



R8B Communications Receiver

Service Manual

SAFETY INSTRUCTIONS

SAFETY PRECAUTION

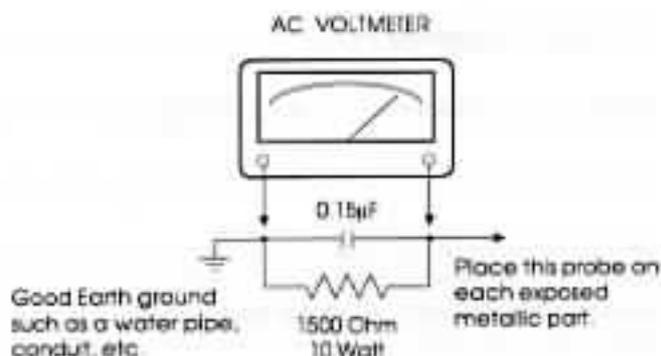
WARNING: Service should not be attempted by anyone unfamiliar with the necessary precautions on this unit.

The following are the necessary precautions to be observed before servicing this chassis.

1. When replacing a chassis in the cabinet, always be certain that all the protective devices are put back in place. Examples of these items are: non-metallic control knobs, insulating covers, shields, and isolation resistor-capacitor networks etc.

2. Before returning the set to the customer, always perform an AC leakage current check on the exposed metallic parts of the cabinet, as well as antennas, terminals, screwheads, metal overlays, control shafts etc. Be sure the set is safe to operate without danger of electric shock. Plug the AC line cord directly into the 120V AC outlet (do not use a line isolation transformer during this check). Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner:

Connect a 1500 ohm, 10 watt resistor, paralleled by a 0.15 mF, AC type capacitor, between a known good earth ground (water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination of 1500 ohms resistor and 0.15 mF capacitor, reverse the AC plug at the AC outlet and repeat AC voltage measurements for each exposed metallic part. Voltage measured must not exceed 0.3 volts RMS. This corresponds to 0.2 milliamp AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.



PRODUCT SAFETY NOTICE

Many electrical and mechanical parts in this chassis have special safety-related characteristics. These characteristics are often passed unnoticed by a visual inspection and the protection afforded by them cannot necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts with these safety characteristics are identified in this manual and are shaded on the schematics.

Before replacing any of these components, read the parts list in this manual carefully. The use of substitute replacement parts which do not have the same safety characteristics as specified in the parts list may create shock, fire, or other hazards.

BEFORE ATTEMPTING SERVICE

CAUTION: UNPLUG RECEIVER'S POWER CORD BEFORE PLUGGING IN CABLES ON PRINTED CIRCUIT BOARDS AND OTHER COMPONENTS. THEN DOUBLE CHECK FOR CORRECT CABLE POSITIONING BEFORE APPLYING POWER.

EVEN A MOMENTARY IMPROPER CABLE CONNECTION TO PRINTED CIRCUIT BOARDS OR OTHER COMPONENTS CAN CAUSE WIDE SPREAD DAMAGE TO INTEGRATED CIRCUITS AND DISCRETE COMPONENTS. NOTE: CABLES ARE NOT KEYED IN ALL CASES TO PREVENT IMPROPER INSERTION.

POWER MUST BE DISCONNECTED FROM RECEIVER'S POWER CORD TO PREVENT POSSIBLE DAMAGE WHEN INSERTING CABLES SINCE MANY CIRCUITS REMAIN OPERATIVE WHEN THE POWER BUTTON IS 'OFF.' ALWAYS DOUBLE CHECK FOR CORRECT CABLE POSITIONING BEFORE APPLYING POWER.

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4 Introduction

USING THE SERVICE MANUAL

This manual is divided into several sections for clarity and ease of use. Each major section is written with the assumption that the preceding portions of the manual have been read and understood by the user.

Section 1 is introductory in nature, and provides a general discussion of operating theory and module location.

Section 2 contains complete information on each functional element of the receiver. This information includes detailed circuit description, parts list, component location and schematic diagram. This section of the manual is divided by major functional element such as circuit board, module chassis, etc. for the purpose of rapid circuit, component and problem identification.

Section 3 is a complete alignment procedure for the receiver, and includes test equipment requirements/recommendations and test point locations.

Section 4 includes a complete description of any available accessories, including circuit descriptions, pictorials and schematics.

LOCATING A MALFUNCTION

The design of the receiver permits access to the Synthesizer board by removing only the bottom cover of the receiver. The Synthesizer board contains all the reference frequency generation and the entire microprocessor/digital control of the receiver. The Front End board is accessible by removing the top cover of the receiver. The Front End board contains all circuitry that converts the input signal to the 50 kHz IF prior to the main selectivity and audio detection. The FM detection circuitry is also contained on this board. The 2nd IF/Audio board is located immediately below the Front End board. It is accessible by securing the Front End board in a vertical position near the rear of the receiver by positioning the routed tabs on the board into the slots provided on the top surface of the rear panel metal chassis. Note that cabling to the Front End board is designed to permit full electrical operation of the receiver with the board temporarily positioned vertically. The Front Panel board is accessible by hinging the front panel down by removal of the top two screws securing the panel to the subpanel and loosening the lower two screws. Interconnection from board to board or control-to-board is with use of either flexible ribbon cable or flexible wire cable. RF signal interconnects are accomplished using coaxial pin and shield cables that mate to a board mounted coaxial connector at each termination end. Thus boards can be removed for part replacement if necessary and easily replaced for testing.

The first step in troubleshooting the receiver is the isolation of the malfunction to the major board. Refer to the **Generalized Theory of Operation** section for a general discussion of theory of operation which circuit board and specific section would cause the problem at hand. In most cases, the problem will involve only one of the four major boards. Once the problem has been isolated, refer to the appropriate portion of Section 2 for a full scale description of the circuit.

GENERALIZED THEORY OF OPERATION

Receiver Section

Incoming signals from antenna 1, antenna 2, antenna 3 receptacles are first routed through the antenna module. The 50/500 Ohm antenna 2 input is connected to a 9:1 transformer prior to being routed to the antenna module.

The output of this module is followed by a selector switch providing 10 dB of attenuation when engaged.

The signal is then sent to a 9 band, pin diode bandpass filter network.

The bandpass filter output is routed through a preamplifier providing a nominal 10 dB of gain. The output of the preamp is then supplied to a lowpass filter which serves to attenuate signals above 30 MHz. The signal is then mixed with the 45.0 MHz local oscillator (LO) to create a 45 MHz 1st IF signal. Conversion is accomplished by a low level, low noise active balanced mixer, to provide a wide dynamic range. The output of the mixer is filtered by a 4-pole, monolithic 45 MHz crystal filter. The purpose of the filter is to attenuate signals more than ± 6 kHz relative to the 45 MHz IF center frequency, thus protecting the subsequent stages of the receiver from strong adjacent channel signals, permitting sufficient bandwidth for proper narrow band reception. In this manner, optimum receiver dynamic range is preserved while providing proper sensitivity.

The output of the crystal filter is then amplified by the 2nd IF stage and then split into two paths. One path is sent to the FM detector circuitry and the other path is sent to the remaining 45 MHz IF circuitry.

When the FM mode is operational, the 45 MHz 1st IF signal is demodulated by a dual conversion FM detector integrated circuit. The detected RF level is used to control an audio squelch gate. The recovered audio is routed through the squelch gate to the audio amplifier stage.

In the remaining AM, CW, RTTY, LSB, and USB modes, the signal is amplified by a tuned, dual-gate FET amplifier to which automatic gain control (AGC) voltage is also applied. The output of this amplifier stage is then routed to the image reject mixer (IRM) which converts the 45 MHz 1st IF frequency to the 50 kHz 2nd IF frequency while simultaneously helping to further suppress the image response attenuation provided by the crystal filter. The IRM uses a 45.05 MHz \pm 3 kHz LO frequency to accomplish the conversion of the 45 MHz IF signal to the 50 kHz 2nd IF signal.

The 50 kHz 2nd IF signal is then applied to the main IF circuitry. The first stage of the IF is a dual-gate FET to which AGC voltage is applied. The output of this amplifier is routed to the noise blanker circuit. When activated, the noise blanker acts on short duration noise pulses removing them before they reach the 50 kHz bandpass filters which would cause the pulses to be stretched thus rendering the blanker ineffective.

Following the noise blanker is the first of two 4-pole bandpass filter networks which provide a cascaded 8-pole response. An amplifier between the first 4-pole and second 4-pole provides another stage of AGC controlled gain as well as impedance matching for the filter sections. The two filter networks are electronically switched to provide the 6.0, 4.0, 2.3, 1.8, and 0.5 kHz IF bandwidths. Following the IF selectivity, the signal is further amplified by one last dual-gate FET which is also AGC controlled, before being demodulated either by a product detector for USB, LSB, CW, RTTY, and AM or an AM synchronous detector. The product detector utilizes a locally generated 50 kHz beat frequency oscillator (BFO) carrier that tracks with the 2nd LO. The synchronous detector generates a synthesized 50 kHz carrier that is locked to the received AM carrier. The loop time constant is sufficiently long to maintain the 50 kHz carrier during periods when the received AM signal fades.

Once detected, the recovered audio is routed to the noise blanker. As noise bursts are detected on the 50 kHz IF signal, the IF signal is turned off for the duration of the pulse. The audio is routed through the noise blanker so that the audio signal level is held at a constant level for the duration of the noise pulse. The audio is then applied to the notch circuit. With the notch circuit enabled, audio frequencies from 500 Hz to 5 kHz are nulled by summing the audio with a 180 degree phase-shifted and bandpassed audio signal. The notch is disabled by turning off the bandpass filter section of the circuit. Following the notch circuitry, the audio is routed to the squelch detector/gate circuitry. The squelch reference for all modes (including FM) is the buffered AGC line.

In all modes, except for FM, the AGC line can be influenced by the front panel RF Gain control setting. In the FM mode, the AGC voltage applied to the squelch detector is the FM RSSI relative signal strength voltage. The RF Gain control is inhibited from affecting the squelch reference in the FM mode of operation. In all modes (including FM), the squelch trip point is set via the front panel Squelch control.

After the squelch detector/gate circuitry, the audio is passed through a lowpass filter with a cutoff frequency of 5 kHz. The audio then splits into two main paths. One path routes the audio to two buffered audio line outputs. The other path applies the audio to the tone control circuitry which provides approximately \pm 10 dB of bass boost and bass cut as the front panel tone control is rotated to its extremes. From the tone control circuitry, the audio is routed through the volume control which in turn feeds the audio power amplifier for the speaker. The output of the power amplifier passes through the headphone jack prior to the selector switch which provides output to the internal speaker, external speaker or both internal and external speakers.

AGC voltage, developed prior to the demodulation, is used to control the gain of the IF stages. The same AGC signal is used to drive the 5-meter circuit to provide accurate received signal strength indication. AGC decay time constants are electronically selected by front panel and micro-processor control.

6 Introduction cont'd.

FREQUENCY CONTROL

The receiver features synthesizer control of the received frequency. This allows the receiver to cover a wide frequency range without the use of range crystals or other frequency determining elements.

The reference for the synthesizer is generated by a 35 MHz crystal oscillator on the synthesizer board. This reference is used by each of three nested phase locked loops which operate over the range of 45.01 - 75.0 MHz to provide a first local oscillator signal. When this first local oscillator output is mixed with 10 kHz to 30 MHz incoming signals, the result is a 45 MHz 1st IF frequency. Additionally, the 35 MHz reference is used in each loop to mix or translate signals to the appropriate frequencies. In the PLL 1 loop, the 35 MHz reference is used to translate the output of the PLL 2 loop from 6.0 MHz to 41.0 MHz. Similarly, the 35 MHz reference is doubled to produce 70 MHz which is used in PLL 2 and PLL 3 loops to translate signals. The 35 MHz reference is also divided by 10 to produce a 3.5 MHz reference for the optional VHF Converter board.

The three phase locked loops are nested such that the inner most loop (PLL 3) provides a reference signal to the middle loop (PLL 2). The middle loop in turn provides a reference signal to the outer loop (PLL 1). The inner loop voltage controlled oscillator is divided by 20 from a frequency of 130 MHz to 130.2 MHz. This signal is used to lock PLL 2 on frequency. A 2 kHz step change at 130 MHz becomes a 100 Hz step at 6.5 MHz and the PLL 2 voltage controlled oscillator will change by 100 Hz.

In similar fashion, the PLL 2 voltage controlled oscillator output is divided by 10 from a frequency of approximately 60 MHz. This 6.0 MHz signal is used to lock PLL 1 on frequency. A 10 kHz frequency step change at 60 MHz becomes a 1 kHz step at 6.0 MHz and the PLL 1 voltage controlled oscillator will change by 1 kHz. A frequency step change of 1 kHz in PLL 3 is tracked, in turn by PLL 2 and then by PLL 1. Thus a 2 kHz frequency step in PLL 3 becomes a 100 Hz step in PLL 2 and a 10 Hz step in PLL 1, the desired minimum frequency step size of the synthesizer output.

Synthesizer load numbers are generated by the microprocessor and sent to each of the three synthesizer loops. The load number is recalculated each time the frequency is changed, either by the front panel keyboard or the main tuning wheel digital encoder. The programmable divider value 'N' is thus determined for each synthesizer loop. To cover the range of 45.01 - 75.0 MHz, four individual voltage controlled oscillators actually comprise VCO 1. The respective oscillator ranges are as follows: 45.010000 to 52.499999 MHz, 52.500000 to 59.999999 MHz, 60.000000 to 66.999999 MHz and 67.000000 to 75.000000 MHz. The microprocessor and related circuitry uniquely selects the proper oscillator from one of the four individual oscillators. Within software, the information corresponding to the operating frequency of the receiver is generated and sent to the front panel LCD display.

The passband tuning control is connected to a 22.525 MHz voltage controlled crystal oscillator (VCXO) which is doubled to produce 45.05 MHz. This oscillator is controlled by the front panel PASSBAND OFFSET control and microprocessor digital to analog conversion control which permits manual override of the automatic passband offsets by mode. Although this oscillator is crystal controlled, it is designed to allow its frequency to be moved over a limited range (approximately ± 3 kHz) centered on 45.05 MHz. The 45.05 MHz output is used as the injection for the image reject mixer (IRM) on the Front End board which converts the 45 MHz 1st IF signal to the 50 kHz 2nd IF frequency.

The 45.05 MHz oscillator is also mixed with the 35 MHz reference oscillator to produce a 10.05 MHz signal which is used as one input to a digital mixer. The 35 MHz reference oscillator is divided by 7 to produce a 5 MHz reference which is used as the second input to the digital mixer. The resultant output of the mixer is a 50 kHz IF signal that tunes ± 3 kHz in step with the 45.05 MHz 2nd mixer injection. This 50 kHz signal is used as the BFO to the AM and SSB product detector. Since the 45.05 MHz oscillator is used as the mixer injection which produces the 50 kHz IF signal and BFO, the 45.05 MHz output can be moved in frequency without changing the receiver operating frequency. Therefore, as the 50 kHz BFO is changed (by changing the PASSBAND OFFSET control voltage), the 45.05 MHz injection signal to the IRM is changed by an equal amount. This allows the 50 kHz 2nd IF signal to be positioned anywhere within a ± 3 kHz range with respect to the passband of two cascaded four-pole 50 kHz bandpass filters on the 2nd IF/Audio board while the receiver remains tuned to the incoming signal. This technique provides the PASSBAND OFFSET.

Interconnect Drawing Parts List/Misc. Chassis Parts List 7

INTERCONNECT DRAWING PARTS LIST

REF	PART NUM	DESCRIPTION
C1	3151405	CAP AXIAL .001 μ F, 10%, Y5P AX
D1	3080036	DISPLAY, LCD
DS1	3470004	LAMP-NEON #NE-2E/A9A
E1	3260015	ENCODER WHEEL #EC24B100B-9
F1	3420127	FUSE, T2A, 250V, 5x20mm
FOR 90-132V OPERATION		
F2	3420258	FUSE, T400mA, 250V, 5x20mm
FOR 218-264V OPERATION		
F2	3420255	FUSE, T200mA, 250V, 5x20mm
J1	3281024	JACK PHONE #YK821-5006
J2	3280011	UHF 50-239 CONNECTOR
J3	3280011	UHF 50-239 CONNECTOR
J7	3301264	2P QUICKCONNECT
KBD1	2055191	31 DIG. KEYBRD-PAD ASSY
MTR1	3580009	"S" METER
R1	3260005	RES VAR AF/RF GAIN 5K/3K
R2	3260006	RES VAR PBT/SQUEL 10K/10K
R3	3260009	RES VAR TONE/NOTCH 100K/100K
R4	3220055	RES C.FILM 100 OHM 5% 1/4W
R5	3220055	RES C.FILM 100 OHM 5% 1/4W
R6	3220000	RES C.FILM 0 OHM 1/4W
R7	3220215	RES C.FILM 5.6 K 5% 1/4W
R90	3250409	RES COMP 4.7 MEG 10% 1/2W
S1	3670550	SW VOLT.SELECT #J-R1026-01
SPK1	3640035	SPEAKER 4-OHM, LAUBE #FEB450F
T1	3690388	POWER XFMR

MISCELLANEOUS CHASSIS PARTS

PART NUMBER	DESCRIPTION
3372630	TERMINAL, ELECTRIC TINNED #008-0115002
3350914	WASHER, LOCK 3/8" ID EXTERNAL TOOTH
3372503	JUMPER 2-CIRCUIT SHUNT
3390017	FOOT SET, REAR
3390150	FOOT, RIGHT
3390155	FOOT, LEFT
3495050	BAIL
4454013	KNOB, TUNING WITH INSERT
3450002	KNOB, SMALL BOTTOM
3450003	KNOB, SMALL TOP TAPERED
3473210	LENS (DIFFUSER) LCD LGT.
3472616	REFLECTOR LGHT, HOUSING/LCD HOLDER
3282018	SOCKET, AC 3-PRONG
3712032	CORD, LINE 18/3 SVT BLACK 6' DETACHABLE
3851305	OWNER'S MANUAL
4440603	REAR PANEL SCREENED
4442586	FRONT SCREENED PANEL
4807518	COVER, TOP BLK VINYL
4807550	COVER, BOTTOM
2707319	CABLE ASSEMBLY 14-14R CKT DISPLAY CONNECT
3711164	CABLE, COAXIAL 20 INCH
4442595	SUBPANEL
4350213	BRACKET, LCD SWITCHING POWER SUPPLY/AUDIO BOARD
4350214	BRACKET, LCD SWITCHING POWER SUPPLY/AUDIO BOARD
4560073	SHIELD, LCD SWITCHING POWER SUPPLY/AUDIO BOARD
4560311	SHIELD, ANTENNA-WALL
4560312	SHIELD, ANTENNA-TOP
3360020	NYLINER
3320381	SCREW, PLASTITE #4-20x1/2" PAN PHL
3320244	SCREW, #4-40x1/4" PAN PHL ZINC
3320572	SCREW, #6-32x1/4" TRUSS PHL BLACK
3320461	SCREW, #6x5/8" PAN PHL DEEP THREAD ZINC (Foot Screws)

8 Notes



The page contains two columns of horizontal lines for writing notes. The left column has approximately 25 lines, and the right column has approximately 25 lines. The lines are evenly spaced and extend across most of the width of each column.

FRONT END BOARD THEORY OF OPERATION

Incoming signals from the ANT 1 and the converter antenna receptacles are first routed through the antenna switching circuitry consisting of relay K4 and K2. ANT 2 is first routed through a 9:1 impedance matching transformer, then to K4. ANT 1 is selected when both K2 and K4 are in the off state. When ANT 2 is selected by the user via the front panel controls, K4 is energized by Q7 and its associated circuitry. When the converter antenna is selected, K2 is energized by Q5 and its associated circuitry. Both Q5 and Q7 receive their control signals from the microprocessor/synthesizer board via the connector P5.

The signal is then sent through a receiver protection network formed by circuit elements CR31 through CR38, L61, C151 and C152. Following the protection network, the signal is then sent through a selectable attenuator which is formed by K3, R84 and R102. When K3 is in the off state, the attenuator is selected. Attenuation is provided by circuit components R84 and R102 which form an approximately 10 dB resistive pad. When K3 is energized by a control signal sent to Q8 (via connector P5), the attenuator is bypassed. The signal path continues through a 9:1 impedance matching transformer before reaching the bandpass filters. The signal is then routed through 1 of 9 bandpass filters.

The cutoff frequencies of each filter is as follows:

- 0-0.5 MHz
- 0.5-1.5 MHz
- 1.5-2.5 MHz
- 2.5-4.0 MHz
- 4.0-7.5 MHz
- 7.5-10.5 MHz
- 10.5-15 MHz
- 15-22 MHz
- 22-30 MHz

Each bandpass filter has a set of PIN diodes that are normally reversed biased unless the filter is selected. The appropriate filter is automatically selected dependant on the displayed frequency. This is accomplished when U4 (74LS145) receives data from the microprocessor (via connector P5) and selects the appropriate filter by tuning on one of its outputs, which in turn removes the reverse bias voltage on the selected filter's pin diodes allowing the signal to pass. Following the bandpass filter, the signal is applied to a selectable preamplifier consisting of relay K1, Q9 (BFR91A) and its related circuitry. K1 is controlled by Q6 and when energized Q9 provides 10 dB of gain.

The preamplifier output is sent through the master low pass before reaching the input of the first mixer. The master low pass filter consists of the following components, C118, C121, C122, C126, C127, C128, C129, L52, L53, and L54.

At the first mixer, formed by Q3, Q4 and associated components, the incoming signal is mixed with the output of the synthesizer VCO to create a 45 MHz intermediate frequency (IF) signal. Q3, Q4 and associated components form a high level, low noise, active balanced mixer, to provide wide dynamic range. The signal is injected at transformer T8 and the high-side local oscillator (LO) is injected at J1. The output of the first mixer stage is connected to a matching transformer, T3 and resonating capacitor which passes the 45 MHz signal to the input of a 4-pole, monolithic 45 MHz crystal filter. Capacitor C74, provides matching for the crystal filter. The purpose of this filter is to attenuate signals more than ± 6 kHz removed from the 45 MHz IF center frequency, thus protecting the remaining stages of the receiver from strong adjacent signals, yet permitting sufficient bandwidth for proper narrow-band FM reception. In this manner, optimum receiver dynamic range is preserved while providing proper sensitivity. The output of the crystal filter is matched by transformer, T2 and associated resonating capacitor C72. Following the matching elements, the signal is applied to a dual gate mosfet amplifier stage, Q1 and associated components. The gain of the stage is controlled by an AGC voltage applied through R54 and R55 to gate 1 of Q2. The main signal path is impedance matched by transformer, T1 and applied to the Image Reject mixer circuitry, composed of M1, M2 and associated components. The signal present at the junction of T1 and R44 is applied through C68 to the FM detector circuitry composed of integrated circuit, U2 and associated components.

The FM detector is comprised of U2 and its accompanying circuitry. U2 is basically a complete narrowband FM receiver which provides recovered FM audio and an RSN (Received Signal Strength Indicator) output. Both the audio and the relative signal strength voltage are sent to the 2nd IF/Audio board.

After leaving amplifier stage Q2 and transformer T1, the 45 MHz IF signal enters the Image Reject Mixer circuit (IRM). The IRM provides protection from the unwanted image frequency as well as providing the 50 kHz 2nd IF frequency. The IRM is composed of four circuit elements: the 45 MHz, 90 degree divider formed by L41, L42, L45, L46, C93, C101, C109, C104, C106 and R58; the 0 degree divider formed by R81, R82 and R83; the 50 kHz 90 degree divider formed by L56, L57, L58, L59, C135, C150, C136, C148, C149 and R82; and two double balanced mixers, M1 and M2.

Front End Board Parts List 13

PC BOARD ASSEMBLY, P/N: 2070707

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C1	3184068	CAP FILM .1 @ 100V 10% RD	C62	3150845	CAP AX 47.0 PF 5% N750 AX
C2	3184068	CAP FILM .1 @ 100V 10% RD	C63	3151515	CAP AX .01 MF 20% Y5P AX
C3	3151648	CAP AX .10 MF 50V T&R AX	C64	3180109	CAP ELEC 22@25 20% RD
C4	3151648	CAP AX .10 MF 50V T&R AX	C65	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C5	3151259	CAP AX 220 PF 10% Y5P AX	C66	3166120	CAP CHIP .001UF X7R (0805) SF
C6	3184019	CAP FILM .001 @ 100V 5% RD	C67	3205208	CAP VAR TRIMMER 6.8-45 PF
C7	3184019	CAP FILM .001 @ 100V 5% RD	C68	3167520	CAP CHIP 56 PF NPO (0805) SF
C8	3151648	CAP AX .10 MF 50V T&R AX	C69	3166105	CAP CHIP .01UF X7R (0805) SF
C9	3180109	CAP ELEC 22@25 20% RD	C70	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C10	3151259	CAP AX 220 PF 10% Y5P AX	C71	3167555	CAP CHIP 0.0047UF X7R (0805)SF
C11	3180064	CAP ELEC 10@50 20% RD	C72	3205208	CAP VAR TRIMMER 6.8-45 PF
C12	3184068	CAP FILM .1 @ 100V 10% RD	C73		NOPART
C13	3184068	CAP FILM .1 @ 100V 10% RD	C74	3167507	CAP CHIP 12 PF NPO (0805) SF
C14	3151259	CAP AX 220 PF 10% Y5P AX	C75		NOPART
C15	3151345	CAP AX 470 PF 10% Y5P AX	C76	3151515	CAP AX .01 MF 20% Y5P AX
C16	3151515	CAP AX .01 MF 20% Y5P AX	C77	3151065	CAP AX 100PF 5% GP 50V AX
C17	3151345	CAP AX 470 PF 10% Y5P AX	C78	3150550	CAP AX 20.0 PF 5% NPO AX
C18	3151345	CAP AX 470 PF 10% Y5P AX	C79	3150550	CAP AX 20.0 PF 5% NPO AX
C19	3151515	CAP AX .01 MF 20% Y5P AX	C80	3151515	CAP AX .01 MF 20% Y5P AX
C20	3180109	CAP ELEC 22@25 20% RD	C81	3180109	CAP ELEC 22@25 20% RD
C21	3151155	CAP AX 150 PF 10% Y5P AX	C82	3167520	CAP CHIP 56 PF NPO (0805) SF
C22	3151515	CAP AX .01 MF 20% Y5P AX	C83	3166105	CAP CHIP .01UF X7R (0805) SF
C23	3151065	CAP AX 100PF 5% GP 50V AX	C84	3180109	CAP ELEC 22@25 20% RD
C24	3151648	CAP AX .10 MF 50V T&R AX	C85	3205207	CAP VAR TRIMMER 4-20 PF
C25	3151515	CAP AX .01 MF 20% Y5P AX	C86	3180152	CAP ELEC 100@50 RD
C26	3180012	CAP ELEC 1@50 20% RD	C87	3151515	CAP AX .01 MF 20% Y5P AX
C27	3151405	CAP AX .001 MF 10% Y5P AX	C88	3150550	CAP AX 20.0 PF 5% NPO AX
C28	3184068	CAP FILM .1 @ 100V 10% RD	C89	3151040	CAP AX 82.0 PF 5% N750 AX
C29	3180012	CAP ELEC 1@50 20% RD	C90	3150420	CAP AX 12.0 PF 5% NPO AX
C30	3151515	CAP AX .01 MF 20% Y5P AX	C91	3150508	CAP AX 15.0 PF 5% NPO AX
C31	3151295	CAP AX 330 PF 10% Y5P AX	C92	3151515	CAP AX .01 MF 20% Y5P AX
C32	3151155	CAP AX 150 PF 10% Y5P AX	C93	3150595	CAP AX 22.0 PF 5% NPO AX
C33	3151155	CAP AX 150 PF 10% Y5P AX	C94		NOPART
C34	3151515	CAP AX .01 MF 20% Y5P AX	C95	3166105	CAP CHIP .01UF X7R (0805) SF
C35	3180109	CAP ELEC 22@25 20% RD	C96	3167520	CAP CHIP 56 PF NPO (0805) SF
C36	3151065	CAP AX 100PF 5% GP 50V AX	C97	3151648	CAP AX .10 MF 50V T&R AX
C37	3180012	CAP ELEC 1@50 20% RD	C98	3151515	CAP AX .01 MF 20% Y5P AX
C38	3151648	CAP AX .10 MF 50V T&R AX	C99	3150779	CAP AX 43.0 PF 5% NPO AX
C39	3151648	CAP AX .10 MF 50V T&R AX	C100	3150420	CAP AX 12.0 PF 5% NPO AX
C40	3151515	CAP AX .01 MF 20% Y5P AX	C101	3150420	CAP AX 12.0 PF 5% NPO AX
C41	3150595	CAP AX 22.0 PF 5% NPO AX	C102	3151515	CAP AX .01 MF 20% Y5P AX
C42	3151259	CAP AX 220 PF 10% Y5P AX	C103	3180109	CAP ELEC 22@25 20% RD
C43	3151040	CAP AX 82.0 PF 5% N750 AX	C104	3205228	CAP VAR TRIMMER 10-120 PF
C44	3151040	CAP AX 82.0 PF 5% N750 AX	C105	3150595	CAP AX 22.0 PF 5% NPO AX
C45	3151040	CAP AX 82.0 PF 5% N750 AX	C106	3205228	CAP VAR TRIMMER 10-120 PF
C46	3151515	CAP AX .01 MF 20% Y5P AX	C107	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C47	3180109	CAP ELEC 22@25 20% RD	C108	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C48	3150595	CAP AX 22.0 PF 5% NPO AX	C109	3150595	CAP AX 22.0 PF 5% NPO AX
C49	3184042	CAP FILM .022 @ 100V 5% RD	C110	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C50	3151648	CAP AX .10 MF 50V T&R AX	C111	3151515	CAP AX .01 MF 20% Y5P AX
C51	3151648	CAP AX .10 MF 50V T&R AX	C112	3150305	CAP AX 8.2PF 10% NPO AX
C52	3150781	CAP AX 47.0 PF 5% NPO AX	C113	3150690	CAP AX 33.0 PF 5% NPO AX
C53	3150040	CAP AX 2.7 PF 10% GP AX	C114	3150305	CAP AX 8.2PF 10% NPO AX
C54	3151648	CAP AX .10 MF 50V T&R AX	C115	3150305	CAP AX 8.2PF 10% NPO AX
C55	3150115	CAP AX 4.7PF 10% NPO AX	C116	3151515	CAP AX .01 MF 20% Y5P AX
C56	3150640	CAP AX 27.0 PF 5% NPO AX	C117	3180109	CAP ELEC 22@25 20% RD
C57	3151425	CAP AX .0022MF 20% Y5P AX	C118	3167530	CAP CHIP 120PF NPO (0805) SF
C58	3150990	CAP CER. 68pF, 5%, N750 AX	C119	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C59	3151515	CAP AX .01 MF 20% Y5P AX	C120	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C60	3151117	CAP AX 120 PF 5% GP AX	C121	3166140	CAP CHIP 10 PF NPO (0805) SF
C61	3150845	CAP AX 47.0 PF 5% N750 AX			

