at P6-3 is passed, via front-panel KEY switch S1, to U7 and Q4. A LO to the paging or link transmitter is passed to rear-panel txkey* J1-3 (TB3-1). The receiver must be unsquelched in order for the keyline to become active.
- S1 set to DIS. Keying is disabled.
- S1 set to KEY. The txkey* output is active (LO).

6.5 Line Driver Circuit (optional) (IF board)

Refer to ***Figure 3-4,*** *Receiver* ***Functional Diagram.*** The line out audio input at front-panel LINE OUT control R57 is amplified by op-amp U8-1 and drives transformer T1, whose balanced output exits the chassis at rear-panel J1-10 and -15 (TB2-7, -8). Comparators U8-7 and U8-8 control front-panel HIGH and OK D15. Refer to *Paragraph 7.7* to adjust level.

7 MAINTENANCE

This section explains the setup and use of the receiver.

7.1 Test Conditions

Refer to *Figure 3-2, Receiver Rear View,* and *Figure 7-2, Test Setup.* For all RF and audio tests, when input power is required, supply a 10-30-Vdc power supply capable of supplying three amperes to rear-mounted TB 1 as follows: 10.6-30V TB 1-2 (on right) to (+), GND TB1-1 (left) to (-). A standard test signal consists of an RF carrier supplied to RF INPUT J1 at a level of -47 dBm, modulated by a 1000-Hz tone at +1-3-kHz (+/-1.5 kHz for narrow-band) deviation. *Figure 7-2* illustrates how test equipment is to be attached.

7.2 Power Supply (PS/A board unless noted)

Perform the following procedure to check the power supply operation. Note that the power supply output is fixed.

Power Supply Check

1. Check that input power (28 Vdc or within range of specifications) is supplied to rear-mounted TB1-2 (10.6-30V) and ground TB1-1 (GND).
2. Turn on front-panel power switch. Front-panel POWER LED (IF board) should light.
3. Check that input power is present at D4-cathode (near right-rear corner of pcb).
4. Check voltage at red TP1. Voltage should be 11.5 to 12.5 Vdc.
5. Check voltage at red TP2. Voltage should be 14.5 to 15.5 Vdc.

7.3 Local Oscillator Setup (synthesizer board, unless noted)

Perform the following procedure whenever it becomes necessary to set the receive frequency. If an external oscillator is normally used when the receiver is in an equipment rack, set JR1 to 2-3 and remove (set movable jumper so that it makes no electrical connection) JR3. An internal reference oscillator must be present before the procedure can be performed. Restore jumpers to normal operating positions when done. *Figure 7-1, Synthesizer Controls and Indicators,* shows synthesizer controls and indicators.

Synthesizer Programming Procedure

1. Determine required receive frequency. If the frequency is listed in *Table 7-5, Synthesizer Switch Settings for Common Frequencies,* use appropriate switch settings. Otherwise, calculate hexadecimal and binary values of A and N and switch settings by using BASIC program listed with *Figure 7-4, Test Setup,* or use formula with calculator.
2. Set segments of DIP switches Si and S2, as required by results of step 1. Note that 1 = off = up and 0 = ON = down.

3. Install and remove JR4 to reset synthesizer. Once synthesizer frequency is programmed, front-panel red FAULT LED should be off. If it is on, coarse tuning of VCO may be necessary. Refer to VCO tuning procedure. If FAULT LED is off, proceed to next step.
4. Apply standard test signal at newly programmed frequency. If test signal is heard, programming new frequency was successful.
5. Connect frequency counter to VCO output SMA connector that goes to RF board J2. Frequency should be receive frequency minus 45 MHz. If 1.o. frequency is off by more than 10 kHz, check programming steps.
6. To precisely set reference frequency, slowly adjust U6 trim cap (if using internal reference oscillator) while checking detected audio for minimum distortion (done as part of RF and IF Tuning Procedure).
7. Once l.o. frequency is changed and verified, check VCO voltage using VCO Adjustment Procedure.
8. (optional) Measure l.o. injection level with spectrum analyzer or RF millivoltmeter; level should be 15 to 17 dBm.

7.4 VCO Tuning (synthesizer board unless noted)

Perform the following procedure whenever a major change in receive frequency has been effected or when it is necessary to check performance, especially if the FAULT LED is lit. Even if the FAULT LED is off, a centered voltage results in improved performance over temperature extremes and yields improved phase-noise performance.

VCO Adjustment Procedure

1. Refer to Figure *Figure 7-1.*
2. Check control voltage at TP1 (near S1). Voltage should be 5-7 Vdc.
3. If necessary, adjust C46 to bring control voltage into range.

7.5 RF and IF Tuning (IF board unless noted)

Apply standard test signal and reduce generator level to check that receiver meets minimum sensitivity listed in *Table 2-1, Specifications.* If specifications are met, tuning is not recommended. Refer to *Figure 7-4, RF Assembly - Adjustments,* and *Figure 7-5, IF Board Controls and Indicators.* Unless noted, references are to the IF board. Attach test equipment as shown in *Figure 7-2.*

Second-Local-Oscillator Adjustment Procedure

Note

Hint: If sensitivity is low, and there is question whether the trouble lies in the RF section or the IF section, inject a 45-MHz signal into IF board P5 and adjust the 45-MHz and 455-kHz circuits. The 12-dB SINAD at P5 should be -116 dBm or better.

Once proper operation of the IF section is validated, concentrate on the RF section and local oscillator.

RF and IF Tuning Procedure

Note

Hint: You may prefer to use the RSSI output at RF board J1-12 (TB3-5), rather than tuning for maximum sensitivity by ear.

1. Attach RF signal generator to rear-panel antenna input J1. Set generator to receive frequency. Modulate with 1000-Hz tone at +1- 3.0-kHz deviation (+/-1.5-kHz for 12.5-kHz-spaced channels). Set level to -47 dBm.

Note

This is the standard test signal standard test signal.

2. Set front-panel SQUELCH switch to TEST.
3. Adjust speaker audio level with VOLUME control to suit user preference.

Caution

The RF front-end adjustments should be tuned for a relatively flat response characteristic, not for peak response. Do not perform steps 4 through 8 unless this is an emergency repair. The factory setup procedure requires a spectrum analyzer. Call Glenayre for assistance in replacing the assembly or in performing the alignment. Alignment should not be necessary unless a major change in frequency has taken place.

4. Refer to *Figure 7-4.* Loosen lock nuts on RF assembly resonators L2, L3, L4, L7, L8, and L9.
5. Reduce signal generator input as required. Using hex wrench, adjust resonators in sequence for maximum sensitivity. Repeat this step until no further improvement is noted.
6. Adjust RF resonators L2, L3, L4, L7, L8, and L9 for signal peak. While holding resonators firmly with hex wrench, tighten all lock nuts to prevent further resonator movement. Constantly check that receiver sensitivity has not been degraded by inadvertent movement of resonators or stress to mechanical assemblies.

Caution

Do not overtighten lock nuts.

7. Passband ripple tends to he additive when all adjustments are made to cause a peak response at a single frequency. To ensure that passband ripple does not degrade performance due to temperature drift, set synthesizer to 3 MHz above carrier frequency and set signal generator accordingly. Response should be within 2.5 dB of performance at carrier frequency.

8. Repeat sensitivity check at 3 MHz below carrier frequency. Set synthesizer and signal generator back to carrier frequency when done. **Be** sure to have front-end adjustment performed by factory personnel as soon as possible.
9. Refer to *Figure 7-5.* On IF board, adjust Ll, L3, L5, L7, and L8 for maximum sensitivity. Repeat this step until no further improvement is noted.
10. (narrowband receiver only) Adjust C51 for maximum sensitivity.
11. Place audio analyzer probe at ac_audio line, J1-1 (TB2-1).
12. Adjust L5 for minimum distortion with 100-Hz audio signal.
13. Set signal generator level to -47 dBm and restore audio frequency to 1000 Hz. Distortion may be minimized by slightly detuning L1, L3, and L7 for minimum distortion, as observed on distortion analyzer. Use audio oscillator and distortion analyzer to measure distortion at 1000 Hz and adjust for best overall distortion. Do not detune components more than 1/4 turn.
14. Adjust second l.o. at C52 for minimum distortion. If using internal reference oscillator, adjust trim cap on U6 for minimum distortion. Do not detune more than 1/4 turn.
15. Restore jumpers and controls to normal positions.

7.6 Squelch and RSSI Adjustment (IF board unless noted)

The following procedure sets TIGHT squelch for normal operation.

TIGHT Squelch Adjustment Procedure

1. Set signal generator level for the desired signal quality (typically 30 dB SINAD, approximately -100 dBm).
2. Set front-panel SQUELCH switch to TIGHT to enable carrier squelch.
3. Set front-panel TIGHT squelch control so that signal is barely squelched. (If signal cannot be squelched, leave control completely cw. This is highly unlikely.) Front-panel SQUELCH LED should go on and off, depending on squelch status.

The following procedure sets NORMAL squelch. Perform the procedure after completing the TIGHT squelch procedure.

NORMAL Squelch Adjustment Procedure

1. Set signal generator level for desired signal quality (typically 12 dB SINAD, approximately -116 dBm).
2. Set front-panel SQUELCH switch to NORMAL to enable noise squelch.
3. Adjust front-panel NORMAL SQUELCH control to barely squelch receiver. Verify level. UNSQUELCH LED4 should go on and off, depending on squelch status.
4. Set front-panel SQUELCH switch to TIGHT.

