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PRC1099A

HF Transceiver

Technical Manual

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Revision History

Date of Revision	Revision Letter	Description of Changes	Pages Affected
2/06	M	Changes to format, text, boards, schematics and part lists.	All
4/08	N	Revised to describe new Synthesizer board.	Chapter 3 Chapter 4
5/10	P	Battery pack, weight, duty cycle, audio specs. Add internal option PRC1099A-IP. Remove reference to internal option (1099AME). Update boards, schematics, part lists.	1-2 1-3, 6-19 Chapter 6 Chapters 3, 4, 6
6/11	R	Update component locations diagrams, schematics and parts lists to the latest revisions.	Chapter 4, Chapter 6
02/17	S	Updated manual format. Eliminated Chapter 2: Installation. This information is covered in the Operator manual. Renamed and restructured Chapters 3 and 4. Divided Chapter 4 into separate chapters for each board. Added Front Panel Assembly chapter. Updated component locations diagrams, schematics, and parts lists to the latest revision. Removed references to internal battery charger. This option is now obsolete.	All All Chapter 3, 4 Chapter 12 All Chapter 11

Warranty

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Technical Support Services
Datron World Communications Inc.
3055 Enterprise Court
Vista, California 92081

The equipment must be packed securely. Datron shall not be responsible for any damage incurred in transit. A letter containing the following information must be included with the equipment:

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b. Name of dealer or supplier of the equipment.
c. Detailed explanation of problem.
d. Return shipping instructions.
e. Telephone or fax number where Buyer may be contacted.

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3055 Enterprise Court
Vista, California 92081; and

b. Include a letter with the following information:
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2. Serial number and model of equipment
3. Date of installation

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Buyer's sole remedies and the entire liability of Datron are set forth above. In no event will Datron be liable to Buyer or any other person for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of use of, or inability to use the equipment.

Safety Considerations

This product and manual must be thoroughly understood before attempting installation and operation. To do so without proper knowledge can result in equipment failure and bodily injury.

Caution: Before applying AC power, be sure that the equipment has been properly configured for the available line voltage. Attempted operation at the wrong voltage can result in damage and voids the warranty. See the manuals section on installation. DO NOT operate equipment with cover removed.

Earth Ground

All Datron products are supplied with a standard, 3-wire, grounded AC plug. **DO NOT** attempt to disable the ground terminal by using 2-wire adapters of any type. Any disconnection of the equipment ground causes a potential shock hazard that could result in personal injury. DO NOT operate any equipment until a suitable ground has been established. Consult the manual section on grounding.

Servicing

Only trained personnel should perform product repair. To avoid electric shock, **DO NOT** open the case unless qualified to do so.

Various measurements and adjustments described in this manual are performed with AC power applied and the protective covers removed. Capacitors (particularly the large power supply electrolytic type) can remain charged for a considerable time after the unit has been shut off. Use particular care when working around them, as a short circuit can release sufficient energy to cause damage to the equipment and possible injury.

To protect against fire hazard, always replace line fuses with ones of the same current rating and type (normal delay, slow blow, etc.). **DO NOT** use higher value replacements in an attempt to prevent fuse failure. If fuses are failing repeatedly this indicates a probable defect in the equipment that needs attention.

Use only genuine Datron factory parts for full performance and safety of this product.

Made in the USA

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Chapter 1: Introduction

1.1 The PRC1099A

The PRC1099A is an HF/SSB tactical manpack transceiver designed for demanding high-visibility battlefield applications. It is rugged, lightweight, easy to use, and configurable with numerous add-on accessories to create a wide variety of manpack, mobile or base station systems.

The PRC1099A includes the following features:

- 1.6 to 30 MHz transmit frequency range adjustable in 10 Hz steps
- Menu-driven control from front panel LCD
- Rugged chassis configurable for manpack, mobile and base station systems
- ALE option

This manual provides technical information for the service and repair of the PRC1099A. Included are schematic diagrams, operational theory, test and alignment procedures and detailed parts lists. For installation and operation instruction, refer to the PRC1099A-MSOP operator manual.

1.2 Technical Specifications

Note: Specifications are subject to change without notice or obligation.

Characteristic	Specification
General	
Frequency Range	1.6 to 30 MHz
Available Channels	2,840,000 in 10 Hz steps
Preset Channels	100 programmable memory channels
Scanning	Radio and ALE scan modes
Channel Programming	From front panel or remotely via computer
Modes	USB, LSB, CW, AME; simplex or half-duplex
Input Power	11 to 15 VDC
Battery Pack	BB-LA6 sealed lead calcium BA5598/
Low Battery Indicator	LCD battery icon
Antenna Port	BNC for 50 ohm broadband antennas or for connection to external amplifier; whip antenna port
Display	Multifunction custom LED with backlight
Mechanical/Environmental	
Size W x H x D, including battery pack	11.1 in. x 4.1 in. x 9.25 in. (28.2 cm x 10.5 cm x 23.5 cm);
Weight	9.7 lb. (4.4 kg) without battery pack; BB-LA6 pack 5.2 lb. (2.4 kg)
Package	Olive drab green, sealed, including battery pack
Temperature	-30° to +60°C, operating
Shock, Vibration, Humidity, Fungus, Altitude	Per MIL-STD-810
Transmitter	
RF Power Output	5/20W, PEP, or average, in manpack; 5/20/100/400W in mobile configuration
Duty Cycle	Continuous duty service at 5W
Harmonics	-50 db (2 to 30 MHz)
Receiver	
Sensitivity	10 db SINAD for 0.5 uV input

Characteristic	Specification
Squelch	Audio derived, noise immune
Audio	500 mW into 16 ohm, 50 mW at 150 ohm, 0 dBm into 600 ohm
Antenna Tuning	
Whip	AT-271A/U and longwires (use LWA for wires longer than 15m), fully automatic antenna tuning, 100-channel memory
Tune Time	1 to 3 seconds initial tune; 20 ms, memory mode for preset channels (no RF output in memory tune mode)
Antenna Switching	Tuner bypassed and 50 ohm port automatically engaged when whip (or long wire) antenna removed.
Internal Options	
1099ALE	FED-STD-1045A ALE
PRC1099A-IP	Internet protocol interface for 10Base-T Ethernet TCP/IP connection

1.3 Reference Manual

Refer to the PRC1099A-MSOP operator manual for detailed information on operating and programming the PRC1099A radio set.

1.4 Glossary of Terms

ALE — Automatic link establishment. A complex system that combines software and hardware to establish the best quality communications link between two or more radios.

AM — Amplitude modulation. A common form of modulation where the modulating signal varies the amplitude of the carrier signal.

AME — Amplitude modulation enhanced. A single sideband transmission with an inserted carrier which can be received on radios that can only receive AM modulated transmissions. Signals can also be transmitted using single sideband and received with an AM receiver.

BITE — Built-in-test-equipment. Internal firmware that tests the installed hardware and boards in the radio to verify presence and functionality.

CW — Continuous wave signal. Also known as Morse code.

Channel — A group of preset parameters stored in permanent memory associated with a transmit and receive frequency.

LSB	Lower sideband. The information carrying band of frequencies below the carrier frequency in SSB transmissions.
Scan group	A preset group of ALE channels stored in memory to which the radio scans or listens for incoming ALE calls. The ALE option must be installed and turned on.
Squelch	A radio function (syllabic squelch) that reduces background noise to a received signal by turning off the speaker unless audio (voice) is detected. This eliminates the noise between syllables during normal voice audio.
USB	Upper sideband. The information carrying band of frequencies above the carrier frequency in SSB transmissions.
VSWR	Voltage standing wave ratio. The ratio of peak voltage in the standing wave to the minimum voltage. Standing waves are stationary interference patterns inside the antenna feed line formed by forward and reflected RF power.

Chapter 2: System Overview

This chapter provides an overview of the various PRC1099A's operations including frequency conversion, receive and transmit paths and control signals. Chapter 3 through 14 provides detailed circuit descriptions of each board as well as technical specifications and servicing data. Figure 2-2 on page 2-14 provides a system block diagram and Figure 2-3 on page 2-15 provides a wiring diagram.

2.1 Frequency Conversion

The PRC1099A up-converts transmit signals from 1650 or 1647 kHz to 75 MHz IF and then down-coverts the 75 MHz IF to the selected channel frequency (1.6 to 30 MHz). The receive signal is first up-converted from the selected channel frequency to the 75 MHz IF and then down-converted to either 1650 or 1647 kHz IF modulated by the receive audio.

In transmit mode, the PRC1099A mixes the modulated 1650 or 1647 kHz IF with the 73.35 MHz second LO to the first IF output at 75 MHz, the Direct Digital Synthesizer (DDS) generates the first local oscillator (LO) frequency in the range of 76.6 and 105 MHz in 1 Hz steps. The second conversion from 75 MHz to 1650 kHz requires a local oscillator frequency of 73.35 MHz.

The PRC1099A provides selectable USB/LSB operation using separate BFO frequencies of 1650 and 1647 kHz, respectively. The synthesizer is automatically offset by 3 kHz when the sidebands are switched however, there is no change in the output frequency.

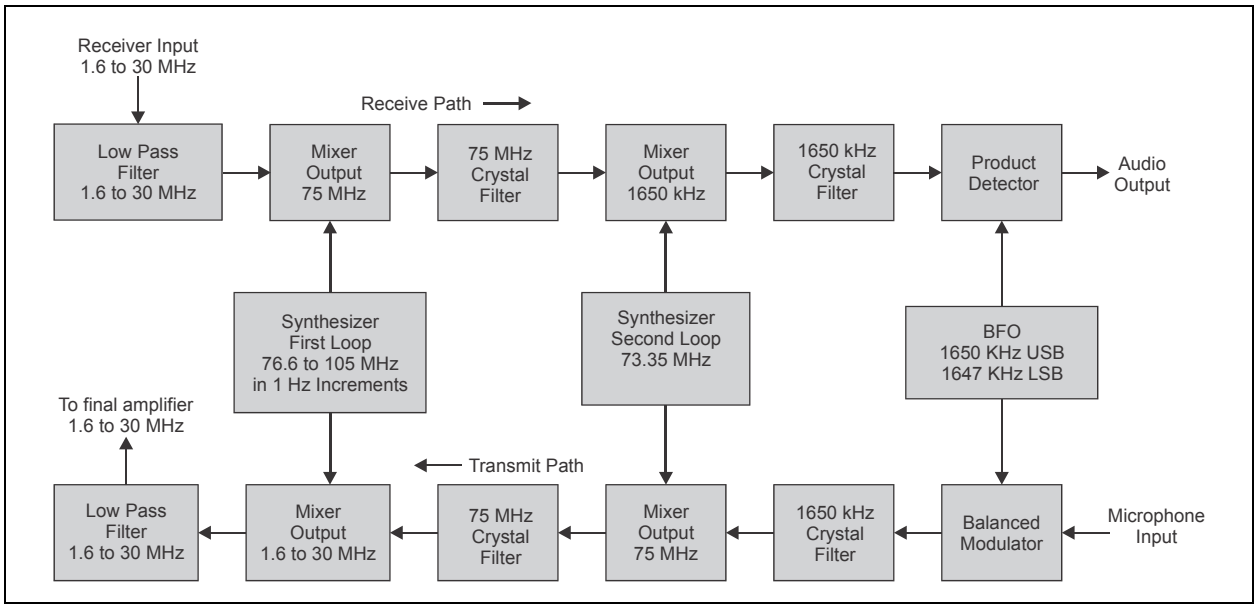

Figure 2-1 Frequency Conversion Plan

2.2 DDS Synthesizer

The DDS synthesizer outputs two local oscillator frequencies and a beat frequency oscillator (BFO) frequency that it derives from a single reference oscillator. The first local oscillator frequency (LO1) is a variable output ranging from 76.6 to 105 MHz in 1 Hz steps. The second local oscillator (LO2) is a fixed output frequency is 73.35, and the BFO is either 1647 kHz (LSB mode) or 1650 kHz (USB mode),

2.3 Processor Control

The processor controls the DDS synthesizer, display, antenna tuner and many other functions using the firmware program stored in permanent read-only memory (ROM). Programmable functions such as channel frequencies and antenna tune information are stored in random access memory (RAM). A lithium battery with a nominal life of ten years provides DC power backup for the RAM.

The serial peripheral interface (SPI) bus delivers data and control signals to the appropriate boards. The data is decoded on the individual boards. The front panel controls also interface with the processor to control and configure radio functions. The serial data extends to the Accessory connector to control external accessories such as a RF power amplifier.

2.4 Receive Path

2.4.1 Antenna Tuner Board Receive Path

The receive path extends from the antenna to a handset or headset connected to one of the Audio connectors on the front panel. The input receive signal is received at the antenna and is then applied to the Antenna Tuner board that matches the radio output impedance to the antenna to achieve the best RF power transfer.

2.4.2 Audio/Filter Board Receive Path 1

From the Antenna Tuner board, the receive signal is applied to the Audio/Filter board where it passes through one of six 5-pole, elliptic-function filters, and then through a 1600 kHz high-pass filter to prevent overload from FM broadcast stations. The receive signal is then routed to the Mixer board.

2.4.3 Mixer Board Receive Path

On the Mixer board, the receive signal is filtered using a 30 MHz low-pass filter to prevent VHF responses and then applied to a high level, double-balanced mixer where it is mixed with the first LO (LO1) from the DDS on the Synthesizer board to produce a 75 MHz IF signal. The 75 MHz output is amplified using a high dynamic range amplifier before passing through the 4-pole, monolithic 75 MHz filter.

The 75 MHz filter maintains the +11 dBm intercept point through to the output. Output from the 75 MHz filter is amplified by an AGC-controlled, dual gate MOSFET amplifier and is then down-converted in a dual gate MOSFET mixer to the second LO (LO2) to 1650 kHz and output to the 1650 kHz IF board.

2.4.4 1650 kHz IF Board Receive Path

On the 1650 kHz IF board, the receive signal is applied to a 6-pole crystal sideband filter and then amplified by an AGC-controlled dual-gate MOSFET amplifier. A fixed-gain bipolar amplifier provides the final IF amplification. From the 1650 kHz IF board, the receive signal is routed back to the Audio/Filter board.

2.4.5 Audio/Filter Board Receive Path 2

Back on the Audio/Filter board, the receive signal is applied to the product detector that removes the 1650 kHz IF frequency leaving just the audio signal. From the product detector, the audio split into two paths; one passes through the squelch circuit where it is processed and applied to a pulse counter that detects the low-frequency FM component in human speech. This output controls the squelch which opens when speech is detected and closed for background noise.

2.4.6 Audio Outputs Receive Path

The other audio path is routed to the front panel Volume control potentiometer. This path is also split into two paths: one is routed to the front panel Audio connector for a handset or headset. The other path is routed to the 600 Ohm output at the front panel Accessory connector for an external loud speaker.

2.5 Transmit Path

2.5.1 Audio/Filter Board Transmit Path 1

The transmit path begins at a microphone attached to one of the front panel Audio connectors. From the Audio connector the audio signal is applied to the VOGAD that automatically adjusts the gain to provide constant audio output to the balanced modulator. The balanced modulator injects the transmit audio signal with a 1650 kHz carrier frequency that produces a 1650 kHz, double-sideband (DBS), suppressed carrier output (1647 kHz for LSB operation). The modulated DBS transmit signal is routed to the 1650 kHz IF board.

2.5.2 1650 kHz IF Board Transmit Path

The 1650 kHz DSB signal is routed to the 1650 kHz IF board where it is applied to an TX IF amplifier and then filtered with a 6-pole, crystal sideband filter where either the upper or lower sideband is removed. From the crystal filter, the single sideband (SSB) transmit signal is routed to the Mixer board.

2.5.3 Mixer Board Transmit Path

From the 1650 kHz IF board, the 1650 kHz, SSB, suppressed carrier, transmit signal is applied to the Mixer board where a balanced mixer combines the 1650 kHz signal with the 73.35 MHz second LO (LO2) from the DDS on the Synthesizer board to produce a 75 MHz IF signal. This IF signal is amplified at the 75 MHz amplifier and then applied to the 75 MHz crystal filter.

The 75 MHz IF amplifier has ALC applied that is derived from the currents and voltages at the transmitter output. The ALC system limits the maximum current and voltage from the RF power amplifier so that the transceiver can be safely operated at any VSWR level.

The 75 MHz signal is then down-converted in a double-balanced mixer to the selected channel frequency. A broadband 1.6 to 30 MHz amplifier increases the exciter output to approximately +3 dBm. A low-pass filter at the output removes the image frequencies. From the Mixer board, the SSB channel frequency transmit signal is routed to the Power Amplifier board.

2.5.4 Power Amplifier Board

On the Power Amplifier (PA) board, the high-power final RF power amplifiers that consist of a Class A pre-driver, a push-pull driver stage, and a push-pull final output stage boost the transmit signal to its final RF output power or approximately 20W in high power mode or 5W in low power mode. The PA board uses special broadband transformers for interstage and output coupling. From the PA board, the SSB channel frequency signal is routed back to the Audio/Filter board.

2.5.5 Audio/Filter Board Transmit Path 2

On the Audio/Filter board, the 20W transmit signal transmit signal is applied to one of six separate high-performance, elliptical-function filters that provide effective attenuation of the harmonic spectrum. The processor selects the filter based on the selected channel. The signal passes through the ALC detector and is routed to the Antenna Tuner board.

2.5.6 Automatic Antenna Tuner Transmit Path

The Antenna Tuner board uses detectors at the transmit signal input and follows a tuning routine, controlled by the processor, to match the radio output impedance to the antenna for maximum output. To protect the RF power amplifiers from damage, the output is automatically switched to the 50 ohm antenna connector when the whip or long-wire antenna is removed.

2.6 DC Power

The PRC1099A operates from a 12 to 15 VDC supply source. The critical circuitry operates from the regulated 8V and 5V supply lines. The higher power circuitry operates directly from the 12V supply but continues to operate down to 10.5V with only minimal reduction in performance specifications.

Table 2-1 Board Functionality

Function	Path	Description	I/O
Audio/Filter Board			
VOGAD - U8C	Transmit	Amplifies microphone input and automatically controls gain.	Input from front-panel handset. Output to balanced modulator U6.
Balanced Modulator - U6	Transmit	Generates DSB 1650 kHz signal, suppresses carrier.	Input from VOGAD. Output to J10 to 1650 kHz IF board.
Product Detector - U4	Receive	Demodulates 1650 kHz SSB signal.	Input from 1650 kHz IF board amplifier. Output to squelch and audio PA. BFO input from Synthesizer board.

Table 2-1 Board Functionality (continued)

Function	Path	Description	I/O
Squelch - U1, U2, and U3	Receive	Detects low-frequency FM voice components to actuate squelch.	Input from product detector U4. Output to squelch gates Q1 and Q2.
Audio PA - U5	Receive	Amplifies audio for handset or loudspeaker.	Input from product detector U4 through audio gain control. Output to handset.
Audio AMP - U10A	Receive	Provides 0 dBm 600 ohm audio output.	Input from product detector U4. Output to Accessory socket.
RF Gate - Q23, Q24	Transmit	Detects RF output and opens sidetone gate.	Input from ALC circuitry. Output to squelch gates.
Squelch Gates - Q1, Q2	Receive	Switches on Audio PA (U5). Controls current in RX front end.	Input from squelch control. Output to Audio PA gate and gates Mixer board.
CW Hold - Q17	Transmit	Provides semi break-in CW and ATU tune signal.	Input from CW key and processor. Output to tone generator Processor board.
Filter Switching - K2–K11		Decodes serial data & selects correct filter range.	Input serial data from Processor board. Output switches RF filters in and out of transmit and receive path.
ALC - Q21	Transmit	Measures RF current & RF voltage. Provides 5W and 20W level output control.	Input from TX PA output. Output to Sidetone Gate, ALC gain Mixer board.
T/R Relay - K13		Switches TX/RX RF and R+8V and T+8V lines.	Input from PTT, Processor board.
Low-Pass RF Filters	Transmit	Low-pass filters for TX signal.	Input from PA board. Output to Antenna Tuner board.
	Receive	Low-pass filters for RX signal.	Input from Antenna Tuner board Output to Mixer board through high-pass filters.
1650 kHz IF Board			
1650 kHz Filter - Y1–Y6	Transmit	Removes a single sideband from the transmit signal.	Input from TX amp Output to Mixer board.
	Receive	Provides narrowband RX selectivity.	Input from the Mixer board; output to RX IF amps.
RX IF Amps - Q1, Q2	Receive	Amplifies 1650 kHz IF signal.	Input from 1650 kHz filter. Output to Audio/Filter board.

Table 2-1 Board Functionality (continued)

Function	Path	Description	I/O
AGC - Q4, Q5	Receive	Amplifies AGC IF gain.	Input from RX IF output. Output to 1650 kHz IF amp, 75 MHz IF amp Mixer board.
TX IF Amp - Q3	Transmit	Amplifies 1650 kHz DSB signal from Audio/Filter board.	Input from balanced modulator Audio/Filter board. Output to 1650 kHz sideband filter.
Mixer Board			
Double-Balanced Mixer - MX1	Transmit	Converts 75 MHz IF to selected channel frequency.	Input from 75 MHz IF filter; output to TX 1.6 to 30 MHz amp. 1st LO: 76.597 to 105 MHz SYN1 buffer
	Receive	Converts selected channel frequency receive signal to 75 MHz IF.	Input from antenna through Audio/Filter board; output to RX 75 MHz IF amp. 1st LO: 76.6 to 105 MHz SYN1 buffer
RX 75 MHz IF Amp - U4	Receive	Amplifies 75 MHz IF receive signal.	Input from double-balanced mixer MX1. Output to 75 MHz filter Y1.
75 MHz Crystal Filter - Y1	Transmit	Filters 75 MHz IF signal for transmit path.	Input from 75 MHz IF amplifier Q11 Output to MX1 mixer.
	Receive	Filters 75 MHz IF signal for receive path.	Input from 75 MHz IF amplifier U4 Output to RX amplifier Q7.
RX 75 MHz IF Amp - Q7	Receive	Amplifies 75 MHz IF RX signal, controlled by AGC circuit.	Input from 75 MHz filter Y1. Input from ALC on 1650 kHz IF Board. Output to RX mixer Q8.
RX Mixer - Q8	Receive	Down-converts 75 MHz IF signal to 1650 or 1647 kHz signal.	Input from 75 MHz IF amp Q7. 2nd LO: 73.35 MHz SYNTH2 buffer Q10. Output to 1650 kHz IF board.
TX 75 MHz IF Amp - Q11	Transmit	Amplifies 75 MHz IF TX signal, controlled by ALC circuit.	Input from the TX mixer U2. Input from ALC switch Q12. Output to the 75 MHz IF filter Y1
TX Mixer - U2	Transmit	Up-converts 1650 or 1647 kHz signal to 75 MHz IF signal.	Input from 1650 kHz IF board. Osc. 73.35 MHz Syn. 2 buffer. Output to 75 MHz IF amp TX.

Table 2-1 Board Functionality (continued)

Function	Path	Description	I/O
First LO - MX1	Transmit	Down-converts 75 MHz IF signal to selected channel frequency.	Inputs 75 MHz IF from75 MHz filter Y1. Inputs 76.6 to 105 MHz LO1 from Synthesizer board at SYN1. Output to transmit current regulator U1.
	Receive	Up-converts selected channel frequency to 75 MHz IF signal.	Inputs 20W receive signal at the selected channel frequency from the Audio/Filter board. Inputs 76.6 to 105 MHz LO1 from Synthesizer board at SYN1.
30 MHz Low-Pass Filter	Transmit	Filters transmit/receive signal for unwanted image and spurious responses above 30 MHz.	Input transmit signal at selected channel frequency from MX1 mixer. Output to transmit amplifier U1.
	Receive		Inputs receive signal at selected channel frequency from Audio/Filer board. Outputs to MX1 mixer.
MMIC Transmit Amplifier - U1	Transmit	Amplifies 1.6 to 30 MHz transmit signal.	Inputs transmit signal from 30 MHz LPF. Outputs to PA board through J1-A2.
Voltage Regulator - Q3	Transmit	Provides a constant current source to transmit amplifier U1 in transmit mode.	Inputs +12V from the Junction board. Outputs constant 100 mA to U1.
Power Amplifier Board			
Predriver - U1	Transmit	Class A amplifier amplifies transmit signal to the necessary level for Q2 and Q3 drivers.	Inputs transmit signal from Mixer board. Outputs amplified transmit signal to driver amps Q2 and Q3.
Driver Amps - Q2, Q3	Transmit	Push-pull amplifiers in class AB configuration; drive the signal for power amplifiers.	Inputs transmit signal from predriver U1. Outputs to transmit signal to RF power amps Q3 and Q4.
Power amplifiers - Q4, Q5	Transmit	Power amplifiers in class AB configuration; provide final RF output of 5 or 20W.	Inputs transmit signal from driver amplifiers Q2 and Q3. Output to LP filters on Audio/Filter board.

Table 2-1 Board Functionality (continued)

Function	Path	Description	I/O
Driver amplifier bias voltage circuit - U3, Q6	Transmit	Provide temperature adjusted bias voltage to driver amplifiers Q2 and Q3.	Inputs thermally-compensated voltage from D1. Outputs bias voltage to driver amplifiers Q2 and Q3.
Power amplifier bias voltage circuit - U4, Q7	Transmit	Provide temperature adjusted bias voltage to driver amplifiers Q4 and Q5.	Inputs thermally-compensated voltage from D2. Outputs bias voltage to driver amplifiers Q4 and Q5.
Antenna Tuner Board			
Antenna Tuner - matching network (C1, C2, C5, and L1–L10) Relays K1–K10, K13, K15 and K17	Transmit	Translates 20W RF output signal at selected channel frequency through matching network for maximum power transfer.	Inputs transmit signal at the selected channel frequency from low-pass filters on the Audio/Filter board. Outputs to either whip antenna or 50 Ohm front panel antenna connector.
	Receive	Translates 20W RF input signal at selected channel frequency through matching network for maximum power transfer.	Input receive signal at the select channel frequency from either whip antenna or 50 Ohm front panel antenna connector. Outputs receive signal at selected channel frequency to low-pass filters on the Audio/Filter board.
Serial Decoders and Relay Drivers - U2, U3, U4	N/A	Selects inductors or capacitors to insert into either transmit or receive signal paths for maximum power transfer.	Inputs serial data from the Processor board. Outputs control signal to latching relays.
Synthesizer Board			
First LO - DDS U9	N/A	76.50 to 105.00 MHz	Outputs LO1 frequency to 1st LO buffer Q1 on Mixer board.
Second LO - DDS U9	N/A	73.35 MHz	Outputs LO2 frequency to 2nd LO buffer Q10 on Mixer board.
BFO - DDS U9	N/A	1650 kHz or 1647 kHz	Outputs BFO frequency to balanced modulator U6 and product detector U4 on Audio/Filter board.
Serial Decoders	N/A		Input from Processor board.
Processor Board			
Serial bus	N/A	Transports data to various control and processing devices on different boards.	Input from processor. Output to all serial ports.
Control Switches	N/A		Read by processor.

Table 2-1 Board Functionality (continued)

Function	Path	Description	I/O
Display Board			
Backlight Generator - U3	N/A	Turns on the LCD backlight	Inputs 189 kHz clock signal from the display driver U1. Outputs square wave to LCD display through step up transformer T1.
Serial Decoders and Segment Drivers	N/A	Drives data to the front panel LCD.	Inputs serial data from the processor on the Processor board. Outputs parallel data to the LCD display.
Junction Board			
+5V Switch Regulator - U1	N/A	Converts switched +12V to +5V supply voltage.	Inputs +12V from the battery through the front panel jumper on the Accessory connector and the front panel Power switch. Outputs +5V supply voltage to the various boards.
+8V Regulator - U2	N/A	Converts switched +12V to +8V supply voltage.	Inputs +12V from the battery through the front panel jumper on the Accessory connector and the front panel Power switch. Output to +8V supply voltage to the various boards. Supplies T8V in transmit mode and R8V in receive mode.
DC Clamps T8 to R8 - Q1, Q2	Transmit	Q1 clamps R8 to ground.	Inputs T8 line from Audio/Filter board.
	Receive	Q2 clamps T8 to ground.	Inputs R8 line from Audio/Filter board.

2.7 Radio Menu Descriptions

Table 2-2 below provides a description of the PRC1099A menus for programming the radio. Refer to the PRC1099A-MSOP Operator manual for detailed information.

Table 2-2 Menu Selection

Menu Selections	Description
Scan Menu	
Scan Select	To activate the channel scanning feature of the PRC1099A. Once activated, the radio starts scanning channels whenever the channel select switch is tuned to channel 9. Enter the channels to be scanned using the following two selections.
Scan Group Number	To select the group of channels to scan. A maximum of 30 scan groups can be retained in memory, 00 through 29.
Modify Scan Group	To enter a scan group or modify an already entered scan group. All channels in the radio, 00 through 99, are displayed one at a time. Those channels that are already selected in the scan group will have an asterisk (*) next to the channel number. Press the **Whip Tune** button to select or deselect a channel for the scan group.
Scan Rate	To select the length of time (0.5 to 64.9 seconds) the radio is to remain at each scanning channel during the scan cycle.
Scan Hold	To select the amount of time the radio is to remain at a particular channel during the scan cycle after a link.
Voice Detect Select	To detect voice communication of scanned channels and stop at those channels when voice communications are detected.
Voice Detect Hold	To set the amount of time the radio remains at that channel without hearing additional voice communications. When voice detect is enabled, the radio automatically stops scanning on channels where voice communications are detected.
Data Menu	
Source Select	To select the source from which the data to the accessory connector is originating. Sources are either the keyfill device or a remote peripheral.
Baud Rate	To select the baud rate of the data to and from the radio accessory connector (75 to 9600 baud).
Data Bit	To select the number of data bits used to communicate through the accessory connector. The number of data bits are selectable at either 7 or 8 bits.
Stop Bit	To select the number of stop bits that are required to communicate through the accessory connector. The number of stop bits are selectable at either 1 or 2.
Parity	To select the data parity. The parity can be **E** (even), **O** (odd), or **N** (none).

Table 2-2 Menu Selection (continued)

Menu Selections	Description
Flow Control	Not enabled at this time. To control the character flow-control protocol of input and output data. Flow control refers to XON and XOFF characters inserted into the data stream as flow control markers to mark the beginning and end of data streams.
Radio Address	To select the address number of this radio, when more than one radio is connected on the same data bus (00 through 99).
Message Menu	
Rx Message	To read messages received from other stations.
Tx Message	To compose messages to send with the ALE message.
Option Menu	
TransAdapt Select	The TransAdapt option is not available.
Automatic Link Establishment Select ALE	To activate the ALE option if it is installed. If the option is not installed, this selection is not displayed. If both the TransAdapt and ALE options are installed, activating one option automatically deactivates the other.
BITE Test	To activate the BITE function. Once activated, the BITE feature takes control of the radio and performs all necessary checks before returning control to the operator. After BITE is completed, the result is displayed on the front panel.
Frequency Lock	To prevent radio channel frequencies from being accidentally changed. Once activated, the radio channel frequencies cannot be changed, until this selection is deactivated.
Battery Test	To check the battery voltage. The battery is checked in increments of 0.25 VDC. A display of **BATT BAD** indicates the battery is either below 10.5 or above 15 VDC.
Password	To enter a password allowing access to all menus. If the correct password (five letter maximum) is entered, the selection listed below are accessible. If an incorrect password is entered, access is denied. If no password is entered, **NONE** is displayed when the selections listed below are accessed.
Lock Select	To lock access to the DATA and ALE menus. **Lock ON** prevents unauthorized alterations to settings.
New Password	To enter a new password or change an existing password. If no password exists, accessing Lock Select displays **NONE**. Access is allowed only when the same password is entered. To remove a password, enter a blank password.
Call Menu	
ALE Call	When the ALE option is installed and activated the ALE Call Menu is displayed. Use ALE Call to enter the address of the station to be called.

Table 2-2 Menu Selection (continued)

Menu Selections	Description
From Address	To include the address of the calling station (required in an ALE message).
Message Number	To indicate which message, if any, is to be sent with an ALE transmission. The message to send is entered or modified using the selection described in Tx Message. If no message is to be sent, **NONE IS SELECTED**.

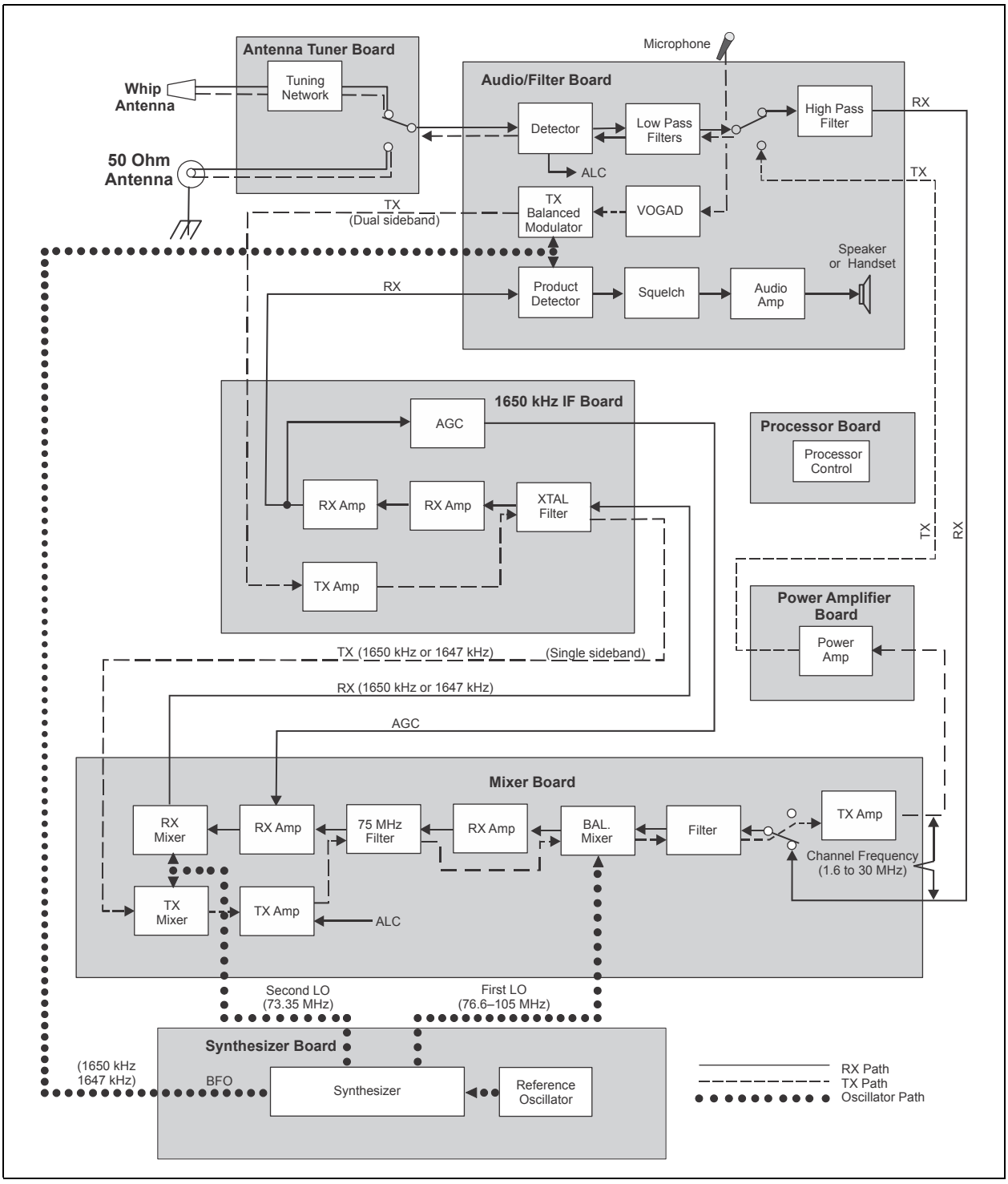

Figure 2-2 PRC1099A System Block Diagram

REV	ECN	DESCRIPTION	DATE	APPR
A	PRC1099-287	RELEASE	9-21-92	
B	PRC1099-373	ADD FILTER TX AUDIO	11-9-95	
C	10-0539	SEE ECN	10-20-10	

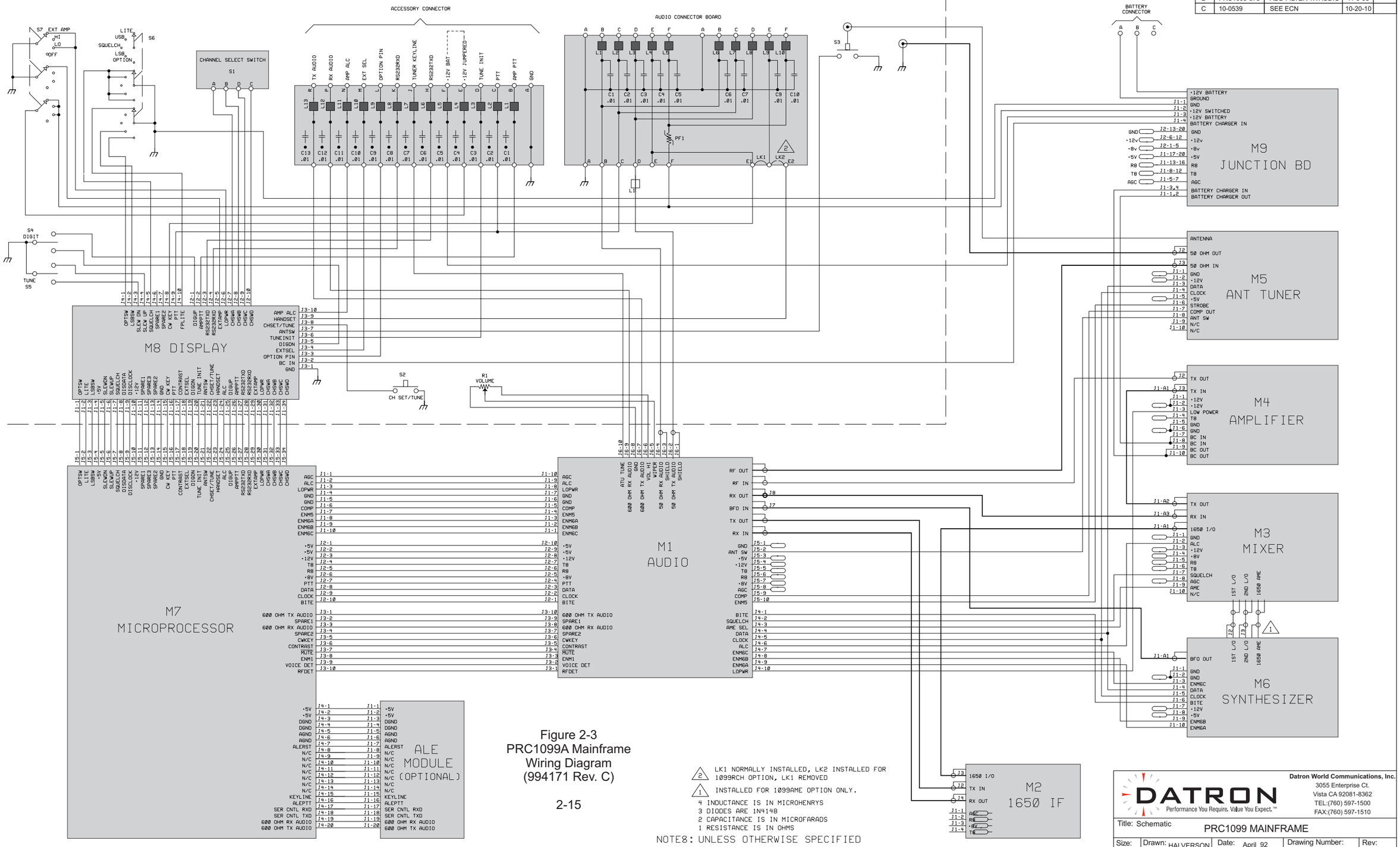

Figure 2-3
PRC1099A Mainframe
Wiring Diagram
(994171 Rev. C)

2-15

2 LK1 NORMALLY INSTALLED, LK2 INSTALLED FOR 1099RCH OPTION, LK1 REMOVED

1 INSTALLED FOR 1099AME OPTION ONLY.

4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTE8: UNLESS OTHERWISE SPECIFIED

PRC1099A-MS

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Title: Schematic	PRC1099 MAINFRAME			
Size: D	Drawn: HALVERSON	Date: April 92	Drawing Number: 994171	Rev: C
	Appr:	Date:		
Scale: NONE			Sheet: 1 of 1	

Table 2-3 Mainframe Parts List (PRC1099ABA Rev. T)

Designator	Part Number	Description
C1	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C10	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C2	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C3	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C4	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C5	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C6	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C7	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C9	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
L1	459032	“IND ASY,3T#30 MAGNET 1-490201”
L10	459032	“IND ASY,3T#30 MAGNET 1-490201”
L2	459032	“IND ASY,3T#30 MAGNET 1-490201”
L3	459032	“IND ASY,3T#30 MAGNET 1-490201”
L4	459032	“IND ASY,3T#30 MAGNET 1-490201”
L5	459032	“IND ASY,3T#30 MAGNET 1-490201”
L6	459032	“IND ASY,3T#30 MAGNET 1-490201”
L7	459032	“IND ASY,3T#30 MAGNET 1-490201”
L8	459032	“IND ASY,3T#30 MAGNET 1-490201”
L9	459032	“IND ASY,3T#30 MAGNET 1-490201”
PF1	550042	“FUSE,POLY RESISTOR 1.4 AMPS”

Chapter 3: Audio/Filter Board

3.1 Circuit Description

The Audio/Filter board includes the transmit and receive RF filtering, transmit/receive (T/R) switching, audio modulation and demodulation, and other control functions. The following sections discuss the components of the block diagram as shown in Figure 4-1.

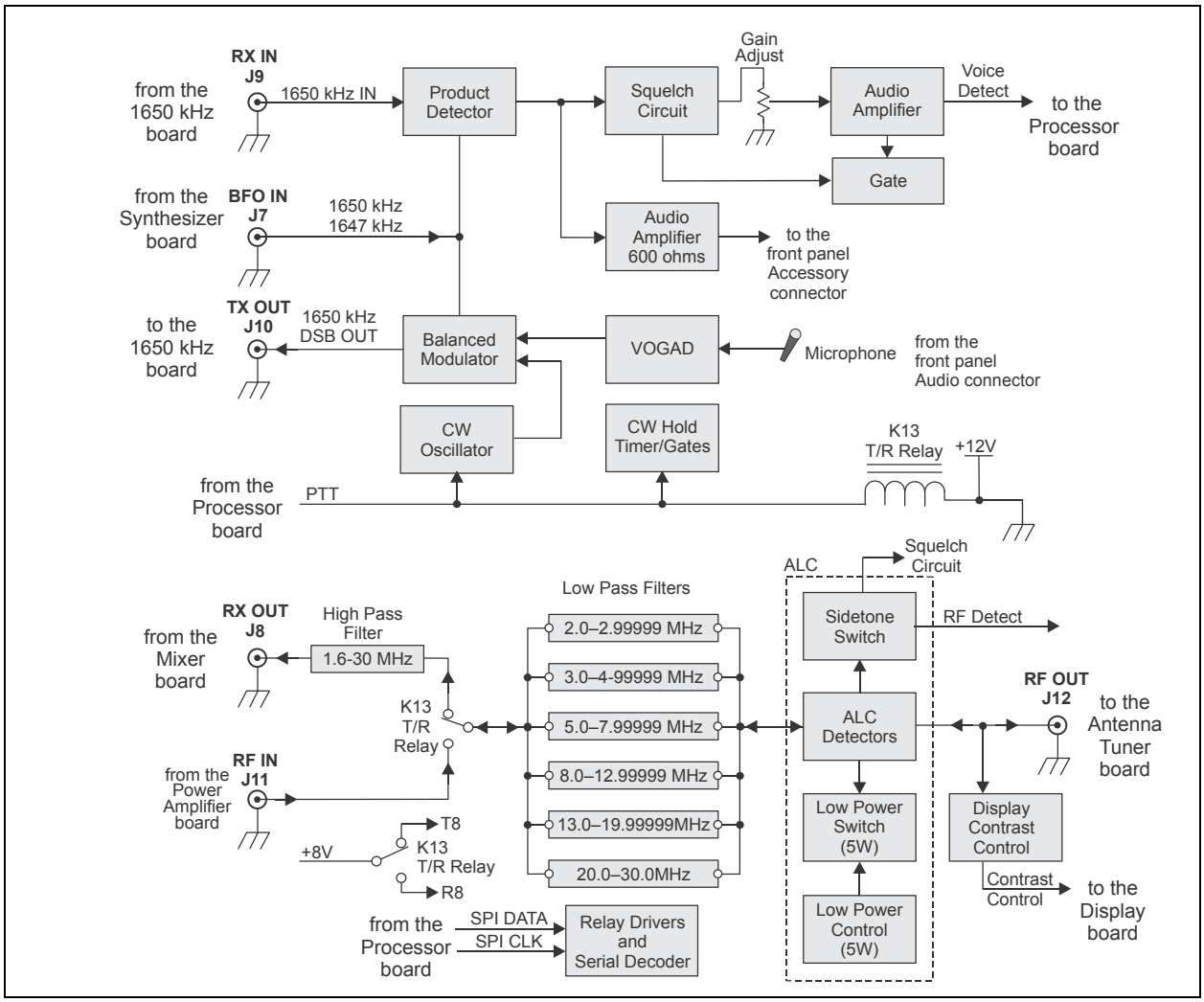


Figure 3-1 Audio/Filter Board Block Diagram

3.1.1 Transmit Path

The transmit signal path begins at a microphone or headset connected to one of the front panel audio connectors. It is routed through the front panel Audio connector (50 OHM TX AUDIO) and then applied to VOGAD device U8 on the Audio/Filter board.

VOGAD

The transmit audio signal is applied to U8C, a single, integrated circuit VOGAD (voice operated gain adjusting device). The VOGAD is referred to as a compandor because it expands or compresses the audio to maintain a consistent output audio signal level applied to the balanced modulator regardless of the input signal level.

Op amp U8A is the input signal amplifier for the compandor that provides a set point for compandor U8C. The gain of U8A is set using resistor divider R133 and R134. R134 and C153 form a low-pass filter for the U8A input to filter low frequency noise. Resistor R132 sets the reference voltage at approximately half of Vcc to prevent large audio signals from getting clipped or distorted.

Compandor U8C expands low level audio signals and compresses high level signals to maintain a consistent audio signal level regardless of the audio input. Capacitor C148 sets the attack and release time of the compandor which determines how fast the compandor reacts to changes in the audio signal.

Op amp U8D is the output signal amplifier that brings the audio signal to the level required for the balanced modulator. The voltage divider network of resistors R126 and R127 set the gain of output signal amplifier U8D.

Accessory Connector Audio Input

Attenuator and RF filter C31, L13, C32 and R46 attenuate and filter the high level, 0 dBm audio input (600 OHM TX AUDIO) from the Accessory connector before it is applied to pin 1 on balanced modulator U6.

Balanced Modulator

Balanced modulator U6 mixes the audio signal with the beat frequency oscillator (BFO) frequency of 1650 kHz (USB) or 1647 kHz (LSB) and then suppresses the carrier frequency. The amplified and leveled audio output signal from U8D is applied to pin 1 of U6. The BFO from the Synthesizer board is applied to pin 10 of the balanced modulator. The output from U6 is a low-distortion, 1650 or 1647 kHz, double-sideband signal with a suppressed carrier.

Potentiometer R50 applies an adjustable offset current to pin 4 that balances the modulator precisely to provide maximum carrier suppression.

In CW mode, the CW tone oscillator is applied to U6 through R72.

The supply voltages for the U6 and the VOGAD are supplied from the T8 line. In data mode (**OPT**), these components are supplied from the +8V line and are not switched off in receive mode. This eliminates disturbances when using high speed switching in the ARQ mode.

Off-Board Transmit Path

The output of U6 is applied to coax connector J10 (TX OUT) where it is routed to the 1650 kHz IF board. On the 1650 kHz IF board, one of the sidebands is stripped away. The 1650 kHz IF board is discussed in Chapter 4. The single sideband transmit signal is then applied to the Mixer board where it is up-converted from the BFO frequency of 1647 or 1650 kHz to an IF frequency of 75 MHz and then down-converted to the selected channel frequency. The Mixer board is discussed in Chapter 5.

From the Mixer board the transmit signal is routed to the Power Amplifier board where it is amplified to the selected output power. Then it returns to the Audio/Filter board through coax connector J11. The PA board is discussed in Chapter 6.

Low-Pass Filters

From the J11 coax connector, the transmit signal is filtered through the appropriate high performance, 5-pole, elliptic function low-pass filters selected by the processor according to the selected channel frequency, as discussed in "Relay Drivers and Decoder" below. These filters cover the following frequency ranges:

- 2.0 to 2.99999 MHz
- 3.0 to 4.99999 MHz
- 5.0 to 7.99999 MHz
- 8.0 to 12.99999 MHz
- 13.0 to 19.99999 MHz
- 20.0 to 30.0 MHz

These filters use high-Q toroidal inductors and precision capacitors to remove high frequency noise and harmonics.

Relay Drivers and Decoder

The microprocessor on the Processor board selects the correct low-pass filter using latching relays K1 through K12. The latching relays use dual windings and require separate current pulses to open or close the relay. Latching relays are only energized to open or close the relay; otherwise they are not energized, saving battery power.

Switching transistors Q8 through Q13 control the on-switching current pulse to each pair of relays while reset transistor Q14 controls the off-switching pulse to all the relays. Shift register U7 decodes the serial data from the processor and drives the switching transistors. The firmware ensures that all relays are reset before selecting a new filter. The program performs the same function whenever the transceiver is switched on or there is a power interruption. This ensures that the relays are always correctly reset.

From the low-pass filters the transmit signal passes through the detector for the ALC circuit discussed in "ALC Circuit" on page 3-6. It is then applied to coax connector J12 where it is routed to the Antenna Tuner board and then to either the whip antenna connector or 50 Ohm antenna output connector.

3.1.2 Receive Path

The Audio/Filter board receives the receive signal through coax connector J12 (RF OUT) from the Antenna Tuner board. From J12 the receive signal passes through single-turn transformer T1 that provides the signal for the ALC circuit covered in "ALC Circuit" on page 3-6—the ALC circuit has no function in the receive path.

Low-Pass Filters After transformer T1 the receive signal passes one of the high performance, 5-pole, elliptic function low-pass filters selected by the processor as discussed in "Low-Pass Filters" above.

High-Pass Filters After passing through the low-pass filter, the receive signal passes through a 7-pole Chebyshev filter with a cutoff frequency of 1.6 MHz (C107, C106, C105, C104, L17, L16 and L15). This filter provides a high level of attenuation to signals below 1.6 MHz in the broadcast band and prevents overload when operating in the vicinity of a powerful broadcast station. From the high-pass filter, the receive signal is applied to coax connector J8 (RX OUT) where the signal is routed to the Mixer board.

Off-Board Receive Path On the Mixer board the receive signal is up-converted from the selected channel frequency to an IF frequency of 75 MHz, amplified, filtered, and then down converted to the final IF of 1647 or 1650 kHz. The Mixer board is discussed in Chapter 5. The modulated IF signal is routed from the Mixer board to the 1650 kHz IF board where the unwanted frequencies are filtered out and the 1650 kHz or 1647 kHz IF signal and the signal is amplified. The 1650 kHz IF board is discussed in Chapter 4.

After the 1650 kHz IF board, the modulated IF signal is returned to the Audio/Filter board through J9 (RX IN) where it is applied to the product detector.

Product Detector Product detector U4 is an integrated circuit that removes the 1650 kHz IF frequency from the receive signal leaving the audio base band signal. The 1650 kHz IF from the 1650 kHz IF board is applied to the input at pin 2. The 1650 kHz carrier oscillator (1650 kHz for USB;1647 kHz for LSB) from the Synthesizer board is applied to the input at pin 1. The output at pin 8 is the sum and difference frequencies from the two input signals. The sum frequency at 3.3 MHz is filtered by C17. The difference frequency is approximately zero as the 1650 kHz BFO and the 1650 kHz receive IF signal cancel each other leaving the audio baseband. The audio is routed to either the squelch circuit, to the front panel audio connectors (50 OHM RX AUDIO) through audio amplifier U5, or to the front panel Accessory connector (600 OHM RX AUDIO) through audio amplifier U10A.

Squelch Circuit The squelch circuit operates by detecting the syllabic rate of change in the human voice to switch audio off in between words and sentences in the transmit and receive signals. The squelch is immune to impulse noise, static, carriers, and general background noise. The squelch is preset internally and is activated in the USB mode when the **Mode** knob is turned to the squelch

position (refer to “SQUELCH Position” on page 12-4).

The audio output from product detector U4 is fed into two sections of quad op amp U1. These stages operate at high gain and the noise or signal is amplitude limited, producing a square wave output to trigger one-shot U2A and U2B. The output from the one-shot is a series of pulses that go through the high-pass filter formed by C2, R5, C3, and R6 and the low-pass filter R7, C4, R8 and C5. This presents a DC level signal proportional to the input frequency of the one shot to the inverting input of U1C.

The DC level changes as the frequency shifts, representing the change in frequency of the human voice at a syllabic rate between 0.5 and 2.5 Hz. This signal is AC coupled through C6 to low frequency differentiation amplifier U1C. The output is applied to U1D, which pulls down D4 if any signal appears at D2/D3 with a positive or negative amplitude of 0.9V or greater. This unipolar converter enables the squelch to detect the first syllabic rate change at the output of the product detector.

Diode D4 is connected to U2C and U2D that form a timer with R16 on the input and C9 on the output to hold the audio on for approximately four seconds after the last syllabic change is detected. The squelch is turned off when the timer output is grounded through R18 ($\overline{\text{MUTE}}$). The microprocessor can also disable the audio through D23 by setting the output at U9 pin 5 low.

Squelch Gates

Squelch switch PNP bipolar transistor Q6 turns off the receive audio by switching off the +12 V supply to U5. Q6 is controlled by the input from side tone switch Q24 or by Q1 and Q2 that are, in turn, driven by the squelch timer U2C and U2D or the $\overline{\text{MUTE}}$ signal from the processor. The output from Q1 also controls current reduction circuitry in the Mixer board. This circuitry is also controlled by the T8 line, isolated by diode gates D5 and D6.

Audio Amplifier Handset/Speaker

The output from product detector U4 is coupled through the front panel audio gain control potentiometer (VOLUME) R1 to audio amplifier U5, with a gain of 26 dB. This device has a constant voltage output into a wide range of load impedances. It also provides direct output to the handset or earphones (50 OHM RX AUDIO).

Audio Amplifier 600 Ohm

From product detector U4, the receive audio signal is applied to audio amplifier U10A. U10A is half of a fixed-gain operational amplifier that provides a separate fixed-level audio output for external devices such as RTTY modems. The amplifier has low impedance output and provides a level of 0 dBm into a 600 ohm load (600 OHM RX AUDIO) connected to the front panel Accessory connector.

3.1.3 ALC Circuit

The automatic level control (ALC) circuit regulates the transmit output power to maintain a stable radio output power.

The ALC circuit samples the transmit output power current using single-turn current detector transformer T1and R76. Transformer T1 consists of a ferrite toroid with the antenna lead passing through the core to form a one turn primary winding. Diode D19 rectifies the RF output when the RF voltage exceeds the adjustable reverse bias applied through the power adjustment control potentiometer R82. The rectified output voltage is amplified and the polarity reversed by Q21 that, in turn, drives ALC amplifier Q12 on the Mixer board.

The voltage detector circuit formed by C111, C110, and D20 operates with a fixed bias threshold of 8V and limits the maximum output voltage to 36V.

The current detector controls the output level in loads of 50 ohms or less and limits the maximum output current to 630 mA, which corresponds to 20W RF output power into a 50 ohm load even when there is a short circuit on the antenna. If the impedance is higher than 50 ohms (most mismatches present high impedance loads), the voltage detector limits the maximum output voltage to 36V. This ALC system prevents the rapid fall in output power into mismatched loads yet ensures the transistors are not operated outside of their ratings.

Low Power Switch

Low-power switch Q22 causes low-power control potentiometer R82 to shunt the bias voltage at the current detector so the ALC activates at a lower power level. R82 is adjusted for 5W output after the high-power level is set. Q22 is controlled by the processor through shift register U7.

Sidetone Switch

A sidetone is only present when the transmitter is operating at the correct RF output power. The sidetone switch automatically compensates when the front panel **POWER** switch is switched from **HI** to **LO** power output. The sidetone switch detects the ALC output voltage. Because detector diodes D19 and D20 in the ALC system are biased so that there is no output until the correct current or voltage level is reached, the system automatically checks for correct operation of the final amplifier. U10B is a voltage comparator on the ALC line and Q23/Q24 form a hold timer so that the switch does not operate at a syllabic rate on voice signals. Q24 controls Q6 that turns off the audio amplifier when there is no RF output.

3.1.4 CW Circuit

CW Oscillator

Op amps U3B and U3C form a keyed oscillator for the CW function. The oscillation frequency is set by R65. The output is inherently stabilized by limiter stage U3C that feeds a 20% clipped waveform back into bandpass filter U3B. The resulting output is less than 1% distortion.

The oscillator is keyed by pulling the limiter's inverting input down near ground via Q19. The CW key is attached to the base of Q19 through the tone key input at J3 pin 6.

Q19 conducts when the key is open. When the key is closed, correct bias is restored and the oscillator starts smoothly from a zero amplitude to the level where the 20% clipping occurs in the limiter. When the key is opened, the oscillator stops within a few cycles as Q19 saturates. The keyed envelopes are trapezoidal. When the transmitter gain is enough to reach ALC limits, the transmitter reaches full output before the oscillator does. The attack and decay times of the transmitter are less than those of the oscillator.

CW Hold Timer and Gate

PNP transistor Q17 with associated components R57, R58, R59, D12, and C91 form a hold timer that holds the transmitter in the transmit mode for a short time after the key is released. Diode gates D13, D14, and D15 isolate the following different functions; ATU tune, tone key, CW key.