14 Front End Board Parts List cont'd.

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C122	3167530	CAP CHIP 120PF NPO (0805) SF	L8	3524188	COIL RADIAL 82.0 UH RD
C123	3151648	CAP AX .10 MF 50V T&R AX	L9	3524186	COIL RADIAL 68.0 UH RD
C124	3180064	CAP ELEC 10@50 20% RD	L10	3524196	COIL RADIAL 270.0 UH RD
C125	3151405	CAP AX .001 MF 10% Y5P AX	L11	3524188	COIL RADIAL 82.0 UH RD
C126	3166148	CAP CHIP 33 PF NPO (0805) SF	L12	3524185	COIL RADIAL 56.0 UH RD
C127	3167533	CAP CHIP 180PF NPO (0805) SF	L13	3524185	COIL RADIAL 56.0 UH RD
C128	3166155	CAP CHIP 47 PF NPO (0805) SF	L14	3524176	COIL RADIAL 22.0 UH RD
C129	3167533	CAP CHIP 180PF NPO (0805) SF	L15	3524188	COIL RADIAL 82.0 UH RD
C130	3151648	CAP AX .10 MF 50V T&R AX	L16	3524185	COIL RADIAL 56.0 UH RD
C131	3151515	CAP AX .01 MF 20% Y5P AX	L17	3524178	COIL RADIAL 33.0 UH RD
C132	3180012	CAP ELEC 10@50 20% RD	L18	3524178	COIL RADIAL 33.0 UH RD
C133	3151648	CAP AX .10 MF 50V T&R AX	L19	3524510	COIL VAR.SHLD 7K3-20.0MHZ
C134	3151515	CAP AX .01 MF 20% Y5P AX	L20	3524173	COIL RADIAL 15.0 UH RD
C135	3184046	CAP FILM .033 @ 100V 5%	L21	3524185	COIL RADIAL 56.0 UH RD
C136	3184042	CAP FILM .022 @ 100V 5% RD	L22	3524177	COIL RADIAL 27.0 UH RD
C137	3180064	CAP ELEC 10@50 20% RD	L23	3524172	COIL RADIAL 18.0 UH RD
C138	3151648	CAP AX .10 MF 50V T&R AX	L24	3524170	COIL RADIAL 8.2 UH RD
C139	3151648	CAP AX .10 MF 50V T&R AX	L25	3524172	COIL RADIAL 18.0 UH RD
C140	3151648	CAP AX .10 MF 50V T&R AX	L26	3524177	COIL RADIAL 27.0 UH RD
C141	3151515	CAP AX .01 MF 20% Y5P AX	L27	3524171	COIL RADIAL 10.0 UH RD
C142	3151515	CAP AX .01 MF 20% Y5P AX	L28	3524173	COIL RADIAL 15.0 UH RD
C143	3151459	CAP AX .0047MF+80-20 Z5U AX	L29	3524160	COIL RADIAL 3.3 UH RD
C144	3151648	CAP AX .10 MF 50V T&R AX	L30	3524173	COIL RADIAL 15.0 UH RD
C145	3180152	CAP ELEC 100@50 RD	L31	3524171	COIL RADIAL 10.0 UH RD
C146		NO PART	L32	3524165	COIL RADIAL 5.6 UH RD
C147		NO PART	L33	3524168	COIL RADIAL 6.8 UH RD
C148	3184042	CAP FILM .022 @ 100V 5% RD	L34	3524171	COIL RADIAL 10.0 UH RD
C149	3184042	CAP FILM .022 @ 100V 5% RD	L35	3524171	COIL RADIAL 10.0 UH RD
C150	3184046	CAP FILM .033 @ 100V 5%	L36	3524155	COIL RADIAL 2.2 UH RD
C151	3151587	CAP AX .047 MF +80-20 Z5U AX	L37	3524168	COIL RADIAL 6.8 UH RD
C152	3151587	CAP AX .047 MF +80-20 Z5U AX	L38	3524165	COIL RADIAL 5.6 UH RD
C153	3151648	CAP AX .10 MF 50V T&R AX	L39	3524165	COIL RADIAL 5.6 UH RD
C154	3151648	CAP AX .10 MF 50V T&R AX	L40	3524165	COIL RADIAL 5.6 UH RD
C155	3151648	CAP AX .10 MF 50V T&R AX	L41	2510083	INDUCTOR TOROID-1290-1293
C156	3166105	CAP CHIP .01UF X7R (0805) SF	L42	2510083	INDUCTOR TOROID-1290-1293
C157	3166105	CAP CHIP .01UF X7R (0805) SF	L43	3524152	COIL RADIAL 1.8 UH RD
C158	3166105	CAP CHIP .01UF X7R (0805) SF	L44	3524165	COIL RADIAL 5.6 UH RD
C159	3166105	CAP CHIP .01UF X7R (0805) SF	L45	2510083	INDUCTOR TOROID-1290-1293
C160	3166105	CAP CHIP .01UF X7R (0805) SF	L46	2510083	INDUCTOR TOROID-1290-1293
C161	3166105	CAP CHIP .01UF X7R (0805) SF	L47	3524155	COIL RADIAL 2.2 UH RD
C162	3166105	CAP CHIP .01UF X7R (0805) SF	L48	3524160	COIL RADIAL 3.3 UH RD
C163	3166105	CAP CHIP .01UF X7R (0805) SF	L49	3524148	COIL RADIAL 1.0 UH RD
C164	3150550	CAP AX 20.0 PF 5% NPO AX	L50	3524160	COIL RADIAL 3.3 UH RD
CF5	3140424	CER. DISCRMNTR., MURATA CDB456C34	L51	3524155	COIL RADIAL 2.2 UH RD
J1	3280042	CONN.COAXPCMT.#TMP-J01X-V6	L52	3524140	COIL RADIAL 0.33 UH RD
J2	3280042	CONN.COAXPCMT.#TMP-J01X-V6	L53	3524138	COIL RADIAL 0.27 UH RD
J3	3280042	CONN.COAXPCMT.#TMP-J01X-V6	L54	3524138	COIL RADIAL 0.27 UH RD
J4	3280042	CONN.COAXPCMT.#TMP-J01X-V6	L55		NO PART
J5	3280042	CONN.COAXPCMT.#TMP-J01X-V6	L56	3520534	CHOKE ASSY 160.0 UH AX
J6	3301253	TERM.STP 3-CKT #LGR-0310-0001	L57	3520534	CHOKE ASSY 160.0 UH AX
K1	3620112	RELAY TAKAMISAWA #R2-12K	L58	3520534	CHOKE ASSY 160.0 UH AX
K2	3620108	RELAY TAKAMISAWA #MZ-12HS-K	L59	3520534	CHOKE ASSY 160.0 UH AX
K3	3620108	RELAY TAKAMISAWA #MZ-12HS-K	L60	3524196	COIL RADIAL 270.0 UH RD
K4	3620108	RELAY TAKAMISAWA #MZ-12HS-K	L61	3524078	COIL AIR 5-1/2T .11 UH
L1	3524199	COIL RADIAL 1.0 MH RD	L62	3524199	COIL RADIAL 1.0 MH RD
L2	3524193	COIL RADIAL 150.0 UH RD	M1	3045014	I.C. BAL.MIXER MCL-TUF-1
L3	3524196	COIL RADIAL 270.0 UH RD	M2	3045014	I.C. BAL.MIXER MCL-TUF-1
L4	3524193	COIL RADIAL 150.0 UH RD	P1	3280723	CONN.P.C. J5T#T3B-SQ-1
L5	3524199	COIL RADIAL 1.0 MH RD	P2	3280723	CONN.P.C. J5T#T3B-SQ-1
L6	3524196	COIL RADIAL 270.0 UH RD	P3	3280723	CONN.P.C. J5T#T3B-SQ-1
L7	3524186	COIL RADIAL 68.0 UH RD			

Front End Board Parts List cont'd. 15

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
P4	3280723	CONN P.C. J51#T3B-SQ-1	R52	3250834	RES CHIP 5.6K OHM 5% (0805) SF
P5	3280720	CONN P.C. J51#T8B-SQ-1 AX	R53	3250645	RES CHIP 1.5M OHM 5% (0805) SF
P6	3280720	CONN P.C. J51#T8B-SQ-1 AX	R54	3250857	RES CHIP 470 OHM 5% (0805) ?
Q1	3030104	TRANS 2N3904 MOTOROLA RD	R55	3220055	RES C.FILM 100 OHM 5% 1/4W AX
Q2	3030283	TRANS 35K179 NEC T&R SF	R56	3220055	RES C.FILM 100 OHM 5% 1/4W AX
Q3	3030511	TRANS SK152-3 RANK ONLY	R57	3220210	RES C.FILM 4.7 K 5% 1/4W AX
Q4	3030511	TRANS SK152-3 RANK ONLY	R58	3220035	RES C.FILM 10 K 5% 1/4W AX
Q5	3030104	TRANS 2N3904 MOTOROLA RD	R59	3250806	RES CHIP 22 OHM 5% (0805) ?
Q6	3030104	TRANS 2N3904 MOTOROLA RD	R60	3250810	RES CHIP 100 OHM 5% (0805) SF
Q7	3030104	TRANS 2N3904 MOTOROLA RD	R61	3250819	RES CHIP 1.0K OHM 5% (0805) SF
Q8	3030104	TRANS 2N3904 MOTOROLA RD	R62	3250807	RES CHIP 330 OHM 5% (0805) SF
Q9	3030302	TRANS BFR91A	R63	3220090	RES C.FILM 330 OHM 5% 1/4W AX
R1	3220255	RES C.FILM 18 K 5% 1/4W AX	R64	3220055	RES C.FILM 100 OHM 5% 1/4W AX
R2	3220190	RES C.FILM 2.2 K 5% 1/4W AX	R65	3220055	RES C.FILM 100 OHM 5% 1/4W AX
R3	3220195	RES C.FILM 2.7 K 5% 1/4W AX	R66	3220210	RES C.FILM 4.7 K 5% 1/4W AX
R4	3220190	RES C.FILM 2.2 K 5% 1/4W AX	R67	3260672	RES VAR PT10V 50K ?
R5	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R68	3250849	RES C 12K OHM 5% (0805) ?
R6	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R69	3250837	RES CHIP 22K OHM 5% (0805) SF
R7	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R70	3250806	RES CHIP 22 OHM 5% (0805) ?
R8	3220255	RES C.FILM 18 K 5% 1/4W AX	R71	3250849	RES C 12K OHM 5% (0805) ?
R9	3220160	RES C.FILM 1.0 K 5% 1/4W AX	R72	3250792	RES CHIP 430 OHM 5% (0805) ?
R10	3220300	RES C.FILM 68 K 5% 1/4W AX	R73	3250800	RES CHIP 10 OHM 5% (0805) SF
R11	3220300	RES C.FILM 68 K 5% 1/4W AX	R74	3250792	RES CHIP 430 OHM 5% (0805) ?
R12	3220145	RES C.FILM 820 OHM 5% 1/4W AX	R75	3220055	RES C.FILM 100 OHM 5% 1/4W AX
R13		NOPART	R76	3220055	RES C.FILM 100 OHM 5% 1/4W AX
R14	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R77	3220210	RES C.FILM 4.7 K 5% 1/4W AX
R15	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R78	3260687	RES VAR PT10V LIN 250 OHM ?
R16	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R79	3250806	RES CHIP 22 OHM 5% (0805) ?
R17	3220235	RES C.FILM 10 K 5% 1/4W AX	R80		NOPART
R18	3220315	RES C.FILM 100 K 5% 1/4W AX	R81	3220010	RES C.FILM 4.7 K 5% 1/4W AX
R19	3220090	RES C.FILM 330 OHM 5% 1/4W AX	R82	3220010	RES C.FILM 4.7 K 5% 1/4W AX
R20	3220060	RES C.FILM 120 OHM 5% 1/4W AX	R83	3220010	RES C.FILM 4.7 K 5% 1/4W AX
R21	3220170	RES C.FILM 1.2 K 5% 1/4W AX	R84	3220055	RES C.FILM 100 OHM 5% 1/4W AX
R22	3220235	RES C.FILM 10 K 5% 1/4W AX	R85	3220090	RES C.FILM 330 OHM 5% 1/4W AX
R23	3220100	RES C.FILM 390 OHM 5% 1/4W AX	R86	3220215	RES C.FILM 5.6 K 5% 1/4W ?
R24	3220260	RES C.FILM 22 K 5% 1/4W AX	R87	3220035	RES C.FILM 10 K 5% 1/4W AX
R25	3220300	RES C.FILM 68 K 5% 1/4W AX	R88	3220085	RES C.FILM 270 OHM 5% 1/4W ?
R26		NOPART	R89	3220035	RES C.FILM 10 K 5% 1/4W AX
R27		NOPART	R90	3220210	RES C.FILM 4.7 K 5% 1/4W AX
R28	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R91	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R29	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R92	3220235	RES C.FILM 10 K 5% 1/4W ?
R30	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R93	3220315	RES C.FILM 100 K 5% 1/4W AX
R31	3220160	RES C.FILM 1.0 K 5% 1/4W AX	R94	3220315	RES C.FILM 100 K 5% 1/4W AX
R32	3220330	RES C.FILM 220 K 5% 1/4W AX	R95	3220315	RES C.FILM 100 K 5% 1/4W AX
R33	3220330	RES C.FILM 220 K 5% 1/4W AX	R96	3220315	RES C.FILM 100 K 5% 1/4W AX
R36	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R97	3220315	RES C.FILM 100 K 5% 1/4W AX
R37	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R98	3250806	RES CHIP 22 OHM 5% (0805) ?
R38	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R99	3250800	RES CHIP 10 OHM 5% (0805) SF
R39	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R100	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R41	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R101	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R42	3220055	RES C.FILM 100 OHM 5% 1/4W AX	R102	3220047	RES C.FILM 75 OHM 5% 1/4W ?
R43	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R103	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R44	3250800	RES CHIP 10 OHM 5% (0805) SF	R104	3260672	RES VAR PT10V 50K ?
R45	3250817	RES CHIP 470 OHM 5% (0805) SF	R105	3220240	RES C.FILM 12 K 5% 1/4W ?
R46	3250810	RES CHIP 100 OHM 5% (0805) SF	T1	2510116	INDCTR TOROID FEAGCAMPOLUT-1293
R47	3220055	RES C.FILM 100 OHM 5% 1/4W AX	T2	2510116	INDCTR TOROID FEAGCAMPIN-1293
R48	3220055	RES C.FILM 100 OHM 5% 1/4W AX	T3	3524125	COIL VAR 1.85 UH-1293-MITSUMI
R49	3220210	RES C.FILM 4.7 K 5% 1/4W AX	T4	2510107	INDCTR TOROID -1293-1295
R50	3250810	RES CHIP 100 OHM 5% (0805) SF	T5	2510106	INDCTR TOROID -1293-1295
R51	3250834	RES CHIP 5.6K OHM 5% (0805) SF	T6	2510106	INDCTR TOROID -1293-1295

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			MECHANICAL PARTS		
REFERENCE	PART NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	DESCR
T7	2510079	INDUCTOR TOROID-1290-1293-1295			
T8	2510106	INDUCTOR TOROID-1293-1295-2460			
T9	2510079	INDUCTOR TOROID-1290-1293-1295	3	3100707	BD. FRN. END RBA/
T10	2510078	INDUCTOR TOROID-1290-1293-1295	1	4560276	SHIELD-WALL/SMAL
T11	2510079	INDUCTOR TOROID-1290-1293-1295	1	4560308	SHIELD-WALL RBA/
U1	3040094	I.C. LM358			
U2	3040596	I.C. MC13136P MOTOROLA			
U3	3040094	I.C. LM358			
U4	3040509	I.C. 74LS145N			
Y2	3120289	XTAL 34.3 MHZ 10PPM 3RD 30 OHM			
Y3	3120136	XTAL 10.245MHZ 30PPM 32PF			
CF1	3140403	FILT CER. SFE 10.7MJZ MULTI			
CF2	3140405	FILT CER. CFU455E-2			
CF3	3140127	XTAL FILTER SET #45U12BF			
CF4	3140127	XTAL FILTER SET #45U12BF			
CF5	3140416	FLT MURATA CSB455E			
CR1	3020297	DIODE ISS135 T&R AX			
CR2	3020297	DIODE ISS135 T&R AX			
CR3	3020297	DIODE ISS135 T&R AX			
CR4	3020297	DIODE ISS135 T&R AX			
CR5	3020297	DIODE ISS135 T&R AX			
CR6	3020297	DIODE ISS135 T&R AX			
CR7	3020297	DIODE ISS135 T&R AX			
CR8	3020297	DIODE ISS135 T&R AX			
CR9	3020297	DIODE ISS135 T&R AX			
CR10	3020297	DIODE ISS135 T&R AX			
CR11	3020297	DIODE ISS135 T&R AX			
CR12	3020297	DIODE ISS135 T&R AX			
CR13	3020297	DIODE ISS135 T&R AX			
CR14	3020297	DIODE ISS135 T&R AX			
CR15	3020297	DIODE ISS135 T&R AX			
CR16	3020297	DIODE ISS135 T&R AX			
CR17	3020297	DIODE ISS135 T&R AX			
CR18	3020297	DIODE ISS135 T&R AX			
CR19	3020297	DIODE ISS135 T&R AX			
CR20	3020297	DIODE ISS135 T&R AX			
CR21	3020297	DIODE ISS135 T&R AX			
CR22	3020297	DIODE ISS135 T&R AX			
CR23	3020297	DIODE ISS135 T&R AX			
CR24	3020297	DIODE ISS135 T&R AX			
CR25	3020297	DIODE ISS135 T&R AX			
CR26	3020297	DIODE ISS135 T&R AX			
CR27	3020220	DIODE 1N4005-PLASTIC AX			
CR28	3020220	DIODE 1N4005-PLASTIC AX			
CR29	3020220	DIODE 1N4005-PLASTIC AX			
CR30	3020220	DIODE 1N4005-PLASTIC AX			
CR31	3020297	DIODE ISS135 T&R AX			
CR32	3020297	DIODE ISS135 T&R AX			
CR33	3020090	DIODE 1N4148 AX			
CR34	3020090	DIODE 1N4148 AX			
CR35	3020297	DIODE ISS135 T&R AX			
CR36	3020297	DIODE ISS135 T&R AX			
CR37	3020090	DIODE 1N4148 AX			
CR38	3020090	DIODE 1N4148 AX			
LP1	3470004	LAMP NEON #NE-2E/A9A RD			
VR1	3040092	I.C. LM317LZ			
VR2	3040031	I.C. 78L05-ACP RD			

THEORY OF OPERATION 2ND IF/AUDIO/PS

1. Noise Blanker
2. Step Variable BPF
3. IF AMP and AGC Generator
4. AM and SSB Detectors
5. Audio Processing

1. Noise Blanker

The noise blanker IC U1 incorporates internally an AGC'd amplifier strip, AGC control, peak detector, noise differentiator, time controlled RF gate, and time controlled audio hold circuits. Pin outs are provided for externally connected timing elements.

Noise bursts entering along with the IF signal are differentiated and trigger the RF gate off. Triggering threshold is raised by paralleling the differentiating cap C14 with a resistor. Switching a 1K resistor (R23) disables the triggering completely. Once triggered, the gate off time is determined by the RF blank resistance (R25 and R26). The triggering of the RF gate is followed by the triggering of the audio hold after an externally programmed delay (R37) passes. The audio hold time, determined by R36 and C25, is selected to span the "hole" created after gating off the RF carrier.

2. Step Variable BPF

The BPF has five bandwidth selections which default in response to the mode of transmission selected (i.e. 6 kHz for AM). The other bandwidths can be invoked in sequence from the default BW. Passband tuning can be utilized to skew the signal reception to either side of the passband center for improved channel rejection and/or frequency response.

The BPF results from the cascade of two four-pole Chebyshev (BPF) sections isolated by one stage of AGC'd amplification. Centered at 50 kHz, all bandwidths are designed around fixed inductor values of 9.5 mH. Coupling and shunt capacitor values are switched via analog gates (U2, U3, U5 and U12) and discrete transistors respectively. In addition, the loading of the filter is switched similarly. Switching a source resistor in the JFET amp stage preceding the BPF compensates for the insertion loss of the 6 kHz bandwidth filter network.

3. IF AMP and AGC Generator

The AGC'd IF amplifier is comprised of three mosfet stages. Each stage has a different gain control time delay to ensure stability of the loop. The output stage has the least delay, and the input stage has the most delay. The gain control signal is generated as follows. The output of the last mosfet stage, Q47, is further amplified by transistor stage Q61 before the signal splits into two paths. One path is applied to the synchronous detector/AM/SSB detector circuitry and the other path is applied to the AGC circuitry.

The 50 kHz IF signal is applied to the AGC detector stage, Q63. Transistor Q62 is normally turned off for Fast or Slow AGC operation. In AGC Off operation, Q62 is enabled, thus clamping the 50 kHz IF signal prior to the detector stage, Q63. R353 and C266 provide some low pass filtering of the signal following the detector stage. C271, R352, and R320 set up the attack time constant. Transistors, Q69 and Q71, each connected in an emitter follower configuration with associated components, form a high gain stage to provide a DC window for the detected IF signal. The output from the emitter follower stages feeds the decay time constant networks switched by Q69 and Q70. For operating conditions other than Scan, Q70 is enabled which switches in the Fast AGC time constant network comprised of R348 and C269. When Slow AGC is enabled, transistor Q69 conducts, thereby selecting the additional time constant network comprised of R346 and C268. In Scan operation, both Q69 and Q70 are disabled, resulting in a very fast decay time constant. The resulting voltage is buffered by Q58. The emitter circuit of Q58 sources the resting AGC voltage applied to the three operational amplifier stages of U17 and U18. Each stage has its own reference setting potentiometer. One half of U17 develops a conditioned AGC voltage which is applied to the last two 50 kHz IF stages, comprised of Q47 and Q24. The other half of U17 develops a conditioned AGC voltage which is applied to the first 50 kHz IF stage, Q1. Finally, one half of U18 develops a conditioned AGC voltage which is applied to the Front End 45MHz stage, Q2. The three individual thresholds are set via R264, R310 and R247 for AGC 1, 2, and 3 respectively. The three AGC voltages are summed into U18 which in turn feeds the S-Meter circuit.

The front panel RF Gain control voltage is applied through R299 and CR17 to be summed with the resting AGC voltage that is applied to the operational amplifier stages.

Additionally, the resting AGC voltage is split and fed through R295 to the squelch DC amplifier comprised of one fourth of U16 and associated components. The output of this amplifier stage feeds the squelch comparator comprised of an additional one fourth of U16 and associated components.

Transistor stages Q66, Q57 and Q58 comprise the mute circuitry that is used to clamp the AGC and squelch the audio path for external transmitter use.

4. AM Synchronous and SSB Detectors

50 kHz input is applied to Q54 which provides a sufficiently large AC signal to drive the pre-limiter stage, Q51. The output of Q51 is supplied to pin 1 of U13 to provide a hard limited signal. R212 allows setting the threshold at pin 1 of U13 to establish a 50% duty cycle limited IF signal out at pin 3 of U13. The limited 50 kHz signal is applied to pin 4 of U13, 1/4 of an exclusive-or gate, for quadrature phase comparison with a locally generated 50 kHz carrier. A locked condition yields a 50% duty cycle output signal at pin 6 of U13 which controls a voltage-to-frequency converter comprised of U10 and Q39.

20 Circuit Description cont'd.

The SYNCH DET control line is held at a logic high state for the envelope detection mode. This high state at SYNCH DET has R191 connected which provides a fast acquisition time constant for the voltage-to-frequency converter. When the synchronous detection mode is engaged, the SYNCH DET line delays approximately 3 seconds and then switches to a logic low state to open the analog switch, U11 (pins 3-4) thereby providing for a very slow loop operation, due to R190 and C182. The BFO ENA control line switches to a logic low state for the synchronous detection mode. This action opens the analog switch, U11 (pins 1-2) thereby removing the fixed one-half supply bias from the voltage-to-frequency converter and allowing the loop to lock from the control line voltage applied to pin 3 of U10.

The locally supplied 50 kHz carrier is generated by a phase shift oscillator running at a 200 kHz rate. The phase shift oscillator is formed by 1/2 of U10 (pins 5, 6, and 7) and associated components R168, C196, C179, and Q39. Q39 provides variable resistance for the phase shift oscillator when Q35 is turned off (BFO ENA at a logic low). Q39 and U10 form a voltage-to-frequency converter, as explained previously. The 200 kHz carrier is divided by a factor of four by U14 to produce a 50 kHz carrier. With the synchronous detection mode enabled and the loop locked, the output at pin 5 of U14 is a 50 kHz carrier that is phase shifted 90 degrees relative to the input signal at pin 4 of U13. The output from U14, pin 5, is also applied through R358 to pin 13 of U13. An in-phase 50 kHz carrier that is output at pin 9 of U14 is applied through R357 to pin 10 of U13. For synchronous detection only, a logic low at SSB/DSB enables pin 12 of U13. The output at U13, pin 11, a quadrature carrier signal whose phase can be changed ± 180 degrees with the USB/LSB control line, is applied to pin 7 of U6, a 2-quadrant multiplier IC. The 50 kHz incoming signal is applied to pin 5 of U6 and detected. The resultant audio signal is low pass filtered and supplied to the phase shift board assembly as the "Q" channel audio signal. Also, for the synchronous detection mode, the in-phase locally generated carrier at pin 9 of U14 is applied through R357 to U13, as previously mentioned. The output of U13 supplies the in-phase 50 kHz carrier to pin 7 of U7, a 2-quadrant multiplier IC. The 50 kHz incoming signal is applied to pin 5 of U7 and detected. The resultant audio signal is low pass filtered and supplied to the phase shift board assembly as the "I" channel audio signal. The "I" and "Q" audio signals are phase shifted individually by appropriate amounts to permit in-phase summing of the signals to recover the originally transmitted audio signal. The audio signal is routed through C219 to U11, pin 11, and is switched through U11 to the input of the noise blanker and remaining audio stages for all reception modes except envelope detection. Envelope detection of the received 50 kHz signal is performed by Q55 and associated components, with the resultant audio supplied to pin 8 of U11. The audio gating is controlled by the SYNCH DET control and Q40 with its associated components.

For SSB product detection, the BFO/ENA logic control inhibits U14 via Q52, and turns Q53 off which permits the BFO input signal to be supplied to the carrier input (pin 7) of U7.

5. Audio Processing

The detected audio from the demodulator IC, U12, passes through the audio hold circuit of the noise blanker IC, U7. The hold function is only available in the AM mode. Leaving the hold circuit, the audio passes through a buffer stage, Q6, and then to the audio notch circuit, composed of U9 and associated components. The notching frequency is made variable by employing an electronically tuneable band pass filter in a split signal network that cancels at the band pass filter center frequency. The output from the notch circuit is applied to the Y1 input (pin 5) of analog multiplexer IC, U15. When the NOTCH ENA control line is active, the output of the notch circuit is switched through U15 to pin 3 of U15 and on to an audio frequency low pass filter comprised of U8 and associated components. When the notch is not enabled, the logic control on pins 9 and 10 of U15 selects the Y3 input (pin 4) of U15, which connects the audio present at the input to the notch circuit. When the FM ENA control line is active, audio from the FM detector and output of buffer stage, Q48, is switched through U15 from the inputs Y0 and Y2 to the output pin 3 of U15. Regardless of the selected audio path, the audio output from the multiplexer IC, U15, always feeds the low pass filter stage, U8. The squelch detector circuitry is composed of two sections of IC stage, U16. The squelch reference is a composite voltage level of the buffered AGC control voltage from Q58, the front panel RF Gain control, and the FM RSSI relative signal strength voltage from the FM detector circuitry. The signal is applied to pin 10 of U16. R258 sets an internal threshold level for the squelch level detector. The output from pin 8 of U16 passes through a selectable time constant circuit comprised of R244, R243, C239, and R241 or R242. The conditioned squelch voltage is applied to pin 6 of U15, the squelch gate. The signal level trip point is determined by the setting of the front panel squelch control. With the output at pin 1 of U16 at a logic high, the multiplexer IC, U15, is inhibited. The result is no audio output and the receiver is squelched. Note that a mute control signal applied through R257 and CR18 also has the action of quieting the receiver audio.

Following the 5kHz low pass filter stage, the audio splits into two main paths. One path consists of two buffered line audio output amplifier stages, Q30 and Q41. The other path applies the audio to the tone control stage comprised of the second half of U8 and associated components. The audio from the output of the tone control circuit is applied to the front panel volume control (AF Gain). The volume control feeds the audio to the audio power amplifier, U4. The output of the power amplifier connects the audio to the headphone jack and the rear panel speaker switch. The switch selects either the internal speaker, the external speaker, or both speakers.