The following procedure checks the approximate RSSI indication for various RF input levels.

RSSI Level Observation Procedure

1. Set front-panel SQUELCH switch to TEST.
2. Connect voltmeter to J1-12 (TB3-5).
3. Set RF input level to -30 dBm. RSSI level should at least 4.9 Vdc.
4. Set RF level to -76 dBm. RSSI level should be at least 3.0 Vdc.
5. Turn RF input level off. RSSI level should be less than 0.7 Vdc.

Fill out *Table 7-2, RSSI Levels,* to chart the signal-strength intensity with RSSI voltage.

Note

The RSSI level is a good indicator of signal levels. Periodically record the RSSI level while the receiver is receiving the desired signal. Use *Table 7-3, RSSI Levels when Receiving a Signal from Link Transmitter,* as an example. The record will show unplanned variations in the quality of the signal path.

Table 7-2 RSSI Levels

RF input (dBm)	RSSI voltage (Vdc)	RF input (dBm)	RSSI voltage (Vdc)	
-120		-84		
-117		-81		
-114		-78		
-111		-75		
-108		-72		
-105		-69		
-102		-66		
-99		-63		
-96		-60		
-93		-57		
-90		-54		
-87		-51		

Table 7-3 RSSI Levels when Receiving a Signal from Link Transmitter

	receiver model	receive frequency (MHz)	serial number
	date	**RSSI level (Vdc)**	**note**

7.7 Audio Level Adjustment (IF board unless noted)

Perform this procedure only after RF and squelch adjustment procedures have been performed. Refer to *Figure 7-5, IF* ***Board Controls and Indicators.***

IF-Board Audio Level Adjustment Procedure

1. Set SQUELCH switch to TEST to allow audio path to be turned on. Place audio voltmeter at J1-2 (TB2-2) and ground.
2. Apply standard test signal. Set modulation to +/-3.0 kHz for 5-kHz systems or to +/-1.5 kHz for 2.5-kHz systems.
3. Adjust R51 so that ac-coupled voltmeter reads 1Vp-p. Continue with the line audio procedure, if necessary.

Line Audio Level Adjustment Procedure

This circuitry is optional and is used in LD models.

1. Perform this procedure after the preceding procedure is completed.
2. Adjust front-panel LINE OUT R57 so that front-panel LINE OK HI D15 is lit green with modulation from standard test signal. Note that LED flickers to green and red during normal operation. Line output level is approximately 0 dBm. Red occurs at approximately +2 dBm.

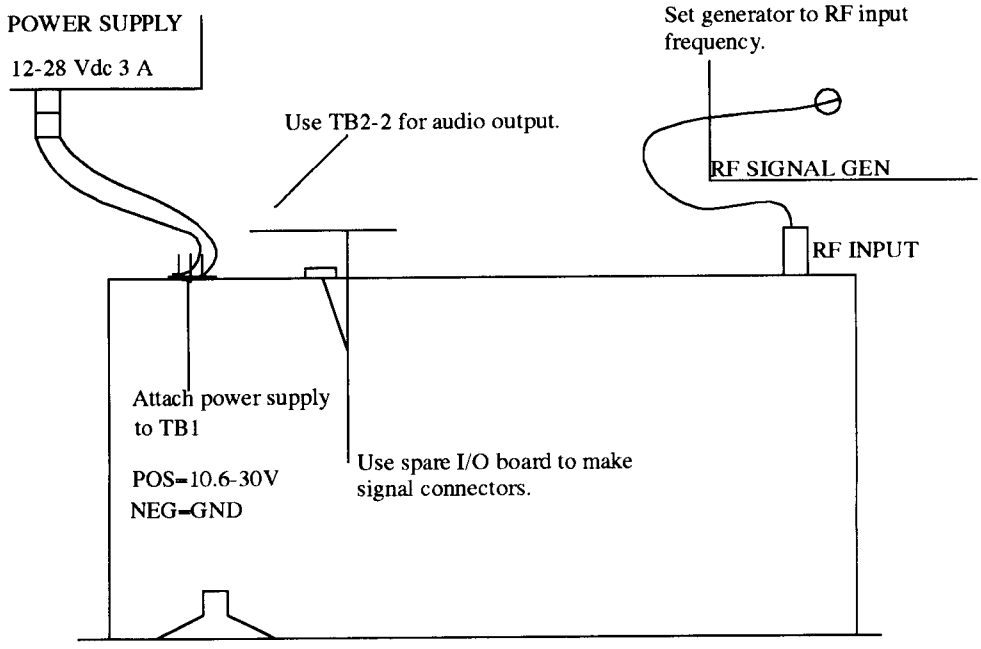


Figure 7-2 Test Setup

BASIC Listing for Programming Synthesizer

```
90 CLS
100 REM program to calculate RL-903 receive frequency
110 PRINT "This program helps calculate the Si and S2 switch settings."
120 PRINT "for the RL-903 synthesizer."
130 PRINT "Enter the receive frequency (MHz). Press Ctrl-Scroll Lock to exit."
140 INPUT D
150 IF D>1100 OR D<870 THEN 130
160 H=INT(((D-864.2)*160)+0.5)
165 PRINT "Frequency (MHz) is "; D;",  exactly"; ((H+138272!)/160);")."
170 PRINT " Hex value is ";
175 HH$=HEX$(H)
180 PRINT HEX$(H)
185 GOSUB 500
190 PRINT "Binary value is ";
200 FOR I=1 TO 4
210 PRINT HI$(I);"I";
220 NEXT I
230 PRINT "Si segments 1-4 = "; HR$(4)
240 PRINT "Si segments 5-8 = "; HR$(3)
250 PRINT "S2 segments 1-4 = "; HR$(2)
260 PRINT "S2 segments 5-8 = "; HR$(1)
270 PRINT "NOTE: 0 = ON, 1 = off"
280 PRINT
290 GOTO 130
500 REM calculate hex and binary
510 HH$="0000"+HH$
520 HH$=RIGHT$(HH$,4)
530 FOR I=1 TO 4
535 B$=MID$(HH$,I,1)
540 GOSUB 700
550 HI$(I)=A$: HR$(I)=RR$
560 NEXT I
570 RETURN
700 REM look up binary values from hex
710 A$="."
720 IF B$="0" THEN A$="0000":RR$="0000"
730 IF B$="l" THEN A$="0001":RR$="1000"
740 IF B$="2" THEN A$="0010":RR$="0100"
750 IF B$="3" THEN A$="0011":RR$="1100"
760 IF B$=" 4" THEN A$="0100":RR$=" 0010"
770 IF B$="5" THEN A$="0101":RR$=" 1010"
780 IF B$="6" THEN A$="0110":RR$="0110"
790 IF B$="7" THEN A$="0111":RR$="1110"
800 IF B$="8" THEN A$="1000":RR$="0001"
810 IF B$="9" THEN A$="1001":RR$="1001"
820 IF B$="A" THEN A$="1010":RR$=" 0101"
830 IF B$="B" THEN A$="1011":RR$=" 1101"
840 IF B$="C" THEN A$="1100":RR$="0011"
850 IF B$=" D" THEN A$="1101":RR$=" 1011"
860 IF B$="E" THEN A$="1110":RR$="0111"
870 IF B$=" F" THEN A$="1111":RR$=" 1111"
880 IF A$=" ." THEN PRINT "000000ps, B$= "; B$: STOP
890 RETURN
```

RL-903 Synthesizer Programming

Enter and run the BASIC listing using BASIC or GWBASIC. Alternatively, use this formula:

hex number = hex(int(((fc 864.2)*160)+0.5)) where

fc = operating frequency in MHz,

int = integer function, and

hex = hexadecimal conversion function

Convert the hex number to binary using the following chart. Note that 0 = ON = blank and 1 = off = filled in.

Table 7-4 Programming Synthesizer Frequency

4or8	3or7	2or6	lor5	E	SlorS2switch segment	
setting of above switch segment						
8	4	2	1	hex value	decimal value	
				0	0	
				1	1	
				2	2	
				3	3	
				4	4	
				5	5	
				6	6	
				7	7	
				8	8	
				9	9	
				A	10	
				B	11	
				C	12	
				D	13	
				E	14	
				F	15	
					-1 — off	
					-0 — ON	

Note

Some switch manufacturers may construct and label their switches differently. If the correct frequency is not programmed, try setting all switch segments to the opposite setting.