3.1.5 Control Circuitry

T/R Switching

The transmit/receive (T/R) switching is controlled by the PTT line. Closing the PTT line activates double-pole, high-reliability, fast-acting relay K13. One pole of K13 switches the antenna from the receive signal to the transmit. The other pole switches the regulated +8V line to transmit (T8) and receive (R8) control lines. These two control lines provide for transmit/receive functions throughout the receiver.

Contrast Control

Differential amplifier U3D and the associated circuitry make up a temperature sensing contrast control for the Display board. Variable resistor R107 sets the reference voltage at the non-inverting input of U3D. The voltage at the inverting input is supplied through Q25 that is essentially connected as a diode. As the temperature and the contrast of the display change, the characteristics of Q25 change. Once inverted through U3D and applied to the display, this contrast voltage provides a more constant display contrast.

Function Decoder

The serial data from the processor is clocked through shift register U7 into U9, where it is decoded. This data controls several functions on the Audio/Filter board listed below.

Output	State	Function
Q1 (pin 4)	Normal: low Active: high	Sets the transceiver to 5W RF output by turning on low power switch Q22 (refer to “Low Power Switch” on page 3-6). Initiated by front panel Power switch setting.
Q2 (pin 5)	Normal: high Active: low	Activates squelch hold circuit U2C and U2D (refer to “Squelch Circuit” on page 3-4).
Q3 (pin 6)	Normal: high Active: low	Mutes transmit audio by grounding audio from VOGAD through D8 to balanced modulator U6

Output	State	Function
Q4 (pin 7)	Normal: low Active: high	Turns on Q20 that activates the AME selection function on the Mixer board (refer to “AME Option” on page 5-6).
Q5 (pin 14)	Normal: Active:	Energizes the transmitter and the CW oscillator.
Q6 (pin 13)	Normal: high Active: low	Not used.
Q7 (pin 12)	Normal: low Active: high	Grounds the receive audio output from product detector U4 through Q5.
Q8 (pin 11)	Normal: low Active: high	Grounds the modulated transmit line from balanced modulator U6 through Q7.

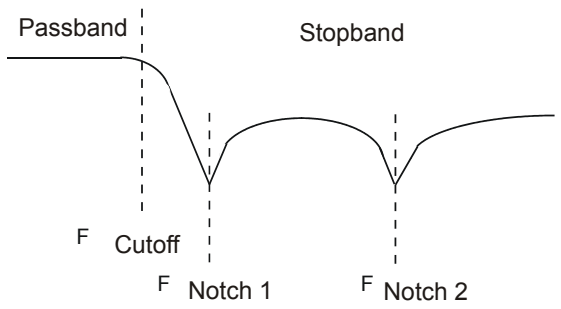
3.1.6 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 3-1 Audio/Filter Board Specifications

Characteristic	Specifications
Transmit	
Current	8 VDC at 31 mA 12 VDC at 0 mA (see Note 1 below)
Output:	1650 kHz, DSB, 80 mV, PEP
Input	Microphone or 1000 Hz
Receive	
Current	8 VDC at 8 mA 12 VDC at 0 mA (squelched) (see Note 2 below)
Output	1000 Hz
Input	1651 kHz
System Gain	48 dB
Low-Pass Filters	
Return Loss	15 dB, minimum
Stopband	Filter adjusted for specified stopband with frequencies.

Table 3-1 Audio/Filter Board Specifications (continued)

Characteristic	Specifications
Ranges	**Range** / **Notch 1** / **Notch 2** 2.0–2.99999 MHz / 4.2 MHz / 6.1 MHz 3.0–4.99999 MHz / 6.6 MHz / 9.9 MHz 5.0–7.99999 MHz / 10.8 MHz / 16.35 MHz 8.0–12.99999 MHz / 17.2 MHz / 27.0 MHz 13.0–19.99999 MHz / 27.6 MHz / 43.0 MHz 20.0–30.0 MHz / 40.5 MHz / 60.4 MHz
Ranges (continued)	
Note 1: Momentary high +12 VDC current during relay switching. Note 2: Current increases with high audio output into low impedance loads.	

3.2 Connector Pin Assignments

This section includes the pin assignments for all the major connectors on the Audio/Filter board.

3.2.1 J1 Connector

J1 connects to J1 on the Processor board.

Table 3-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	ENM6C	No connection on Audio/Filter board. Jumpered to J4 pin 7.
2	ENM6B	No connection on Audio/Filter board. Jumpered to J4 pin 8.
3	ENM6A	No connection on Audio/Filter board. Jumpered to J4 pin 9.
4	ENM5	No connection on Audio/Filter board. Jumpered to J4 pin 10.

Table 3-2 J1 Connector Pin Assignments (continued)

Pin	Signal	Description
5	COMP	No connection on Audio/Filter board. Jumpered to J5 pin 9.
6	GND	Ground
7	GND	Ground
8	LOWPWR	Connects to Audio/Filter board J4 pin 10 only
9	ALC	Automatic level control, sets output power level in transmit
10	AGC	No connection on the Audio/Filter board. Jumpered from the Processor board to the Mixer and Junction board (J5 pin 8).

3.2.2 J2 Connector

J2 connects to J2 on the Processor board.

Table 3-3 J2 Connector Pin Assignments

Pin	Signal	Description
1	BITE	No connection on the Audio/Filter board. Jumpered from the Processor board to the Synthesizer board (J4 pin 1).
2	CLOCK	Internal processor clock information.
3	DATA	Internal processor data information.
4	PTT	Switches the radio to transmit mode.
5	+8V	+8 VDC supply voltage to Processor board.
6	R8	+8 VDC in receive only, supplied to Processor board.
7	T8	+8 VDC in transmit only, supplied to Processor board.
8	+12V	+12 VDC supply voltage to Processor board.
9	+5V	+5 VDC supply voltage to Processor board.
10	+5V	+5 VDC supply voltage to Processor board.

3.2.3 J3 Connector

J3 connects to J3 on the Processor board.

Table 3-4 J3 Connector Pin Assignments

Pin	Signal	Description
1	RF DET	RF detect, informs microprocessor of output power.

Table 3-4 J3 Connector Pin Assignments (continued)

Pin	Signal	Description
2	VOICE DET	Voice detect informs microprocessor of received human speech.
3	ENM1	Enable pulse enables U7 and U9.
4	MUTE	Low going pulse from microprocessor to disable receive audio.
5	CONTRAST	Output to Display board to set display contrast.
6	CW KEY	A signal from outside radio to key transmitter as well as energize CW oscillator.
7	SPARE2	Not used.
8	600 OHM RX AUDIO	Receive audio output to microprocessor.
9	SPARE1	Not used.
10	600 OHM TX AUDIO	Transmit audio input from microprocessor.

3.2.4 J4 Connector

J4 connects to the Mixer and Synthesizer boards.

Table 3-5 J4 Connector Pin Assignments

Pin	Signal	Description
1	BITE	No connection on the Audio/Filter board. Jumpered from the Processor board (J2 pin 1) to the Synthesizer board.
2	SQUELCH	Output to Mixer board to disable the receive audio.
3	AME SEL	Amplitude modulation equivalent output to Mixer board.
4	DATA	Microprocessor data output to rest of radio.
5	CLOCK	Microprocessor clock output to rest of radio.
6	ALC	Automatic level control output to Mixer board.
7	ENM6C	Output enable pulses from microprocessor to Synthesizer board.
8	ENM6B	Output enable pulses from microprocessor to Synthesizer board.
9	ENM6A	Output enable pulses from microprocessor to Synthesizer board.
10	LOWPWR	Input from PA board to automatically switch to low power, when PA board overheats.

3.2.5 J5 Connector

J5 connects to multiple boards with T8, R8 +8, and +5 supply voltages.

Table 3-6 J5 Connector Pin Assignments

Pin	Signal	Description
1	GND	Ground.
2	ANT SW	Antenna switch output to Antenna Tuner board.
3	+5V	+5V input from Junction board.
4	+12V	+12V input from Junction board.
5	T8	+8V supply voltage from Junction board in transmit mode only.
6	R8	+8V supply voltage from Junction board in receive mode only.
7	+8V	+8V supply voltage from Junction board.
8	AGC	No connection on the Audio/Filter board. Jumpered from the Processor board (J1 pin 10) to the Mixer and Junction board.
9	COMP	Connects to Audio/Filter board J1 pin 5 only
10	ENM5	Connects to Audio/Filter board pin 4 only

3.2.6 J6 Connector

J6 connects to the front panel Audio and Accessory connectors as well as the front panel Volume control potentiometer.

Table 3-7 J6 Connector Pin Assignments

Pin	Signal	Description
1	GND	Transmit audio cable shield to ground.
2	50 OHM TX AUDIO	Transmit audio input (microphone) from front panel Audio connector. Coax connection.
3	GND	Receive audio cable shield to ground.
4	50 OHM RX AUDIO	Receive audio input (microphone) to front panel Audio connector. Coax connection.
5	WIPER	Connects to wiper of front panel Volume control.
6	VOL HI	Connects to high side of front panel Volume control.
7	600 OHM TX AUDIO	Transmit audio input from front panel Accessory connector.

Table 3-7 J6 Connector Pin Assignments (continued)

Pin	Signal	Description
8	GND	Connects to low side of front panel Volume control.
9	600 OHM RX AUDIO	Receive audio output to front panel Accessory connector
10	ATU TUNE	Input from Accessory connector to key radio and CW oscillator for tuning of external equipment.

3.2.7 J7 to J12 Coax Connectors

Connector J7 to J12 are RF coax connector carrying either transmit or receive or BFO signals as listed below.

Connector	Signal
J7 - BFO IN	1650 kHz BFO from the Synthesizer board.
J8 - RX OUT	Modulated receive signal (selected channel frequency) output to the Mixer board.
J9 - RX IN	Modulated receive signal (1650 kHz) input from the 1650 kHz IF board.
J10 - TX OUT	Modulated transmit signal (1650 kHz) output to 1650 kHz IF board.
J11 - RF IN	5/20W modulated transmit signal (selected channel frequency) input from the PA board.
J12 - RF OUT	Transmit: 5/20W modulated transmit signal (selected channel frequency) to the Antenna Tuner board.

3.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Audio/Filter board.

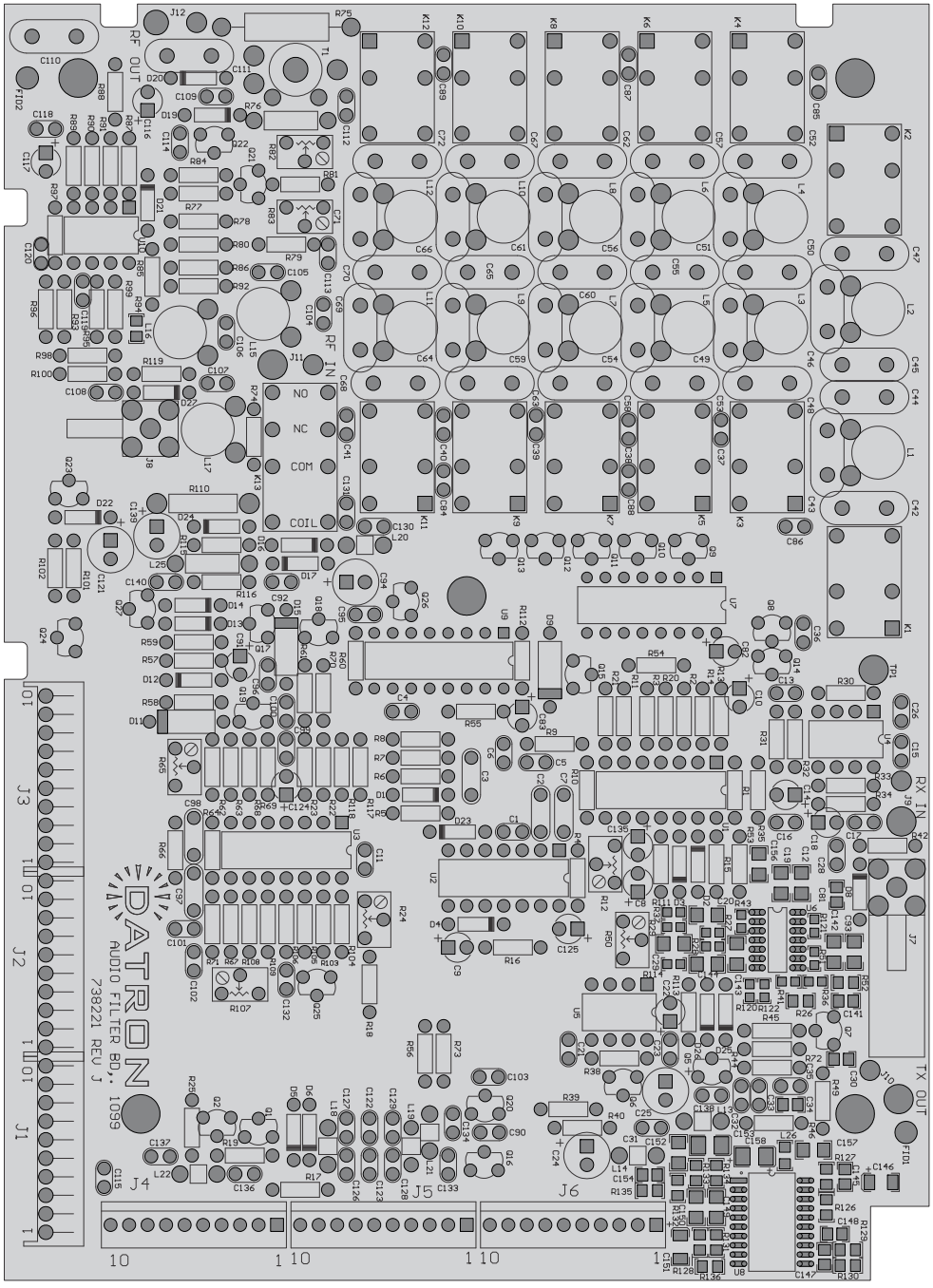


Figure 3-2 Audio/Filter Board Component Locations (738221 Rev. J)

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
REV	ECO			DRAFTER	DATE APPROVED
		A	PRC1099-282 RELEASE		03-21-92
		B	PRC1099-332 ADD RCVR PROTECTION		05-31-94
		C	PRC1099-345 R75 WAS 2.2K 1/2W		09-26-94
		D	PRC1099-349 SEE ECN		11-22-94
		E	PRC1099-362 SEE ECN		05-17-95
		F	05-0165 ADDED 10K RES 3PL (side-tone/ squelch)		6-28-05
		G	05-0201 FIXED BNC PIN COUNT		1-17-06
		H	09-0152 U6 WAS DIP8 IS SO14	RB	09-15-09
		J	10-0147 RB6 WAS 1K	RB	03-22-10
		K	12-0267 VOGAD REPLACEMENT,U8	JN	05/07/12
		L	12-0383 R49 WAS 390, R134 WAS 6.8K, R135 WAS 1K	RB	07/17/12

PRODUCT DETECTOR
CARRIER BALANCE
BALANCED MODULATOR
SQUELCH CONTROL
VOGAD

SPARE2 J3-7
SPARE1 J3-9
LOWPWR J4-10
LOWPWR J1-8
ENM6A J4-9
ENM6A J1-3
ENM6B J4-8
ENM6B J1-2
ENM6C J4-7
ENM6C J1-1
ENM5 J5-10
ENM5 J1-4
COMP J5-9
COMP J1-5
AGC J5-8
AGC J1-10
BITE J4-1
BITE J2-1

4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 3-3
Audio/Filter Board
Schematic Diagram 1 of 2
(994172 Rev. L)

3-15

PCB: 738221
ASSY: 009-00101

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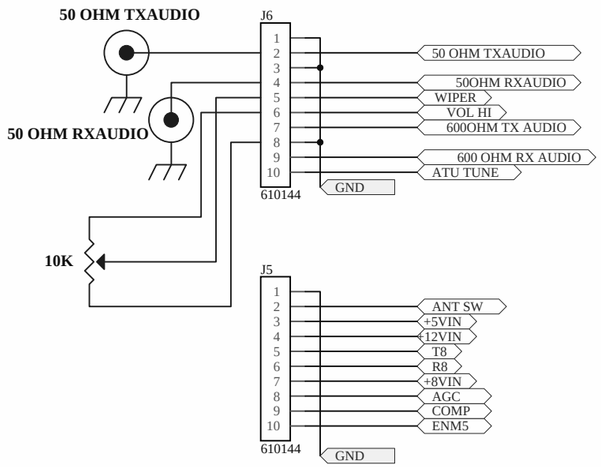
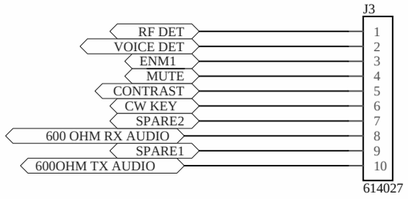
TITLE: SCHEMATIC, PRC1099-M1 AUDIO/ RF FILTER

APPROVALS	DATE	SIZE	FSCM NO.	DWG. NO.	REV
DRAFTER A.MARTINEZ	04-29-97	D	66943	994172	L
CHECKER					
PROJ ENGR		SCALE: NONE	FILENAME:994172L_sh1.SchDoc	SHEET 1 OF 2	
MFG ENGR					

4/29/2016 7:18:44 AM

PRC1099A-M





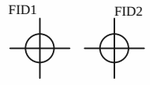


Figure 3-4
Audio/Filter Board
Schematic Diagram 2 of 2
(994172 Rev. L)

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4/29/2016 7:17:51 AM

PRC1099A-MS

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
C1	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C10	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C100	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C101	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C102	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C103	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C104	211222	“CAP, 2200PF NP0 100V 2% 0.1LS”
C105	211102	“CAP, 1000PF NP0 100V 2% 0.1LS”
C106	211102	“CAP, 1000PF NP0 100V 2% 0.1LS”
C107	211222	“CAP, 2200PF NP0 100V 2% 0.1LS”
C108	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C109	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C11	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C110	220101	“CAP, 100PF MICA 500V 5% DM15”
C111	220200	“CAP, 20PF MICA 500V 5% DM15”
C112	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C113	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C114	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C115	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C116	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C117	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C118	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C119	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C12	021106002	“CAP, 10UF X7R 16V 10% 1206”
C120	2751001	“CAP, 10PF NPO 50V 5% RAD 0.1S”
C121	237470	“CAP, 47UF AL 16V 20% 6.3X7 RAD”
C122	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C123	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C124	237022	“CAP, 2.2UF, AL, 50V, 20%, 4X5X1.5”
C125	237022	“CAP, 2.2UF, AL, 50V, 20%, 4X5X1.5”
C126	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
C127	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C128	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C129	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C13	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C130	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C131	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C132	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C133	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C134	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C135	237022	“CAP, 2.2UF, AL, 50V, 20%, 4X5X1.5”
C136	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C137	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C138	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C139	237101	“CAP, 100UF AL 16V 20% 6.3X7X2.5LS”
C14	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C140	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C141	021106003	“CAP, 10UF X7R 10V 10% 0805”
C142	021105004	“CAP, 1UF X7R 25V 10% 1206”
C143	021105004	“CAP, 1UF X7R 25V 10% 1206”
C144	DNP	“NULL PART, VACANT PCB LOCATION”
C145	021105007	“CAP, 1.0UF 16V X7R 10% 0805”
C146	022106003	“CAP, 10UF, TA, 16V, 20%, 3216-18”
C147	021270000	“CAP, 27PF NP0 100V 5% 0805”
C148	021474001	“CAP, 0.47UF X7R 16V 10% 0805”
C149	021475002	“CAP, 4.7UF X5R 25V 10% 1206”
C15	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C150	021106009	“CAP, 10UF X5R 25V 10% 1206”
C151	022106003	“CAP, 10UF, TA, 16V, 20%, 3216-18”
C152	021106009	“CAP, 10UF X5R 25V 10% 1206”
C153	022225000	“CAP, 2.2UF TA 20V 10% 3528-21”
C154	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C156	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
C157	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C158	022225000	“CAP, 2.2UF TA 20V 10% 3528-21”
C16	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C17	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C18	237010	“CAP, 1UF, AL, 50V, 20%, 4X5X1.5”
C19	021106002	“CAP, 10UF X7R 16V 10% 1206”
C2	274183	“CAP, 0.018UF BX 50V 10% BOX 0.2LS”
C20	DNP	“NULL PART, VACANT PCB LOCATION”
C21	211102	“CAP, 1000PF NP0 100V 2% 0.1LS”
C22	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C23	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C24	237101	“CAP, 100UF AL 16V 20% 6.3X7X2.5LS”
C25	237101	“CAP, 100UF AL 16V 20% 6.3X7X2.5LS”
C26	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C28	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C29	021105004	“CAP, 1UF X7R 25V 10% 1206”
C3	274183	“CAP, 0.018UF BX 50V 10% BOX 0.2LS”
C30	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C31	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C32	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C33	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C34	021106003	“CAP, 10UF X7R 10V 10% 0805”
C35	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C36	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C37	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C38	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C39	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C4	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C40	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C41	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C42	220821	“CAP, 820PF MICA 300V 5% DM15”
C43	220241	“CAP, 240PF MICA 500V 5% DM15”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
C44	220511	“CAP, 510PF MICA 500V 5% DM15”
C45	220102	“CAP, 1000PF MICA 100V 5% DM15”
C46	220821	“CAP, 820PF MICA 300V 5% DM15”
C47	220821	“CAP, 820PF MICA 300V 5% DM15”
C48	220511	“CAP, 510PF MICA 500V 5% DM15”
C49	220151	“CAP, 150PF MICA 500V 5% DM15”
C5	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C50	220911	“CAP, 910PF MICA 100V 5% DM15”
C51	220511	“CAP, 510PF MICA 500V 5% DM15”
C52	220511	“CAP, 510PF MICA 500V 5% DM15”
C53	220301	“CAP, 300PF MICA 500V 5% DM15”
C54	220910	“CAP, 91PF MICA 500V 5% DM15”
C55	220561	“CAP, 560PF MICA 300V 5% DM15”
C56	220301	“CAP, 300PF MICA 500V 5% DM15”
C57	220301	“CAP, 300PF MICA 500V 5% DM15”
C58	220201	“CAP, 200PF MICA 500V 5% DM15”
C59	220560	“CAP, 56PF MICA 500V 5% DM15”
C6	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C60	220331	“CAP, 330PF MICA 500V 5% DM15”
C61	220221	“CAP, 220PF MICA 500V 5% DM15”
C62	220201	“CAP, 200PF MICA 500V 5% DM15”
C63	220121	“CAP, 120PF MICA 500V 5% DM15”
C64	220360	“CAP, 36PF MICA 500V 5% DM15”
C65	220221	“CAP, 220PF MICA 500V 5% DM15”
C66	220121	“CAP, 120PF MICA 500V 5% DM15”
C67	220121	“CAP, 120PF MICA 500V 5% DM15”
C68	220750	“CAP, 75PF MICA 500V 5% DM15”
C69	220240	“CAP, 24PF MICA 500V 5% DM15”
C7	274183	“CAP, 0.018UF BX 50V 10% BOX 0.2LS”
C70	220131	“CAP, 130PF MICA 500V 5% DM15”
C71	220750	“CAP, 75PF MICA 500V 5% DM15”
C72	220750	“CAP, 75PF MICA 500V 5% DM15”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
C8	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C81	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C82	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C83	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C84	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C85	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C86	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C87	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C88	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C89	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C9	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C90	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C91	237022	“CAP, 2.2UF, AL, 50V, 20%, 4X5X1.5”
C92	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C93	DNP	“NULL PART, VACANT PCB LOCATION”
C94	237470	“CAP, 47UF AL 16V 20% 6.3X7 RAD”
C95	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C96	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C97	276153	“CAP, 0.015UF X7R 50V 10% 0.2LS”
C98	276153	“CAP, 0.015UF X7R 50V 10% 0.2LS”
C99	211102	“CAP, 1000PF NP0 100V 2% 0.1LS”
D1	320002	“DIODE, 1N4148/1N4150 DO-35”
D11	320003	“DIODE,GE 1N34A”
D12	320002	“DIODE, 1N4148/1N4150 DO-35”
D13	320002	“DIODE, 1N4148/1N4150 DO-35”
D14	320002	“DIODE, 1N4148/1N4150 DO-35”
D15	320003	“DIODE,GE 1N34A”
D16	320002	“DIODE, 1N4148/1N4150 DO-35”
D17	320204	“DIODE, ZENER 5.1V”
D19	320002	“DIODE, 1N4148/1N4150 DO-35”
D2	320002	“DIODE, 1N4148/1N4150 DO-35”
D20	320002	“DIODE, 1N4148/1N4150 DO-35”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
D21	320002	“DIODE, 1N4148/1N4150 DO-35”
D22	320002	“DIODE, 1N4148/1N4150 DO-35”
D23	320002	“DIODE, 1N4148/1N4150 DO-35”
D24	320002	“DIODE, 1N4148/1N4150 DO-35”
D25	320002	“DIODE, 1N4148/1N4150 DO-35”
D26	320002	“DIODE, 1N4148/1N4150 DO-35”
D27	320005	“DIODE, BA482 PIN SWITCH DO-34”
D3	320002	“DIODE, 1N4148/1N4150 DO-35”
D4	320002	“DIODE, 1N4148/1N4150 DO-35”
D5	320002	“DIODE, 1N4148/1N4150 DO-35”
D6	320002	“DIODE, 1N4148/1N4150 DO-35”
D8	320002	“DIODE, 1N4148/1N4150 DO-35”
D9	320003	“DIODE,GE 1N34A”
J1	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J2	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J3	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J4	610144	“HEADER,MLX,10PIN,.100”
J5	610144	“HEADER,MLX,10PIN,.100”
J6	610144	“HEADER,MLX,10PIN,.100”
J7	610510	“CONN, SMB PCB JACK-F RT AGL TH”
J8	610510	“CONN, SMB PCB JACK-F RT AGL TH”
K1	540066	“RELAY, SPDT 2A LATCH 12V”
K10	540066	“RELAY, SPDT 2A LATCH 12V”
K11	540066	“RELAY, SPDT 2A LATCH 12V”
K12	540066	“RELAY, SPDT 2A LATCH 12V”
K13	540080	“RELAY,DPDT 2 AMP SEALED”
K2	540066	“RELAY, SPDT 2A LATCH 12V”
K3	540066	“RELAY, SPDT 2A LATCH 12V”
K4	540066	“RELAY, SPDT 2A LATCH 12V”
K5	540066	“RELAY, SPDT 2A LATCH 12V”
K6	540066	“RELAY, SPDT 2A LATCH 12V”
K7	540066	“RELAY, SPDT 2A LATCH 12V”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
K8	540066	“RELAY, SPDT 2A LATCH 12V”
K9	540066	“RELAY, SPDT 2A LATCH 12V”
L1	459013	“IND ASSY,17T#26GAC 2-490033”
L10	459019	“IND ASSY,8T#22 GA 1-490034”
L11	459019	“IND ASSY,8T#22 GA 1-490034”
L12	459021	“IND ASSY,6T#22GA 1-490034”
L13	459032	“IND ASY,3T#30 MAGNET 1-490201”
L14	459032	“IND ASY,3T#30 MAGNET 1-490201”
L15	459023	“IND, 20T#26AWG, 1-490060”
L16	459022	“IND, 19T#26AWG, 1-490060”
L17	459023	“IND, 20T#26AWG, 1-490060”
L18	459032	“IND ASY,3T#30 MAGNET 1-490201”
L19	459032	“IND ASY,3T#30 MAGNET 1-490201”
L2	459143	“IND ASSY, 19T#26 AWG”
L20	459032	“IND ASY,3T#30 MAGNET 1-490201”
L21	459032	“IND ASY,3T#30 MAGNET 1-490201”
L22	459032	“IND ASY,3T#30 MAGNET 1-490201”
L25	430021	“IND, 22UH, FE, 140MA, 10%, IM-2”
L26	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L3	459143	“IND ASSY, 19T#26 AWG”
L4	459411	“IND ASSY, 10T, 24GA, 2-490033”
L5	459117	“IND ASSY,15T#24GA 1-490033”
L6	459016	“IND ASSY,13T#24 GA 1-490034”
L7	459059	“IND ASSY,12T#24GA 1-490034”
L8	459001	“IND,ASSY,6T,22AWG,2-490034”
L9	459017	“IND ASSY,10T#22 GA 1-490034”
Q1	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q10	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q11	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q12	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q13	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q14	310003	“XSTR, 2N3567 NPN 300MA TO92”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
Q15	310052	“XSTR, PN2907A PNP TO92”
Q16	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q17	310060	“XISTOR,PNP,DARL,MPSD54,TO92”
Q18	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q19	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q2	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q20	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q21	310007	“XISTOR,PNP,PN3638A,TO92”
Q22	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q23	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q24	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q25	310057	“XISTOR,NPN,PN2222A,TO92”
Q26	310138	“N-MOSFET, VN2222LL, 150MA, 60V, TO92”
Q27	310057	“XISTOR,NPN,PN2222A,TO92”
Q5	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q6	310052	“XSTR, PN2907A PNP TO92”
Q7	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q8	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q9	310003	“XSTR, 2N3567 NPN 300MA TO92”
R1	113335	“RES,3.3M OHM 1/8W CF 5%”
R10	113335	“RES,3.3M OHM 1/8W CF 5%”
R100	113101	“RES,100 OHM 1/8W CF 5%”
R101	113273	“RES,27K OHM 1/8W CF 5%”
R102	113273	“RES,27K OHM 1/8W CF 5%”
R103	113683	“RES,68K 1/8W 5% CARBON FILM”
R104	113101	“RES,100 OHM 1/8W CF 5%”
R105	113223	“RES,22K OHM 1/8W CF 5%”
R106	113223	“RES,22K OHM 1/8W CF 5%”
R107	170221	“RES,10K TRIMMER CERMET”
R108	113823	“RES,82K OHM 1/8W 5% CF”
R109	113393	“RES,39K OHM 1/8W CF 5%”
R11	113274	“RES,270K 1/8W 5% CARBON FILM”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
R110	134472	“RES, 4.7K OHM, 1/2W, CF, 5%”
R111	113105	“RES,1M OHM 1/8W CF 5%”
R112	113102	“RES, 1K OHM 1/8W CF 5%”
R113	113103	“RES, 10K OHM 1/8W CF 5%”
R114	012330201	“RES, 33K OHM, 1/10W, 1%, TK, 0603”
R115	113222	“RES,2.2K OHM 1/8W CF 5%”
R116	113103	“RES, 10K OHM 1/8W CF 5%”
R117	113682	“RES,6.8K 1/8W 5% CARBON FILM”
R118	113472	“RES, 4.7K OHM 1/8W CF 5%”
R119	113222	“RES,2.2K OHM 1/8W CF 5%”
R12	170221	“RES,10K TRIMMER CERMET”
R120	012237101	“RES, 2.37K OHM 0.1W 1% TK 0603”
R121	012237101	“RES, 2.37K OHM 0.1W 1% TK 0603”
R122	012665101	“RES, 6.65K OHM 0.1W 1% TK 0603”
R126	013150200	“RES, 15K OHM 1/8W 1% TK 0805”
R127	013110200	“RES, 11K OHM 1/8W 1% TK 0805”
R128	013768100	“RES, 7.68K OHM 1/8W 1% TK 0805”
R129	013472000	“RES, 4.7K OHM 1/8W 5% TK 0805”
R13	113103	“RES, 10K OHM 1/8W CF 5%”
R130	013472000	“RES, 4.7K OHM 1/8W 5% TK 0805”
R131	013105000	“RES,1M OHM 1/8W 5% TK 0805”
R132	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R133	013303000	“RES, 30.1K OHM 1/8W 1% TK 0805”
R134	013619100	“RES, 6.19K OHM 1/8W 1% TK 0805”
R135	013470001	“RES, 470 OHM 1/8W 1% TK 0805”
R136	DNP	“NULL PART, VACANT PCB LOCATION”
R14	113103	“RES, 10K OHM 1/8W CF 5%”
R15	113105	“RES,1M OHM 1/8W CF 5%”
R16	113474	“RES,470K OHM 1/8W CF 5%”
R17	113103	“RES, 10K OHM 1/8W CF 5%”
R18	113472	“RES, 4.7K OHM 1/8W CF 5%”
R19	113223	“RES,22K OHM 1/8W CF 5%”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
R2	113332	“RES,3.3K OHM 1/8W CF 5%”
R20	113103	“RES, 10K OHM 1/8W CF 5%”
R21	113103	“RES, 10K OHM 1/8W CF 5%”
R22	113103	“RES, 10K OHM 1/8W CF 5%”
R23	113273	“RES,27K OHM 1/8W CF 5%”
R24	170225	“RES,100K VARIABLE MINI”
R25	113103	“RES, 10K OHM 1/8W CF 5%”
R26	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R27	012499000	“RES, 499 OHM 0.1W 1% TK 0603”
R28	012499000	“RES, 499 OHM 0.1W 1% TK 0603”
R29	012806001	“RES, 806 OHM 0.1W 1% TK 0603”
R3	113334	“RES, 330K OHM, 1/8W, 5%, CF”
R30	113102	“RES, 1K OHM 1/8W CF 5%”
R31	113222	“RES,2.2K OHM 1/8W CF 5%”
R32	113562	“RES,5.6K OHM 1/8W CF 5%”
R33	113103	“RES, 10K OHM 1/8W CF 5%”
R34	113272	“RES,2.7K OHM 1/8W CF 5%”
R35	113332	“RES,3.3K OHM 1/8W CF 5%”
R36	012698001	“RES, 698 OHM 0.1W 1% TK 0603”
R37	012330201	“RES, 33K OHM, 1/10W, 1%, TK, 0603”
R38	113100	“RES,10 OHM 1/8W 5% FILM”
R39	113153	“RES,15K OHM 1/8W CF 5%”
R4	113473	“RES, 47K OHM 1/8W CF 5%”
R40	113682	“RES,6.8K 1/8W 5% CARBON FILM”
R41	012806001	“RES, 806 OHM 0.1W 1% TK 0603”
R42	113223	“RES,22K OHM 1/8W CF 5%”
R43	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R44	113222	“RES,2.2K OHM 1/8W CF 5%”
R45	113103	“RES, 10K OHM 1/8W CF 5%”
R46	113102	“RES, 1K OHM 1/8W CF 5%”
R49	113471	“RES,470 OHM 1/8W CF 5%”
R5	113104	“RES,100K OHM 1/8W CF 5%”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
R50	170231	“RES,5K TRIMMER “”W”” TYPE”
R51	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R52	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R53	113221	“RES,220 OHM 1/8W 5% CF”
R54	113103	“RES, 10K OHM 1/8W CF 5%”
R55	113473	“RES, 47K OHM 1/8W CF 5%”
R56	113102	“RES, 1K OHM 1/8W CF 5%”
R57	113562	“RES,5.6K OHM 1/8W CF 5%”
R58	113224	“RES,220K OHM 1/8W CF 5%”
R59	113104	“RES,100K OHM 1/8W CF 5%”
R6	113104	“RES,100K OHM 1/8W CF 5%”
R60	113472	“RES, 4.7K OHM 1/8W CF 5%”
R61	113104	“RES,100K OHM 1/8W CF 5%”
R62	113103	“RES, 10K OHM 1/8W CF 5%”
R63	113103	“RES, 10K OHM 1/8W CF 5%”
R64	113103	“RES, 10K OHM 1/8W CF 5%”
R65	170232	“RES,50K SEALED TRIM 1/4 SQ”
R66	113152	“RES,1.5K OHM 1/8W CF 5%”
R67	113104	“RES,100K OHM 1/8W CF 5%”
R68	113104	“RES,100K OHM 1/8W CF 5%”
R69	113104	“RES,100K OHM 1/8W CF 5%”
R7	113104	“RES,100K OHM 1/8W CF 5%”
R70	113222	“RES,2.2K OHM 1/8W CF 5%”
R71	113202	“RES, 2K 1/8W 5% CARBON FILM”
R72	113152	“RES,1.5K OHM 1/8W CF 5%”
R73	113473	“RES, 47K OHM 1/8W CF 5%”
R74	113222	“RES,2.2K OHM 1/8W CF 5%”
R75	144562	“RES, 5.6K OHM 1W 5% FP MOX”
R76	124101	“RES,100 OHM 1/4W 5% CF”
R77	113472	“RES, 4.7K OHM 1/8W CF 5%”
R78	113472	“RES, 4.7K OHM 1/8W CF 5%”
R79	113272	“RES,2.7K OHM 1/8W CF 5%”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
R8	113104	“RES,100K OHM 1/8W CF 5%”
R80	113821	“RES,820 OHM 1/8W CF 5%”
R81	113222	“RES,2.2K OHM 1/8W CF 5%”
R82	170231	“RES,5K TRIMMER “”W”” TYPE”
R83	170231	“RES,5K TRIMMER “”W”” TYPE”
R84	113222	“RES,2.2K OHM 1/8W CF 5%”
R85	113223	“RES,22K OHM 1/8W CF 5%”
R86	113392	“RES,3.9K 1/8W 5% CARBON FILM”
R87	113623	“RES, 62K OHM, 1/8W, CF, 5%”
R88	113621	“RES,620 OHM 1/8W CF 5%”
R89	113104	“RES,100K OHM 1/8W CF 5%”
R9	113334	“RES, 330K OHM, 1/8W, 5%, CF”
R90	113104	“RES,100K OHM 1/8W CF 5%”
R91	113103	“RES, 10K OHM 1/8W CF 5%”
R92	113472	“RES, 4.7K OHM 1/8W CF 5%”
R93	113103	“RES, 10K OHM 1/8W CF 5%”
R94	013124000	“RES, 120K OHM 1/8W 5% TK 0805”
R95	113103	“RES, 10K OHM 1/8W CF 5%”
R96	113104	“RES,100K OHM 1/8W CF 5%”
R97	113106	“RES,10M 1/8W 5% CARBON FILM”
R98	113473	“RES, 47K OHM 1/8W CF 5%”
R99	113333	“RES,33K OHM 1/8W CF 5%”
T1	459100	“IND ASSY,10T#26GA 1-490302”
TP1	653003	PIN PRINTED CIRCUIT BOARD
U1	330030	“IC,LIN,LM324N,DIP14,OP-AMP”
U10	330081	“IC, LM2904 OP-AMP DIP-8”
U2	330134	“IC, 4001B QUAD 2-IN NOR DIP14”
U3	330030	“IC,LIN,LM324N,DIP14,OP-AMP”
U4	330274	“IC, CA3028BE RF AMP DIP-8”
U5	330083	“IC, LM386N-4 OP-AMP DIP-8”
U6	033304073	“IC,MC1496B BAL MODULATOR SO14”
U7	330126	“IC,4094B 8-STG SHIFT REG DIP16”

Table 3-8 Audio/Filter Board Parts List (009-00101 Rev. AK)

Designator	Part Number	Description
U8	033304160	“IC, SA575 COMPANDOR SO20”
U9	330126	“IC,4094B 8-STG SHIFT REG DIP16”
XU1	621005	“SOCKET, IC DIP-14 PIN”
XU10	621003	“SOCKET, IC DIP-8 PIN”
XU2	621005	“SOCKET, IC DIP-14 PIN”
XU3	621005	“SOCKET, IC DIP-14 PIN”
XU4	621003	“SOCKET, IC DIP-8 PIN”
XU5	621003	“SOCKET, IC DIP-8 PIN”
XU9	621004	“SOCKET, IC DIP-16 PIN”

Chapter 4: 1650 kHz IF Board

4.1 Circuit Description

The 1650 kHz IF board includes a SSB filter included in both the transmit and receive signal paths with separate amplifiers for each mode. The AGC system is generated in this board. The following sections discuss the components of the block diagram in Figure 4-6.

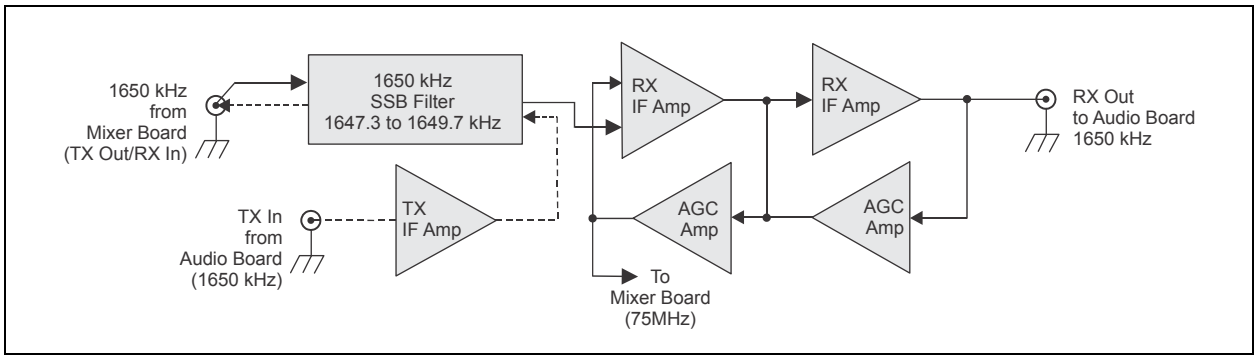


Figure 4-1 1650 kHz IF Board Block Diagram

4.1.1 Transmit Path

In the transmit signal path, the 1650 kHz IF board receives the transmit signal from the Audio/Filter board on coax connector J2 (TX IN). It is then applied to 1650 kHz transmit amplifier Q3.

1650 kHz TX Amplifier

Transmit IF amplifier Q3 amplifies the low-level, dual sideband signal from the balanced modulator on the Audio/Filter board. It also provides correct matching to the 1650 kHz sideband filter.

1650 kHz Crystal Sideband Filter

The 1650 kHz crystal sideband filter consists of six crystal filters. In transmit mode, the 1650 kHz sideband filter removes one of the sidebands from the double-sideband suppressed carrier signal generated by the balanced modulator on the Audio/Filter board.

In upper sideband mode, the DDS on the Synthesizer board generates a BFO frequency of 1650 kHz that is routed through the high side of the filter. In lower sideband mode, the DDS generates a BFO of 1647 kHz on the lower side of the filter passband. The transmit signal consists of the suppressed carrier (1650 or 1647 kHz) modulated by the transmit audio

The filter output is a modulated 1650 kHz suppressed carrier, single-sideband signal that is applied to coax connector J3 (1650 I/O) and then routed to the Mixer board.

4.1.2 Receive Path

In the receive signal path, the 1650 kHz IF board receives the receive signal from the Mixer board on coax connector J3 (1650 I/O). It is then applied to the 1650 kHz crystal sideband filter.

1650 kHz Sideband Filter

In receive mode, the 1650 kHz SSB filter provides a 3 kHz passband between 1647 and 1650 kHz that rejects unwanted signals outside the 3 kHz passband spectrum. The filter passband is symmetrical, enabling the use of one filter for both upper and lower sideband operations.

In upper sideband operation, the BFO frequency is 1650 kHz on the high side of the filter passband. In lower sideband mode, the BFO frequency is 1647 kHz on the lower side of the filter passband. The DDS automatically shifts the BFO by 3 kHz when switching sidebands.

RX IF Amplifier 1

From the 1650 kHz sideband filter, the receive signal is applied to first 1650 kHz IF amplifier Q1. Dual-gate MOSFET Q1 amplifies the receive signal from the 1650 kHz sideband filter and integrates the AGC signal to prevent high receive signal levels that may damage components. It is capacitor-coupled to the filter the amplifier input and has a high input impedance that provides correct filter matching. The stage gain is controlled by applying the AGC voltage to gate 2 (Q1 pin 2). The output is transformer-coupled to the next stage through transformer T3.

RX IF Amplifier 2

Second 1650 kHz IF amplifier Q2 is a fixed-gain common emitter stage with an unbypassed emitter. The output is transformer-coupled (T4) to the Audio/Filter board through 3 dB attenuator R10 and R11.

Sidetone Generator

The 1650 kHz IF system also generates the transmit sidetone for the internal speaker or headset. The receive IF amplifiers remain switched on in the transmit mode *listening* to the low level transmitter exciter output. Diode switch D7 is connected to the drain of Q1 and shorts the drain load of T3. This prevents overload of the receive IF amplifiers. This method of sidetone generation provides a complete check of the entire audio, balanced-modulator, product-detector and 1650 kHz IF system. When coupled with the RF sidetone gate, the sidetone becomes a powerful diagnostic tool in determining the complete system performance (BITE).

4.1.3 Automatic Gain Control (AGC)

Automatic gain control monitors and adjusts the receive output signal to insure it is not too large for an attached speaker. The AGC circuit taps the receive line at the output of second receive IF amplifier Q2 and feeds that output signal back to the input of first receive IF amplifier circuit Q7 on the Mixer board. The AGC taps the output receive signal at variable step-down transformer T4 and routes the sample to RF amplifier Q5.

RF Amplifier

AGC RF amplifier Q5 is an emitter-follower bipolar transistor. The low impedance output drives the base of Q4 through voltage doubler rectifier D3 and D4.

DC Amplifier

AGC DC amplifier Q4 is a common emitter bipolar transistor with R18 as the high impedance collector load. This gives a negative-going AGC output of 4V to 0V. The AGC output controls the first 1650 kHz IF amplifier Q1 and 75 MHz IF amplifier Q7 on the Mixer board.

4.1.4 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 4-1 1650 kHz IF Board Specifications

Characteristic	Specification
Transmit	
Current	8 VDC at 4 mA
Output	1650 kHz, SSB
Input	1650 kHz, DSB
System Gain	14 dB
Receive	
Current	8 VDC at 6 mA
Output	1650 kHz
Input	1650 kHz
System Gain	44 dB
AGC Range	55 dB
Filter	
-6 dB	1647.3 to 1649.7 kHz
-60 dB	1646.0 to 1651.0 kHz

4.2 Connector Pin Assignments

The 1650 kHz IF board has the following connections: J1, J2, J3, and J4.

4.2.1 J1 Connector

J1 connects with the Audio/Filter, the Junction, and the Mixer boards.

Table 4-2 J1 Connector Pin Assignments

Pin	Description	Connection
1	AGC	Automatic gain control for setting the audio level in receive mode to the Mixer board. Typically 4 VDC
2	R8	+8 VDC when radio is in receive mode, 0 VDC in transmit mode from the Audio/Filter board.
3	+8V	+8 VDC from power supply from the Junction board.
4	T8	+8 VDC when radio is in transmit mode, 0 VDC in receive mode from the Audio/Filter board.

4.2.2 J2 Connector

Coax connector J2 (TX IN) carries the transmit signal from the Audio/Filter board.

4.2.3 J3 Connector

Coax connector J3 (1650 I/O) carries the transmit output signal to the Mixer board and the receive input signal from the Mixer board.

4.2.4 J4 Connector

Coax connector J4 (RX OUT) carries the receive signal to the Audio/Filter board.

4.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the 1650 kHz IF board.

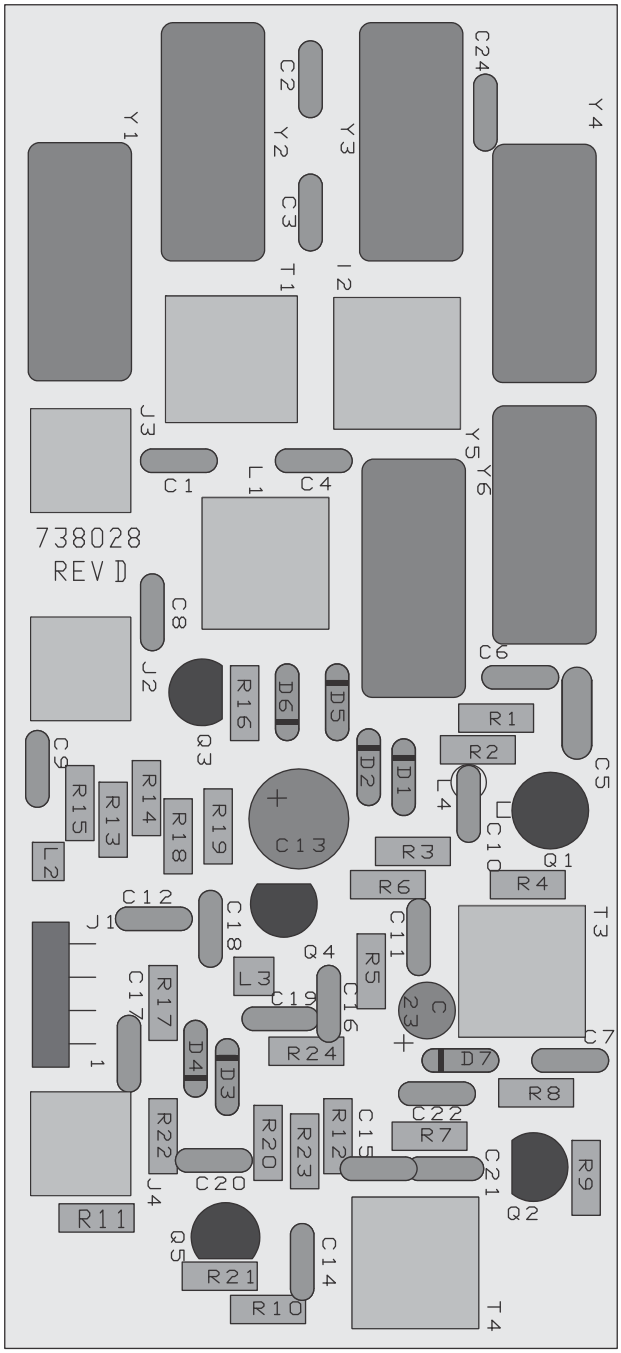
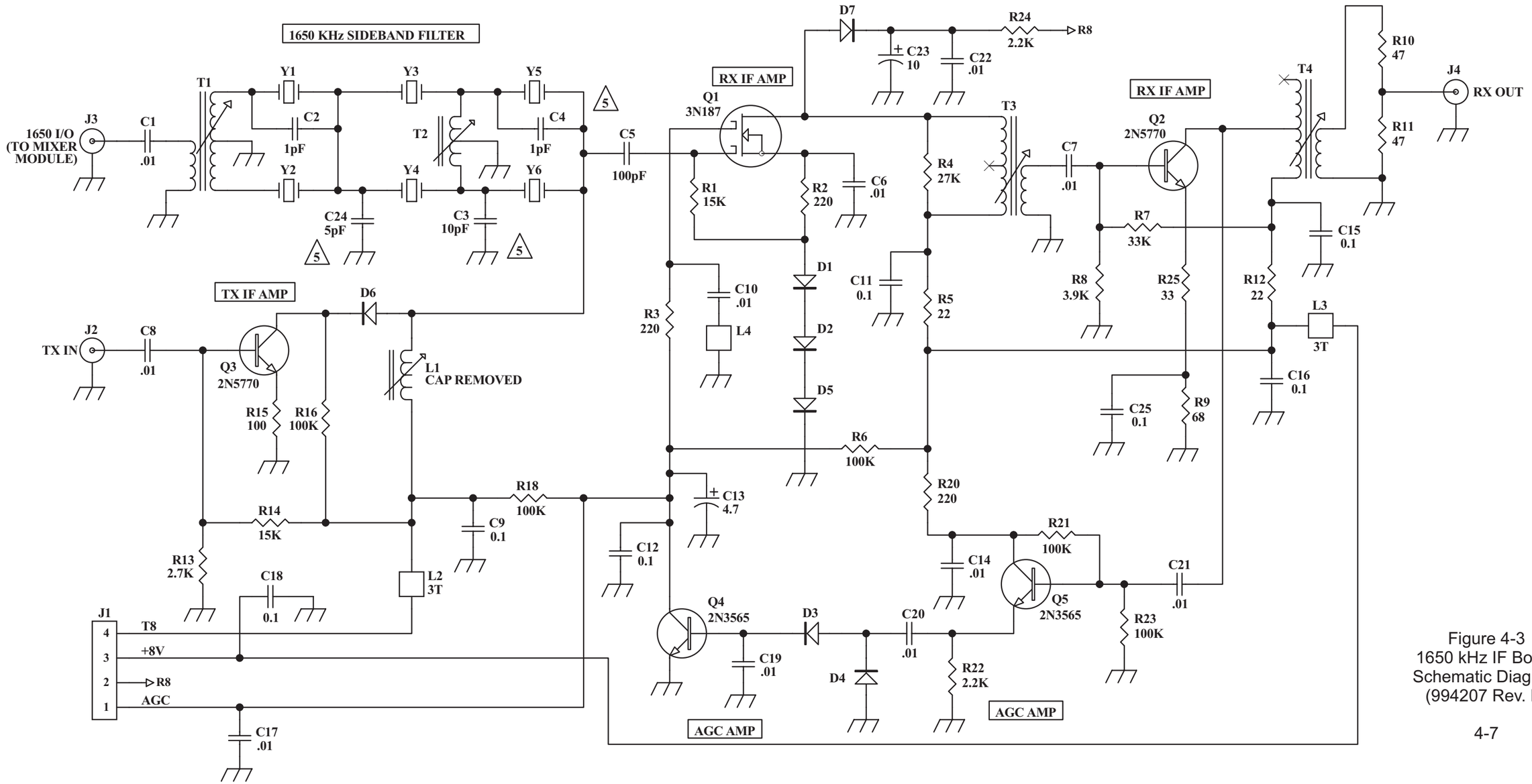


Figure 4-2 1650 kHz IF Board Component Locations (738028 Rev D)

REV	ECO	DESCRIPTION	DATE	APPR
A	1099-288	RELEASE	10-01-92	
B	05-0372	Q1 WAS 3N204, ADDED C25 AND R25, R9 WAS 100 OHMS BB	10-18-05	



NOTE: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE 1/8W 5%.
2. RESISTANCE IS IN OHMS.
3. CAPACITANCE IS IN MICROFARADS.
4. ALL DIODES ARE IN 1N4148/1N4150.
5. PARTS C2, C3, C4 FITTED OR C24 FITTED.

Figure 4-3
1650 kHz IF Board
Schematic Diagram
(994207 Rev. B)

PRC1099A-MS

Datron World Communications, Inc.
3055 Enterprise Ct.
Vista CA 92081-8362
TEL:(760) 597-1500
FAX:(760) 597-1510

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Title: Schematic	PRC1099 - M2 1650 IF			
Size: B	Drawn: MACKLIN	Date: 10-01-94	Drawing Number: 994207	Rev: B
	Appr:	Date:		
Scale: NONE	File: 994207b.SCH	Date: 18-Oct-2005	Time: 17:15:14	Sheet: 1 of 1

Table 4-3 1650 kHz IF Board Parts List (009-00202 Rev. R)

Designator	Part Number	Description
C1	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C10	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C11	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C12	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C13	241040	“CAP,T,4.7UF,16V,20%,RA,.1SP”
C14	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C15	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C16	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C17	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C18	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C19	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C20	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C21	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C22	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C23	237100	“CAP, 10UF AL 16V 20% 4X5X1.5LS”
C25	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C3	2751001	“CAP, 10PF NPO 50V 5% RAD 0.1S”
C5	221101	“CAP, 100PF MICA 300V 5% DM5”
C6	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C7	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C8	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C9	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
D1	320002	“DIODE, 1N4148/1N4150 DO-35”
D2	320002	“DIODE, 1N4148/1N4150 DO-35”
D3	320002	“DIODE, 1N4148/1N4150 DO-35”
D4	320002	“DIODE, 1N4148/1N4150 DO-35”
D5	320002	“DIODE, 1N4148/1N4150 DO-35”
D6	320002	“DIODE, 1N4148/1N4150 DO-35”
D7	320002	“DIODE, 1N4148/1N4150 DO-35”
J1	610235	“HEADER, 1X4 MLX RA+SB LOCK 0.1”
J2	610510	“CONN, SMB PCB JACK-F RT AGL TH”

Table 4-3 1650 kHz IF Board Parts List (009-00202 Rev. R)

Designator	Part Number	Description
J3	610510	“CONN, SMB PCB JACK-F RT AGL TH”
J4	610510	“CONN, SMB PCB JACK-F RT AGL TH”
L1	420051	“INDUCTOR,1650 KHZ, NO CAPACITOR”
L2	459032	“IND ASY,3T#30 MAGNET 1-490201”
L3	459032	“IND ASY,3T#30 MAGNET 1-490201”
L4	490201	BEAD FERRITE SHIELD 73 MAT.
Q1	310126	“310126, SCREENED”
Q2	310032	“XISTOR,NPN,2N5770,TO92”
Q3	310032	“XISTOR,NPN,2N5770,TO92”
Q4	310006	“XSTR,PN3565 NPN 50MA TO-92”
Q5	310006	“XSTR,PN3565 NPN 50MA TO-92”
R1	113153	“RES,15K OHM 1/8W CF 5%”
R10	113470	“RES,47 OHM 1/8W 5% CARBON FILM”
R11	113470	“RES,47 OHM 1/8W 5% CARBON FILM”
R12	113220	“RES,22 OHM 1/8W 5% CARBON FILM”
R13	113272	“RES,2.7K OHM 1/8W CF 5%”
R14	113153	“RES,15K OHM 1/8W CF 5%”
R15	113101	“RES,100 OHM 1/8W CF 5%”
R16	113104	“RES,100K OHM 1/8W CF 5%”
R17	1110000	“RES,0 OHM,1/8W,1%”
R18	113104	“RES,100K OHM 1/8W CF 5%”
R19	1110000	“RES,0 OHM,1/8W,1%”
R2	113221	“RES,220 OHM 1/8W 5% CF”
R20	113221	“RES,220 OHM 1/8W 5% CF”
R21	113104	“RES,100K OHM 1/8W CF 5%”
R22	113222	“RES,2.2K OHM 1/8W CF 5%”
R23	113104	“RES,100K OHM 1/8W CF 5%”
R24	113222	“RES,2.2K OHM 1/8W CF 5%”
R25	013330	“RES,33 OHM 1/4W 5% TK 1206”
R3	113221	“RES,220 OHM 1/8W 5% CF”
R4	113273	“RES,27K OHM 1/8W CF 5%”
R5	113220	“RES,22 OHM 1/8W 5% CARBON FILM”

Table 4-3 1650 kHz IF Board Parts List (009-00202 Rev. R)

Designator	Part Number	Description
R6	113104	“RES,100K OHM 1/8W CF 5%”
R7	113333	“RES,33K OHM 1/8W CF 5%”
R8	113392	“RES,3.9K 1/8W 5% CARBON FILM”
R9	013680	“RES,68 OHMS 1/4W 5% SMT”
T1	420018	INDUCTOR IF 1650KHZ
T2	420018	INDUCTOR IF 1650KHZ
T3	420018	INDUCTOR IF 1650KHZ
T4	420018	INDUCTOR IF 1650KHZ
Y1	361001	“CRYSTAL, FILTER, TW100”
Y2	361004	“CRYSTAL, FILTER, TW100”
Y3	361003	“CRYSTAL, FILTER, TW100”
Y4	361002	“CRYSTAL, FILTER, TW100”
Y5	361001	“CRYSTAL, FILTER, TW100”
Y6	361004	“CRYSTAL, FILTER, TW100”

Chapter 5: Mixer Board

5.1 Circuit Description

The Mixer board includes the first and second frequency conversion mixers. In transmit mode, the audio modulated 1650 kHz low-level SSB signal is up-converted to 75 MHz, amplified, filtered, down-converted to the 1.6 to 30 MHz range, and then amplified again to approximately +3 dBm.