Second IF Board Parts List 21

2nd IF BOARD, P/N: 2070039; 2nd IF BOARD & PHASE SHIFT MODULE BOARD ASSEMBLY, P/N: 2070509

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C1	3166105	CAP CHIP .01UF X7R (0805) SF	C61	3180152	CAP ELEC 100@50 RD
C2	3180109	CAP ELEC 22@25 20% RD	C62	3151260	CAP RD 220 PF 5% N470 RD
C3	3180109	CAP ELEC 22@25 20% RD	C63	3166120	CAP CHIP .001UF X7R (0805) SF
C4	3167541	CAP CHIP 470PF NPO (0805) SF	C64	3167544	CAP CHIP 680PF 2%(0805) SF
C5	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C65	3166135	CAP CHIP 5.6PF NPO (0805) SF
C6	3167555	CAP CHIP 0.0047UF X7R (0805)SF	C66	3180064	CAP ELEC 10@50 20% RD
C7	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C67	3180064	CAP ELEC 10@50 20% RD
C8	3166120	CAP CHIP .001UF X7R (0805) SF	C68	3180007	CAP ELEC 47@50 (T&R) RD
C9	3180109	CAP ELEC 22@25 20% RD	C69	3167544	CAP CHIP 680PF 2%(0805) SF
C10	3180109	CAP ELEC 22@25 20% RD	C70	3166150	CAP CHIP 39 PF NPO (0805) SF
C11	3166120	CAP CHIP .001UF X7R (0805) SF	C71	3166143	CAP CHIP 18 PF NPO (0805) SF
C12	3151650	CAP AX .1 MF 100V MET.POLY AX	C72	3166141	CAP CHIP 6.8PF NPO (0805) SF
C13	3180064	CAP ELEC 10@50 20% RD	C73	3166120	CAP CHIP .001UF X7R (0805) SF
C14	3180012	CAP ELEC 1@50 20% RD	C74		NO-PART
C15	3180064	CAP ELEC 10@50 20% RD	C75	3167507	CAP CHIP 12 PF NPO (0805) SF
C16	3180064	CAP ELEC 10@50 20% RD	C76	3167507	CAP CHIP 12 PF NPO (0805) SF
C17	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C77	3180349	CAP ELEC 6800@35
C18		NO-PART	C78	3180064	CAP ELEC 10@50 20% RD
C19	3167544	CAP CHIP 680PF 2%(0805) SF	C79	3180241	CAP ELEC 470@16 RD
C20	3151050	CAP AX 91.0 PF 2% NPO AX	C80	3180018	CAP ELEC 2.2@50 RD
C21	3151260	CAP RD 220 PF 5% N470 RD	C81	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C22	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C82	3166120	CAP CHIP .001UF X7R (0805) SF
C23	3167528	CAP CHIP 100PF NPO (0805) SF	C83	3151050	CAP AX 91.0 PF 2% NPO AX
C24	3167507	CAP CHIP 12 PF NPO (0805) SF	C84	3166140	CAP CHIP 10 PF NPO (0805) SF
C25	3184009	CAP FILM .0015MF @ 50V 5% RD	C85	3166150	CAP CHIP 39 PF NPO (0805) SF
C26	3180018	CAP ELEC 2.2@50 RD	C86	3166145	CAP CHIP 27 NPO (0805) SF
C27	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C87	3167507	CAP CHIP 12 PF NPO (0805) SF
C28	3166140	CAP CHIP 10 PF NPO (0805) SF	C88	3167507	CAP CHIP 12 PF NPO (0805) SF
C29	3167520	CAP CHIP 56 PF NPO (0805) SF	C89	3167528	CAP CHIP 100PF NPO (0805) SF
C30	3166143	CAP CHIP 18 PF NPO (0805) SF	C90	3166145	CAP CHIP 27 NPO (0805) SF
C31	3167507	CAP CHIP 12 PF NPO (0805) SF	C91	3151260	CAP RD 220 PF 5% N470 RD
C32	3167507	CAP CHIP 12 PF NPO (0805) SF	C92	3150779	CAP AX 43.0 PF 5% NPO AX
C33	3166120	CAP CHIP .001UF X7R (0805) SF	C93		NO-PART
C34	3166140	CAP CHIP 10 PF NPO (0805) SF	C94	3150783	CAP AX 51.0 PF 2% NPO AX
C35	3166150	CAP CHIP 39 PF NPO (0805) SF	C95	3166120	CAP CHIP .001UF X7R (0805) SF
C36	3166143	CAP CHIP 18 PF NPO (0805) SF	C96	3151260	CAP RD 220 PF 5% N470 RD
C37		NO-PART	C97	3180064	CAP ELEC 10@50 20% RD
C38	3150779	CAP AX 43.0 PF 5% NPO AX	C98	3166100	CAP CHIP 220PF NPO (0805) SF
C39	3150783	CAP AX 51.0 PF 2% NPO AX	C99	3167551	CAP CHIP 0.0015UF X7R (0805)SF
C40	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C100	3180109	CAP ELEC 22@25 20% RD
C41	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C101	3167542	CAP CHIP 470PF 2% (0805) SF
C42	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C102	3180012	CAP ELEC 1@50 20% RD
C43	3180018	CAP ELEC 2.2@50 RD	C103	3184060	CAP FILM .047 @ 50V 5%
C44	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C104	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C45	3166145	CAP CHIP 27 NPO (0805) SF	C105	3166105	CAP CHIP .01UF X7R (0805) SF
C46	3167521	CAP CHIP 68 PF NPO (0805) SF	C106	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C47	3166145	CAP CHIP 27 NPO (0805) SF	C107	3180241	CAP ELEC 470@16 RD
C48	3166150	CAP CHIP 39 PF NPO (0805) SF	C108	3180239	CAP ELEC 470@25 RD
C49	3167507	CAP CHIP 12 PF NPO (0805) SF	C109	3180064	CAP ELEC 10@50 20% RD
C50	3180064	CAP ELEC 10@50 20% RD	C110	3180239	CAP ELEC 470@25 RD
C51	3166141	CAP CHIP 6.8PF NPO (0805) SF	C111	3180109	CAP ELEC 22@25 20% RD
C52	3166145	CAP CHIP 27 NPO (0805) SF	C112	3166105	CAP CHIP .01UF X7R (0805) SF
C53	3151260	CAP RD 220 PF 5% N470 RD	C113	3180064	CAP ELEC 10@50 20% RD
C54	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C114	3167544	CAP CHIP 680PF 2%(0805) SF
C55	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C115	3151050	CAP AX 91.0 PF 2% NPO AX
C56	3180349	CAP ELEC 6800@35	C116	3151260	CAP RD 220 PF 5% N470 RD
C57	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C117	3166105	CAP CHIP .01UF X7R (0805) SF
C58	3180241	CAP ELEC 470@16 RD	C118	3167528	CAP CHIP 100PF NPO (0805) SF
C59	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C119	3167507	CAP CHIP 12 PF NPO (0805) SF
C60	3180012	CAP ELEC 1@50 20% RD	C120	3180241	CAP ELEC 470@16 RD

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REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C121	3166120	CAP CHIP .001UF X7R (0805) SF	C181	3180007	CAP ELEC .47@50 (T&R) RD
C122	3180064	CAP ELEC 10@50 20% RD	C182	3180152	CAP ELEC 100@50 RD
C123	3180018	CAP ELEC 2.2@50 RD	C183	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C124	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C184	3151432	CAP RD 0033MF 2% NPO RD
C125	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C185	3180064	CAP ELEC 10@50 20% RD
C126	3167520	CAP CHIP 56 PF NPO (0805) SF	C186	3166105	CAP CHIP .01UF X7R (0805) SF
C127		NOPART	C187	3167544	CAP CHIP 680PF 2%(0805) SF
C128	3167507	CAP CHIP 12 PF NPO (0805) SF	C188	3166150	CAP CHIP 39 PF NPO (0805) SF
C129	3167507	CAP CHIP 12 PF NPO (0805) SF	C189	3166143	CAP CHIP 18 PF NPO (0805) SF
C130	3166120	CAP CHIP .001UF X7R (0805) SF	C190	3166141	CAP CHIP 6.8PF NPO (0805) SF
C131	3166140	CAP CHIP 10 PF NPO (0805) SF	C191	3166120	CAP CHIP .001UF X7R (0805) SF
C132	3166150	CAP CHIP 39 PF NPO (0805) SF	C192		NOPART
C133	3166143	CAP CHIP 18 PF NPO (0805) SF	C193	3167507	CAP CHIP 12 PF NPO (0805) SF
C134		NOPART	C194	3167507	CAP CHIP 12 PF NPO (0805) SF
C135	3150779	CAP AX 43.0 PF 5% NPO AX	C195	3180125	CAP ELEC 47@16 RD
C136	3190030	CAP 51.0 PF 1% RD	C196	3205228	CAP VAR TRIMMER 10-120 PF
C137	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C197	3180064	CAP ELEC 10@50 20% RD
C138	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C198	3151260	CAP RD 220 PF 5% N470 RD
C139	3184027	CAP FILM .0068 @ 100V 5% AX	C199	3151432	CAP RD 0033MF 2% NPO RD
C140	3184046	CAP FILM .033 @ 100V 5%	C200	3180064	CAP ELEC 10@50 20% RD
C141	3184042	CAP FILM .022 @ 100V 5% RD	C201	3180064	CAP ELEC 10@50 20% RD
C142	3184066	CAP FILM .1 @ 100V 10%	C202	3180018	CAP ELEC 2.2@50 RD
C143	3166105	CAP CHIP .01UF X7R (0805) SF	C203	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C144	3180018	CAP ELEC 2.2@50 RD	C204	3166120	CAP CHIP .001UF X7R (0805) SF
C145	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C205	3151050	CAP AX 91.0 PF 2% NPO AX
C146	3166143	CAP CHIP 18 PF NPO (0805) SF	C206	3166140	CAP CHIP 10 PF NPO (0805) SF
C147	3166145	CAP CHIP 27 NPO (0805) SF	C207	3166150	CAP CHIP 39 PF NPO (0805) SF
C148	3167528	CAP CHIP 100PF NPO (0805) SF	C208	3166148	CAP CHIP 33 PF NPO (0805) SF
C149	3166145	CAP CHIP 27 NPO (0805) SF	C209	3167507	CAP CHIP 12 PF NPO (0805) SF
C150	3166150	CAP CHIP 39 PF NPO (0805) SF	C210		NOPART
C151	3167507	CAP CHIP 12 PF NPO (0805) SF	C211	3167528	CAP CHIP 100PF NPO (0805) SF
C152	3180064	CAP ELEC 10@50 20% RD	C212	3167507	CAP CHIP 12 PF NPO (0805) SF
C153	3166141	CAP CHIP 6.8PF NPO (0805) SF	C213	3166145	CAP CHIP 27 NPO (0805) SF
C154	3166145	CAP CHIP 27 NPO (0805) SF	C214	3167544	CAP CHIP 680PF 2%(0805) SF
C155	3151260	CAP RD 220 PF 5% N470 RD	C215	3150779	CAP AX 43.0 PF 5% NPO AX
C156	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C216	3190030	CAP 51.0 PF 1% RD
C157	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C217	3180125	CAP ELEC 47@16 RD
C158	3184021	CAP FILM .0047 @ 50V 5% RD	C218	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C159	3184021	CAP FILM .0047 @ 50V 5% RD	C219	3180007	CAP ELEC .47@50 (T&R) RD
C160	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C220	3184039	CAP FILM .015 @ 100V 5%
C161	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C221	3180064	CAP ELEC 10@50 20% RD
C162	3184021	CAP FILM .0047 @ 50V 5% RD	C222	3180241	CAP ELEC 470@16 RD
C163	3184021	CAP FILM .0047 @ 50V 5% RD	C223	3166120	CAP CHIP .001UF X7R (0805) SF
C164	3184068	CAP FILM .1 @ 100V 10%	C224	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C165	3167537	CAP CHIP 330PF NPO (0805) SF	C225	3166105	CAP CHIP .01UF X7R (0805) SF
C166	3184032	CAP FILM .01 @ 50V 5%	C226		NOPART
C167	3184032	CAP FILM .01 @ 50V 5%	C227	3167551	CAP CHIP 0.0015UF X7R (0805)SF
C168	3166120	CAP CHIP .001UF X7R (0805) SF	C228	3180064	CAP ELEC 10@50 20% RD
C169	3180064	CAP ELEC 10@50 20% RD	C229	3151260	CAP RD 220 PF 5% N470 RD
C170	3180064	CAP ELEC 10@50 20% RD	C231	3180064	CAP ELEC 10@50 20% RD
C171	3151260	CAP RD 220 PF 5% N470 RD	C232	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C172	3166120	CAP CHIP .001UF X7R (0805) SF	C233	3180109	CAP ELEC 22@25 20% RD
C173	3167544	CAP CHIP 680PF 2%(0805) SF	C234	3180007	CAP ELEC .47@50 (T&R) RD
C174	3166135	CAP CHIP 5.6PF NPO (0805) SF	C235	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C175	3180007	CAP ELEC .47@50 (T&R) RD	C236	3167571	CAP CHIP 0.022 UF X7R (0805)SF
C176	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C237	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C177	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C238	3184068	CAP FILM .1 @ 100V 10%
C178	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C239	3180002	CAP ELEC 22@50 L LEAK RD
C179	3166100	CAP CHIP 220PF NPO (0805) SF	C240	3184019	CAP FILM .001 @ 100V 5%
C180	3167577	CAP CHIP 0.1 UF Y5V (0805) SF			

Second IF Board Parts List cont'd. 23

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C241	3180064	CAP ELEC 10@50 20% RD	P1	3290760	CONN P.C. MOLEX #26-60-1020
C242	3184019	CAP FILM .001 @ 100V 5%	P2	3290760	CONN P.C. MOLEX #26-60-1020
C243	3180064	CAP ELEC 10@50 20% RD	P3	3280723	CONN P.C. JST#T3B-SQ-1
C244	3180007	CAPELEC .47@50 (T&R) RD	P4	3280723	CONN P.C. JST#T3B-SQ-1
C245	3166105	CAP CHIP .01UF X7R (0805) SF	P5	3281505	RECPT DIN 5 PIN
C246	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	P6	3280720	CONN P.C. JST#T68-SQ-1
C247	3180152	CAPELEC 100@50 RD	P7	3280723	CONN P.C. JST#T38-SQ-1
C248	3180152	CAPELEC 100@50 RD	P8	3280723	CONN P.C. JST#T38-SQ-1
C249	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	P9	3280722	CONN P.C. JST#T28-SQ-1
C250	3184039	CAP FILM .015 @ 100V 5%	P10	3280723	CONN P.C. JST#T38-SQ-1
C251	3184039	CAP FILM .015 @ 100V 5%	P11	3280723	CONN P.C. JST#T38-SQ-1
C252		NOPART	P12	3280723	CONN P.C. JST#T38-SQ-1
C253	3184039	CAP FILM .015 @ 100V 5%	P13	3280723	CONN P.C. JST#T38-SQ-1
C254	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	P14	3280724	CONN P.C. JST#T48-SQ-1
C255	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	Q1	3030667	TRANS 35K133A SOT143 SF
C256	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	Q2	3030504	TRANS J-310 RD
C257	3166105	CAP CHIP .01UF X7R (0805) SF	Q3	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C258	3184046	CAP FILM .033 @ 100V 5%	Q4	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C259	3184032	CAP FILM .01 @ 50V 5%	Q5	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C260	3180007	CAPELEC .47@50 (T&R) RD	Q6	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C261	3166100	CAP CHIP 220PF NPO (0805) SF	Q7	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C262	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	Q8	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C263	3180125	CAPELEC 47@16 RD	Q9	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C264	3180032	CAPELEC 4.7@25 OR 4.7@50 RD	Q10	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C265	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	Q11	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C266	3184046	CAP FILM .033 @ 100V 5%	Q12	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C267	3167528	CAP CHIP 100PF NPO (0805) SF	Q13	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C268	3180152	CAP ELEC 100@50 RD	Q14	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C269	3180032	CAPELEC 4.7@25 OR 4.7@50 RD	Q15	3030292	TRANS MP5A13 RD
C270	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	Q16	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C271	3184125	CAP FILM .47 @ 100V 20% 15MM	Q17	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C272	3184032	CAP FILM .01 @ 50V 5%	Q18	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C273		NOPART	Q19	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C300	3184009	CAP FILM .0015uF, 5%	Q20	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
C400	3151405	CAP CER., .001uF, 10%, Y5P AX	Q21	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J1	3280042	CONN COAX PC MT. #TMP-J01X-V6	Q22	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J2	3281695	RECPT PHONO 1P PC MT	Q23	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J3	3281695	RECPT PHONO 1P PC MT	Q24	3030292	TRANS MP5A13 RD
J4	3281695	RECPT PHONO 1P PC MT	Q25	3030567	TRANS 35K133A SOT143 SF
J5	3281025	JACK PHONE #YKB21-5012	Q26	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J6	3280043	CONN COAX PC MT. #TMP-J02X-A1	Q27	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J7	3280753	CONN P.C. MOLEX #520-11-1010	Q28	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J8	3280753	CONN P.C. MOLEX #520-11-1010	Q29	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
J9	3280753	CONN P.C. MOLEX #520-11-1010	Q30	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
K1	3620108	RELAY TAKAMISAWA #MZ-12H5-K	Q31	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
K2	3620112	RELAY TAKAMISAWA #RZ-12K	Q32	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L1	3524241	COIL FIXED 47MH 10%, C9-B	Q35	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L2	2055127	POT-CORE ASSY-1290-1293-1294	Q36	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L3	2055127	POT-CORE ASSY-1290-1293-1294	Q37	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L4	2055127	POT-CORE ASSY-1290-1293-1294	Q38	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L5	3524241	COIL FIXED 47MH 10%, C9-B	Q39	3030201	TRANS 2N5246T092 NS PACK 97RD
L6	2055127	POT-CORE ASSY-1290-1293-1294	Q40	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L7	2055127	POT-CORE ASSY-1290-1293-1294	Q41	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L8	2055127	POT-CORE ASSY-1290-1293-1294	Q42	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L9	2055127	POT-CORE ASSY-1290-1293-1294	Q43	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L10	3524241	COIL FIXED 47MH 10%, C9-B	Q44	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L11	2055127	POT-CORE ASSY-1290-1293-1294	Q45	3036015	TRAN CHIP #MMBT3904 LT1 SOT23
L12	3524196	COIL RADIAL 270.0 UH RD			
L13	3524241	COIL FIXED 47MH 10%, C9-B			

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REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
Q46	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R31	3250838	RES CHIP 33K OHM 5% (0805) SF
Q47	3030667	TRANS 3SK133A SOT143 SF	R32	3250837	RES CHIP 22K OHM 5% (0805) SF
Q48	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R33	3250837	RES CHIP 22K OHM 5% (0805) SF
Q49	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R34	3250831	RES CHIP 10K OHM 5% (0805) SF
Q50	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R35	3250842	RES CHIP 47K OHM 5% (0805) SF
Q51	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R36	3250846	RES CHIP 100K OHM 5% (0805) SF
Q52	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R37	3250645	RES CHIP 1.5M OHM 5% (0805) SF
Q53	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R38	3250831	RES CHIP 10K OHM 5% (0805) SF
Q54	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R39	3250831	RES CHIP 10K OHM 5% (0805) SF
Q55	3030292	TRANS MPSA 13 RD	R40	3260668	RES VAR PT10V 20K
Q56	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R41	3250868	RES CHIP 10.0 MEG 5% (0805) SF
Q57	3036014	TRANS CHIP MMBT3906 SOT23 SF	R42	3250831	RES CHIP 10K OHM 5% (0805) SF
Q58	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R43	3250831	RES CHIP 10K OHM 5% (0805) SF
Q59	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R44	3250868	RES CHIP 10.0 MEG 5% (0805) SF
Q60	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R45	3250837	RES CHIP 22K OHM 5% (0805) SF
Q61	3036017	TRANS CHIP #MMBT10 LT1 SOT23	R46	3250837	RES CHIP 22K OHM 5% (0805) SF
Q62	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R47	3250825	RES CHIP 2.7K OHM 5% (0805) SF
Q63	3030292	TRANS MPSA 13 RD	R48	3250810	RES CHIP 100 OHM 5% (0805) SF
Q64	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R49	3250846	RES CHIP 100K OHM 5% (0805) SF
Q65	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R50	3250837	RES CHIP 22K OHM 5% (0805) SF
Q66	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R51	3250831	RES CHIP 10K OHM 5% (0805) SF
Q67	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R52	3250837	RES CHIP 22K OHM 5% (0805) SF
Q68	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R53	3250831	RES CHIP 10K OHM 5% (0805) SF
Q69	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R54	3250837	RES CHIP 22K OHM 5% (0805) SF
Q70	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R55	3250838	RES CHIP 33K OHM 5% (0805) SF
Q71	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R56	3250838	RES CHIP 33K OHM 5% (0805) SF
Q72	3036015	TRAN CHIP #MMBT3904 LT1 SOT23	R57	3250837	RES CHIP 22K OHM 5% (0805) SF
R1	3250803	RES CHIP 47 OHM 5% (0805) SF	R58	3250837	RES CHIP 22K OHM 5% (0805) SF
R2	3250803	RES CHIP 47 OHM 5% (0805) SF	R59	3250819	RES CHIP 1.0K OHM 5% (0805) SF
R3	3250834	RES CHIP 5.6K OHM 5% (0805) SF	R60	3250810	RES CHIP 100 OHM 5% (0805) SF
R4	3250833	RES CHIP 15K OHM 5% (0805) SF	R61	3250831	RES CHIP 10K OHM 5% (0805) SF
R5	3250645	RES CHIP 1.5M OHM 5% (0805) SF	R62	3250838	RES CHIP 33K OHM 5% (0805) SF
R6	3250910	RES CHIP 270K OHM 5% (0805) SF	R63	3250831	RES CHIP 10K OHM 5% (0805) SF
R7	3250817	RES CHIP 470 OHM 5% (0805) SF	R64	3250840	RES CHIP 39K OHM 5% (0805) SF
R8	3250832	RES CHIP 3.9K OHM 5% (0805) SF	R65	3250844	RES CHIP 68K OHM 5% (0805) SF
R9	3250833	RES CHIP 15K OHM 5% (0805) SF	R66	3250845	RES CHIP 56K OHM 5% (0805) SF
R10	3250803	RES CHIP 47 OHM 5% (0805) SF	R67	3250833	RES CHIP 15K OHM 5% (0805) SF
R11	3250800	RES CHIP 10 OHM 5% (0805) SF	R68	3250837	RES CHIP 22K OHM 5% (0805) SF
R12	3250910	RES CHIP 270K OHM 5% (0805) SF	R69	3250837	RES CHIP 22K OHM 5% (0805) SF
R13	3250845	RES CHIP 56K OHM 5% (0805) SF	R70	3250803	RES CHIP 47 OHM 5% (0805) SF
R14	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R71	3250868	RES CHIP 10.0 MEG 5% (0805) SF
R15	3250831	RES CHIP 10K OHM 5% (0805) SF	R72	3250831	RES CHIP 10K OHM 5% (0805) SF
R16	3250846	RES CHIP 100K OHM 5% (0805) SF	R73	3250910	RES CHIP 270K OHM 5% (0805) SF
R17	3250833	RES CHIP 15K OHM 5% (0805) SF	R74	3250819	RES CHIP 1.0K OHM 5% (0805) SF
R18	3250831	RES CHIP 10K OHM 5% (0805) SF	R75	3250846	RES CHIP 100K OHM 5% (0805) SF
R19	3250833	RES CHIP 15K OHM 5% (0805) SF	R76	3250837	RES CHIP 22K OHM 5% (0805) SF
R20	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R77	3250803	RES CHIP 47 OHM 5% (0805) SF
R21	3250849	RES.C 12K OHM 5% (0805) SF	R78	3250817	RES CHIP 470 OHM 5% (0805) SF
R22	3250810	RES CHIP 100 OHM 5% (0805) SF	R79	3250645	RES CHIP 1.5M OHM 5% (0805) SF
R23	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R80	3250833	RES CHIP 15K OHM 5% (0805) SF
R24	3250835	RES CHIP 8.2K OHM 5% (0805) SF	R81	3250834	RES CHIP 5.6K OHM 5% (0805) SF
R25	3250910	RES CHIP 270K OHM 5% (0805) SF	R82	3250831	RES CHIP 10K OHM 5% (0805) SF
R26	3250862	RES CHIP 1.0 MEG 5% (0805) SF	R83	3250837	RES CHIP 22K OHM 5% (0805) SF
R27	3250831	RES CHIP 10K OHM 5% (0805) SF	R84	3250837	RES CHIP 22K OHM 5% (0805) SF
R28	3250831	RES CHIP 10K OHM 5% (0805) SF	R85	3250795	RES CHIP 120 OHM 5% (0805) SF
R29	3250831	RES CHIP 10K OHM 5% (0805) SF			
R30	3250831	RES CHIP 10K OHM 5% (0805) SF			

Second IF Board Parts List cont'd. 25

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R86	3250837	RES CHIP 22K OHM 5% (0805) SF	R146	3250800	RES CHIP 10 OHM 5% (0805) SF
R87	3260612	RES VAR PT10V LIN 500K	R147	3250831	RES CHIP 10K OHM 5% (0805) SF
R88	3250845	RES CHIP 56K OHM 5% (0805) SF	R148	3250824	RES CHIP 3.3K OHM 5% (0805) SF
R89	3250833	RES CHIP 15K OHM 5% (0805) SF	R149	3250810	RES CHIP 100 OHM 5% (0805) SF
R90	3250860	RES CHIP 18K OHM 5% (0805) SF	R150	3250837	RES CHIP 22K OHM 5% (0805) SF
R91	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R151	3250831	RES CHIP 10K OHM 5% (0805) SF
R92	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R152	3250837	RES CHIP 22K OHM 5% (0805) SF
R93	3250807	RES CHIP 330 OHM 5% (0805) SF	R153	3250831	RES CHIP 10K OHM 5% (0805) SF
R94	3250829	RES CHIP 680 OHM 5% (0805) SF	R154	3250837	RES CHIP 22K OHM 5% (0805) SF
R95	3250846	RES CHIP 100K OHM 5% (0805) SF	R155	3250838	RES CHIP 33K OHM 5% (0805) SF
R96	3250831	RES CHIP 10K OHM 5% (0805) SF	R156	3250838	RES CHIP 33K OHM 5% (0805) SF
R97	3250838	RES CHIP 33K OHM 5% (0805) SF	R157	3250837	RES CHIP 22K OHM 5% (0805) SF
R98	3250837	RES CHIP 22K OHM 5% (0805) SF	R158	3250837	RES CHIP 22K OHM 5% (0805) SF
R99	3250837	RES CHIP 22K OHM 5% (0805) SF	R159	3250841	RES CHIP 30K OHM 5% (0805) SF
R100	3250831	RES CHIP 10K OHM 5% (0805) SF	R160	3250836	RES CHIP 1.2K OHM 5% (0805) SF
R101	3250831	RES CHIP 10K OHM 5% (0805) SF	R161	3250822	RES CHIP 2.2K OHM 5% (0805) SF
R102	3250644	RES CHIP 6.8OHM 5% (0805) SF	R162	3250822	RES CHIP 2.2K OHM 5% (0805) SF
R103	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R163	3252101	RES CHIP 9.09K 1% (0805) SF
R104	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R164	3251079	RES CHIP 10.0 K 1% (0805) SF
R105	3250835	RES CHIP 8.2K OHM 5% (0805) SF	R165	3251085	RES CHIP 40.2K 1% (0805) SF
R106	3250810	RES CHIP 100 OHM 5% (0805) SF	R166	3250831	RES CHIP 10K OHM 5% (0805) SF
R107	3250831	RES CHIP 10K OHM 5% (0805) SF	R167	3250841	RES CHIP 30K OHM 5% (0805) SF
R108	3250916	RES CHIP 1.5 OHM 5% (0805) SF	R168	3251077	RES CHIP 4.99K 1% (0805) SF
R109	3250829	RES CHIP 680 OHM 5% (0805) SF	R169	3250840	RES CHIP 39K OHM 5% (0805) SF
R110	3250807	RES CHIP 330 OHM 5% (0805) SF	R170	3250831	RES CHIP 10K OHM 5% (0805) SF
R111	3250800	RES CHIP 10 OHM 5% (0805) SF	R171	3250488	RES M.FILM 200 K 1% 1/4 W AX
R112	3250831	RES CHIP 10K OHM 5% (0805) SF	R172	3250831	RES CHIP 10K OHM 5% (0805) SF
R113	3250824	RES CHIP 3.3K OHM 5% (0805) SF	R173	3250487	RES M.FILM 100 K 1% 1/4 W AX
R114	3250810	RES CHIP 100 OHM 5% (0805) SF	R174	3250807	RES CHIP 330 OHM 5% (0805) SF
R115	3250831	RES CHIP 10K OHM 5% (0805) SF	R175	3250831	RES CHIP 10K OHM 5% (0805) SF
R116	3250868	RES CHIP 10.0 MEG 5% (0805) SF	R176	3250838	RES CHIP 33K OHM 5% (0805) SF
R117	3250831	RES CHIP 10K OHM 5% (0805) SF	R177	3250831	RES CHIP 10K OHM 5% (0805) SF
R118	3250831	RES CHIP 10K OHM 5% (0805) SF	R178	3250840	RES CHIP 39K OHM 5% (0805) SF
R119	3250868	RES CHIP 10.0 MEG 5% (0805) SF	R179	3250844	RES CHIP 68K OHM 5% (0805) SF
R120	3250837	RES CHIP 22K OHM 5% (0805) SF	R180	3250845	RES CHIP 56K OHM 5% (0805) SF
R121	3250837	RES CHIP 22K OHM 5% (0805) SF	R181	3250833	RES CHIP 15K OHM 5% (0805) SF
R125	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R182	3250837	RES CHIP 22K OHM 5% (0805) SF
R126	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R183	3250837	RES CHIP 22K OHM 5% (0805) SF
R127	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R184	3250833	RES CHIP 15K OHM 5% (0805) SF
R128	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R185	3250831	RES CHIP 10K OHM 5% (0805) SF
R129	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R186	3250849	RES.C 12K OHM 5% (0805) SF
R130	3250831	RES CHIP 10K OHM 5% (0805) SF	R187	3250841	RES CHIP 30K OHM 5% (0805) SF
R131	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R188	3250801	RES CHIP 15 OHM 5% (0805) SF
R132	3250846	RES CHIP 100K OHM 5% (0805) SF	R189	3251083	RES CHIP 20.0K 1% (0805) SF
R133	3250831	RES CHIP 10K OHM 5% (0805) SF	R190	3250853	RES CHIP 330K OHM 5% (0805) SF
R134	3250643	RES CHIP 510 OHM 5% (0805) SF	R191	3250843	RES CHIP 6.8K OHM 5% (0805) SF
R135	3250839	RES CHIP 5.1K OHM 5% (0805) SF	R192	3250819	RES CHIP 1.0K OHM 5% (0805) SF
R136	3250824	RES CHIP 3.3K OHM 5% (0805) SF	R193	3250820	RES CHIP 1.8K OHM 5% (0805) SF
R137	3250806	RES CHIP 22 OHM 5% (0805) SF	R194	3250831	RES CHIP 10K OHM 5% (0805) SF
R138	3250824	RES CHIP 3.3K OHM 5% (0805) SF	R195	3250842	RES CHIP 47K OHM 5% (0805) SF
R139	3250806	RES CHIP 22 OHM 5% (0805) SF	R196	3250842	RES CHIP 47K OHM 5% (0805) SF
R140	3250807	RES CHIP 330 OHM 5% (0805) SF	R197	3250810	RES CHIP 100 OHM 5% (0805) SF
R141	3260668	RES VAR PT10V 20K	R198	3250831	RES CHIP 10K OHM 5% (0805) SF
R142	3250845	RES CHIP 56K OHM 5% (0805) SF	R199	3250845	RES CHIP 56K OHM 5% (0805) SF
R143	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R200	3250842	RES CHIP 47K OHM 5% (0805) SF
R144	3250807	RES CHIP 330 OHM 5% (0805) SF			
R145	3250829	RES CHIP 680 OHM 5% (0805) SF			