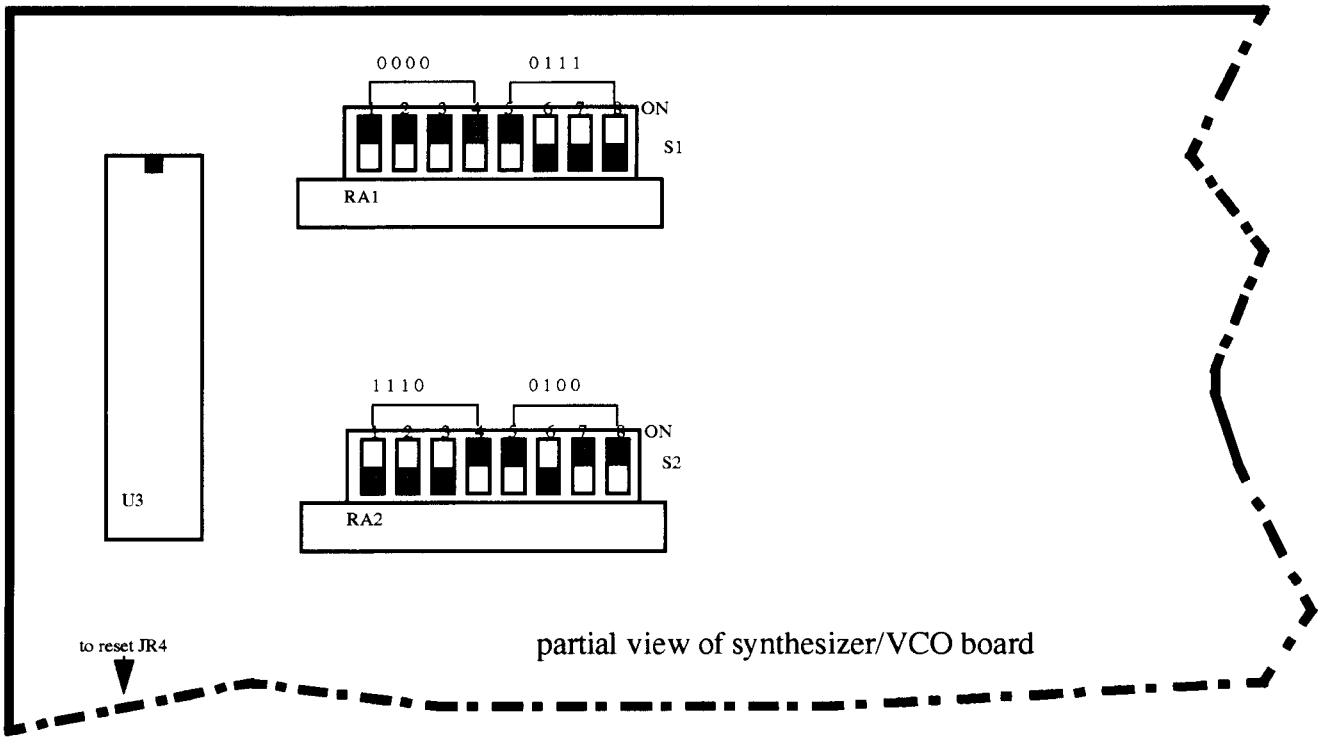


Figure 7-3 Programming Synthesizer Frequency

Table 7-5 Synthesizer Switch Settings for Common Frequencies

frequency (MHz)	**Si** 1..... 8	**32** 1..... 8	**frequency (MHz)**	**S1** 1..... 8	**32** 1..... 8	**frequency (MHz)**	**Si** 1..... 8	**82** 1..... 8
928.0125	01000111	11100100	931.2125	01000111	10010100	932.00625	10000110	01010100
928.0375	01100111	11100100	931.2375	01100111	10010100	932.01875	11000110	01010100
928.0625	01010111	11100100	931.2625	01010111	10010100	932.03125	10100110	01010100
928.0875	01110111	11100100	931.2875	01110111	10010100	932.04375	11100110	01010100
928.1125	01001111	11100100	9313125	01001111	10010100	932.05625	10010110	01010100
928.1375	01101111	11100100	9313375	01101111	10010100	932.06875	11010110	01010100
928.1625	01011111	11100100	9313625	01011111	10010100	932.08125	10110110	01010100
928.1875	01111111	11100100	9313875	01111111	10010100	932.09375	11110110	01010100
928.2125	01000000	00010100	931.4125	01000000	01010100	932.10625	10001110	01010100
928.2375	**01100000**	00010100	931.4375	01100000	01010100	932.11875	11001110	01010100
928.2625	01010000	00010100	931.4625	01010000	01010100	932.13125	10101110	01010100
928.2875	01110000	00010100	931.4875	01110000	01010100	932.14375	11101110	01010100
9283125	01001000	00010100	9321.5125	01001000	01010100	932.15625	10011110	01010100
9283375	01001000	00010100	931.5375	01101000	01010100	932.16875	11011110	01010100
928.8625	01010110	00010100	9315625	01011000	01010100	932.18125	10111110	01010100
928.8875	01110110	00010100	931.5875	01111000	01010100	932.19375	11111110	01010100
928.9125	01001110	00010100	931.6125	01000100	01010100	932.20625	10000001	01010100
928.9375	01101110	00010100	931.6375	01100100	01010100	932.21875	11000001	01010100
928.9625	01011110	00010100	931.6625	01010100	01010100	932.23125	10100001	01010100
928.9875	01111110	00010100	931.6875	01110100	01010100	932.24375	11100001	01010100
			931.7125	01001100	01010100	932.25625	10010001	01010100
931.0125	01000011	10010100	931.7375	01101100	01010100	932.26875	11010001	01010100
931.0375	01100010	10010100	931.7625	01011100	01010100	932.28125	10110001	01010100
931.0625	01010011	10010100	931.8125	01000010	01010100	932.29375	11110001	01010100
931.0875	01110011	10010100	931.8375	01100010	01010100	932.30625	10001001	01010100
931.1125	01001011	10010100	931.8625	01010010	01010100	932.31875	11001001	01010100
931.1375	01101011	10010100	931.8875	01110010	01010100	932.33125	10101001	01010100
931.1625	01011011	10010100	931.9125	01001010	01010100	932.34375	11101001	01010100
931.1875	01111011	10010100	931.9375	01101010	01010100	932.35625	10011001	01010100
931.9625	01011010	10010100				932.37875	10111001	01010100
931.9875	01111010	10010100				932.38125	10111001	01010100

Table 7-5 Synthesizer Switch Settings for Common Frequencies (continued)

frequency (MHz)	S1 1..... 8	S2 1.....8	frequency (MHz)	SI 1..... 8	$2 1..... 8	frequency (MHz)	S1 1..... 8	52 1..... 8
						932.39375	11111001	01010100
						932.40625	10000101	01010100
						932.41875	11000101	01010100
						932.43125	10100101	01010100
						932.44375	11100101	01010100
						932.45625	10010101	01010100
						932.46875	11010101	01010100
						932.48125	10110101	01010100
						932.49375	11110101	01010100
941.00625	10000000	00001100	941.38125	10111100	00001100			
941.01875	11000000	00001100	941.39375	11111100	00001100	956.2625	01010001	10011100
941.03125	10100000	00001100	941.45625	10010010	00001100	956.2875	01110001	10011100
941.04375	11100000	00001100	941.46875	11010010	00001100	956.3125	01001001	10011100
941.05625	10010000	00001100	941.48125	10110010	00001100	956.3375	01101001	10011100
941.06875	11010000	00001100	941.49375	11110010	00001100	956.3625	01011001	10011100
941.08125	10110000	00001100				956.3875	01111001	10011100
941.09375	11110000	00001100	952.0125	01000111	01101100	956.4125	01000101	10011100
941.10625	10001000	00001100	952.0375	01100111	01101100	956.4375	01100101	10011100
941.11875	11001000	00001100	952.0625	01010111	01101100			
941.13125	10101000	00001100	952.0875	01110111	01101100	959.8625	01010011	11011100
941.14375	11100000	00001100	952.1125	01001111	01101100	959.8875	01110011	11011100
941.15625	10011000	00001100	952.1375	01101111	01101100	959.9125	01001011	11011100

Table 7-5 Synthesizer Switch Settings for Common Frequencies (continued)

frequency (MHz)	S1 1.....8	S2 1.....8	frequency (MHz)	$1 1.....8	$2 1.....8	frequency (MHz)	SI 1.....8	82 1.....8
941.16875	11011000	**00001100**	952.1625	01011111	01101100			
941.18125	10111000	00001100	952.1875	01111111	01101100			
941.19375	11111000	00001100	952.2125	01000000	11101100			
941.20625	10000100	00001100	952.2375	01000000	11101100			
941.21875	11000100	**00001100**	952.2625	**01010000**	11101100			
941.23125	**10100100**	00001100	952.2875	01110000	11101100			
941.24375	11100100	00001100	952.3125	01001000	11101100			
941.25625	10010100	00001100	9523375	01101000	11101100			
941.26875	11010100	00001100						
941.28125	10110100	00001100						
941.29375	11110100	00001100						
94130625	10001100	00001100						
941.31875	11001100	00001100						
94133125	10101100	00001100						
941.34375	11101100	00001100						
94135625	10011100	00001100						
94137875	10111100	00001100						

Table 7-6 RF Board Controls

	reference designator	function		
	L2/L3/L4	resonators on helical filter #1	**CAUTION See text before attempting to adjust.**	
	L7/L8/L9	resonators on helical filter #2		