In receive mode, the receive signal from the Audio/Filter board is up-converted from the channel frequency to 75 MHz, amplified, filtered, amplified again, and then down-converted to 1650 (USB) or 1647 (LSB) kHz. The following sections discuss the components of the block diagram shown in Figure 5-1 below.

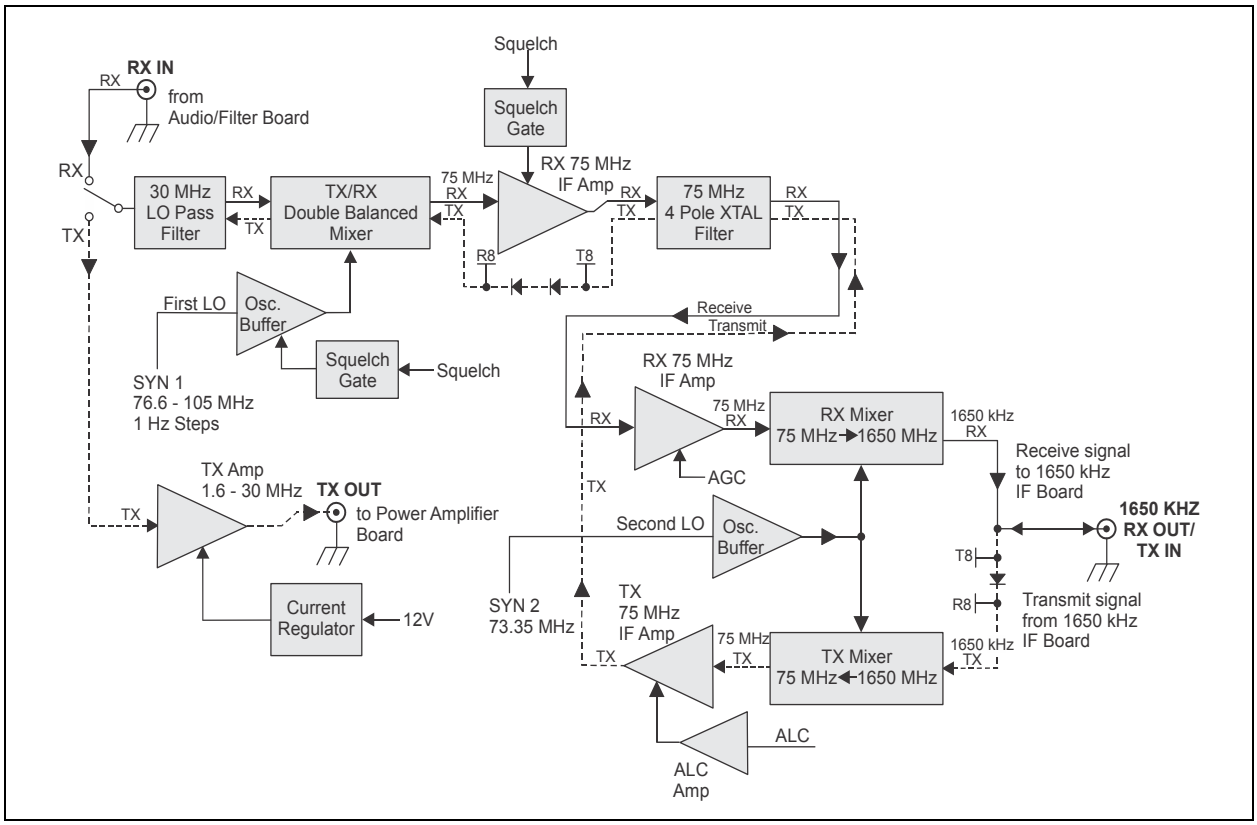

Figure 5-1 Mixer Board Block Diagram

5.1.1 Transmit Mode

The single sideband transmit signal is received from the 1650 kHz IF board at the 1650 kHz terminal. From the 1650 kHz terminal, the SSB transmit signal is applied to mixer U2.

Up-Conversion Mixer

This stage up-converts the 1650 kHz SSB signal to 75 MHz. Active double-balanced mixer U2 mixes the 1650 kHz IF (USB mode) signal with the 73.35 MHz second LO from the Synthesizer board to produce the 75 MHz IF signal. Potentiometer R37 sets the mixer gain. In transmit mode, PIN diode D13 is forward-biased by T8 (+8V), enabling the 1650 kHz IF input signal to be applied to mixer U2. The 75 MHz IF output is coupled to Q11 through the π filter formed by C64, L22, and variable capacitor C65.

LO2 Buffer

Second local oscillator buffer Q10 amplifies the low level 73.35 MHz LO2 input from the Synthesizer board to an output level of 2 Vrms. Tuned output circuit L20 and variable capacitor C58 insure good spectral purity. In transmit mode, the level is dropped to 100 mV through R43 for injection into transmit mixer U2.

TX Gain Controlled Amplifier

Dual gate MOSFET amplifier Q11 integrates the automatic level control (ALC) signal from the Audio/Filter board to control the stage gain. The ALC signal from Q12 is input at Q11 gate 2 (pin 3) with the 75 MHz IF signal at gate 1 (pin 4).

The ALC signal received from Audio/Filter board is applied to ALC amplifier Q12 (refer to “ALC Circuit” on page 3-6). When the ALC circuit is not active, a maximum voltage of 4V is applied to gate 2 through voltage divider R54 and R55.

The drain of Q11 is connected through broadband transformer T4 to the 50 ohm input of the 75 MHz filter through PIN diode switch D11. D11 is forward-biased in transmit mode by T8 (+8V) through R33, R34, and T4.

75 MHz Filter

In transmit mode, 75 MHz filter Y1 rejects the image output from mixer U2 and provides additional attenuation of the LO2. The output from the 75 MHz filter passes through a tuned matching network consisting of C18, L5, and C17 that matches the high impedance crystal filter with the resonant tank circuit of L6 and C24. PIN diodes D1 and D2 act as T/R switches directing the transmit signal from the LC matching network to the resonant tank circuit of C24, L6, and then to double-balanced mixer MX1. T8 forward-biases D1 and D2 in transmit mode; R8 reverse-biases D1 and D2 in receive mode.The transmit signal bypasses the RX IF amplifier U4.

LO1 Buffer

First local oscillator buffer Q1 amplifies the low-level DDS synthesizer LO1 output to a level of approximately +7 dBm for injection into the 50 ohm oscillator port of MX1. The output from Q1 is coupled to mixer MX1 through broadband transformer T1 and 105 MHz, low-pass, LC π filter C6, L2, and C7. The response is substantially flat over the Q1 output range of 76.6 to 105 MHz.

Down-Conversion Mixer	Double-balanced mixer MX1 mixes the 75 MHz IF signal with the 76.6 to 105 MHz first local oscillator (LO1) from the LO1 input (SYN1) from the Synthesizer board to produce an audio-modulated transmit signal at the selected channel frequency. MX1 runs at a very low-level to minimize spurious outputs.
30 MHz Low-Pass Filter	At the output of RF mixer MX1, the 30 MHz low-pass filter, consisting of C9, L3, C10, L4, and C11 removes the image frequency as well as unwanted image and spurious responses above 30 MHz. These spurious responses are produced from mixing the 75 MHz IF signal with LO1.
Amplifier 1.6 to 30 MHz	The low-level transmit output from double-balanced mixer MX1 is amplified by MMIC (monolithic, microwave, integrated circuit) U1, providing a stable 50 ohms to 50 ohms amplification over a very wide frequency range without any external components.
Current Regulator	MMIC (U1) is designed to operate from a 20V supply using a series bias resistor in the supply load. Since the PRC1099A is designed to operate over a supply range in excess of 10V to 15V, current regulator U3 provides a constant current source for U1. The current output is determined by R60 and R61. The current to U1 is switched on by TX gate Q5 that is controlled by the R8 line.
Transmit/Receive Switch	The transmit signal is output to the PA board through the transmit/receive (T/R) switch controlled by relay K1. The relay is activated by T8 (+8V). The transmit signal is output at the TX OUT terminal.

5.1.2 Receive Mode

In receive mode, the Mixer board receives the receive signal from the Audio/Filter board on the RX IN terminal and applies it to the 30 MHz low-pass filter circuit after being switched through T/R switch by relay K1.

30 MHz Low-Pass Filter	The low-pass filter consisting of C9, L3, C10, L4, and C11, located at the input of RF mixer MX1, removes the unwanted image and spurious responses above 30 MHz from the receive signal before being mixed with the local oscillator frequency.
Squelch Gates	For battery powered manpack configurations, power conservation is a constant design consideration. Squelch gates Q2 and Q4 provide a way to reduce the LO1/mixer circuit current drain in receive mode when squelch is turned on (receive signal is muted).

Note: When referring to squelch states in this manual, “squelch is turned *on*,” means the same as “squelch is *closed*. Conversely, “squelch is turned *off*,” means the same as “squelch is *open*.” When squelch is turned *on*, the receive signal is muted. When squelch is turned off, the receive signal is unmuted. When the receive signal includes voice modulation, squelch is broken and temporarily switches from *on* or *closed* to *off* or *open*.

The LO1 buffer and double-balanced mixer MX1 as well as the IF amplifier U4 draw significant current levels in receive mode.

Squelch gate Q2 controls the current drain of LO1 buffer Q1. Q1 emitter resistors R5 (47 ohms) and R4 (820 ohms) set the current draw for the buffer circuit. When squelch is turned on, gate Q2 turns off. This increases the emitter resistance by adding R4 to the emitter. In transmit mode and when squelch is turned off, the squelch line is high and Q2 is turned on. This decreases the emitter resistance by shorting R4 to ground.

Increasing the emitter resistance (47 to 867 ohms) reduces the Q2 circuit current drain, saving valuable battery power when the radio is idle (not actively receiving a signal). Similarly, when squelch gate Q13 is turned on, it adds R67 (100 ohms) to the output of IF amplifier U4.

Double-Balanced Mixer

Double-balanced mixer MX1 mixes the selected channel receive frequency from the 30 MHz filter with the local oscillator LO1 frequency (76.597 to 105 MHz) from the Synthesizer board to up-convert to the 75 MHz first IF frequency.

75 MHz IF Amplifier 1

75 MHz IF amplifier U4 amplifies the 75 MHz output from the MX1 and provides a broadband 50 ohm match to the MX1. The output is matched to high impedance crystal filter Y1 by the matching network consisting of C17, L5, and C18.

75 MHz Crystal Filter

75 MHz filter Y1 is a monolithic, 4-pole crystal filter with 25 MHz bandwidth that provides the primary selectivity. The filter has a stopband of -70 dB and rejects the IF image and other spurious frequencies. The filter output is impedance matched to 50 ohms by the matching network C44, L14, and C45.

75 MHz IF Amplifier 2

Dual-gate MOSFET Q7 integrates the AGC signal with the filtered 75 MHz IF signal from crystal filter Y1. The AGC signal from the 1650 kHz IF board is applied to gate 2 (pin 3). The AGC signal regulates the receive signal to prevent large incoming receive signals that can cause component damage (refer to “Automatic Gain Control (AGC)” on page 4-3).

The 50 ohm output from the 75 MHz crystal filter is matched to the input of Q7 by 50 ohm to 450 ohm broadband transformer T2. The matching network consisting of C52, L18, and C53 matches the Q7 output to the input of mixer Q8.

LO2 Buffer

Second local oscillator buffer Q10 amplifies the low level 73.35 MHz LO2 input from the Synthesizer board to an output level of 2 Vrms. Tuned output circuit L20 and variable capacitor C58 insure good spectral purity. In receive mode, the output is coupled directly into gate 2 (pin 3) of receiver mixer Q8.

1650 kHz Mixer

Second conversion mixer Q8 is a dual-gate MOSFET with the receive signal input to gate 1 (pin 4) and the LO2 oscillator input (73.35 MHz) to gate 2 (pin 3). Mixer Q8 combines the 75 MHz IF receive signal from Q7 with the second local oscillator (LO2) from the DDS on the Synthesizer board to produce the 1650 kHz IF receive signal.

The 1650 kHz output receive signal is coupled through transformer T3 to the 1650 KHZ terminal. From the 1650 kHz IF board, the 1650 kHz receive signal is routed to the 1650 kHz IF board.

Transmit/Receive Switch

Transistor Q9 acts as a T/R switch, grounding the T3 secondary in receive mode. In receive mode, Q9 is biased on from R8 (+8V); in transmit mode, R8 is 0V so Q9 is biased off, leaving the T3 secondary open. In receive mode, T3 connects the output of Q8 to the 1560 KHZ terminal.

5.1.3 ALC Circuit

The automatic level control (ALC) circuit controls the transmit power output signal to maintain a stable radio output power. Potentiometer R37 sets the double-balanced mixer U2 gain. It is adjusted to provide an output signal from the Mixer board that produces a minimum transmit signal of 20W from the RF power amplifiers on the PA board in lowest output channels—typically the higher frequency channels (around 30 MHz).

The ALC circuit monitors the RF output power on the Audio/Filter board to maintain the 20W output in channels where the transmit signal may exceed 20W—typically the lower frequency channels (around 2 MHz). If the output exceeds 20W by a preset value, the ALC circuit reduces the transmit signal level output at dual-gate FET Q11 on the Mixer board.

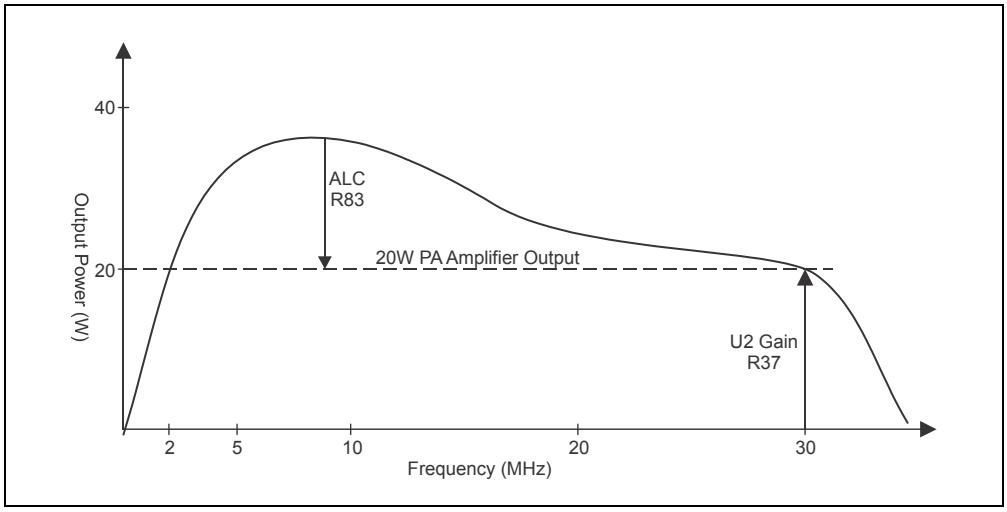

Figure 5-2 ALC Frequency vs PA Output Power

The ALC circuit begins on the Audio/Filter board by sampling the transmit output power and then rectifying and amplifying the sampled current before sending it to the Mixer board.

On the Mixer board, the ALC signal is amplified by bipolar transistor Q12 and injected into the transmit amplifier N-channel dual-gate MOSFET Q11. If the transmit output power signal (current) exceeds a preset level set by

potentiometer R83 on the Audio/Filter board, the ALC signal drives the Q11 transmit output signal lower. The lower control limit is set by U2 gain adjust potentiometer R37.

When ALC voltage from the Audio/Filter board is applied to Q12, it conducts, causing the Q12 collector and Q11 control gate 2 voltage to drop. The gain of Q11 decreases causing the Q11 output transmit signal to decrease. Diode D12 provides the fixed reference voltage for gate 1 (pin 4).

The ALC system is normally peak-reading. Capacitor C74 is charged up by T8 through R54; when ALC is active, C74 discharges through Q12. This provides a slow released of Q11 gain to smooth the changes in Q11 gain over time.

5.1.4 AME Option

The AME option circuit injects the 1647 or 1650 kHz BFO (full carrier) signal from the Synthesizer board directly into the transmit path at double-balanced mixer U2 as shown in Figure 5-3 on page 5-7 to prevent the carrier being controlled by the ALC circuit.

The BFO signal is applied to the input of mixer U2 using PIN diode attenuators D14 and D15 as an on/off switch. In the AME off position, D14 is forward-biased, shorting the 1650 kHz carrier to ground through R49; D15 is reverse-biased. This gives approximately 60 dB of attenuation. The 1650 kHz carrier from the 1650 kHz IF board with the suppressed carrier and either upper or lower sideband removed is routed to mixer U2

When carrier switch Q20 on the Audio/Filter board is turned on, D14 is reverse-biased and D15 is forward-biased. Input potentiometer R51 sets the carrier level.The full 1650 kHz carrier from the Synthesizer board is applied to mixer U2.

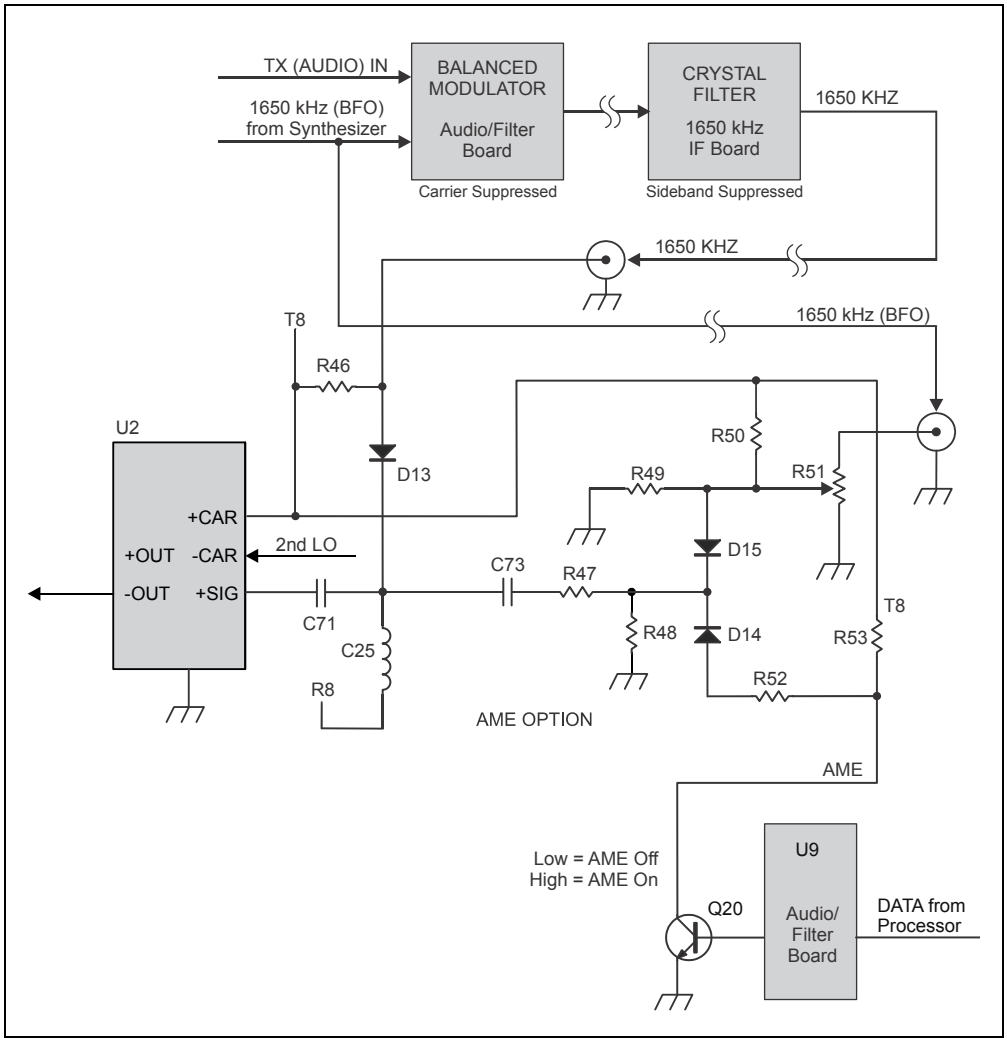

Figure 5-3 AME Option Circuit

5.1.5 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 5-1 Mixer Board Specifications

Characteristic	Specification
Transmit	
Current	8 VDC at 43 mA 12 VDC at 44 mA
Output	Channel frequency (Fs)
Input	1650 kHz
Gain	31 dB

Table 5-1 Mixer Board Specifications (continued)

Characteristic	Specification
Receive	
Current	8 VDC at 20 mA 8 VDC at 12.5 mA (squelched) 12 VDC at 17.5 mA 12 VDC at 5.7 mA (squelched)
Output	1650 kHz
Input	Channel frequency (Fs)
Gain	32 dB
Oscillators	
Level at TP1	+7 dBm at 76.6 to 105 MHz 2 Vrms at 73.35 MHz
Level at U2-10	2 Vrms at 73.35 MHz
Level at U2-10	100 mVrms at 73.35 MHz

5.2 Connector Pin Assignments

The Mixer board has the following interconnections with the transceiver.

5.2.1 J1 Connector

J1 connects to the Junction, Audio/Filter, and 1650 kHz IF boards.

Table 5-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	GND	Chassis ground.
2	ALC	Automatic level control from the Audio/Filter board for setting the output power level in transmit mode.
3	+12V	12 VDC from the Junction board.
4	+8V	8 VDC from the Junction board.
5	R8	8 VDC in receive from Audio/Filter board.
6	T8	8 VDC in transmit from Audio/Filter board.
7	SQUELCH	Squelch signal from the Audio/Filter board to disable receive audio.
8	AGC	Automatic gain control from the 1650 kHz IF board for setting audio level in receive mode.
9	AME	For enabling AME option, when installed, from the Audio/Filter board.

Table 5-2 J1 Connector Pin Assignments (continued)

Pin	Signal	Description
10		No connection.
A1	1650 kHz	Receive output to and transmit input from the Audio/Filter board.
A2	TX OUT	Transmit output signal to the PA board.
A3	RX IN	Receive input signal from the Audio/Filter board.

5.2.2 Coax Cable Connections

The Mixer board includes two coax cables for LO1 and LO2, and an optional cable for the 1650 kHz AME option.

Table 5-3 Coax Cable Connections

Connector	Signal	Description
J2	LO1	Local oscillator 1 output (76.6 to 105 MHz) to the Mixer board.
J3	LO2	Local oscillator 2 output (73.35 MHz) to the Mixer board.
J7	AME OPTION	AME option input (1647 or 1650 kHz) from the Audio/Filter board (not installed unless ordered).

5.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Mixer board.

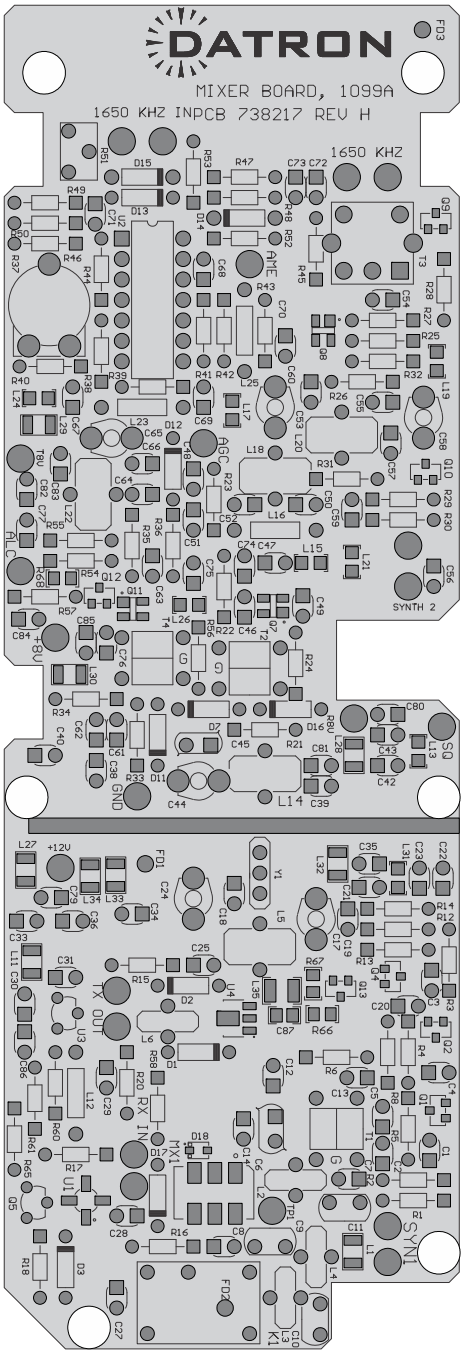

Figure 5-4 Mixer Board Component Locations (738217 Rev. H)

NOTES: UNLESS OTHERWISE SPECIFIED

4. INDUCTANCE IS IN MICROHENRYS
3. DIODES ARE 1N4148
2. CAPACITANCE IS IN MICROFARADS
1. RESISTANCE IS IN OHMS

U_994173_SH2
994173Y_SH2.SchDoc

U_994173_SH3
994173Y_SH3.SchDoc

FD1 FD2 FD3

REVISIONS

REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	PRC1099-287	RELEASE		9-21-92	
B	PRC1099-291	C1 WAS .01	BS	11-17-92	
C	PRC1099-333	ADD L35,L36. DEL C15		5-31-94	
D	PRC1099-359	ADD L37-L40		12-21-94	
E	PRC1099-362	SEE ECN	BS	5-17-95	
F	PRC1099-383	REVISED BIAS CKT	JC		
G	ECO-01-0656	ADDED AME OPTION BORDER	JC	12-19-01	
H	ECO-03-0174	ADDED C86	BB	7-23-03	
J	ECO-05-0089	CHG VALUE OF R60-R63	BB	4-21-05	
K	ECO-05-0125	DNP R62,63 ADD R65	BB	5-19-05	
L	ECO-05-0191	ADDED PROTECTION DIODES, DEL R62,63,CHANGED MX1	BB	7-13-05	
M	ECO-05-0351	Q7,Q8,Q11 WAS MFE211 R23 WAS 4.7K	BB	10-11-05	
N	ECO-05-0403	Q7 WAS NE2513P. R23 WAS 27K	BB	12-02-05	
P	07-0267	C86 WAS .001	RB	7-24-07	
R	07-0357	D19, D26 WAS 5V	RB	10-15-07	
T	08-0380	R27 WAS 470. Q11,Q8 WAS NE25139. D8,9,10 BUS WIRE	RB	12-21-08	
U	09-0102	D19,D20 WAS 8.5	BB	7-24-07	
V	10-0147	R54 WAS 100K	RB	03-22-10	
W	10-0146	D19, D20 DNP	JN	04-08-10	
Y	12-0388	SEE ECO	JN	07/19/12	

Figure 5-5
Mixer Board
Schematic Diagram 1 of 3
(994173 Rev. Y)

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APPROVALS	DATE
DRAFTER JAIME	8-10-09
CHECKER *	
PROJ ENGR	
MFG ENGR	

DATRON
Datron World Communications, Inc.
3055 Enterprise Court
Vista, CA 92081
TEL (760) 597-1500 FAX (760)597-1510

TITLE SCHEMATIC,
M3 MIXER MODULE PRC1099A

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994173	Y

SCALE: NONE | FILENAME: 994173Y_SH1.SchDoc | SHEET 1 OF 3

PRC1099A-MS

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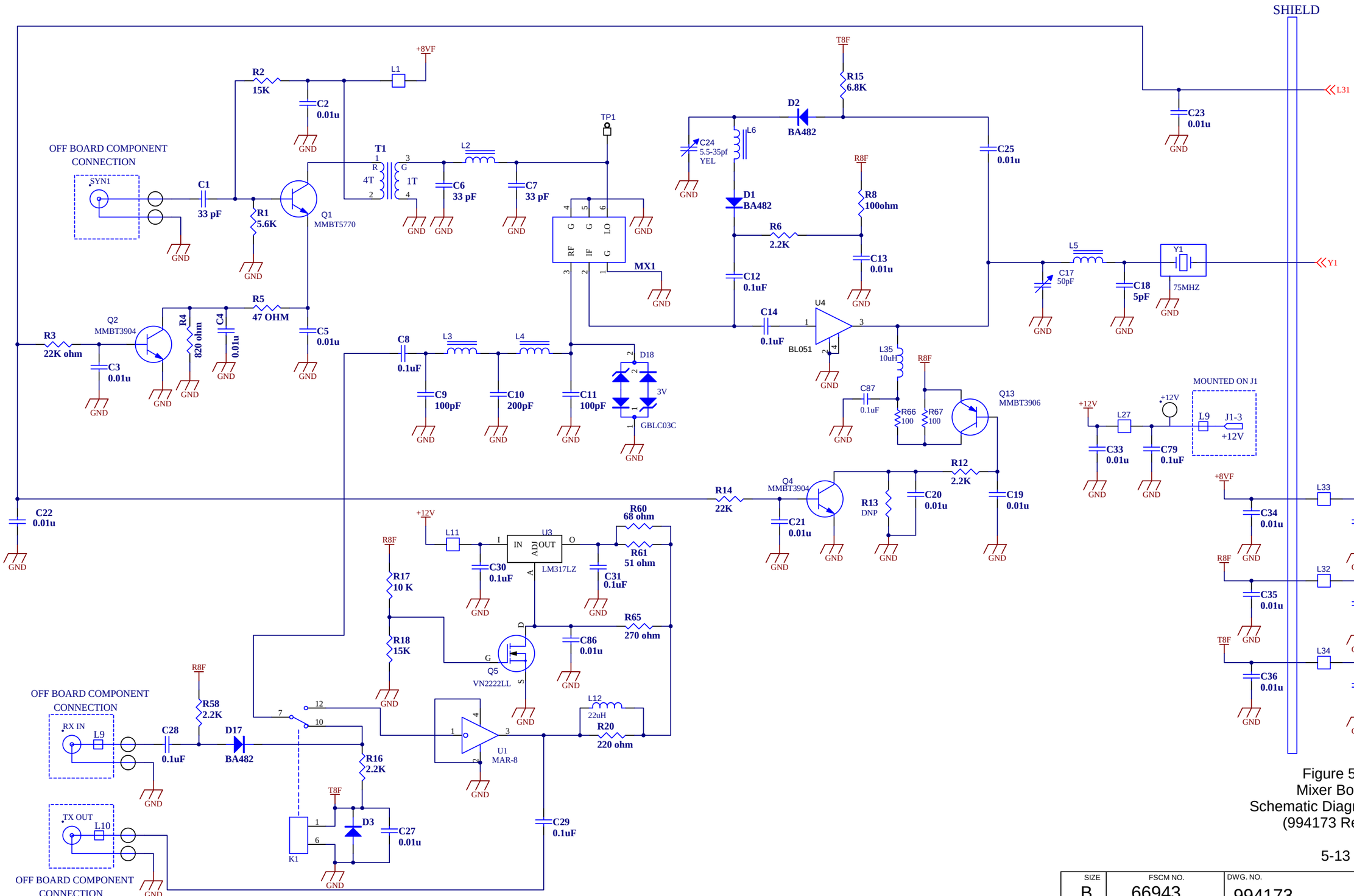
SEE SH 1 FOR REVISIONS



PRC1099A-MS

Figure 5-6
Mixer Board
Schematic Diagram 2 of 3
(994173 Rev. Y)

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994173	Y
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SEE SH 1 FOR REVISIONS

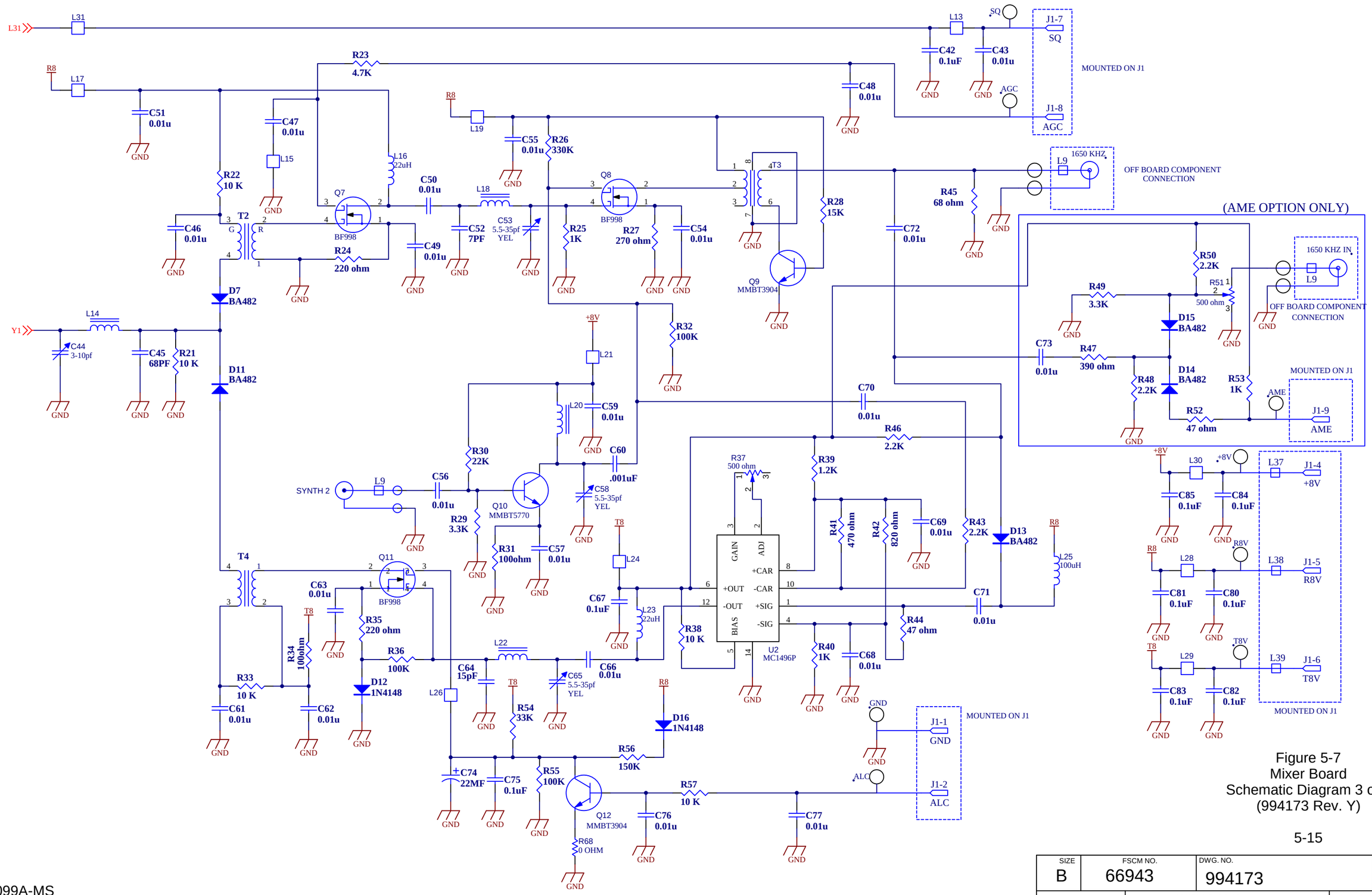


Figure 5-7
Mixer Board
Schematic Diagram 3 of 3
(994173 Rev. Y)

5-15

PRC1099A-MS

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994173	Y
SCALE: NONE	FILENAME:994173Y_SH3.SchDoc		SHEET 3 OF 3
4/28/2016	3:14:26 PM		

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
C1	210330	“CAP,33 PF DISC NP0”
C10	221201	“CAP, 200PF MICA 100V 5% DM5”
C11	221101	“CAP, 100PF MICA 300V 5% DM5”
C12	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C13	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C14	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C17	261500	“CAP, 50PF 5MM TRIMMER”
C18	210050	“CAP, 5PF NP0 50V 0.25P 0.1LS DSK”
C19	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C2	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C20	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C21	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C22	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C23	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C24	261250	“CAP, 30PF 5MM TRIMMER”
C25	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C27	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C28	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C29	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C3	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C30	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C31	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C33	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C34	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C35	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C36	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C38	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C39	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C4	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C40	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C42	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C43	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
C44	261251	“CAP, 10PF 5MM TRIMMER”
C45	221680	“CAP,68PF MICA 300V 5% DM5”
C46	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C47	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C48	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C49	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C5	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C50	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C51	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C52	210070	“CAP,7PF NP0 50V 0.5PF 0.1LS DSK”
C53	261250	“CAP, 30PF 5MM TRIMMER”
C54	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C55	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C56	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C57	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C58	261250	“CAP, 30PF 5MM TRIMMER”
C59	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C6	221330	“CAP,33PF DM5 300V 5% MICA”
C60	276102	“CAP, 1000PF X7R 50V 10% 0.1LS”
C61	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C62	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C63	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C64	210150	“CAP,15PF NP0 50V 5% 0.1LS DSK”
C65	261250	“CAP, 30PF 5MM TRIMMER”
C66	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C67	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C68	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C69	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C7	221330	“CAP,33PF DM5 300V 5% MICA”
C70	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C71	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C72	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
C73	DNP	“NULL PART, VACANT PCB LOCATION”
C74	237220	“CAP,22MF 16V ELECT VRT”
C75	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C76	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C77	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C79	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C8	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C80	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C81	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C82	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C83	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C84	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C85	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C86	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C87	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C9	221101	“CAP, 100PF MICA 300V 5% DM5”
D1	320005	“DIODE, BA482 PIN SWITCH DO-34”
D11	320005	“DIODE, BA482 PIN SWITCH DO-34”
D12	320002	“DIODE, 1N4148/1N4150 DO-35”
D13	320005	“DIODE, BA482 PIN SWITCH DO-34”
D14	DNP	“NULL PART, VACANT PCB LOCATION”
D15	DNP	“NULL PART, VACANT PCB LOCATION”
D16	320002	“DIODE, 1N4148/1N4150 DO-35”
D17	320005	“DIODE, BA482 PIN SWITCH DO-34”
D18	037700008	“DIODE, GBLC03C, TVS, BI, 3VBRK, SOD323”
D2	320005	“DIODE, BA482 PIN SWITCH DO-34”
D3	320002	“DIODE, 1N4148/1N4150 DO-35”
D7	320005	“DIODE, BA482 PIN SWITCH DO-34”
K1	540060	“RELAY, SPDT, 9VDC”
L1	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L11	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L12	430021	“IND, 22UH, FE, 140MA, 10%, IM-2”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
L13	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L14	459025	“IND ASSY,17T#26GA 1-490031”
L15	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L16	430021	“IND, 22UH, FE, 140MA, 10%, IM-2”
L17	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L18	459025	“IND ASSY,17T#26GA 1-490031”
L19	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L2	459030	“IND ASSY,7T#26 GA 1-490032”
L20	459027	“IND ASSY,9T#26 GA 1-490031”
L21	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L22	459160	“IND ASSY, 15T#26 GA 1-490031”
L23	430021	“IND, 22UH, FE, 140MA, 10%, IM-2”
L24	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L25	430014	“IND, 100UH, FR, 84MA, 10%, IM-2”
L26	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L27	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L28	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L29	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L3	459031	“IND ASSY,16T#26 GA 1-490032”
L30	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L31	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
L32	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L33	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L34	045000001	“BEAD, FERRITE, Z=120, 0.4A, 25%, 1206”
L35	041103007	“IND,SM,10UH,10%,0.8A,1210”
L4	459031	“IND ASSY,16T#26 GA 1-490032”
L5	459028	“IND ASSY,20T#26 GA 1-490031”
L6	459029	“IND ASSY,11T#26 AWG 1-490031”
MX1	066000001	“MIXER,SM,0.5 TO 500MHZ, ADE-1”
Q1	031100032	“XSTR, MMBT5770 NPN RF SOT-23”
Q10	031100032	“XSTR, MMBT5770 NPN RF SOT-23”
Q11	031102017	“MOSFET-N, BF998 DUAL-G SOT-143”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
Q12	031100023	“XSTR, MMBT3904, NPN, 40V, 0.2A, SOT23-3”
Q13	031101008	“XSTR, SMT MMBT3906 PNP SOT-23”
Q2	031100023	“XSTR, MMBT3904, NPN, 40V, 0.2A, SOT23-3”
Q4	031100023	“XSTR, MMBT3904, NPN, 40V, 0.2A, SOT23-3”
Q5	310138	“N-MOSFET, VN2222LL, 150MA, 60V, TO92”
Q7	031102017	“MOSFET-N, BF998 DUAL-G SOT-143”
Q8	031102017	“MOSFET-N, BF998 DUAL-G SOT-143”
Q9	031100023	“XSTR, MMBT3904, NPN, 40V, 0.2A, SOT23-3”
R1	113562	“RES,5.6K OHM 1/8W CF 5%”
R12	113222	“RES,2.2K OHM 1/8W CF 5%”
R13	DNP	“NULL PART, VACANT PCB LOCATION”
R14	113223	“RES,22K OHM 1/8W CF 5%”
R15	113682	“RES,6.8K 1/8W 5% CARBON FILM”
R16	113222	“RES,2.2K OHM 1/8W CF 5%”
R17	113103	“RES, 10K OHM 1/8W CF 5%”
R18	113153	“RES,15K OHM 1/8W CF 5%”
R2	113153	“RES,15K OHM 1/8W CF 5%”
R20	113221	“RES,220 OHM 1/8W 5% CF”
R21	113103	“RES, 10K OHM 1/8W CF 5%”
R22	113103	“RES, 10K OHM 1/8W CF 5%”
R23	113472	“RES, 4.7K OHM 1/8W CF 5%”
R24	113221	“RES,220 OHM 1/8W 5% CF”
R25	113102	“RES, 1K OHM 1/8W CF 5%”
R26	113334	“RES, 330K OHM, 1/8W, 5%, CF”
R27	113271	“RES,270 OHM 1/8W 5% CF”
R28	113153	“RES,15K OHM 1/8W CF 5%”
R29	113332	“RES,3.3K OHM 1/8W CF 5%”
R3	113223	“RES,22K OHM 1/8W CF 5%”
R30	113223	“RES,22K OHM 1/8W CF 5%”
R31	113101	“RES,100 OHM 1/8W CF 5%”
R32	113104	“RES,100K OHM 1/8W CF 5%”
R33	113103	“RES, 10K OHM 1/8W CF 5%”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
R34	113101	“RES,100 OHM 1/8W CF 5%”
R35	113221	“RES,220 OHM 1/8W 5% CF”
R36	113104	“RES,100K OHM 1/8W CF 5%”
R37	170110	“POT,500 OHMS CARBON 10MM VERT”
R38	113103	“RES, 10K OHM 1/8W CF 5%”
R39	113122	“RES,1.2K OHM 1/8W CF 5%”
R4	113821	“RES,820 OHM 1/8W CF 5%”
R40	113102	“RES, 1K OHM 1/8W CF 5%”
R41	113471	“RES,470 OHM 1/8W CF 5%”
R42	113821	“RES,820 OHM 1/8W CF 5%”
R43	113222	“RES,2.2K OHM 1/8W CF 5%”
R44	113470	“RES,47 OHM 1/8W 5% CARBON FILM”
R45	113680	“RES,68 OHM 1/8W 5% CF”
R46	113222	“RES,2.2K OHM 1/8W CF 5%”
R47	DNP	“NULL PART, VACANT PCB LOCATION”
R48	DNP	“NULL PART, VACANT PCB LOCATION”
R49	DNP	“NULL PART, VACANT PCB LOCATION”
R5	113470	“RES,47 OHM 1/8W 5% CARBON FILM”
R50	DNP	“NULL PART, VACANT PCB LOCATION”
R51	DNP	“NULL PART, VACANT PCB LOCATION”
R52	DNP	“NULL PART, VACANT PCB LOCATION”
R53	DNP	“NULL PART, VACANT PCB LOCATION”
R54	113333	“RES,33K OHM 1/8W CF 5%”
R55	113104	“RES,100K OHM 1/8W CF 5%”
R56	113154	“RES,150K OHM 1/8W CF 5%”
R57	113103	“RES, 10K OHM 1/8W CF 5%”
R58	113222	“RES,2.2K OHM 1/8W CF 5%”
R6	113222	“RES,2.2K OHM 1/8W CF 5%”
R60	113680	“RES,68 OHM 1/8W 5% CF”
R61	113510	“RES,51 OHM 1/8W 5% CARBON FILM”
R65	113271	“RES,270 OHM 1/8W 5% CF”
R66	013101000	“RES,100 OHM 1/8W 5% TK 0805”

Table 5-4 Mixer Board Parts List (009-00301 Rev. AU)

Designator	Part Number	Description
R67	013101000	“RES,100 OHM 1/8W 5% TK 0805”
R68	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R8	113101	“RES,100 OHM 1/8W CF 5%”
T1	459033	“IND ASSY,4T1T#30 MAG 1-491301”
T2	459034	“IND ASSY,1T3T#30 MAG 1-491301”
T3	420018	INDUCTOR IF 1650KHZ
T4	459034	“IND ASSY,1T3T#30 MAG 1-491301”
U1	380010	“IC, MAR-8 RF AMPLIFIER MICRO-X”
U2	330006	“IC, MC1496P BAL DE/MOD DIP14”
U3	330343	“IC, LM317LZ ADJ VREG 100 MA TO-92”
U4	033306042	“IC, BL051 RF AMP 4GHZ SOT89”
XY1	868000	“GASKET,EMI,.125 X 0.156”
Y1	370007	CRYSTAL FILTER 75MHZ 4 POLE

Chapter 6: Power Amplifier Board

6.1 Circuit Description

The Power Amplifier (PA) board amplifies the low level (+3 dBm) transmitter signal from the Mixer board to a RF power level of 20W. Apart from the predriver, the PA board operates in class AB to minimize current drain. The following sections discuss the components of the block diagram in Figure 6-1 below.

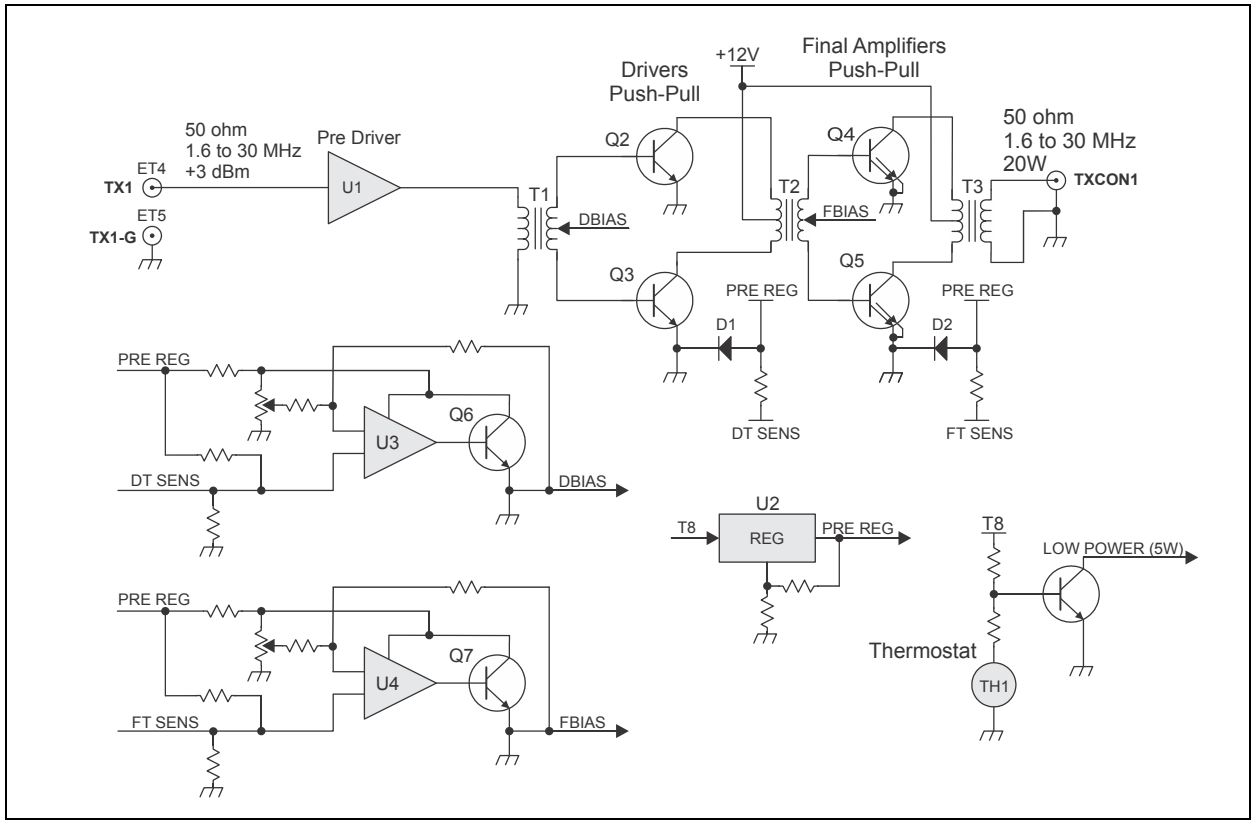


Figure 6-1 Power Amplifier Board Block Diagram

6.1.1 Predriver Amplifier

Predriver amplifier U1 is a class A amplifier with fixed bias. The predriver amplifier stage includes a gain leveling network that consists of C59, R60, R61, R62, and R64. The output from the collector is coupled through broadband transformer T1. The stage is powered from the regulated T8 line and is switched off in receive mode.

6.1.2 Driver Amplifier

The driver amplifier stage consists of linear broadband amplifiers Q2 and Q3 in a push-pull amplifier configuration. The driver amplifiers operate in class AB with a regulated bias supply and grounded emitters. The input from the predriver amplifier is coupled through broadband transformer T1. The driver amplifiers uses collector-to-base feedback provided through R7A and C14, and R10 and C10. The emitters are grounded. The output is coupled to the final amplifier through broadband tubular-type, ferrite-loaded transformer T2 with a push-pull primary and secondary. The driver amplifiers operate directly from the 12V supply and is switched off by the bias supply (DBIAS).

6.1.3 Final Amplifier

The final RF amplifier stage consists of RF power amplifiers Q4 and Q5 in a push-pull configuration. The RF power amplifier transistors are designed for SSB service in the HF range. The input from the driver amplifiers is coupled through T2. The transistors operate in class AB using collector-to-base feedback R16/C20 and R13/C23. The transistor bias is derived from the bias regulator circuits.

Output transformer T3 is a tubular-type, ferrite-loaded transformer with a push-pull primary and a single-ended 50 ohm secondary. The final amplifier stage operates directly from the 12V supply and is switched on and off by controlling the bias supply. The final amplifier is capable of power outputs of 30 to 40W.

6.1.4 Bias Regulators

Driver amplifier bias regulator circuit U3 compensates for temperature variations by adjusting the driver amplifier bias voltage. Driver amplifier Q3 temperature is sensed by diode D1. The current through D1 increases as temperature increases, which decreases the DT SENS voltage. DT SENS is scaled by R48 and R33 and then applied to the non-inverting input of op-amp U3. As the voltage decreases, the output of Q6 (DBIAS) decreases, lowering the base bias to driver amplifiers Q2 and Q3. The quiescent operating point for the driver stage is set by adjusting R19.

For final RF power amplifiers Q4 and Q5, the bias regulator circuit operates the same as for the driver amplifiers. D2 senses the Q5 temperature and drives bias regulator U4 at pin 3. U4 biases the base of Q7 up or down according to the input FTSENS which drives RF power amplifiers Q4 and Q5. The quiescent operating point for the final stage is set by adjusting R24.

6.1.5 Temperature Switch

The PA board includes a temperature-sensitive resistor (thermistor TH1) with a positive temperature coefficient to prevent damage to RF power amplifiers Q4 and Q5 from overheating. Thermistors change resistance with temperature; this means that as the thermistor temperature increases, its resistance increases. Bipolar transistor Q8 forms a voltage divider with TH1 and conducts when the heat sink temperature exceeds 80°C, pulling the LOW POWER line to ground. This forces the radio RF power output to 5W or less until the RF power amplifiers cools. TH1 is mounted in a hole in the board heat sink under the PA board and normally measures about 150 ohms at room temperature.

6.1.6 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 6-1 Power Amplifier Board Specifications

Characteristic	Description
Transmit	
Current	+8 VDC at 65 mA +12 VDC at 250 mA (quiescent) +12 VDC at 3.6A (20W, CW, output)
Frequency	1.6 to 30 MHz
Output	20W, CW into 50 ohm
Input	0 ±2 dB
Gain	43 dB

6.2 Connector Pin Assignments

The Power Amplifier board includes the following interconnections with the transceiver:

Table 6-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	+12V	12 VDC supply voltage from the Junction board.
2	+12V	12 VDC supply voltage from the Junction board.
3	LOW POWER	Line transitions low (0V) when the final amplifiers overheat, otherwise +5V. This sets the radio to low power (5W) mode.
4	T8	+8 VDC supply voltage when radio is in transmit, 0 VDC in receive.
5	GND	Chassis ground.
6	GND	Chassis ground.

6.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Power Amplifier board.

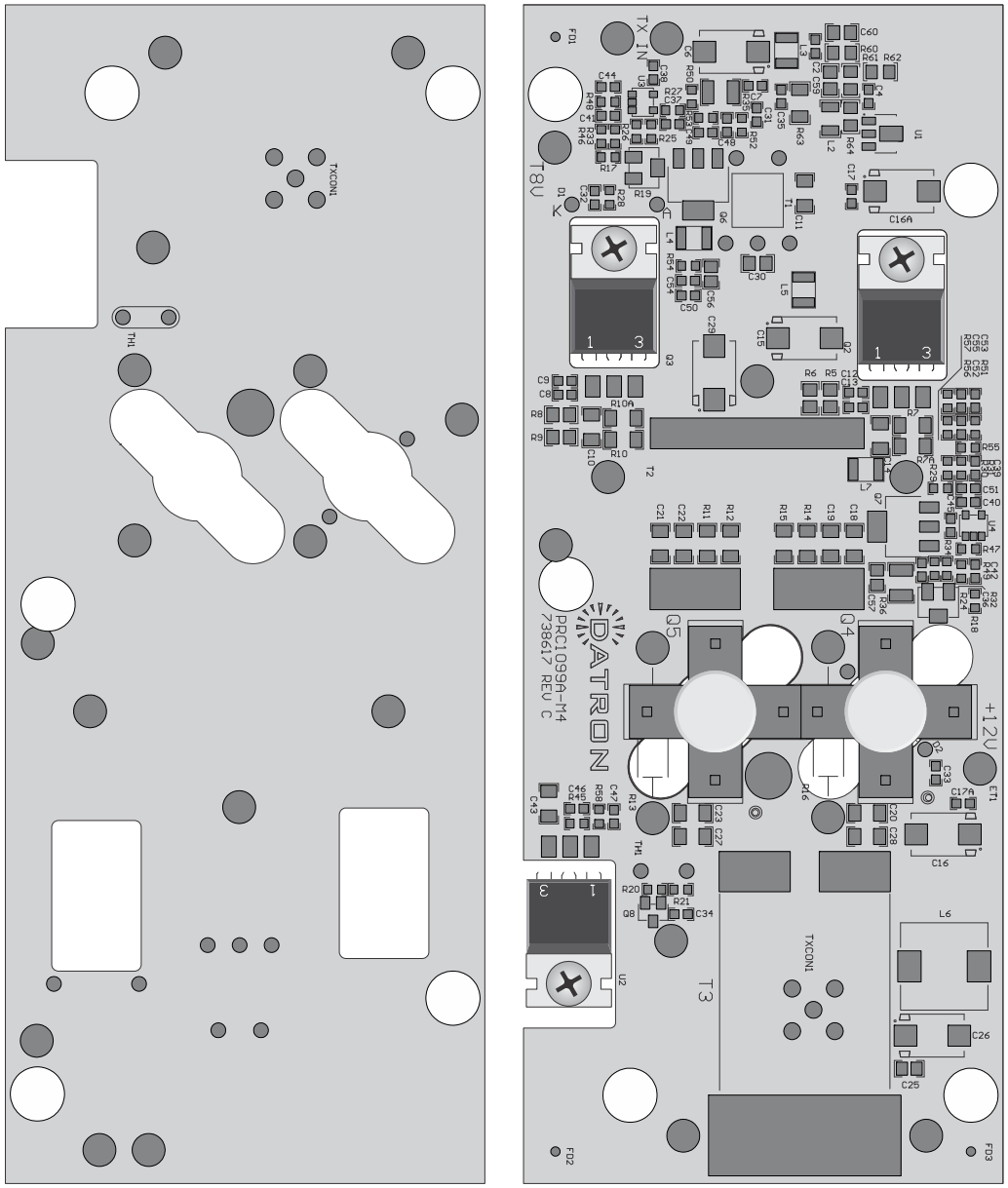
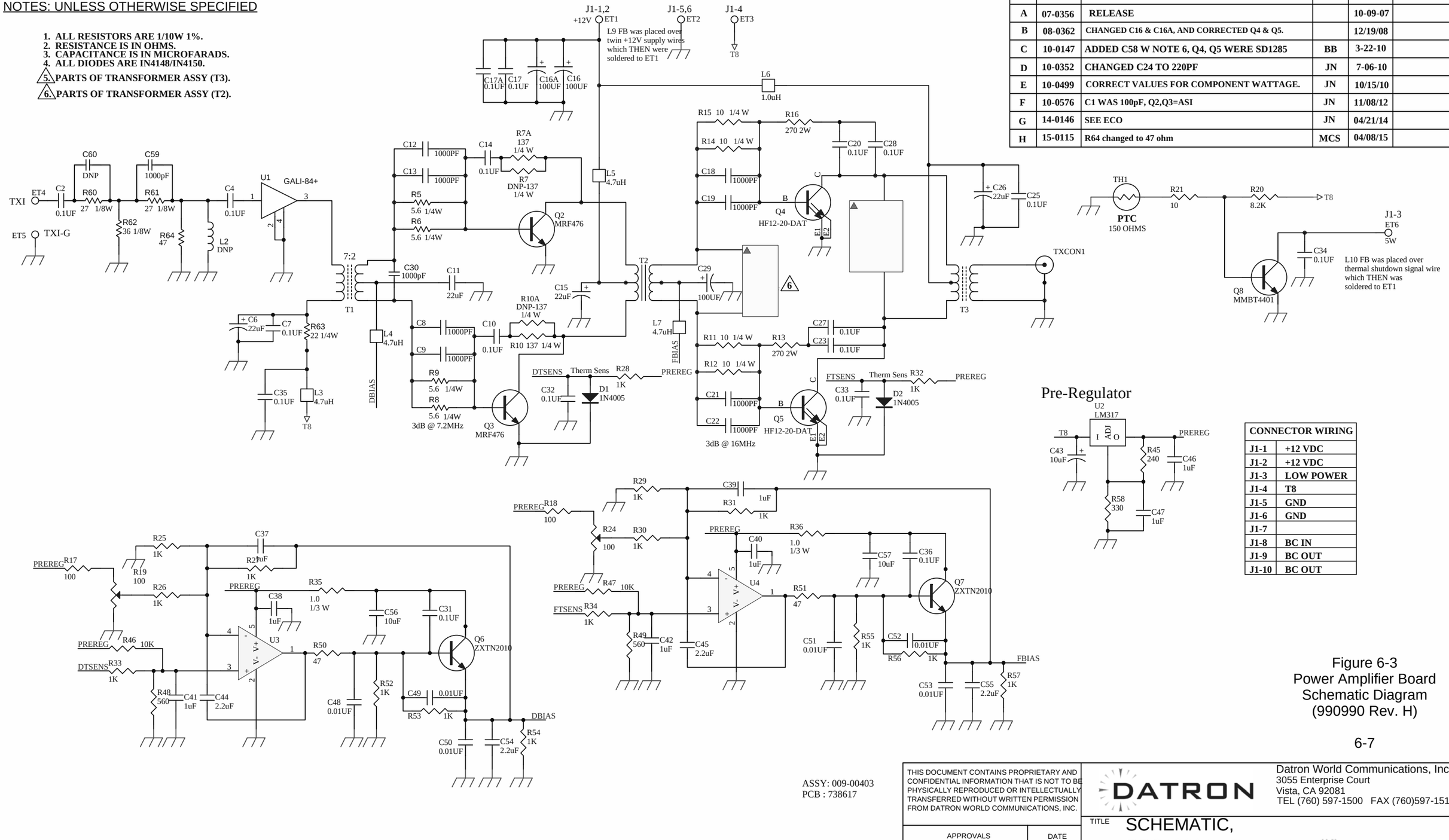


Figure 6-2 Power Amplifier Board Component Locations (738617 Rev. C)

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/10W 1%.
2. RESISTANCE IS IN OHMS.
3. CAPACITANCE IS IN MICROFARADS.
4. ALL DIODES ARE IN4148/IN4150.
5. PARTS OF TRANSFORMER ASSY (T3).
6. PARTS OF TRANSFORMER ASSY (T2).