26 Second IF Board Parts List cont'd.

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R202	3250837	RES CHIP 22K OHM 5% (0805) SF	R261	3250838	RES CHIP 33K OHM 5% (0805) SF
R203	3250837	RES CHIP 22K OHM 5% (0805) SF	R262	3250819	RES CHIP 1.0K OHM 5% (0805) SF
R204	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R263	3250821	RES CHIP 1.1K OHM 5% (0805) SF
R205	3250868	RES CHIP 10.0 MEG 5% (0805) SF	R264	3260654	RES VAR PT10V LIN 1K
R206	3250831	RES CHIP 10K OHM 5% (0805) SF	R265	3250843	RES CHIP 6.8K OHM 5% (0805) SF
R207	3250817	RES CHIP 470 OHM 5% (0805) SF	R266	3250831	RES CHIP 10K OHM 5% (0805) SF
R208	3250803	RES CHIP 47 OHM 5% (0805) SF	R267	3250842	RES CHIP 47K OHM 5% (0805) SF
R209	3250910	RES CHIP 270K OHM 5% (0805) SF	R268	3250846	RES CHIP 100K OHM 5% (0805) SF
R210	3250645	RES CHIP 1.5M OHM 5% (0805) SF	R269	3250817	RES CHIP 470 OHM 5% (0805) SF
R211	3250833	RES CHIP 15K OHM 5% (0805) SF	R270	3250842	RES CHIP 47K OHM 5% (0805) SF
R212	3260664	RES VAR PT10V 10K	R271	3250850	RES CHIP 150K OHM 5% (0805) SF
R213	3250846	RES CHIP 100K OHM 5% (0805) SF	R272	3250817	RES CHIP 470 OHM 5% (0805) SF
R214	3250831	RES CHIP 10K OHM 5% (0805) SF	R273	3250831	RES CHIP 10K OHM 5% (0805) SF
R215	3250800	RES CHIP 10 OHM 5% (0805) SF	R274	3250842	RES CHIP 47K OHM 5% (0805) SF
R216	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R275	3250645	RES CHIP 1.5M OHM 5% (0805) SF
R217	3250831	RES CHIP 10K OHM 5% (0805) SF	R276	3250817	RES CHIP 470 OHM 5% (0805) SF
R218	3250831	RES CHIP 10K OHM 5% (0805) SF	R277	3250854	RES CHIP 82K OHM 5% (0805) SF
R219	3250831	RES CHIP 10K OHM 5% (0805) SF	R278	3250821	RES CHIP 1.1K OHM 5% (0805) SF
R220	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R279	3250843	RES CHIP 6.8K OHM 5% (0805) SF
R221	3250837	RES CHIP 22K OHM 5% (0805) SF	R280	3250802	RES CHIP 82 OHM 5% (0805) SF
R222		NOPART	R281	3250842	RES CHIP 47K OHM 5% (0805) SF
R223	3250831	RES CHIP 10K OHM 5% (0805) SF	R282	3250842	RES CHIP 47K OHM 5% (0805) SF
R224	3250834	RES CHIP 5.6K OHM 5% (0805) SF	R283	3250790	RES CHIP 43K OHM 5% (0805) SF
R225	3250803	RES CHIP 47 OHM 5% (0805) SF	R284	3250801	RES CHIP 15 OHM 5% (0805) SF
R226	3250799	RES CHIP 39 OHM 5% (0805) SF	R285	3250801	RES CHIP 15 OHM 5% (0805) SF
R227	3250801	RES CHIP 15 OHM 5% (0805) SF	R286	3250838	RES CHIP 33K OHM 5% (0805) SF
R228	3250837	RES CHIP 22K OHM 5% (0805) SF	R287	3250831	RES CHIP 10K OHM 5% (0805) SF
R229	3250848	RES CHIP 120K OHM 5% (0805) SF	R288	3250847	RES CHIP 27K OHM 5% (0805) SF
R230	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R289	3250830	RES CHIP 820 OHM 5% (0805) SF
R231	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R290	3250830	RES CHIP 820 OHM 5% (0805) SF
R232	3250910	RES CHIP 270K OHM 5% (0805) SF	R291	3250831	RES CHIP 10K OHM 5% (0805) SF
R233	3250810	RES CHIP 100 OHM 5% (0805) SF	R292	3250819	RES CHIP 1.0K OHM 5% (0805) SF
R234	3250820	RES CHIP 1.3K OHM 5% (0805) SF	R293	3250910	RES CHIP 270K OHM 5% (0805) SF
R235	3250831	RES CHIP 10K OHM 5% (0805) SF	R294	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R236	3250822	RES CHIP 2.2K OHM 5% (0805) SF	R295	3250831	RES CHIP 10K OHM 5% (0805) SF
R237	3250831	RES CHIP 10K OHM 5% (0805) SF	R296	3250831	RES CHIP 10K OHM 5% (0805) SF
R238	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R297	3250846	RES CHIP 100K OHM 5% (0805) SF
R239	3250831	RES CHIP 10K OHM 5% (0805) SF	R298	3250822	RES CHIP 2.2K OHM 5% (0805) SF
R240	3250854	RES CHIP 82K OHM 5% (0805) SF	R299	3250837	RES CHIP 22K OHM 5% (0805) SF
R241	3250857	RES CHIP 470K OHM 5% (0805) SF	R300	3250820	RES CHIP 1.8K OHM 5% (0805) SF
R242	3250645	RES CHIP 1.5M OHM 5% (0805) SF	R301	3250810	RES CHIP 100 OHM 5% (0805) SF
R243	3250831	RES CHIP 10K OHM 5% (0805) SF	R302	3250831	RES CHIP 10K OHM 5% (0805) SF
R244	3250831	RES CHIP 10K OHM 5% (0805) SF	R303	3250817	RES CHIP 470 OHM 5% (0805) SF
R245	3250857	RES CHIP 470K OHM 5% (0805) SF	R304	3250845	RES CHIP 56K OHM 5% (0805) SF
R246	3250831	RES CHIP 10K OHM 5% (0805) SF	R305	3250854	RES CHIP 82K OHM 5% (0805) SF
R247	3260654	RES VAR PT10V LIN 1K	R306	3250847	RES CHIP 27K OHM 5% (0805) SF
R248	3250827	RES CHIP 390 OHM 5% (0805) SF	R307	3250832	RES CHIP 3.9K OHM 5% (0805) SF
R249	3250809	RES CHIP 220 OHM 5% (0805) SF	R308	3250821	RES CHIP 1.1K OHM 5% (0805) SF
R250	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R309	3250834	RES CHIP 5.6K OHM 5% (0805) SF
R251	3250831	RES CHIP 10K OHM 5% (0805) SF	R310	3260654	RES VAR PT10V LIN 1K
R252	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R311	3250845	RES CHIP 56K OHM 5% (0805) SF
R253	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R312	3250837	RES CHIP 22K OHM 5% (0805) SF
R254	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R313	3250831	RES CHIP 10K OHM 5% (0805) SF
R255	3250831	RES CHIP 10K OHM 5% (0805) SF	R314	3250831	RES CHIP 10K OHM 5% (0805) SF
R256	3250831	RES CHIP 10K OHM 5% (0805) SF	R315	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R257	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R316		NOPART
R258	3260688	RES VAR PT10V LIN 2K	R317	3250831	RES CHIP 10K OHM 5% (0805) SF
R259	3250834	RES CHIP 5.6K OHM 5% (0805) SF	R318	3250810	RES CHIP 100 OHM 5% (0805) SF
R260	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R319	3250828	RES CHIP 4.7K OHM 5% (0805) SF
			R320	3250846	RES CHIP 100K OHM 5% (0805) SF

Second IF/Audio Output Board Parts List cont'd. 27

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R321	3250810	RES CHIP 100 OHM 5% (0805) SF	U1	2070798	IC ULN3845A ASSEMBLY
R322	3250846	RES CHIP 100K OHM 5% (0805) SF	U2	3041054	IC 14052
R323	3250810	RES CHIP 100 OHM 5% (0805) SF	U3	3041054	IC 14052
R324	3250831	RES CHIP 10K OHM 5% (0805) SF	U4	3040551	IC TDA2003
R325	3250835	RES CHIP 8.2K OHM 5% (0805) SF	U5	3041054	IC 14052
R326	3250810	RES CHIP 100 OHM 5% (0805) SF	U6	3040133	IC PC1037HA
R327	3250831	RES CHIP 10K OHM 5% (0805) SF	U7	3040133	IC PC1037HA
R328	3250831	RES CHIP 10K OHM 5% (0805) SF	U8	3040097	IC LF353N
R329	3250831	RES CHIP 10K OHM 5% (0805) SF	U9	3040097	IC LF353N
R330	3250831	RES CHIP 10K OHM 5% (0805) SF	U10	3040097	IC LF353N
R331	3250803	RES CHIP 47 OHM 5% (0805) SF	U11	3041058	IC 14066BCP CMOS
R332	3250828	RES CHIP 4.7K OHM 5% (0805) SF	U12	3041054	IC 14052
R333	3250851	RES CHIP 220K OHM 5% (0805) SF	U13	3040033	IC 74HC86
R334	3250828	RES CHIP 4.7K OHM 5% (0805) SF	U14	3040011	IC 74HC74
R335	3250828	RES CHIP 4.7K OHM 5% (0805) SF	U15	3041054	IC 14052
R336	3250819	RES CHIP 1.0K OHM 5% (0805) SF	U16	3040131	IC MC3405
R337	3260668	RES VAR PT10V 20K	U17	3040094	IC LM358
R338	3250819	RES CHIP 1.0K OHM 5% (0805) SF	U18	3040094	IC LM358
R339	3250828	RES CHIP 4.7K OHM 5% (0805) SF	U19	3040024	IC 74HC4066
R340	3260668	RES VAR PT10V 20K	CR1	3020220	DIODE 1N4005-PLASTIC AX
R341	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR2	3020220	DIODE 1N4005-PLASTIC AX
R342	3250831	RES CHIP 10K OHM 5% (0805) SF	CR3	3020220	DIODE 1N4005-PLASTIC AX
R343	3250831	RES CHIP 10K OHM 5% (0805) SF	CR4	3020220	DIODE 1N4005-PLASTIC AX
R344	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR5	3024812	DIODE 6A20 6.0A 200V FORMED RD
R345	3250831	RES CHIP 10K OHM 5% (0805) SF	CR6	3024812	DIODE 6A20 6.0A 200V FORMED RD
R346	3250803	RES CHIP 47 OHM 5% (0805) SF	CR7	3024812	DIODE 6A20 6.0A 200V FORMED RD
R347	3250822	RES CHIP 2.2K OHM 5% (0805) SF	CR8	3024812	DIODE 6A20 6.0A 200V FORMED RD
R348	3250817	RES CHIP 470 OHM 5% (0805) SF	CR9	3024812	DIODE 6A20 6.0A 200V FORMED RD
R349	3250831	RES CHIP 10K OHM 5% (0805) SF	CR10	3020220	DIODE 1N4005-PLASTIC AX
R350	3250909	RES CHIP 180K OHM 5% (0805) SF	CR11	3020220	DIODE 1N4005-PLASTIC AX
R351	3250831	RES CHIP 10K OHM 5% (0805) SF	CR12	3020090	DIODE 1N4148 AX
R352	3250825	RES CHIP 2.7K OHM 5% (0805) SF	CR13	3020090	DIODE 1N4148 AX
R353	3250825	RES CHIP 2.7K OHM 5% (0805) SF	CR14	3020090	DIODE 1N4148 AX
R354	3250833	RES CHIP 15K OHM 5% (0805) SF	CR15	3020090	DIODE 1N4148 AX
R355	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR16	3020090	DIODE 1N4148 AX
R356	3250831	RES CHIP 10K OHM 5% (0805) SF	CR17	3020401	DIODE 1S597-2-ND4973-7E AX
R357	3250825	RES CHIP 2.7K OHM 5% (0805) SF	CR18	3020090	DIODE 1N4148 AX
R358	3250822	RES CHIP 2.2K OHM 5% (0805) SF	CR19	3020090	DIODE 1N4148 AX
R359	3250837	RES CHIP 22K OHM 5% (0805) SF	CR21	3020090	DIODE 1N4148 AX
R360	3250919	RES CHIP 0.0OHM (0805) T&R SF	CR22	3020090	DIODE 1N4148 AX
R361	3250829	RES CHIP 680 OHM 5% (0805) SF	SW1	3670541	SW SLIDE DP3T #SLY-23-05P
R362	3250843	RES CHIP 6.8K OHM 5% (0805) SF	VR1	3040166	IC LM2940CT-5.0
R363	3250831	RES CHIP 10K OHM 5% (0805) SF	VR2	3040164	IC LM2940CT-10
R364	3250831	RES CHIP 10K OHM 5% (0805) SF	VR3	3040031	IC 78L05-ACP RD
R365	3250831	RES CHIP 10K OHM 5% (0805) SF			
R366	3250831	RES CHIP 10K OHM 5% (0805) SF			
R367	3250831	RES CHIP 10K OHM 5% (0805) SF			
R368	3250838	RES CHIP 33K OHM 5% (0805) SF			
R369	3250837	RES CHIP 22K OHM 5% (0805) SF			
R370	3250823	RES CHIP 1.5K OHM 5% (0805) SF			
R371	3250819	RES CHIP 1.0K OHM 5% (0805) SF			
R400	3220260	RES C. FILM 22 K 5% 1/4W AX			
R401	3220202	RES C. FILM 3.6 K 5% 1/4W AX			

MECHANICAL PARTS

REFERENCE	PART NUMBER	DESCRIPTION
1	2150019	HT.SINK(5073B)-TDA2003 ASSY
1	2715606	COAX 178 4.0 1/2-1/2
1	3100039	BD R88 2ND F/AUDIO/PS
1	3371060	RIVET TUBULAR 3479-314-0.187
1	3493030	HT SINK AAVID #5073B
2	4560254	SHLD POT CORE R8 SERIES
1	4560332	SHIELD 2ND IF SYNCRO-WALL R8B
1	4490045	INSULATOR (CR6, 7, 8, 9)

28 Second IF Board Parts List cont'd.

PHASE SHIFT BOARD ASSEMBLY, P/N: 2070865

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C1	3184040	CAP FILM .01 @ 100V 10% RD			
C2	3184022	CAP FILM .0022 @ 50V 5% RD			
C3	3190100	CAP RAD'L 1000PF 1% NPO AVX RD			
C4	3190100	CAP RAD'L 1000PF 1% NPO AVX RD			
C5	3180062	CAP ELEC 10@35 RD			
C6	3190100	CAP RAD'L 1000PF 1% NPO AVX RD			
C7	3190100	CAP RAD'L 1000PF 1% NPO AVX RD			
C8	3184021	CAP FILM .0047 @ 50V 5% RD			
C9	3190100	CAP RAD'L 1000PF 1% NPO AVX RD			
P1	3280713	CONN P.C. JST#TS5B-SQ-1			
R1	3260673	RES VAR FT10H(2.5)LIN 50K			
R2	3251079	RES CHIP 10.0 K 1% (0805) SF			
R3	3251079	RES CHIP 10.0 K 1% (0805) SF			
R4	3251079	RES CHIP 10.0 K 1% (0805) SF			
R5	3250831	RES CHIP 10K OHM 5% (0805) SF			
R6	3251089	RES CHIP 80.6K 1% (0805) SF			
R7	3252249	RES CHIP 249K 1% 0805 SF			
R8	3250910	RES CHIP 270K OHM 5% (0805) SF			
R9	3250859	RES CHIP 820K OHM 5% (0805) SF			
R10	3251079	RES CHIP 10.0 K 1% (0805) SF			
R11	3251079	RES CHIP 10.0 K 1% (0805) SF			
R12	3251070	RES CHIP 200K OHM 1% (0805) SF			
R13	3252486	RES CHIP 48.7K 1% 0805 SF			
R14	3251079	RES CHIP 10.0 K 1% (0805) SF			
R15	3251089	RES CHIP 80.6K 1% (0805) SF			
R16	3250646	RES CHIP 75K OHM 5% (0805) SF			
R17	3251079	RES CHIP 10.0 K 1% (0805) SF			
R18	3251079	RES CHIP 10.0 K 1% (0805) SF			
R19	3251079	RES CHIP 10.0 K 1% (0805) SF			
R20	3250628	RES CHIP 4.7K OHM 5% (0805) SF			
R21	3250846	RES CHIP 100K OHM 5% (0805) SF			
R22	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R23	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R24	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R25	3251079	RES CHIP 10.0 K 1% (0805) SF			
R26	3251079	RES CHIP 10.0 K 1% (0805) SF			
R27	3251079	RES CHIP 10.0 K 1% (0805) SF			
R28	3251079	RES CHIP 10.0 K 1% (0805) SF			
R29	3250831	RES CHIP 10K OHM 5% (0805) SF			
R30	3252210	RES CHIP 210K 1% 0805 SF			
R31	3252249	RES CHIP 249K 1% 0805 SF			
R32	3252249	RES CHIP 249K 1% 0805 SF			
R33	3252248	RES CHIP 24.9K 1% 0805 SF			
R34	3251070	RES CHIP 200K OHM 1% (0805) SF			
R35	3251085	RES CHIP 40.2K 1% (0805) SF			
R36	3251070	RES CHIP 200K OHM 1% (0805) SF			
R37	3252576	RES CHIP 576K 1% 0805 SF			
R38	3251079	RES CHIP 10.0 K 1% (0805) SF			
R39	3251079	RES CHIP 10.0 K 1% (0805) SF			
R40	3251079	RES CHIP 10.0 K 1% (0805) SF			
R41	3251079	RES CHIP 10.0 K 1% (0805) SF			
U1	3045514	IC PRECSN QUAD OP-AMP NE5514			
U2	3040097	IC LF353N			
U3	3045514	IC PRECSN QUAD OP-AMP NE5514			

SYNTHESIZER/MICROPROCESSOR THEORY OF OPERATION

The synthesizer/microprocessor board provides several RF signals and all the logic control signals required by other boards in the receiver. The RF signals provided by the synth/uP board include:

- 1) VCO or 1st LO which is a 45.01-75 MHz signal to the 1st mixer on the Front End board.
- 2) 2nd LO which is a 45.05 MHz signal to the 2nd mixer on the Front End board.
- 3) BFO or beat frequency oscillator which is a 50 kHz signal required for SSB reception by the AM detector on the 2nd IF/AUDIO/POWER SUPPLY board.
- 4) VHF REF which is a 3.5 MHz reference signal to the PLL on the optional VHF converter board.

Logic control signals required by other boards include:

- 1) Serial clock and data to the front panel display driver.
- 2) Front panel keyboard scanning.
- 3) Serial clock and data to optional VHF converter.
- 4) Latched, steady state control voltages to 2nd IF/AUDIO/POWER SUPPLY board for bandwidth selection, AGC ON/OFF and SLOW/FAST, Natch ON/OFF etc.
- 5) Latched, steady state control voltages to Front End board for BPF selection, preamp/atten enable, and 1/2/converter.

Let's discuss the circuits involved with generating the 4 RF signals, beginning with the 1st LO. **Note that for most of the discussion that follows, the circuitry is located on the 'SYNTHESIZER CIRCUITS' schematic.**

1st LO

The 1st LO is generated or synthesized by 3 nested phase locked loops (PLL'S), producing an injection signal that tunes from 45.01 MHz to 75.0 MHz in 10 Hz steps. This provides HF band reception from 10 kHz to 30 MHz in 10 Hz steps with the 1st IF frequency at 45.0 MHz.

Four distinct circuits are used to generate the 1st LO:

- 1) Reference oscillator
- 2) PLL3
- 3) PLL2
- 4) PLL1

Before discussing the specifics of these individual circuits, a brief overview of how the PLL circuits are interconnected is in order.

The PLL's are nested such that the inner most loop (PLL3) provides a reference signal to the middle loop (PLL2), and the middle loop provides a reference signal to the outer loop (PLL1). The inner loop VCO output is divided by 20 from approximately 130 MHz by U27. This 6.5 MHz signal is used by the middle loop to lock the middle loop VCO on frequency. A 2 kHz step at 130 MHz becomes a 100 Hz step at 6.5 MHz and the middle loop VCO will move or shift 100 Hz.

Similarly, the middle loop VCO output is divided by 10 from approximately 60 MHz by U28. This 6.0 MHz signal is used by the outer loop to lock the outer loop VCO on frequency. A 10 kHz step at 60 MHz becomes a 1 kHz step at 6.0 MHz and the outer loop VCO will move or shift 1 kHz. Likewise, a 2 kHz step in the inner loop becomes a 100 Hz step in the middle loop, which becomes a 10 Hz step at the outer loop VCO frequency. In other words, the middle loop tracks any frequency changes in the inner loop, and the outer loop tracks any changes in the middle loop. And the outer loop VCO frequency is the desired synthesized output.

REFERENCE OSCILLATOR

All three loops are phase locked to the highly stable, temperature compensated, crystal controlled, 35 MHz reference oscillator. The reference oscillator consists of a 35 MHz crystal (Y4), transistor Q42, and associated components. Resistors R260, R278 and R275 provide bias to the transistor. Capacitor C341 has a N750 temperature coefficient and provides the major temperature compensation. Variable inductor L56 provides the frequency tuning adjustment. Transistors Q39, Q41, Q43 and associated components provide buffering and reverse isolation.

For the outer loop (PLL1), the 35 MHz is routed through capacitor C340, coax X4 and capacitor C123 to U14 Pin 8. For PLL2 and PLL3, the reference frequency is divided by 10 to 3.5 MHz by U35. This 3.5 MHz reference signal is coupled to PLL2, U31 Pin 1, through capacitor C294 and to PLL3, U30 Pin 1, through C292. The 3.5 MHz signal is also the reference signal for the optional VHF converter. This signal path will be discussed later.

Additionally, the 35 MHz reference is used in each loop to mix or translate signals to appropriate frequencies. In the outerloop, U23 uses the 35 MHz reference to translate the output of the middle loop from 6.0 MHz to 41.0 MHz. Similarly, in PLL2 and PLL3, U26 and U33 use 70 MHz to translate signals. The 70 MHz is obtained by doubling the frequency of the 35 MHz reference. The 35 MHz to 70 MHz doubler circuit consists of diode CR38, variable coil L55, transistor Q40 and associated components.

INNER LOOP PLL3

PLL3 is the inner most loop and provides the smallest step size and finest resolution. Its main component is U30: MC145157. U30 consists of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the uP through the serial data bus. The reference signal at Pin 1 is divided by R3. The VCO signal at Pin 8 is divided by N3. Since R3 is constant, the uP loads R3 only during the power-on sequence which is initiated by depressing the front panel power button. N3 is variable and needs to be loaded whenever the frequency changes.

32 Circuit Description cont'd.

A 2 kHz step is achieved by changing N3. The step size of PLL3 is determined by the reference signal into Pin 1 of U30 and the division ratio R3 as follows:

Step size = reference frequency divided by R3. The reference signal at Pin 1 is 3.5 MHz, and R3 = 1750, giving a minimum step size of 2 kHz. This also represents the frequency at which the phase comparator inside U30 compares the VCO signal at Pin 8 to the reference signal.

The output of the phase comparator is a DC tuning voltage at Pin 5 used to tune the VCO. The tuning voltage is filtered by the loop filter, a LPF consisting of U29, R209, R210, C255 and C256. The loop filter output voltage at Pin 7 of U29, is applied to varactors CR31 and CR32 in the VCO. This VCO, VCO3, consisting of transistors Q27 and associated components, tunes from 130.002 MHz to 130.200 MHz in 2 kHz steps. Capacitors C225, C226, C228, C229, variable inductor L36 and varactors CR31 and CR32 determine the frequency of oscillation.

The VCO3 output is filtered by a LPF and buffered by Q24 and Q32. After Q24, the VCO3 output is mixed with the second harmonic of 70 MHz (ie, 140 MHz) at U33 and translated from the 130.002 - 130.200 MHz range to the 9.998 - 9.800 MHz range. The 9.998 - 9.800 MHz signal is the VCO signal presented to U30 Pin 8. A 10 MHz LPF after Q34 filters off the undesired mixing products and Q34 provides enough gain to ensure U30 sees at least a 1 volt PTP signal at Pin 8.

U30 must divide the 9.998 - 9.800 MHz VCO signal down to 2 kHz for the internal phase comparison. This division ratio, N3, is calculated by the uP and loaded into U30. N3 will be an integer number within the following limits:

$$4900 \leq N3 \leq 4999$$

Returning to the VCO3 output and Q24, after Q122 the VCO3 output is divided by 20 at U27. The output of U27 at Pin 4 is considered the PLL3 output. The PLL3 output signal covers the range from 6.5001 MHz to 6.5100 MHz in 100 Hz steps and is used by the middle loop (PLL2) to lock the middle loop VCO.

The frequency relationships of PLL3 are given by the following equations:

$$\begin{aligned} R3 &= 1750 \\ f_{ref} &= 35 \text{ MHz reference signal} \\ f_{VCO3} &= 4 \times f_{ref} - f_{PLL3} / 10 \times 1/R3 \times N3 \\ &= f_{ref} (4 - N3/17500) \\ PLL3 &= f_{VCO3} + 20 \\ &= (f_{ref}/20) (4 - N3/17500) \\ &= (f_{ref}/10) (2 - N3/35000) \end{aligned}$$

MIDDLE LOOP PLL2

PLL2 is similar to PLL3 but provides the medium step size and resolution. Its main component is U31: MC145157. U31 is identical to U30 in PLL3 and consists of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the uP through the serial data bus. The reference signal at Pin 1 is divided by R2. The VCO signal at Pin 8 is divided by N2. R2, like R3, is constant and the uP loads R2 only during the power-on sequence. N2, like N3, is variable and needs to be loaded whenever the frequency changes. A 10 kHz step is achieved by changing N2, and a 100 Hz step is obtained via PLL3. The step size of PLL2 is determined by the reference signal and R2:

$$\text{Step size} = \text{ref signal}/R2$$

The reference signal at Pin 1 is 3.5 MHz, R2 = 350, giving a PLL2 step size of 10 kHz. This also represents the frequency at which the phase comparison is performed inside U31.

The output of the phase comparator is a DC tuning voltage at Pin 5, and it is used to tune the VCO. The tuning voltage is filtered by the loop filter, a LPF consisting of U32, R211 and R212, C260 and C261. The loop filter output voltage at Pin 1 of U32 is applied to varactors CR28 and CR29 in the VCO. This VCO, VCO2, consisting of transistor Q26 and associated components, tunes from 60 to 61 MHz. Capacitors C234, C235, C237 and C238, variable inductor L37, and varactors CR28 and CR29 determine the frequency of oscillation.

The VCO2 output is filtered by a LPF and buffered by Q25 and Q33. After Q33, the VCO2 output is mixed with a 63 MHz signal and translated to approximately 3 MHz by U34. The 63 MHz signal is directly related to the PLL3 frequency. The PLL3 output is mixed with 70 MHz at U26. A 63 MHz BPF selects the desired mixing product and completes the translation of the PLL3 output from the 6.5001 - 6.5100 MHz range to 63.4999 - 63.4900 MHz range. U34 mixes the 63.49 MHz signal and the 60-61 MHz VCO2 signal and produces a 2.50 - 3.49 MHz signal. A 4 MHz LPF after U34 filters off the undesired mixing product and Q35 provides enough gain to ensure U31 sees at least a 1V PTP signal at Pin 8.

The internal divider must divide the 2.50 - 3.49 MHz signal down to 10 kHz. This division ratio, N2, is calculated by the uP and loaded into U31. N2 will be an integer number within the following limits.

$$250 \leq N2 \leq 349$$

Returning to the VCO output and Q25, after Q25 the VCO2 output is divided by 10 at U28. The output of U28 at Pin 4 is considered the PLL2 output. The PLL2 output signal covers the range from 6.0 - 6.1 MHz in 10 Hz steps and is used by the outer loop PLL1 to lock the outer loop VCO.

The frequency relationships of PLL2 are given by the following equations:

$$\begin{aligned} f_{VCO2} &= (2 \times (f_{REF}) - PLL3) - f_{REF} / 10 \times 1/R2 \times N2 \\ &= 2 \times (f_{REF}) - (f_{REF} / 10)(2 - N3/35000) - f_{REF} / 10 \times 1/350 \times N2 \\ &= f_{REF} (2 - 1/10(2 - N3/35000) - N2/3500) \\ &= f_{REF} (1.8 + N3/350000 - N2/3500) \end{aligned}$$

$$\begin{aligned} PLL2 &= f_{VCO2} / 10 \\ &= (f_{REF} / 10)(2 - 1/10(2 - N3/35000) - N2/3500) \\ &= (f_{REF}) (1/10) (1.8 + N3/350000 - N2/3500) \\ &= f_{REF} (0.18 + N3/3500000 - N2/35000) \end{aligned}$$

OUTER LOOP PLL1

PLL1 is the outer phase-locked loop used to synthesize the 1st LO signal. The output signal of the outer loop VCO, VCO1, is the desired 1st LO signal. VCO1 is actually 4 different oscillators, each covering a different frequency band. The correct oscillator is selected and enabled by the uP control signals (VCO1 - VCO3). The main component in PLL1 is U14: M887086. U14 is similar to U30 and U31, consisting of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the uP through the serial data bus. The reference signal at Pin 8 is divided by R1. The VCO signal at Pin 1 is divided by N1. R1, like R3 and R2, is constant and the uP loads R1 only during the power-on sequence. N1 is variable and needs to be updated whenever the frequency changes. A 100 kHz step is achieved by changing N1, and a 10 Hz step is obtained via PLL2.

The step size obtained by PLL1 is determined by the reference signal and R1:

$$\text{Step size} = \text{ref signal}/R1$$

The reference signal at Pin 8 is 35 MHz; R1 = 350, resulting in a step size of 100 kHz. This also is the frequency at which the phase comparison is performed inside U14.