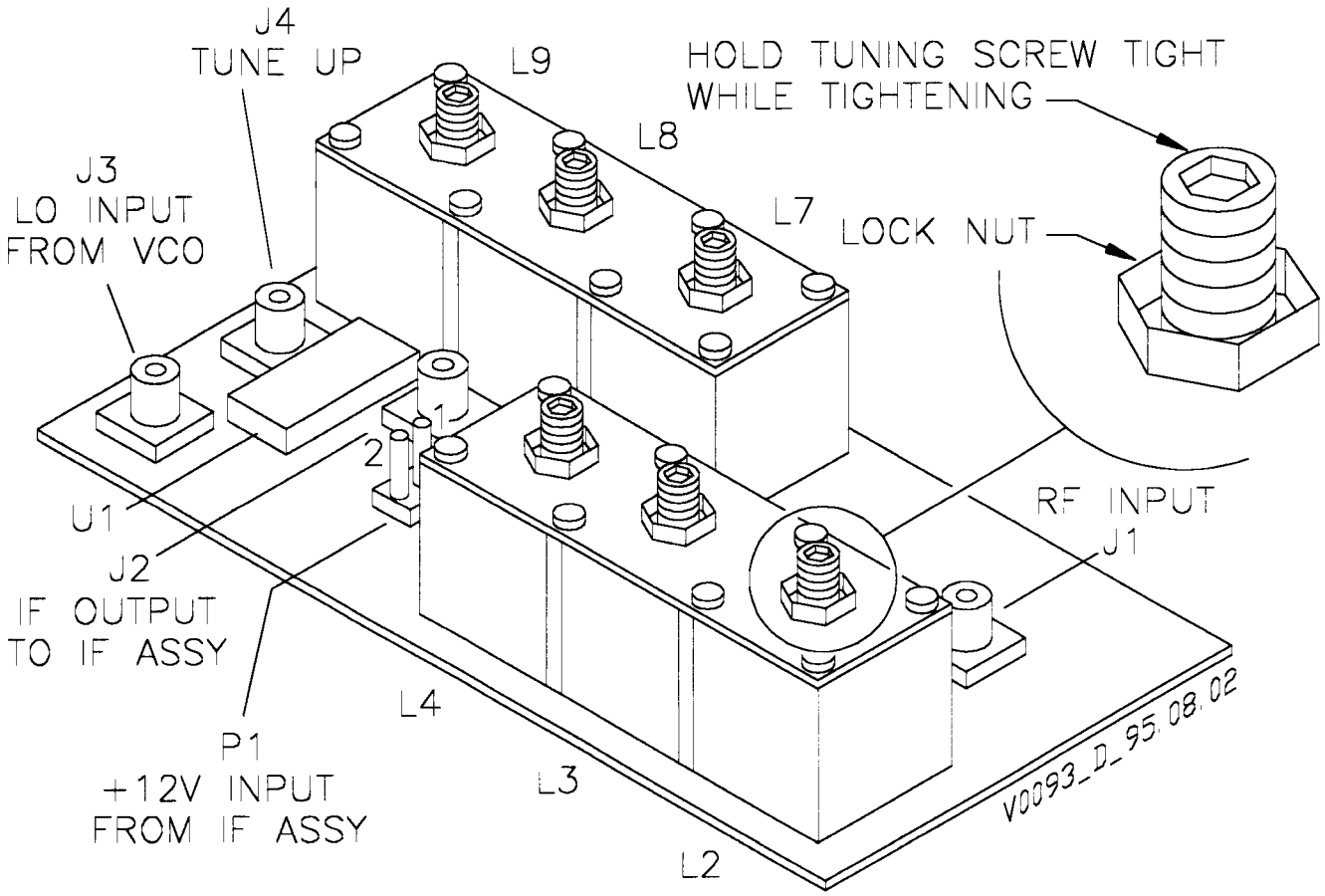


Figure 7-4 RF Assembly - Adjustments

Table 7-7 IF ***Board Controls and Indicators***

	reference designator	function	
	C51, L l, L3, L7, L8	IF tuning and filter matching	
	L5	quadrature coil	
	C52	second l.o. fine-tune	

*Table 7-7 IF **Board Controls and Indicators (continued)***

reference designator	function
D21 (green)	**POWER -** indicates power supply on when lit
D11 (green)	**KEY -** tx **key**
D14 (green)	**SQUELCH -** indicates unsquelched when lit
D15 (red; green)	green - line output J1-8, -9 at or above preset level red - line output above preset level see text) (optional)
R5	voting tone level (not used)
R51	audio level to IF board
R57	**LINE OUT -** line audio level (optional)
R80	**NORMAL -** noise squelch
R81	**TIGHT -** carrier squelch
S1	**KEY/DISable/REMOTE** switch
S2	**SQUELCH** select
JR3/JR4	3 - line audio on, ignores squelch logic 4 - line audio controlled by squelch logic
JR5/JR6	6 - voting tone disabled (movable jumper not required 5 - voting tone enabled
JR7/JR8	8 - tone board bypassed or used in link-transmitter configuration 7- tone board audio path enabled, paging-transmitter configuration
JR9/JR10/ JR11/JR12	10, 11 - true audio phase 9,12 - inverted audio phase
JR13/JR14	14 - delay processor bypassed 13 - delay processor enabled
JR15/JR16	16 - flat, ac-coupled audio fed to J1-2 (TB2-2) 15- deemphasized, ac-coupled audio fed to J1-2 (TB2-2)
Shaded items are accessible from the front panel.	
TP1	detected audio
TP2	RSSI
Shaded items are accessible from the front panel.	

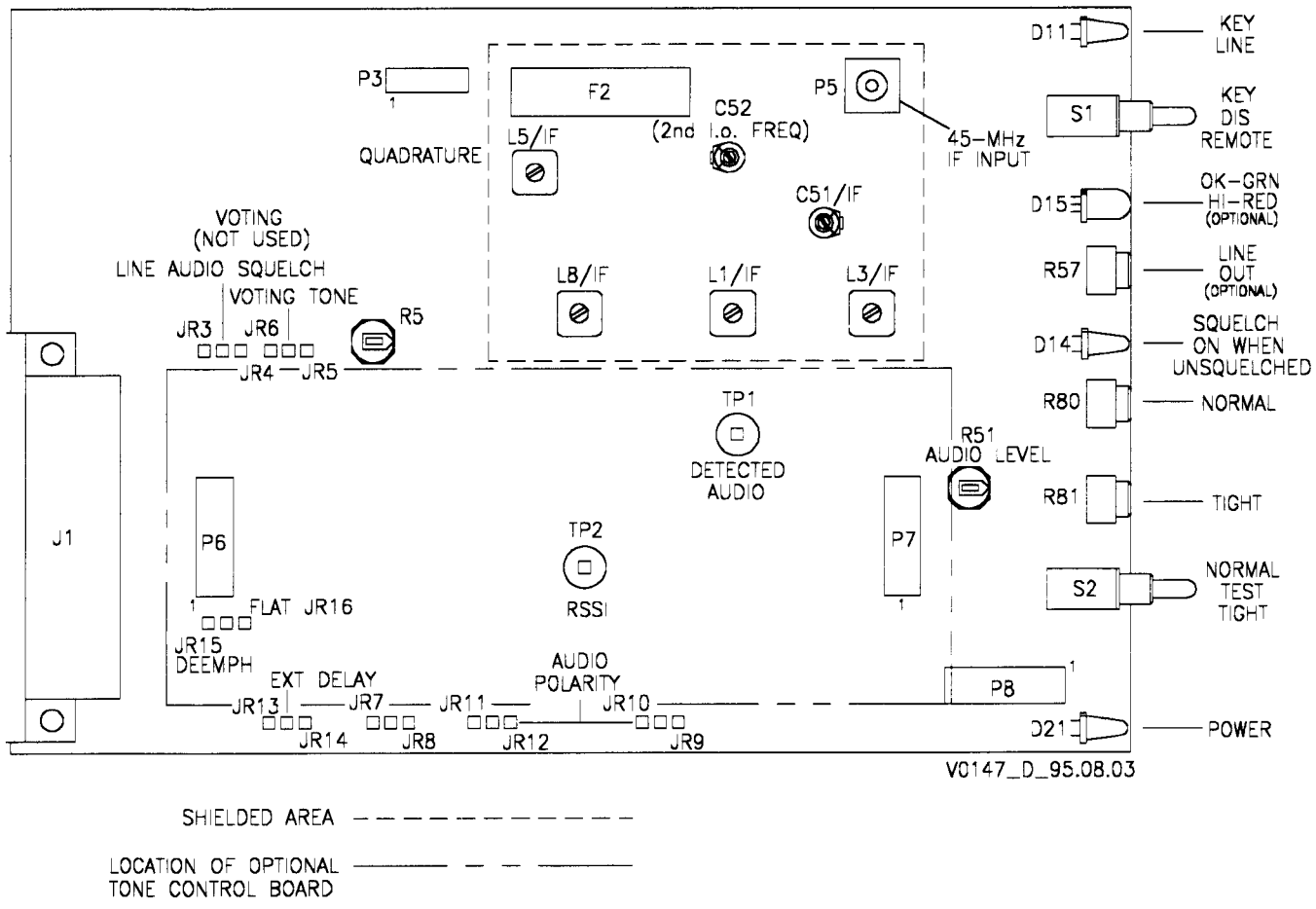


Figure 7-5 IF Board Controls and Indicators

*Table 7-8 PS/A **Board Controls***

reference designator	function
VOLUME R27	adjusts front-panel speaker level
S W 1	controls power input to power supply
SW2	jumper to enable speaker audio