REVISIONS					
REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	07-0356	RELEASE		10-09-07	
B	08-0362	CHANGED C16 & C16A, AND CORRECTED Q4 & Q5.		12/19/08	
C	10-0147	ADDED C58 W NOTE 6, Q4, Q5 WERE SD1285	BB	3-22-10	
D	10-0352	CHANGED C24 TO 220PF	JN	7-06-10	
E	10-0499	CORRECT VALUES FOR COMPONENT WATTAGE.	JN	10/15/10	
F	10-0576	C1 WAS 100pF, Q2,Q3=ASI	JN	11/08/12	
G	14-0146	SEE ECO	JN	04/21/14	
H	15-0115	R64 changed to 47 ohm	MCS	04/08/15	



Pre-Regulator

CONNECTOR WIRING	
J1-1	+12 VDC
J1-2	+12 VDC
J1-3	LOW POWER
J1-4	T8
J1-5	GND
J1-6	GND
J1-7	
J1-8	BC IN
J1-9	BC OUT
J1-10	BC OUT

Figure 6-3
Power Amplifier Board
Schematic Diagram
(990990 Rev. H)

ASSY: 009-00403
PCB : 738617

PRC1099A-MS

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APPROVALS	DATE
DRAFTER J.NEGRETE	12/19/08
CHECKER *	
PROJ ENGR	
MFG ENGR	

Datron World Communications, Inc.
3055 Enterprise Court
Vista, CA 92081
TEL (760) 597-1500 FAX (760)597-1510

TITLE SCHEMATIC,
PRC1099A - Power Amplifier

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	990990	H

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Table 6-3 Power Amplifier Board Parts List (009-00403 Rev. F)

Designator	Part Number	Description
C10	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C11	021226002	“CAP, 22UF X5R 6.3V 20% 1206”
C12	021102001	“CAP, 1000PF 50V X7R 10% 0603”
C13	021102001	“CAP, 1000PF 50V X7R 10% 0603”
C14	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C15	022226003	“CAP,22UF TA L-ESR 35V 10% 7343”
C16	022107004	“CAP,100UF,TA,20V,20%,7343-43”
C16A	022107004	“CAP,100UF,TA,20V,20%,7343-43”
C17	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C17A	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C18	021102007	“CAP, 1000PF NP0 200V 5% 1206”
C19	021102007	“CAP, 1000PF NP0 200V 5% 1206”
C2	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C20	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C21	021102007	“CAP, 1000PF NP0 200V 5% 1206”
C22	021102007	“CAP, 1000PF NP0 200V 5% 1206”
C23	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C25	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C26	022226003	“CAP,22UF TA L-ESR 35V 10% 7343”
C27	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C28	021104011	“CAP, 0.1UF, X7R, 100V, 10%, 1206”
C29	022107002	“CAP,100UF TA LESR 16V 10% 7343”
C30	021102000	“CAP, 1000PF NP0 100V 5% 0805”
C31	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C32	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C33	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C34	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C35	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C36	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C37	021105010	“CAP, 1UF X7R 16V 10% 0603”
C38	021105010	“CAP, 1UF X7R 16V 10% 0603”

Table 6-3 Power Amplifier Board Parts List (009-00403 Rev. F)

Designator	Part Number	Description
C39	021105010	“CAP, 1UF X7R 16V 10% 0603”
C4	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C40	021105010	“CAP, 1UF X7R 16V 10% 0603”
C41	021105010	“CAP, 1UF X7R 16V 10% 0603”
C42	021105010	“CAP, 1UF X7R 16V 10% 0603”
C43	021106002	“CAP, 10UF X7R 16V 10% 1206”
C44	021225004	“CAP, 2.2UF X7R 10V 10% 0603”
C45	021225004	“CAP, 2.2UF X7R 10V 10% 0603”
C46	021105010	“CAP, 1UF X7R 16V 10% 0603”
C47	021105010	“CAP, 1UF X7R 16V 10% 0603”
C48	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C49	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C50	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C51	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C52	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C53	021103001	“CAP, 0.01UF 50V X7R 10% 0603”
C54	021225004	“CAP, 2.2UF X7R 10V 10% 0603”
C55	021225004	“CAP, 2.2UF X7R 10V 10% 0603”
C56	021106003	“CAP, 10UF X7R 10V 10% 0805”
C57	021106003	“CAP, 10UF X7R 10V 10% 0805”
C59	021102000	“CAP, 1000PF NP0 100V 5% 0805”
C6	022226003	“CAP,22UF TA L-ESR 35V 10% 7343”
C60	DNP	“NULL PART, VACANT PCB LOCATION”
C7	021104006	“CAP,0.1UF,X7R,25V,10%,0603”
C8	021102001	“CAP, 1000PF 50V X7R 10% 0603”
C9	021102001	“CAP, 1000PF 50V X7R 10% 0603”
L2	DNP	“NULL PART, VACANT PCB LOCATION”
L3	041472006	“IND, 4.7UH FR 650MA 20% 1210”
L4	041472006	“IND, 4.7UH FR 650MA 20% 1210”
L5	041472006	“IND, 4.7UH FR 650MA 20% 1210”
L6	041102002	“IND, 1 UH FR 7A 20% 10MM”
L7	041472006	“IND, 4.7UH FR 650MA 20% 1210”

Table 6-3 Power Amplifier Board Parts List (009-00403 Rev. F)

Designator	Part Number	Description
Q6	031100024	“XSTR,ZXTN2010GT NPN 6A SOT223”
Q7	031100024	“XSTR,ZXTN2010GT NPN 6A SOT223”
Q8	031100025	“XSTR, MMBT4401 NPN SOT-23”
R10	014137000	“RES, 137 OHM 1/4W 1% TK 1206”
R10A	DNP	“NULL PART, VACANT PCB LOCATION”
R11	014100901	“RES, 10 OHM 1/4W 1% TK 1206”
R12	014100901	“RES, 10 OHM 1/4W 1% TK 1206”
R14	014100901	“RES, 10 OHM 1/4W 1% TK 1206”
R15	014100901	“RES, 10 OHM 1/4W 1% TK 1206”
R17	012100000	“RES, 100 OHM 1/10W 1% TK 0603”
R18	012100000	“RES, 100 OHM 1/10W 1% TK 0603”
R19	010100000	“POT, 100 OHM 5-T TOP ADJ 4MM”
R20	012820100	“RES, 8.2K OHM 1/10W 1% TK 0603”
R21	012100900	“RES, 10 OHM 1/10W 1% TK 0603”
R24	010100000	“POT, 100 OHM 5-T TOP ADJ 4MM”
R25	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R26	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R27	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R28	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R29	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R30	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R31	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R32	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R33	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R34	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R35	015100800	“RES, 1.0 OHM 1/3W 1% TK 1210”
R36	015100800	“RES, 1.0 OHM 1/3W 1% TK 1210”
R45	012240000	“RES, 240 OHM 1/10W 1% TK 0603”
R46	012100200	“RES, 10K OHM 1/10W 1% TK 0603”
R47	012100200	“RES, 10K OHM 1/10W 1% TK 0603”
R48	012560000	“RES, 560 OHM 1/10W 1% TK 0603”
R49	012560000	“RES, 560 OHM 1/10W 1% TK 0603”

Table 6-3 Power Amplifier Board Parts List (009-00403 Rev. F)

Designator	Part Number	Description
R5	013560801	“RES, 5.6 OHM 1/4W 1% TK 1206”
R50	012470900	“RES, 47 OHM 1/10W 1% TK 0603”
R51	012470900	“RES, 47 OHM 1/10W 1% TK 0603”
R52	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R53	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R54	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R55	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R56	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R57	012100101	“RES, 1K OHM 0.1W 1% TK 0603”
R58	012330000	“RES, 330 OHM 1/10W 1% TK 0603”
R6	013560801	“RES, 5.6 OHM 1/4W 1% TK 1206”
R60	013270000	“RES,27 OHM 1/8W 5% TK 0805”
R61	013270000	“RES,27 OHM 1/8W 5% TK 0805”
R62	013360900	“RES, 36 OHM 1/8W 1% TK 0805”
R63	014220900	“RES, 22 OHM 1/4W 1% TK 1206”
R64	013470900	“RES, 47 OHM 1/8W 1% TK 0805”
R7	014137000	“RES, 137 OHM 1/4W 1% TK 1206”
R7A	DNP	“NULL PART, VACANT PCB LOCATION”
R8	013560801	“RES, 5.6 OHM 1/4W 1% TK 1206”
R9	013560801	“RES, 5.6 OHM 1/4W 1% TK 1206”
U1	033306039	“IC,GALI-84+ RF AMP 6 GHZ SOT89”
U3	033304106	“IC,OPA342 RRO OP-AMP SOT23-5”
U4	033304106	“IC,OPA342 RRO OP-AMP SOT23-5”

Chapter 7: Antenna Tuner Board

7.1 Circuit Description

The tuning circuits on the Antenna Tuner board must match the radio RF output impedance to that of the standard AT-271A/U whip antenna as well as a variety of long wire antennas over the 1.6 to 30 MHz range. In a manpack radio, this poses special design problems because the antenna is very short in relation to a resonant antenna over most of the frequency range. Additionally, the ground system is extremely poor in the manpack configuration. Since very small movements by the operator detunes the antenna, it is very difficult to maintain an exact match to the antenna. The tuner must perform quickly, have low current drain in tune mode, and have no standby current drain. It is also desirable to keep the tune power as low as possible and to retain the tune data in memory for the fixed channel frequencies.

7.1.1 Matching Network

The resonant frequency of the whip antenna is approximately 24 MHz. This means that over most of the frequency range the antenna has a capacitive reactance that can be cancelled by an equivalent series inductance. The tuner uses a binary-sequenced series of inductors to cancel out the reactive component of the antenna. If the antenna has inductive reactance, the tuner adds capacitance so the antenna appears capacitive and cancels small residual reactance by adding series inductance.

The internal capacitors match the whip antenna and most long wire antennas, but on some frequencies the inductive reactance can be very high. The long wire adapter contains a series capacitor to bring the reactance within the tuning range of the network. After the reactance is cancelled, the tuner presents a resistive load between 6 and 400 ohms to the transceiver. A broadband impedance transformer selects the closest available matching impedance: 12.5, 50, or 200 ohms.

7.1.2 Tuning System

The PRC1099A uses very simple and reliable tuning system. Instead of a VSWR detector, a current detector measures the current flowing to the antenna. The transceiver operates in low power (5W); a 10 dB attenuator reduces the

power to 500 mW. Because the output impedance of the transmitter is 50 ohms (determined by the resistive pad), maximum current flows when there is a conjugate match or a resistive load of 50 ohms. This system is simple, reliable, and accurately determines minimum VSWR.

7.1.3 Tuning Resolution

The antenna tuner typically tunes for a VSWR of less than 1.5:1 but can reach 2:1 if the resistive component falls midway between the impedance taps. In a manpack environment, the impedance match changes every time the operator moves. The final amplifier is tolerant of mismatched loads.

The PRC1099A final amplifier is capable of a power output of 30 to 40W and can deliver 20W into substantial mismatches. At VSWRs of 2:1 there is typically less than 0.5 dB output degradation and, even at a VSWR of 3:1 there is only about 1 dB performance change.

7.1.4 Tuning Program

The tuning program resides in ROM and is controlled by the processor on the Processor board. When an operator presses the front panel **Whip Tune** button, the processor checks the channel frequency and determines which elements to use. The transmitter is keyed in low power and the firmware steps through the inductors in a special sequence until it detects a current peak. If the tuning program does not detect a current peak, the antenna is inductive and the tuning program combines capacitors with the inductors until it detects a tuning peak. At this point the tuning program checks the antenna current. If the current is low, it checks the alternate tap positions, and selects the tap with the optimum current. The tuning program then rechecks the current. If the current is low, the processor signals an incorrect tune.

You can operate the transceiver even when the processor indicates an incorrect tune—the tuner remains at the setting that achieved the best match. The processor keeps the last tune settings in memory and automatically selects it each time the channel is changed. The processor updates tune information in memory each time the **Whip Tune** button is pressed. The processor automatically selects the antenna tuner when the whip or long wire adapter is used. A rod on the end of the antenna mount or long wire adapter activates a microswitch that disconnects the 50 ohm connector.

Figure 7-1 on page 7-3 provides a block diagram of the antenna tuner and control circuitry. The following sections describe the components of the block diagram.

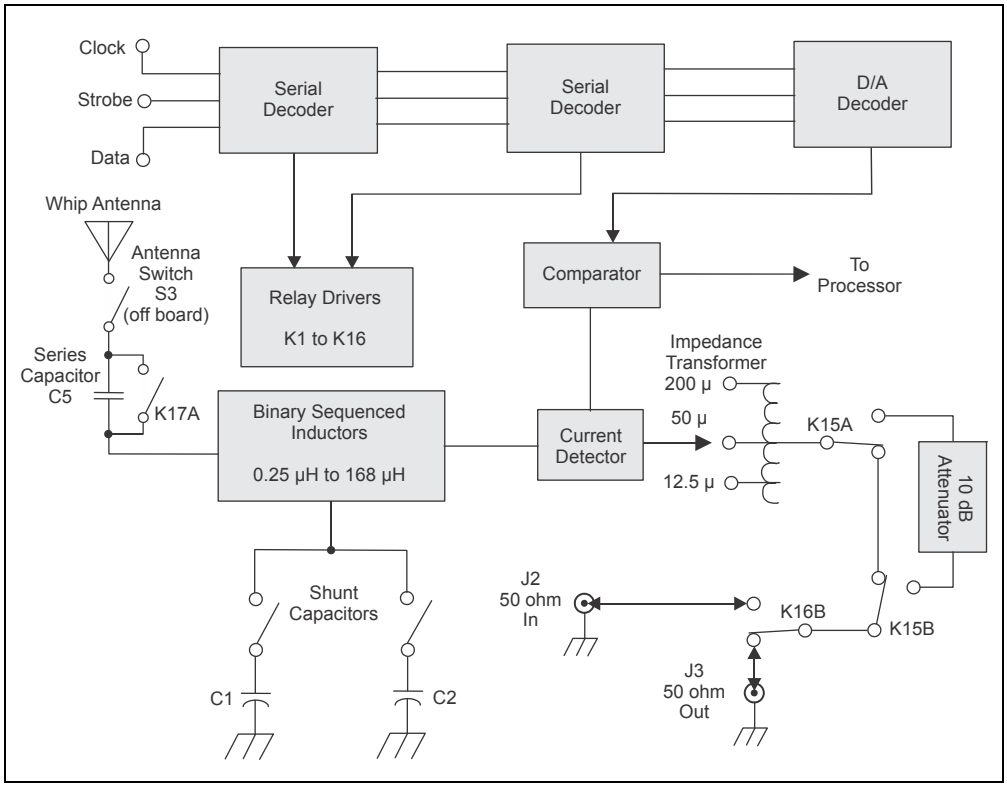


Figure 7-1 Antenna Tuner Board Block Diagram

7.1.5 Binary Sequenced Inductors

To resonate the whip antenna at 2 MHz requires an inductance of approximately 168 µH, therefore it must be possible to vary the inductance from 0 to 168 µH. The best solution is a series of inductors, switched in and out of circuit in a binary progression. The tuning program starts with L1, a 0.33 µH inductor, and doubles the size of each inductor up to 84 µH, making it possible to change the inductance in 0.33 µH steps from 0 (zero) up to 168 µH using only nine inductors. The tuner uses ten inductors, since it is necessary to use two separate 44 µH inductors, L9 and L10, for the final inductance step.

When using the whip antenna, very high voltages are generated at maximum inductance. To prevent possible RF burns to the operator, the power is automatically reduced when inductors L8, L9, and L10 are in circuit. This keeps the maximum output voltage from exceeding approximately 1000V.

7.1.6 Shunt Capacitors

The tuning program uses shunt capacitors C1 and C2 when the antenna exhibits inductive reactance. These capacitors give 50 to 150 pF in 50 pF steps. The tuner uses the minimum step size that causes the antenna to appear capacitive and cancels the remaining reactance with series inductance. The capacitors are connected between L6 and L7 to minimize the effects of stray capacitance and reduce the required voltage rating.

7.1.7 Series Capacitor

Series capacitor C5 is connected between the antenna terminal and the largest binary inductor, L10. The tuning program switches C5 in and out of the network using relay K17 in instances where the antenna impedance is near resonance. It rotates the impedance to a value that can be matched by the rest of the network.

7.1.8 Current Detector

The current detector uses a saturated transformer directly in line with the series inductors. Transformer T1 is a ferrite toroid with a single-turn primary winding and a multi-turn secondary winding virtually shorted by 47 ohm resistor R4. The detector output is a voltage that is proportional to the current flowing in the primary winding. The RF voltage is rectified using diode D1.

7.1.9 Impedance Transformer

Impedance transformer T2 is a 2:1 ferrite balun switched using relays K13 and K14. The transformer can be switched out of circuit to provide a 50 ohm match. It can also act as a step-up transformer for a 200 ohm match and as a step-down transformer for a 12.5 ohm match. With these three impedances available, the transformer provides a match of 2:1 or better over the impedance range of 6 ohms to 400 ohms.

7.1.10 10 dB Attenuator

Relay K15 switches attenuator pad R1, R2, and R3 (9.5 dB) into the tuning circuit during a tuning cycle. The transmitter operates in low power mode (5W) during the tune cycle; the attenuator further reduces the output power to 500 mW. The resistive pad ensures that the transmitter has a true output impedance of 50 ohms, so that maximum output is with a 50 ohm load (a conjugate match); maximum output current to the antenna corresponds with minimum VSWR.

7.1.11 Comparator

Comparator U1B is the heart of the element selection circuitry. It compares the output from current detector T1 through amplifier U1A to the reference level from digital-to-analog convertor U2A through amplifier U1C.

The output from the current detector is divided by voltage divider R5 and R30, amplified, and applied to the non-inverting input of amplifier U1A. Switches Q2 and Q3 switch R7 and R8 to ground, giving three different gain levels set by the ratio of R21 to R6, R7, or R8. This lowers the gain of comparator U1B as the voltage from the current detector increases.

Amplifier U1C amplifies the reference level set by digital-to-analog converter U2A through resistors R12 through R17 and applies it to the non-inverting input of U1C.

Comparator U1B compares the current detector voltage to the reference level and sends the value back to the processor. The processor uses that value to determine the current peak that corresponds to the lowest level VSWR.

7.1.12 D/A Decoder

The processor can only recognize a high or low output, so it is necessary to provide a reference level to comparator U1B to measure the analog output from the current detector. The output from the decoder is controlled by the processor and is quantised into 64 steps. The binary steps are selected by switching R12 through R17. Switching R7 and R8 controls the gain of amplifier U1A.

7.1.13 Serial Decoder

Serial decoders U3A and U4A translate the serial data from the processor to 16 different outputs controlling the relay drivers that switch the various inductors or capacitors in or out of the RF path to or from the antenna.

7.1.14 Relay Drivers

Relay drivers U5, and U6 are 16 NPN transistors contained in two 16-pin DIP packages. There are 14 latching relays in the tuner that have separate coils for latching and unlatching the relay. The relays require short current pulses for latching or unlatching and draw no current in the static condition. Separate drivers latch each relay, while transistor Q1, driven by output Q8 of U3A, unlatches all relays. The processor always unlatches all relays before each switching operation and resets those latched relays that require no change of state, as well as those relays requiring switching. No separate drivers are required to unlatch each relay.

The Antenna Tuner switches between transmit and receive operation using the T/R relay that switches the antenna input between the receiver input and the transmitter output. A second pole on this relay switches the regulated 8V line to provide T8 and R8 voltage outputs. These control lines switch the transceiver circuitry. Transistor and diode gates are used extensively for the switching function. The input to the double-balanced mixer is switched by a relay to minimize high level intermodulation distortion.

7.1.15 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 7-1 Antenna Tuner Board Specifications

Characteristic	Specification
Current Drain	
Static	1.2 mA typical at 12V 5 mA typical at 5V
Tuning	400 mA average at 12V 2000 mA maximum instantaneous at 12V 16 mA average at 5V
Rated Input Power	
Output ≤1 kV	20W PEP
Output exceed 1 kV	5W PEP (power level automatically switched by Processor board)
Maximum Output Voltage	1000V RF
Usable Antennas	Antenna — Range 3m whip — 2.0 to 30 MHz 7m whip — 1.6 to 30 MHz 1.5m whip (very short range operation) — 5.0 to 30 MHz 7 to 16m long wire — 1.6 to 30 MHz Longer antennas with LWA adaptor — 1.6 to 30 MHz
Manual Tune Time	1 sec typical 12 sec maximum before fault
Memory Tune Time	20 ms typical
Tune Indicator	900 Hz side tone
Fault Indicator	Pulsating tone

7.2 RF Paths

7.2.1 Receive Path

The receive signal from the front panel whip antenna connector is received on the hard wire (white) input to the Antenna Tuner board. It is routed through the tuning network of inductors and capacitors. It then passes through current detector T1 and impedance transformer T2 and then bypasses the 10 dB attenuator. It is output through onboard coax connector J3 to the Audio Filter board.

The receive signal can also be received from the 50 ohm load input and is received through the coax connection in connector J2. It is routed directly to onboard coax connector J3, bypassing the tuning network, current detector, and impedance transformer.

A relay switch mounted inside the front panel whip antenna connector notifies the processor whether or not an antenna is connected to the whip antenna connector. If not, the ANT SW signal activates relays K15 and K16 to switch the receive signal between the whip antenna path and the 50 ohm connector path.

7.2.2 Transmit Path

The transmit path through the Antenna Tuner board is exactly the opposite of the receive path. The transmit path is received at onboard connector J3 from the Audio Filter board and is switched to either the whip antenna connector or the 50 ohm connector. From J3, the transmit signal to the 50 ohm connector is routed directly to the coax connector in J2.

From J3, the transmit signal to the whip antenna connector is routed through impedance transformer T2, current detector transformer T1, the tuning network, and out the hard wire to the whip antenna connector.

7.3 Connector Pin Assignments

The Antenna Tuner board includes the following connections.

Table 7-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	GND	Ground.
2	+12V	+12 VDC supply voltage from the Junction board.
3	DATA	Matching element selection data to shift registers from the Processor board.
4	CLOCK	Clock pulse to shift registers from the Processor board.

Table 7-2 J1 Connector Pin Assignments

Pin	Signal	Description
5	+5V	+5 VDC supply voltage from the Junction board.
6	STROBE	Strobes to shift registers from the Processor board.
7	COMP OUT	Comparator output to the Processor board, (for tuning cycles).
8	ANT SW	Antenna switch (0 VDC without antenna, 4.8 VDC with).
9, 10		No connection.

7.4 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Antenna Tuner board.

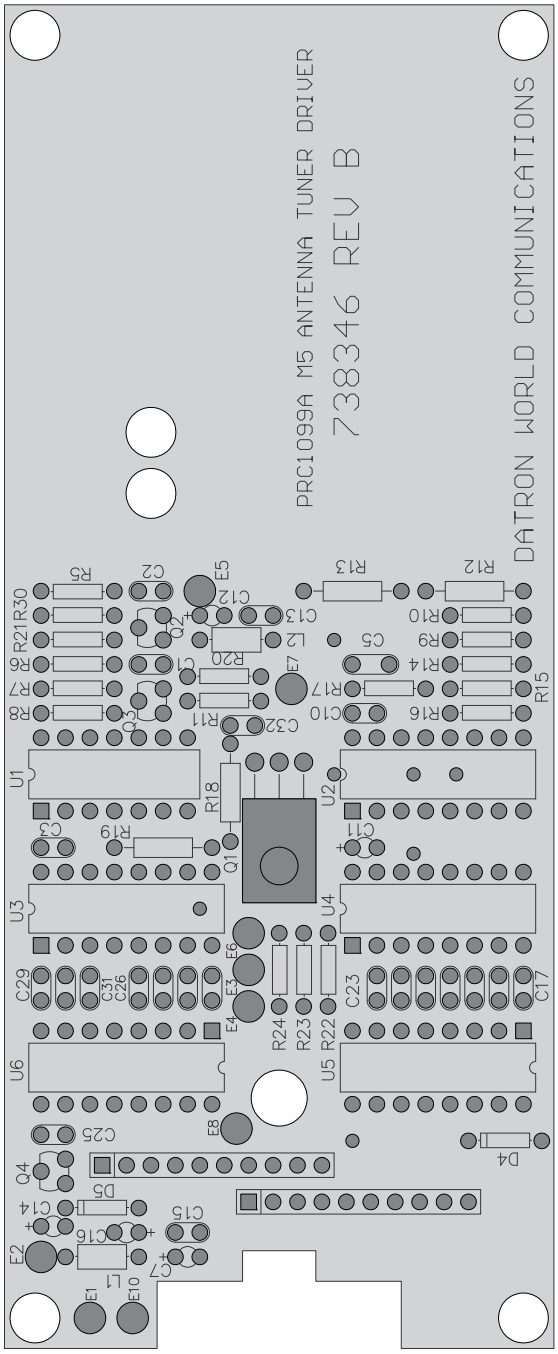


Figure 7-2 Antenna Tuner Driver Board Component Locations (738346 Rev. B)

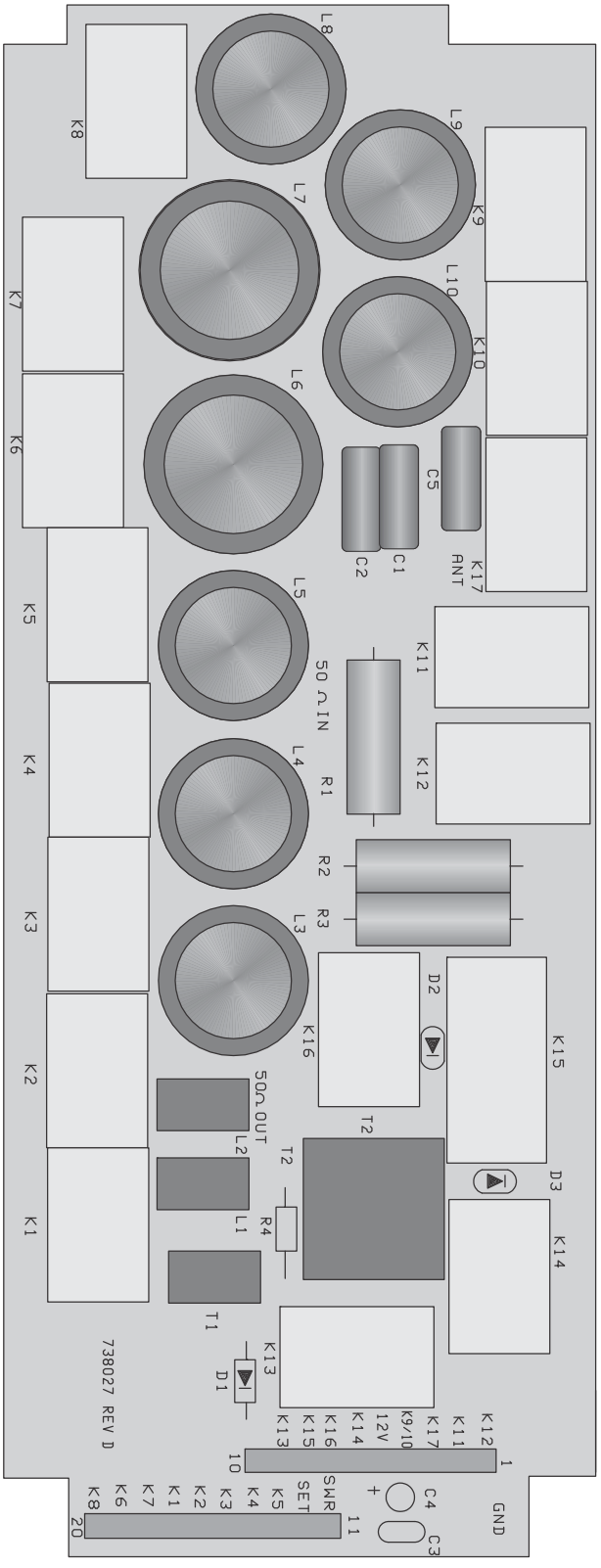
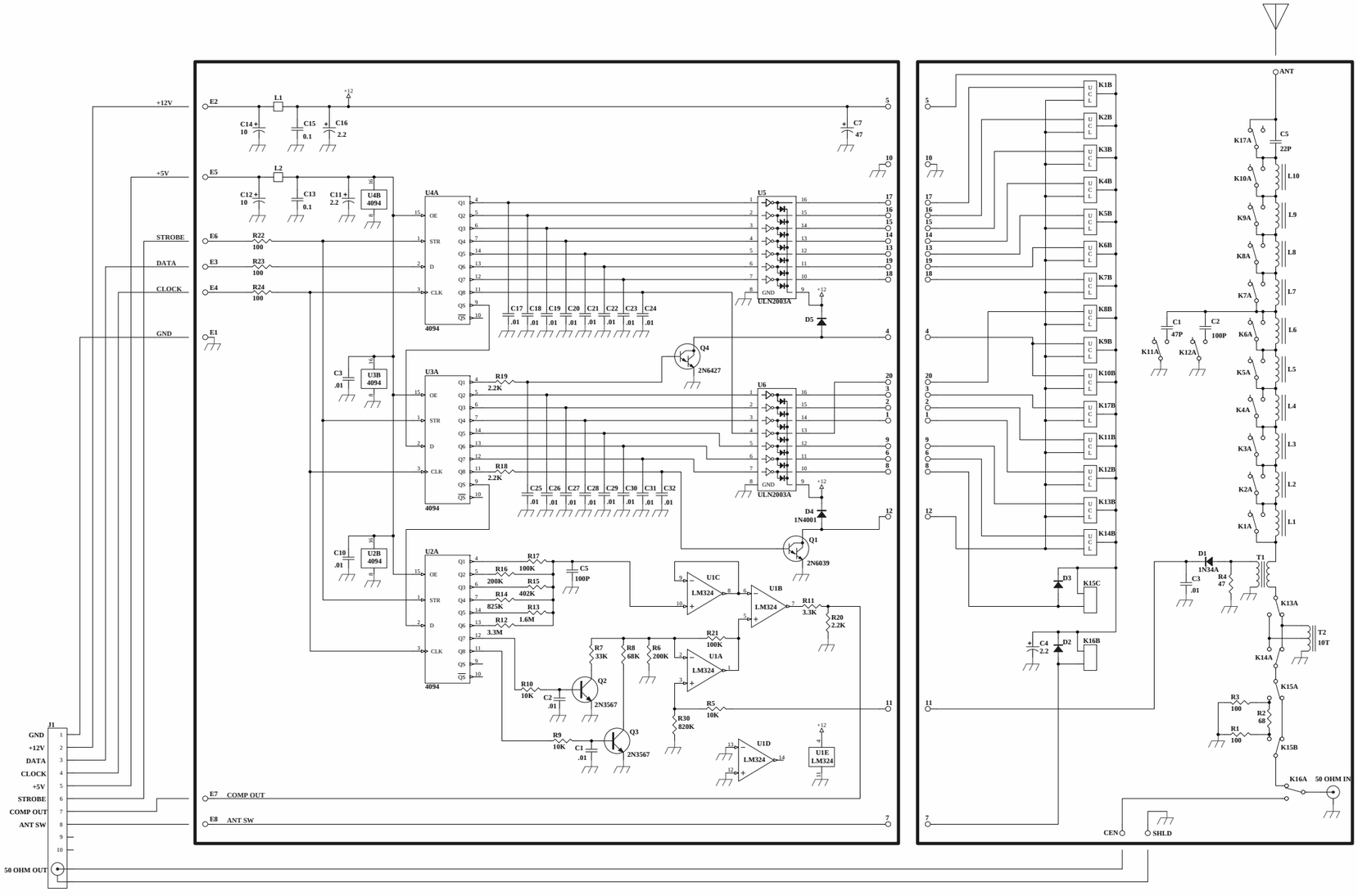


Figure 7-3 Antenna Tuner Board Component Locations (738027 Rev. D)

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	PRC1099-371	RELEASE			1NOV94
B	PS-01122	TITLE WAS PRC1099B		BB	4.24.95



5 LATCHING RELAYS SHOWN IN RESET POSITION
4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 7-4
Antenna Tuner Board
Antenna Tuner Driver Board
Schematic Diagram
(994303 Rev. B)

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TITLE
SCHEMATIC,
PRC1099A M5 ANTENNA TUNER

APPROVALS	DATE
DRAFTER "	"
CHECKER "	
PROJ ENGR	
MFG ENGR	

SIZE	FSCM NO.	DWG. NO.	REV
D	66943	994303	B

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Table 7-3 Antenna Tuner Driver Board Parts List (009-00502 Rev. K)

Designator	Part Number	Description
C1	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C10	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C11	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C12	241100	“CAP, 10UF TA 16V 20% DIP 0.1LS”
C13	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C14	241100	“CAP, 10UF TA 16V 20% DIP 0.1LS”
C15	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C16	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C17	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C18	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C19	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C2	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C20	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C21	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C22	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C23	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C24	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C25	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C26	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C27	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C28	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C29	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C3	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C30	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C31	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C32	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C5	210101	“CAP,100PF NP0 50V 5%.2LS DISK”
C7	241476	“CAP, 47UF TA 20V 20% 0.1LS”
D4	320102	“DIODE, 1N4001 1A 50V DO-41”
D5	320002	“DIODE, 1N4148/1N4150 DO-35”
L1	459032	“IND ASY,3T#30 MAGNET 1-490201”

Table 7-3 Antenna Tuner Driver Board Parts List (009-00502 Rev. K)

Designator	Part Number	Description
L2	459032	“IND ASY,3T#30 MAGNET 1-490201”
Q1	310103	“XSTR,2N6039 NPN DARL 4A TO-225”
Q2	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q3	310003	“XSTR, 2N3567 NPN 300MA TO92”
Q4	310064	“XSTR,2N6427 NPN DARL TO-92”
R10	113103	“RES, 10K OHM 1/8W CF 5%”
R11	113332	“RES,3.3K OHM 1/8W CF 5%”
R12	1113304	“RES,3.3M 1/4W 1% FILM”
R13	1111604	“RES,1.62M OHM 1/4W 1% MF RN55”
R14	1118253	“RES,825K 1/8W 1% FILM”
R15	1114023	“RES,402 K 1/8W 1% FILM”
R16	1112003	“RES,200K 1/8W 1% FILM”
R17	1111003	“RES,100K 1/8W 1% FILM”
R18	124222	“RES, 2.2K OHM 1/4W 5% CF”
R19	124222	“RES, 2.2K OHM 1/4W 5% CF”
R20	113222	“RES,2.2K OHM 1/8W CF 5%”
R21	113104	“RES,100K OHM 1/8W CF 5%”
R22	113101	“RES,100 OHM 1/8W CF 5%”
R23	113101	“RES,100 OHM 1/8W CF 5%”
R24	113101	“RES,100 OHM 1/8W CF 5%”
R30	113824	“RES,820K OHM 1/8W CF 5%”
R5	113103	“RES, 10K OHM 1/8W CF 5%”
R6	1112003	“RES,200K 1/8W 1% FILM”
R7	113333	“RES,33K OHM 1/8W CF 5%”
R8	113683	“RES,68K 1/8W 5% CARBON FILM”
R9	113103	“RES, 10K OHM 1/8W CF 5%”
U1	330030	“IC,LIN,LM324N,DIP14,OP-AMP”
U2	330126	“IC,4094B 8-STG SHIFT REG DIP16”
U3	330126	“IC,4094B 8-STG SHIFT REG DIP16”
U4	330126	“IC,4094B 8-STG SHIFT REG DIP16”
U5	330527	“IC,ULN2003A PERIPH DRVR DIP16”
U6	330527	“IC,ULN2003A PERIPH DRVR DIP16”

Table 7-3 Antenna Tuner Driver Board Parts List (009-00502 Rev. K)

Designator	Part Number	Description
XU1	621005	“SOCKET, IC DIP-14 PIN”
XU2	621004	“SOCKET, IC DIP-16 PIN”
XU3	621004	“SOCKET, IC DIP-16 PIN”
XU4	621004	“SOCKET, IC DIP-16 PIN”
XU5	621004	“SOCKET, IC DIP-16 PIN”
XU6	621004	“SOCKET, IC DIP-16 PIN”

Table 7-4 Antenna Tuner Board Parts List (009-00503 Rev. K)

Designator	Part Number	Description
C1	220470	“CAP, 47PF MICA 500V 5% DM15”
C2	220101	“CAP, 100PF MICA 500V 5% DM15”
C3	214103	“CAP, 0.01UF X7R 50V 10% 0.1LS”
C4	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C5	220220	“CAP, 22PF MICA 500V 5% DM15”
D1	320003	“DIODE,GE 1N34A”
D2	320002	“DIODE, 1N4148/1N4150 DO-35”
D3	320002	“DIODE, 1N4148/1N4150 DO-35”
K1	540066	“RELAY, SPDT 2A LATCH 12V”
K10	540066	“RELAY, SPDT 2A LATCH 12V”
K11	540066	“RELAY, SPDT 2A LATCH 12V”
K12	540066	“RELAY, SPDT 2A LATCH 12V”
K13	540066	“RELAY, SPDT 2A LATCH 12V”
K14	540066	“RELAY, SPDT 2A LATCH 12V”
K15	540080	“RELAY,DPDT 2 AMP SEALED”
K16	540056	“RELAY, SPDT 12VDC”
K17	540066	“RELAY, SPDT 2A LATCH 12V”
K2	540066	“RELAY, SPDT 2A LATCH 12V”
K3	540066	“RELAY, SPDT 2A LATCH 12V”
K4	540066	“RELAY, SPDT 2A LATCH 12V”
K5	540066	“RELAY, SPDT 2A LATCH 12V”
K6	540066	“RELAY, SPDT 2A LATCH 12V”
K7	540066	“RELAY, SPDT 2A LATCH 12V”
K8	540066	“RELAY, SPDT 2A LATCH 12V”
K9	540066	“RELAY, SPDT 2A LATCH 12V”
L1	459005	“IND, 0.164 UH 7T#22 1-490030”
L10	459118	“IND, 47.5 UH 74T #30 2-490001”
L2	459004	“IND, 0.406 UH 11T#22 1-490030”
L3	459003	“IND, 0.970 UH 15T#22 1-490010”
L4	459002	“IND, 2.06 UH 23T#22 1-490010”
L5	459006	“IND, 4.45 UH 23T#22 2-490010”

Table 7-4 Antenna Tuner Board Parts List (009-00503 Rev. K)

Designator	Part Number	Description
L6	459007	“IND, 9.81 UH 32T#24 2-490019”
L7	459010	“IND, 19.7UH 42T#26 2-490050”
L8	459008	“IND, 43.6UH 70T#30 2-490050”
L9	459118	“IND, 47.5 UH 74T #30 2-490001”
R1	154101	“RES,100 OHM 2W 5% MOX STD”
R2	154680	“RES, 68 OHM MOX 2W 5%”
R3	154101	“RES,100 OHM 2W 5% MOX STD”
R4	124470	“RES, 47 OHM 1/4W 5% CF”
T1	459009	“XFMR ASSY, 6T#24 1-490302”
T2	459011	“XFMR ASSY,10T#24 CT 1-490350”

Chapter 8: Synthesizer Board

8.1 Circuit Description

The Synthesizer board generates three frequencies used to modulate, demodulate, up-convert, and down-covert transmit and receive signals. The variable first local oscillator is 76.6 to 105 MHz, depending on the channel frequency, the fixed second local oscillator is 73.35 MHz, and the beat frequency oscillator (BFO) is1650 kHz or 1647 kHz, depending on sideband selection.

Note: Although the synthesizer is capable of 1 Hz resolution, the output frequencies are limited to 10 Hz resolution.

The Synthesizer board includes the following major components:

- Reference oscillator at 100 MHz
- Four-channel direct digital synthesizer (DDS) device that generates all three local oscillators (fourth channel is unused)
- PLL/Tracking filter that follows the LO output from the DDS

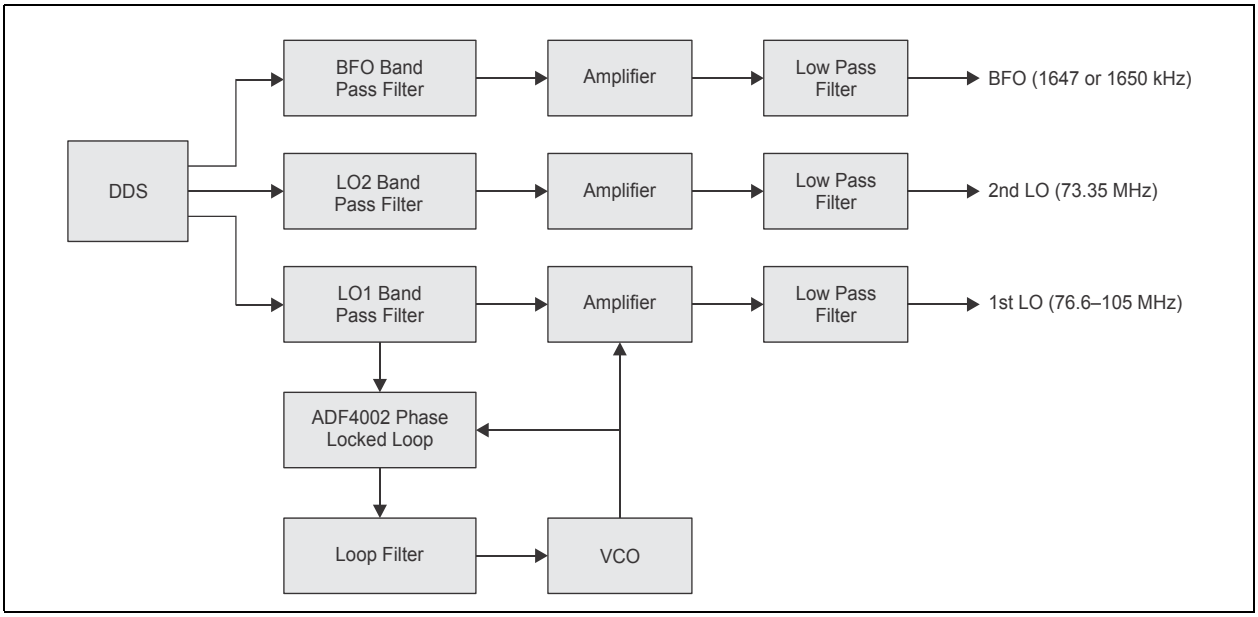


Figure 8-1 Synthesizer Board Block Diagram

8.1.1 Reference Oscillator

Temperature-compensated crystal oscillator (TCXO) Y1 provides a 100 MHz reference frequency for the DDS synthesizer with a standard frequency tolerance of 1 ppm over temperature. It includes a fine adjustment to allow centering of the oscillator's frequency at the time of synthesizer calibration.

The complete frequency determination of the entire transceiver is locked to this reference, giving the output frequency a stability equal to that of the TCXO. An in-line 1:1 balun transformer converts the single-ended oscillator output to a balanced input for the DDS.

8.1.2 Direct Digital Synthesizer (DDS)

The Direct Digital Synthesizer (DDS) generates two local oscillator frequencies: LO1 and LO2, that are routed to the Mixer board where they either up-convert or down-convert the transmit or receive frequency. The DDS receives channel frequency data from the processor over SPI serial data lines.

The BFO (beat frequency oscillator) output (1647 or 1650 kHz) is routed to the Audio/Filter board where it is modulated by the transmit audio. The BFO is also used to demodulate the receive signal leaving just the receive audio.

The 4-channel DDS produces all the local oscillator outputs, including the BFO. The BFO is generated in channel 2, the first LO (76.6 to 105 MHz) is generated in channel 1, and the second LO (73.35 MHz) is generated by channel 0. The fourth channel is unused.

The DDS operates all three local oscillators at the appropriate frequency. The device is tuned by inputting a 32-bit digital tuning word expressed by:

$F_o = (FTW)(Fs)/2^{32}$ where:

F_o = DDS output frequency

$0 <= FTW <= 2^{31}$

FTW = Frequency tuning word

Fs = System clock rate

8.1.3 PLL/Tracking Filter

The first LO uses a phase-locked loop (PLL) circuit that filters the output of the DDS first local oscillator (LO1) to remove any wide-band spurious signals and noise. The loop filter of the PLL is composed of U17, R101, R102 and R133 together with C121, C123, C124, and C125. The output of U17 controls the frequency of VCO U16.

The PLL circuit also tracks the LO1 output frequency exactly using low-noise VCO U16 so there is no additional division noise commonly associated with phase locked loops.

Serial-programmed synthesizer U18 operates in phase detector mode with the R and N counters bypassed. The charge pump is configured for a current of 5 mA and negative polarity because of the inverting loop filter. The reference input to U18 (LO1_OUT) comes from the filtered output of the DDS at the correct frequency for LO1. The charge pump output from U18 controls U16 that tracks the DDS frequency. This provides narrow bandpass filtering of the DDS output, eliminating the numerous spurs that are present.

8.1.4 First LO

The first LO (76.6 to 105 MHz depending on the channel frequency) is generated by channel 1 of DDS U9 and applied to the RX and TX double-balanced mixer (MX1) through LO1 buffer Q1 on the Mixer board. In receive mode, LO1 mixes with the selected channel frequency (1.6 to 30 MHz) at MX1 to up-convert to the IF frequency of 75 MHz.

In transmit mode, LO1 mixes with the modulated 75 MHz transmit frequency at MX1 to down-convert to the selected channel frequency (1.6 to 30 MHz).

8.1.5 Second LO

The second LO (73.35 MHz) is generated by channel 0 of DDS U9 and applied to the RX (Q8) and TX (U2) mixers through LO2 buffer Q10 on the Mixer board. In receive mode, LO2 mixes with the first IF (nominal 75 MHz) at N-channel, dual-gate MOSFET Q8 to down-convert to the final IF of 1650 kHz.

In transmit mode, LO1 mixes with the modulated 1650/1647 MHz transmit frequency at balanced modulator U2 to up-convert to the first IF (75 MHz).

8.1.6 BFO Output

The BFO is required to supply two frequencies, 1647 kHz for lower sideband and 1650 kHz for upper sideband. In receive mode, these frequencies demodulate the audio-modulated 1650/1647 kHz IF signal in the product detector on the Audio/Filter board to remove the carrier, leaving only the base receive audio signal. In transmit mode, these BFO frequencies is modulated by the transmit audio in the balanced modulator on the Audio/Filter board to the generate the first carrier frequency of 1650 kHz which is suppressed by the balanced modulator.

The BFO is also bandpass filtered to remove any wideband spurious and noise frequencies. Table 8-1 on page 8-4 shows some sample FTW programming values compared to target frequencies.

Table 8-1 Sample FTW Programming Values

Output	Target F_O	Value Dec	FTW Hex Value	Actual F_O	Error in Hz	% Error
1st LO	76,650,000.00	658,418,486.48	273EAB36	76,649,999.94	0.0555	7.24159E-08
	86,650,000.00	744,317,832.40	2C5D6388	86,649,999.95	0.0462	5.33106E-08
	96,650,000.00	830,217,178.32	317C1BDA	96,649,999.96	0.0369	6.81587E-08
	105,650,000.00	901,943,132.16	35C28F5C	104,999,999.98	0.0186	1.77395E-08
2nd LO	73,350,000.00	630,071,702.32	258E2196	73,349,999.96	0.0376	5.12957E-08
BFO	1,647,000.00	14,147,622.27	D7E026	1,646,999.97	0.0318	1.92957E-06
	1,650,000.00	14,173,392.08	D844D0	1,649,999.99	0.0089	5.4186E-07
	1.00	8.59	8	0.93	0.0687	6.867742538

8.2 Connector Pin Assignments

8.2.1 J1 Connector

J1 connects to the Processor board J3 connector through the Audio/Filter board.

Table 8-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	GND	Chassis ground.
2	GND	Chassis ground.
3	ENM6C	No connection.
4	SPI_DATA	SPI data to U9, U11 and U18 from the Processor board.
5	SPI_CLK	SPI clock input from the Processor board
6	BITE	Analog signal from phase detector to Processor board.
7	+12V	+12 VDC supply voltage from the Junction board.
8	+5V	No connection.
9	ENM6B	Enable for address decoder U12 from the Processor board through the Audio/Filter board.
10	ENM6A	Enables latch clock for shift register from the Processor board through the Audio/Filter board.

Table 8-2 J1 Connector Pin Assignments (continued)

Pin	Signal	Description
11	BFO_GND	Ground for BFO coax.
12	BFO_OUT	Coax output signal BFO/LO3 (1650/1647 kHz) to the Audio/Filter board.
13	BFO_GND	Ground for BFO coax.

8.2.2 J2 Connector

J2 is the coaxial connection that carries the first local oscillator frequency (76.6 to 105 MHz) from the DDS to the Mixer board.

8.2.3 J3 Connector

J3 is the coaxial connection that carries the second local oscillator frequency 73.35 MHz or from the DDS to the Mixer board.

8.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Antenna Tuner board.