The output of the phase comparator is two pulsed control signals at Pins 15 and 16. Both control signals are normally at +5 volts and pulse low (0.2 volts) when active. The pulse width determines the amount of correction and is derived from the relative phase information. Pin 15 provides the "UP" pulse and Pin 16 is the "DOWN" pulse. The charge pump and loop filter produce a DC tuning voltage from the UP and DOWN pulses.

There are actually 2 different charge pump/loop filter combinations that tune the 4 oscillators of VCO1. The low band oscillator covers the range from 45.00000 to 52.49999 MHz, and has its own charge pump and loop filter. The low band oscillator consists of transistor Q8 and associated components. The low band charge pump consists of Q13, Q14, and Q17 and associated components. The low band loop filter consists of R122, C115 and C114.

The high band charge pump (Q15, Q18 and Q19) and the high band loop filter (R125, C120 and C121) tune the

remaining 3 oscillators. Q9 tunes from 52.50000 to 59.99999 MHz; Q10 tunes from 60.00000 to 66.99999 MHz; and Q11 tunes from 67.00000 to 75.00000 MHz.

The VCO1 output is buffered by Q7 and filtered by a LPF. After the LPF, the signal path branches into two directions. Q16, Q1 and Q2 provide gain and reverse isolation at J100. J100 is the 1st LO output port to the front end board. Q16 and Q21 buffer the VCO1 to U16. The VCO1 output is mixed with a 41 MHz signal and translated from the 45.01 - 75.0 MHz range to the 4.0 - 34.0 MHz range by U16. The 41 MHz signal is directly related to the PLL2 frequency. The PLL2 output is mixed with 35 MHz at U23. A 41 MHz BPF selects the desired mixing product and completes the translation of the PLL2 output from the 6.0 - 6.1 MHz range to the 41.0 - 41.1 MHz range. A 35 MHz LPF after U16 filters off the undesired mixing products. Q22 and Q23 provide enough gain to ensure U14 sees at least 1 volt PTP at Pin 1.

The programmable divider inside U14 must divide the 4.0 - 34.0 MHz signal down to 100 kHz. This division ratio, N1, is calculated by the uP and loaded into U14.

N1 will be an integer number within the following limits:
 $40 \leq N1 \leq 340$

The frequencies in PLL1 are as follows:

$$\begin{aligned} f_{VCO1} &= \text{desired 1st LO output} \\ &= f_{REF}/R1 \times N1 + (f_{REF} + PLL2) \\ &= f_{REF} (N1/350) + f_{REF} + f_{REF} (0.18 + N3/3.5E6 - N2/3.5E4) \\ &= f_{REF} (1.18 + N1/350 - N2/3.5E4 + N3/3.5E6) \end{aligned}$$

2nd LO/PBT (PASS BAND TUNING)

The 2nd LO is a 45.05 MHz signal that is sent to the Front End board and digital mixer circuit. The 2nd LO frequency actually varies depending on mode and front panel PBT adjustment, thus providing IF shifting. The 45.05 MHz signal is produced by doubling a varactor tuned, crystal controlled 22.525 MHz oscillator. The oscillator consists of a 22.525 MHz crystal (Y3), transistor Q28 and associated components. It is not referenced back to the 35 MHz reference signal thus requiring its own temperature compensation. Capacitor C243 has a N1500 temperature coefficient and provides the major temperature compensation. Variable coil L32 provides the frequency tuning adjustment. Varactor CR30 provides a fine tune frequency adjustment. Fine tuning can be accomplished in two ways:

- 1) Front panel PBT adjustment
- 2) uP controlled DAC

Note that in the following text, circuit references to digital control can be located on the "MICROPROCESSOR CIRCUITS" schematic.

The front panel PBT control is a user adjustment which provides approximately ± 3 kHz shift at 45.05 MHz. The uP controlled DAC provides programmable offsets which can be different for each mode.

34 Circuit Description cont'd.

The μ P controlled DAC for PBT tuning is formed by U21 and associated output resistors connected into the non-inverting input of operational amplifier U25B. U21, under μ P control through the parallel data bus, switches a combination of 8 precision 1% resistors to either ground or +5 VDC, thereby changing the reference voltage of the operational amplifier circuit composed of U25B and associated components. Each mode (AM, CW, USB, etc.) can be programmed with a unique combination, allowing a different factory programmed PBT frequency for each mode. Additional tuning is available to the user through the front panel PBT control. The front panel PBT pot is read by the μ P (U17 Pin 54) and the digital-to-analog converter is adjusted accordingly. Both factory programmed offsets and front panel PBT tuning are accomplished through the digital-to-analog converter.

Q30 and Q31 disable the 45.05 MHz signal when in the FM mode. Tuned circuits around L39, L40, L42, L50 and L51 are tuned to 45.05 MHz thus enhancing the 2nd harmonic. L41 allows the signal to be split into two paths. Q37 amplifies the 45.05 MHz signal which is then coupled to J8. Connector J8 is the 2nd LO output port to the front endboard. Q36 amplifies the 45.05 MHz signal which is coupled into the digital mixer circuit.

BFO/DIGITAL MIXER

The digital mixer combines the 45.05 MHz 2nd LO signal and the 35 MHz reference signal to produce the 50 kHz BFO signal. The BFO signal is used in CW, RTTY, USB and LSB modes. Because the BFO signal is directly related to the 45.05 MHz signal, as the PBT is varied, the operating frequency does not change but rather IF shifting occurs.

Q44 amplifies the 35 MHz reference signal to the 4.5 volt PTP levels required by the digital integrated circuits. Likewise, Q45 amplifies the 45.05 MHz signal to 4.5 volts PTP. U37D mixes 35 MHz and 45.05 MHz and produces 10.05 MHz at Pin 11. U36 and U37A combine to divide the 35 MHz reference signal by 7 producing a 5 MHz signal at U36 Pin 12. U37B together with the input phase shift circuit (L53, C326, C327 and R265) double the 5 MHz signal to 10 MHz at U37B Pin 6. U37C mixes the 10 MHz signal from Pin 6 and the 10.05 MHz signal from Pin 11 to produce the 50 kHz BFO signal at Pin 8. A LPF reduces the undesired higher frequency products and provides a clean 50 kHz signal to J7.

$$f_{BFO} = f_{2ndLO} - f_{ref} + (2 \times 5 \text{ MHz})$$

VHF REFERENCE

The VHF reference is a 3.5 MHz signal derived from the 35 MHz reference oscillator and sent to the optional VHF converter board via J6. The 35 MHz reference signal is divided by 10 by U35. The 3.5 MHz output at U35 Pin 4 is buffered by Q38. A LPF reduces harmonic content and provides a sinusoidal 3.5 MHz signal to J6.

Synthesizer and Microprocessor Board Parts List 35

PC BOARD ASSEMBLY, P/N: 2070864

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C1	3151648	CAP AX .10 MF 50V T&R AX	C69	3150350	CAP AX 10.0PF 5% NPO AX
C2	3151405	CAP AX .001 MF 10% Y5P AX	C70	3150640	CAP AX 27.0 PF 5% NPO AX
C3	3151648	CAP AX .10 MF 50V T&R AX	C71	3205205	CAP VAR TRIM. 3.3-20.5 PF
C4	3151405	CAP AX .001 MF 10% Y5P AX	C72	3151405	CAP AX .001 MF 10% Y5P AX
C5	3180241	CAP ELEC 470@16 RD	C73	3151648	CAP AX .10 MF 50V T&R AX
C6	3180012	CAP ELEC 1@50 20% RD	C74	3151648	CAP AX .10 MF 50V T&R AX
C7	3166105	CAP CHIP .01UF X7R (0805) SF	C75	3151648	CAP AX .10 MF 50V T&R AX
C8	3166105	CAP CHIP .01UF X7R (0805) SF	C76	3151648	CAP AX .10 MF 50V T&R AX
C9	3166105	CAP CHIP .01UF X7R (0805) SF	C77	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C10	3166105	CAP CHIP .01UF X7R (0805) SF	C78	3180339	CAP ELEC 2200@16 16X20 RD
C11	3166105	CAP CHIP .01UF X7R (0805) SF	C79	3166148	CAP CHIP 33 PF NPO (0805) SF
C12	3166105	CAP CHIP .01UF X7R (0805) SF	C80	3151648	CAP AX .10 MF 50V T&R AX
C13	3166105	CAP CHIP .01UF X7R (0805) SF	C81	3151648	CAP AX .10 MF 50V T&R AX
C14	3166105	CAP CHIP .01UF X7R (0805) SF	C82	3151066	CAP AX 100PF 5% NPO AVX AX
C15	3166105	CAP CHIP .01UF X7R (0805) SF	C83	3151405	CAP AX .001 MF 10% Y5P AX
C17	3166105	CAP CHIP .01UF X7R (0805) SF	C84	3150640	CAP AX 27.0 PF 5% NPO AX
C18	3166105	CAP CHIP .01UF X7R (0805) SF	C85	3150899	CAP AX 68.0 PF 5% NPO AX
C19	3166105	CAP CHIP .01UF X7R (0805) SF	C86	3150640	CAP AX 27.0 PF 5% NPO AX
C20	3166105	CAP CHIP .01UF X7R (0805) SF	C87	3151425	CAP AX .0022MF 20% Y5P AX
C21	3166105	CAP CHIP .01UF X7R (0805) SF	C88	3150899	CAP AX 68.0 PF 5% NPO AX
C25	3151259	CAP AX 220 PF 10% Y5P AX	C89	3150896	CAP AX 56.0 PF 5% NPO AX
C26	3150350	CAP AX 10.0PF 5% NPO AX	C90	3150750	CAP AX 39.0 PF 5% NPO AX
C27	3180109	CAP ELEC 22@25 20% RD	C91	3150750	CAP AX 39.0 PF 5% NPO AX
C28	3150305	CAP AX 8.2PF 10% NPO AX	C92	3180295	CAP ELEC 1000@16 RAD'L RD
C29	3150690	CAP AX 33.0 PF 5% NPO AX	C93	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C30	3151648	CAP AX .10 MF 50V T&R AX	C95	3151405	CAP AX .001 MF 10% Y5P AX
C31	3150305	CAP AX 8.2PF 10% NPO AX	C96	3151405	CAP AX .001 MF 10% Y5P AX
C32	3150595	CAP AX 22.0 PF 5% NPO AX	C97	3151405	CAP AX .001 MF 10% Y5P AX
C33	3151648	CAP AX .10 MF 50V T&R AX	C98	3151405	CAP AX .001 MF 10% Y5P AX
C34	3150305	CAP AX 8.2PF 10% NPO AX	C99	3151405	CAP AX .001 MF 10% Y5P AX
C35	3150420	CAP AX 12.0 PF 5% NPO AX	C100	3151405	CAP AX .001 MF 10% Y5P AX
C36	3151648	CAP AX .10 MF 50V T&R AX	C101	3151425	CAP AX .0022MF 20% Y5P AX
C37	3150305	CAP AX 8.2PF 10% NPO AX	C102	3151405	CAP AX .001 MF 10% Y5P AX
C38	3150350	CAP AX 10.0PF 5% NPO AX	C103	3151405	CAP AX .001 MF 10% Y5P AX
C39	3151648	CAP AX .10 MF 50V T&R AX	C105	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C40	3166105	CAP CHIP .01UF X7R (0805) SF	C106	3151405	CAP AX .001 MF 10% Y5P AX
C41	3166105	CAP CHIP .01UF X7R (0805) SF	C107	3151648	CAP AX .10 MF 50V T&R AX
C42	3166105	CAP CHIP .01UF X7R (0805) SF	C108	3151515	CAP AX .01 MF 20% Y5P AX
C43	3166105	CAP CHIP .01UF X7R (0805) SF	C110	3151515	CAP AX .01 MF 20% Y5P AX
C44	3166105	CAP CHIP .01UF X7R (0805) SF	C113	3151515	CAP AX .01 MF 20% Y5P AX
C45	3166105	CAP CHIP .01UF X7R (0805) SF	C114	3184068	CAP FILM .1 @ 100V 10%
C46	3166105	CAP CHIP .01UF X7R (0805) SF	C115	3183011	CAP TANT RAD'L 1.0@35 10%
C47	3166105	CAP CHIP .01UF X7R (0805) SF	C116	3180152	CAP ELEC 100@50 RD
C48	3166105	CAP CHIP .01UF X7R (0805) SF	C117	3180109	CAP ELEC 22@25 20% RD
C49	3166105	CAP CHIP .01UF X7R (0805) SF	C118	3151515	CAP AX .01 MF 20% Y5P AX
C50	3166105	CAP CHIP .01UF X7R (0805) SF	C119	3180152	CAP ELEC 100@50 RD
C51	3166105	CAP CHIP .01UF X7R (0805) SF	C120	3183011	CAP TANT RAD'L 1.0@35 10%
C52	3166105	CAP CHIP .01UF X7R (0805) SF	C121	3184068	CAP FILM .1 @ 100V 10%
C55	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C122	3151345	CAP AX 470 PF 10% Y5P AX
C56	3166120	CAP CHIP .001UF X7R (0805) SF	C123	3151515	CAP AX .01 MF 20% Y5P AX
C57	3166120	CAP CHIP .001UF X7R (0805) SF	C124	3150896	CAP AX 56.0 PF 5% NPO AX
C58	3180241	CAP ELEC 470@16 RD	C125	3151648	CAP AX .10 MF 50V T&R AX
C59	3150078	CAP AX 3.9PF 10% NPO AX	C126	3167522	CAP CHIP 20 PF NPO (0805) SF
C60	3150690	CAP AX 33.0 PF 5% NPO AX	C127	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C61	3151648	CAP AX .10 MF 50V T&R AX	C128	3151405	CAP AX .001 MF 10% Y5P AX
C62	3150350	CAP AX 10.0PF 5% NPO AX	C129	3150350	CAP AX 10.0PF 5% NPO AX
C63	3150305	CAP AX 8.2PF 10% NPO AX	C130	3150779	CAP AX 43.0 PF 5% NPO AX
C64	3150640	CAP AX 27.0 PF 5% NPO AX	C131	3151515	CAP AX .01 MF 20% Y5P AX
C65	3150305	CAP AX 8.2PF 10% NPO AX	C132	3150040	CAP AX 2.7 PF 10% GP AX
C66	3150640	CAP AX 27.0 PF 5% NPO AX	C133	3150078	CAP AX 3.9PF 10% NPO AX
C67	3150350	CAP AX 10.0PF 5% NPO AX	C134	3150115	CAP AX 4.7PF 10% NPO AX
C68	3150640	CAP AX 27.0 PF 5% NPO AX	C135	3150030	CAP AX 1.5 PF 10% GP AX

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REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C136	3150040	CAP AX 2.7 PF 10% GP AX	C206	3150896	CAP AX 56.0 PF 5% NPO AX
C137	3150040	CAP AX 2.7 PF 10% GP AX	C207	3180064	CAP ELEC 10@50 20% RD
C138	3150350	CAP AX 10.0PF 5% NPO AX	C208	3150595	CAP AX 22.0 PF 5% NPO AX
C139	3151405	CAP AX .001 MF 10% Y5P AX	C209	3180012	CAP ELEC 1@50 20% RD
C140	3151066	CAP AX 100PF 5% NPO AVX AX	C210	3150750	CAP AX 39.0 PF 5% NPO AX
C141	3151405	CAP AX .001 MF 10% Y5P AX	C211	3150040	CAP AX 2.7 PF 10% GP AX
C142	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C212	3150690	CAP AX 33.0 PF 5% NPO AX
C143	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C213	3180064	CAP ELEC 10@50 20% RD
C144	3167522	CAP CHIP 20 PF NPO (0805) SF	C214	3151648	CAP AX .10 MF 50V T&R AX
C145	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C215	3151405	CAP AX .001 MF 10% Y5P AX
C146	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C216	3151405	CAP AX .001 MF 10% Y5P AX
C149	3180012	CAP ELEC 1@50 20% RD	C217	3180012	CAP ELEC 1@50 20% RD
C150	3150030	CAP AX 1.5 PF 10% GP AX	C218	3151515	CAP AX .01 MF 20% Y5P AX
C151	3150779	CAP AX 43.0 PF 5% NPO AX	C219	3150350	CAP AX 10.0PF 5% NPO AX
C152	3150030	CAP AX 1.5 PF 10% GP AX	C220	3151405	CAP AX .001 MF 10% Y5P AX
C153	3150779	CAP AX 43.0 PF 5% NPO AX	C221	3150350	CAP AX 10.0PF 5% NPO AX
C154	3150350	CAP AX 10.0PF 5% NPO AX	C222		NO PART
C155	3151515	CAP AX .01 MF 20% Y5P AX	C223	3150420	CAP AX 12.0 PF 5% NPO AX
C157	3151648	CAP AX .10 MF 50V T&R AX	C224	3150115	CAP AX 4.7PF 10% NPO AX
C158	3151515	CAP AX .01 MF 20% Y5P AX	C225	3150245	CAP AX 6.8PF 10% NPO AX
C160	3151515	CAP AX .01 MF 20% Y5P AX	C226	3150508	CAP AX 15.0 PF 5% NPO AX
C161	3180012	CAP ELEC 1@50 20% RD	C227	3180109	CAP ELEC 22@25 20% RD
C162	3180012	CAP ELEC 1@50 20% RD	C228	3150305	CAP AX 8.2PF 10% NPO AX
C163	3180012	CAP ELEC 1@50 20% RD	C229	3150115	CAP AX 4.7PF 10% NPO AX
C164	3151648	CAP AX .10 MF 50V T&R AX	C230	3184042	CAP FILM .022 @ 100V 5% RD
C165	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C231	3151648	CAP AX .10 MF 50V T&R AX
C166	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C232	3151515	CAP AX .01 MF 20% Y5P AX
C167	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C233	3184042	CAP FILM .022 @ 100V 5% RD
C168	3151648	CAP AX .10 MF 50V T&R AX	C234	3150350	CAP AX 10.0PF 5% NPO AX
C169	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C235	3150350	CAP AX 10.0PF 5% NPO AX
C172	3166120	CAP CHIP .001UF X7R (0805) SF	C236	3180109	CAP ELEC 22@25 20% RD
C173	3166120	CAP CHIP .001UF X7R (0805) SF	C237	3150508	CAP AX 15.0 PF 5% NPO AX
C174	3166120	CAP CHIP .001UF X7R (0805) SF	C238	3150350	CAP AX 10.0PF 5% NPO AX
C175	3166120	CAP CHIP .001UF X7R (0805) SF	C239	3150115	CAP AX 4.7PF 10% NPO AX
C176	3180012	CAP ELEC 1@50 20% RD	C240	3150350	CAP AX 10.0PF 5% NPO AX
C177	3151648	CAP AX .10 MF 50V T&R AX	C241		NO PART
C178	3151648	CAP AX .10 MF 50V T&R AX	C242	3150350	CAP AX 10.0PF 5% NPO AX
C180	3151515	CAP AX .01 MF 20% Y5P AX	C243	3164032	CAP DISC 33.0 5% #E330JV RD
C181	3151515	CAP AX .01 MF 20% Y5P AX	C244	3164160	CAP DISC 330 5% #M331KE RD
C182	3151515	CAP AX .01 MF 20% Y5P AX	C245	3150350	CAP AX 10.0PF 5% NPO AX
C183	3150350	CAP AX 10.0PF 5% NPO AX	C246	3150779	CAP AX 43.0 PF 5% NPO AX
C184	3151515	CAP AX .01 MF 20% Y5P AX	C247	3150350	CAP AX 10.0PF 5% NPO AX
C186	3151066	CAP AX 100PF 5% NPO AVX AX	C248	3151515	CAP AX .01 MF 20% Y5P AX
C187	3150750	CAP AX 39.0 PF 5% NPO AX	C249	3151405	CAP AX .001 MF 10% Y5P AX
C188	3150040	CAP AX 2.7 PF 10% GP AX	C250	3180109	CAP ELEC 22@25 20% RD
C189	3150595	CAP AX 22.0 PF 5% NPO AX	C251	3180109	CAP ELEC 22@25 20% RD
C190	3151066	CAP AX 100PF 5% NPO AVX AX	C252	3151515	CAP AX .01 MF 20% Y5P AX
C191	3150896	CAP AX 56.0 PF 5% NPO AX	C253	3151515	CAP AX .01 MF 20% Y5P AX
C192	3150595	CAP AX 22.0 PF 5% NPO AX	C254	3151515	CAP AX .01 MF 20% Y5P AX
C193	3151066	CAP AX 100PF 5% NPO AVX AX	C255	3184068	CAP FILM .1 @ 100V 10%
C194	3180012	CAP ELEC 1@50 20% RD	C256	3184022	CAP FILM .0022 @ 50V 5% RD
C196	3166120	CAP CHIP .001UF X7R (0805) SF	C257	3151515	CAP AX .01 MF 20% Y5P AX
C197	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	C258	3151648	CAP AX .10 MF 50V T&R AX
C198	3166105	CAP CHIP .01UF X7R (0805) SF	C259	3151515	CAP AX .01 MF 20% Y5P AX
C199	3151515	CAP AX .01 MF 20% Y5P AX	C260	3184042	CAP FILM .022 @ 100V 5% RD
C200	3150350	CAP AX 10.0PF 5% NPO AX	C261	3151345	CAP AX 470 PF 10% Y5P AX
C201	3180012	CAP ELEC 1@50 20% RD	C262	3151515	CAP AX .01 MF 20% Y5P AX
C202	3151648	CAP AX .10 MF 50V T&R AX	C263	3151515	CAP AX .01 MF 20% Y5P AX
C203	3151405	CAP AX .001 MF 10% Y5P AX	C264	3151515	CAP AX .01 MF 20% Y5P AX
C204	3151405	CAP AX .001 MF 10% Y5P AX	C265	3180109	CAP ELEC 22@25 20% RD
C205	3150595	CAP AX 22.0 PF 5% NPO AX	C266	3180109	CAP ELEC 22@25 20% RD

Synthesizer and Microprocessor Board Parts List cont'd. 37

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C267	3151405	CAP AX .001 MF 10% Y5P AX	C336	3180109	CAP ELEC 22@25 20% RD
C268	3151515	CAP AX .01 MF 20% Y5P AX	C337	3150690	CAP AX 33.0 PF 5% NPO AX
C269	3150420	CAP AX 12.0 PF 5% NPO AX	C338	3151515	CAP AX .01 MF 20% Y5P AX
C270	3150779	CAP AX 43.0 PF 5% NPO AX	C339	3150245	CAP AX 6.8PF 10% NPO AX
C271	3150350	CAP AX 10.0PF 5% NPO AX	C340	3151405	CAP AX .001 MF 10% Y5P AX
C272	3150350	CAP AX 10.0PF 5% NPO AX	C341	3151345	CAP AX 470 PF 10% Y5P AX
C273	3150779	CAP AX 43.0 PF 5% NPO AX	C342	3151515	CAP AX .01 MF 20% Y5P AX
C274	3150420	CAP AX 12.0 PF 5% NPO AX	C343	3151155	CAP AX 150 PF 10% Y5P AX
C279	3151515	CAP AX .01 MF 20% Y5P AX	C344	3150895	CAP AX 56.0 PF 5% N750 AX
C280	3151648	CAP AX .10 MF 50V T&R AX	C345	3151515	CAP AX .01 MF 20% Y5P AX
C281	3151515	CAP AX .01 MF 20% Y5P AX	C346	3180109	CAP ELEC 22@25 20% RD
C282	3151515	CAP AX .01 MF 20% Y5P AX	C347	3151648	CAP AX .10 MF 50V T&R AX
C283	3151515	CAP AX .01 MF 20% Y5P AX	C348	3151155	CAP AX 150 PF 10% Y5P AX
C286	3150420	CAP AX 12.0 PF 5% NPO AX	C349	3151515	CAP AX .01 MF 20% Y5P AX
C287	3150690	CAP AX 33.0 PF 5% NPO AX	C350	3151648	CAP AX .10 MF 50V T&R AX
C288	3150595	CAP AX 22.0 PF 5% NPO AX	C351	3151515	CAP AX .01 MF 20% Y5P AX
C289	3151405	CAP AX .001 MF 10% Y5P AX	C352	3151117	CAP AX 120 PF 5% GP AX
C290	3151405	CAP AX .001 MF 10% Y5P AX	C353	3151648	CAP AX .10 MF 50V T&R AX
C291	3151515	CAP AX .01 MF 20% Y5P AX	C354	3151405	CAP AX .001 MF 10% Y5P AX
C292	3151515	CAP AX .01 MF 20% Y5P AX	C355	3150899	CAP AX 68.0 PF 5% NPO AX
C293	3180109	CAP ELEC 22@25 20% RD	C356	3150750	CAP AX 39.0 PF 5% NPO AX
C294	3151515	CAP AX .01 MF 20% Y5P AX	C357	3150690	CAP AX 33.0 PF 5% NPO AX
C295	3151515	CAP AX .01 MF 20% Y5P AX	C358	3150899	CAP AX 68.0 PF 5% NPO AX
C296	3151345	CAP AX 470 PF 10% Y5P AX	C359	3151066	CAP AX 100PF 5% NPO AVX AX
C297	3150595	CAP AX 22.0 PF 5% NPO AX	C360	3151515	CAP AX .01 MF 20% Y5P AX
C298	3151066	CAP AX 100PF 5% NPO AVX AX	C361	3151405	CAP AX .001 MF 10% Y5P AX
C299	3150690	CAP AX 33.0 PF 5% NPO AX	C362	3151515	CAP AX .01 MF 20% Y5P AX
C300	3150595	CAP AX 22.0 PF 5% NPO AX	C363	3151515	CAP AX .01 MF 20% Y5P AX
C302	3151515	CAP AX .01 MF 20% Y5P AX	C364	3151515	CAP AX .01 MF 20% Y5P AX
C303	3151515	CAP AX .01 MF 20% Y5P AX	C365	3151648	CAP AX .10 MF 50V T&R AX
C304	3151648	CAP AX .10 MF 50V T&R AX	C366	3167529	CAP CHIP 150PF NPO (0805) SF
C305	3151515	CAP AX .01 MF 20% Y5P AX	C367	3166105	CAP CHIP .01UF X7R (0805) SF
C307	3151648	CAP AX .10 MF 50V T&R AX	C368	3166105	CAP CHIP .01UF X7R (0805) SF
C308	3151405	CAP AX .001 MF 10% Y5P AX	C369	3166105	CAP CHIP .01UF X7R (0805) SF
C309	3151405	CAP AX .001 MF 10% Y5P AX	C370	3167577	CAP CHIP 0.1 UF Y5V (0805) SF
C310	3151405	CAP AX .001 MF 10% Y5P AX	C371	3166155	CAP CHIP 47 PF NPO (0805) SF
C311	3151515	CAP AX .01 MF 20% Y5P AX	C372	3151648	CAP AX .10 MF 50V T&R AX
C312	3151345	CAP AX 470 PF 10% Y5P AX	C373	3166105	CAP CHIP .01UF X7R (0805) SF
C313	3151418	CAP AX .0015MF 20% Y5P AX	C374	3166105	CAP CHIP .01UF X7R (0805) SF
C314	3151345	CAP AX 470 PF 10% Y5P AX	C375	3166120	CAP CHIP .001UF X7R (0805) SF
C315	3151648	CAP AX .10 MF 50V T&R AX	C376	3166120	CAP CHIP .001UF X7R (0805) SF
C316	3151405	CAP AX .001 MF 10% Y5P AX	C377	3167528	CAP AX 100PF 5% NPO AVX AX
C317	3151648	CAP AX .10 MF 50V T&R AX	J1	3280042	CONN COAX PC MT.#TMP-J01X-V6
C318	3151405	CAP AX .001 MF 10% Y5P AX	J2	3280753	CONN P.C.MOLEX #520-11-1010
C319	3151405	CAP AX .001 MF 10% Y5P AX	J3	3280753	CONN P.C.MOLEX #520-11-1010
C320	3151405	CAP AX .001 MF 10% Y5P AX	J4	3280753	CONN P.C.MOLEX #520-11-1010
C321	3151648	CAP AX .10 MF 50V T&R AX	J5	3280756	CONN RT ANG WAKA #WDRF-A180
C322	3151405	CAP AX .001 MF 10% Y5P AX	J6	3280042	CONN COAX PC MT.#TMP-J01X-V6
C323	3180109	CAP ELEC 22@25 20% RD	J7	3280042	CONN COAX PC MT.#TMP-J01X-V6
C324	3151405	CAP AX .001 MF 10% Y5P AX	J8	3280042	CONN COAX PC MT.#TMP-J01X-V6
C325	3151405	CAP AX .001 MF 10% Y5P AX	L1	3524165	COIL RADIAL 5.6 UH RD
C326	3151345	CAP AX 470 PF 10% Y5P AX	L2	3524165	COIL RADIAL 5.6 UH RD
C327	3150690	CAP AX 33.0 PF 5% NPO AX	L3	3524165	COIL RADIAL 5.6 UH RD
C328	3151405	CAP AX .001 MF 10% Y5P AX	L4	3524165	COIL RADIAL 5.6 UH RD
C329	3180109	CAP ELEC 22@25 20% RD	L5	3524165	COIL RADIAL 5.6 UH RD
C330	3150690	CAP AX 33.0 PF 5% NPO AX	L6	3524138	COIL RADIAL 0.27 UH RD
C331	3150750	CAP AX 39.0 PF 5% NPO AX	L7	3524118	COIL VAR 0.35 UH MITSUMI
C332	3151405	CAP AX .001 MF 10% Y5P AX	L8	3524118	COIL VAR 0.35 UH MITSUMI
C333	3150420	CAP AX 12.0 PF 5% NPO AX	L9	3524116	COIL VAR 0.25 UH MITSUMI
C334		NO PART	L10	3524116	COIL VAR 0.25 UH MITSUMI
C335	3150420	CAP AX 12.0 PF 5% NPO AX	L11	3524215	COIL AXIAL 0.15 UH AX
			L12	3524215	COIL AXIAL 0.15 UH AX