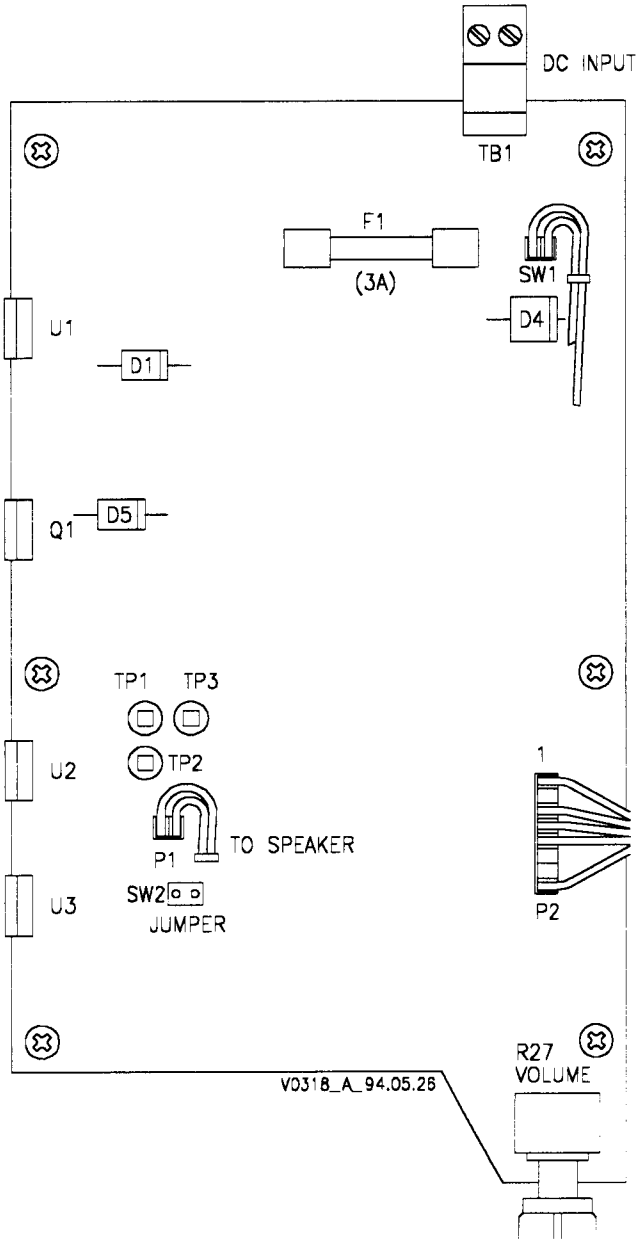


Figure 7-6 PS/A Board Controls and Indicators

8 CHECKOUT AND TROUBLESHOOTING

Refer to the system manual to isolate a fault to a piece of equipment. Use this section to isolate a fault to an assembly. If the receiver does not function correctly, perform the procedures listed in this section to determine the problem. Keeping records of performance of this receiver is helpful. Use *Table 2-1, Specifications,* to determine the expected sensitivity of the receiver. Refer to ***Figure 3-3, Top View of Internal Assemblies,*** to locate the assemblies.

8.1 Power Supply (PS/A board unless noted)

Check power supply output and delivery to pc assemblies in this procedure. *Figure 7-6, PS/A Board Controls and Indicators,* provides a view of the pc board.

Dc Power Checks

1. Check that input power (28 Vdc or within range of specifications) is supplied to rear-mounted TB 1.
2. Turn on front-panel power switch. Front-panel POWER LED IF board D21 should light.
3. Check that fuse is okay.
4. Check voltage at TP2. Voltage should be 14.5 to 15.5 Vdc.
5. Check voltage at TP1. Voltage should be 11.5 to 12.5 Vdc.
6. Refer to *Figure 7-5.* Check voltage at IF-board P7-1 and -2. Level should be same as in previous step.
7. Refer to *Figure 7-1.* Check voltage at VCO-board U10-output (U10 is next to reference assembly U11; output is at leg toward corner). Level should be 4.75 to 5.25 Vdc.

8.2 Audio (IF board unless noted)

This procedure verifies that the audio section is functioning properly. Refer to *Figure 7-5, IF Board Controls and Indicators.*

Audio Checks

Verify that the audio section is working in order to more easily troubleshoot RF and IF problems.

1. Set SQUELCH switch S2 to TEST. Be sure that SQUELCH LED D14 is lit, indicating open squelch.
2. Apply standard test signal to receiver. Note that RSSI voltage at J1-12 (TB3-5) can indicate status of RF and IF stage even if audio section is not functioning.
3. Verify that installation of jumpers is correct. Refer to *Table 7-7, IF* ***Board Controls and Indicators.*** Be sure that R51 is not turned completely down.
4. If receiver uses tone board, temporarily disable tone board path by setting JR7/JR8 to JR8.

9 REMOVAL AND REINSTALLATION

Remove all power from the equipment before performing any of the following procedures.

Note

Unless otherwise noted, the reinstallation of assemblies is obvious from reading the procedure for removal.

Caution

When reattaching plugs onto pc boards, be certain to observe correct polarity and alignment.

Note

The VCO board contains internal switches which are used to program the receive frequency.

The IF board contains jumpers which characterize its operation.

The IF board may be wideband or narrowband.

The TONE board contains switches which determine its decoding and notch frequency.

If you replace one or more of these boards or the entire receiver, ensure that the replacement is configured the same as the original.

9.1 Access to Internal Assemblies

Perform the following procedure to gain access to the controls on internal assemblies or to remove or install them.

Accessing Internal Assemblies

1. Remove all input power from cabinet.
2. Slide receiver mostly out of rack by removing screws which hold front panel to rails and pulling forward to gain access to rear.
3. Mark and disconnect wires and connectors which are connected to rear of chassis.
4. If interface board is part of station wiring, leave it connected to station wiring and disconnect it from rear of receiver by unscrewing retaining screws from standoffs.
5. Pull off removable portion of TB 1 (some versions). If not needed for troubleshooting, leave connected to system wiring.
6. Complete removal of receiver from rack.
7. Remove cover by loosening appropriate screws, pulling up on front of top cover, and sliding cover toward rear.
8. Place receiver on test bench and make provision for standard test setup. See *Figure 7-2, Test Setup.*

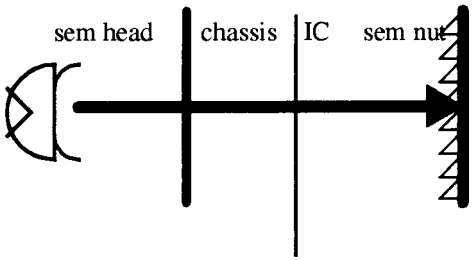
Removing Receiver Rear Panel

1. Continue disassembly if removal of major internal assemblies is required. Removal of rear panel is required for some assemblies.
2. Disconnect BNC cable plug from front-end (RF assembly) and VCO/synthesizer receptacles.
3. Remove 4 screws which hold receiver back and remove rear panel.

9.2 PS/A Board

PS/A Board Removal

1. Remove rear panel.
2. Mark and remove connectors for electrical connections. Observe polarity of P2.
3. Record arrangement of hardware and remove hardware holding IC heat sinks to side of chassis.



4. Remove screws holding pc board to chassis and lift up and toward rear.

9.3 IF Audio Board

IF Board Removal

1. Remove rear panel.
2. Mark and remove connectors for electrical connections. Observe polarity of connectors.
3. Remove tone board if required.
4. Remove screws holding pc board to chassis and lift board up and toward rear.

9.4 VCO Board

VCO Board Removal

1. Mark and remove power and signal connectors. Note polarity of connectors.
2. Remove rear panel or BNC feedthrough to allow pc board clearance.
3. Use nutdriver to remove shield.

4. Use nutdriver to remove nuts holding pc board to shock-mounting pegs. Hold bott of mounting screws with screwdriver from bottom, if necessary.
5. Lift board up and toward rear.
6. Record positions of jumpers and programming switch if new board is to be install
7. Replace shield and fasten with hardware, as appropriate.

Note

Be certain that no loose hardware, such as springs, is lost while the VCO is out of its mounting.

9.5 RF Board Assembly

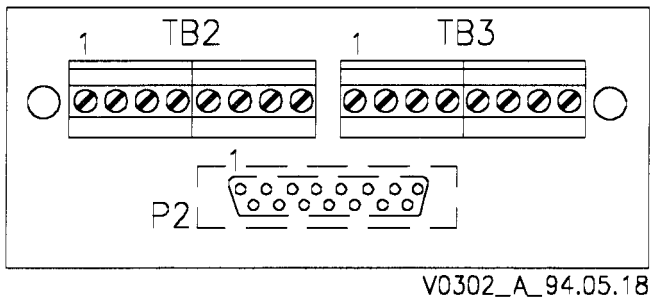
RF Board Assembly Removal

1. Mark and remove power and signal connectors. Note polarity of connectors.
2. Remove rear panel or BNC feedthrough to allow pc board clearance.
3. Remove screws which hold pc board to chassis.
4. Remove pc board by carefully lifting up.

Note

Be certain that the new RF board is tuned to the correct range if you are replacing the front end assembly.