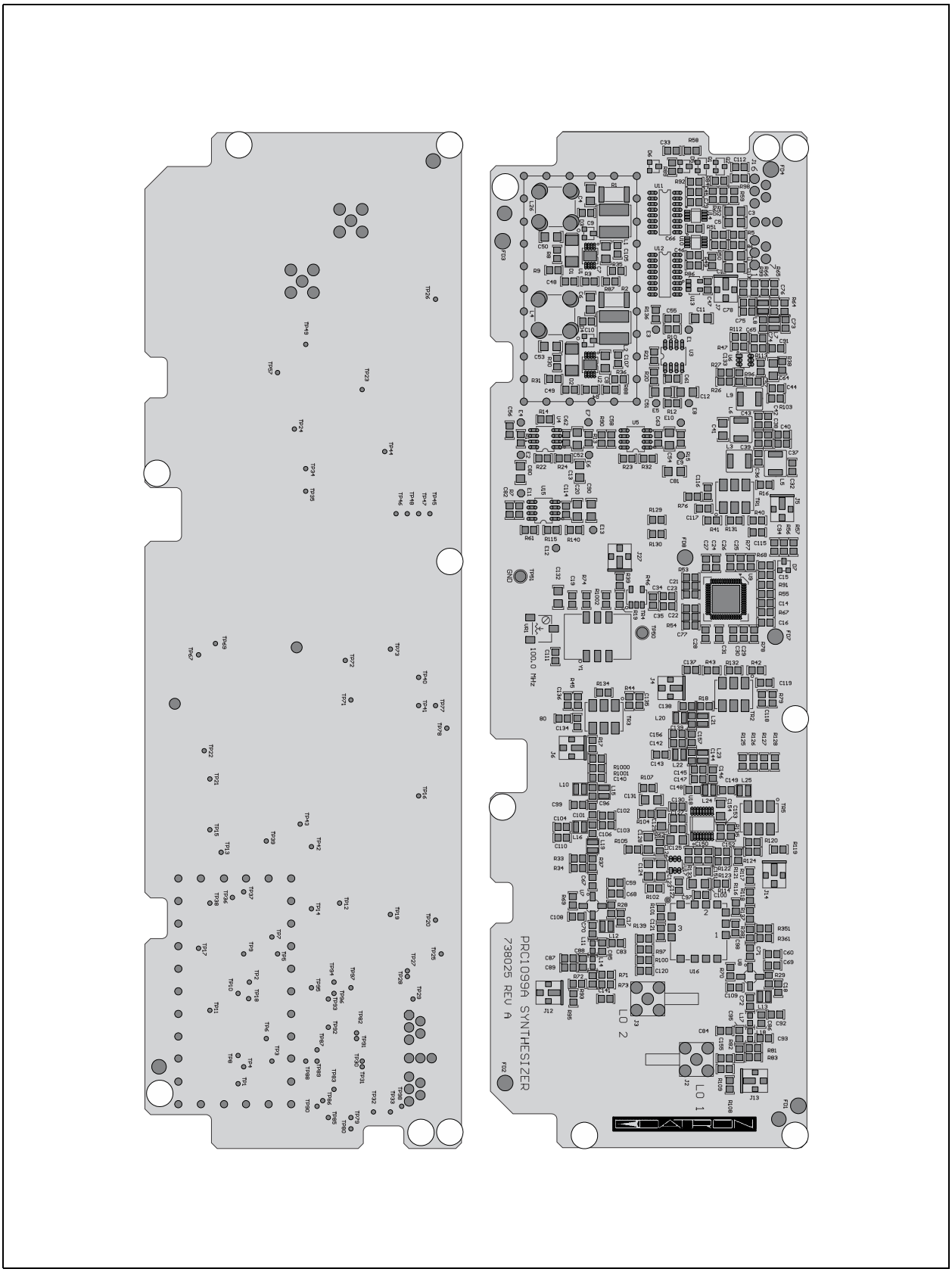


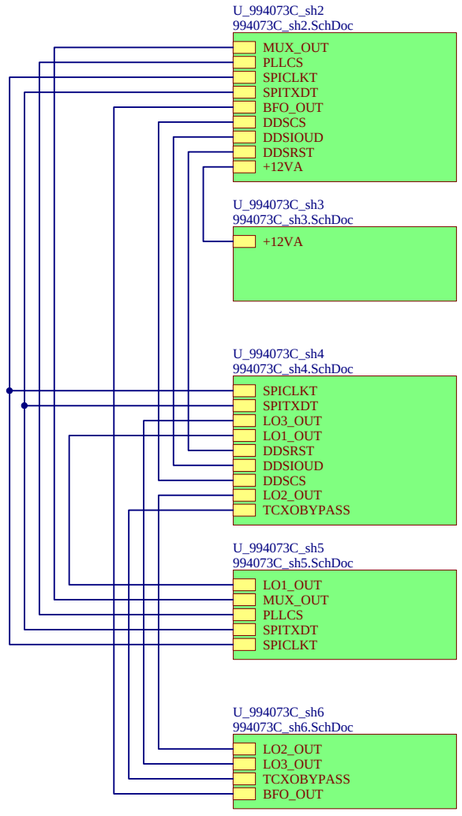
Figure 8-2 Synthesizer Board Component Locations (738025 Rev. A)

NOTES: UNLESS OTHERWISE SPECIFIED

1. REF- PCA 009-00606
2. REF - PCB 738025
3. ALL CAPS ARE IN MICROFARADS
4. ALL RESISTORS ARE IN OHMS

REVISIONS

REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	06-0430	RELEASE	BB	2-18-07	
B	08-0403	REVISED R115 AND R61 VALUE ON SHEET 3	JN	12-18-08	
C	10-0502	U16 WAS UMJ-950-D14, R72 WAS 75ohm, R71 & R73 WAS 100ohm	JN	10/04/10	
D	11-0165	R101 was value 274R	BB	3-31-11	



FD1 FIDUCIAL FD2 FIDUCIAL FD3 FIDUCIAL FD4 FIDUCIAL FD7 FIDUCIAL FD8 FIDUCIAL

Figure 8-3
Synthesizer Board
Schematic Diagram 1 of 6
(994073 Rev. D)

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APPROVALS	DATE
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PROJ ENGR	
MFG ENGR	

TITLE SCHEMATIC,
PRC1099A Synthesizer Board

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D

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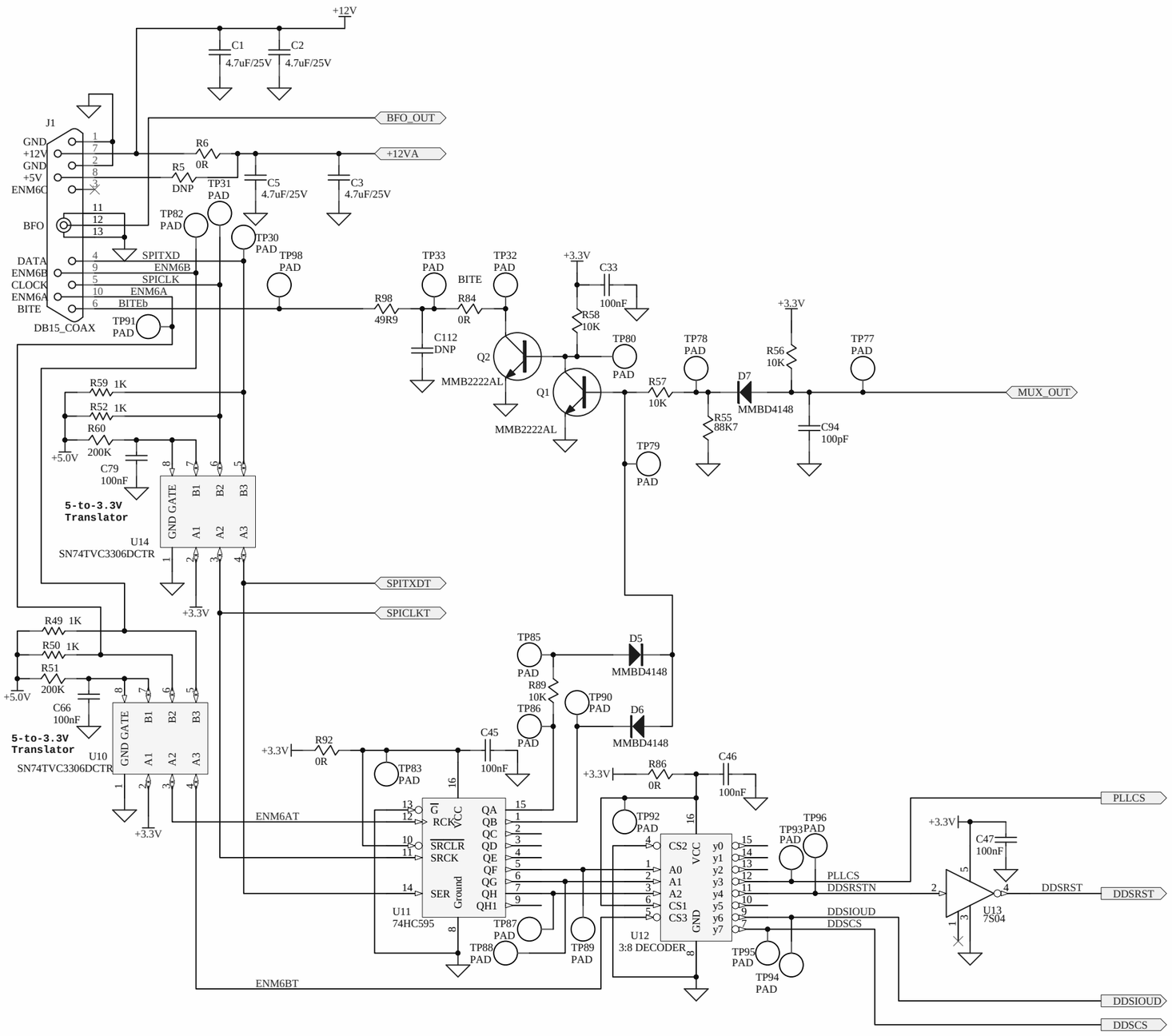

Figure 8-4
Synthesizer Board
Schematic Diagram 2 of 6
(994073 Rev. D)

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D
SCALE: NONE	FILENAME:994073D_sh2.SchDoc		SHEET 2 OF 6
5/26/2015	2:38:05 PM		

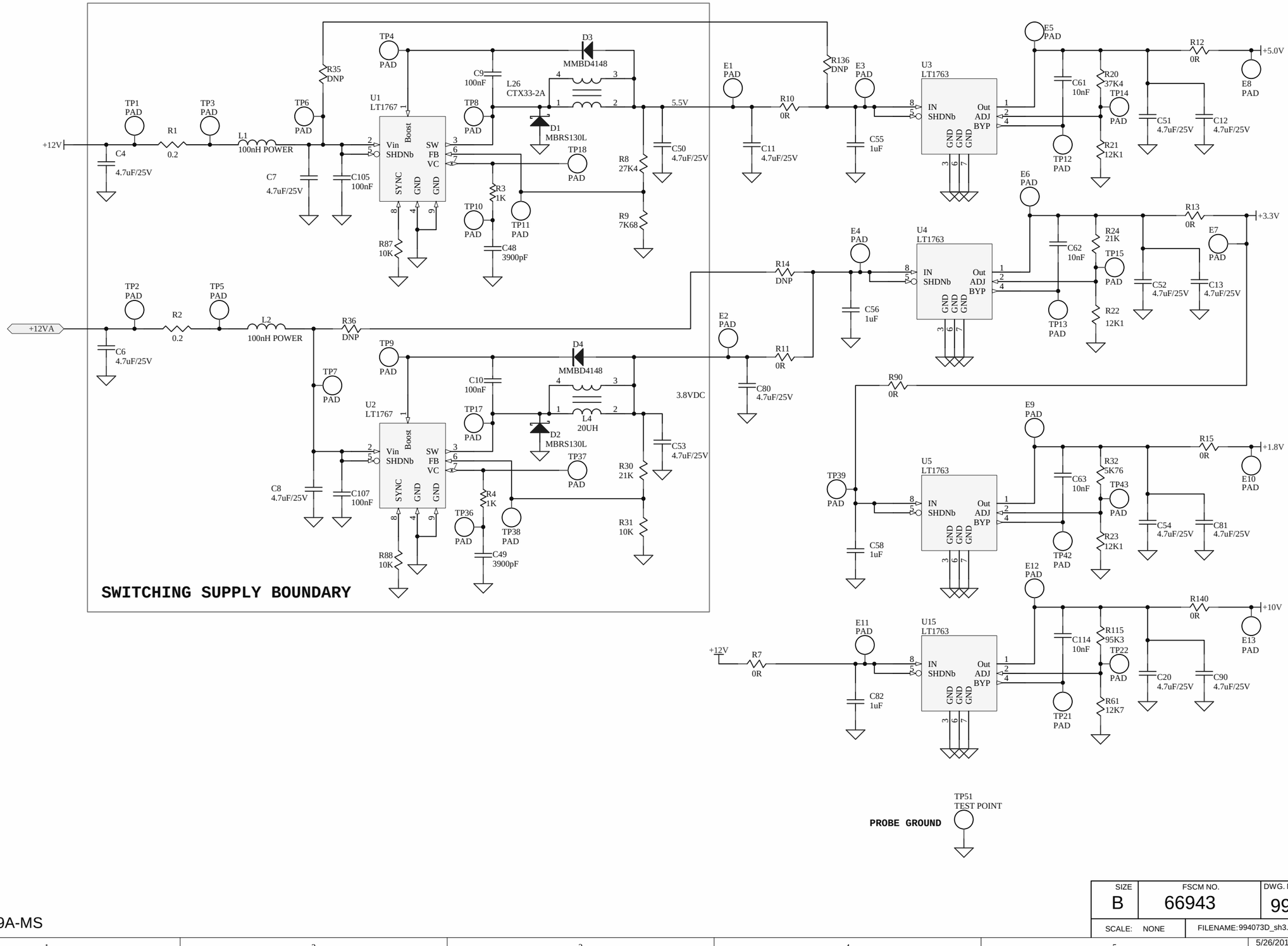

Figure 8-5
Synthesizer Board
Schematic Diagram 3 of 6
(994073 Rev. D)

PRC1099A-MS

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D
SCALE: NONE	FILENAME:994073D_sh3.SchDoc		SHEET 3 OF 6

5/26/2015 2:38:56 PM

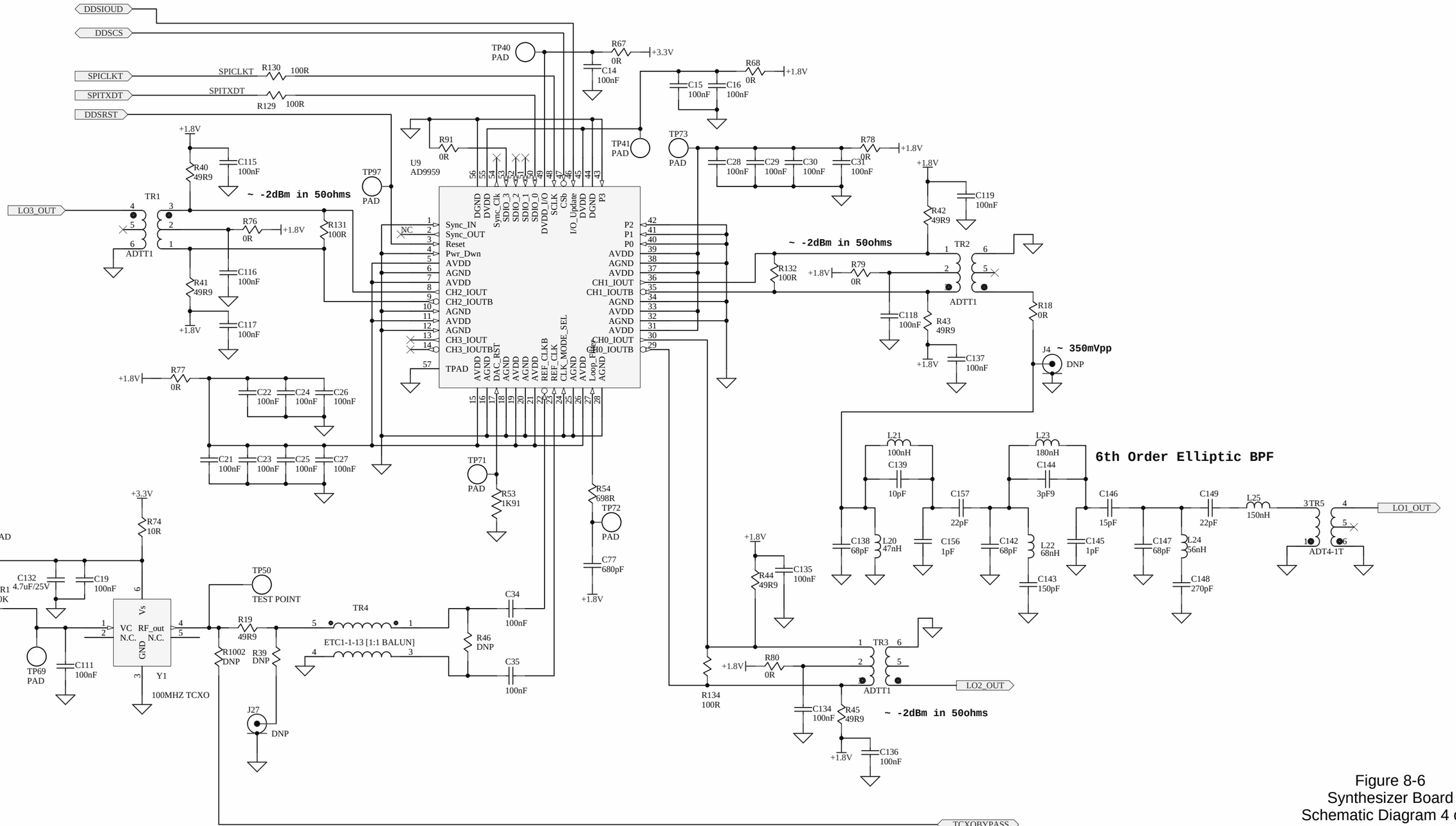

Figure 8-6
Synthesizer Board
Schematic Diagram 4 of 6
(994073 Rev. D)

PRC1099A-MS

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D
SCALE: NONE	FILENAME:994073D_sh4.SchDoc		SHEET 4 OF 6
5/26/2015	2:39:55 PM		

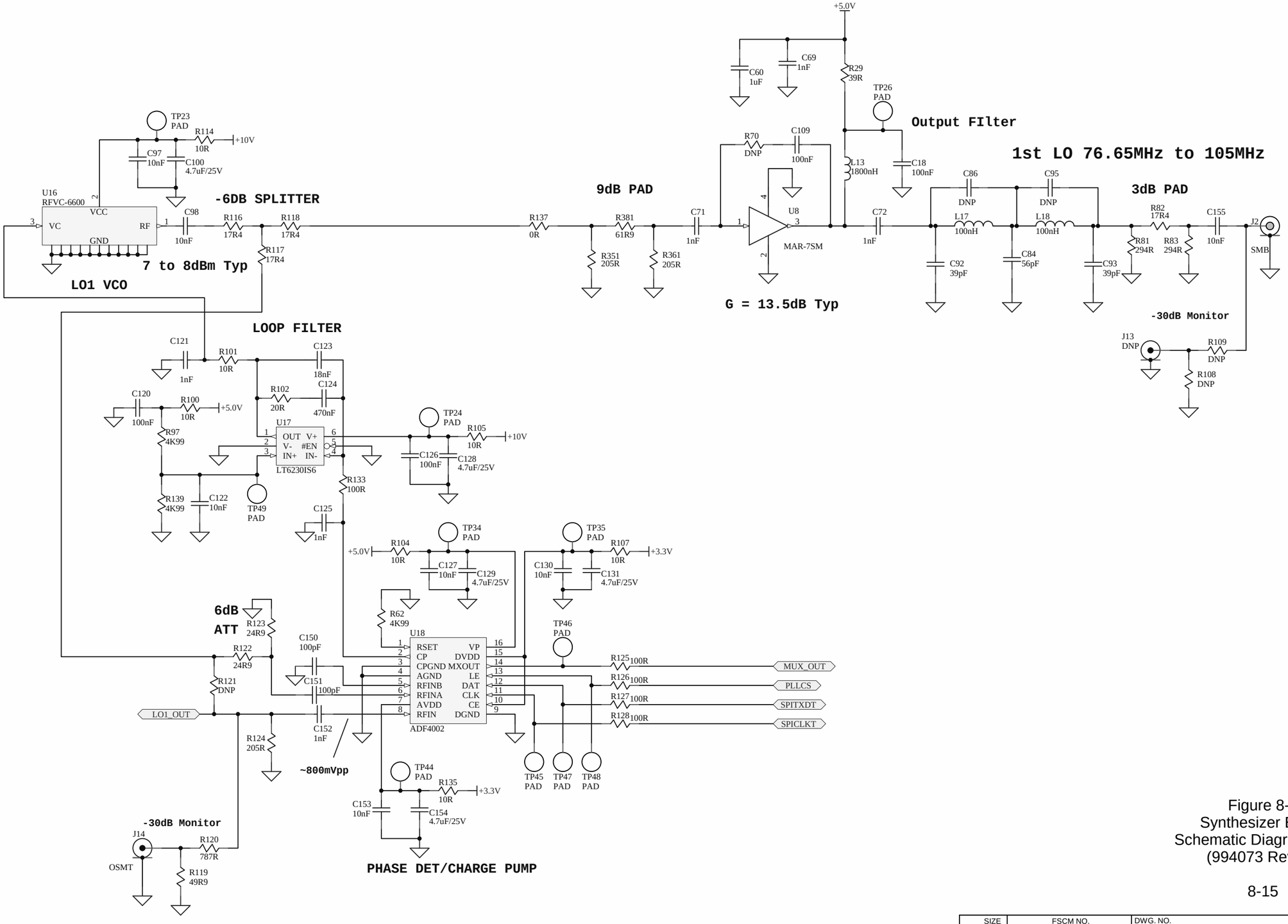

Figure 8-7
Synthesizer Board
Schematic Diagram 5 of 6
(994073 Rev. D)

PRC1099A-MS

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D
SCALE: NONE	FILENAME:994073D_sh5.SchDoc		SHEET 5 OF 6
5/26/2015	2:43:17 PM		

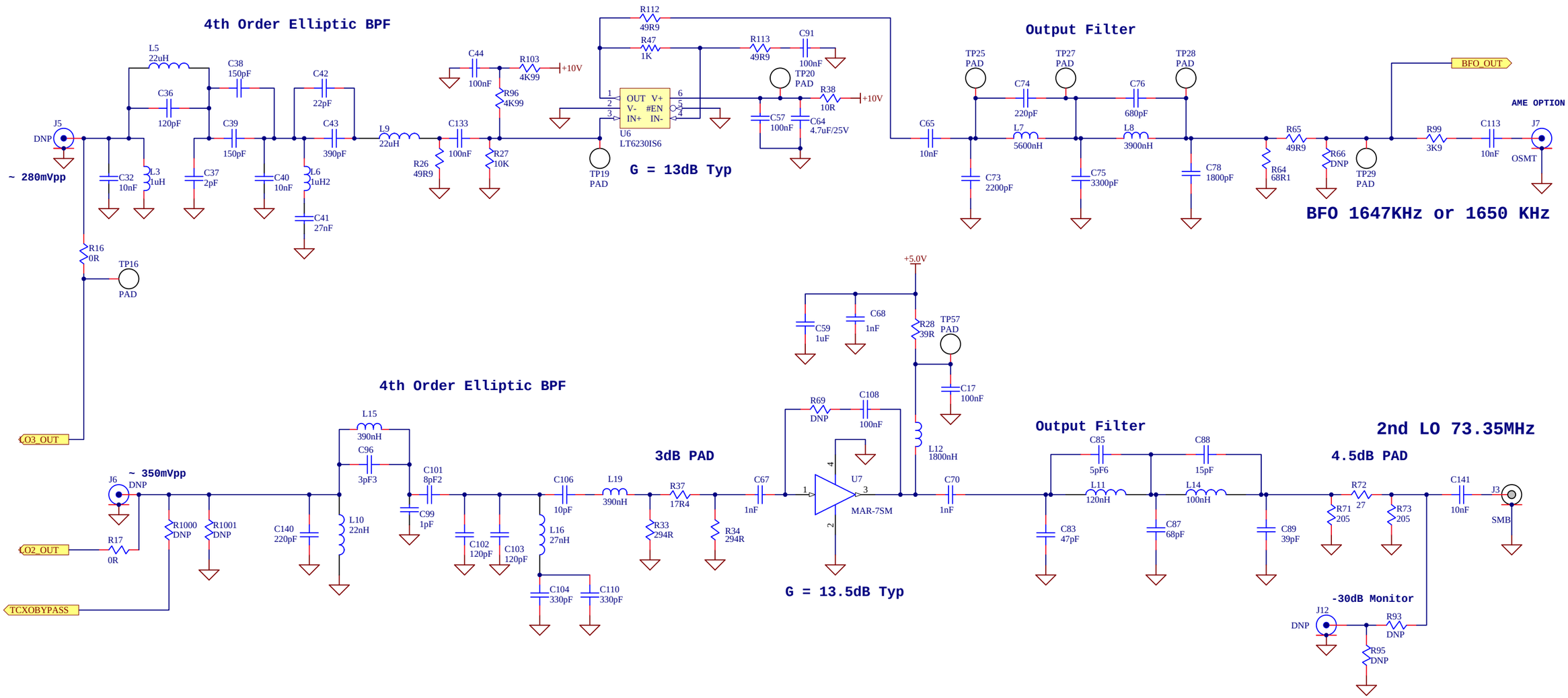

Figure 8-8
Synthesizer Board
Schematic Diagram 6 of 6
(994073 Rev. D)

PRC1099A-MS

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994073	D
SCALE: NONE	FILENAME:994073D_sh6.SchDoc		SHEET 6 OF 6

5/26/2015 2:44:03 PM

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
C1	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C10	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C100	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C101	021829000	“CAP, 8.2PF, NP0, 100V, 0.25PF, 0805”
C102	021121000	CAP 120PF NP0 100V 5% 0805
C103	021121000	CAP 120PF NP0 100V 5% 0805
C104	021331000	“CAP, 330PF NP0 100V 5% 0805”
C105	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C106	021100000	“CAP, 10PF, NP0, 100V, 5%, 0805”
C107	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C108	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C109	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C11	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C110	021331000	“CAP, 330PF NP0 100V 5% 0805”
C111	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C112	DNP	“NULL PART, VACANT PCB LOCATION”
C113	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C114	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C115	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C116	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C117	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C118	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C119	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C12	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C120	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C121	021102000	“CAP, 1000PF NP0 100V 5% 0805”
C122	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C123	025183000	“CAP, 0.018UF PPS 16V 2% 1206”
C124	025474000	“CAP, 0.47UF PET 16V 20% 1206”
C125	021102007	“CAP, 1000PF NP0 200V 5% 1206”
C126	021104000	“CAP, 0.1UF X7R 25V 5% 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
C127	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C128	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C129	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C13	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C130	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C131	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C132	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C133	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C134	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C135	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C136	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C137	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C138	021680000	“CAP, 68PF NP0 100V 5% 0805”
C139	021100000	“CAP, 10PF, NP0, 100V, 5%, 0805”
C14	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C140	021221000	“CAP, 220PF NP0 100V 5% 0805”
C141	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C142	021680000	“CAP, 68PF NP0 100V 5% 0805”
C143	021151000	“CAP, 150PF NP0 100V 5% 0805”
C144	021399000	“CAP,3.9PF NP0 100V 0.25PF 0805”
C145	021100800	“CAP, 1PF NP0 100V 0.25PF 0805”
C146	021150000	“CAP, 15PF, NP0, 100V, 5%, 0805”
C147	021680000	“CAP, 68PF NP0 100V 5% 0805”
C148	021271000	“CAP, 270PF NP0 100V 5% 0805”
C149	021220003	“CAP, 22PF NP0 100V 2% 0805”
C15	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C150	021101000	“CAP, 100PF NP0 100V 5% 0805”
C151	021101000	“CAP, 100PF NP0 100V 5% 0805”
C152	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C153	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C154	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C155	021103000	“CAP, 0.01UF X7R 50V 5% 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
C156	021100800	“CAP, 1PF NP0 100V 0.25PF 0805”
C157	021220003	“CAP, 22PF NP0 100V 2% 0805”
C16	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C17	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C18	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C19	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C2	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C20	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C21	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C22	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C23	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C24	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C25	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C26	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C27	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C28	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C29	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C3	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C30	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C31	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C32	025103002	“CAP, 0.01UF PPS 16V 2% 0805”
C33	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C34	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C35	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C36	021121000	CAP 120PF NP0 100V 5% 0805
C37	021209000	“CAP, 2.0PF NP0 100V 0.25PF 0805”
C38	021151000	“CAP, 150PF NP0 100V 5% 0805”
C39	021151000	“CAP, 150PF NP0 100V 5% 0805”
C4	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C40	025103002	“CAP, 0.01UF PPS 16V 2% 0805”
C41	025273000	“CAP, 0.027UF PPS 16V 2% 1206”
C42	021220003	“CAP, 22PF NP0 100V 2% 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
C43	021391000	“CAP, 390PF NP0 100V 2% 0805”
C44	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C45	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C46	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C47	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C48	021392000	“CAP, 3900PF, X7R, 100V, 5%, 0805”
C49	021392000	“CAP, 3900PF, X7R, 100V, 5%, 0805”
C5	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C50	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C51	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C52	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C53	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C54	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C55	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C56	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C57	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C58	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C59	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C6	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C60	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C61	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C62	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C63	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C64	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C65	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C66	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C67	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C68	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C69	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C7	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C70	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C71	021102002	“CAP, 1000PF X7R 50V 10% 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
C72	021102002	“CAP, 1000PF X7R 50V 10% 0805”
C73	021222000	“CAP, 2200PF X7R 100V 5% 0805”
C74	021221000	“CAP, 220PF NP0 100V 5% 0805”
C75	021332001	“CAP, 3300PF NP0 50V 5% 0805”
C76	021681000	“CAP, 680PF NP0 100V 5% 0805”
C77	021681000	“CAP, 680PF NP0 100V 5% 0805”
C78	021182003	“CAP,1800PF NP0 50V 5% 0805”
C79	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C8	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C80	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C81	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C82	021105006	“CAP,1.0UF 10V X7R 10% 0805”
C83	021470000	“CAP, 47PF NP0 100V 5% 0805”
C84	021560000	“CAP, 56PF NP0 100V 5% 0805”
C85	021569001	“CAP, 5.6PF NP0 100V 0.25P 0805”
C86	DNP	“NULL PART, VACANT PCB LOCATION”
C87	021680000	“CAP, 68PF NP0 100V 5% 0805”
C88	021150000	“CAP, 15PF, NP0, 100V, 5%, 0805”
C89	021390003	“CAP, 39PF NP0 100V 2% 0805”
C9	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C90	021475000	“CAP, 4.7UF 25V X7R 10% 1206”
C91	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C92	021390003	“CAP, 39PF NP0 100V 2% 0805”
C93	021390003	“CAP, 39PF NP0 100V 2% 0805”
C94	021101000	“CAP, 100PF NP0 100V 5% 0805”
C95	DNP	“NULL PART, VACANT PCB LOCATION”
C96	021339001	“CAP,3.3PF NP0 100V 0.25PF 0805”
C97	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C98	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C99	021100800	“CAP, 1PF NP0 100V 0.25PF 0805”
D1	037702004	“DIODE, PWR MBR130LT 1A 30V SMB”
D2	037702004	“DIODE, PWR MBR130LT 1A 30V SMB”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
D3	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D4	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D5	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D6	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D7	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
J1	610037	“CONN, DB-15M + 8MM RF RT”
J12	DNP	“NULL PART, VACANT PCB LOCATION”
J13	DNP	“NULL PART, VACANT PCB LOCATION”
J14	080002000	“CONN, OSMT RF PCB RECPT-M”
J2	610510	“CONN, SMB PCB JACK-F RT AGL TH”
J27	DNP	“NULL PART, VACANT PCB LOCATION”
J3	610510	“CONN, SMB PCB JACK-F RT AGL TH”
J4	DNP	“NULL PART, VACANT PCB LOCATION”
J5	DNP	“NULL PART, VACANT PCB LOCATION”
J6	DNP	“NULL PART, VACANT PCB LOCATION”
J7	080002000	“CONN, OSMT RF PCB RECPT-M”
L1	042101000	“XFMR, 100NH SLC7530D SMT”
L10	040220001	“IND, 22NH AIR 1A 2% 1008CS”
L11	041121002	“INDUCTOR, 120NH 5% CC 0603”
L12	040182000	“IND, 1.8UH AIR 0.3A 2% 1008CS”
L13	040182000	“IND, 1.8UH AIR 0.3A 2% 1008CS”
L14	041101003	“IND,100NH,CC,0.4A,2%,0603CS”
L15	040391000	“IND, 390NH AIR 0.47A 2% 1008CS”
L16	040270000	“IND, 27NH AIR 1A 2% 1008CS”
L17	041101003	“IND,100NH,CC,0.4A,2%,0603CS”
L18	041101003	“IND,100NH,CC,0.4A,2%,0603CS”
L19	040391000	“IND, 390NH AIR 0.47A 2% 1008CS”
L2	042101000	“XFMR, 100NH SLC7530D SMT”
L20	040470001	“IND, 47NH AIR 1A 2% 1008CS”
L21	040101000	“IND, 100NH AIR 0.65A 2% 1008CS”
L22	040680001	“IND, 68NH AIR 1A 2% 1008CS”
L23	040181000	“IND, 180NH AIR 0.6A 2% 1008CS”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
L24	040560002	“IND, 56NH AIR 1A 2% 1008CS”
L25	040151001	“IND, 150NH AIR 0.58A 2% 1008CS”
L26	042333000	“XFMR,CTX33-2A 33UH FR 1-1 20%”
L3	041102001	“IND, 1UH FR 2.9A 5% 1812FS”
L4	042203000	“XFMR, 20UH CTX20-2A FR SMT”
L5	041223002	“IND, 22 UH FR 0.8A 5% 1812FS”
L6	041122002	“IND, 1.2UH FR 2.6A 5% 1812FS”
L7	041562001	“IND, 5.6UH AIR 0.24A 5% 1008CS”
L8	040392000	“IND, 3.9UH AIR 0.26A 2% 1008CS”
L9	041223002	“IND, 22 UH FR 0.8A 5% 1812FS”
Q1	032004	“XSTR,MMBT2222A NPN SOT23”
Q2	032004	“XSTR,MMBT2222A NPN SOT23”
R1	019R20000	“RES, 0.20 OHM 1W 1% TK 2512”
R10	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R100	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R1000	DNP	“NULL PART, VACANT PCB LOCATION”
R1001	DNP	“NULL PART, VACANT PCB LOCATION”
R1002	DNP	“NULL PART, VACANT PCB LOCATION”
R101	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R102	013200900	“RES, 20 OHM 1/8W 1% TK 0805”
R103	013492000	“RES, 4.99K OHM 1/8W 1% TK 0805”
R104	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R105	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R107	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R108	DNP	“NULL PART, VACANT PCB LOCATION”
R109	DNP	“NULL PART, VACANT PCB LOCATION”
R11	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R112	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R113	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R114	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R115	013953200	“RES, 95.3K OHM 1/8W 1% TK 0805”
R116	013174900	“RES, 17.4 OHM 1/8W 1% TK 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
R117	013174900	“RES, 17.4 OHM 1/8W 1% TK 0805”
R118	013174900	“RES, 17.4 OHM 1/8W 1% TK 0805”
R119	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R12	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R120	013787000	“RES, 787 OHM 1/8W 1% TK 0805”
R121	DNP	“NULL PART, VACANT PCB LOCATION”
R122	013249900	“RES, 24.9 OHM 1/8W 1% TK 0805”
R123	013249900	“RES, 24.9 OHM 1/8W 1% TK 0805”
R124	013205000	“RES, 205 OHM 1/8W 1% TK 0805”
R125	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R126	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R127	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R128	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R129	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R13	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R130	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R131	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R132	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R133	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R134	013101002	“RES, 100 OHM 1/8W 1% TK 0805”
R135	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R136	DNP	“NULL PART, VACANT PCB LOCATION”
R137	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R139	013492000	“RES, 4.99K OHM 1/8W 1% TK 0805”
R14	DNP	“NULL PART, VACANT PCB LOCATION”
R140	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R15	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R16	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R17	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R18	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R19	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R2	019R20000	“RES, 0.20 OHM 1W 1% TK 2512”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
R20	013374200	“RES, 37.4K OHM 1/8W 1% TK 0805”
R21	013121200	“RES, 12.1K OHM 1/8W 1% TK 0805”
R22	013121200	“RES, 12.1K OHM 1/8W 1% TK 0805”
R23	013121200	“RES, 12.1K OHM 1/8W 1% TK 0805”
R24	013210200	“RES, 21.0K OHM 1/8W 1% TK 0805”
R26	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R27	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R28	013390900	“RES, 39 OHM 1/8W 1% TK 0805”
R29	013390900	“RES, 39 OHM 1/8W 1% TK 0805”
R3	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R30	013210200	“RES, 21.0K OHM 1/8W 1% TK 0805”
R31	013102200	“RES, 10.2K OHM 1/8W 1% TK 0805”
R32	013576100	“RES, 5.76K OHM 1/8W 1% TK 0805”
R33	013294000	“RES, 294 OHM 1/8W 1% TK 0805”
R34	013294000	“RES, 294 OHM 1/8W 1% TK 0805”
R35	DNP	“NULL PART, VACANT PCB LOCATION”
R351	013205000	“RES, 205 OHM 1/8W 1% TK 0805”
R36	DNP	“NULL PART, VACANT PCB LOCATION”
R361	013205000	“RES, 205 OHM 1/8W 1% TK 0805”
R37	013174900	“RES, 17.4 OHM 1/8W 1% TK 0805”
R38	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R381	013619900	“RES, 61.9 OHM 1/8W 1% TK 0805”
R39	DNP	“NULL PART, VACANT PCB LOCATION”
R4	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R40	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R41	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R42	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R43	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R44	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R45	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R46	DNP	“NULL PART, VACANT PCB LOCATION”
R47	013102002	“RES, 1K OHM 1/8W 1% TK 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
R49	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R5	DNP	“NULL PART, VACANT PCB LOCATION”
R50	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R51	013204000	“RES, 200K OHM 1/8W 1% TK 0805”
R52	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R53	013191100	“RES, 1.91K OHM 1/8W 1% TK 0805”
R54	013698000	“RES, 698 OHM 1/8W 1% TK 0805”
R55	013887200	“RES, 88.7K OHM 1/8W 1% TK 0805”
R56	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R57	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R58	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R59	013102002	“RES, 1K OHM 1/8W 1% TK 0805”
R6	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R60	013204000	“RES, 200K OHM 1/8W 1% TK 0805”
R61	013127200	“RES, 12.7K OHM 1/8W 1% TK 0805”
R62	013492000	“RES, 4.99K OHM 1/8W 1% TK 0805”
R64	013681900	“RES, 68.1 OHM 1/8W 1% TK 0805”
R65	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R66	DNP	“NULL PART, VACANT PCB LOCATION”
R67	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R68	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R69	DNP	“NULL PART, VACANT PCB LOCATION”
R7	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R70	DNP	“NULL PART, VACANT PCB LOCATION”
R71	013205000	“RES, 205 OHM 1/8W 1% TK 0805”
R72	013270000	“RES,27 OHM 1/8W 5% TK 0805”
R73	013205000	“RES, 205 OHM 1/8W 1% TK 0805”
R74	013100900	“RES, 10 OHM 1/8W 1% TK 0805”
R76	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R77	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R78	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R79	013000000	“RES, ZERO OHM, 2A, TK, 0805”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
R8	013274200	“RES, 27.4K OHM, 1/8W, 1%, TK, 0805”
R80	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R81	013294000	“RES, 294 OHM 1/8W 1% TK 0805”
R82	013174900	“RES, 17.4 OHM 1/8W 1% TK 0805”
R83	013294000	“RES, 294 OHM 1/8W 1% TK 0805”
R84	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R86	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R87	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R88	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R89	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R9	013768100	“RES, 7.68K OHM 1/8W 1% TK 0805”
R90	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R91	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R92	013000000	“RES, ZERO OHM, 2A, TK, 0805”
R93	DNP	“NULL PART, VACANT PCB LOCATION”
R95	DNP	“NULL PART, VACANT PCB LOCATION”
R96	013492000	“RES, 4.99K OHM 1/8W 1% TK 0805”
R97	013492000	“RES, 4.99K OHM 1/8W 1% TK 0805”
R98	013499900	“RES, 49.9 OHM 1/8W 1% TK 0805”
R99	013392000	“RES,3.9K OHM 1/8W 5% TK 0805”
TP50	650000	“TEST PNT, BLK 0.125 DIA TH”
TP51	650000	“TEST PNT, BLK 0.125 DIA TH”
TR1	042000015	“XFMR, RF ADTT1-1 CT SMT”
TR2	042000015	“XFMR, RF ADTT1-1 CT SMT”
TR3	042000015	“XFMR, RF ADTT1-1 CT SMT”
TR4	042000016	“XFMR, RF ETC1-1-13 CT SM-22”
TR5	042000018	“XFMR, RF ADTT4-1T CT SMT”
U1	034402009	“IC, LT1767 SWT VREG ADJ MSOP8”
U10	033305032	“IC,74TVC3306 VOLT CLAMP SSOP-8”
U11	033007	“IC,74HC595 8-BIT SIPO SOIC-16”
U12	033039	“IC,74HC138 1-8 DEC/DEMUX,SO-16”
U13	033303102	“IC, INVERTER MC7S04 SOT23-5”

Table 8-3 Synthesizer Board Parts List (009-00606 Rev. P)

Designator	Part Number	Description
U14	033305032	“IC,74TVC3306 VOLT CLAMP SSOP-8”
U15	033304042	“IC, LT1763 VREG ADJ SOIC-8”
U16	065117001	“VCO, RFVC-6600 10V 75-110 MHZ”
U17	033304079	“IC,LT6230-10 RF OP AMP SOT23-6”
U18	033303117	“IC,ADF4002 PLL SYN TSSOP-16”
U2	034402009	“IC, LT1767 SWT VREG ADJ MSOP8”
U3	033304042	“IC, LT1763 VREG ADJ SOIC-8”
U4	033304042	“IC, LT1763 VREG ADJ SOIC-8”
U5	033304042	“IC, LT1763 VREG ADJ SOIC-8”
U6	033304079	“IC,LT6230-10 RF OP AMP SOT23-6”
U7	033306014	“IC, RF AMP MAR-7SM SMT”
U8	033306014	“IC, RF AMP MAR-7SM SMT”
U9	033303103	“IC, AD9959 DDS LFCSP-56”
VR1	010103000	POT 10K ST-5 14T 0.25W 6MM SMT
Y1	065107001	“TCXO, C2310 100MHZ 3.3V SMT”

Chapter 9: Processor Board

9.1 Circuit Description

The Processor board includes a processor and associated components to perform the following control functions in the transceiver:

- Tuning of the synthesizer
- Harmonic filter selection
- Antenna tuner control
- Driving of the LCD frequency display
- Applying the signals from the front panel switches, knobs, and buttons

Communication with the external boards is conducted through a SPI (serial peripheral interface) data bus. The processor operates only during the period required to perform its specific control functions. This gives two important operational advantages. The first is that the processor only draws current during the brief period required to perform the control functions, typically only a few milliseconds. The second advantage is that there is no need to provide extensive shielding to stop noise in the receiver. The processor operates only when controls are changed.

The Processor board also has interface capabilities to an optional ALE card. The Processor board contains a Motorola 68302 processor that performs all radio control functions. The following sections discuss the components of the block diagram on the following page.

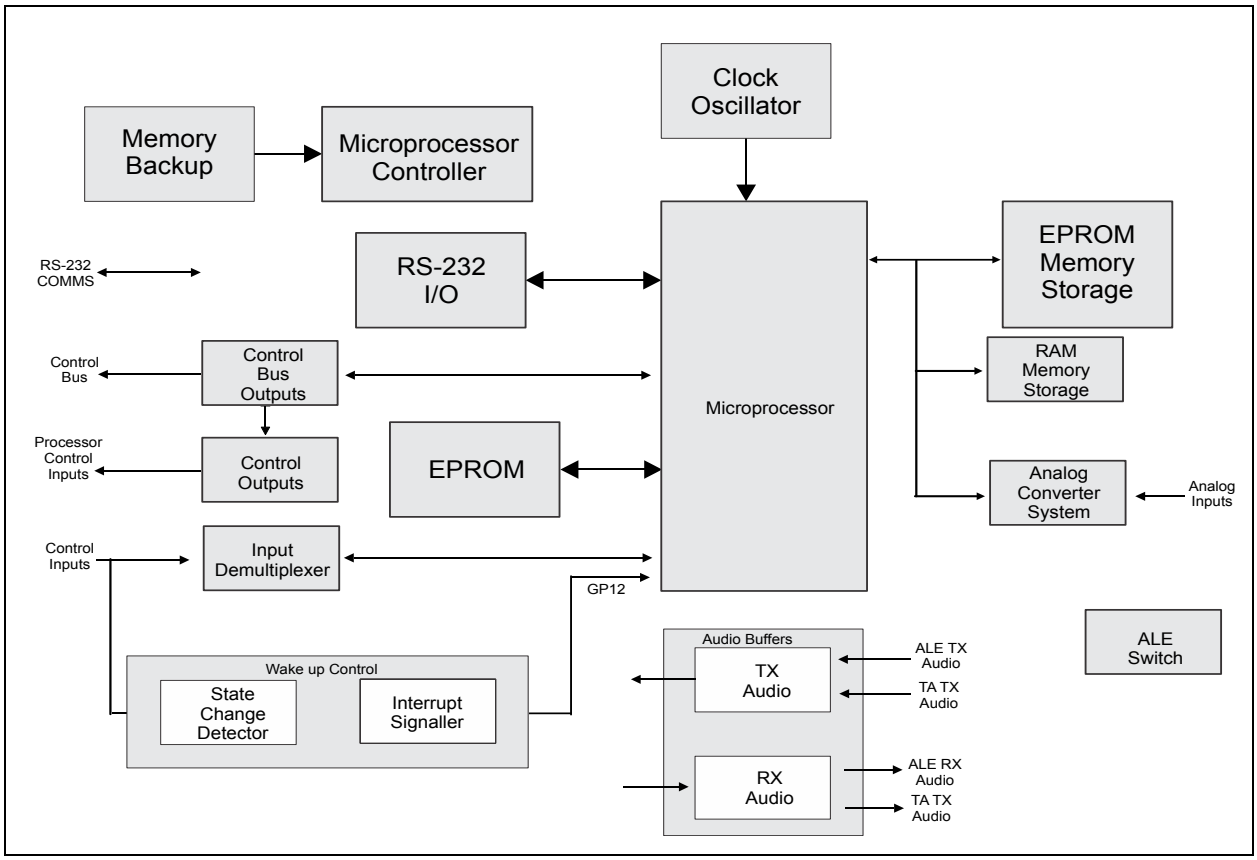

Figure 9-1 Processor Board Block Diagram

9.1.1 Processor

Processor U1 is combined with the input/output circuits to form a special purpose microcomputer. It controls the operation of the transceiver in response to the control inputs, in accordance with the program stored in memory.

The processor is a Motorola MC68302 that uses a 68000 processor core. This processor has the capability of addressing up to 2 Mb of EPROM memory and 64 kB of static RAM for future program expansion. It also has three UARTS, two timers, 18 bidirectional input/output lines, and four external interrupt sources.

The processor operates at a clock frequency of 4 MHz and uses an internal oscillator controlled by Y1. UART1 provides RS-232 communications through the front panel Accessory connector. UART2 communicates with the optional ALE card.

PA2 through PA7 drive the control bus, while PA10 through PA14 are for the d-mux bus. PA15 and PB0 through PB4 are for miscellaneous control functions.

GPI1 through GPI3 are for external interrupt sources while address lines A1 through A20 and data lines D0 through D15 communicate with the external EPROM, RAM, and analog converter system.

9.1.2 EPROM Program Storage

EPROM chips U2 and U3 provide storage for the main software operating program.

9.1.3 RAM Program Storage

RAM chips U4 and U5 provide storage for all the channel frequency data, display data, and memory tuner information.

9.1.4 Clock Oscillator Circuit

The clock oscillator is internal within the processor, except for the external crystal Y1, and capacitors C48 and C49.

9.1.5 Processor Controller

Controller U9 provides three functions. As a reset controller it has a voltage detector that monitors the +5V line. It generates a reset output to hold the processor's reset line low whenever the +5V line is below 4.65 VDC. An internal monostable multivibrator holds the reset line low for 200 milliseconds after the +5V line rises above 4.65 VDC. This prevents repeated toggling of the reset line.

U9 is also a power failure detector that issues a non-maskable interrupt to the processor whenever a power failure occurs. This lets the processor power down in the correct state before data is lost.

U9 also functions as memory backup preserving the contents of RAM memory storage. This is storage for frequency program information and must be preserved at all times. When a power failure is detected, the lithium battery is automatically switched in to preserve the RAM memory data.

9.1.6 Memory Backup Circuit

The memory backup power circuit includes memory backup battery BT1, current limiting resistor R22, and reverse protection diode D3. This battery provides backup power for the RAM chip to prevent settings loss.

9.1.7 RS-232 I/O Circuit

RS-232 chip U8 communicates with the front panel communications port. U8 has an on-board capacitor charge pump for generating the -10 VDC and +10 VDC necessary for RS232 communications. This circuit can easily handle baud rates up to 9600 baud. It also can be put into a low power idle mode for low power consumption.

9.1.8 Control Bus Outputs

Control bus outputs PA2 through PA7 provide serial programming information to the other radio boards. This bus includes synthesizer select signals, data and clock signals along with filter and tuner signals. The control bus also outputs the display information to the Display board.

9.1.9 Control Outputs

The control outputs from serial shift register U15 control the following devices:

- Tune initiate from the front panel.
- Enable and shutdown signals to the RS-232 chip.
- AGC time constant switching.
- Display backlight on/off control.
- External amplifier PTT enable.
- ALE Board switch.

9.1.10 EEPROM Memory

Serial EEPROM memory chip U18 stores critical operating settings necessary for proper radio operation.

9.1.11 Input Demultiplexer

Input demultiplexer U14 interfaces the 16 input lines to the processor. Analog multiplexer/demultiplexer U14 has 16 channels and four address lines. The processor communicates with the input demultiplexer through the d-mux bus. The five-line D-mux bus consists of four address lines connected to PA10 through PA13 from the processor and an input line connected to PA14. The processor outputs the desired input channel address through the address lines, and data is read in through the input line.

9.1.12 Wake-Up Control

State-change detector U12 represents half of the wake-up control block. It monitors the input lines for any change in the state of the inputs, then triggers an interrupt to the processor. U12 is an MC14531 12-bit parity tree with 12 inputs, odd/even parity-select input and a parity valid output. The interrupt signaller U13 is an MC14528B dual-monostable multivibrator. One section of the multivibrator is configured to trigger on the rising edge of the parity tree input and the other on the falling edge. The outputs of the multivibrators drive the interrupt line of the processor, which then bring the processor out of the standby state.

9.1.13 Analog Converter System

The analog converter system consists of the analog-to-digital converter (ADC) chip U6 and the analog multiplexer chip U7.

The analog multiplexer selects the proper input into the ADC chip. The ADC chip has a 256-position precision resistor array that lets it determine the input voltage down to a resolution of 20 mV. The analog converter system allows precise monitoring of the battery voltage, ALC line, AGC line, handset voltage, 8 VDC, receive 8 VDC, and transmit 8 VDC.

9.1.14 Audio Buffers

Op amp U19 buffers the transmit and receive audio signals to and from the optional ALE card.

9.1.15 ALE Switch

FET switch U21 switches the power to the optional ALE card on and off.

9.1.16 Program Operation

Most of the time, the processor is in standby mode waiting for a command from any of the inputs. When a control input changes, the state-change detector signals the processor to switch to active mode. The processor then polls all the inputs through the input demultiplexer to find out which input triggered the interrupt.

Upon determining the correct input, the processor executes the proper instructions to perform the command determined by the specific input. For example, a change in the channel switch line would wake up the processor, that then retrieves the new channel frequency data stored in RAM. The new channel data is then sent to the synthesizer, antenna tuner, and harmonic filter through the control bus, and the Display board data is sent through the display bus.

The input to any of the UART's and the rest of the interrupt sources is very similar, except all the interrupt circuitry is internal to the 68302 chip.

9.1.17 Control Bus

The control bus basically consists of three signals: clock, data, and select. The processor places the first data bit on the data line at the SPTXD pin. It then toggles the clock line (SPCLK) twice, so that the data is shifted into the selected shift register. This is repeated until all the data in the data stream is shifted out. 3-to-8 Demultiplexer U10 chooses the desired select line by putting the proper address on PA2 through PA4. The processor toggles the select line twice to latch the shifted data into the desired register.

The display has its own interface bus lines, PA6 and PA7, which are display data and display clock, respectively. Display bus operation is similar to the control bus, except that there is no select line because the display is the only device on the bus.

9.1.18 Memory Dump Feature

The PRC1099A is equipped with a memory dump feature that allows the operator to quickly erase all frequencies and channel information stored in memory (channels 00 through 99). The ability to quickly erase memory is very useful to avoid compromising unit frequencies in the event of an enemy capture.

To erase the frequencies stored in memory, hold the **DIGIT** knob down while holding the **TUNE** knob up and then turn the radio on. The radio resets all programmed frequencies to 2.000 MHz.

9.1.19 BITE Description

BITE is a series of built-in tests that enable the radio operator to test various sections of the PRC1099A radio. The BITE software is capable of performing tests on the following sections of the radio:

- Battery
- Antenna
- LCD display
- Processor RAM
- Receiver
- Transmitter
- Antenna tuner

The following sections describe the operation of the BITE program. They provide an overview of the BITE program, describe each test step in detail, include pass or fail indications, and areas of required operator interaction.

Operation

Before starting BITE, configure the radio as follows:

1. Install the whip antenna (or adapter, when using a long wire antenna).
2. Connect a handset to one of the audio connectors.
3. Set the Mode knob to **USB**.
4. Turn the **Vol** knob to **5**.
5. Initiate the BITE tests are by selecting **BITE TST** from the **OPT** menu.
6. Start the BITE test sequence by pressing the **Whip Tune** button.

BITE ON is displayed on the front panel LCD. The BITE program begins stepping through each test routine and stops if a failure occurs (except with tests requiring operator interaction).

A failure results in the display of an error message.

CAUTION: Do not press PTT when performing BITE tests.

BITE Test Descriptions

The following table provides the sequence of tests performed by BITE.

Test	Description
Battery	Reads the battery voltage using the analog converter system. If the battery voltage is below the minimum level of 11V, **BAT LOW** is displayed and BITE stops. If the battery voltage is above 15V, **BAT HIGH** is displayed and BITE stops. Otherwise, **BAT PASS** is displayed and BITE proceeds to next test.
Whip Antenna	Tests the antenna whip switch and verifies that a whip antenna or antenna adapter is installed (required for transmitter tests). If an antenna is not installed, BITE fails, stops, and **ANT FAIL** is displayed. Otherwise, **ANT PASS** is displayed and BITE proceeds to next test.
LCD Display	Tests the LCD display and verifies that each digit, segment, and icon functions properly. BITE tests each digit/segment by performing a walking digit test in which the entire 14 digit segment is displayed on the left and then shifted over one digit to the right, through all eight digit positions. A second test exercises the colons of the display by shifting a colon. A third test shifts the icons. This test requires the operator to determine test pass/fail. When test is completed, **DIS PASS** is displayed and BITE proceeds to next test.
Processor RAM	Performs a non-destructive memory test on static RAM chips U4 and U5 that writes and reads selected test bit patterns to insure integrity of battery backup RAM. Upon any read/write cycle failure, **RAM FAIL** is displayed and BITE stops. If no memory test error is detected, **RAM PASS** is displayed and BITE proceeds to next test.
USB Receiver	Tests the receiver circuitry of radio in upper sideband mode. During this test, an audible tone is heard for at least 2 seconds in the handset. If BITE does not detect the tone, **USB FAIL** is displayed and BITE stops. Otherwise, USB PASS is displayed and BITE proceeds to next test.

<table>
<tr><th>Test</th><th>Description</th></tr>
<tr><td>LSB Receiver</td><td>Tests the receiver circuitry in lower sideband mode. An audible tone is heard for at least two seconds in the handset. If BITE does not detect the tone, LSB FAIL displays and BITE stops. Otherwise, LSB PASS is displayed and BITE proceeds to next step.</td></tr>
<tr><td>Transmitter</td><td>Exercises the transmitter functions. It begins by tuning the Synthesizer to one of six test frequencies in USB mode (see table below). It sets the radio to low power and attempts to tune the antenna to the current test frequency. An audible test tone is generated through the handset for two seconds and verified by the operator. If radio passes, BITE switches the transmitter to high power for two seconds (if the resulting antenna tune setting includes L8, L9, or L10, transmitter stays in low power).
Operator verifies the test tone is audible. If the antenna tuning fails to tune during transmitter test sequence, BITE displays XXX FAIL (XXX = current test frequency). If the test tone is not present or fades during the low/high power sections of any transmitter tests, the current test is failed by the operator.
<table>
<tr><td>29.9 Test</td><td>29.9000 MHz</td></tr>
<tr><td>19.9 Test</td><td>19.9000 MHz</td></tr>
<tr><td>12.9 Test</td><td>12.9000 MHz</td></tr>
<tr><td>7.9 Test</td><td>7.9000 MHz</td></tr>
<tr><td>4.9 Test</td><td>4.9000 MHz</td></tr>
<tr><td>2.9 Test</td><td>2.9000 MHz</td></tr>
</table>
</td></tr>
</table>

9.1.20 Specifications

Note: These specifications are subject to change without notice or obligation.

Table 9-1 Processor Board Specifications

Characteristic	Specification
Current Drain	Static: 20 mA typical at 5V Operating: 40 mA typical at 5V Lithium Cell: 2 μA typical at 2.5V
Lithium Cell Life	5 years minimum, 10 years typical

9.2 Connector Pin Assignments

The Processor board has the following interconnects with the Audio/Filter and Display boards.

9.2.1 J1 Connector

J1 connects to J1 on the Audio/Filter board.

Table 9-2 J1 Connector Pin Assignments

Pin	Signal	Description
1	AGC	Automatic gain control from the 1650 kHz IF board.
2	ALC	Automatic level control from the Audio/Filter board.
3	LOPWR	Low power line from the front panel Power switch (S7).
4	GND	Ground.
5	GND	Ground.
6	COMP	Comparator output from the Antenna Tuner board.
7	ENM5	Strobe line to the Antenna Tuner board.
8	ENM6A	Enables latch clock for shift register on the Synthesizer board.
9	ENM6B	Enables address decoder on the Synthesizer board.
10	ENM6C	Enable line to Synthesizer board (open connection on Synthesizer board).

9.2.2 J2 Connector

J2 connects to the Audio/Filter board J2 connector.

Table 9-3 J2 Connector Pin Assignments

Pin	Signal	Description
1, 2	+5	+5 VDC supply voltage from the Junction board through Audio/Filter board.
3	+12	+12 VDC supply voltage from the Junction board through Audio/Filter board.
4	T8	Transmit 8 VDC supply voltage from the Audio/Filter board (only available in transmit mode).

Table 9-3 J2 Connector Pin Assignments (continued)

Pin	Signal	Description
5	R8	Receive 8 VDC supply voltage from the Audio/Filter board (only available in receive mode)
6	+8	+8 VDC supply voltage from the Junction board through the Audio/Filter board.
7	PTT	+13.6 VDC in receive mode; 0 VDC in transmit mode to Audio/Filter board.
8	DATA	SPI data line to Audio/Filter, Synthesizer, and Antenna Tuner boards.
9	CLOCK	SPI clock line to Audio/Filter, Synthesizer, and Antenna Tuner boards.
10	BITE	Phase detector output from Synthesizer board.

9.2.3 J3 Connector

J3 connects to the Audio/Filter board J3 connector

Table 9-4 J3 Connector Pin Assignments

Pin	Signal	Description
1	TX AUDIO	FSK modulated ALE transmit tones to the Audio/Filter board for an ALE call.
2	SPARE1	No connection on the Display board.
3	RX AUDIO	Receive audio from the Audio/Filter board to FSK modem U20 for an ALE call.
4	SPARE2	No connection on the Display board.
5	CWKEY	CW tone (in transmit mode) from front panel Audio connector to the Audio/Filter board.
6	CONTRAST	LCD display contrast control from the Audio/Filter board.
7	MUTE	Mute control signal to the Audio/Filter board.
8	ENM1	Strobe line to shift registers U7 and U9 on the Audio/Filter board.
9	VOICEDET	Voice detect line from squelch circuit on the Audio/Filter board.
10	RF DET	No connection.

9.2.4 J4 Connector

J4 connects to the optional ALE board J1 connector.

Table 9-5 J4 Connector Pin Assignments

Pin	Signal	Description
1, 2	+5	+5 VDC from the Junction board.
3, 4	GND	Digital ground.
5, 6	GND	Analog ground.
7	ALERST	ALE reset to the ALE board.
8 to 14	NC	No connection.
15	KEYLINE	PTT input from on the ALE board.
16	ALEPTT	ALE PTT output to the ALE board.
17	SCRXD	ALE serial data receive from the ALE board.
18	SCTXD	ALE serial data transmit to the ALE board.
19	ALERXA	Receive audio from the Audio/Filter board to the ALE board.
20	ALETXA	FSK modulated ALE transmit audio to the ALE board.

9.2.5 J5 Connector

J5 connects to the Display J1 connector.

Table 9-6 J5 Connector Pin Assignments

Pin	Signal	Description
1	OPTSW	Option switch line from front panel Mode switch (S6). Activates the AME option on the Mixer board.
2	LITE	Enables LCD backlight from front panel Mode switch (S6) in the **LITE** position.
3	LSBSW	Selects lower sideband from front panel Mode switch (S6).
4	+5	5 VDC supply voltage to the Display board.
5	SLEWDN	**TUNE** switch (S5) down position.
6	SLEWUP	**TUNE** switch (S5) up position.
7	SQUELCH	Enables squelch function from front panel Mode switch (S6).
8	DISDATA	Display data line to Display board driver.
9	DISCLK	Display clock line to Display board driver.

Table 9-6 J5 Connector Pin Assignments (continued)

Pin	Signal	Description
10	+12	12 VDC supply voltage for the LCD backlight.
11	SPARE1	Open connection on Audio/Filter board.
12	SPARE3	No connection.
13	SPARE2	Open connection on Audio/Filter board.
14	GND	Ground.
15	CWKEY	CW Key line from both front panel Audio connectors.
16	PTT	PTT from front panel Audio connectors and Accessory connector.
17	CONTRAST	Contrast control from the Audio/Filter board. Sets contrast of LCD display to display driver U1.
18	EXTSEL	External amplifier RA100 filter select line.
19	DIGDN	Digital knob down position line.
20	TUNEINIT	Initiates tune cycle to RAT7000B antenna tuner through front panel Accessory connector pin D.
21	ANTSW	From internal antenna switch in the Whip Antenna connector.
22	CHSET/TUNE	From the front panel Whip tune button.
23	HANDSET	Not used.
24	ALC	ALC line to a RA100 external RF amplifier through the front panel Accessory connector pin N. ALC signal from the RA100 ALC activates PRC1099A ALC circuitry.
25	DIGUP	From front panel DIGIT switch (S4) up position.
26	AMPPTT	PTT output to RA100 external amplifier.
27	RS232TXD	Serial data line to external RA100 amplifier or RAT7000B antenna tune. Also serial TX line for remote control terminal.
28	RS232RXD	Serial clock line to external RA100 amplifier or RAT7000B antenna tuner. Also serial RX line for remote control terminal.
29	EXTAMP	From the front panel Power switch (S7) **EXT AMP** position. Sets to radio to low RF output power (5W) for use with external amplifier RA100.