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REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
L13	3524165	COIL RADIAL 5.6 UH RD	Q3	3030104	TRANS 2N3904 MOTOROLA RD
L14	3524165	COIL RADIAL 5.6 UH RD	Q4	3030104	TRANS 2N3904 MOTOROLA RD
L15	3524165	COIL RADIAL 5.6 UH RD	Q5	3030104	TRANS 2N3904 MOTOROLA RD
L16	3524165	COIL RADIAL 5.6 UH RD	Q6	3030104	TRANS 2N3904 MOTOROLA RD
L17	3524156	COIL RADIAL 2.7 UH RD	Q7	3030061	TRANS 2N3563 RD
L18	3524156	COIL RADIAL 2.7 UH RD	Q8	3030507	TRANS-25K192-BL CODE ONLY
L19	3524104	COIL VAR 7-1/2T .4UH.S7-T3	Q9	3030507	TRANS-25K192-BL CODE ONLY
L20	3524155	COIL RADIAL 2.2 UH RD	Q10	3030507	TRANS-25K192-BL CODE ONLY
L21	3524156	COIL RADIAL 2.7 UH RD	Q11	3030507	TRANS-25K192-BL CODE ONLY
L22	3524104	COIL VAR 7-1/2T .4UH.S7-T3	Q12	3030061	TRANS 2N3563 RD
L23	3524104	COIL VAR 7-1/2T .4UH.S7-T3	Q13	3030111	TRANS 2N4125 RD
L24	3524111	COIL VAR 4-1/2T 0.19 UH.S7-T3	Q14	3030104	TRANS 2N3904 MOTOROLA RD
L25	3524176	COIL RADIAL 22.0 UH RD	Q15	3030111	TRANS 2N4125 RD
L26	3524176	COIL RADIAL 22.0 UH RD	Q16	3030061	TRANS 2N3563 RD
L27	3524176	COIL RADIAL 22.0 UH RD	Q17	3030104	TRANS 2N3904 MOTOROLA RD
L28	3524176	COIL RADIAL 22.0 UH RD	Q18	3030104	TRANS 2N3904 MOTOROLA RD
L29	3524111	COIL VAR 4-1/2T 0.19 UH.S7-T3	Q19	3030104	TRANS 2N3904 MOTOROLA RD
L30	3524111	COIL VAR 4-1/2T 0.19 UH.S7-T3	Q20	3030225	TRANS 2N7000 RD
L31	3524165	COIL RADIAL 5.6 UH RD	Q21	3030061	TRANS 2N3563 RD
L32	3524529	COIL VAR. SHLD.#950-2 24 E2	Q22	3030061	TRANS 2N3563 RD
L33	3524148	COIL RADIAL 1.0 UH RD	Q23	3030061	TRANS 2N3563 RD
L34	3524138	COIL RADIAL 0.27 UH RD	Q24	3030061	TRANS 2N3563 RD
L35	3524138	COIL RADIAL 0.27 UH RD	Q25	3030061	TRANS 2N3563 RD
L36	3524111	COIL VAR 4-1/2T 0.19 UH.S7-T3	Q26	3030061	TRANS 2N3563 RD
L37	3524117	COIL VAR 0.50 UH MITSUMI	Q27	3030061	TRANS 2N3563 RD
L38	3524148	COIL RADIAL 1.0 UH RD	Q28	3030061	TRANS 2N3563 RD
L39	3524129	COIL VAR 7-1/2T .4UH.S7-T3 W/SHLD	Q29	3030061	TRANS 2N3563 RD
L40	3524129	COIL VAR 7-1/2T .4UH.S7-T3 W/SHLD	Q30	3030061	TRANS 2N3563 RD
L41	2510078	INDUCTOR TOROID-1290-1293-1295	Q31	3030104	TRANS 2N3904 MOTOROLA RD
L42	3524129	COIL VAR 7-1/2T .4UH.S7-T3 W/SHLD	Q32	3030061	TRANS 2N3563 RD
L43	3524176	COIL RADIAL 22.0 UH RD	Q33	3030061	TRANS 2N3563 RD
L44	3524170	COIL RADIAL 8.2 UH RD	Q34	3030104	TRANS 2N3904 MOTOROLA RD
L45	3524170	COIL RADIAL 8.2 UH RD	Q35	3030104	TRANS 2N3904 MOTOROLA RD
L46	3524176	COIL RADIAL 22.0 UH RD	Q36	3030061	TRANS 2N3563 RD
L47	3524165	COIL RADIAL 5.6 UH RD	Q37	3030302	TRANS BFR91A
L48	3524160	COIL RADIAL 3.3 UH RD	Q38	3030061	TRANS 2N3563 RD
L49	3524160	COIL RADIAL 3.3 UH RD	Q39	3030061	TRANS 2N3563 RD
L50	3524129	COIL VAR 7-1/2T .4UH.S7-T3 W/SHLD	Q40	3030061	TRANS 2N3563 RD
L51	3524129	COIL VAR 7-1/2T .4UH.S7-T3 W/SHLD	Q41	3030061	TRANS 2N3563 RD
L52	2510084	INDUCTOR TOROID-1290-1293	Q42	3030061	TRANS 2N3563 RD
L53	3524172	COIL RADIAL 18.0 UH RD	Q43	3030061	TRANS 2N3563 RD
L54	3524138	COIL RADIAL 0.27 UH RD	Q44	3030061	TRANS 2N3563 RD
L55	3524111	COIL VAR 4-1/2T 0.19 UH.S7-T3	Q45	3030061	TRANS 2N3563 RD
L56	3524515	COIL VAR. SHLD. KYOEI #2	Q46	3030104	TRANS 2N3904 MOTOROLA RD
L57	3524156	COIL RADIAL 2.7 UH RD	Q47	3030104	TRANS 2N3904 MOTOROLA RD
L58	3524165	COIL RADIAL 5.6 UH RD	Q48	3030104	TRANS 2N3904 MOTOROLA RD
P1	3280720	CONN P.C. JST#T8B-SQ-1	Q49	3030104	TRANS 2N3904 MOTOROLA RD
P2	3280724	CONN P.C. JST#T4B-SQ-1	Q50	3030104	TRANS 2N3904 MOTOROLA RD
P3	3280723	CONN P.C. JST#T3B-SQ-1	Q51	3030104	TRANS 2N3904 MOTOROLA RD
P5	3280723	CONN P.C. JST#T3B-SQ-1	Q52	3030104	TRANS 2N3904 MOTOROLA RD
P6	3280718	CONN P.C. JST#T10B-SQ-1	Q53	3030104	TRANS 2N3904 MOTOROLA RD
P8	3280723	CONN P.C. JST#T3B-SQ-1	R1	3220015	RES C.FILM 22 OHM 5% 1/4W AX
P9	3280725	CONN P.C. #22-03-2111	R2	3220245	RES C.FILM 15 K 5% 1/4W AX
P10	3280726	CONN P.C. JST#T6B-SQ-1	R3	3220086	RES C.FILM 270 OHM 5% 1/4W AX
P11	3280723	CONN P.C. JST#T3B-SQ-1	R4	3220235	RES C.FILM 10 K 5% 1/4W AX
P12	3280723	CONN P.C. JST#T3B-SQ-1	R5	3220235	RES C.FILM 10 K 5% 1/4W AX
P13	3280723	CONN P.C. JST#T3B-SQ-1	R6	3220055	RES C.FILM 100 OHM 5% 1/4W AX
P14	3280699	CONN P.C. JST#T14B-SQ-1	R7	3220065	RES C.FILM 150 OHM 5% 1/4W AX
P15	3280722	CONN P.C. SAMTEK SL-108-TT-10	R8	3220035	RES C.FILM 47 OHM 5% 1/4W AX
Q1	3030061	TRANS 2N3563 RD	R9	3220285	RES C.FILM 47 K 5% 1/4W AX
Q2	3030061	TRANS 2N3563 RD	R10	3220210	RES C.FILM 4.7 K 5% 1/4W AX
Q39	3030061	TRANS 2N3563 RD			

Synthesizer and Microprocessor Board Parts List cont'd. 39

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R11	3220285	RES C.FILM 47 K 5% 1/4W AX	R79	3250825	RES CHIP 2.7K OHM 5% (0805) SF
R12	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R81	3220070	RES C.FILM 180 OHM 5%1/4W AX
R13	3220285	RES C.FILM 47 K 5% 1/4W AX	R82	3220060	RES C.FILM 120 OHM 5%1/4W AX
R14	3220210	RES C.FILM 4.7 K 5% 1/4W AX	R83	3220235	RES C.FILM 10 K 5% 1/4W AX
R15	3220285	RES C.FILM 47 K 5% 1/4W AX	R84	3250831	RES CHIP 10K OHM 5% (0805) SF
R16	3220235	RES C.FILM 10 K 5% 1/4W AX	R85	3250846	RES CHIP 100K OHM 5% (0805) SF
R18	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R86	3220115	RES C.FILM 510 OHM 5%1/4W AX
R19	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R87	3220270	RES C.FILM 27 K 5% 1/4W AX
R20	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R88	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R21	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R89	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R22	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R90	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R23	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R91	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R24	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R93	3220015	RES C.FILM 22 OHM 5%1/4W AX
R25	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R94	3220115	RES C.FILM 510 OHM 5%1/4W AX
R26	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R95	3220270	RES C.FILM 27 K 5% 1/4W AX
R27	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R96	3220235	RES C.FILM 10 K 5% 1/4W AX
R28	3250826	RES CHIP 4.7K OHM 5% (0805) SF	R97	3220070	RES C.FILM 180 OHM 5%1/4W AX
R29	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R98	3220085	RES C.FILM 270 OHM 5%1/4W AX
R30	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R99	3220175	RES C.FILM 1.5 K 5% 1/4W AX
R31	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R100	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R32	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R101	3220085	RES C.FILM 270 OHM 5%1/4W AX
R33	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R102	3220100	RES C.FILM 390 OHM 5%1/4W AX
R39	3220235	RES C.FILM 10 K 5% 1/4W AX	R103	3220110	RES C.FILM 470 OHM 5%1/4W AX
R40	3220070	RES C.FILM 180 OHM 5%1/4W AX	R104	3220180	RES C.FILM 1.8 K 5% 1/4W AX
R41	3220055	RES C.FILM 100 OHM 5%1/4W AX	R105	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R42	3220055	RES C.FILM 100 OHM 5%1/4W AX	R106	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R43	3220055	RES C.FILM 100 OHM 5%1/4W AX	R107	3220125	RES C.FILM 560 OHM 5%1/4W AX
R44	3220235	RES C.FILM 10 K 5% 1/4W AX	R108	3220060	RES C.FILM 120 OHM 5%1/4W AX
R45	3220110	RES C.FILM 470 OHM 5%1/4W AX	R109	3220100	RES C.FILM 390 OHM 5%1/4W AX
R46	3220110	RES C.FILM 470 OHM 5%1/4W AX	R110	3220055	RES C.FILM 100 OHM 5%1/4W AX
R47	3220110	RES C.FILM 470 OHM 5%1/4W AX	R111	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R48	3220110	RES C.FILM 470 OHM 5%1/4W AX	R112	3220175	RES C.FILM 1.5 K 5% 1/4W AX
R49	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R113	3220085	RES C.FILM 270 OHM 5%1/4W AX
R50	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R114	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R51	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R115	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R52	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R116	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R53	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R117	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R54	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R119	3250828	RES CHIP 4.7K OHM 5% (0805) SF
R55	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R120	3220235	RES C.FILM 10 K 5% 1/4W AX
R56	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R121	3220235	RES C.FILM 10 K 5% 1/4W AX
R57	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R122	3220085	RES C.FILM 270 OHM 5%1/4W AX
R58	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R123	3220005	RES C.FILM 10 OHM 5%1/4W AX
R59	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R124	3220005	RES C.FILM 10 OHM 5%1/4W AX
R60	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R125	3220085	RES C.FILM 270 OHM 5%1/4W AX
R61	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R126	3220070	RES C.FILM 180 OHM 5%1/4W AX
R62	3250819	RES CHIP 1.0K OHM 5% (0805) SF	R127	3220235	RES C.FILM 10 K 5% 1/4W AX
R64	3250806	RES CHIP 22 OHM 5% (0805) SF	R128	3220260	RES C.FILM 22 K 5% 1/4W AX
R65	3250831	RES CHIP 10K OHM 5% (0805) SF	R130	3250831	RES CHIP 10K OHM 5% (0805) SF
R66	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R131	3220170	RES C.FILM 1.2 K 5% 1/4W AX
R67	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R132	3220070	RES C.FILM 180 OHM 5%1/4W AX
R68	3250831	RES CHIP 10K OHM 5% (0805) SF	R133	3220215	RES C.FILM 5.6 K 5% 1/4W AX
R69	3220055	RES C.FILM 100 OHM 5%1/4W AX	R134	3220145	RES C.FILM 820 OHM 5%1/4W AX
R70	3220235	RES C.FILM 10 K 5% 1/4W AX	R135	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R71	3220320	RES C.FILM 150 K 5% 1/4W AX	R136	3220060	RES C.FILM 120 OHM 5%1/4W AX
R72	3220320	RES C.FILM 150 K 5% 1/4W AX	R137	3220195	RES C.FILM 2.7 K 5% 1/4W AX
R73	3220320	RES C.FILM 150 K 5% 1/4W AX	R138	3220235	RES C.FILM 10 K 5% 1/4W AX
R74	3220320	RES C.FILM 150 K 5% 1/4W AX	R139	3220140	RES C.FILM 680 OHM 5%1/4W AX
R75	3220320	RES C.FILM 150 K 5% 1/4W AX	R140	3250831	RES CHIP 10K OHM 5% (0805) SF
R76	3220320	RES C.FILM 150 K 5% 1/4W AX	R141	3250846	RES CHIP 100K OHM 5% (0805) SF
R77	3220320	RES C.FILM 150 K 5% 1/4W AX	R142	3220170	RES C.FILM 1.2 K 5% 1/4W AX
R78	3220320	RES C.FILM 150 K 5% 1/4W AX	R144	3250468	RES M.FILM 40.2K 1% 1/4W AX

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REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R145	3250496	RES M.FILM 324 K 1% 1/4 W AX	R209	3220245	RES C.FILM 15 K 5% 1/4W AX
R146	3250491	RES M.FILM 162 K 1% 1/4 W AX	R210	3220200	RES C.FILM 3.3 K 5% 1/4W AX
R147	3250486	RES M.FILM 80.6K 1% 1/4 W AX	R211	3220235	RES C.FILM 10 K 5% 1/4W AX
R148	3250361	RES M.FILM 4.99K 1% 1/4 W AX	R212	3220255	RES C.FILM 18 K 5% 1/4W AX
R149	3250325	RES M.FILM 2.49K 1% 1/4 W AX	R213	3220205	RES C.FILM 3.9 K 5% 1/4W AX
R150	3250489	RES M.FILM 1.0 MEG 1% 1/4W AX	R214	3220205	RES C.FILM 3.9 K 5% 1/4W AX
R151	3250425	RES M.FILM 10.0K 1% 1/4 W AX	R215	3220235	RES C.FILM 10 K 5% 1/4W AX
R152	3250463	RES M.FILM 20.0K 1% 1/4 W AX	R216	3220055	RES C.FILM 100 OHM 5%1/4W AX
R153	3220235	RES C.FILM 10 K 5% 1/4W AX	R217	3220055	RES C.FILM 100 OHM 5%1/4W AX
R154	3250810	RES CHIP 100 OHM 5% (0805) SF	R218	3220110	RES C.FILM 470 OHM 5%1/4W AX
R155	3250810	RES CHIP 100 OHM 5% (0805) SF	R219	3220315	RES C.FILM 100 K 5% 1/4W AX
R156	3250810	RES CHIP 100 OHM 5% (0805) SF	R220	3220065	RES C.FILM 100 OHM 5%1/4W AX
R157	3250831	RES CHIP 10K OHM 5% (0805) SF	R221	3220055	RES C.FILM 100 OHM 5%1/4W AX
R158	3220230	RES C.FILM 8.2 K 5% 1/4W AX	R222	3220055	RES C.FILM 100 OHM 5%1/4W AX
R159	3250828	RES CHIP 4.7K OHM 5% (0805) SF	R223	3220235	RES C.FILM 10 K 5% 1/4W AX
R160	3220170	RES C.FILM 1.2 K 5% 1/4W AX	R224	3220170	RES C.FILM 1.2 K 5% 1/4W AX
R161	3220025	RES C.FILM 33 OHM 5%1/4W AX	R225	3220055	RES C.FILM 100 OHM 5%1/4W AX
R162	3250810	RES CHIP 100 OHM 5% (0805) SF	R226	3220210	RES C.FILM 4.7 K 5% 1/4W AX
R163		NO PART	R227	3220260	RES C.FILM 22 K 5% 1/4W AX
R164	3250831	RES CHIP 10K OHM 5% (0805) SF	R228	3220075	RES C.FILM 220 OHM 5%1/4W AX
R167	3250846	RES CHIP 100K OHM 5% (0805) SF	R229	3220145	RES C.FILM 820 OHM 5%1/4W AX
R168	3220055	RES C.FILM 100 OHM 5%1/4W AX	R230	3220110	RES C.FILM 470 OHM 5%1/4W AX
R169	3220055	RES C.FILM 100 OHM 5%1/4W AX	R231	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R170	3220315	RES C.FILM 100 K 5% 1/4W AX	R232	3220145	RES C.FILM 820 OHM 5%1/4W AX
R171	3220110	RES C.FILM 470 OHM 5%1/4W AX	R233	3220055	RES C.FILM 100 OHM 5%1/4W AX
R172	3220180	RES C.FILM 1.8 K 5% 1/4W AX	R234	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R173	3220180	RES C.FILM 1.8 K 5% 1/4W AX	R235	3220170	RES C.FILM 1.2 K 5% 1/4W AX
R174	3220110	RES C.FILM 470 OHM 5%1/4W AX	R236	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R175	3220055	RES C.FILM 100 OHM 5%1/4W AX	R237	3220230	RES C.FILM 8.2 K 5% 1/4W AX
R176	3220315	RES C.FILM 100 K 5% 1/4W AX	R238	3220005	RES C.FILM 10 OHM 5%1/4W AX
R177	3220055	RES C.FILM 100 OHM 5%1/4W AX	R239	3220025	RES C.FILM 33 OHM 5%1/4W AX
R178	3220235	RES C.FILM 10 K 5% 1/4W AX	R240	3220002	RES C.FILM 3.3 OHM 5%1/4W AX
R179	3220230	RES C.FILM 8.2 K 5% 1/4W AX	R241	3220002	RES C.FILM 3.3 OHM 5%1/4W AX
R180	3220300	RES C.FILM 68 K 5% 1/4W AX	R242	3220025	RES C.FILM 33 OHM 5%1/4W AX
R181	3220285	RES C.FILM 47 K 5% 1/4W AX	R243	3220005	RES C.FILM 10 OHM 5%1/4W AX
R182	3220315	RES C.FILM 100 K 5% 1/4W AX	R244	3220230	RES C.FILM 8.2 K 5% 1/4W AX
R183	3220060	RES C.FILM 120 OHM 5%1/4W AX	R245	3220050	RES C.FILM 82 OHM 5%1/4W AX
R184	3220110	RES C.FILM 470 OHM 5%1/4W AX	R246	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R185	3220240	RES C.FILM 12 K 5% 1/4W AX	R247	3220045	RES C.FILM 68 OHM 5%1/4W AX
R186	3220235	RES C.FILM 10 K 5% 1/4W AX	R248	3220045	RES C.FILM 68 OHM 5%1/4W AX
R187	3220315	RES C.FILM 100 K 5% 1/4W AX	R249		NO PART
R188	3220260	RES C.FILM 22 K 5% 1/4W AX	R250	3220055	RES C.FILM 100 OHM 5%1/4W AX
R189	3220055	RES C.FILM 100 OHM 5%1/4W AX	R251	3220235	RES C.FILM 10 K 5% 1/4W AX
R190	3220260	RES C.FILM 22 K 5% 1/4W AX	R252	3220215	RES C.FILM 5.6 K 5% 1/4W AX
R191	3220315	RES C.FILM 100 K 5% 1/4W AX	R253	3220180	RES C.FILM 1.8 K 5% 1/4W AX
R192	3220235	RES C.FILM 10 K 5% 1/4W AX	R254	3220140	RES C.FILM 680 OHM 5%1/4W AX
R193	3220240	RES C.FILM 12 K 5% 1/4W AX	R255	3220085	RES C.FILM 270 OHM 5%1/4W AX
R194	3220110	RES C.FILM 470 OHM 5%1/4W AX	R256	3220055	RES C.FILM 100 OHM 5%1/4W AX
R195	3220090	RES C.FILM 330 OHM 5%1/4W AX	R257	3220220	RES C.FILM 6.8 K 5% 1/4W AX
R196	3220055	RES C.FILM 100 OHM 5%1/4W AX	R258	3220235	RES C.FILM 10 K 5% 1/4W AX
R197	3220215	RES C.FILM 5.6 K 5% 1/4W AX	R259	3220075	RES C.FILM 220 OHM 5%1/4W AX
R198	3220085	RES C.FILM 270 OHM 5%1/4W AX	R260	3220235	RES C.FILM 10 K 5% 1/4W AX
R199	3220245	RES C.FILM 15 K 5% 1/4W AX	R261	3220190	RES C.FILM 2.2 K 5% 1/4W AX
R200	3220055	RES C.FILM 100 OHM 5%1/4W AX	R262	3220220	RES C.FILM 6.8 K 5% 1/4W AX
R201	3220055	RES C.FILM 100 OHM 5%1/4W AX	R263	3220235	RES C.FILM 10 K 5% 1/4W AX
R202	3220315	RES C.FILM 100 K 5% 1/4W AX	R264	3220055	RES C.FILM 100 OHM 5%1/4W AX
R203	3220110	RES C.FILM 470 OHM 5%1/4W AX	R265	3220195	RES C.FILM 2.7 K 5% 1/4W AX
R204	3220055	RES C.FILM 100 OHM 5%1/4W AX	R266	3220160	RES C.FILM 1.0 K 5% 1/4W AX
R205	3220055	RES C.FILM 100 OHM 5%1/4W AX	R267	3220075	RES C.FILM 220 OHM 5%1/4W AX
R206	3220235	RES C.FILM 10 K 5% 1/4W AX	R268	3220140	RES C.FILM 680 OHM 5%1/4W AX
R207	3220205	RES C.FILM 3.9 K 5% 1/4W AX	R269	3220055	RES C.FILM 100 OHM 5%1/4W AX
R208	3220245	RES C.FILM 15 K 5% 1/4W AX	R270	3220045	RES C.FILM 68 OHM 5%1/4W AX

Synthesizer and Microprocessor Board Parts List cont'd. 41

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
R271	3220160	RES C.FILM 1.0K 5% 1/4W AX	U4	3040021	IC 74HC02
R272	3220210	RES C.FILM 4.7K 5% 1/4W AX	U5	3040019	IC 74HC138
R273	3220055	RES C.FILM 100 OHM 5% 1/4W AX	U6	3040006	IC 74HC273
R274	3220235	RES C.FILM 10K 5% 1/4W AX	U7	3040006	IC 74HC273
R275	3220190	RES C.FILM 2.2K 5% 1/4W AX	U8	3040006	IC 74HC273
R276	3220055	RES C.FILM 100 OHM 5% 1/4W AX	U9	3042026	IC TC8521AP
R277	3220055	RES C.FILM 100 OHM 5% 1/4W AX	U10	3040035	IC 74HC10
R278	3220235	RES C.FILM 10K 5% 1/4W AX	U11	4671649	IC 27C512DTP (RBB Firmware V.11)
R279	3220005	RES C.FILM 10 OHM 5% 1/4W AX	U12	3042038	IC LC36256AL SRAM
R280	3220055	RES C.FILM 100 OHM 5% 1/4W AX	U13	3040006	IC 74HC273
R281	3220085	RES C.FILM 270 OHM 5% 1/4W AX	U14	3041166	IC MB87086 PLL
R282	3220210	RES C.FILM 4.7K 5% 1/4W AX	U15	3040016	IC 74HC14
R283	3220075	RES C.FILM 220 OHM 5% 1/4W AX	U16	3045003	IC DBL.BAL.MIXER NE612
R284	3220210	RES C.FILM 4.7K 5% 1/4W AX	U17	3042135	IC UPD78213CW
R285	3220075	RES C.FILM 220 OHM 5% 1/4W AX	U18	3040014	IC 74HC32
R286	3220115	RES C.FILM 510 OHM 5% 1/4W AX	U19	3040025	IC 74HC237
R287	3220075	RES C.FILM 220 OHM 5% 1/4W AX	U20	3040009	IC 74HC573
R288	3220180	RES C.FILM 1.8K 5% 1/4W AX	U21	3040006	IC 74HC273
R289	3220180	RES C.FILM 1.8K 5% 1/4W AX	U22	3040005	IC 74HC244
R290	3220160	RES C.FILM 1.0K 5% 1/4W AX	U23	3045003	IC DBL.BAL.MIXER NE612
R291	3220160	RES C.FILM 1.0K 5% 1/4W AX	U24	3043050	IC MAX232RS232.2RCV.2XMIT
R292	3220055	RES C.FILM 100 OHM 5% 1/4W AX	U25	3040094	IC LM358
R293	3220180	RES C.FILM 1.8K 5% 1/4W AX	U26	3045003	IC DBL.BAL.MIXER NE612
R294	3220140	RES C.FILM 680 OHM 5% 1/4W AX	U27	3045007	IC MB467 1/10
R295	3220160	RES C.FILM 1.0K 5% 1/4W AX	U28	3045007	IC MB467 1/10
R296	3220180	RES C.FILM 1.8K 5% 1/4W AX	U29	3040097	IC LF353N
R297	3220015	RES C.FILM 22 OHM 5% 1/4W AX	U30	3041167	IC 145157 PLL
R298	3220235	RES C.FILM 10K 5% 1/4W AX	U31	3041167	IC 145157 PLL
R299	3220210	RES C.FILM 4.7K 5% 1/4W AX	U32	3040097	IC LF353N
R300	3220070	RES C.FILM 180 OHM 5% 1/4W AX	U33	3045003	IC DBL.BAL.MIXER NE612
R301	3220180	RES C.FILM 1.8K 5% 1/4W AX	U34	3045003	IC DBL.BAL.MIXER NE612
R302	3220015	RES C.FILM 22 OHM 5% 1/4W AX	U35	3045007	IC MB467 1/10
R303	3220075	RES C.FILM 220 OHM 5% 1/4W AX	U36	3041064	IC 74F163
R304	3220015	RES C.FILM 22 OHM 5% 1/4W AX	U37	3041063	IC 74F86
R305	3220015	RES C.FILM 22 OHM 5% 1/4W AX	U38	3040006	IC 74HC273
R306	3220145	RES C.FILM 820 OHM 5% 1/4W AX	U100	3045016	IC UP SUPVR CKT DS-1231-20
R307	3220015	RES C.FILM 22 OHM 5% 1/4W AX	Y1	3120285	XTAL 38.768 KHZ SEIKO
R308	3220005	RES C.FILM 10 OHM 5% 1/4W AX	Y2	3120004	RESONATOR CERAMIC 12.0 MHZ
R309	3220110	RES C.FILM 470 OHM 5% 1/4W AX	Y3	3120288	XTAL 22.525MHZ 10PPM SER 30OHM
R310	3220140	RES C.FILM 680 OHM 5% 1/4W AX	Y4	3120292	XTAL 35.0 MHZ 5PPM SER 50 OHM
R311	3250831	RES CHIP 10K OHM 5% (0805) SF	CR1	3020090	DIODE 1N4148 AX
R312	3220200	RES C.FILM 3.3K 5% 1/4W AX	CR2	3020090	DIODE 1N4148 AX
R313	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR3	3020090	DIODE 1N4148 AX
R314	3250831	RES CHIP 10K OHM 5% (0805) SF	CR4	3020090	DIODE 1N4148 AX
R315	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR6	3020088	DIODE 1N4099 6.8V 5% 25W AX
R316	3250822	RES CHIP 2.2K OHM 5% (0805) SF	CR7	3020297	DIODE ISS135 T&R AX
R317	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR8	3020297	DIODE ISS135 T&R AX
R318	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR9	3020297	DIODE ISS135 T&R AX
R319	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR10	3020297	DIODE ISS135 T&R AX
R320	3251155	RES CHIP 8.25K 1% (0805) SF	CR12	3020090	DIODE 1N4148 AX
R321	3252005	RES CHIP 3.83K 1% (0805) SF	CR13	3024711	VARACTOR ITT310
R322	3250831	RES CHIP 10K OHM 5% (0805) SF	CR14	3024711	VARACTOR ITT310
R323	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR15	3024711	VARACTOR ITT310
R324	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR16	3024711	VARACTOR ITT310
R325	3250828	RES CHIP 4.7K OHM 5% (0805) SF	CR17	3020090	DIODE 1N4148 AX
R326	3250851	RES CHIP 220K OHM 5% (0805) SF	CR18	3020401	DIODE 1SS97-2-ND4973-7E AX
R327	3250851	RES CHIP 220K OHM 5% (0805) SF	CR19	3020401	DIODE 1SS97-2-ND4973-7E AX
R328	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR20	3020090	DIODE 1N4148 AX
R329	3250819	RES CHIP 1.0K OHM 5% (0805) SF	CR22	3020110	DIODE 1N4734A 5.6V 5% 1W AX
R330	3250822	RES CHIP 2.2K OHM 5% (0805) SF	CR23	3020110	DIODE 1N4734A 5.6V 5% 1W AX
R900	3220235	RES C.FILM 10K 5% 1/4W AX	CR24	3020110	DIODE 1N4734A 5.6V 5% 1W AX
R901	3220235	RES C.FILM 10K 5% 1/4W AX	CR25	3020110	DIODE 1N4734A 5.6V 5% 1W AX
			CR28	3024701	VARACTOR 1S2206B

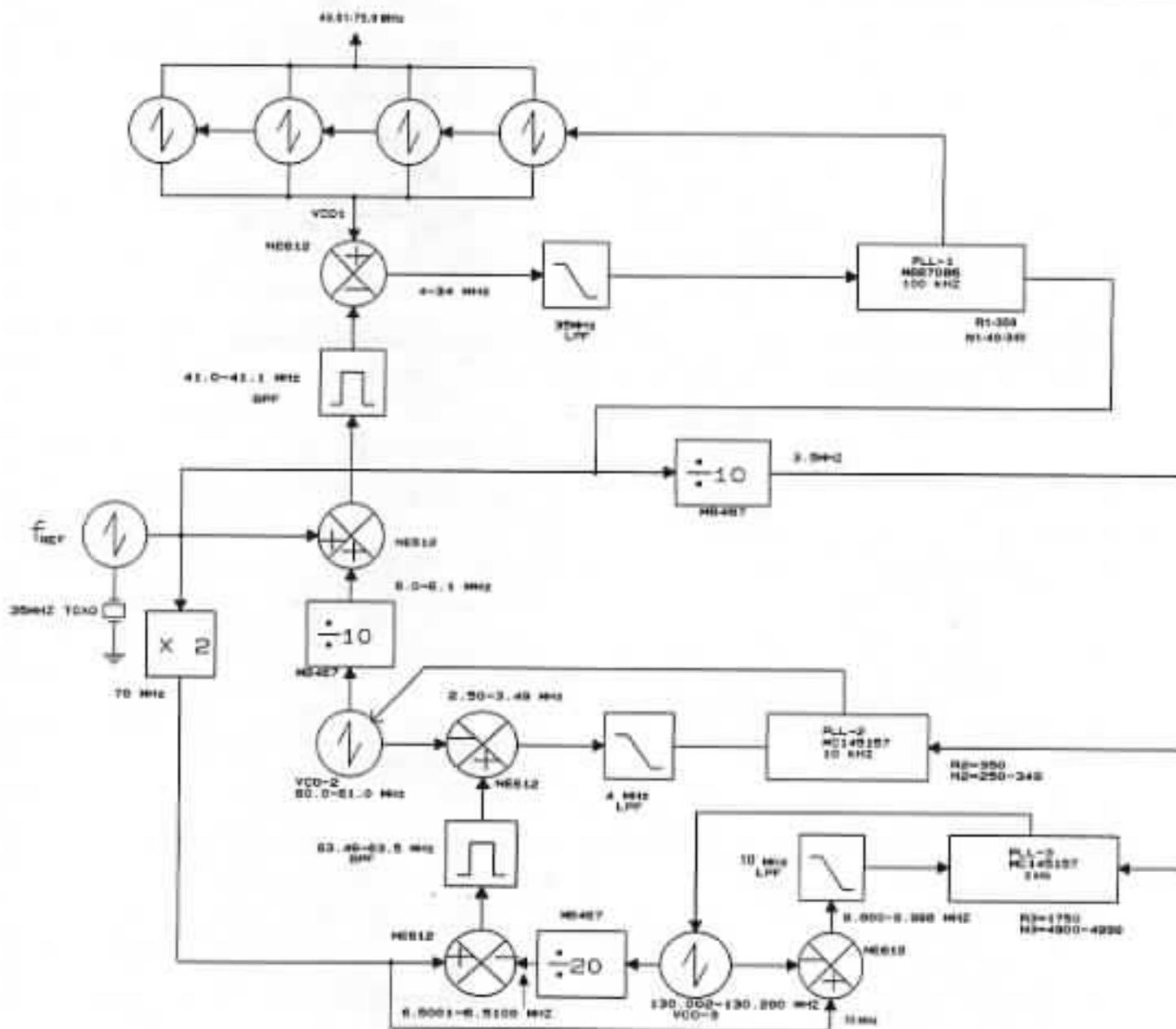
42 Synthesizer and Microprocessor Board Parts List cont'd.