10 FIGURES



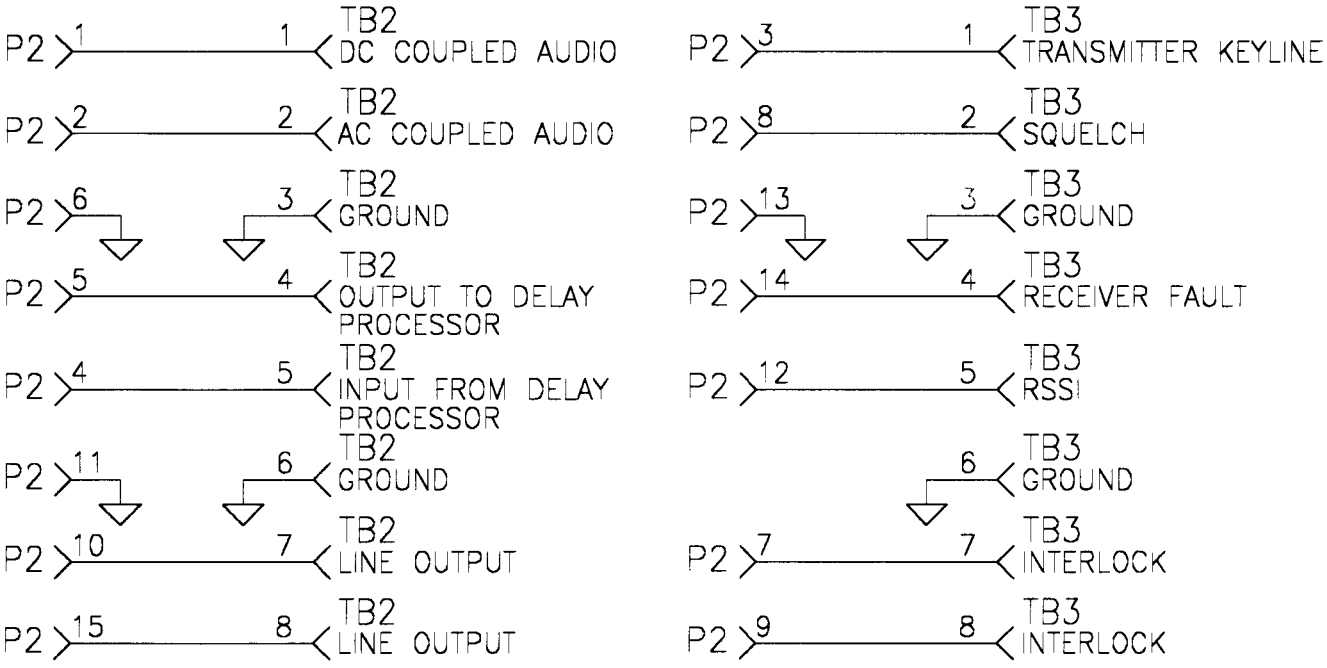


Figure 10-1 Interface Board 265-0305-002 Assembly and Schematic

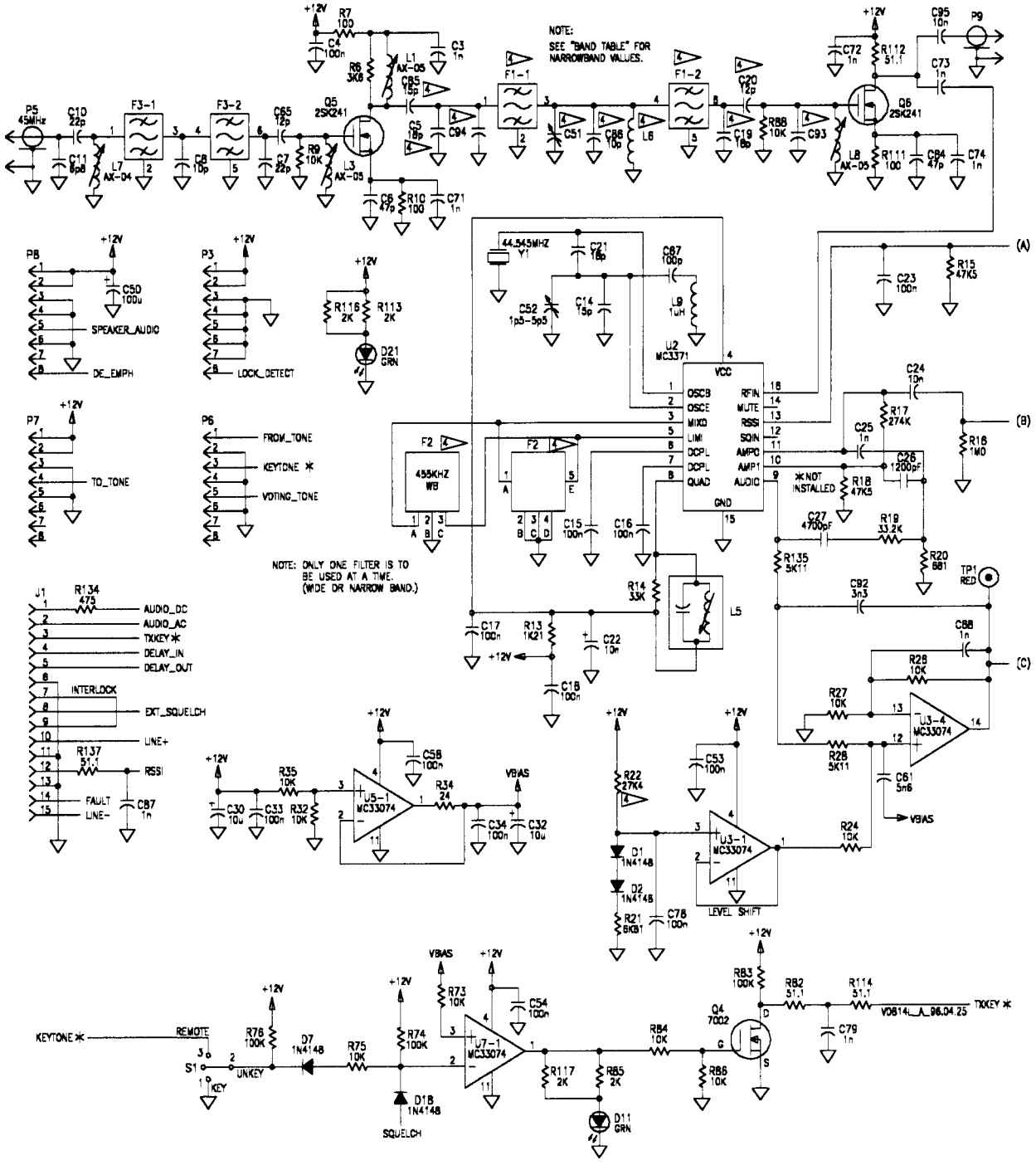


Figure 10-2 IF Audio Board Schematic

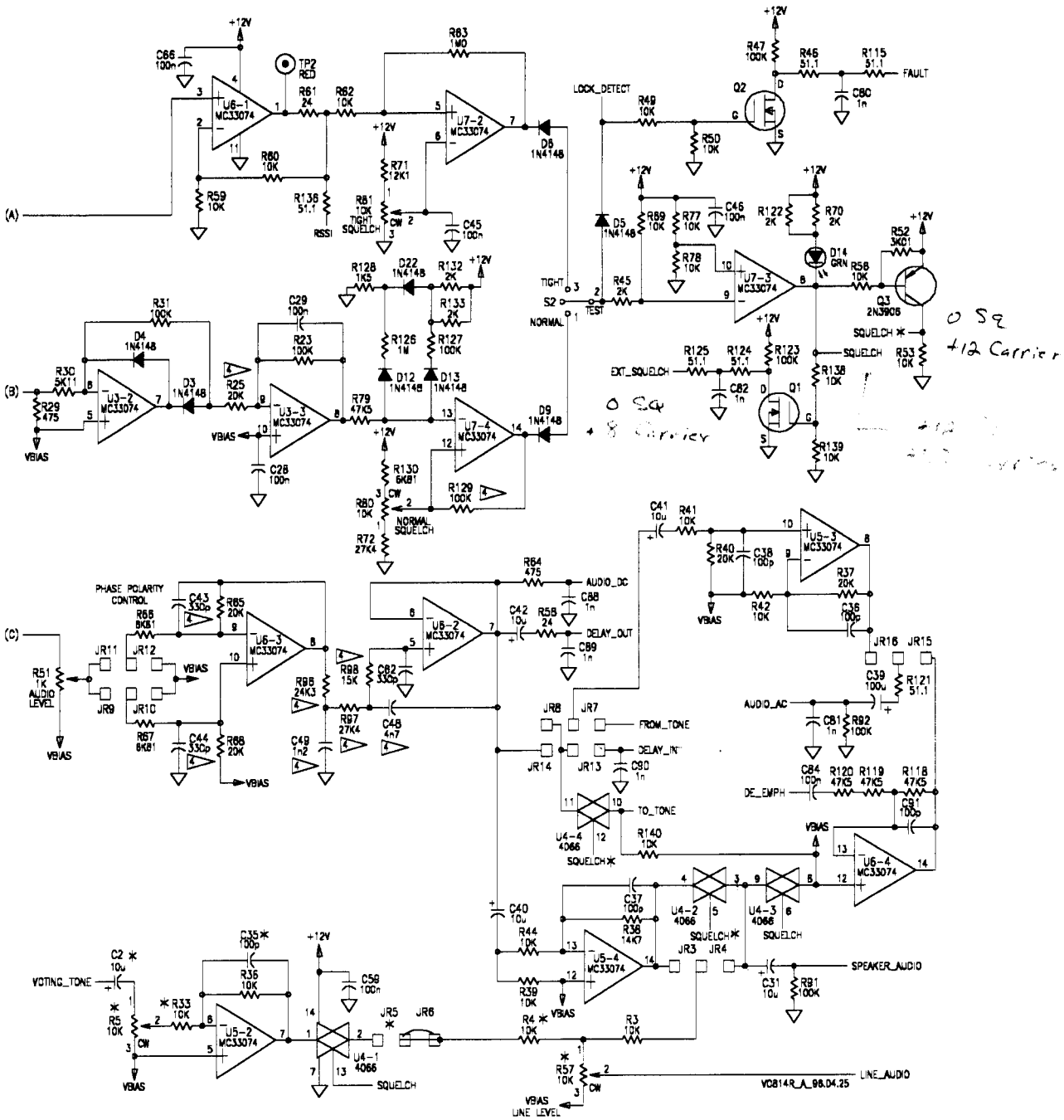
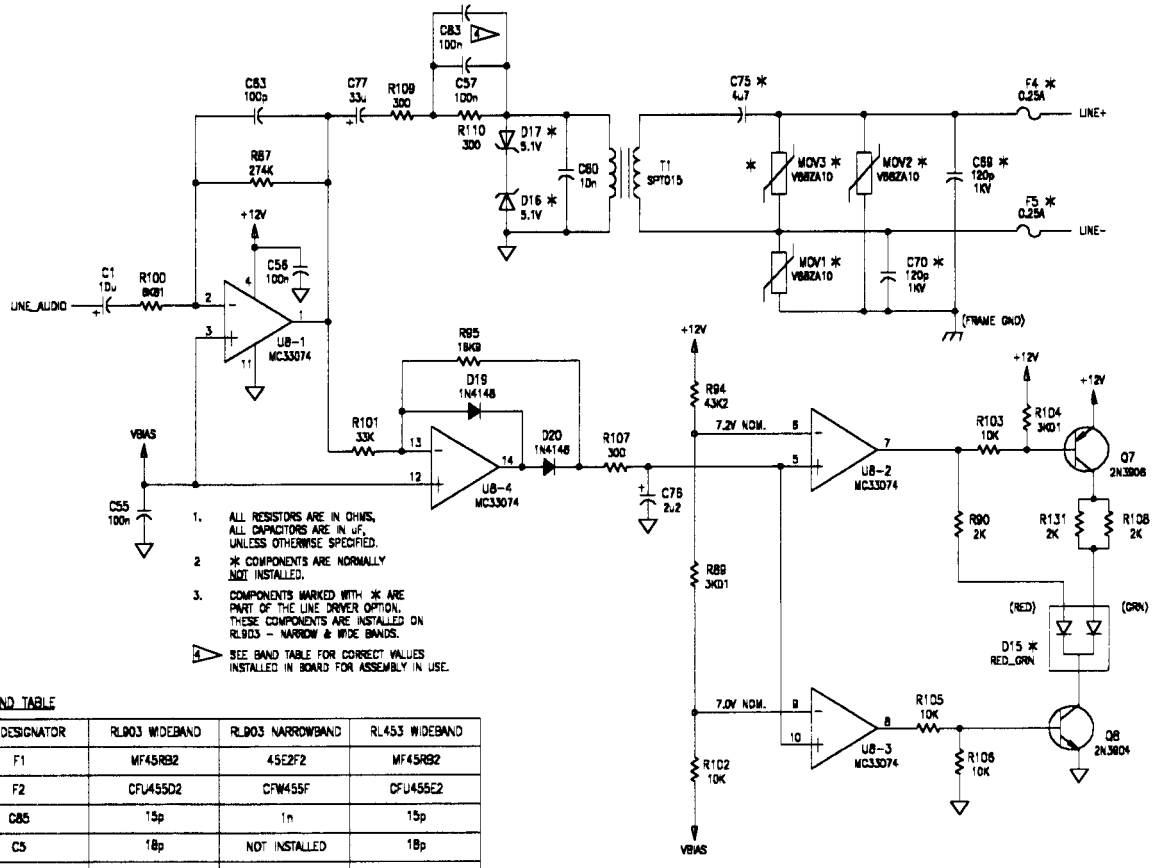


Figure 10-2, IF Audio Board Schematic (continued)



BAND TABLE

REF DESIGNATOR	RL903 WIDEBAND	RL903 NARROWBAND	RL453 WIDEBAND
F1	MF45R92	45E2F2	MF45R92
F2	CFU455D2	CFW455F	CFU455E2
C85	15p	1n	15p
C5	18p	NOT INSTALLED	18p
L8	NOT INSTALLED	1.5uH	NOT INSTALLED
C51	NOT INSTALLED	0.5 TO 1.5p	NOT INSTALLED
C86	10p	2p2	10p
C19	18p	NOT INSTALLED	18p
C20	12p	100p	12p
R88	10K	3K65	10K
C93	NOT INSTALLED	8p8	NOT INSTALLED
C94	NOT INSTALLED	8p8	NOT INSTALLED
C83	NOT INSTALLED	0.1uF	0.1uF
R96	24K3	20K	12K1
R97	27K4	22K1	12K1
R98	15K	16K9	5K11
R22	27K4	30K1	27K4
R25	20K	6.81K	20K
R129	100K	82.5K	100K
C49	1.2n	1.2n	47p
C48	4.7n	4.7n	1n
C43,C44	330pF	330pF	NOT INSTALLED

JUMPER TABLE