Table 9-6 J5 Connector Pin Assignments (continued)

Pin	Signal	Description
30	LOWPWR	From the front panel Power switch (S7) **LO** power position. Sets to radio to low RF output power (5W).
31	CHSWA	From front panel **CHANNEL** switch (S1) for the A-bit in 4-bit BCD code for channel selection.
32	CHSWB	From front panel **CHANNEL** switch (S1) for the B-bit in 4-bit BCD code for channel selection.
33	CHSWC	From front panel **CHANNEL** switch (S1) for the C-bit in 4-bit BCD code for channel selection.
34	CHSWD	From front panel **CHANNEL** switch (S1) for the D-bit in 4-bit BCD code for channel selection.

9.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Processor board.

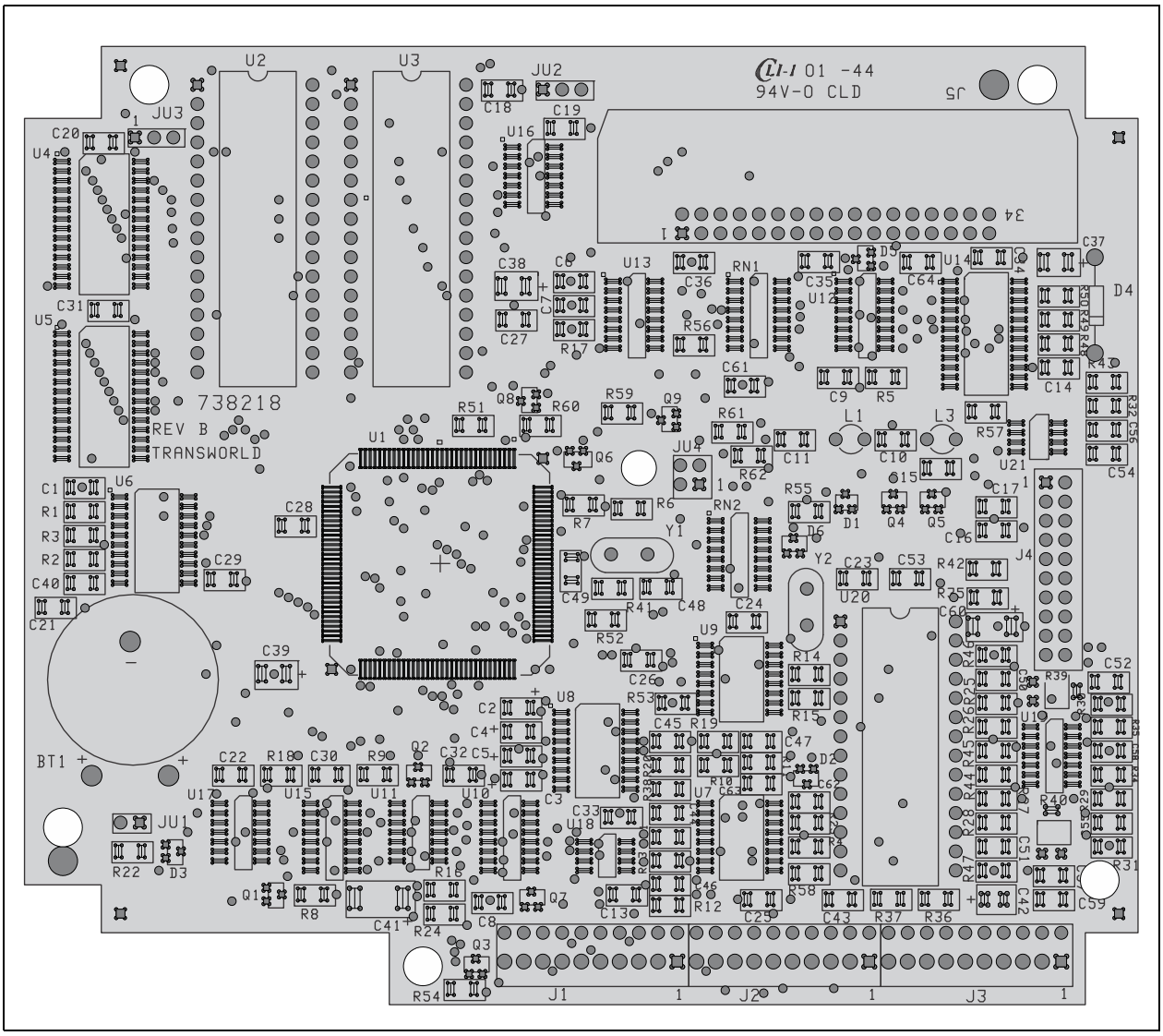

Figure 9-2 Processor Board Component Locations (738218 Rev. B)

REV	ECN	DESCRIPTION	DATE	APPR
J	ECO 04-0131	SEE ECO	BB 05-06-04	
K	09-0131	ADD R63, R64	BB 06-09-09	
L	11-0378	ADD C65	LN 8-2-11	
M	ECO 13-0116	CHANGE C65 TO 100P	KL 04-25-13	

REV	DESCRIPTION	DATE	APPR
B	PRC1099-303	CHG R27 TO 22K	11-17-92
C	PRC1099-303	ADD C67, C63	04-16-93
D	PRC1099-310	SEE ECN	07-19-93
E	PRC1099-344	SEE ECN	09-19-94
F	PRC1099-334	DEL R18	09-26-94
G	ECO 00-0387	ADDED U14 MODULE	BB 11-26-03
H	ECO 00-0063	ADDED ZENER	BB 03-26-04

Figure 9-3
Processor Board
Schematic Diagram
(994183 Rev. M)

9-15

PRC1099A-MS

3	FOR 009-10702 Y1 FREQ IS 4.9152 MHz, FOR 009-00702 Y1 FREQ IS 4.0000 MHz
8	JUMPER INTALLED FROM PAD ON U12-9 TO E-PAD ON CHIP CARRIER
7	JUMPER A NORMALLY INSTALLED.
6	JUMPER A NORMALLY INSTALLED.
5	INSTALL FOR 1099TA/TC OPTION ONLY.

4 INDUCTANCE IS IN MICROHENRYS.
3 DIODES ARE 1N4148.
2 CAPACITANCE IS IN MICROFARADS.
1 RESISTANCE IS IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED

DATRON
Datron World Communications, Inc.
3055 Enterprise Court TEL (760) 597-1500
Vista, CA 92081 FAX (760) 597-1510

TITLE: SCHEMATIC,
PRC1099-M7 PROCESSOR

SIZE	FSCM NO.	DWG. NO.	REV
D	66943	994183	M

SCALE: NONE | FILENAME: 994183M.SchDoc | HALVERSON 03-12-97 | SHEET 1 OF 1

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
BT1	750057	“BATT, CR2450, 0.54AH, 3V, LI, 3-TAB COIN”
C1	020101	“CAP,100PF 100V 5% NP0 1206”
C10	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C11	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C13	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C14	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C15	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C16	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”
C17	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C18	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C19	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C2	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C20	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C21	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C22	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C23	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C24	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C25	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C26	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C27	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C28	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C29	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C3	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C30	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C31	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C32	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C33	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C34	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C35	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C36	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C37	022225000	“CAP, 2.2UF TA 20V 10% 3528-21”

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
C38	022225000	“CAP, 2.2UF TA 20V 10% 3528-21”
C39	022225000	“CAP, 2.2UF TA 20V 10% 3528-21”
C4	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C40	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C41	023470	“CAP, 47UF TA 10V 10% 7343-31”
C42	022010	“CAP, 1UF TA 16V 10% 1206”
C43	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C44	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C45	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C46	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C47	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C48	020270	“CAP, 27PF NP0 50V 5% 1206”
C49	020270	“CAP, 27PF NP0 50V 5% 1206”
C5	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C50	020101	“CAP,100PF 100V 5% NP0 1206”
C51	020101	“CAP,100PF 100V 5% NP0 1206”
C52	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C53	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C54	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”
C55	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”
C56	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C57	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C58	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C59	022010	“CAP, 1UF TA 16V 10% 1206”
C6	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C60	022106001	“CAP,10UF,TA,16V,10%,6032-28”
C61	021103	“CAP, 0.01UF, X7R, 50V, 10%, 1206”
C62	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C63	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C64	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C7	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”
C8	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
C9	021102	“CAP, 1000PF, X7R, 50V, 10%, 1206”
D1	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D2	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D3	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D4	320433	“DIODE, 1N6373 ZNR TVS 6V 1500W”
D5	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D6	037700005	“DIODE,BAS16,75V,0.2A,SOT-23”
D7	320422	“DIODE,1N4689 5.1V ZENER LOCUR”
J1	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J2	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J3	614027	“CONN,10 POS BOTTOM ENTRY MOLX”
J4	620028	“HEADER,20 PIN 0.025 SQ FEMALE”
J5	620027	“HEADER, 17X2 MLX 0.1 RT BOXED”
JU1	650048	“HEADER, PIN 1X2 MLX 0.1 TH”
JU2	620167	“HEADER, 3 PIN”
JU3	620167	“HEADER, 3 PIN”
JU4	620025	“HEADER, 2X2 MLX 0.1 VERT”
L1	459032	“IND ASY,3T#30 MAGNET 1-490201”
L3	459032	“IND ASY,3T#30 MAGNET 1-490201”
Q1	032004	“XSTR,MMBT2222A NPN SOT23”
Q2	032004	“XSTR,MMBT2222A NPN SOT23”
Q3	032004	“XSTR,MMBT2222A NPN SOT23”
Q4	032004	“XSTR,MMBT2222A NPN SOT23”
Q5	032004	“XSTR,MMBT2222A NPN SOT23”
Q6	032004	“XSTR,MMBT2222A NPN SOT23”
Q7	032004	“XSTR,MMBT2222A NPN SOT23”
Q8	032004	“XSTR,MMBT2222A NPN SOT23”
Q9	032004	“XSTR,MMBT2222A NPN SOT23”
R1	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R10	013104	“RES,100K OHM 1/4W 5% TK 1206”
R11	013473	“RES, 47K OHM 1/4W 5% TK 1206”
R12	013104	“RES,100K OHM 1/4W 5% TK 1206”

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
R13	013473	“RES, 47K OHM 1/4W 5% TK 1206”
R14	013124	“RES,120K OHM 1/4W 5% TK 1206”
R15	013473	“RES, 47K OHM 1/4W 5% TK 1206”
R16	013472	“RES, 4.7K OHM, 1/4W, 5%, TK, 1206”
R17	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R19	013104	“RES,100K OHM 1/4W 5% TK 1206”
R2	013222	“RES, 2.2K OHM, 1/4W, 5%, TK, 1206”
R20	013473	“RES, 47K OHM 1/4W 5% TK 1206”
R21	013473	“RES, 47K OHM 1/4W 5% TK 1206”
R22	013470	“RES,47 OHM 1/4W 5% TK 1206”
R23	013391	“RES,390 OHM 1/8W 5% SMT 1206”
R24	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R25	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R26	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R27	013223	“RES, 22K OHM, 1/4W, 5%, TK, 1206”
R28	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R29	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R3	013222	“RES, 2.2K OHM, 1/4W, 5%, TK, 1206”
R30	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R31	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R32	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R33	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R34	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R35	013513	“RES, 51K OHM 1/4W 5% TK 1206”
R36	013513	“RES, 51K OHM 1/4W 5% TK 1206”
R37	013333	“RES,33K 1/8W 5% SMT 1206”
R38	013104	“RES,100K OHM 1/4W 5% TK 1206”
R39	017003	“TRIMMER, 10K OHM, 1/4W, VERT, 1-T, 4MM”
R4	013472	“RES, 4.7K OHM, 1/4W, 5%, TK, 1206”
R40	017003	“TRIMMER, 10K OHM, 1/4W, VERT, 1-T, 4MM”
R41	013684	“RES,680K 1/8W 5% SMT 1206”
R42	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
R43	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R44	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R45	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R46	013621	“RES, 620 OHM 1/4W 5% TK 1206”
R47	013621	“RES, 620 OHM 1/4W 5% TK 1206”
R48	013104	“RES,100K OHM 1/4W 5% TK 1206”
R49	013104	“RES,100K OHM 1/4W 5% TK 1206”
R5	013104	“RES,100K OHM 1/4W 5% TK 1206”
R50	013104	“RES,100K OHM 1/4W 5% TK 1206”
R51	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R52	013472	“RES, 4.7K OHM, 1/4W, 5%, TK, 1206”
R53	013472	“RES, 4.7K OHM, 1/4W, 5%, TK, 1206”
R54	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R55	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R56	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R57	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R58	001001	“RES, 1K OHM, 1/4W, 1%, TK, 1206”
R59	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R6	013223	“RES, 22K OHM, 1/4W, 5%, TK, 1206”
R60	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R61	013104	“RES,100K OHM 1/4W 5% TK 1206”
R62	013105	“RES,1M OHM 1/4W 5% TK 1206”
R7	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R8	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
R9	013103	“RES, 10K OHM, 1/4W, 5%, TK, 1206”
RN1	018003	“RNET, 100K X 15 BUSS 5% TK SOIC16”
RN2	018002	“RNET, 10K OHM X 15 BUSSED SOIC16”
U1	033080	“IC,MC68302EH UPC 16MHZ PQFP132”
U10	033039	“IC,74HC138 1-8 DEC/DEMUX,SO-16”
U11	033035	“IC,74HCT14 HEX SCH TRIG SO-14”
U13	033013	“IC, MC14528BD DUAL M-VIB S016”
U15	033007	“IC,74HC595 8-BIT SIPO SOIC-16”

Table 9-7 Processor Board Parts List (009-10702 Rev. W)

Designator	Part Number	Description
U16	033077	“IC, 74HCT32 QUAD 2-I OR SOIC14”
U17	033076	“IC, 74HCT04 HEX INVERTER SO14”
U18	033030	“IC,93C46 SER EEPROM 1K SOIC-8”
U19	033024	“IC, MC33079D, SM, SO-14”
U21	033084	“XSTR,SI9405DY PWR P-FET SO-8”
U4	033078	“IC,SRAM MS6264 8KX8 SOP-28”
U5	033078	“IC,SRAM MS6264 8KX8 SOP-28”
U6	033032	“IC, ADC0804 8-BIT A/DC SOW-20”
U7	033046	“IC,74HC4051 ANLG MUX/DEM SOW16”
U8	033305005	“IC, MAX242EWN RS232 XCVR SO-18”
U9	033019	“IC, MAX695, SM, SOW-16”
XJU1	621105	“MICRO SHUNT, 0.10 IN 1.5A SN”
XJU2	621105	“MICRO SHUNT, 0.10 IN 1.5A SN”
XJU3	621105	“MICRO SHUNT, 0.10 IN 1.5A SN”
XJU4B	621105	“MICRO SHUNT, 0.10 IN 1.5A SN”
XU2	621021	“SOCKET, IC DIP-32 SCREW”
XU20	621009	“SOCKET,28 PIN DIP”
XU3	621021	“SOCKET, IC DIP-32 SCREW”
Y1	361108	“XTAL,4.9152 MHZ HC49/US CASE”
Y2	361081	“CRYSTAL,3.579545 MHZ”

Chapter 10: Display Board

10.1 Circuit Description

The Display board includes the LCD, the display driver, and the backlight generator. It also acts as a connection point connecting the Processor board to the front panel switches as well as the Accessory and Audio connectors.

10.1.1 Display

The custom LCD display provides eight, 14-segment alphanumeric characters as well as 12 custom icons. The display also has up/down and left/right indicators for menu navigation. The display is driven by PCF8576 CMOS LCD driver U1, capable of driving up to 40 segments with four backplanes. The display driver has an internal clock running at 189 kHz as determined by R1. The data is delivered to the display driver to and from the processor through the DISDATA line with the clock delivered on the DISCLOCK line. The display contrast control is provided through the CONTRAST line from the Audio/Filter board.

10.1.2 Backlight Generator

The LCD is backlit by an electroluminescent display on the backplane. The signal that drives the backplane is generated from display driver U1 internal clock signal. This 189 kHz clock signal is divided by 256 by counter/divider U3, to give approximately 738 Hz to drive the backplane.

The backplane is energized when the NPN bipolar transistor Q2 emitter is grounded through Q1, saturating the transistor. The LITE signal from the processor transitions high, turning on Q1 which pulls the Q2 emitter to ground. The FPLITE line from the front panel **Mode** switch can also pull the Q2 emitter to ground when **LITE** is selected. It is grounded through the **Mode** switch center conductor.

Once Q2 is turned on, the square wave signal from U3 is applied to step-up auto transformer T1. The output of T1 is approximately 150 Vpp, and is used to power the backlight.

CAUTION: Do not switch on the backlight while working on the display.

10.1.3 Jumpers

The Display board includes three jumpers: LK1, LK2, and LK3. Jumper LK1 is normally installed; the other jumpers are no longer used.

10.2 Connector Pin Assignments

The Display board has the following interconnections with the transceiver.

10.2.1 J1 Connector

J1 connects to the Processor board J5 connector.

Table 10-1 J1 Connector Pin Assignments

Pin	Signal	Description
1	OPTSW	Option switch line from front panel **MODE** switch (S6) to activate the AME option on the Mixer board; connects to J4 pin 1.
2	LITE	Turns on Q1, that turns on Q2 to enable LCD backlight from front panel **MODE** switch (S6) in the **LITE** position.
3	LSBSW	Selects lower sideband from front panel **MODE** switch (S6); connects to J4 pin 2.
4	+5V	5 VDC supply voltage from the Processor board.
5	SLEWDN	**TUNE** switch (S5) down position; connects to J4 pin 3.
6	SLEWUP	**TUNE** switch (S5) up position; connects to J4 pin 4.
7	SQUELCH	Enables squelch function from front panel **MODE** switch (S6); connects to J4 pin 5.
8	DISDATA	Display data line to Display board driver from Processor board.
9	DISCLOCK	Display clock line to Display board driver from Processor board.
10	+12V	12 VDC supply voltage for the LCD backlight.
11	SPARE1	Connects to J4 pin 6 (open connection).
12	SPARE3	No connection.
13	SPARE2	Connects to J4 pin 7 (open connection).

Table 10-1 J1 Connector Pin Assignments (continued)

Pin	Signal	Description
14	GND	Ground.
15	CWKEY	CW Key line from both front panel Audio connectors; connects to J4 pin 8.
16	PTT	PTT from front panel Audio connectors and Accessory connector; connects to J4 pin 9
17	CONTRAST	Contrast control from the Audio/Filter board, sets contrast of LCD display to display driver U1.
18	EXTSEL	External amplifier RA100 filter select line; connects to J3 pin 4.
19	DIGDN	Digital knob down position line; connects to J3 pin 5.
20	TUNEINIT	Initiates tune cycle to RAT7000B antenna tuner through front panel Accessory connector pin D; connects to J3 pin 6.
21	ANTSW	From internal antenna switch in the Whip Antenna connector; connects to J3 pin 7.
22	CHSET/TUNE	From the front panel Whip tune button; connects to J3 pin 8.
23	HANDSET	Not used; connects to J3 pin 9.
24	ALC	ALC line to a RA100 external RF amplifier through the front panel Accessory connector pin N. ALC signal from the RA100 ALC activates PRC1099A ALC circuitry; connects to J3 pin 10.
25	DIGUP	From front panel DIGIT switch (S4) up position; connects to J2 pin 1.
26	AMPPTT	PTT to RA100 external amplifier; connects to J2 pin 2.
27	RS232TXD	Serial data line to external RA100 amplifier or RAT7000B antenna tune. Also serial TX line for remote control terminal; connects to J2 pin 3.
28	RS232RXD	Serial clock line to external RA100 amplifier or RAT7000B antenna tuner. Also serial RX line for remote control terminal; connects to J2 pin 4.
29	EXTAMP	From the front panel **POWER** switch (S7) **LO** power position. Sets to radio to low RF output power (5W) for use with external amplifier RA100; connects to J2 pin 5.

Table 10-1 J1 Connector Pin Assignments (continued)

Pin	Signal	Description
30	LOWPWR	From the front panel **POWER** switch (S7) **LO** power position. Sets to radio to low RF output power (5W); connects to J2 pin 6.
31	CHSWA	From front panel **CHANNEL** switch (S1) for the A-bit in 4-bit BCD code for channel selection; connects to J2 pin 7.
32	CHSWB	From front panel **CHANNEL** switch (S1) for the B-bit in 4-bit BCD code for channel selection; connects to J2 pin 8.
33	CHSWD	From front panel **CHANNEL** switch (S1) for the C-bit in 4-bit BCD code for channel selection; connects to J2 pin 9.
34	CHSWC	From front panel **CHANNEL** switch (S1) for the D-bit in 4-bit BCD code for channel selection; connects to J2 pin 10.

10.2.2 J2 Connector

J2 connects to the front panel Accessory connector, the front panel Channel rotary switch, and the front panel Power switch. None of the pin assignments have onboard connections.

Table 10-2 J2 Connector Pin Assignments

Pin	Signal	Description
1	DIGUP	Connects J1 pin 25 to ground when the front panel **DIGIT** switch is pushed to the down to select menus or alphanumeric digits. Moves the highlight left on the LCD.
2	AMPPTT	Connects J1 pin 26 to the RA100 external power amplifier through the front panel Accessory connector pin B to activate PTT relays in the RA100.
3	RS232TXD	Connects J1 pin 27 to front panel Accessory connector pin H for serial data line with RA100 external amplifier and RAT7000B antenna tuner. Also used for remote control communications.
4	RS232RXD	Connects J1 pin 28 to front panel Accessory connector pin K for serial clock line with RA100 external amplifier and RAT7000B antenna tuner. Also used for remote control communications.

Table 10-2 J2 Connector Pin Assignments (continued)

Pin	Signal	Description
5	EXTAMP	Connects J1 pin 30 to ground through the front panel **POWER** switch (S7) **LO** power position. Sets to radio to low RF output power (5W) for use with external amplifier RA100.
6	LOPWR	Connects J1 pin 30 to ground through the front panel **POWER** switch (S7) **LO** power position. Sets to radio to low RF output power (5W).
7	CHSWA	Connects J1 pin 31 to front panel **CHANNEL** switch (S1) for the A-bit in 4-bit BCD code for channel selection.
8	CHSWB	Connects J1 pin 32 to front panel **CHANNEL** switch (S1) for the B-bit in 4-bit BCD code for channel selection.
9	CHSWC	Connects J1 pin 33 to front panel **CHANNEL** switch (S1) for the C-bit in 4-bit BCD code for channel selection.
10	CHSWD	Connects J1 pin 34 to front panel **CHANNEL** switch (S1) for the D -bit in 4-bit BCD code for channel selection.

10.2.3 J3 Connector

J3 connects to the front panel Accessory connector, Audio connector, Channel tune switch. None of the pin assignments have onboard connections.

Table 10-3 J3 Connect Pin Assignments

Pin	Signal	Description
1	GND	Ground.
2	BC IN	Not used.
3	OPTION PIN	Not used.
4	EXTSEL	Connects J1 pin 18 to the RA100 external RF amplifier through front panel Accessory connector pin M to select the appropriate filter.
5	DIGDN	Connects J1 pin 19 to ground when the front panel **DIGIT** switch is pushed to the down to select menus or alphanumeric digits. Moves the highlight left on the LCD.
6	TUNEINIT	Connects to J1 pin 20 to a RAT7000B antenna tuner through front panel Accessory connector pin D to initiate a tune cycle.

Table 10-3 J3 Connect Pin Assignments (continued)

Pin	Signal	Description
7	ANTSW	Connects J1 pin 21 to ground when an antenna is installed in the Whip antenna connector.
8	CHSET/TUNE	Connects J1 pin 22 to ground when the front panel **WHIP TUNE** button is pressed to initiate a tune cycle and save tune data for the selected antenna tuner.
9	HANDSET	Not used; connects J1 pin 23 and J3 pin 3 through jumper LK1.
10	AMPALC	Connects J1 pin 24 to a RA100 external RF amplifier through the front panel Accessory connector pin N. ALC signal from the RA100 ALC to activate PRC1099A ALC circuitry.

10.2.4 J4 Connector

J4 connects to front panel Power, Mode, and Tune switches, and CW Key and PTT lines on the Audio and Accessory connectors.

Table 10-4 J4 Connect Pin Assignments

Pin	Signal	Description
1	OPTSW	Connects J1 pin 1 to ground through the front panel **MODE** switch **OPT** position.
2	LSBSW	Connects J1 pin 3 to ground when the front panel **MODE** switch is set to the **LSB** position to select lower side band mode.
3	SLEWDN	Connects J1 pin 5 to ground through the front panel **TUNE** switch is pushed to the down position to move down through selections and settings within menus on the LCD.
4	SLEWUP	Connects J1 pin 6 to ground when the front panel **TUNE** switch is pushed to the up position to move up through selections and settings within menus on the LCD.
5	SQUELCH	Connects J1 pin 7 to ground when the front panel **MODE** switch is set to the **SQUELCH** position to disable squelch.
6	SPARE1	Connects J1 pin 11 to open connection.
7	SPARE2	Connects J1 pin 13 to open connection.

Table 10-4 J4 Connect Pin Assignments (continued)

Pin	Signal	Description
8	CWKEY	Connects a CW key device connected to either front panel Audio connector pin E to J1 pin 15 to ground to activate CW tone oscillator on the Audio/Filter board.
9	PTT	Connects a handset or headset PTT connected to the front panel Accessory connector pin C or to either Audio connector pin C to J1 pin 16 to activate PTT for transmitting.
10	FPLITE	Connects onboard Q1 emitter to ground through the front panel **MODE** switch **LITE** position to energize LCD backlight.

10.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Display board.

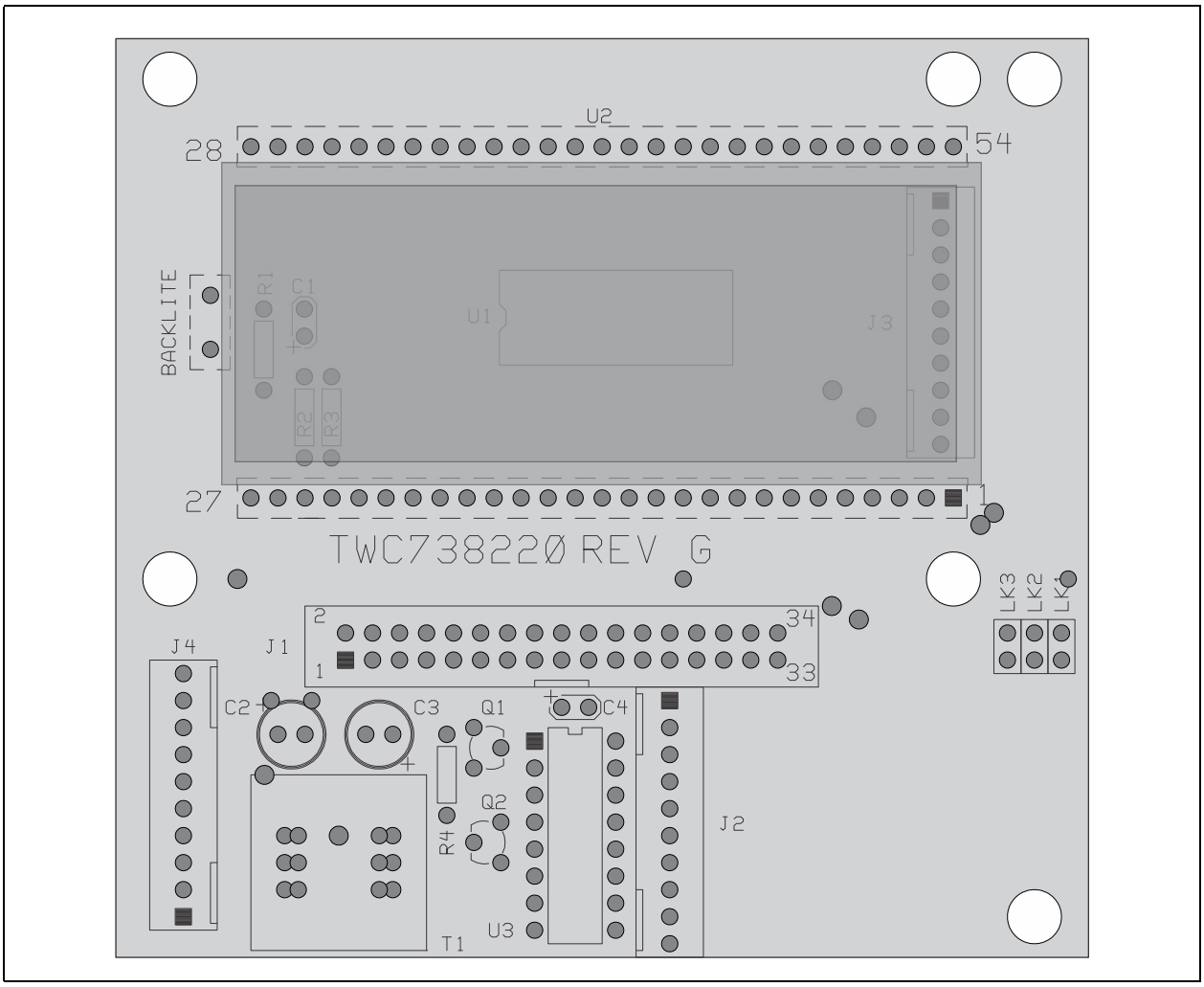

Figure 10-1 Display Board Component Location Diagram (738220 Rev. G)

REV	ECN	DESCRIPTION	DATE	APPR
A	PRC1099-287	RELEASE	9-21-92	
B	10-0539	SEE ECN	10-20-10	

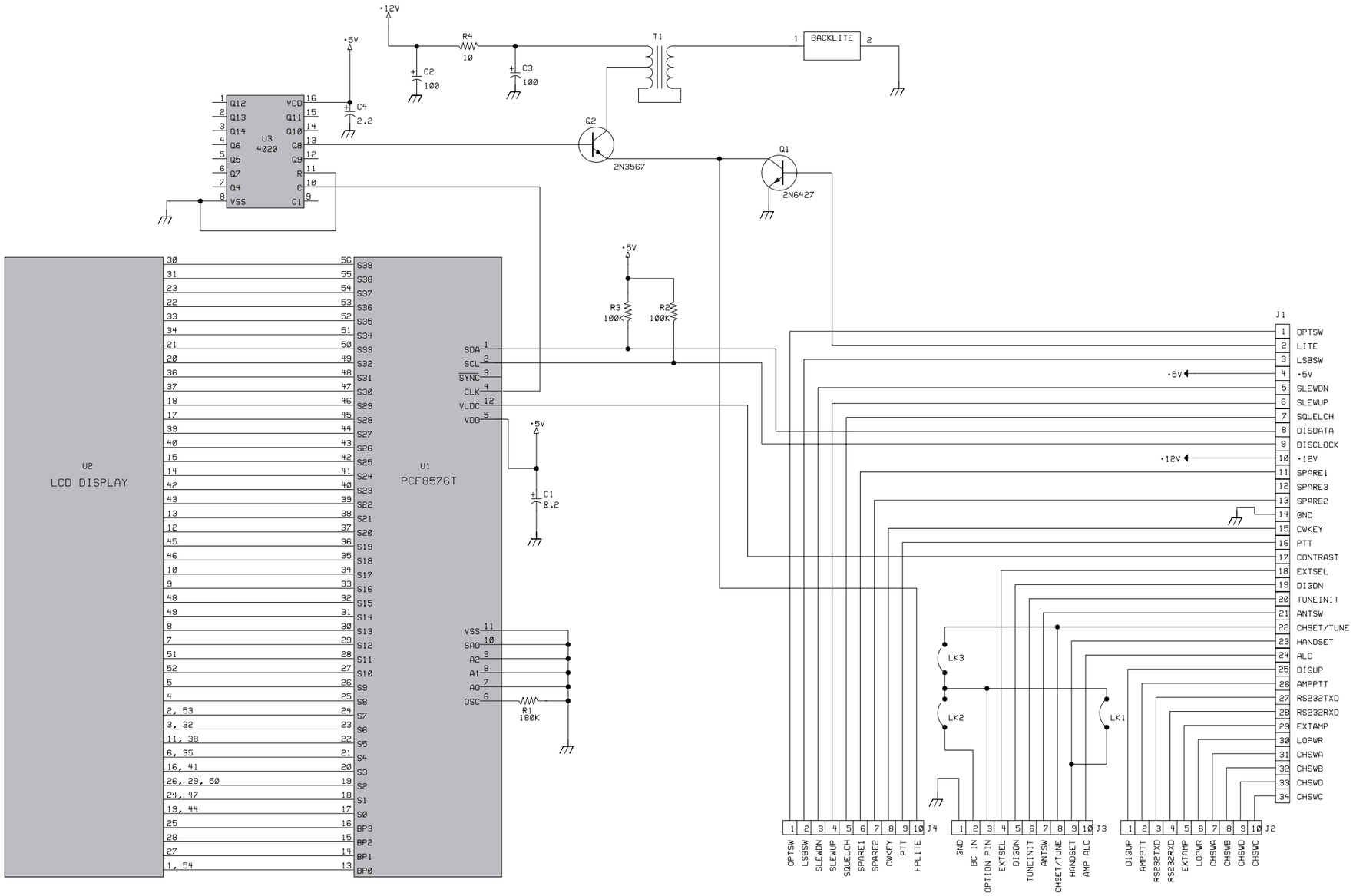

Figure 10-2
Display Board
Schematic Diagram
(994165 Rev. B)

7 FOR REMOTE TUNE OPTION, REMOVE LK1 AND INSTALL LK3
6 FOR BC OPTION, REMOVE LK1 AND INSTALL LK2
5 LK1 NORMALLY INSTALLED
4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTE8: UNLESS OTHERWISE SPECIFIED

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Title: Schematic	PRC1099 - ALE M8 DISPLAY			
Size: C	Drawn: HALVERSON	Date: April 92	Drawing Number: 994165	Rev: B
	Appr:	Date:		
Scale: NONE			Sheet: 1 of 1	

Table 10-5 Display Board Parts List (009-10801 Rev. L)

Designator	Part Number	Description
C1	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C2	237101	“CAP, 100UF AL 16V 20% 6.3X7X2.5LS”
C3	237101	“CAP, 100UF AL 16V 20% 6.3X7X2.5LS”
C4	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
J2	610208	“HEADER,1X10 MLX RA+SB LOCK 0.1”
J3	610208	“HEADER,1X10 MLX RA+SB LOCK 0.1”
J4	610208	“HEADER,1X10 MLX RA+SB LOCK 0.1”
LK1	620073	“HEADER, 2X3 MLX 0.1 STR”
LK2	620073	“HEADER, 2X3 MLX 0.1 STR”
LK3	620073	“HEADER, 2X3 MLX 0.1 STR”
Q1	310064	“XSTR,2N6427 NPN DARL TO-92”
Q2	310003	“XSTR, 2N3567 NPN 300MA TO92”
R1	113184	“RES, 180K OHM 1/8W 5% CF”
R2	113104	“RES,100K OHM 1/8W CF 5%”
R3	113104	“RES,100K OHM 1/8W CF 5%”
R4	113100	“RES,10 OHM 1/8W 5% FILM”
T1	410019	“XFMR, AUDIO MINI 600CT - 600CT”
U1	033083	“IC,PCF8576T DISPLAY DR SOT190”
U2	320806	“LCD,CUSTOM PRC1099”
U3	330209	“IC, 4020B 14-B BIN CNTR DIP16”
XU2	610223	“SOCKET STRIP,SIL,27 CONT,.100”
XU3	621004	“SOCKET, IC DIP-16 PIN”

Chapter 11: Junction Board

11.1 Circuit Description

The Junction board supplies DC power to the radio; it also acts as a junction point for board interconnects. The Junction board includes the +5 VDC and +8 VDC regulators as well as clamps for the R8 and T8 lines.

11.1.1 +5V Supply

The Junction board provides the +5V supply voltage that supplies power for the entire transceiver. DC to DC switching voltage converter U1 converts the +12V input voltage to +5 VDC. Resistor R1 limits the +5V supply to a maximum current of approximately 700 mA. The output of the converter is heavily filtered by L1, L4, C2 to C4, and C17 to reduce the voltage ripple of the converter to less than 20 mVpp. Trimmer resistor R4 sets the converter output which is measured at TP3. Poly resistor PF1 and diode D3 provide protection against voltage converter U1 failure.

11.1.2 +8V Supply

Regulator U2 converts the +12 VDC input voltage to provide the +8V supply. It includes an internal thermal overload protection that allows the output to short circuit without damaging the device. The output voltage is filtered by C6, C10, C13, and L5 to remove any residual ripple. Trimmer resistor R5 sets the +8 VDC output which is measured at TP2.

11.1.3 DC Clamps

The Junction board also includes the R8 and T8 DC clamps. These clamps, Q1 and Q2, are alternately energized by either R8 or T8.

In transmit mode, the T8 line energizes Q1, clamping the R8 line to ground; in receive mode, the R8 line energizes Q2, clamping the T8 line to ground.

Switching between T8 and R8 is instantaneous.

11.2 Connector Pin Assignments

The Junction board has the following interconnections with the transceiver.

11.2.1 J1 Connector

J1 connects to multiple boards including the Audio/IF board, Mixer board, Synthesizer board, Antenna Tuner board, 1650 kHz IF board, and the Power Amplifier board. It also connects to the front panel power switch (S7).

Pin	Signal	Description
1	BAT CHG OUT	Not used.
2	BAT CHG OUT	Not used.
3	BAT CHG IN	Not used.
4	BAT CHG IN	Not used.
5 to 7	AGC	Jumpered AGC lines.
8 to 12	T8	Interconnections for T8 line
13 to 16	R8	Interconnections for R8 line
17	+5V	+5 VDC supply voltage
20	+5V	+5 VDC supply voltage to Synthesizer only

11.2.2 J2 Connector

J2 connects to multiple boards including the Audio/IF board, Mixer board, Synthesizer board, Antenna Tuner board, and the Power Amplifier board.

Table 11-1 J3 Connector Pin Assignments

Pin	Signal	Description
1 to 5	+8V	+8 VDC supply voltage
6 to 12	+12V	+12 VDC supply voltage
13 to 20	GND	Interconnections for ground

11.2.3 J3 Connector

J3 connects to the front panel Power switch (S7) and the battery or DC power source.

Table 11-2 J3 Connector Pin Assignments

Pin	Signal	Description
1	GND	Ground to battery.
2	+12V	Switched +12 VDC supply voltage from front panel power switch.

Table 11-2 J3 Connector Pin Assignments (continued)

Pin	Signal	Description
3	+12V	+12 VDC battery voltage from external battery through the front panel Accessory connector.
4	BATTERY CHARGER	Not used.

11.3 Component Locations, Schematics, and Parts List

This section provides a component location diagram, schematic and parts list for the Junction board.

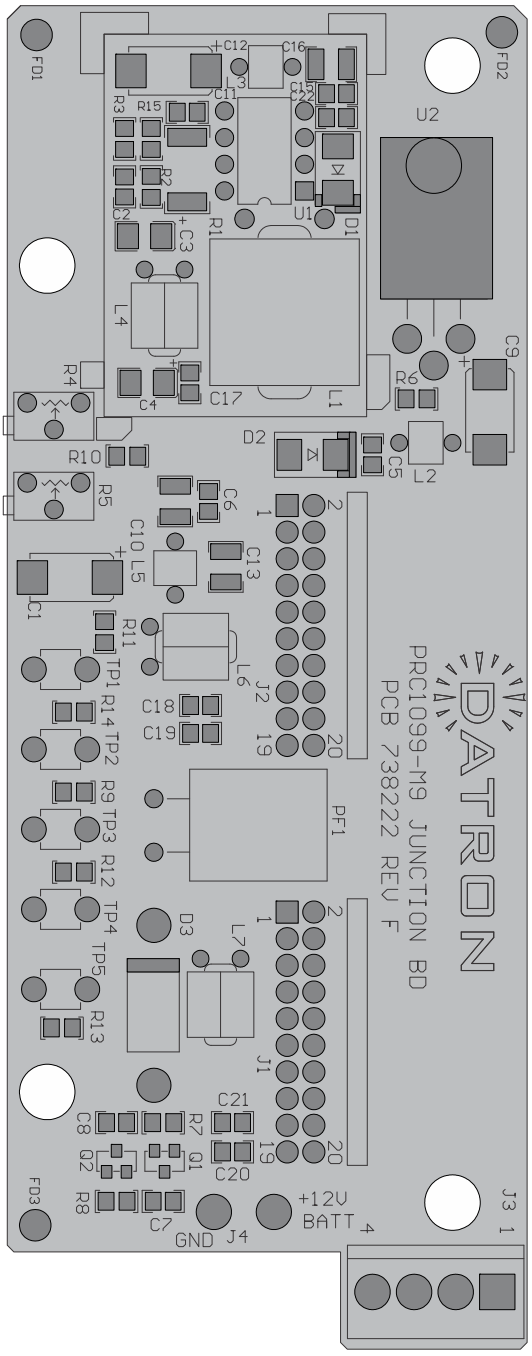

Figure 11-1 Junction Board Component Locations (738222 Rev. F)

DWG. NO.	SH	REV
994164	1	F

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTANCE IS IN OHMS
2. CAPACITANCE IS IN MICROFARADS
3. DIODES ARE 1N4148
4. INDUCTANCE IS IN MICROHENRYS

REVISIONS

REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	PRC1099-287	RELEASE		9-21-92	
B	PRC1099-291	DEL C14 ADD C14 47P		11/92	
C	PRC1099-303	DEL C14		4-16-93	
D	PRC1099-351	SEE ECN		11-21-94	
E	PRC1099-372	R5 WAS 200		11-7-95	
F	10-0445	C1,C3,C9,C10,C12 AND C13 COMP. CHANGE C3 AND C4 VALUE AND FOOTPRINT CHANGE.	JN	08/25/10	

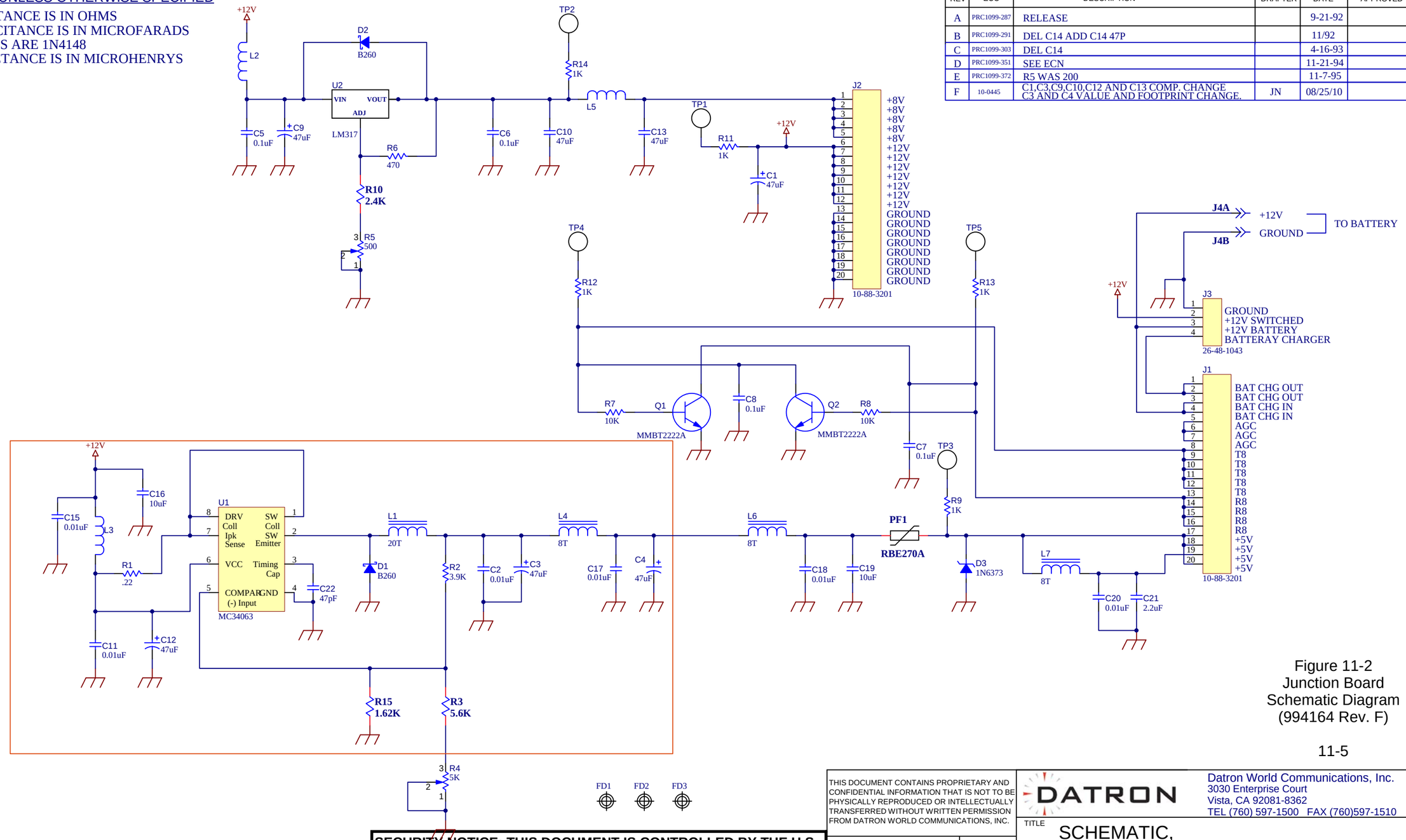

Figure 11-2
Junction Board
Schematic Diagram
(994164 Rev. F)

11-5

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PRC1099-M9 JUNCT BD

SIZE	FSCM NO.	DWG. NO.	REV
B	66943	994164	F

SCALE: NONE | FILENAME:994164F.SchDoc | SHEET 1 OF 1

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Table 11-3 Junction Board Parts List (009-00901 Rev. W)

Designator	Part Number	Description
C1	022476006	“CAP, 47UF TA 35V 20% 7343-43”
C10	021476000	“CAP, 47UF 20%, 16V, X5R, 1210”
C11	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C12	022476006	“CAP, 47UF TA 35V 20% 7343-43”
C13	021476000	“CAP, 47UF 20%, 16V, X5R, 1210”
C15	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C16	021106006	“CAP, 10UF X7R 25V 10% 1210”
C17	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C18	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C19	021106003	“CAP, 10UF X7R 10V 10% 0805”
C2	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C20	021103000	“CAP, 0.01UF X7R 50V 5% 0805”
C21	021225003	“CAP, 2.2UF X7R 25V 10% 0805”
C22	021470003	“CAP, 47PF, NP0, 100V, 2%, 0805”
C3	022476007	“CAP, 47UF TA 10V 20% 3528-21”
C4	022476007	“CAP, 47UF TA 10V 20% 3528-21”
C5	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C6	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C7	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C8	021104000	“CAP, 0.1UF X7R 25V 5% 0805”
C9	022476006	“CAP, 47UF TA 35V 20% 7343-43”
D1	037702014	“DIODE,B260 SCHOTTKY 2A 60V SMB”
D2	037702014	“DIODE,B260 SCHOTTKY 2A 60V SMB”
D3	320433	“DIODE, 1N6373 ZNR TVS 6V 1500W”
J1	610280	“HEADER, 2X10 PIN MLX RT ANG”
J2	610280	“HEADER, 2X10 PIN MLX RT ANG”
J3	610211	“HEADER,MLX,4PIN,.156,POLAR”
L1	459241	“IND ASSY,20T#28 AWG 1-490061”
L2	459032	“IND ASY,3T#30 MAGNET 1-490201”
L3	459032	“IND ASY,3T#30 MAGNET 1-490201”
L4	459263	“IND ASSY,8T#30GA MAG 1-490303”

Table 11-3 Junction Board Parts List (009-00901 Rev. W)

Designator	Part Number	Description
L5	459032	“IND ASY,3T#30 MAGNET 1-490201”
L6	459263	“IND ASSY,8T#30GA MAG 1-490303”
L7	459263	“IND ASSY,8T#30GA MAG 1-490303”
PF1	550043	“FUSE,POLY RESISTOR 2.7 AMPS”
Q1	032004	“XSTR,MMBT2222A NPN SOT23”
Q2	032004	“XSTR,MMBT2222A NPN SOT23”
R1	018R22001	“RES, 0.22 OHM MF 1W 1% 2512”
R10	013242000	“RES,2.4K OHM 1/8W 5% TK 0805”
R11	013102000	“RES, 1K OHM 1/8W 5% TK 0805”
R12	013102000	“RES, 1K OHM 1/8W 5% TK 0805”
R13	013102000	“RES, 1K OHM 1/8W 5% TK 0805”
R14	013102000	“RES, 1K OHM 1/8W 5% TK 0805”
R15	013162100	“RES, 1.62K OHM 1/8W 1% TK 0805”
R2	013392000	“RES,3.9K OHM 1/8W 5% TK 0805”
R3	013562000	“RES,SM,CF,5.6K,0.1W,5%,0805”
R4	170223	“RES,5K TRIMMER”
R5	170339	“RES,500 OHM,VAR,MINI,SIDE ADJ”
R6	013471000	“RES, 470 OHM 1/8W 5% TK 0805”
R7	013103000	“RES,10K OHM 1/8W 5% TK 0805”
R8	013103000	“RES,10K OHM 1/8W 5% TK 0805”
R9	013102000	“RES, 1K OHM 1/8W 5% TK 0805”
TP1	620035	JACK TEST MINI HORIZONTAL
TP2	620035	JACK TEST MINI HORIZONTAL
TP3	620035	JACK TEST MINI HORIZONTAL
TP4	620035	JACK TEST MINI HORIZONTAL
TP5	620035	JACK TEST MINI HORIZONTAL
U1	330191	“IC,MC34063PI,SWPS CTLR,DIP8”
U2	330340	“IC, LM317AT VREG ADJ 1A TO-220”

Chapter 12: Front Panel Assembly

The Front Panel assembly includes the front panel along with all the switches, knobs and the LCD display.

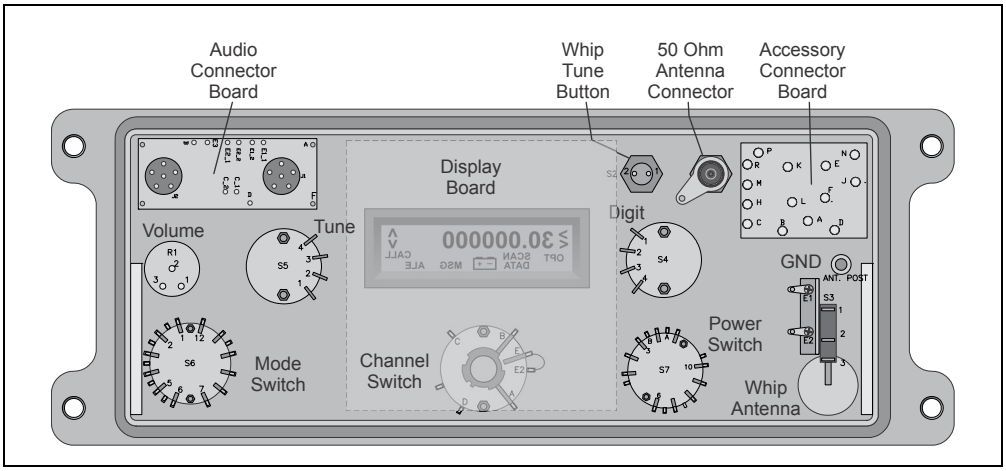


Figure 12-1 Front Panel Assembly (Rear View)

12.1 Switches

12.1.1 Channel Switch

The Channel switch selects one of ten channels. Each channel number is converted to a four-digit BCD code that is applied to input demultiplexer U14 on the Processor board through the Display board where the processor reads the four BCD lines and selects the appropriate channel. These lines are held high (+5V) until they are forced low by the BCD encoder within the switch, therefore 0 = +5V and 1 = 0V.

Table 12-1 Channel Switch BCD Code to Processor

Switch Position	CHSWA	CHSWB	CHSWC	CHSWD
MAN	0	0	0	0
1	1	0	0	0
2	0	1	0	0

Table 12-1 Channel Switch BCD Code to Processor (continued)

Switch Position	CHSWA	CHSWB	CHSWC	CHSWD
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

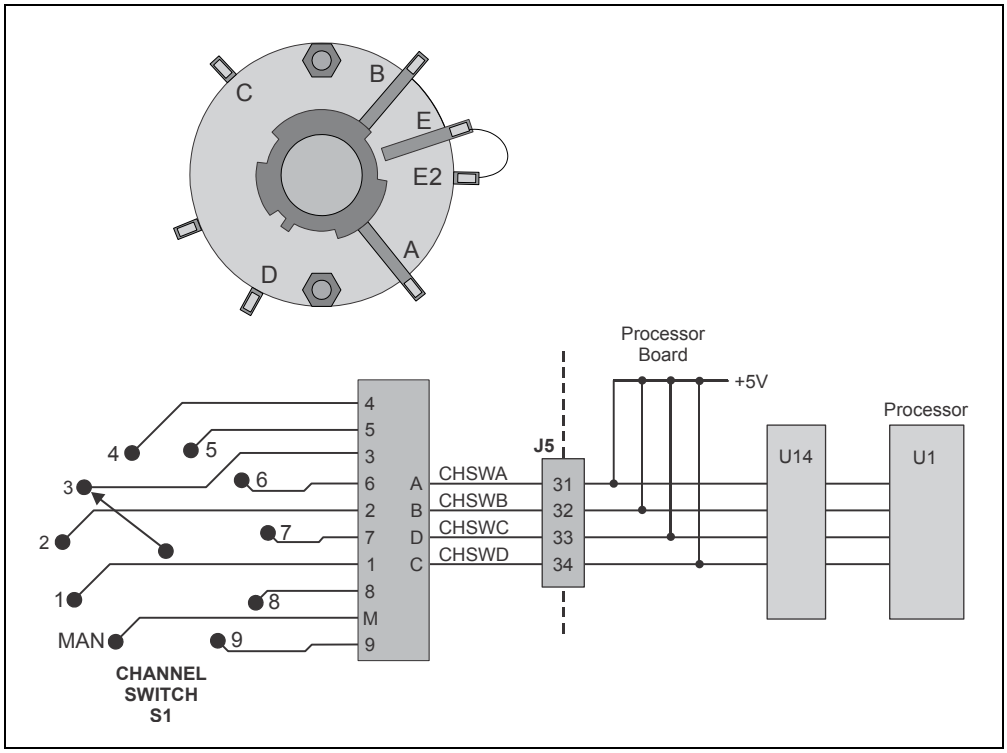


Figure 12-2 Channel Switch (S1) Diagram

12.1.2 Power Switch (S7)

The Power switch applies DC power to the radio and sets the RF output power to either **LO** (5W), **HI** (20W), or selects an external RF power amplifier in the **EXT AMP** position.

OFF Position

The Power switch receives +12V battery voltage from the Junction board through the Accessory connector jumper (must be installed). In all positions except **OFF**, it switches the +12 V back to the Junction board where it is converted to +8V and +5V supply voltages.

LO Power Position

In the **LO** position, the Power switch grounds the LOPWR signal that passes through the Display board and is applied to input demultiplexer U14 on the Processor board. The processor reads the 0V level on the LOPWR line and activates low power switch Q22 on the Audio/Filter board to lower the RF output power to 5W (refer to "Low Power Switch" on page 3-6).

HI Power Position

The **HI** position is the normal operating mode for the radio. The Power switch connects the +12V BATTERY line from the Junction board, through the Accessory connector jumper to the +12V SWITCHED line on the Junction board. This is the same for all positions on the Power switch except the **OFF** position. This supplies 12V to the radio.

EXT AMP Position

The **EXT AMP** position function is identical to the **LO** position as shown in Figure 12-3 below except that the EXTAMP line is grounded through the Power switch center conductor. When the Power switch is set to **EXT AMP**, the radio outputs approximately 5W as in low power mode. If external amplifier RA100-12/24 is connected to the front panel 50 Ohm output connector, it boosts the RF power to the antenna to 100W.

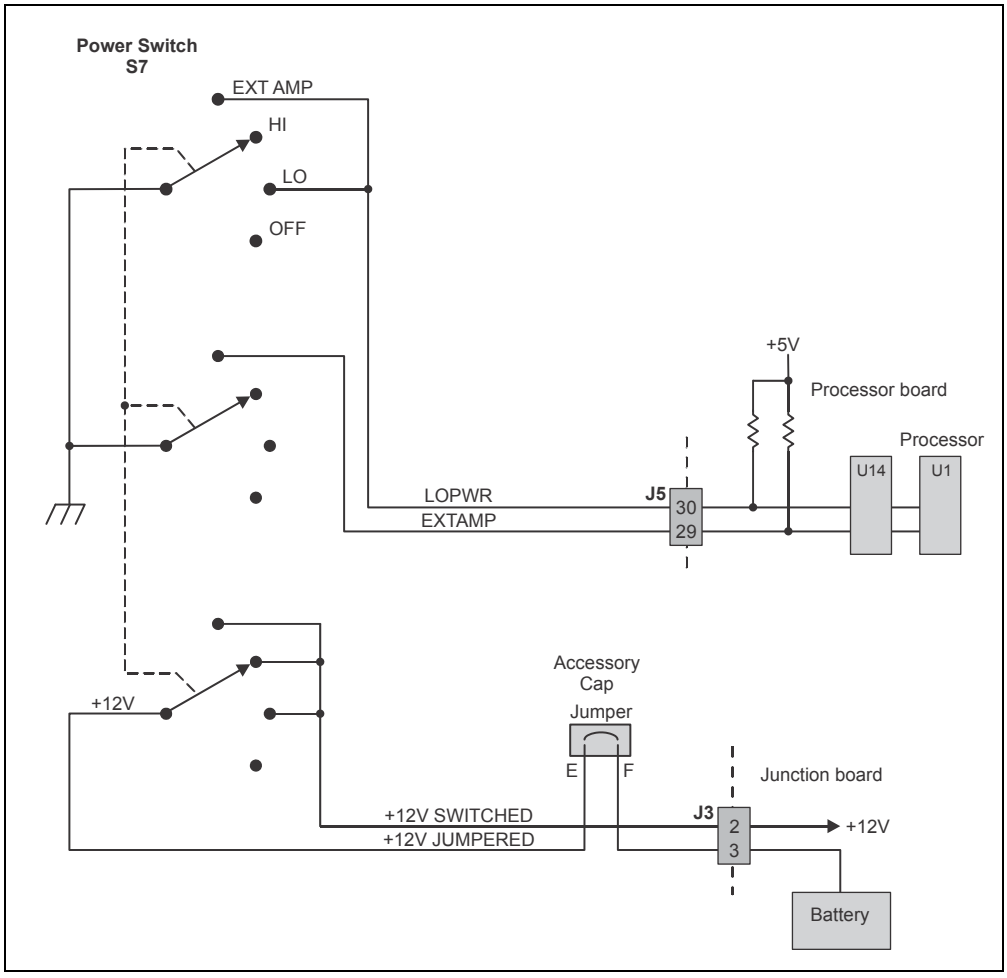


Figure 12-3 Power Switch Diagram

12.1.3 Mode and Option Switch

The front panel Mode and Option switch selects between upper sideband (UPS) and lower sideband (LSB) modes, squelch, and the option switch that selects the AME option mode as shown in Figure 12-4 below.