REFERENCE	PART NUMBER	DESCRIPTION
CR29	3024701	VARACTOR 1SV153
CR30	3020278	DIODE MV209/1SV101
CR31	3024701	VARACTOR 1SV153
CR32	3024701	VARACTOR 1SV153
CR33	3020090	DIODE 1N4148 AX
CR34	3020090	DIODE 1N4148 AX
CR35	3020090	DIODE 1N4148 AX
CR36	3020401	DIODE 1SS97-2-ND4973-7E AX
CR37	3020401	DIODE 1SS97-2-ND4973-7E AX
CR38	3020401	DIODE 1SS97-2-ND4973-7E AX
CR39	3020401	DIODE 1SS97-2-ND4973-7E AX
CR40	3020401	DIODE 1SS97-2-ND4973-7E AX
CR41	3026011	DIODE CHIP, BAT54, SOT23 SF
CR42	3020090	DIODE 1N4148 AX
CR43	3026011	DIODE CHIP, BAT54, SOT23 SF
CR44	3026011	DIODE CHIP, BAT54, SOT23 SF
CR45	3026011	DIODE CHIP, BAT54, SOT23 SF
CR901	3020090	DIODE 1N4148 AX
JP1	3372525	JUMPER 2 CIR. SHNT AMP 881545-4
VR1	3040031	IC 78L05-ACP RD
VR2	3040031	IC 78L05-ACP RD
VR3	3040031	IC 78L05-ACP RD
BAT1	3000024	BATTERY CR2032-1HF1
Y2	3123545	XTAL 12.0960 MHz, 50 PPM, 20pF

MECHANICAL PARTS

QUANTITY	PART NUMBER	DESCRIPTION
1	2715606	COAX 178 4.0 1/2-1/2
1	2715610	COAX 178 6.0 1/2-1/2
2	2715643	COAX 178 6.0 3/16X1/8X3/16
1	2715651	COAX 178 8.5 5/32X5/32X5/32
1	3100864	BD R8B SYNTH 1294
1	3282124	SOCKET IC C-88-28-01
2	3491131	INSUL HC18/V XTAL GLS/TEFL
2	3710045	CABLE COAX RG178B/U-50 OHM
1	4560088	SHIELD/FILTER SYN-1290-1293
1	4560258	SHLD DIG MIX WALL R8-1290-1293
1	4560259	SHLD DIG MIX TOP COV-1290-1293
1	4560260	SHLD DIG MIX BOT COV-1290-1293
1	4560261	SHLD 70 MHZ WALL R8-1290-1293
1	4560262	SHLD 70 MHZ BOT COV-1290-1293
1	4560263	SHLD 70 MHZ TOP COV-1290-1293
1	4560264	SHD LOOP#1 TOP COV R8-1290-1293
2	4560265	SHLD LOOP#2+3 TOP COV-1290-1293
2	4560266	SHLD LOOP#1 WALL R8-1290-1293
2	4560267	SHLD LOOP#2+3 WALL R8-1290-1293
1	4560268	SHLD LOOP #1 BOT COV-1290-1293
1	4560269	SHLD LOOP #2 BOT COV-1290-1293
1	4560270	SHLD LOOP #3 BOT COV-1290-1293
1	4560271	SHLD REF OSC BOT COV-1290-1293
1	4560272	SHLD REF OSC WALL R8-1290-1293
1	4560273	SHLD REF OSC TOP COV-1290-1293
1	4560274	SHLD 41 MHZ R8-1290-1293

Synthesizer Block Diagram 4
D-9733



$$f_{REF} = 35\text{MHz}$$

$$VCO_1 = f_{REF} \left[4 - \frac{N_1}{1000} \right]$$

$$VCO_2 = f_{REF} \left[1.18 + \frac{N_2}{1000} - \frac{N_3}{1000} \right]$$

$$VCO_3 = f_{REF} \left[1.18 + \frac{N_4}{1000} - \frac{N_5}{1000} + \frac{N_6}{1000} \right]$$

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DIGITAL SECTION - THEORY OF OPERATION

1. Microprocessor and Memory
2. Radio Controls
3. Front and Rear Panel I/O Theory of Operation

1. Microprocessor and Memory

The receiver is controlled by a uPD78213 microcontroller, U17, executing software stored in a 27C512 64K EPROM, U11. The system is driven by a 12 MHz oscillator. Nonvolatile memory is stored in the battery backed-up LC36256AL SRAM, U12, which retains memory channels, current radio settings, etc. even with loss of power. A real time clock chip, U9, provides the time for the clock and timer functions. It will continue to keep time for approximately 30 minutes with loss of power due to holding capacitor C78 which provides supply voltage to the chip in the absence of input power.

At power on, the entire system is reset by the $\overline{\text{RESET}}$ line being held low momentarily. This is generated by U100, a μP Supervisory circuits IC. The length of the reset pulse is set by circuitry internal to U100. At power down, U100 also generates a low voltage reset signal. The reset signal is preceded by an interrupt signal (NMI), generated by U100, which allows the controller to save the current radio settings to U12 and perform housekeeping functions to permit an orderly power up when power is restored.

Software execution is such that all functions are performed once every 25 msec. The sequence includes reading the keypad/wheel inputs, setting the radio control lines, setting all frequency synthesizers, and updating the display.

2. Radio Controls

The three frequency synthesizers are all serviced via the same serial port at U17, pins 3 and 4. A 3 to 8 line decoder latch IC, U19, provides the chip select for each of the three synthesizers. Data is latched into the appropriate synthesizer to update their information every 25 msec. The remaining radio controls are provided by the latched outputs from U6, U7, and U8. U19 also provides chip selects for the Master and Slave controller ICs for the display information, as well as the chip select for the optional VHF converter module. The 8 output lines of U21 drive a digital-to-analog converter (DAC). The outputs drive binary weighted resistors which connect at a common summing junction at U25 to provide the reference voltage for the passband filter tuning. This voltage is factory calibrated for each mode of operation (AM, FM, etc.) and stored in the battery backed-up SRAM, U12.

If the optional VHF converter module is installed, the presence of 5 VDC at connector P10, pin 4, will be detected by a μP read of pin 17 of U22. If the receiver is set to a frequency in this band, the converter will be serviced in the normal operating loop of the software. Serial data will be sent to the converter using the serial clock and data lines from U17. These lines are gated to the converter by the chip select provided by U19, pin 12.

48 Notes

Two columns of horizontal lines for writing notes.

3. Front & Rear Panel I/O Theory of Operation

The three front panel keypads are part of a key matrix which is scanned by the controller every 25 msec. Rows are scanned using U13 and column outputs are read from U22. Each key generates a unique row/column combination which is then read and acted on by the controller software. The Power On/Off key is not part of the scanned matrix and is read every 25 msec. All keys are debounced in software.

The encoder wheel interface provides two output waveforms which are square waves 90 degrees out of phase. When the wheel is turned, the encoder B line clocks a logic high into the output of U3, which causes an interrupt at U17, pin 41. When the controller services the interrupt, it counts the High to Low to High transitions at pin 41 and tests inputs at pin 52 to determine in which direction the wheel is being turned. The frequency can then be updated accordingly.

The display is a 4-backplane LCD, controlled by two NEC7225 drivers. U1 acts as the Master driver and U2 acts as the Slave driver. The drivers are serially loaded using pins 6 and 7 of the microprocessor, U17, located on the Synthesizer/ μ P board. Together, the drivers contain the actual display memory. The 124 display segments are partitioned into three groups, and the data for each group is updated once every 75 msec. Controller U17 sets the LED backlight for the display by programming U4 to control the current through the LEDs. U4 and associated components, including Q1, Q4, Q5, Q6, Q7, Q8, CR64 and L3 form an average current controlled switching regulator that provides a programmable constant current source supply for the backlight LEDs. The switching regulator is a Buck-mode type. With transistor Q6 turned on, a 5 VDC reference voltage is established at pin 14 of U4. Transistor stage Q4 and associated components determine the switching oscillation frequency. When operating, a 2.5 VDC reference voltage is present at pin 5 of U4. Transistor Q8 is a driver for Q1 which provides the switching current through the buck inductor, L3. CR64 is a catch diode. Current from L3 flows through the LEDs and returns through resistors R7 and R16 to ground. Transistor stage Q5 adds additional resistance in parallel with R7 and R16 to compensate for the additional current drawn when the 5-Meter backlighting diodes, CR1 through CR6, are turned on by transistor stages Q2 and Q3. A relatively constant backlighting of the display is thereby maintained between the receiver on or off states. The resultant DC voltage and the instantaneous error voltage are summed and sensed at pin 5 of U4 to produce an appropriate pulse width at pin 10 of U4, thereby regulating the output current through L3 and the LEDs.

RS232 communications are handled through U24, an RS232 transceiver, which provides all bit timing and formatting for RS232C, 9600 baud, half Duplex, 1 start bit, 8 data, 1 stop bit, no parity Data, ASCII encoding. Pin 56 of U17 provides a 0-5 VDC carrier detect signal to pin 1 of connector J5 for use in scanning from a terminal or PC.

Front Panel Board Parts List 53

FRONT PANEL BOARD ASSEMBLY, P/N: 2070706

MECHANICAL PARTS

REFERENCE	PART NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	DESCRIPTION
C1	3166166	CAP CHIP 560PF NPO (0805) SF	1	3060036	DSPLY LCD R8A/R8B
C2	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	1	3100706	BD FRNT PAN DSPLY R8A/R8B
C3	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	1	3293021	ZEBRA STRIP 0.1X122X15.2X3
C4	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	2	3472616	LCD HOLDER (MOLDED) R8A/R8B
C5		NOT USED	1	3473210	LENS (DIFFUSER) LCD R8A/R8B
C6	3167577	CAP CHIP 0.1 UF Y5V (0805) SF	1	3522501	CORE SET P/N OD-41408-16
C7	3180247	CAP ELEC 470@25 L-ESR (16mmH)	1	3522504	BOBBIN P/N PCB1408-21
C8	3180241	CAP ELEC 470@16	1	3522505	MT'G CLAMPP/N OOC1408-11
C9	3184022	CAP FILM .0022 @ 50V 5% RD	1	3522506	WASHER P/N W1408-15
C10	3166106	CAP CHIP .01 UF X7R (0805) SF			
L3	2055169	POT-CORE ASSY SW.SUP ESR400			
L4	3520571	CHOKE ASY SFB151 150UH AX			
P1	3280699	CONN P.C. JST#T14B-SQ-1			
Q1	3030325	TRANS 92PU51			
Q2	3030121	TRANS 2N4402 RD			
Q3	3036015	TRANS CHIP #MMBT3904 LT1SF			
Q4	3036015	TRANS CHIP #MMBT3904 LT1SF			
Q5	3036015	TRANS CHIP #MMBT3904 LT1SF			
Q6	3036015	TRANS CHIP #MMBT3904 LT1SF			
Q7	3036015	TRANS CHIP #MMBT3904 LT1SF			
Q8	3036015	TRANS CHIP #MMBT3904 LT1SF			
R1	3250831	RES CHIP 10K OHM 5% (0805) SF			
R2	3250846	RES CHIP 100K OHM 5% (0805) SF			
R3	3250831	RES CHIP 10K OHM 5% (0805) SF			
R4	3250831	RES CHIP 10K OHM 5% (0805) SF			
R5	3250833	RES CHIP 15K OHM 5% (0805) SF			
R6	3250817	RES CHIP 470 OHM 5% (0805) SF			
R7	3220002	RES C.FILM 3.3 OHM 5% 1/4W AX			
R8	3250836	RES CHIP 1.2K OHM 5% (0805) SF			
R9	3250836	RES CHIP 1.2K OHM 5% (0805) SF			
R10	3250836	RES CHIP 1.2K OHM 5% (0805) SF			
R11	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R12	3250846	RES CHIP 100K OHM 5% (0805) SF			
R13	3250842	RES CHIP 47K OHM 5% (0805) SF			
R14	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R15	3220013	RES C.COMP 2.7 OHM 10% 1/4W AX			
R16	3220030	RES C.FILM .39 OHM 5% 1/4W AX			
R17	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R18	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R19	3250849	RES C 12K OHM 5% (0805) SF			
R20	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R21	3250834	RES CHIP 5.6K OHM 5% (0805) SF			
R22	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R23	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R24	3250849	RES C 12K OHM 5% (0805) SF			
R25	3250828	RES CHIP 4.7K OHM 5% (0805) SF			
R26	3250819	RES CHIP 1.0K OHM 5% (0805) SF			
R27	3250831	RES CHIP 10K OHM 5% (0805) SF			
U1	3040166	I.C. UPD7225			
U2	3040166	I.C. UPD7225			
U3	3047007	I.C. CHIP TC74HC14AFN SF			
U4	3047019	I.C. CHIP UC3843D SGS			
CR1	3472065	LGT.GRN.LITE-ON #LTL4231-001			
CR2	3472065	LGT.GRN.LITE-ON #LTL4231-001			
CR3	3026010	DIODE CHIP BAST6 SF			
CR4	3020174	DIODE ZENER 1N5819 AX			
CR5	3026103	DIODE CHIP LS4148 SF			

56 Notes

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ALIGNMENT

I. POWER SUPPLY VOLTAGE CHECKS AND SETTING CLOCK/TIMER

A. Power Supply Voltage Check

1. With AC power disconnected, measure battery voltage at connector P15. It should be 3 Volts \pm 10%.

2. With the receiver connected to AC power and tuned on, measure the following voltage buses at 108 VAC and 132 VAC Line Input with the rear panel AC Line Selector switch set for the 108-132 VAC range.

Set the rear panel AC Line Selector switch to the 216 VAC-264 VAC range and check the following voltage buses at 216 VAC and 264 VAC Line Input.

Switched unregulated	= 11.7 min	16.3 max
10 volts	= 9.5 min	10.5 max
5 volts	= 4.75 min	5.25 max

B. Microprocessor Clock Frequency Check

1. Measure the clock frequency at pin 15 (TP89) of the microprocessor (U17) using a counter with a high impedance probe.

2. The frequency should measure 12.00 MHz \pm 76 kHz.

C. Setting Oscillator for Clock/Timer

1. Jumper together pins 1 and 2 of test connector P3, and connect a reciprocal counter to this jumper.

2. Adjust trimmer C71 for a counter reading of 16.00008 Hz \pm .00001 Hz.

3. Remove the shoring jumper on test terminals of P3 installed in step 1.

4. As an alternate method, loosely couple a counter to the 32.768 kHz clock oscillator with an inductive probe and adjust C71 for 32.768.163 Hz \pm .02 Hz.

II. SYNTHESIZER AND PBT ALIGNMENT AND TEST

A. 35 MHz Reference Oscillator

1. Attach an accurate counter to pin 1 of U35 (TP20) on the synthesizer board and adjust coil L56 for a frequency of 35.00000 MHz \pm 10 Hz with the receiver warmed up for at least 2 hours, or set for 35.00017 MHz \pm 10 Hz with unit at room temperature.

2. Using an accurate oscilloscope, measure the level at pin 1 of U35 with the counter load removed. It should measure at least 1 volt PTP, with 1.5 volts PTP being typical and 2 volts PTP maximum.

3. Using the oscilloscope, measure the level at VHF Reference connector J6. Again, it should measure at least 1 volt PTP, with 1.5 volts PTP being typical and 2 volts PTP maximum.

4. Using the counter, measure the frequency at J6. The frequency should be 3.5 MHz \pm 10 Hz with the receiver hot, or 3.500017 MHz \pm 10 Hz at room temperature.

5. Using the oscilloscope, measure the level of the 70 MHz signal at pin 6 of U33 (TP10). Adjust the yellow coil L55 for maximum level. The level must be greater than 250 mV PTP and is typically 300 mV PTP. The level should not exceed 350 mV.

6. Using an oscilloscope or RF voltmeter, measure the level at pin 8 of U14 (MB 87086) (TP36). It should be 1.4 volt PTP (0.495 V RMS) minimum and should not exceed 2 volts PTP (.707 V RMS).

B. PBT Adjustments

1. Select "AGC Fast". Ground the center pin of the "Factory Test" connector P5. This allows the Main Tuning control to adjust the PBT tuning voltage.

2. Preset the front panel PBT control to the 12:00 o'clock position.

3. Press the VFO A/B button.

4. Attach a high impedance voltmeter to the PBT tuning voltage line (pin 1 of U25) (TP105).

5. Attach an accurate counter to the 2nd LO output jack (J8) and, using the Main Tuning control, adjust the PBT voltage to 5 volts \pm 0.1 volt. Then adjust the 22.525 MHz PBT oscillator coil (L32) for a counter frequency of 45.05 MHz \pm 100 Hz.

6. Using an oscilloscope, measure the level of the 45.05 MHz signal at the junction of C356 and C355 (TP85). Adjust 3 violet coils L39, L40, and L50 for maximum level. Approximately 1 volt PTP \pm 10% should be seen here after these coils are tuned.

7. Measure the RF voltage at the 2nd LO output jack (J8), and adjust L39, L42, and L51 for maximum level. After these coils are tuned, typical voltage swing on the oscilloscope would be:

2.0 to 2.8 V PTP if J8 is loaded with 50 Ohms.
Minimum level is 1.414 V PTP with J8 loaded with 50 ohms.

If power is measured at J8:

Typical +10 to +13 dBm (into 50 Ohms),
Minimum +7 dBm (into 50 Ohms).

If level exceeds +8 dBm, turn L51 clockwise until the level drops to +8 dBm.

8. The following section assumes that the 50 kHz filters have been tuned as per section IV., A. 50 kHz IF Filter Tune Up. Store the PBT offsets for each mode by using the following procedure:

(a) Attach a signal generator to the Antenna 1 terminal at a level of -73 dBm and on the same frequency to which the receiver is tuned \pm the offset shown in the table in step (e). (The receiver frequency may be any frequency within its tuning range.)

(b) Select 500 Hz bandwidth, and Fast AGC.

(c) For each mode and generator frequency shown in the table in step (e), rotate the main tuning wheel for a peak indication on the S-Meter.

(d) Once peaked, press the "V ► M" button to store.

62 Alignment cont'd.

(e) Steps (a) through (d) must be performed for each mode indicated in the following table:

MODE	GENERATOR FREQUENCY
AM	R8B FREQUENCY
USB	R8B FREQUENCY + 1.4 kHz
LSB	R8B FREQUENCY - 1.4 kHz
CW	R8B FREQUENCY + 0.8 kHz
RTTY	R8B FREQUENCY + 2.2 kHz

9. After having completed the above steps, the jumper on the "Factory Test" connector should be removed. This will return the main tuning wheel to the function of changing the receiver frequency as opposed to the PBT frequency.

C. Loop 3 Adjustments

1. Use the front panel controls to set the frequency of the unit to 7.50000 MHz in the CW mode.

2. Adjust the loop 3 VCO coil (L36) for a tuning voltage of 5 VDC \pm 0.1 VDC as measured at the junction of 22K ohm resistor R185 and 15K ohm resistor R208 (TP24). Ensure that the VCO is running at 130.200 MHz \pm 100Hz by measuring with a counter at pin 1 of U33.

3. Set the frequency to 7.49999 MHz in CW mode and ensure that the VCO frequency as measured at pin 1 of U27 (TP12) is 130.002 MHz \pm 100Hz and the tuning voltage is greater than 4.0 VDC and less than 5.0 VDC.

4. Attach a scope and counter to pin 1 of mixer IC U34 (TP60) through a high impedance probe and adjust the three yellow coils (L24, L29, and L30) to produce peak output at 63.5 MHz. The level after peaking should be approximately 100 mV PTP \pm 10% at TP60 or 1.5 V PTP \pm 10% at pin 8 of U31 (TP31) (63.5 MHz will be present at TP60 only).

D. Loop 2 Adjustments

1. Set the frequency to 7.49999 MHz in CW mode and adjust the loop 2 oscillator coil (L37) for a VCO tuning voltage of 6 VDC \pm 0.1 VDC as measured at the junction of 22K Ohm resistor R190 and 3.9K ohm resistor R213 (TP40).

2. Verify that the oscillator frequency is 60.99990 MHz \pm 100Hz, measured with a counter and a high impedance probe at pin 1 of prescaler chip U28 (TP48).

3. Set the frequency to 7.50000 MHz in the CW mode and ensure that the VCO frequency is 60 MHz \pm 100 Hz and the tuning voltage is greater than 3.0 VDC and less than 6.0 VDC.

4. Measure the 3.49 MHz signal level at pin 8 of U31 (TP31) and repeak the three yellow coils (L24, L29, and L30) for maximum level. Approximately 500 mV PTP (\pm 10%) should be observed at this point.

5. Pre-tune VCO-1 coil (L7), 3.5 turns down from flush with top of shield can. Set frequency to 7.49999 MHz in the CW mode.

6. Measure the 11.4 MHz level at pin 1 of U14 (TP34) using an oscilloscope with a high impedance probe and adjust the three violet coils L19, L22, and L23 for maximum level. Approximately 1.5 volts PTP (\pm 10%) should be seen at this point.

E. Loop 1 Adjustments

1. Tune radio to 7.49999 MHz (VCO at 52.49999 MHz) and adjust the low band (VCO-1) VCO coil (L7) so that the tuning voltage is 8.05 \pm 0.05 VDC as measured at the junction of 2.2K ohm resistor R100 and 1K Ohm resistor R88 (TP16). Measure the VCO frequency at J1. The frequency should be 52.49999 MHz.

2. Tune the radio to 0.10000 MHz (VCO at 45.10000 MHz) and ensure that the tuning voltage is greater than 2.7 VDC.

3. Tune the radio to 14.99999 MHz (VCO at 59.99999 MHz) and adjust the low-mid band (VCO-2) VCO coil (L8) so that the tuning voltage is 8.05 VDC \pm 0.05 VDC as measured at the junction of 2.2K Ohm resistor R111 and 1K Ohm resistor R89 (TP37).

4. Tune the radio to 7.50000 MHz (VCO at 52.50000 MHz) and ensure that the tuning voltage is greater than 2.7 VDC.

5. Tune the radio to 21.99999 MHz (VCO at 66.99999 MHz) and adjust the hi-mid band (VCO-3) VCO coil (L9) so that the tuning voltage is 8.05 VDC \pm 0.05 VDC as measured at the junction of 2.2K ohm resistor R111 and 1K Ohm resistor R90 (TP37).

6. Tune the radio to 15.00000 MHz (VCO at 60.00000 MHz) and ensure that the tuning voltage is greater than 2.7 VDC.

7. Tune the radio to 30.00000 MHz (VCO at 75.00000 MHz) and adjust the high band (VCO-4) VCO coil (L10) so that the tuning voltage is 8.0 VDC \pm 0.05 VDC as measured at the junction of 2.2K ohm resistor R111 and 1K ohm resistor R91 (TP37).

8. Tune the radio to 22.00000 MHz (VCO at 67.00000 MHz) and ensure that the tuning voltage is greater than 3.0 VDC.

9. Measure the VCO output level at J1 for each frequency listed below. Output level should be 10 dBm \pm 3 dB.

0.10000 MHz
 7.49999 MHz
 7.50000 MHz
 14.99999 MHz
 15.00000 MHz
 21.99999 MHz
 22.00000 MHz
 30.00000 MHz

F. 50 kHz BFO Checks

1. With the receiver in the CW, SSB, or RTTY modes, measure the output of the 50 kHz jack J7 using an oscilloscope.
2. The level at this point should be approximately 1.5 volts PTP ($\pm 10\%$) and the frequency should be as shown on the following table ± 0.2 kHz.

MODE	FREQUENCY
USB	48.6 MHz
LSB	51.4 MHz
CW	49.2 MHz
RTTY	47.8 MHz

3. Observe that the output at this jack drops to zero on the AM and FM modes.

III. FRONT END BOARD ALIGNMENT AND TEST

A. Check of Front End Bandpass Filters

1. Calibrate a spectrum analyzer and tracking oscillator with a thru connection. Set the tracking oscillator level to -30 dBm and adjust the top of the screen to -20 dBm, sweeping from 0 to 110 MHz. As an alternate method, a signal generator and RF voltmeter can be used, using the same levels as mentioned above.
2. Connect the tracking oscillator (or signal generator) output to the "ANT 1" jack (J5), and select ANT 1 from the receiver's front panel controls.
3. Connect the spectrum analyzer (or RF voltmeter) to P4 so that the mixer input is disconnected.
4. Select each of the 9 front end bandpass filters by tuning the receiver to the frequency listed on the following chart. Filter ripple should not exceed 2 dB and the minimum and maximum frequencies for each filter should be $3.5 \text{ dB} \pm .5 \text{ dB}$ below the through connection reference set up in step 1.

BAND	FREQUENCY RANGE	RCVR FREQ
1	0.01 - 0.5 MHz	3 MHz
2	0.5 - 1.5 MHz	7 MHz
3	1.5 - 2.5 MHz	2.0 MHz
4	2.5 - 4.0 MHz	3.5 MHz
5	4.0 - 7.5 MHz	7.0 MHz
6	7.5 - 10.5 MHz	9.0 MHz
7	10.5 - 15.0 MHz	12.0 MHz
8	15.0 - 22.0 MHz	20.0 MHz
9	22.0 - 30.0 MHz	28.0 MHz

5. The sketch shown below gives an approximate representation of how each filter should appear on the spectrum analyzer.

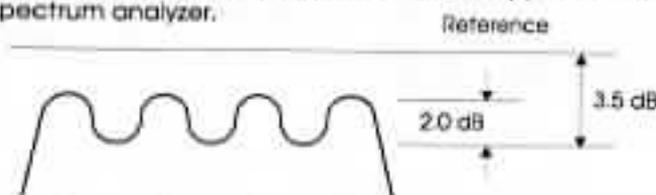


Figure 1: Approximate Front End Filter Waveform

B. Attenuator Check

1. With the 22-30 MHz band selected, enable the Attenuator and check for a $10 \text{ dB} \pm 1.5 \text{ dB}$ drop in spectrum analyzer or RF voltmeter response. Then disable the attenuator.

C. Preamp Check

1. Enable the Preamp and check for a $10 \text{ dB} \pm 1.5 \text{ dB}$ increase in spectrum analyzer or RF voltmeter response. Then disable the preamp.

D. Antenna Switching Checks

1. Select the "ANT 2, 50 OHMS" antenna jack (J6) from the front panel, connect the tracking oscillator or signal generator to J6, and observe that the levels are the same as in step A.
2. Connect the tracking oscillator or signal generator to the "ANT 2, 500 OHMS" antenna jack (J6) using an appropriate impedance adaptor, and observe that the levels are the same as in step A.
3. Temporarily connect pins 1 and 4 of P10 (located on Synthesizer board) together with a 10K resistor. This fools the μP into thinking that a VHF board is installed. Select the "VHF CONV, 50" jack from the front panel and connect the tracking oscillator or signal generator to the "VHF CONV" jack (J2). Then observe that the levels are the same as in step A. Remove the 10K Ohm resistor connecting pins 1 and 4 of P10.

E. 45 MHz IF Section Alignment And Tests

1. Preset R67 (mixer balance) in the center of its range and preset R78 (mixer bias) fully counterclockwise (minimum current). Adjust T3 2 turns down from flush.
2. Calibrate a spectrum analyzer and tracking oscillator (or signal generator and RF voltmeter with 50 ohm termination) with a thru connection. Set the tracker level at -40 dBm and adjust the top of the screen reference for -20 dBm, centered on 45 MHz, with the proper display as needed by the operator.
3. Connect the tracking generator (or signal generator) output to J1.
4. Connect the spectrum analyzer (or RF voltmeter) to pin 1 of P3 which is in the output circuit of Q2. The pin connecting to the input of the next stage should not be connected to anything.
 - (a) Ensure that jumpers connect P2 pins 1 and 2, and P1 pins 2 and 3.

64 Alignment cont'd.

5. Tune trimmer capacitors C85, C72, and C67 for maximum response. The response should appear as shown in Figure 2 which follows. Note that the ideal response would be flat. However, III, as shown in the sketch, is the more likely response and is acceptable within the limits shown.