FEATURE	INSTALL	REMOVE	COMMENTS
AUDIO POLARITY +	JR9 JR12	JR10 JR11	AUDIO PHASE POLARITY CONTROL.
AUDIO POLARITY -	JR10 JR11	JR9 JR12	AUDIO PHASE POLARITY CONTROL.
DELAY	JR8 JR13	JR7 JR14	ROUTES AUDIO TO OPTIONAL EXTERNAL DELAY BOARD. BREAKS AUDIO OUT AT DELAY_OUT, RETURN IN AT DELAY_IN.
TONE	JR7 JR14	JR8 JR13	ROUTES AUDIO TO OPTIONAL TONE BOARD. BREAKS AUDIO OUT AT TO_TONE AND RETURNS AT FROM_TONE.
DELAY/TONE	JR7 JR13	JR8 JR14	ROUTES AUDIO TO OPTIONAL, EXTERNAL DELAY AND OPTIONAL TONE BOARD.
DE-EMPH	JR15	JR16	AC_OUT DE-EMPHASIZED.
FLAT	JR16	JR15	AC_OUT FLAT.
SQUELCHED LINE AUDIO	JR4	JR3	ROUTES SQUELCHED AUDIO TO THE OPTIONAL LINE DRIVER.
UNSQUELCHED LINE AUDIO	JR3	JR4	ROUTES UNSQUELCHED AUDIO TO THE OPTIONAL LINE DRIVER.
VOTING TONE ENABLE	JR5	JR6	ENABLES AUXILLIARY TONE INPUT. (OPTIONAL)
VOTING TONE DISABLE	JR6	JR5	DISABLES AUXILLIARY TONE INPUT. (OPTIONAL)
PASS THRU	JR8 JR14 JR16	JR7 JR13 JR15	STANDARD KC.

VD815_A_96.04.25

Figure 10-2, IF Audio Board Schematic (continued)