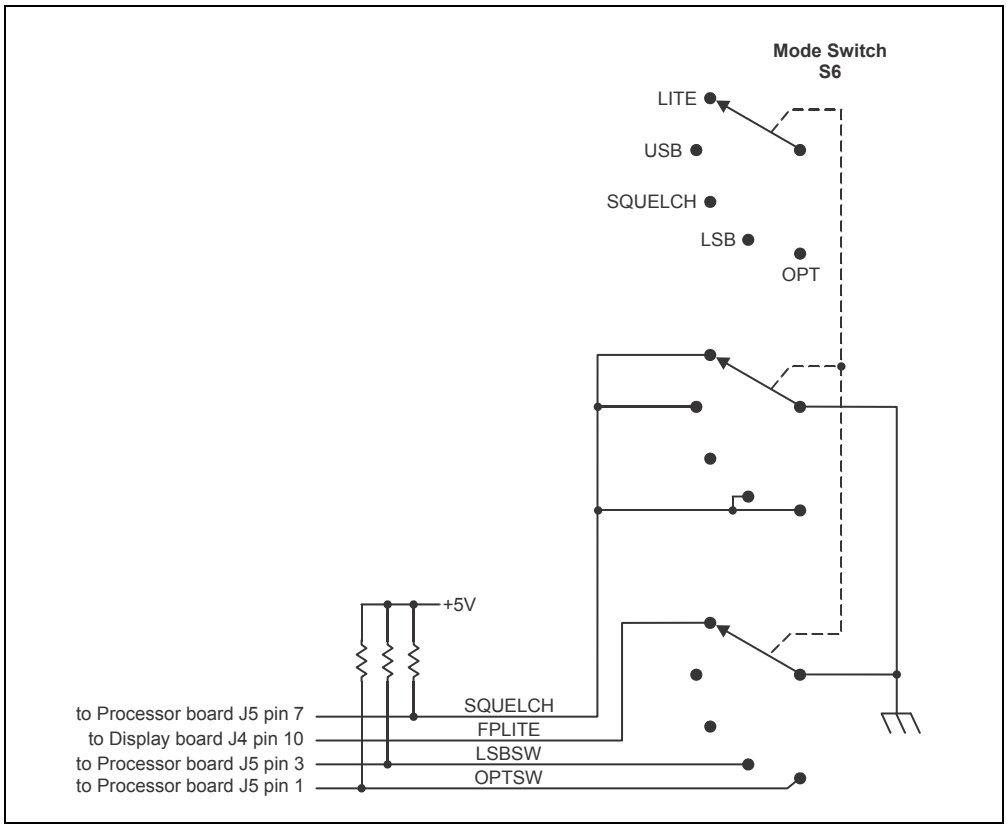


Figure 12-4 Mode and Option Switch Diagram

LITE Position

The **LITE** position switches on the LCD display backlight on the Display board (refer to "Backlight Generator" on page 10-1). Through the center conductor, the Mode and Option switch grounds the FPLITE line to the Display board energizing the LCD display backlight.

USB Position

The **USB** position selects upper sideband operation. USB is the normal operation mode, which means that in all positions except **LSB**, the radio operates in USB mode. In the **USB** position, the Mode and Option switch is open except for the SQUELCH line—no lines except the SQUELCH line are grounded.

SQUELCH Position

The **SQUELCH** position activates the squelch circuit on the Audio/Filter board through the processor on the Processor board. The squelch function mutes the receive audio except when a voice signal is detected. This removes background *hiss* between received spoken words and sentences.

Through the center conductor, the Mode and Option switch opens the SQUELCH line—the SQUELCH line is grounded in all other modes. The opened SQUELCH line is pulled high on the Processor board and applied to

the processor. The processor mutes the receive audio when no voice is detected on the VOICE DET line from the Audio/Filter board (refer to “Squelch Circuit” on page 3-4).

LSB Position

The **LSB** position selects lower sideband operation. The LSB line is grounded through the Mode and Option switch center conductor. The LSB signal is applied to the input demultiplexer U14 on the Processor board and the data is transferred to Processor U1. The Processor sends a control signal to DDS U9 to change the BFO from 1650 kHz to 1647 kHz.

OPT Position

The **OPT** position selects the AME modulation option that allows AM receivers to receive single sideband modulation transmissions. The OPTSW signal to the processor on the Processor board is grounded through the Mode and Option switch center conductor. This signal in normally pulled high (+5V) on the Processor board.

The OPTSW signal is applied to input demultiplexer U14 on the Processor board and the data is transferred to Processor U1. The processor asserts a line on the Audio/Filter board to turn on AME SW Q20 that enables the 1650 KHZ input from the Synthesizer board (refer to “AME Option” on page 5-6).

12.1.4 Digit and Tune Switch

Digit Switch

The front panel **DIGIT** switch selects frequency digits and channels as well as Option, Data, and Scan menu items. When you push the switch up or down, the selected item blinks once to indicate that it is selected.

When you press up on the **DIGIT** switch, the DIGUP line is grounded through the switch center conductor. This line is held high (+5V) until it is grounded using the **DIGIT** switch. The processor reads the low line level at U14 on the Processor board and increments the display on the Display board to the next frequency digit to the right, channel, or option menu. When you press down on the **DIGIT** switch, the DIGDN line is grounded, the processor reads the change and decrements the display to the next frequency digit to the left, channel, or option menu.

For more information about specific menu items, refer to the PRC1099A Operator manual (PRC1099A-MSOP).

Tune Switch

The front panel **TUNE** switch increments or decrements the digit or menu item selected by the **DIGIT** switch. For example, if you select a digit within the channel frequency with the **DIGIT** switch, you use the **TUNE** switch to increment (push the switch up) or decrement (push the switch down) the digit.

You can also use the **TUNE** switch to scroll through the specific menu items in the Option, Data, and Scan menus.

The **TUNE** switch works the same way as the **DIGIT** switch. When you press up on the **TUNE** switch, the SLEWUP line is grounded through the **TUNE** switch center conductor. This signal in normally pulled high (+5V) on the Processor board. The processor reads the low line level at U14 on the Processor board and increments the display on the Display board to the next frequency digit, channel number, or option menu item. When you press down on the **DIGIT** switch, the SLEWDN line is grounded, the processor reads the change and decrements the display to the next frequency digit, channel number, or option menu item.

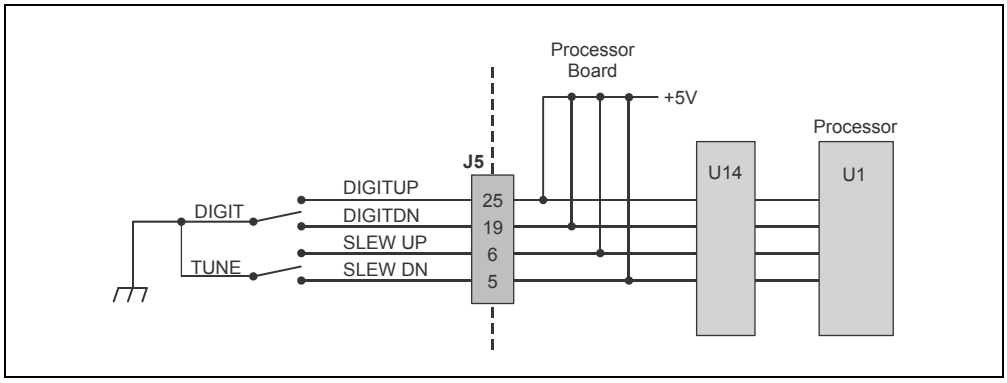


Figure 12-5 Digit and Tune Switches Diagram

12.1.5 Whip Tune Button

The **Whip Tune** button initiates an antenna tune sequence, saving changes made to radio settings, and activating the BITE feature.

Note: This applies to the internal as well as an installed external antenna tuner (when the antenna tuner is selected in **TUNER** under the **OPTION** menu).

Position	Description
Momentary Press	Activates automatic antenna tuner to tune whip or long wire antennas.
Press and Momentary Hold	Saves and stores frequencies, channels and menu settings.
Press and Turn on Transceiver	Activates BITE (Built-In-Test-Equipment).

12.2 Connectors

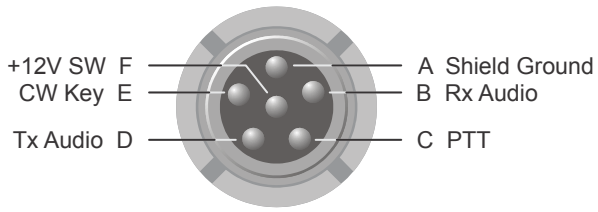
12.2.1 Audio Connectors

The PRC1099A front panel provides two Audio connectors that connect handsets, headsets, and CW key devices to the radio. The PRC1099A supports the following audio devices.

Table 12-2 Supported Audio Devices

Device	Description
DSP9000-HS	High-level encrypting handset. Normal operation is fully automatic—user selects plain or cypher mode. Refer to the Datron Product Catalog for more information.
MHS	H-189/U repairable military handset.
H-250/U	Disposable, Noise-canceling version of the MHS.
H140/U	Ruggedized headphones.
H3M	Headset-boom microphone. Single earphone profile with clip-on PTT switch.
KYR	Morse key with 36 in. (0.9m) cable.
LS-R	Loudspeaker with 5-pin MIL-STD connector.
SHS	Scrambling handset with 5-pin MIL-STD connector. The SHS-KIT programming kit is sold separately.

This section provides the Audio connector pin assignments with a description of each pin assignment.



Pin	Name	Description
A	GND	Shield ground for the audio device cable.
B	RX AUDIO	Receive audio output to handset or headset speaker to Audio/Filter board J6 connector.
C	PTT	PTT from the handset or headset.
D	TX AUDIO	Transmit audio input from handset or headset microphone to Audio/Filter board J6 connector.

Pin	Name	Description
E	CW KEY	CW key tone input to the Processor board.
F	+12V SW	+12 VDC battery power switch through the front panel Power switch.

Figure 12-6 below shows the Audio connector board layout.

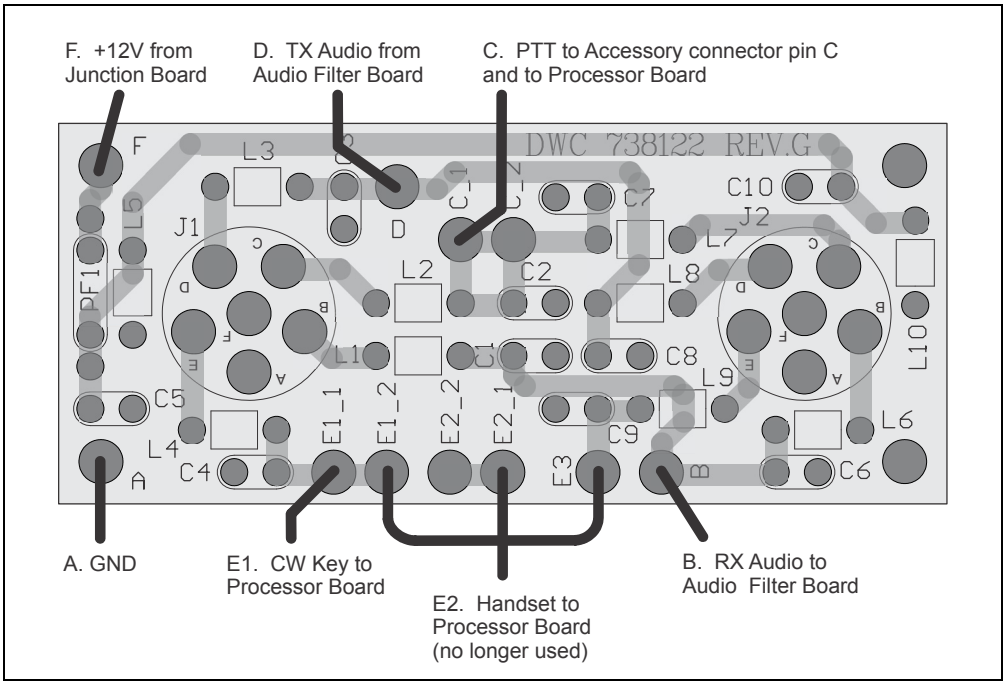


Figure 12-6 Audio Connector Board Pinout

12.2.2 Accessory Connector

The front panel Accessory connector connects to external RF power amplifiers RA100-12 and RA100-24, and antenna tuner RAT7000B through the MT-1099A mobile mount to provide data and control to these devices.

The Accessory connector also allows the PRC1099A to connect with vehicle mounts such as the MT1099A for 12V (MT1099A-12) and 24V (MT-1099A-24) environments.

The Accessory connector cap includes a jumper that shorts pin F to pin E.

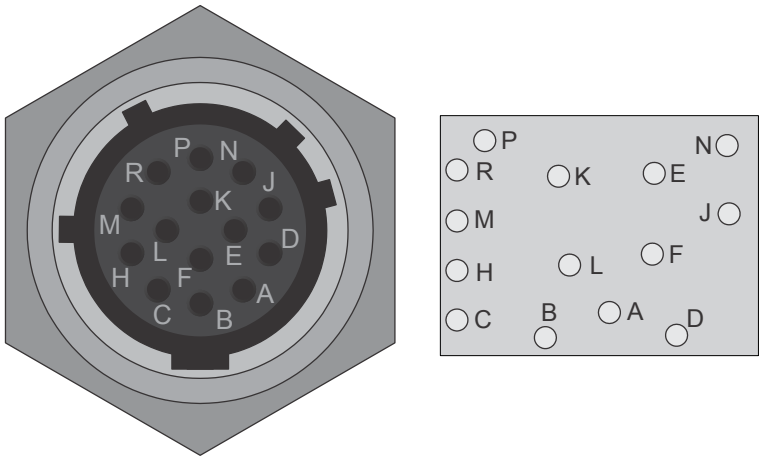
Table 12-3 Supported Accessory Devices

Device	Description
MT-1099A-12	Vehicle adapter and mobile mount for 12V system with integrated loud speaker.
MT-1099A-24	Vehicle adapter and mobile mount for 24V system with integrated loud speaker.

Table 12-3 Supported Accessory Devices

Device	Description
RA100-12	100W 1.6–30 MHz Linear HF amplifier for 12V system with MT-1099A-12 vehicle adapter and RAT7000B tuner.
RA100-24	100W 1.6–30 MHz Linear HF amplifier for 24V system with MT-1099A-12 vehicle adapter and RAT7000B tuner.
RAT7000B	150W automatic antenna tuner.

This section provides the Accessory connector pin assignments with a description of each pin assignment



Pin	Name	Description
A	GND	Ground.
B	AMP PTT	PTT to external 100W RF amplifier RA100-12 or RA100-24 from the Processor board.
C	PTT	PTT from a handset or headset connected to either of the front panel Audio connectors.
D	TUNE INIT	Tune cycle initialization to external antenna tuner RAT7000B from the Processor board.
E	+12V JUMPERED	+12 VDC supply voltage jumpered from pin F using the jumper cap.
F	+12V SW	+12 VDC supply voltage from the battery through the Junction board.
H	RS232 TXD	RS-232 transmit data output signal from the Processor board.
J	TUNER KEYLINE	Keyline from the Processor board to an RAT7000B antenna tuner.

Pin	Name	Description
K	RS232 RXD	RS-232 receive data input signal to the Processor board.
L	OPTION PIN	Jumpered (LK1) to the HANDSET line from the Audio connectors for normal operation. Jumpered (LK3) to the CH/SET line when using the RC2-NG recontrol software.
M	EXT SEL	Filter select line from the Processor board to external antenna tuner RAT7000B.
N	AMP ALC	ALC output line to the RA100-12 or RA100-24 100W RF amplifier
P	RX AUDIO	600 ohm receive audio output to external loudspeaker LS-R to an external device.
R	TX AUDIO	600 ohm transmit audio output to external loudspeaker LS-R from an external device.

12.2.3 Antenna Connections

The PRC1099A supports two front panel antenna outputs: the whip antenna output used for manpack applications and the 50 ohm output used for mobile and base station antennas. The whip antenna connects directly to the whip antenna connector. The 50 ohm output can connect to a RF amplifier and antenna tuner.

Whip Antenna Connector

The whip antenna connector is designed to accommodate the AT-271A/U whip antenna. The AT-271A/U is a folding, multi-section, whip antenna that includes the AB-591/U flexible antenna base.

The ruggedized 100 ft. (30.5m) long-wire antenna kit (ALW-R) and the portable NVIS antenna kit (NVISKIT) also connect to the whip antenna connector. The ALW-R connects to the whip antenna connector through the long-wire adapter (LWA) and uses the PRC1099A's internal antenna tuner.

The NVISKIT consists of the AS-2259/GR NVIS antenna and ground base with thumb screw connector. It also uses the PRC1099A's internal antenna tuner to match to the radio impedance to the antenna. The NVISKIT connects to the whip antenna connector through an whip antenna adapter (AAW) with feed cable C992169 (sold separately).

50 Ohm Antenna Connector

In addition to connecting to a RF amplifier and antenna tuner, the 50 ohm connector can connect to two adjustable resonant dipole antenna kits: ALD and ALD-R. The ALD antenna kit is an adjustable resonant dipole antenna kit that includes a 33 ft. (10m) RG-58/U feed line and throwing lines with weights for deployment in trees. The ALD-R is a ruggedized version of the ALD.

Mobile Antennas

The PRC1099A can be integrated into a mobile communications system using the MT-1099A mobile mount (refer to the PRC1099A Operator manual (PRC1099A-MSOP). In this configuration the PRC1099A can use the MAR-16, MAR-16T, MAR-12, or the RA-MAS mobile antennas.

The MAR-16 antenna kit includes a 16 ft. (4.8m) heavy-duty, fiberglass, military antenna with a flexible spring base and mobile mounting bracket. This antenna can be tied down horizontally to support NVIS communications. The MAR-16 requires an antenna tuner.

The MAR-16T antenna kit is identical to the MAR-16 kit except that it includes a whip adapter with a flexible spring base that allows you to lock the antenna in four different positions. This antenna can be tied down horizontally to support NVIS communications. The MAR-16T requires an antenna tuner.

The MAR-12 antenna kit is also identical to the MAR-16 kit except that the antenna is shorter—12 ft (3.6m) instead of 16 ft.

The RA-MAS antenna kit is identical to the MAR-16 kit except that is has a rigid mobile base and mounting bracket. It also requires an antenna tuner.

Chapter 13: Internal Options

This chapter covers the PRC1099A's optional internal features that can be added to the transceiver at the customer's request. Refer to the PRC1099A Operator manual (PRC1099A-MSOP) for complete operating instructions.

13.1 Automatic Link Establishment Option (1099ALE)

The Automatic Link Establishment (ALE) board contains two processors that work together to perform all the ALE functions. The first main processor is a standard 8-bit processor that processes the ALE data into meaningful messages and call signs for the operator. The second processor is a high-speed digital signal processor (DSP) that generates the transmit ALE tones and detects the incoming ALE tones for processing by the main processor. The two processors communicate through the Dual Port RAM board, leaving messages for each other to process.

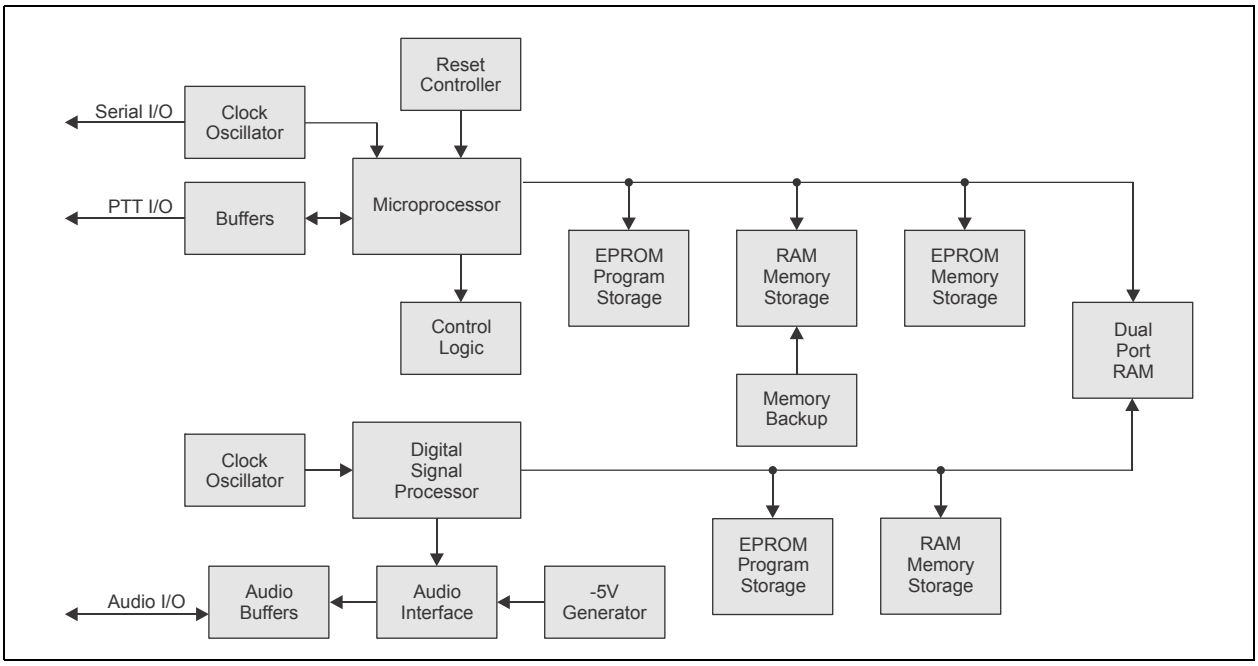


Figure 13-1 ALE Block Diagram

13.1.1 Operation

The ALE functions are all operator-accessible through the front panel menu system. All menu selections for the ALE option are described in the PRC1099A Operator manual (PRC1099A-MSOP).

13.1.2 Circuit Description

The ALE board contains a main processor and a DSP processor. Figure 13-1 on page 13-1 provides a block diagram of the ALE board. The following sections describe the main Processor board components.

Main ALE Processor

Main ALE processor U3 is combined with the input/output circuits to form a special purpose microcomputer. The main ALE processor processes the ALE data received from the DSP. It also prepares the ALE data before it is sent to the DSP for transmission.

This processor can address up to 64 kilobytes of EPROM memory and 64 kilobytes of static RAM for future program expansion. It also includes one UART, two timers, 32 bi-directional input/output lines, and six external interrupt sources.

The main processor operates at a clock frequency of 11.0592 MHz derived from external oscillator U2. The UART communicates with the main radio processor through serial buffers.

P1 ports provide the following control functions:

Port	Function
P1.0	Selects the communications mode for the external serial control interface. This interface is strictly for processor control or control through an external dumb terminal.
P1.1	Sets the serial control interface baud rate of 9600 or 19200 baud.
P1.2	Keyline output drive for keying the PTT line of an external device
P1.3	Input used to read the current status of the PTT line.
P1.4	Provides the processor watchdog output to reset controller chip U1.
P1.5	Provides a control input into the DSP processor.
P1.6	Monitors the dual port RAM interrupt going to the DSP processor.
P1.7	Provides the DSP processor reset pulse for a controlled power up of the DSP processor.

P3 ports provide the following high priority interrupt functions:

Port	Function
P3.1	Transmit driver pin for the serial control interface.
P3.2	Receive driver pin for the serial control interface.
P3.3	Interrupt from the dual port RAM that indicates the DSP has left data for it to retrieve and process.
P3.4, 5	External timing inputs from the DSP processor.

The ALE, PSEN, RD, WR, address/data lines AD0-AD7 and data lines A8-A15 communicate with the external EPROM, RAM, EEPROM, and DSP processor.

Reset Controller

Reset controller U1 provides three functions. The first function is a reset pulse generator that monitors the +5V line. It generates a reset output to hold the processor's reset line low whenever the +5V line is below 4.5 VDC. On power up, an internal monostable multivibrator circuit holds the reset line low for 250 ms, allowing the power supply to stabilize before generating the reset pulse. This also prevents the reset line from toggling repeatedly.

The second function provides a debounced reset-input line for an external push button to reset the processor. It is available on J1 pin 7.

The third function of U1 is a processor watchdog that requires the processor to toggle the STB input at least once every 500 ms. If the processor fails to do so, the reset controller assumes that it has locked up and provides a reset pulse to reset the processor. This function is primarily for firmware development; the ALE card is able to recover from it without any external help.

Clock Oscillator

Clock oscillator U2 (11.0592 MHz) provides the internal clock for main ALE processor U1. Clock oscillator U12 is a high-stability oscillator (20.48 MHz) providing the internal clock and timing for the DSP processor.

Buffers

Inverter/buffer chip U22 protects the main ALE processor from the outside world. Outputs U22D and U22C buffer the serial control interface. Outputs U22E and U22F buffer the PTT input and output.

Program Storage

EPROM chip U80 stores the main firmware operating program for the ALE card. DSP EPROM chips U94 and U98 store the high-speed DSP firmware.

RAM chip U5 stores all the current operating data. DSP RAM chips U14 and U15 execute the high-speed DSP software.

EEPROM chips U6 and U7 are non-volatile memory devices that store long term operating data and parameters.

Memory Backup

Capacitor C10 provides backup power to RAM chip U5. It only provides a few days of reserve power for RAM memory.

Dual Port RAM

Dual port RAM (DPRAM) chip U9 provides an easy interface between the main ALE processor and the DSP processor. Each time the DSP processor receives ALE data, it stores the data in DPRAM. The DPRAM sends an interrupt to the main ALE processor to tell it there is data waiting. The main ALE processor then retrieves and processes the received data. Conversely, when the main ALE processor wants to transmit, it stores the data in the DPRAM. The DPRAM then sends an interrupt to the DSP processor. The DSP processor then retrieves the data and transmits it.

Control Logic

PAL chip U20 is a programmable logic-array chip that contains all the interface logic between the main ALE processor and its memories, and the DSP processor and its memories. It also provides the control interface between the main ALE and DSP processors.

Bus multiplex chip U21 multiplexes the address and data lines coming from the main ALE processor. The address is first presented to the lower address bus and is then latched with the ALE signal from the main ALE processor. The bus is then able to read or write data on AC0-AC8.

Digital Signal Processor (DSP)

Digital Signal Processor (DSP) U13 is a special purpose processor optimized for rapidly processing math functions. The digital processing enables the DSP processor to distinguish ALE tones from normal background noise in noisy environments. It also generates a transmit tone with superb quality, enhancing the likelihood of its detection at the receiving end.

The DSP processor operates at a clock frequency of 20.736 MHz derived from high-stability oscillator U12. This high-stability is necessary for generating and decoding ALE tones with precision.

The DSP processor interfaces to audio interface chip U11 that processes all the incoming received audio and digitizes it for the DSP processor. It also generates the ALE transmit tones from the digital data that the DSP processor sends. The DS, PS, IS, STAB, and RW are used in conjunction with U20 to provide the switching logic for the external EPROM, RAM and DPRAM chips. Address lines A0-A15 and D0-D15 are for communications with the external EPROM, RAM and DPRAM chips.

Audio Interface

Audio interface chip U11 is responsible for the decoding and generating ALE tones. The chip is divided into two parts: receive and transmit circuitry. The receive circuits consist of a 14-bit analog-to-digital converter (ADC) that converts the incoming analog audio signal into a digital sequence that it sends to the DSP processor. The transmitting circuits use a 14-bit digital-to-analog converter (DAC) to convert the incoming digital sequence from the DSP processor into a precise transmit audio tone.

-5V Generator

Voltage converter U10 uses a monolithic charge pump inverter to invert the +5VDC supply to the -5 VDC used by audio interface chip U11 This uses capacitors C3 and C4 at 45 kHz to generate the necessary voltage and current.

Audio Buffers

Audio buffer chip U17 provides buffering of the receive audio input and transmit audio output. It also adjusts the input and output levels by adjusting R10 and R11. For the location of adjustment points, refer to Figure 13-2 on page 13-6.

13.1.3 Connector Pin Assignments

J1 connects with Processor board J4 connector

The ALE board has the following interconnects with the transceiver.

Table 13-1 J1 Connector Pin Assignments

Pin	Signal	Description
1, 2	+5V	5 VDC from the Junction board
3, 4	DGND	Digital ground
5, 6	AGND	Analog ground
7-14	N/C	No connection
15	KEYLINE	ALE PTT input
16	ALEPTT	ALE PTT output
17	SER CNTL RXD	ALE serial data receive
18	SER CNTL TXD	ALE serial data transmit
19	600 OHM RX AUDIO	ALE receive audio
20	600 OHM TX AUDIO	ALE transmit audio

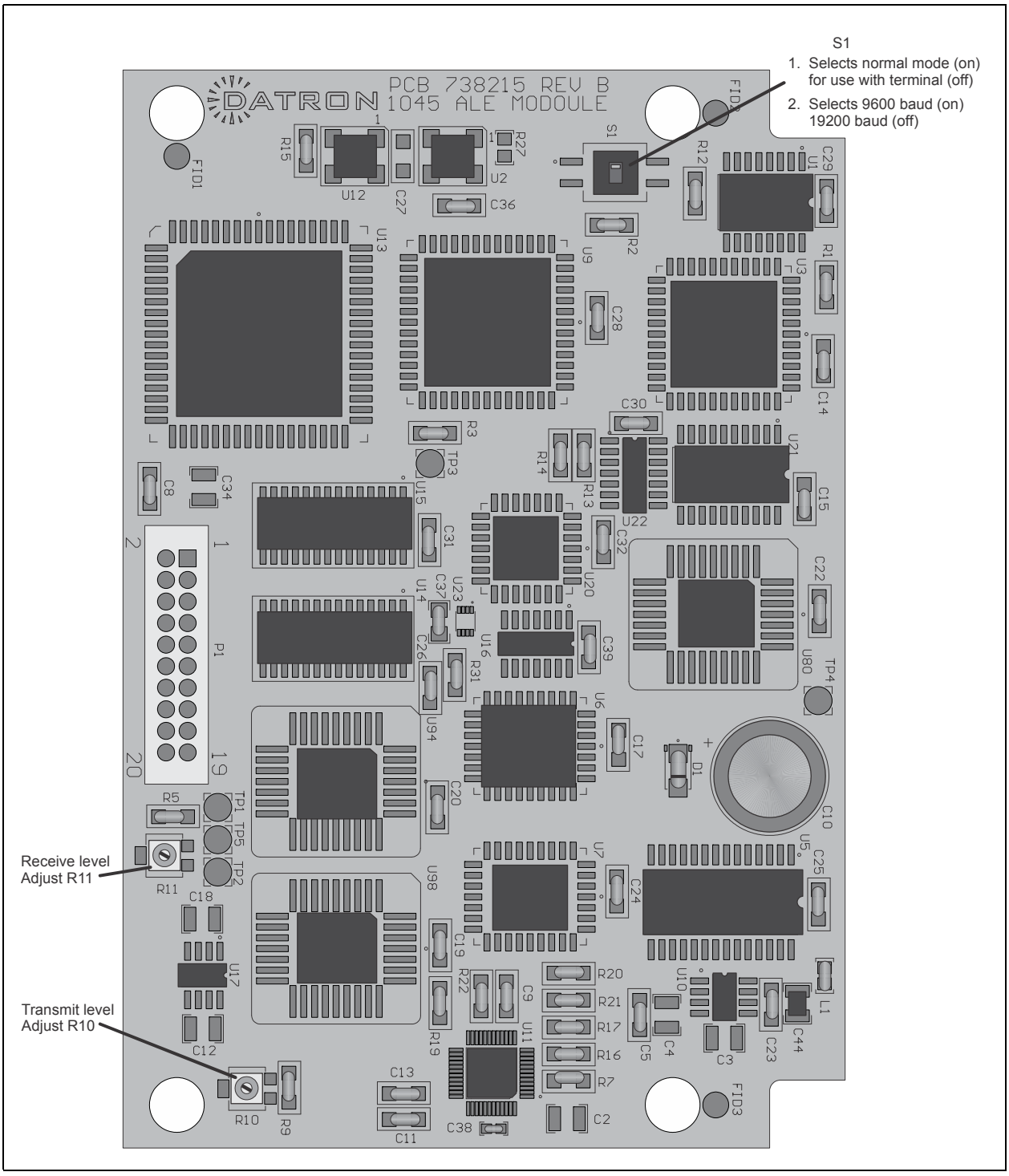


Figure 13-2 ALE Signal Connections and Adjustment Points

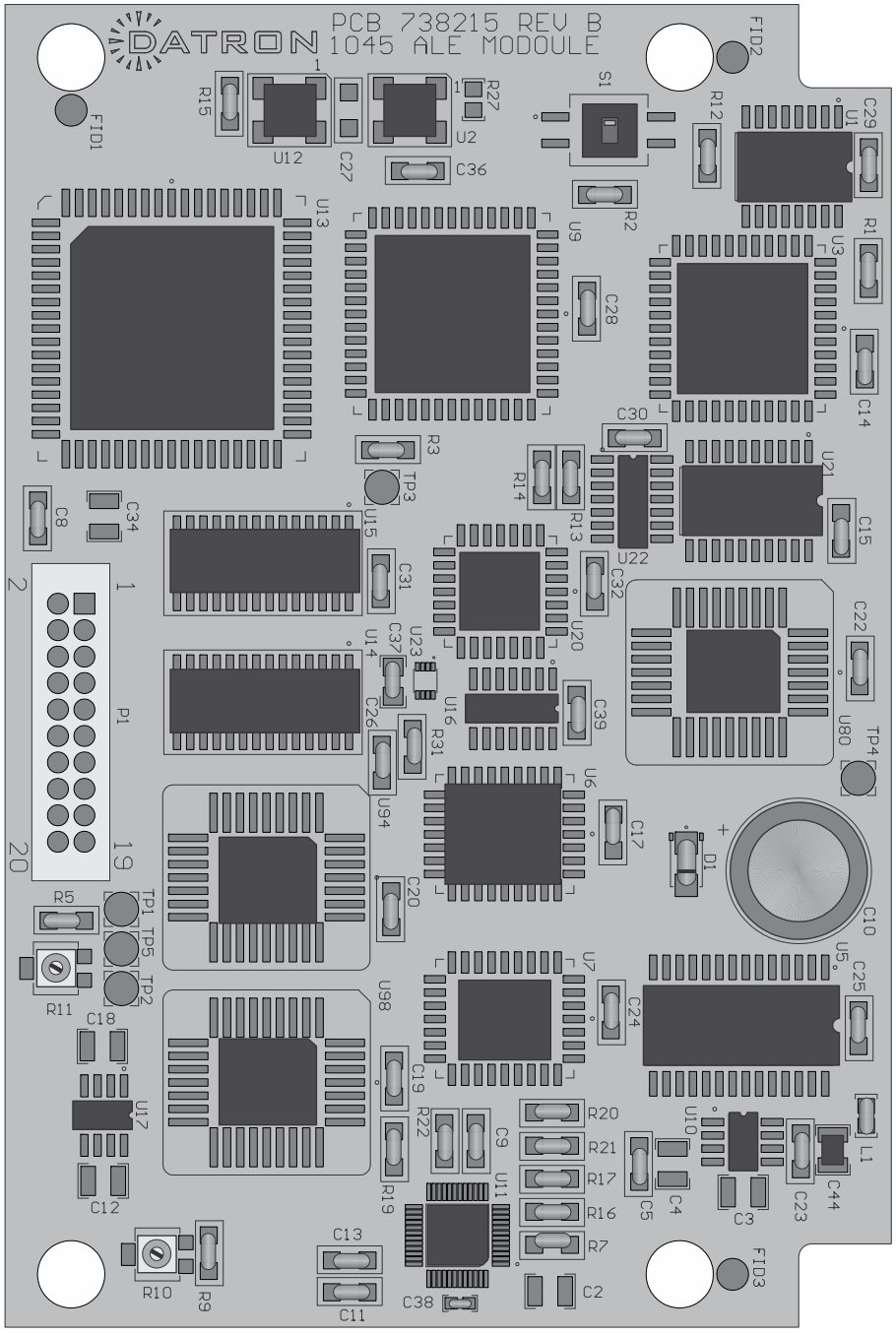


Figure 13-3 ALE Board Component Locations 1 of 2 (738215 Rev. B)

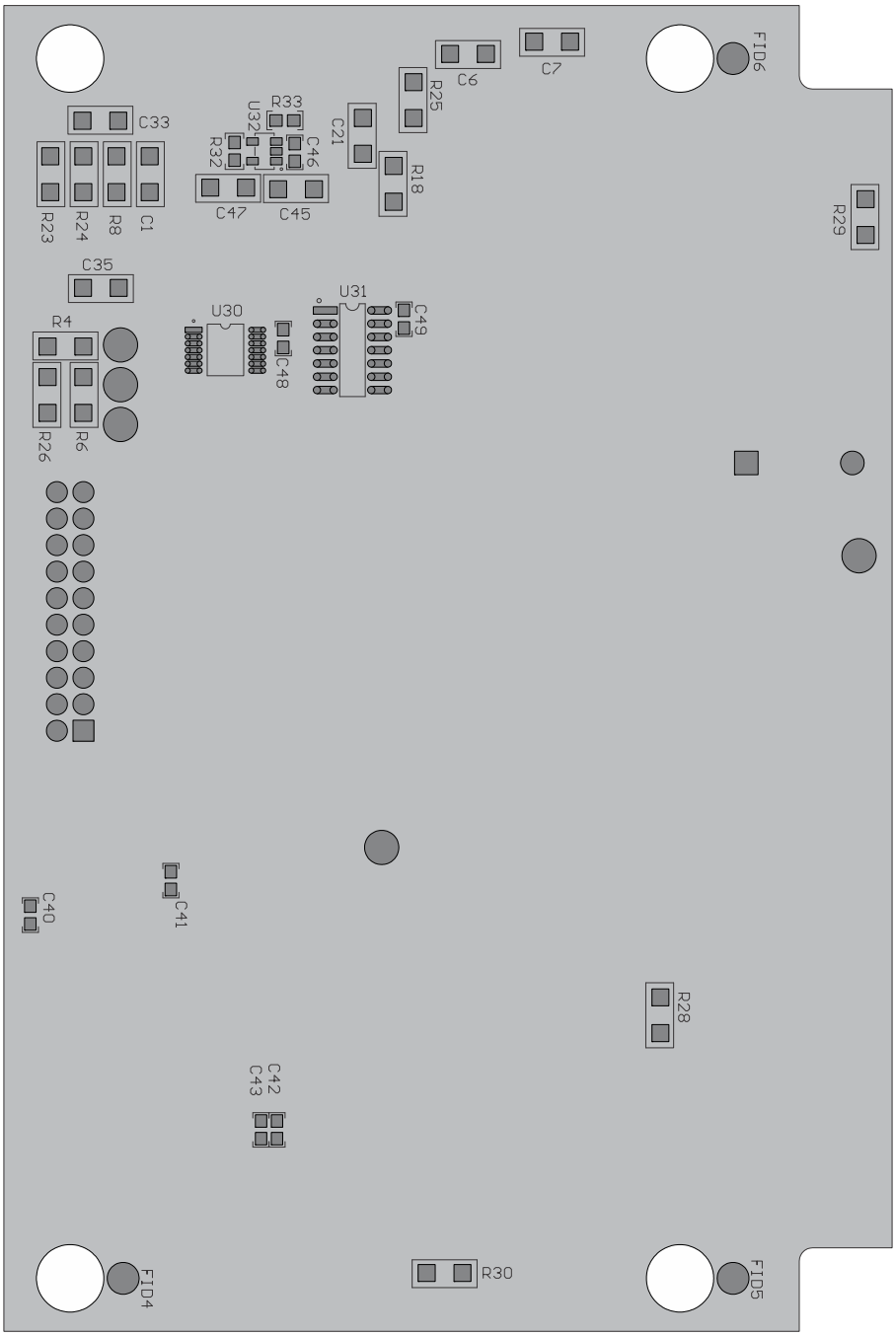


Figure 13-4 ALE Board Component Locations 2 of 2 (738215 Rev. B)

NOTES: UNLESS OTHERWISE SPECIFIED

1 RESISTANCE IS IN OHMS
2 CAPACITANCE IS IN MICROFARADS
3 DIODES ARE 1N4148
4 INDUCTANCE IS IN MICROHENRYS
⚠ INSTALLED FOR 600 OHM AUDIO INPUT.

REVISIONS					
REV	ECO	DESCRIPTION	DRAFTER	DATE	APPROVED
A	PRC1099-287	RELEASE		092192	
B	ALE-005	D1 WAS D8,D2 WAS C12		010595	
C	ALE-010	CORRECT U1 PLACEMENT		040496	
D	05-0413	CORR. TO MATCH BD.	BB	11-09-05	
E	10-0418	U94 was U18, U98 was U19	JN	8/11/10	
F	12-0629	R12 DNP, ADD C50 100uF	JN	12/11/12	
G	13-0006	REMOVE C50	JN	12/11/12	

CLOCK OSC.
RESET CONTROLLER
MAIN PROCESSOR
EPROM PROGRAM STORAGE
RAM
NON-VOLATILE MEMORY
NON-VOLATILE MEMORY
MEMORY BACKUP POWER
SPARE GATES
PROGRAMMABLE LOGIC
VOLTAGE CONVERTER
3.3V REGULATOR
DSP HIGH STABILITY CLOCK OSC.
SPARE GATES
DSP PROCESSOR
EPROM PROGRAM STORAGE
DSP RAM
DUAL PORT RAM
D-TYPE FLIP-FLOP
AUDIO INTERFACE
LEVEL SHIFTERS
AGND PLANE

PRC1099A-MS

Place R25 near U11 pin 33 for single point GND connection

Figure 13-5
ALE Board
Schematic Diagram
(994166 Rev. G)

ASSY: 010-00200
PCB: 738215

13-9

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APPROVALS	DATE
DRAFTER -	03-26-97
CHECKER -	
PROJ ENGR	
MFG ENGR	

TITLE: SCHEMATIC, 1045 ALE MODULE

SIZE	FSCM NO.	DWG. NO.	REV
D	66943	994166	G

SCALE: NONE | FILENAME: 994166G.SchDoc | SHEET 1 OF 1 | 6/18/2015 8:15:54 AM

Table 13-2 ALE Board Parts List (010-00200 Rev. V)

Designator	Part Number	Description
C1	021106002	“CAP, 10UF X7R 16V 10% 1206”
C10	238224	“CAP, 0.22F DLC 20% 5.5V HORIZ PCB”
C11	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C12	021226004	“CAP, 22UF 20%, 25V, X5R, 1210”
C13	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C14	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C15	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C17	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C18	021226004	“CAP, 22UF 20%, 25V, X5R, 1210”
C19	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C2	021226004	“CAP, 22UF 20%, 25V, X5R, 1210”
C20	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C21	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C22	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C23	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C24	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C25	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C26	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C27	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C28	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C29	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C3	021476000	“CAP, 47UF, X5R, 16V, 20%, 1210”
C30	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C31	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C32	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C33	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C34	021476000	“CAP, 47UF, X5R, 16V, 20%, 1210”
C35	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C36	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C37	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C38	021103001	“CAP, 0.01UF 50V X7R 10% 0603”

Table 13-2 ALE Board Parts List (010-00200 Rev. V)

Designator	Part Number	Description
C39	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C4	021476000	“CAP, 47UF, X5R, 16V, 20%, 1210”
C40	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C41	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C42	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C43	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C44	021476000	“CAP, 47UF, X5R, 16V, 20%, 1210”
C45	021106002	“CAP, 10UF X7R 16V 10% 1206”
C46	DNP	“NULL PART, VACANT PCB LOCATION”
C47	021106002	“CAP, 10UF X7R 16V 10% 1206”
C48	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C49	021104018	“CAP, 0.1UF, X7R, 50V, 10%, 0603”
C5	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C6	021106002	“CAP, 10UF X7R 16V 10% 1206”
C7	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C8	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
C9	021104	“CAP, 0.1UF, X7R, 50V, 10%, 1206”
D1	031004	“DIODE, 10MQ040 2.1A 40V SMA”
L1	045000000	“BEAD, FERRITE, Z=600, 0.2A, 25%, 0805”
R1	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R10	017003	“TRIMMER, 10K OHM, 1/4W, VERT, 1-T, 4MM”
R11	017003	“TRIMMER, 10K OHM, 1/4W, VERT, 1-T, 4MM”
R12	DNP	“NULL PART, VACANT PCB LOCATION”
R13	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R14	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R15	013220	“RES,22 OHM 1/8W 5% SMT 1206”
R16	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R17	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R18	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R19	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R2	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R20	DNP	“NULL PART, VACANT PCB LOCATION”

Table 13-2 ALE Board Parts List (010-00200 Rev. V)

Designator	Part Number	Description
R21	DNP	“NULL PART, VACANT PCB LOCATION”
R22	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R23	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R24	013472	“RES, 4.7K OHM, 1/4W, 5%, TK, 1206”
R25	DNP	“NULL PART, VACANT PCB LOCATION”
R26	DNP	“NULL PART, VACANT PCB LOCATION”
R27	013103001	“RES, 10K OHM 1/8W 1% TK 0805”
R28	013220	“RES,22 OHM 1/8W 5% SMT 1206”
R29	014000002	RES 0.0 OHM 1/4W TK 1206 SMD
R3	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R30	013220	“RES,22 OHM 1/8W 5% SMT 1206”
R31	013220	“RES,22 OHM 1/8W 5% SMT 1206”
R32	012270100	“RES, 2.7K OHM, 1/10W, 1%, TK, 0603”
R33	012158100	“RES, 1.58K OHM, 1/10W, 1%, TK, 0603”
R4	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R5	006040	“RES,604 OHM 1/4W 1% TK 1206”
R6	013223	“RES, 22K OHM, 1/4W, 5%, TK, 1206”
R7	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R8	001002	“RES, 10K OHM 1/4W 1% TK 1206”
R9	001002	“RES, 10K OHM 1/4W 1% TK 1206”
S1	053001	“SWITCH, 2-SPST, 0.1LS, DIP-4”
TP1	653004	“TERMINAL ASSEMBLY,PCB”
TP2	653004	“TERMINAL ASSEMBLY,PCB”
TP3	653004	“TERMINAL ASSEMBLY,PCB”
TP4	653004	“TERMINAL ASSEMBLY,PCB”
TP5	653004	“TERMINAL ASSEMBLY,PCB”
U1	033056	“IC,DS1232/S MICRO MONIT,SOW-16”
U10	034402010	“IC, MAX660, DC-DC CNVTR, 0.1A, SO-8”
U11	033303100	“IC, TLV320AIC CODEC PQFP-48”
U12	065206000	“TCXO, 20.480 MHZ 5V 7X5MM”
U13	033301009	“IC,TMS320C25FNA DSP CTL PLCC68”
U14	033049	“IC,SMT 32 X 8 SRAM, SOJ-28-5”

Table 13-2 ALE Board Parts List (010-00200 Rev. V)

Designator	Part Number	Description
U15	033049	“IC,SMT 32 X 8 SRAM, SOJ-28-5”
U16	033057	“IC, 74HC00 QUAD 2-I NAND SOIC14”
U17	033304057	“IC, LMC6492A, DUAL OP-AMP, SOIC-8”
U2	065116000	“OSC, 11.0592MHZ 5V 7X5MM”
U20	010-00101	PROGRAMMED GAL
U21	033058	“IC,74HC573A OCTAL LATCH SOW-20”
U22	033059	“IC,74ACT14M DIGITAL, SO-14”
U23	033303152	“IC, 7SZ74 SINGLE D-FF US-8”
U3	033051	“IC, UCNTLR 80C31 PLCC-44”
U30	033303146	“IC, LV QUAD BUFFER TSSOP14”
U31	033303049	IC SM DIG 74HCT125 SOIC
U32	034400011	“IC, LT1761, LDO VREG, 0.1A, ADJ, SOT23-5”
U5	033300001	“IC, 32KX8 SRAM 70NS SOIC-28”
U6	033050	“IC, 28C64 8KX8 EEPROM PLCC32”
U7	033050	“IC, 28C64 8KX8 EEPROM PLCC32”
U9	033300031	“IC, SRAM, 1KX8 DUAL PORT, PLCC-52”
XU80	089032000	“SOCKET, PLCC32 SMT”
XU94	089032000	“SOCKET, PLCC32 SMT”
XU98	089032000	“SOCKET, PLCC32 SMT”

13.2 Internet Protocol Interface (PRC1099A-IP)

When the PRC1099A is installed in the MT-1099A vehicle mount, the PRC1099A-IP option provides an Ethernet interface allowing the operation of remote control and data application software over a 10Base-T Ethernet TCP/IP network.

For more information about the PRC1099A-IP, refer to the Internet Protocol Interface Operator manual (IPI-MSOP).

Chapter 14: Maintenance

The PRC1099A is a complex radio that uses advanced design techniques to ensure high performance and trouble free service. Only skilled personnel who fully understand the PRC1099A's operation and who are trained to use the correct test equipment should service this radio.

14.1 Test Equipment

Table 14-1 below provides recommendations for using specific test equipment to service the PRC1099A as well as a description of each key characteristic relevant to the PRC1099A.

Table 14-1 Test Equipment List

Equipment	Description
Essential	
Synthesized Signal Generator	Frequency range: 1 to 105 MHz (minimum) Calibration x Setting Accuracy: 1 kHz (minimum) Output: 0.1V to 1V (with accurate attenuator)
SINAD/Audio Level Meter	SINAD: 1000 Hz/Audio Level
Electronic Multimeter	General purpose Input Impedance: 10M ohm (minimum)
Digital Voltmeter (DVM)	General purpose Accuracy: 1% (10V range)
Frequency Counter	Frequency range: 1 to 105 MHz Accuracy: 1 ppm (minimum)
Wattmeter	Impedance: 50 ohm Power: 50W (full scale) Frequency: 2 to 30 MHz (Thruline, 50W Element x Load)
Power Supply	12V, 8A regulated

Table 14-1 Test Equipment List

Equipment	Description
Optional	
Oscilloscope	General purpose Frequency response: 100 MHz
Audio Signal Generator	Frequency range: 300 to 3000 Hz
RF Voltmeter	Frequency range: 0.5 to 100 MHz Range: 10 mV to 3V
Spectrum Analyzer	Frequency range: 1 to 105 MHz Resolution: 100 Hz

14.2 Measurement Techniques

The following information is provided for technicians and engineers who do not have experience testing synthesized equipment.

14.2.1 RF Power Measurement

The PRC1099A RF power output is 20W PEP (peak envelope power) or average power. The power output is 20W average in CW mode and has an instantaneous peak output of 20W on voice peaks.

In CW mode or on a continuous sine wave tone, an average power meter such as the Bird Model 43 indicates the correct output. On a voice signal, the meter indicates an average power that is much lower than the peak power, typically 5W to 7W. On a two-tone test signal, the Bird Model 43 indicates a typical power output of 8W (refer to Figure 14-1 on page 14-3 and Figure 14-2 on page 14-4).

Measure the RF power output at the front panel 50 ohm BNC antenna connector with no antenna mounted to the whip antenna connector—an internal relay disconnects the 50 ohm connector when an antenna is connected to the whip antenna connector.

The DC supply voltage should be at least 12V under load when making RF power measurements. The current drain for voice operation is much lower than when operating in CW mode. Even when the battery voltage is too low for high power CW operation, there may be sufficient capacity for satisfactory voice operation.

The RF power amplifiers in the PRC1099A are capable of 25W to 30W output, however, Datron recommends that you do not set the power level higher than 20W. You would have to at least double the output power before you would notice any increase in transmission performance.

14.2.2 Spectrum Analyzer

Although a spectrum analyzer is not essential for servicing the PRC1099A, it is useful for testing SSB equipment. The spectrum analyzer operates in the frequency domain and allows you to observe frequency and amplitude simultaneously. This is useful for examining the various RF signals for spectral purity and spurious tones. For example, you can monitor the output from the phase-locked loop in the transceiver to ensure that the loop is locking correctly, the phase noise is satisfactory, and that there are no spurious outputs.

Connect the spectrum analyzer to the transceiver output through an attenuator to displays harmonics and unwanted spurious outputs.

CAUTION: Do not overload the spectrum analyzer when making harmonic measurements. If the input level is too high, the mixer in the spectrum analyzer generates harmonics internally.

You can also use the spectrum analyzer to measure distortion using a two-tone test signal—two equal amplitude audio tones in the transmitter audio passband drive the transmitter to full power output (20W PEP). The distortion products appear as signals displaced by the separation of the tone frequencies.

Note: The transmitter PEP is 6 dB higher than the level of each tone in the two-tone test waveform. If the third order distortion products are 26 dB below each wanted tone, the intermodulation distortion level is -32 dB relative to PEP.

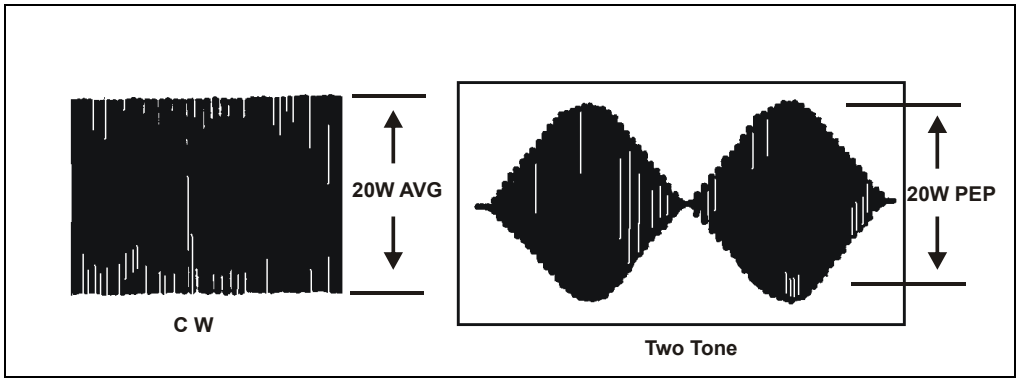


Figure 14-1 Power Measurement Waveforms

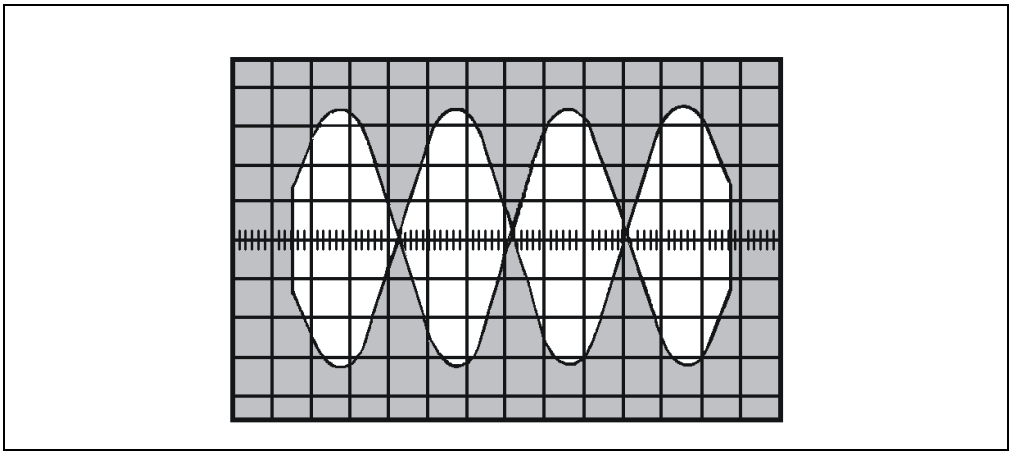


Figure 14-2 Two-Tone Test Signal

14.2.3 Signal Generator

You can use a signal generator to inject controlled signals of a known frequency and amplitude into different circuits of the transceiver. For example, you can use the signal generator as a temporary substitute for one of the local oscillators.

14.2.4 Frequency Counter

Apart from frequency calibration, you can use a frequency counter to service the synthesizer. By connecting the counter to different points in the circuitry, you can verify that the correct divide ratios are occurring in the synthesizer.

14.3 Disassembly

The PRC1099A is designed with individual boards that are easily replaced in the field.

14.3.1 Chassis Disassembly

To disassemble the PRC1099A:

1. Stand the radio on its front panel (refer to Figure 14-3 on page 14-5).
2. Remove the battery case and battery by releasing the latches on each side of the radio case and separate the battery case from the radio case (refer to Figure 14-3 on page 14-5).
3. Remove the radio case by loosening the captive screws and pulling the case from the front panel (refer to Figure 14-4 on page 14-6). If necessary, insert a flat-blade screwdriver between the front panel and the case to pry off the case.

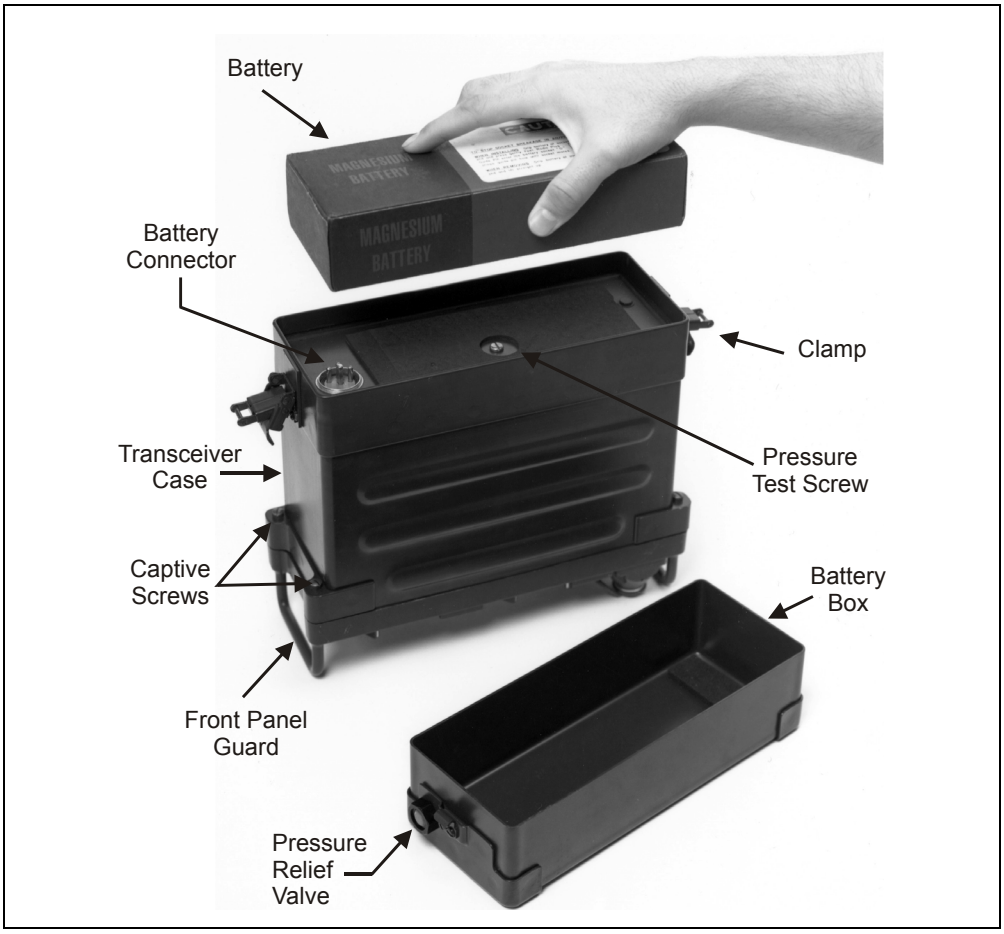


Figure 14-3 Battery Case Removal

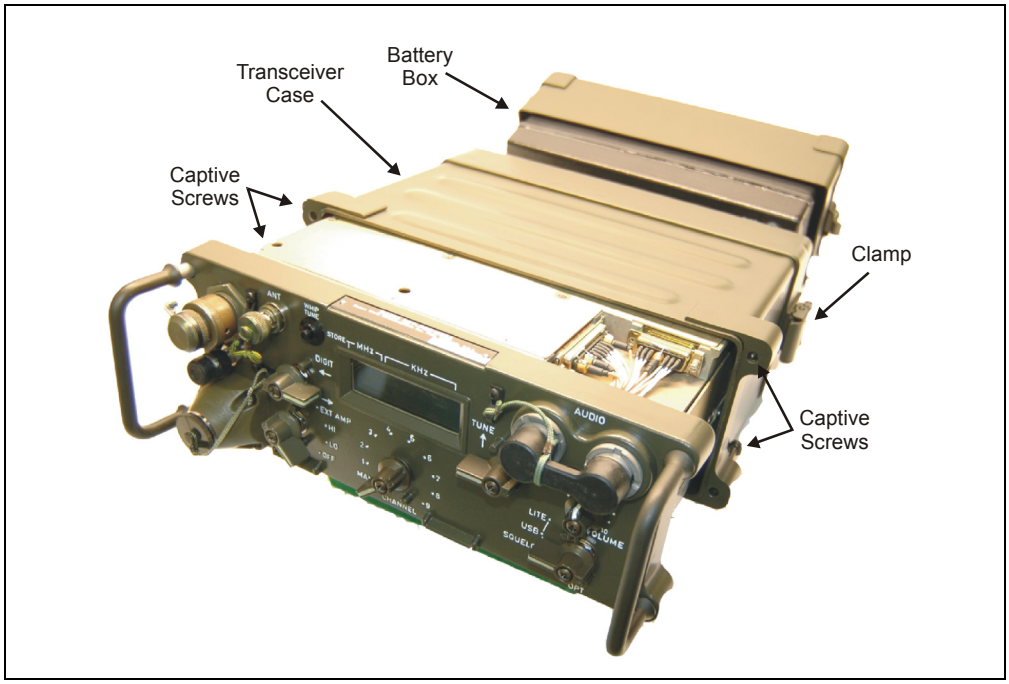


Figure 14-4 Radio Case Removal

14.3.2 Board Locations

This section provides the location of boards inside the PRC1099A chassis.

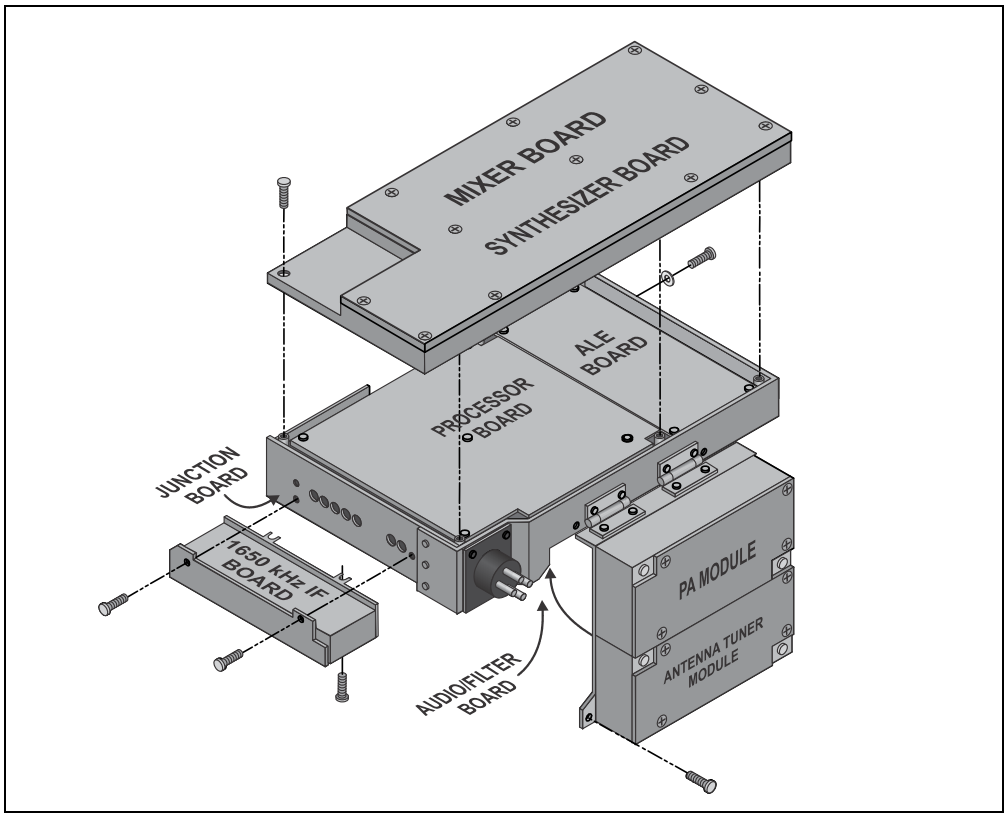


Figure 14-5 Board Locations (Top)

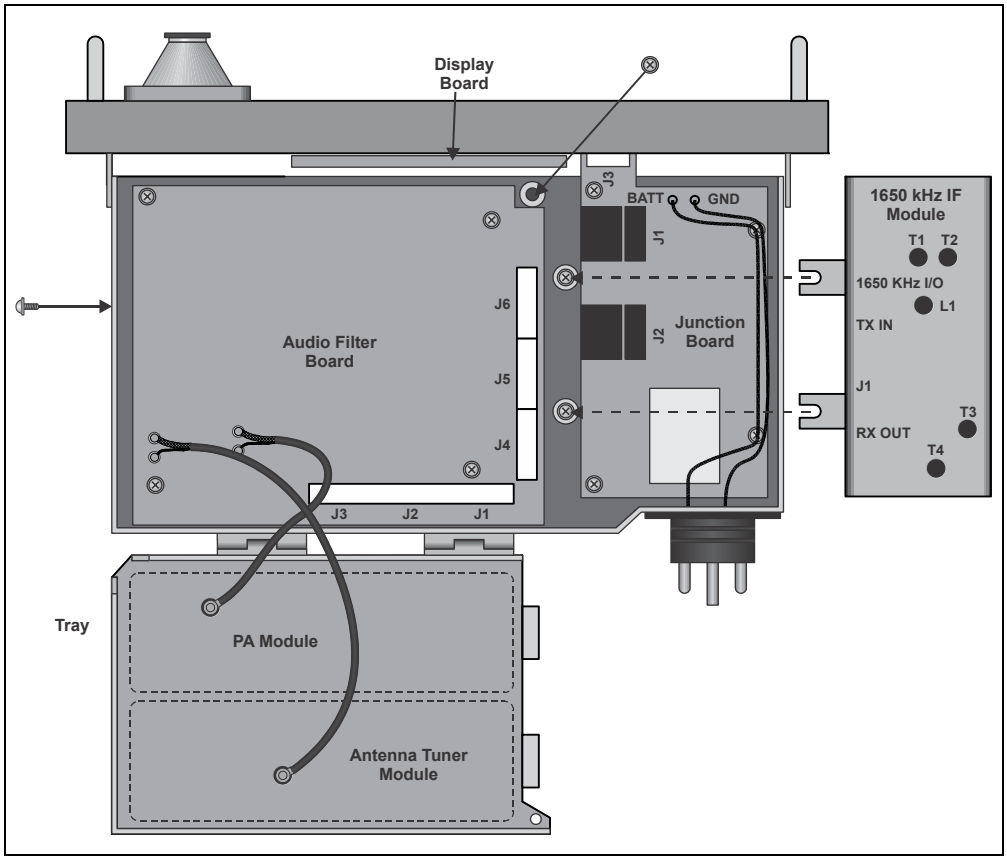


Figure 14-6 Board Locations (Bottom)

14.3.3 Board Removal and Replacement

This section provides procedures for removing each board in the PRC1099A.

Remove and Replace the 1650 kHz IF Board

To remove and replace the 1650 kHz IF board:

1. Disassemble radio chassis (refer to "Chassis Disassembly" on page 14-4).
2. Remove the two side retaining screws (refer to Figure 14-6 above) to release the PA module and Antenna Tuner module tray, and lift the tray off the Audio/Filter board.

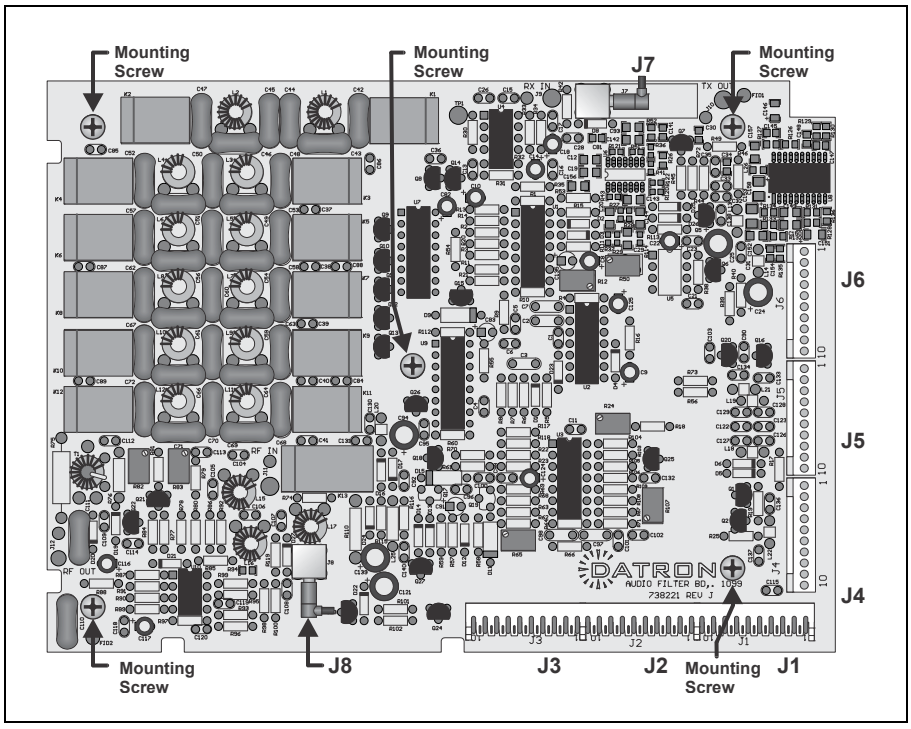
   This makes it easier to remove the J1, J2 J3, and J4 connectors as well as the two retaining screws discussed in step 4.
3. Disconnect RF coax connectors J2, J3, and J4. Disconnect multiple-pin power connector J1.
4. Loosen (do not remove) the two retaining screws on the center plate next to the Audio/Filter board. These screws may be obscured by wiring harnesses from the Audio/Filter board.
5. Tilt the module up and slide it off these screws.
6. Reverse this procedure to install the new 1650 kHz IF board.

Remove and Replace the Audio/Filter Board

The Audio/Filter board is mounted under the Power Amplifier and Antenna Tuner boards. You have to remove some retaining screws and lift the tray with the Power Amplifier and Antenna Tuner boards.

To remove and replace the Audio/Filter board from the chassis:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove the two retaining screws on the Power Amplifier and Antenna Tuner modules tray as shown in Figure 14-6 on page 14-7.
3. Disconnect the white-wire antenna connection from the Antenna Tuner board to the front panel **ANT** connector. This allows the mounting tray to swing fully open.
4. Disconnect the two RF coax connectors from the underside of the Power Amplifier and Antenna Tuner boards and the two onboard RF coax connectors J8 (RX OUT) to the Mixer board. Also, disconnect J7 (BFO INPUT) from the Synthesizer board.



5. Disconnect the multi-pin connectors (J4, J5, and J6) at the side of the Audio/Filter board.

   Removing the 1650 kHz IF board (refer to “Remove and Replace the 1650 kHz IF Board” on page 14-7) makes accessing, disconnecting, and reconnecting connectors J4, J5, and J6 on the Audio/Filter board much easier.

6. Remove the four mounting screws at the corners and the center mounting screw, and then carefully lift the Audio/Filter board up, disconnecting it from the bottom entry connector pins to the Processor board.
7. Reverse this procedure to install the new Audio/Filter board.

Remove and Replace the Power Amplifier Board

To remove and replace the Power Amplifier board from the chassis:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove end connector J1.
3. Unscrew the two retaining bolts.
4. Lift the module out and remove the RF connector from under the Power Amplifier board.
5. Reverse this procedure to install the new Power Amplifier board.

Remove and Replace the Antenna Tuner Board

To remove and replace the Antenna Tuner board:

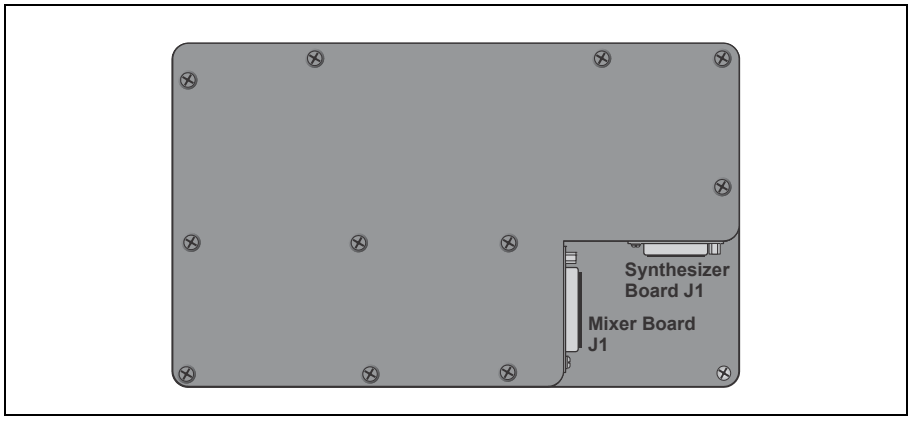
1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove end connector J1.
3. Disconnect the white antenna wire.
4. Unscrew the two retaining bolts.
5. Lift the module out and remove the RF connector from under the Antenna Tuner board.
6. Reverse this procedure to reinstall the new Antenna Tuner board.

Remove and Replace the Mixer Board

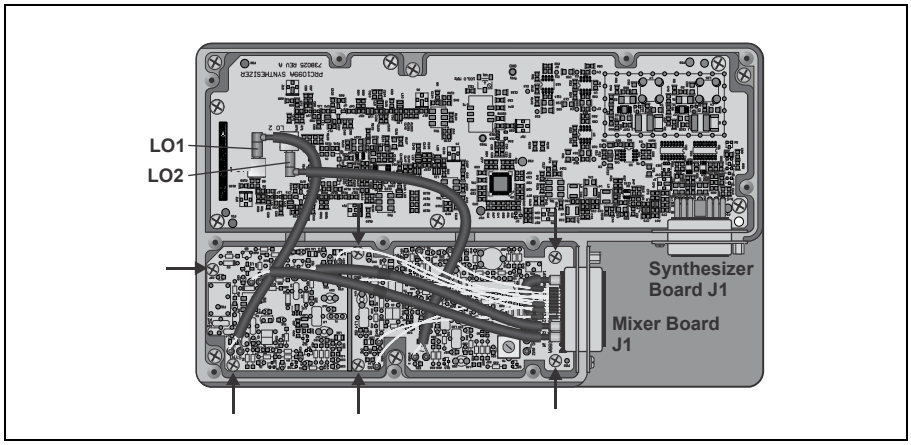
To remove and replace the Mixer board:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Disconnect the Mixer board multiple-pin connector J1.

3. Remove the 11 flat head tray cover retaining screws and remove the cover.



4. Disconnect the coax connectors J2 (LO1) and J3 (LO2) from the Synthesizer board.



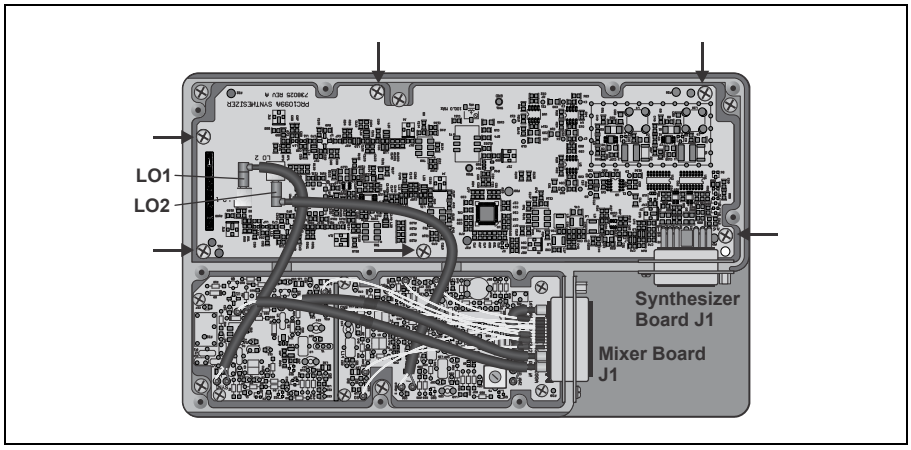
5. Remove the six mounting screws shown above and then lift the Mixer board out of the tray.
6. Reverse this procedure to install the new Mixer board.

Remove and Replace the Synthesizer Board

To remove and replace the Synthesizer board:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Disconnect the Synthesizer board multiple-pin connector J1.
3. Remove the 11 flat head tray cover retaining screws and remove the cover.
4. Disconnect the coax connectors J2 (LO1) and J3 (LO2).

5. Remove the six mounting screws shown below and then lift the Synthesizer board out of the tray.

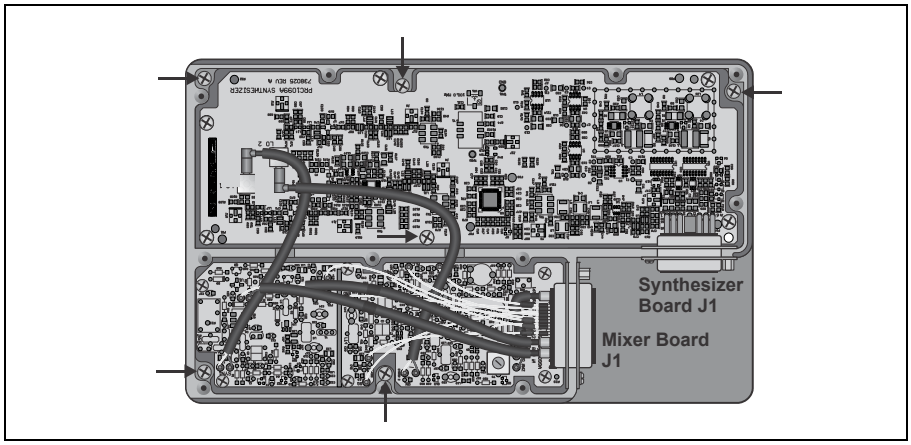


6. Reverse this procedure to install the new Synthesizer board.

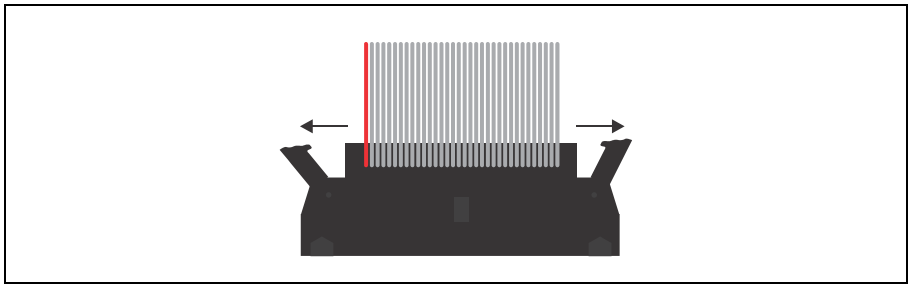
Remove and Replace the Processor Board

To remove and replace the Processor board:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove the 11 flat head tray cover retaining screws and remove the cover (refer to “Remove and Replace the Mixer Board” on page 14-9 step 3).
3. Remove the five retaining screws in the Mixer/Synthesizer tray and lift the tray off the chassis frame.



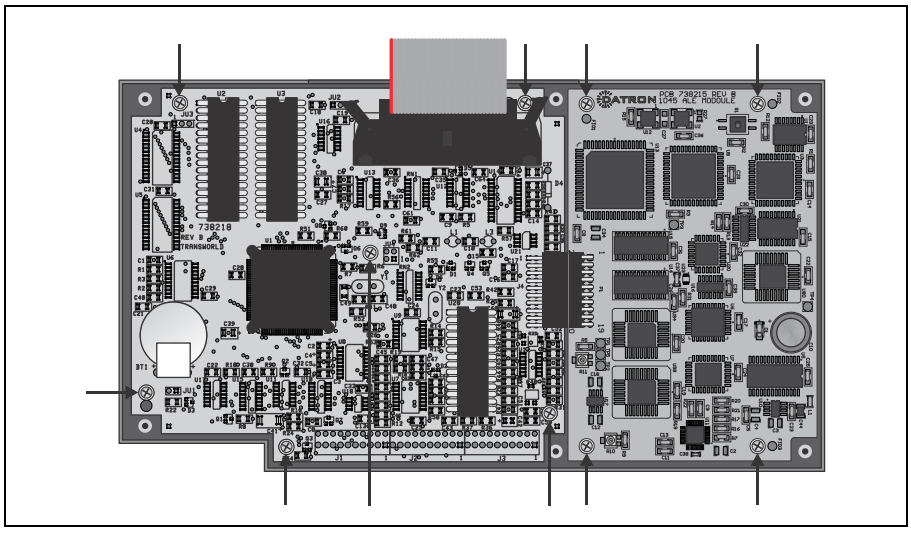
4. Disconnect the 34-pin ribbon cable from the front of the Processor board. Move the two latches outward to release the ribbon cable connection as shown below.



5. Remove the six mounting screws and carefully lift the board to disengage the rear-entry connectors from the Audio/Filter board.

   Note: If an optional ALE board is installed and connected to the Processor board, remove the four retaining screws on the ALE board and remove the Processor and ALE boards together as one board. Separate the optional ALE board from the Processor board after removing them from the tray.

6. Reverse this procedure to install the new Processor board.

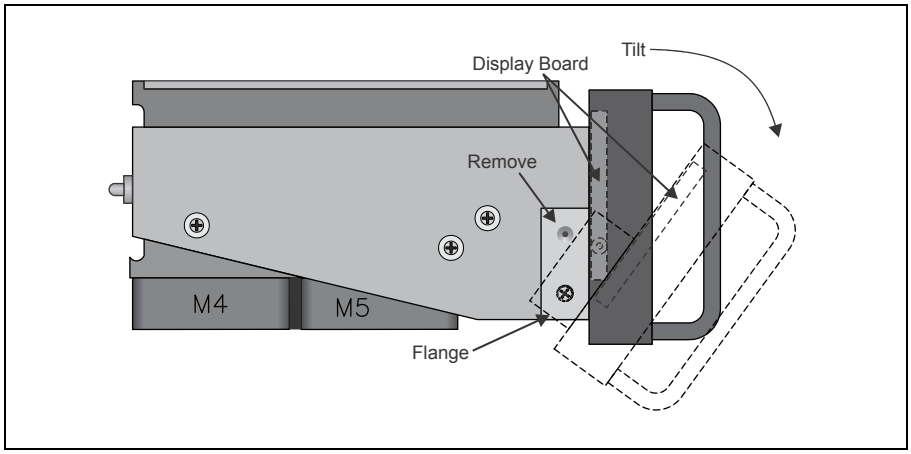


Remove and Replace the Display Board

To remove and replace the Display board:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. With the PRC1099A laying flat and right side up, remove the 11 flat head tray cover retaining screws and remove the cover (refer to “Remove and Replace the Mixer Board” on page 14-9 step 3).
3. Remove the five retaining screws in the Mixer/Synthesizer tray and lift the tray off the chassis frame.
4. Disconnect the ribbon cable from the Processor board.

5. Remove the top two screws on either side of the front panel flange as shown below.
6. Loosen the bottom two screws; do not remove them.
7. Tilt the front panel forward to gain access to the Display board.



8. Tighten the bottom screws again to keep the front panel in place.
9. Disconnect the three connectors and remove the four mounting screws and the board.
10. Lift the Display board off the front panel assembly.
11. Reverse this procedure to install the new Display board.

Remove and Replace the Junction Board

To remove and replace the Junction board:

1. Disassemble radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove the 1650 kHz IF board (refer to “Remove and Replace the 1650 kHz IF Board” on page 14-7).
3. Disconnect the three connectors (J1, J2, and J3).
4. Unsolder the two wires from the battery connector.
5. Remove the four mounting screws and the board and lift the board out of the chassis.
6. Reverse this procedure to install the new Function board.

Remove and Replace the Front Panel Assembly

To remove and replace the Front Panel assembly:

1. Disassemble the radio chassis (refer to “Chassis Disassembly” on page 14-4).
2. Remove the Mixer/Synthesizer tray (refer to “Remove and Replace the Processor Board” on page 14-11, steps 2 and 3).

3. Disconnect the 34-pin ribbon cable from the front of the Processor board.
4. Remove the two screws securing the Power Amplifier and Antenna Tuner modules tray and tilt the tray back to expose the Audio/Filter board.
5. Disconnect the 10-pin J4 connector from the Audio/Filter board.
6. Disconnect the 4-pin cable from the Junction board.
7. Remove the four screws on the flange connecting the front panel to the chassis.
8. Unsolder the coaxial cable connecting to the 50 ohm port on the front panel.
9. Remove the front panel assembly from the chassis.
10. Reverse this procedure to install a new Front Panel assembly.

14.4 Semiconductor Servicing

There are two distinct classes of semiconductors used in the transceiver: discrete devices, such as transistors and diodes, and monolithic integrated circuits. You can obtain substantial information about the operation of the transistors and diodes by measuring the voltage on the various leads. With integrated circuits, however, there is no external access to much of the circuitry, and it is often necessary to use the black box or substitution approach to servicing.

14.4.1 Signal and Switching Diodes

You can check all diodes with an ohmmeter. They should show a low forward resistance and a high reverse resistance. Check the circuit before making any measurements, as the diode is frequently shunted by other components. This requires you to lift one lead before measuring the resistance.

Many of the diodes are used as switches or gates. If the diode is operating correctly, there will be a drop of approximately 0.7V across the diode junction in the ON state.

14.4.2 Varactor Diodes

The varactor diode is designed to change capacitance across the reverse-biased junction as the voltage applied to it changes. Varactors exhibit the same resistance characteristics as signal diodes and can be checked in the same way.

14.4.3 Bipolar Transistors

An out-of-circuit method of checking bipolar transistors is to consider the base-emitter and the base-collector junctions as two separate diodes.

1. Connect one lead of the ohmmeter to the base.
2. Connect the other lead first to the collector and then to the emitter.
3. Reverse the polarity of the ohmmeter leads and repeat the test. This test should indicate high resistance with the leads in one polarization and low resistance in the other. Only in rare instances does a transistor that passes this test prove to be faulty in other ways.
4. Use a DVM to make a simple in-circuit check of a transistor. The potential across the base-emitter junction should be about 0.7V. A substantial difference indicates a fault in the transistor or in the surrounding circuitry.

14.4.4 Integrated Circuits

Complex internal IC circuitry makes it impractical to do any analytical fault detection on IC devices, however the following guidelines can help to locate a fault in circuits with IC components:

1. Isolate the fault to a particular stage. Check pin voltages against typical values given in the manufacturer's specification charts.
2. If there are any substantial variations, check the surrounding circuit components.
3. Check the IC through substitution.

14.5 Component Replacement

All transceiver printed circuit boards are heavy epoxy fiberglass with 2 oz. tinned copper foil, meeting applicable military specifications. Faults in the boards are not likely to occur, unless they are handled improperly when replacing components. If you follow correct component preparation and soldering procedures, you can replace components many times without damaging the board. Most integrated circuit (IC) components are installed in sockets for easy replacement.

For easy component replacement, begin with the correct tools. The soldering iron must have a small, instrument-type tip, no larger than the circuit board pads.

CAUTION: Do not use a tiny, low temperature, instrument type iron; the soldering iron must heat the solder sufficiently to melt the it quickly, otherwise component and/or board damage can occur.

1. Use the soldering iron to melt the solder at the connection.
2. While the solder is still molten, remove it with a desoldering tool.

These come in many forms, but even a simple type, consisting of a suction pump with a teflon tip, is satisfactory.

3. After all solder is removed, remove the component leads from the solder pad with a gentle tug.

   To reduce the risk of damaging the board, do not exert any stress on the foil solder pad while removing the component, especially when the connection is hot. The copper foil adhesive forms an extremely strong bond to the board when cold, but can be removed fairly easily at soldering temperature.

4. Before installing the new component, clear the holes of any remaining solder by again applying heat and using the desoldering tool.

   A frequent cause of foil damage is pushing the component through the hole and melting the solder at the same time. If the lead catches, it frequently lifts the foil from the board.

14.6 Troubleshooting

14.6.1 General Fault Location

Non-technical personnel can determine the reason for many faults without opening the transceiver case. The table below lists the faults that can be identified by using the front panel controls.

Table 14-2 General Fault Location Chart

Symptom	Possible Fault	Action
No Display	Battery dead	Turn **Mode** switch to **USB** and listen for receiver noise. No noise indicates a dead battery. Receiver noise indicates a display fault.
No Audio	Handset fault	Check for sidetone during TX. If sidetone is present, handset is operative and a receiver fault is indicated.
No Sidetone (RX Audio Present)	Transmitter not operating	Absence of an audible tone in the handset speaker means the transmitter is not providing the correct output power. Sidetone audio is inhibited by lack of RF output. Retune the antenna; an incorrect match can restrict output power.
Sidetone Distorted	Fault in transmitter exciter or receiver	The sidetone is generated by listening to the transmitted signal in the receiver. This provides a positive test that the low-level stages are operating correctly.
Battery Icon Illuminated	Battery voltage low	Replace and recharge battery.

Table 14-2 General Fault Location Chart (continued)

Symptom	Possible Fault	Action
Receiver Audio Garbled	One of the stations is set to the wrong frequency or out of calibration.	Use **Tune** knob to retune receiver.
No communication: Receiver and Transmitter appear to operate normally	Incorrect frequency. Incorrect sideband.	Check displayed frequency. Check **Mode** knob (USB normal).

14.6.2 Basic Board Fault Location

Table 14-3 on page 14-17 provides a basic guide for locating faulty boards without the use of test equipment. These methods cannot detect all fault conditions. If this approach is unsuccessful, replace the boards systematically A preliminary check can indicate which boards are operational. For example, the Synthesizer board is used in both receive and transmit modes. This means that the Synthesizer board is not faulty if either the transmitter or receiver is operational.

Before replacing any boards, check all cable connections carefully. A broken wire or a loose connector can prevent the board from operating.

It is normally not necessary to make any adjustments or to realign the transceiver after replacing a board.

For procedures on removing and replacing boards, refer to “Board Removal and Replacement” on page 14-7.

Table 14-3 Fault Location Table

Board	Symptom/Action	Possible Problem/Solution
Preliminary Check Check supply voltages +12, +8, and +5. Measure R8; look for read of 8V. Press PTT; relay K13 on Audio/Filter board should close. Measure T8; look for read of 8V.		
Audio/Filter Board	Audio completely dead, squelch off, no hiss or static, maximum audio gain.	Board or handset defective. Squelch mode is active.
	TX has no output except in CW mode.	Handset defective.
1650 kHz IF board	Receiver operational.	Board should also be operating in transmit mode.
	Disconnect **RX Out** coax connector.	If noise level does not decrease, the board is defective.
Mixer Board	Disconnect 1650 kHz coax connector from 1650 kHz IF board.	If receiver noise level does not decrease, board is defective.

Table 14-3 Fault Location Table (continued)

Board	Symptom/Action	Possible Problem/Solution
Power Amplifier Board	No simple check without instruments.	Carefully check voltages and connections before replacement.
Tuner Board	Tuner does not tune when **Whip Tune** button pressed.	Make sure antenna mount or long-wire adapter is screwed into antenna post.
Synthesizer Board	Transceiver operates in either transmit or receive mode.	Board is operational.
Processor Board	Multiple operating malfunctions.	Processor controls all of the tuning, mode and switching functions.
	Memory functions not retained.	Replace lithium battery. (Nominal life is 10 years).
Display Board	Transceiver operating correctly but display is not operating.	Check connections.
Junction Board	+5, +8, +12V supplies missing.	Board defective.
Microphone	Transmitter does not operate.	Swap with known good handset. Ground pin C of connector and touch pin B with hand. If transmitter shows RF output, microphone is faulty.

14.6.3 Detailed Board Fault Location

This section provides more specific information to measure the performance of each board. You should have a understanding of the operation of the test equipment (refer to “General Fault Location” on page 14-16 and “Basic Board Fault Location” on page 14-17) to locate the fault area and then use the information in this section to confirm the nature of the fault.

Supply Voltages

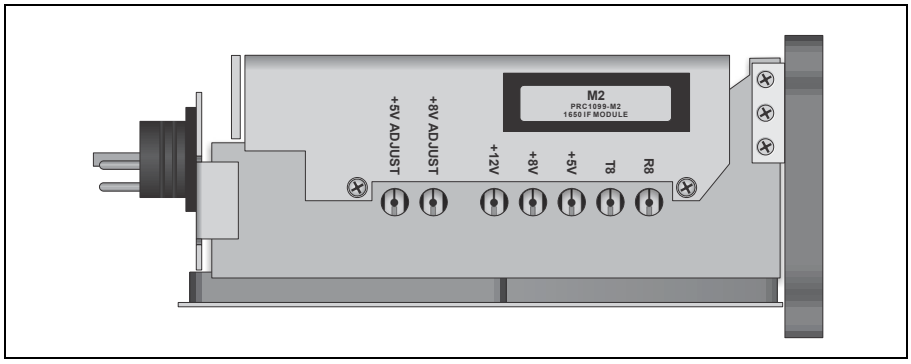
To check the radio supply voltages:

1. Connect an external 13.8V, 5A power supply to the PRC1099A. Use either the PRC-PS power supply or the PRC-CA12V battery cable.

   The PRC-CA12V cable includes a protective diode to prevent damage if the polarity of the power supply is accidentally reversed. There is a small voltage drop across this diode.

2. Turn the **Power** knob to **LO**.

3. On the chassis side panel, use a DVM to probe the supply voltage test points to verify that the +12V supply voltage is 12 VDC, the +8V and R8 (in receive mode) are +8 VDC, and the +5V supply is 5 VDC.



4. Press PTT. Verify that the T8 line is +8 VDC.

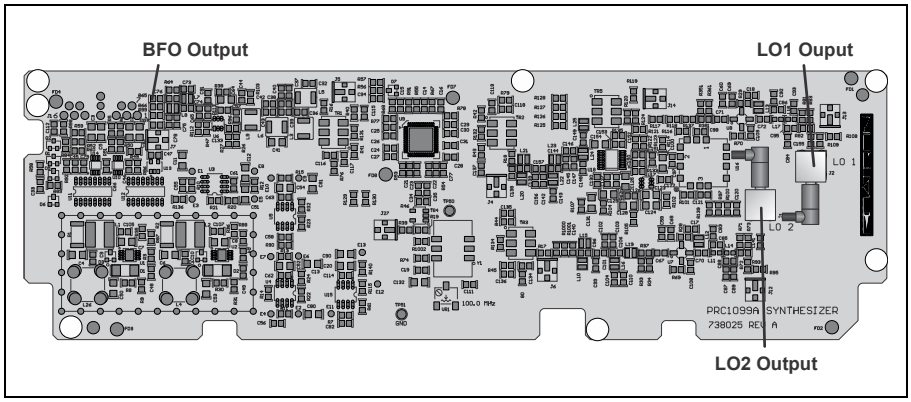
   The voltage regulators and voltage adjustment controls are located on the Junction board, with the R8 and T8 clamps.

CAUTION: Correct operating voltages must be present before checking the transceiver. Check the power supply, wiring and board connections before replacing the Audio or Processor boards.

Synthesizer Board

If the radio works correctly in either the transmit or receive mode, the Synthesizer board is operating normally. To verify signal levels, make the following measurements:

1. Remove the cover on the Mixer/Synthesizer assembly (refer to “Remove and Replace the Synthesizer Board” on page 14-10) to access the RF input and output connections on these boards.
2. Connect a frequency counter to 1st LO output (J2).



The frequency should be the operating frequency of 76.6 to 105 MHz depending on the channel frequency. For example, if the channel frequency is 5.123 MHz, the local oscillator output should be 80.123 MHz in USB mode or 78.473 MHz in LSB mode.

3. Connect the frequency counter to 2nd LO output (J3).

   The frequency should be approximately 73.35 MHz.

4. Connect a frequency counter to BFO output J1 pin 12 (R65 solder pad closest to J1 connector pin 7).

   The frequency should be 1650 kHz in USB mode, or 1647 kHz in LSB mode.

Mixer Board

If the radio works correctly in either the transmit or receive mode, the Mixer board is operating normally. To verify signal levels, make the following measurements:

1. Connect an oscilloscope to **TX OUT** and the signal generator to **1650 kHz I/O** (refer to "Mixer Board Signal Connections and Adjustment Points" on page 14-26).
2. Set the generator frequency to 1650 kHz and the output level to -10 dBm. Key the radio without modulation input.

   The output measured on the oscilloscope at **TX OUT** should be approximately 0.5 Vpp at the channel frequency.

3. Connect the oscilloscope to **1650 kHz I/O** and the signal generator to **RX IN**.
4. Set the signal generator to the transceiver operating frequency (USB +1 kHz) and the output level to -60 dBm.

   The output measured on the oscilloscope should be approximately 20 mVpp at 1650 kHz.

   Note: If the 75 MHz IF amplifier 1 (Q7) is not operating, check the AGC voltage (refer to Figure 14-9 on page 14-26). It should be approximately 4V. The AGC voltage is supplied by the Audio/Filter board, and a fault in this board can prevent the Mixer board from operating correctly in receive mode.

1650 kHz IF Board

In transmit mode, a low level sample is routed through the receive amplifier stages on the 1650 kHz IF board to produce a sidetone signal that is applied to the Audio/Filter board and to the front panel Audio connectors. The presence of a sidetone at the handset or headset verifies that the 1650 kHz IF board is operating correctly in receive mode as well.

1. Connect the oscilloscope to **TX OUT** and the signal generator to **1650 kHz I/O** (refer to "Mixer Board Signal Connections and Adjustment Points" on page 14-26).
2. Connect the signal generator to **TX IN**.
3. Adjust the output level to -18 dBm at 1650 kHz.
4. While listening on a handset or headset connected to one of the front panel Audio connectors, press PTT and speak. Listen for your voice in the handset or headset.

   Normal audio output in the handset or headset indicates the 1650 kHz IF board is operating correctly.

Audio/Filter Board

Perform the Synthesizer, Mixer and 1650 kHz IF board checks to verify these boards are operating properly. The transmit audio sidetone verifies the Audio/Filter board is operating correctly (refer to "1650 kHz IF Board" on page 14-20).

1. Set the front panel Volume control to maximum. With the handset or headset, check for low-level hiss.
2. Press PTT and listen for a clicking sound from the radio when the T/R relays close.
3. Check the tone oscillator by connecting a ATF-2TONE test fixture or a CW key device to one of the front panel Audio connectors.
4. Set the Power switch to **HI**. Measure the output power. It should measure approximately 20W.
5. Set the Power switch to **LO**. Measure the output power. It should measure approximately 5W.
6. Check the other Audio connector at **HI** and **LO** power settings.

   The tone oscillator is used for CW and antenna tuning. If the transmitter operates normally in the CW mode but not on voice, the problem is with the handset or the audio connections to the board.

7. Check RF filters.

   The filters switch at 3.1, 5.1, 8.0, 13 and 20 MHz. Check the filters at 2.0, 3.1, 5.1, 8.1, 13.0. and 20.0 MHz. Incorrect operation in one filter range indicates a fault in the switching relays or the filter.

PA Board

To verify the PA board is operating correctly:

1. Connect a signal generator to **TX IN**.
2. Set the frequency to that of the transceiver (USB +1 kHz)

3. Key the radio without modulation.
4. Increase the output level until the power output is 20W.

   The drive level should be approximately +3 dBm.

Antenna Tuner Board

To verify the Antenna Tuner board is operating correctly:

1. Connect an AT271/U (10 ft. whip with base) into the front panel whip antenna base connector.
2. Press the front panel **Whip Tune** button. The tuner should go through the tune cycle.
3. If the pulse tune tone indicates that the tuner did not achieve a correct match, check the antenna connections and try retuning on a different frequency.
4. If the tune cycle does not initiate, make sure the antenna mount or long-wire adapter is opening the switch at the base of the antenna post.

   Note: The Antenna Tuner board circuitry is controlled by the processor. A fault in the Processor board usually causes other transceiver control malfunctions.

Processor Board

Many of the data and control functions on the Synthesizer, Display, Antenna Tuner boards are under direct control of the processor. A fault in the Processor board normally causes multiple malfunctions in the transceiver. Check the Processor board by direct board replacement.

The lithium-ion battery for memory backup is located on this board. Replace this battery if the radio does not retain channel memory when the radio is turned off.

Display Board

The Display board should only be replaced if all other radio functions are normal. Check the Display board by direct board replacement.

14.7 Adjustments

This section provides the adjustment point descriptions and locations on each board.

14.7.1 Audio/Filter Board

Table 14-4 below provides the adjustments included on the Audio/RF filter board. Figure 14-7 on page 14-24 provides adjustment component locations with adjustments and signal input/outputs indicated.

Table 14-4 Adjustment Potentiometers

Designator	Adjustment
R12	Adjusts the squelch setting; at the factory, this is generally set for the lowest setting that permits squelch to open as an incoming signal is swept through passband.
R50	Adjusts carrier balance—factory set for minimum RF output in a keyed, unmodulated condition.
R83	Sets transmit output to 20W in high power mode.
R82	Sets transmit output to 5W in low power mode.
R65	Sets CW tone oscillator frequency.
R24	Sets voice detect trip point.
R107	Sets contrast level of the Display board.

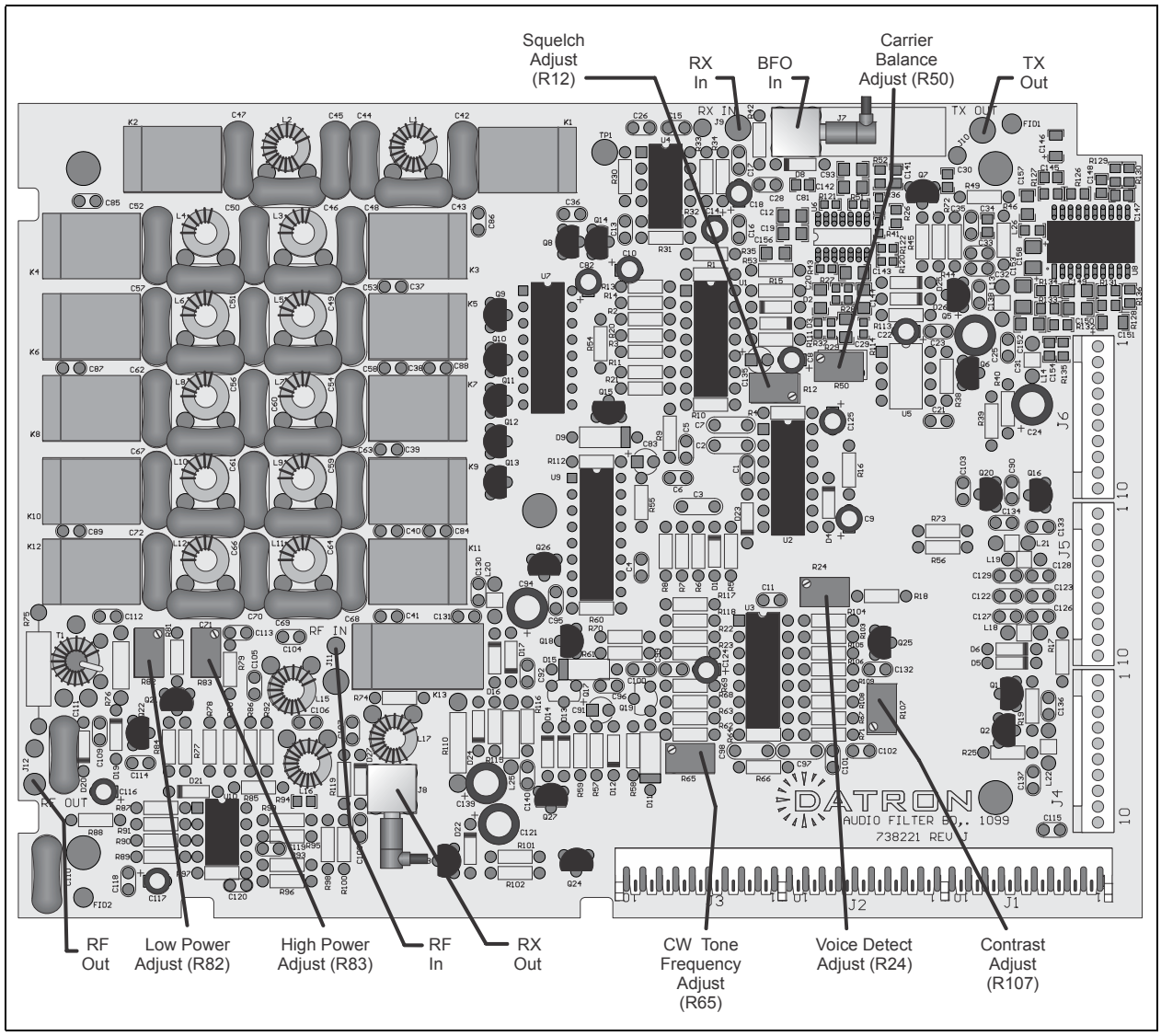


Figure 14-7 Audio/Filter Signal Connections and Adjustment Points

14.7.2 1650 kHz IF Board

Figure 14-8 below provides the component locations for adjustments and signal input/output points. Table 14-5 summarizes the 1650 kHz IF board adjustments.

Table 14-5 1650 kHz IF Board Adjustments

Designator	Adjustment
T1, T2, L1	Aligns the crystal filter for flattest passband response—factory set for ±0.5 dB ripple in transmit mode.
T3, T4	Optimizes output in receive mode—factory set for maximum output.

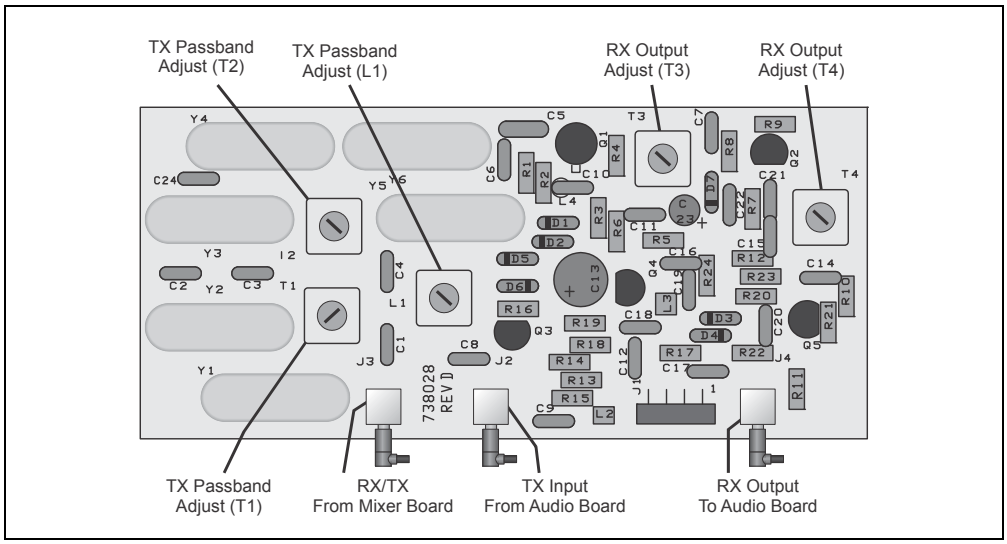


Figure 14-8 1650 kHz IF Board Adjustment Points

14.7.3 Mixer Board

Table 14-6 provides a summary of Mixer board adjustments. Figure 14-9 provides signal input/output points and adjustments.

Table 14-6 Mixer Board Adjustments

Designator	Adjustment
C58	Optimizes 2nd LO. The 2nd LO output should be approximately 2.0 Vrms and monitored at the coaxial cable port. The 1st LO output should be approximately +7 to 10 dBm monitored at TP1.
C53, T3	Sets the receiver output level—these adjustments are performed at factory for maximum RX output.

Table 14-6 Mixer Board Adjustments (continued)

Designator	Adjustment
C44, C17	Optimizes the 75 MHz filter passband. 1 Set the signal generator to 7.0 MHz and the level at -50 dBm. 2 Adjust C44 and C17 for maximum output. 3 Alternate adjustments for C44 and C17 between signal generator settings of 7.0 MHz and 6.999 MHz until levels are equal.
R37, C65, C24	Optimizes CW oscillator. 1 Set the radio to 7.0000 MHz. 2 Connect a wattmeter and dummy load to the 50 ohm output. 3 Using a CW key device, key the radio and adjust C65 and C24for maximum output. 4 Check all test frequencies and insure output power does not deviate more than 3W.

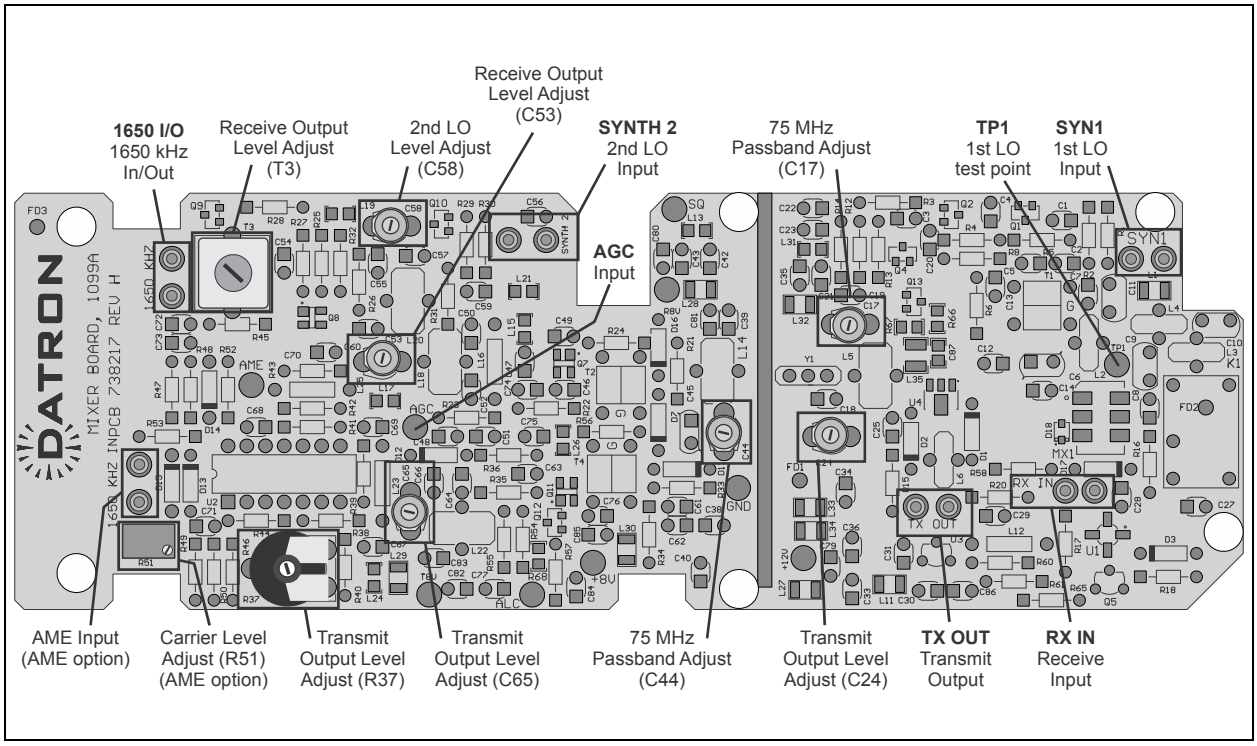


Figure 14-9 Mixer Board Signal Connections and Adjustment Points

14.7.4 PA Board

To adjust the amplifier stage bias current: turn R24 and R19 fully CCW (counter clockwise). Monitor the +12 VDC current into the module. Set the driver bias current to 165 mA by adjusting R19. Using R24, slowly increase the (final bias) current by 85 mA until you obtain a total reading of 250 mA.

Table 14-7 provides a summary of PA board adjustments. Figure 14-10 provides signal input/output points and adjustments.

Table 14-7 PA Board Adjustments

Designator	Adjustment
R19	Sets the driver stage bias level.
R24	Sets the final amplifier stage bias level.

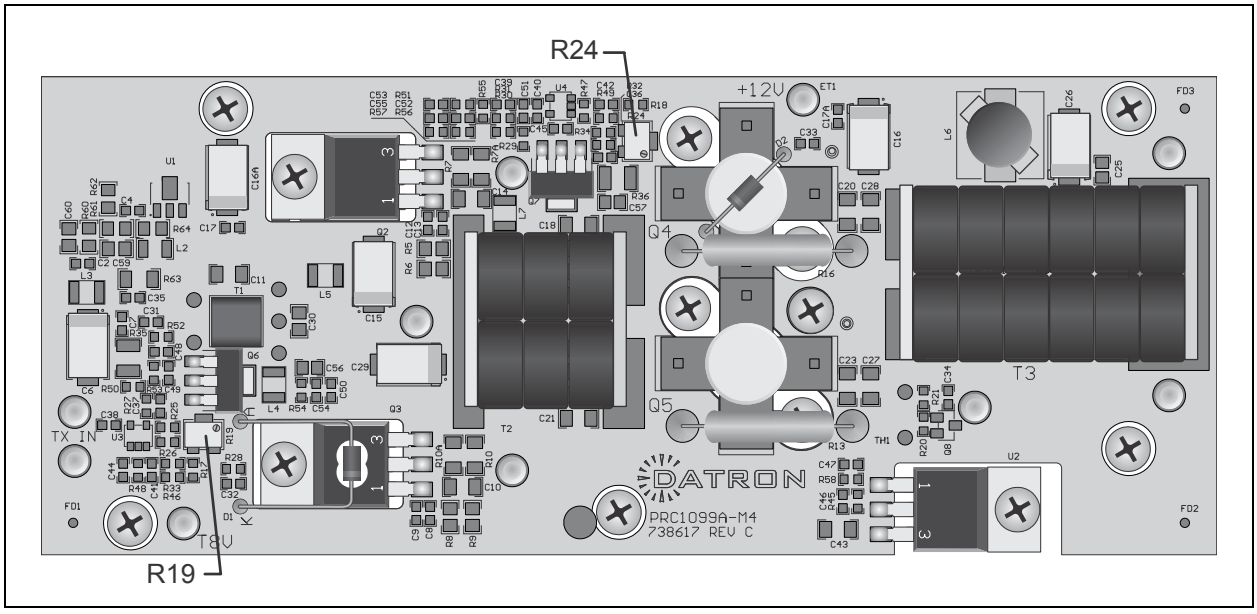


Figure 14-10 PA Board Signal Connections and Adjustment Points

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