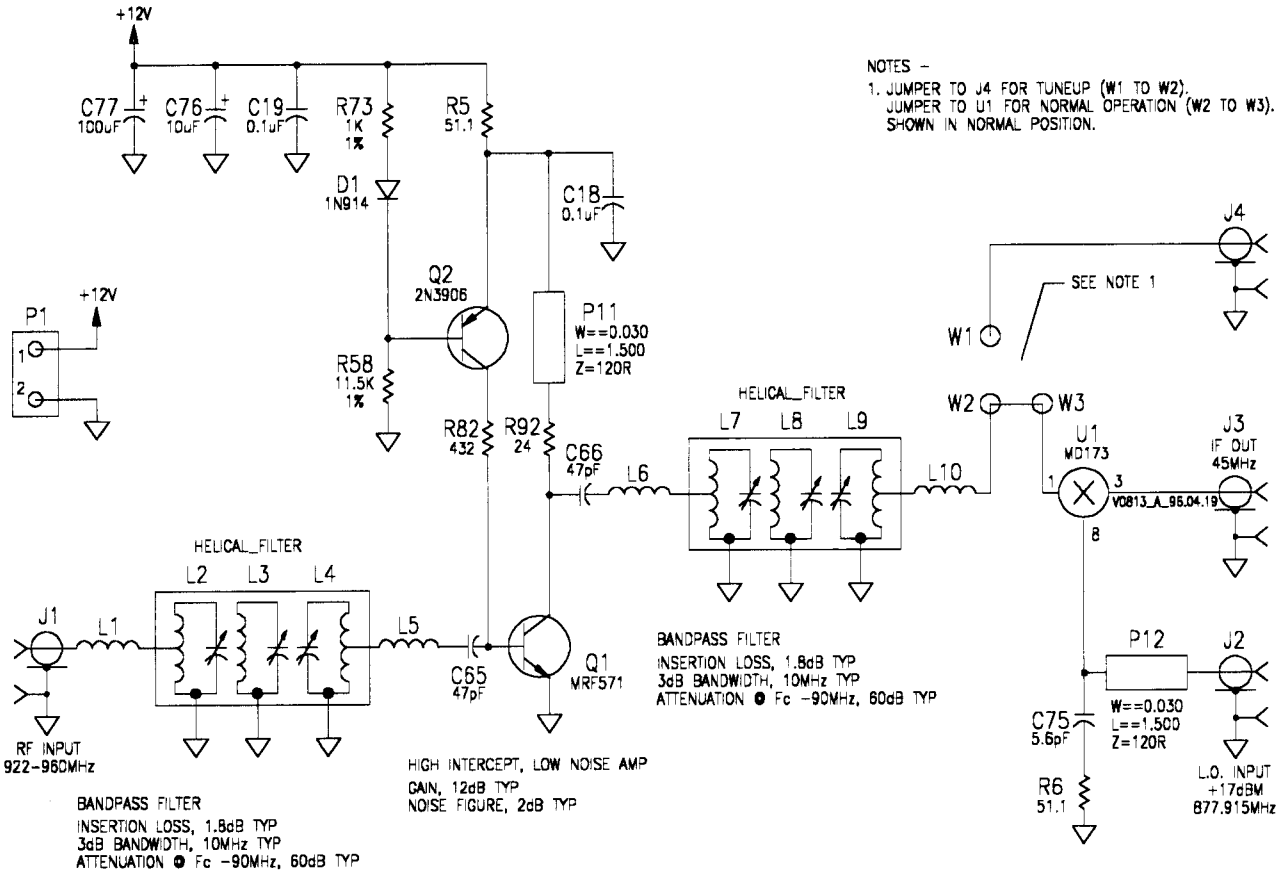


Figure 10-3 Front End Schematic

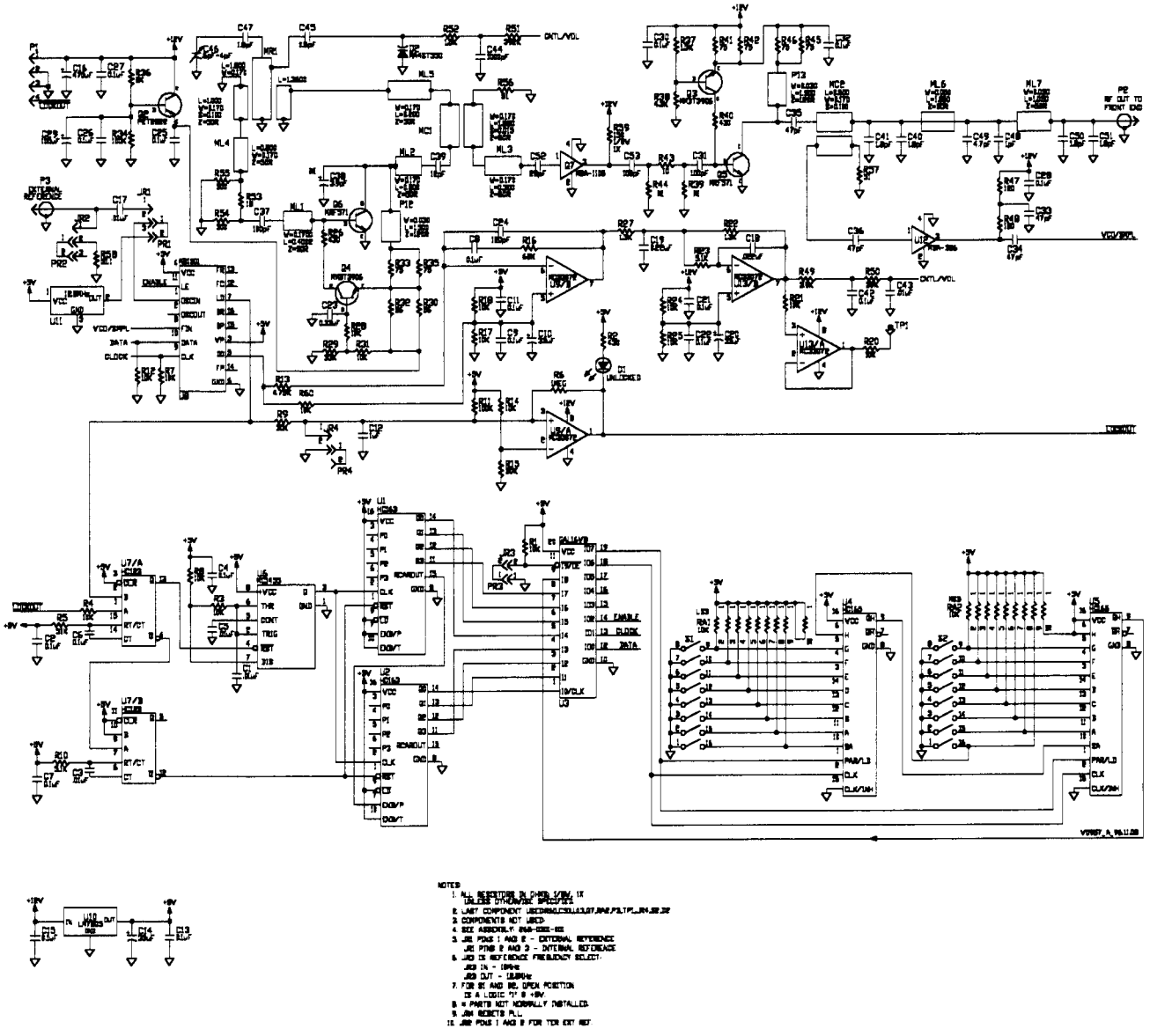


Figure 10-4 VCO Board Schematic

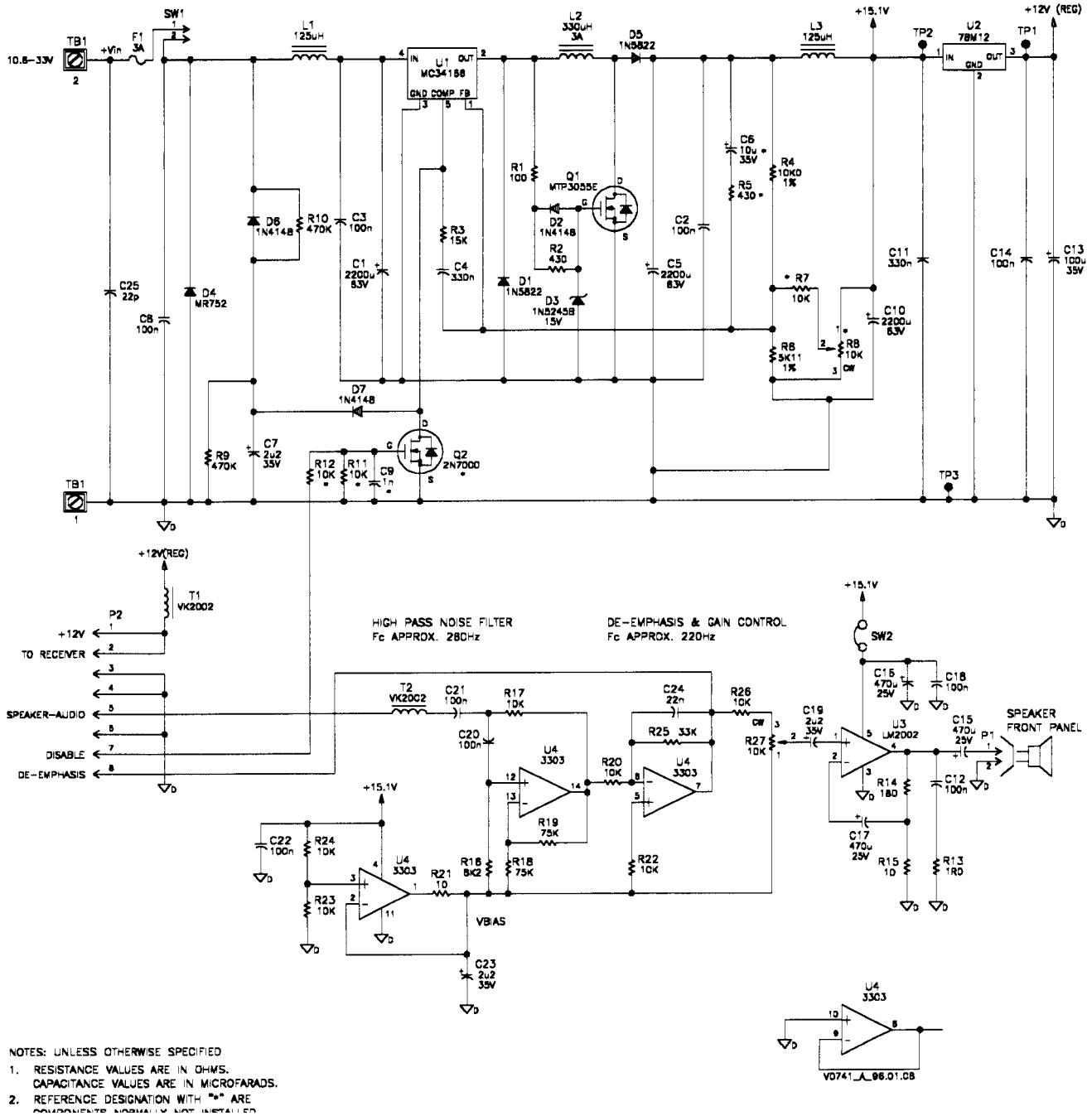


Figure 10-5 PS/A Board Schematic

A

B

C

D

F

G

J

K

L

M

N

P

Q

R

S

T

V

W