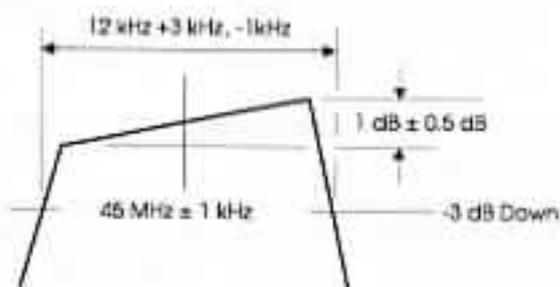


Figure 2: 45 MHz Crystal Filter Response

Observe that the ultimate attenuation is at least 60 dB down as shown in Figure 3. Figure 4 shows an example of an unacceptably poor ultimate attenuation.

6. Advance the RF Gain to the fully clockwise position and connect the tracking oscillator to P4 pin 1. Note that the minimum gain between P4 and P3 is +25 dB. Then rotate the RF Gain control counterclockwise and observe that the gain can be reduced a minimum of 40 dB. (In other words, stage gain between P4 and P3 should be variable from approximately +25 dB to -15 dB). Also check that the pass-band shape does not change over the AGC range.

7. Remove the test equipment from P4 and ensure that jumpers are installed on P4, P2, and P1 so as to establish a signal path from the antenna up to P3.

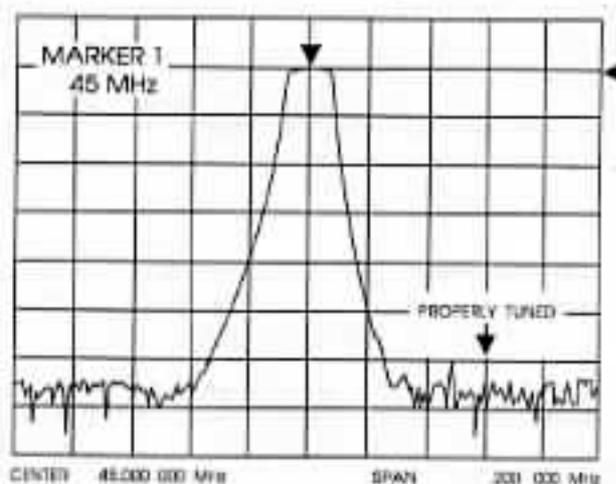


Figure 3: Properly Tuned Filter

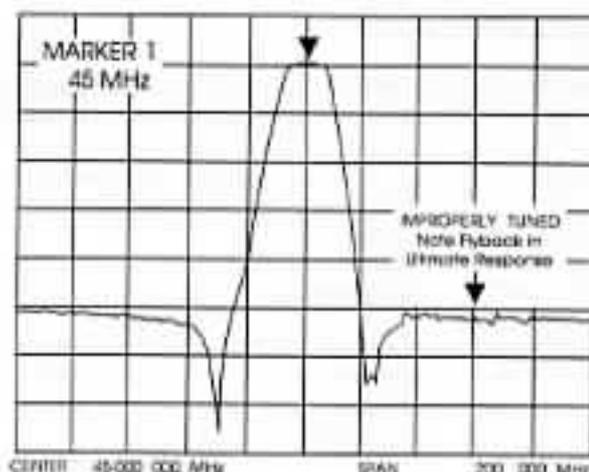


Figure 4: Improperly Tuned Filter

F. First Mixer Adjustment

1. Ensure that R67 is still in the center of its range and that R77 is fully counterclockwise (minimum current).
2. Connect a signal generator to ANT 1 (J5). The generator should be adjusted to 500 kHz (the receiver frequency) at level of -80 dBm and modulated 30% with a 1 kHz tone. Make sure ANT 1 is selected from the receiver's front panel controls.
Note: Pins 2 and 3 of P1, and pins 1 and 2 of P2, and P3 must be jumpered to complete the signal path and obtain audio output.
3. Connect a SINAD meter to the audio output.
4. Tune the receiver to 500 kHz, AM mode.
5. Adjust R67 for best SINAD.
6. Adjust R78 for a reading of $0.22 V \pm 0.005$ as measured across R79 (22 Ohms). Then disconnect the generator and analyzer.

G. Image Reject Mixer Section Alignment And Tests

1. Calibrate a spectrum analyzer and a signal generator by establishing a thru connection between the generator and the analyzer. Set the generator level to -20 dBm and adjust top of the screen reference for -20 dBm. Accurately set the frequency of the signal generator to 45 MHz.
2. Connect the signal generator to P3. The stages proceeding P3 should be disconnected.
3. Connect the spectrum analyzer input to 50 kHz output jack J4, and make sure that 45.05 MHz signal is being supplied to 2nd LO IN Jack J3 at a level of approximately +10 dBm.
4. Locate the 50 kHz output response on the spectrum analyzer, and tune capacitors C104 and C106 for maximum response.

5. Switch the signal generator frequency to 45.1 MHz and retune C104 and C106 for minimum.

6. Repeat steps 4 and 5 for maximum rejection at 45.1 MHz input and maximum output at 45.0 MHz input. **There should be at least 30 dB of 45.1 MHz rejection.**

7. Set signal generator to 45 MHz and check that the insertion loss does not exceed 10 dB.

8. Remove generator and spectrum analyzer, and connect a jumper on P3 so that it connects the output of the 45 MHz IF section to the image Reject Mixer section input.

H. F.M. Detector Alignment And Checks

1. Connect a SINAD meter and a 4 ohm load to the receiver's audio output.

2. Connect a signal generator to the ANT 1 terminal (J5) and set for 29 MHz, -50dBm output, FM modulated, 1 kHz tone, 3.5 kHz deviation. Tune the receiver to 29 MHz, select the FM mode.

3. Ensure that jumpers are in place on P4, P2 and P1 so as to establish a signal path through the receiver to the FM detector.

4. Connect a counter (high impedance input) to pin 3 of the IC (U2) and adjust L19 for $34.300 \text{ MHz} \pm 500 \text{ Hz}$.

5. Connect a counter (high impedance input) to C53 and adjust C58 for $10.246 \text{ MHz} \pm 10 \text{ Hz}$.

6. A 1 kHz tone should be heard at the output of the receiver.

7. Check for a minimum of 12 dB SINAD at -113 dBm input.

I. PL Filter Check

1. With the signal generator still connected as per section H., connect an audio voltmeter or similar audio level measuring device to the audio output. Set the generator level to -60 dBm.

2. Measure and note the audio output level at 1000 Hz.

3. Change the generator modulation frequency to 100 Hz at 3.5 kHz deviation and again note the audio output level.

4. It should be at least 20 dB lower than the level recorded in step 2.

IV. SECOND I.F./ AUDIO BOARD TUNE UP AND TEST

A. 50 kHz IF Filter Tune Up

Prerequisites

- Digital control inputs
- 50 kHz Spectrum Analyzer and Tracking Generator
- Buffer from output of (Q56) to Analyzer (input impedance 2 K ohms or higher at 50 kHz).
- 50 kHz $\pm 10 \text{ Hz}$ source at approximately -30 dBm.

1. Connect tracking generator to the IF input jack (J1) and select the narrowest bandwidth (i.e. 500 Hz) with the digital control inputs.

2. A low level peak should be visible on the analyzer display. Adjust the tuning slugs on all of the pot cores to peak the response. Ensure that the output is not into compression which will cause flattening of the passband. Repeak if necessary.

3. Select 2.3 kHz bandwidth and note the symmetry about 50 kHz. Select 4 kHz bandwidth and note symmetry about 50 kHz. The symmetry about 50 kHz will not be perfect but ripple peak symmetry across the band should be obtained.

4. Switch back to the 2.3 kHz bandwidth and, if needed, touch up the necessary pot cores that affect the response only a minimum amount so that the 500 Hz bandwidth is not grossly affected. Switch to the 500 Hz bandwidth. The peak of the response should be within 4 dB of the 2.3 kHz bandwidth's response. If not, readjust.

5. Switch to the 4 kHz bandwidth and adjust the necessary pot cores that flatten the passband as above. Ripple should be maintained below 2.9 dB PTP. The -6 dB points may end up slightly skewed to the low side when done. Switch to the 500 Hz bandwidth. The peak of the response should be within 4 dB of the 4 kHz bandwidth's peak. If not, readjust.

6. Step through all BW's noting symmetry, passband flatness, and relative loss. Relative loss between any two bandwidths should be less than 5 dB. The -6 dB bandwidth should be within $\pm 10\%$ except on 500 Hz bandwidth where bandwidths over 370 Hz are acceptable. All shape factors (-6 dB/-60 dB) should be less than 1:2.2 except for the 500 Hz bandwidth where anything less than 1:4.0 is acceptable.

B. A.G.C. and S-Meter Setup

Prerequisites

- The 2nd IF PC board AGC-1 pot (R264) should be preset fully CCW.
- The 2nd IF PC board AGC-2 pot (R310) should be preset fully CCW.
- The 2nd IF PC board AGC-3 pot (R247) should be preset fully CCW.
- The 2nd IF PC board Gain pot (R87) should be preset to midscale.
- The signal generator referred to in this section is attached to the antenna input.

66 Alignment cont'd.

Procedure

1. Select the AM mode, AGC F, Preamp OFF, RF Gain full CW, PBT Centered.

2. Monitor the last IF stage output (Collector of Q61 at P14, pin 1) with an oscilloscope.

3. Apply -73 dBm, no modulation, on channel.

4. Set the AGC 1 pot (R264) for 5.0 V PTP at the last IF stage (Collector of Q61 at P14, pin 1).

5. Monitor AGC 1 at P14, pin 2 with an 11 megohm or higher DC voltage measuring device.

6. Reduce the input level to -108 dBm.

7. Adjust the IF Gain (R87) until AGC 1 just starts to move.

8. Monitor AGC 2 at P14, pin 3 with an 11 megohm or higher DC voltage measuring device.

9. Apply -73 dBm on channel.

10. Adjust AGC 2 pot (R310) until AGC 2 just starts to move.

11. Monitor AGC 3 at P14, pin 4 with a 10 megohm or higher DC voltage measuring device.

12. Apply -63 dBm on channel.

13. Adjust AGC 3 pot (R247) until AGC 3 just starts to move.

14. Apply -13 dBm on channel.

15. Set the FM (not FM) full scale pot (R340) for full scale S-Meter reading.

16. Remove signal.

C. SSB-AM Squelch Setup

1. Select AM mode, and set the frequency as desired.

2. Set the signal generator to the same frequency as the receiver. Set the level to OFF.

3. Adjust the front panel Squelch Threshold pot to the 9 o'clock position.

4. Adjust the AM Squelch Threshold pot (R258) until the unit just squelches (no noise).

5. Turn on the generator and set its level to 1 μ V. The receiver should unsquelch.

6. Rotate the front panel Squelch control CW until the unit just squelches again.

7. Increase RF input 10 dB and confirm that the unit unsquelches. Repeat this in 10 dB steps until S9 +50 dB is reached.

D. FM Squelch and S-Meter Adjustment

NOTE: This section assumes the AGC section is aligned.

1. Connect a signal generator to the ANT 1 terminal (J5) and set the receiver and the generator to the same frequency (29 MHz is suggested). Set the receiver mode to FM and set the preamp to OFF. The generator should be FM modulated with a 1 kHz tone and 3.5 kHz deviation. Set the signal generator level to -60 dBm.

2. Adjust the front panel squelch control to the fully clockwise position.

3. Adjust R104 (on the front end board) until the unit just unsquelches (audio is heard).

4. Remove the signal and verify that the front panel SQUELCH control 'unsquelches' the unit at approximately the 10:00 o'clock position.

5. Set the signal generator output to +60 dB above 0.5 μ V (-55 dBm) and adjust R337 (FM Full) on the 2nd IF Audio board for full scale S-Meter reading.

E. Recovered Audio Output Tests

Prerequisites

1. I.F. filter has been tuned.
2. 4 Ohm load for external speaker, 4.7K Ohm load minimum for line outputs.
3. Oscilloscope
4. -50 dBm 50 kHz signal 30% AM modulated with 1 kHz sine wave.
5. Volume pot, RF Gain pot, Tone pot. (These items will be connected already if board is installed in a receiver unit).

1. Preset POWER on, NB off, FM disabled, AGC slow, AGC enabled, BFO disabled, SYNCH DET disabled, NOTCH disabled.

2. Set the BW to 6 kHz, VOLUME to max, EXTERNAL SPEAKER selected, TONE to midrange, and RF GAIN to maximum.

3. Input the modulated 50 kHz signal into the IF strip through (J1).

4. Monitor the 1 kHz demodulated sine wave audio output (terminated in a 4 Ohm load) with an oscilloscope at EXT SPEAKER jack J5.

5. With the VOLUME control at maximum, a minimum of 9 volt PTP undistorted sine wave across the 4 Ohm load should be obtained. This is equivalent to 2.5 Watts. Note: The AC supply should be set to the nominal AC line voltage.

6. Check the two line audio outputs for at least .565 Volts PTP sine waves into 4.7K Ohm loads. This is equivalent to approximately 200 mv RMS.

F. Selectable Sideband Synchronous Detector Alignment.

1. Initial settings:
 - a. R212 - Fully CCW
 - b. R1 (On Phase Shift Module)- Fully CCW
 - c. Front panel PBT pot must be centered.
 - d. Set receiver to 10.000 MHz exactly with AM SYNC (double sideband) mode selected.
- (1) (Note: The AM sync mode is selected by pressing the AM/SYNC button once while in the AM mode. Pressing it again will return the unit to the AM mode. See figure 5.)
- e. Input signal 10.000 MHz \pm 100Hz at a level of -50 dBm with no modulation.

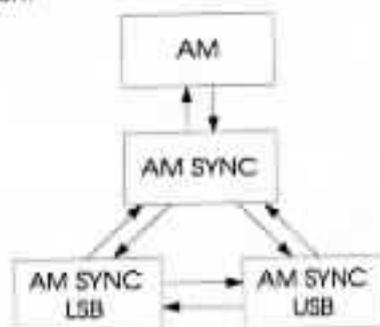


Figure 5: SYNC Mode Selection

2. Locked Oscillator Adjustment.
 - a. With initial settings observed, install a shorting jumper between pins 1 and 2 of P9 and turn on the synchronous detector. Adjust C196 until a zero beat is heard.
3. I.F. signal duty cycle adjustment.
 - a. Monitor pin 3 of U13 with an oscilloscope and set R212 so that a square wave with 50% duty cycle appears. This should occur near the center of the range of R212.
 - b. Remove the jumper across P9.
4. Audio phase shift adjustment and checks.

NOTE: For the following steps, a perfect single sideband carrier signal is needed. Such a signal can be obtained by combining a second generator set to 10.001 MHz at -60 dBm (with no modulation) with the above generator which should still be set at 10.000 MHz, -50 dBm, no modulation. The sum of these signals would represent an A.M. signal at 10.000 MHz with a modulation of 60% at 1 kHz with its lower sideband removed. Moving the second generator to 9.999 MHz would lead to the same signal but with the upper sideband removed. The following procedure assumes that this combined generator method is used. (While the absolute signal generator frequencies used here are not critical, the difference frequencies are, and must be maintained.)

- a. Make sure the shorting jumper across P9 is removed, and set the signal generators as follows:
 - Generator 1 10.000 MHz \pm 100Hz at -50 dBm with NO modulation
 - Generator 2 10.001 MHz \pm 100Hz at -60 dBm with NO modulation
- b. Monitor the audio output with an oscilloscope. Select AM sync LSB, and adjust R1 on phase shift module for minimum audio.

- c. Select AM sync USB and note the audio level. The audio level measured in AM sync LSB should be at least 26 dB below that measured in AM sync USB.
 - (1) Once the unit is in the AM SYNC mode, AM SYNC LSB is selected by pressing LSB and AM SYNC USB is selected by pressing USB. Pressing AM SYNC once returns the unit to AM SYNC (double sideband) and pressing AM SYNC again returns the unit to AM mode. (See figure 5.)
- d. Reset generators as follows:
 - (1) Generator 1 10.000 MHz \pm 100Hz at -50 dBm with NO modulation (as before).
 - (2) Generator 2 9.999 MHz \pm 100Hz at -60 dBm with NO modulation.
- e. Now the audio for AM Sync USB should be at least 26 dB below that measured in AM Sync LSB. If not, try resetting R1 and repeating steps 4., a. thru 4., c. R1 should end up near the center of its range.

5. Check lock range.

- a. Use a single signal generator set to 10.000 MHz with its output set at -50 dBm, AM modulated 30% with a 400 Hz audio tone. The synchronous detector should lock from 9.997 to 10.003 (\pm 3 kHz) regardless of the selected sideband.
- b. Alignment complete. Make sure jumper is removed from P9.

G. Notch Null Adjustments

Prerequisites

- a. Place unit in SSB mode and tune in an external signal generator signal for a beat note at 1.5 kHz. Set generator level high enough to avoid noise when notch depth is checked. A level of -50 dBm is recommended.
- b. Enable Notch.

1. With the above 1.5 kHz sine wave displayed on an oscilloscope connected to the audio output, and the front panel NOTCH control fully clockwise, adjust the level so that the signal spans the 8 vertical divisions of the oscilloscope.
2. Notch out the signal with the front panel NOTCH control.
3. Adjust the Notch Depth pot (R141) to further reduce the signal.
4. Repeat steps 2 and 3 for maximum null. The signal should be less than 1/5 of one of the 8 major divisions which corresponds to $>$ 32 dB of attenuation.
5. Adjust the signal generator for beat notes of 500 Hz and 3 kHz and check notch depth at these points. The attenuation should be equal to or greater than 30 dB.
6. Notch attenuation for modulation above 2.5 kHz should be at least 30 dB.

68 Alignment cont'd.

H. Noise Blanker Check and Adjustment

Prerequisites

- I.F. and audio circuits operational
- Signal Generator set for 2.1 MHz at approximately a -95 dBm output level.
- Pulse Generator set for 250 Hz repetition rate, pulse width of 55 usec and output level set to 0.5 - 1.0 Vpp.

1. Monitor the audio by connecting an oscilloscope to the External Speaker output at the rear panel of the receiver.

2. Switch to the AM mode and with both the signal generator and pulse generator inputs disconnected, observe the audio on the oscilloscope. If horizontal bars appear in the receiver noise output, adjust the Noise Blanker Threshold pot (R40) to a point that the bars are just eliminated. Note that the Threshold pot (R40) is adjusted only to prevent false triggering and has no effect on the blanking depth.

3. Combine the signal generator and pulse generator outputs into the 50 ohm antenna input of the receiver.

4. Set the receiver for LSB mode, 2.3 kHz BW, AGC slow, Preamp Off, Noise Blanker Off, RF Gain fully clockwise and select the "Antenna 1" input. Tune the receiver to a frequency of 2.1 MHz.

5. With the Pulse generator disabled, but connected to the receiver, tune the receiver for a 1 kHz beat note at a received level of S5.

6. Enable the Pulse generator and increase its level to yield a +10dB/S9 S-meter reading in the receiver.

7. Enable the noise blanker. The S-meter reading should reduce to an S5 reading.

V. MISCELLANEOUS TESTS

A. Check MUTE function

Check MUTE function on all modes by grounding the center pin of the rear panel MUTE jack. Note that the S-Meter should drop to zero and audio output should cease.

B. Check the audio output switching as follows:

1. Attach a speaker, or appropriate audio output measuring equipment to the rear panel EXT Speaker jack.

2. Switch the Speaker INT/BOTH/EXT switch through its three positions and observe that the audio output is switched to the internal speaker, both speakers, and to the external speaker as the switch is moved appropriately.

3. Plug headphones or an equivalent audio measuring device into the front panel headphone jack. Note that audio is present at this device and that audio has been removed from the internal and external speaker (or measuring device).

C. Check the external DC input terminals

Check the external DC input terminals by disconnecting the unit from AC power, and connecting it to a power supply providing 11.7 to 16 volts at 2 amps. The unit should function normally.

D. Check the μ P interface connector

Check the μ P interface connector by plugging the unit into the serial port of a dumb terminal or personal computer with the appropriate cable. (Both the computer and receiver should be disconnected from power when connecting and disconnecting this cable).

1. The computer or terminal should be configured for 9600 baud, 8 data bits, 1 stop bit, no parity, and should have a suitable software package installed such as Procomm Plus™ or Bitcom™ 3.58C or higher.

2. Turn on the computer, apply power to the receiver and activate the communications software.

3. Turn on the receiver using either the front panel button or type the "PO" command from the computer keyboard.

4. At the prompt, type the command "ID". The receiver should respond with "R8B.n" (where n = the software revision number) which should appear on the computer or terminal monitor. This indicates that the terminal or computer is communicating properly with the receiver.

5. Disconnect the receiver and the computer from power (unless it is desired to use the computer for some of the subsequent tests), and disconnect the cable from the receiver.

E. Computer Interface Signal Strength Calibration

1. Connect a signal generator with calibrated output level to the ANT 1 terminal.

The generator frequency should be set to 10 MHz. Set the R8B Preamp off, Attenuator off, AGC Fast, RF Gain Fully CW, and PBT centered. Reconnect the computer interface connector to the computer as in the previous section (section D).

2. Ground the center pin of TEST connector P5 on the μ P / Synthesizer Board with a jumper plug.

3. Adjust the generator Level for R88 S-Meter readings shown on the following chart and store the calibration point either from the front panel or from the computer interface.

(1) Front panel:

(a) Press AGC. After this, the numeric keys store the calibration points as follows:

KEY	SIGNAL STRENGTH
0	S1
1	S3
2	S5
3	S7
4	S9
5	+10
6	+20
7	+30
8	+40
9	+60

(2) From the computer interface:

Issue the command "M_n," where n is the same as the key number shown above, for the signal strength being applied.

4. Remove the ground jumper from the TEST pin (P5) to return the R88 to normal operation.

F. Check all front panel push buttons

Check all front panel push buttons by pressing each one and listening for the beep. (Note that the Beep can be disabled with the secondary function of the "9" button so ensure that the beep is engaged before performing this test.)

G. Timer Check

1. Connect a continuity tester to Timer jack P5 on the rear panel. The tester should be able to show continuity between pin 2, and pin 3, and between pin 2 and pin 5. It should also be able to show continuity from pin 4 and chassis ground.

2. With the timer deactivated, confirm continuity between pins 2 and 3. There should be no continuity between pins 2 and 5.

3. Confirm continuity between pin 4 and chassis ground.

4. Activate the timer relay either by typing a "TO" command on the external computer keyboard or by actually setting the timer using the receiver's front panel push buttons. (See the instruction book for details on setting the timer.)

5. With the timer activated, there should now be continuity between pin 2 and pin 5 and there should no longer be continuity between pin 2 and pin 3.

6. If a computer is used, deactivate the timer relay by typing a "TF" command. If the internal timer was used, deactivate the timer using the front panel buttons. See the instruction book for details.

70 Notes

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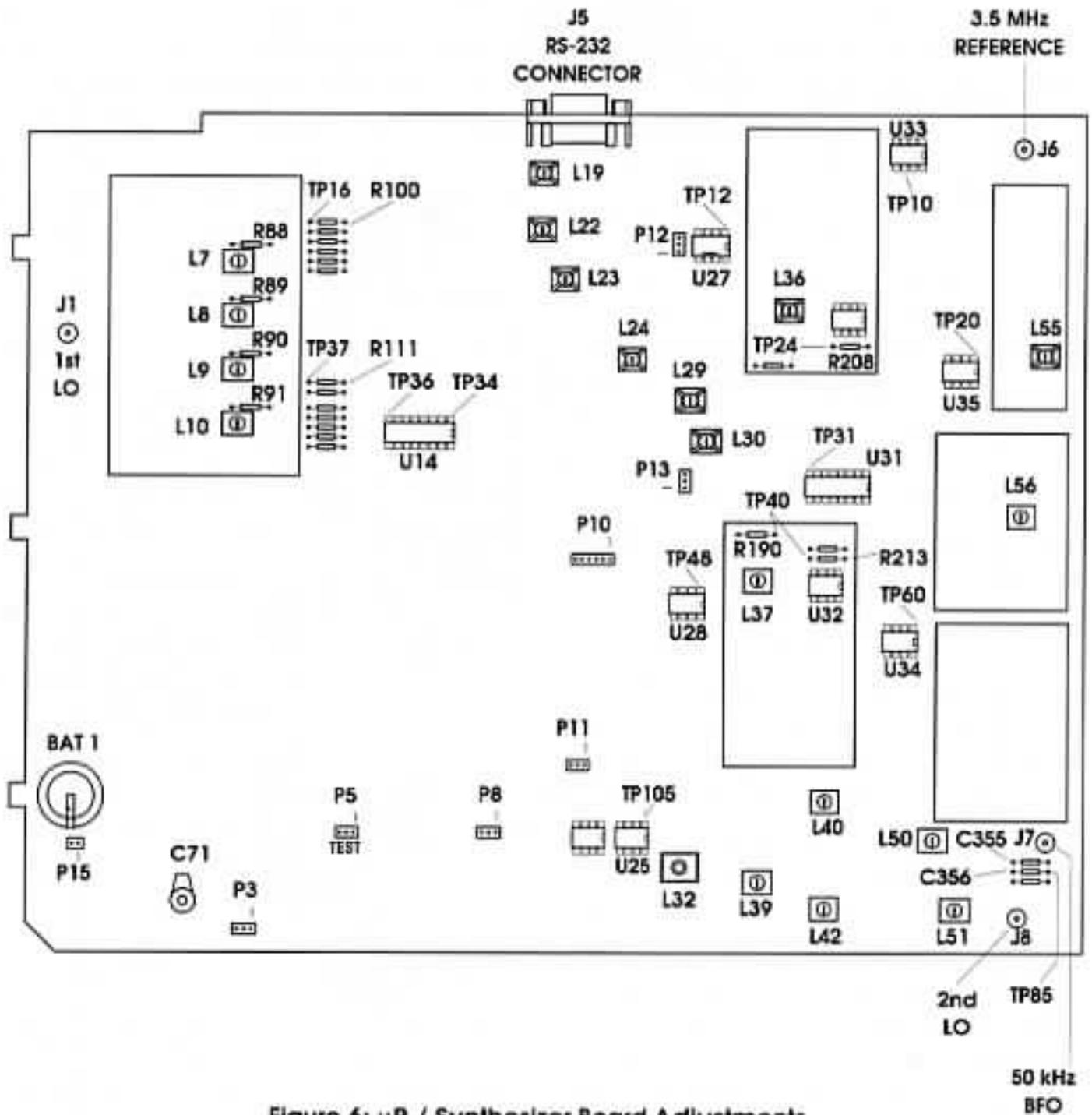


Figure 6: μ P / Synthesizer Board Adjustments

72 Notes

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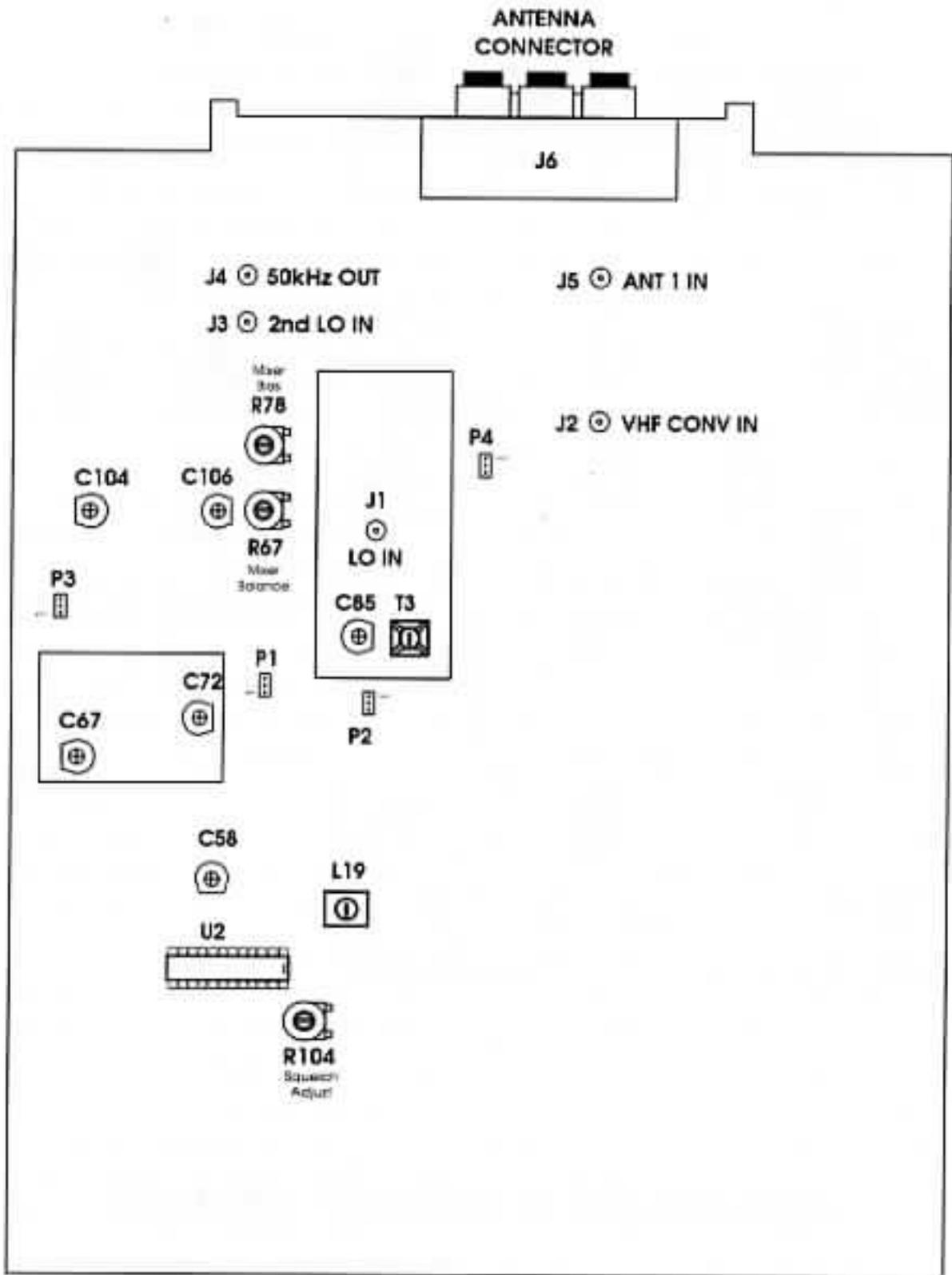


Figure 7: Front End Board Adjustments

74 Notes

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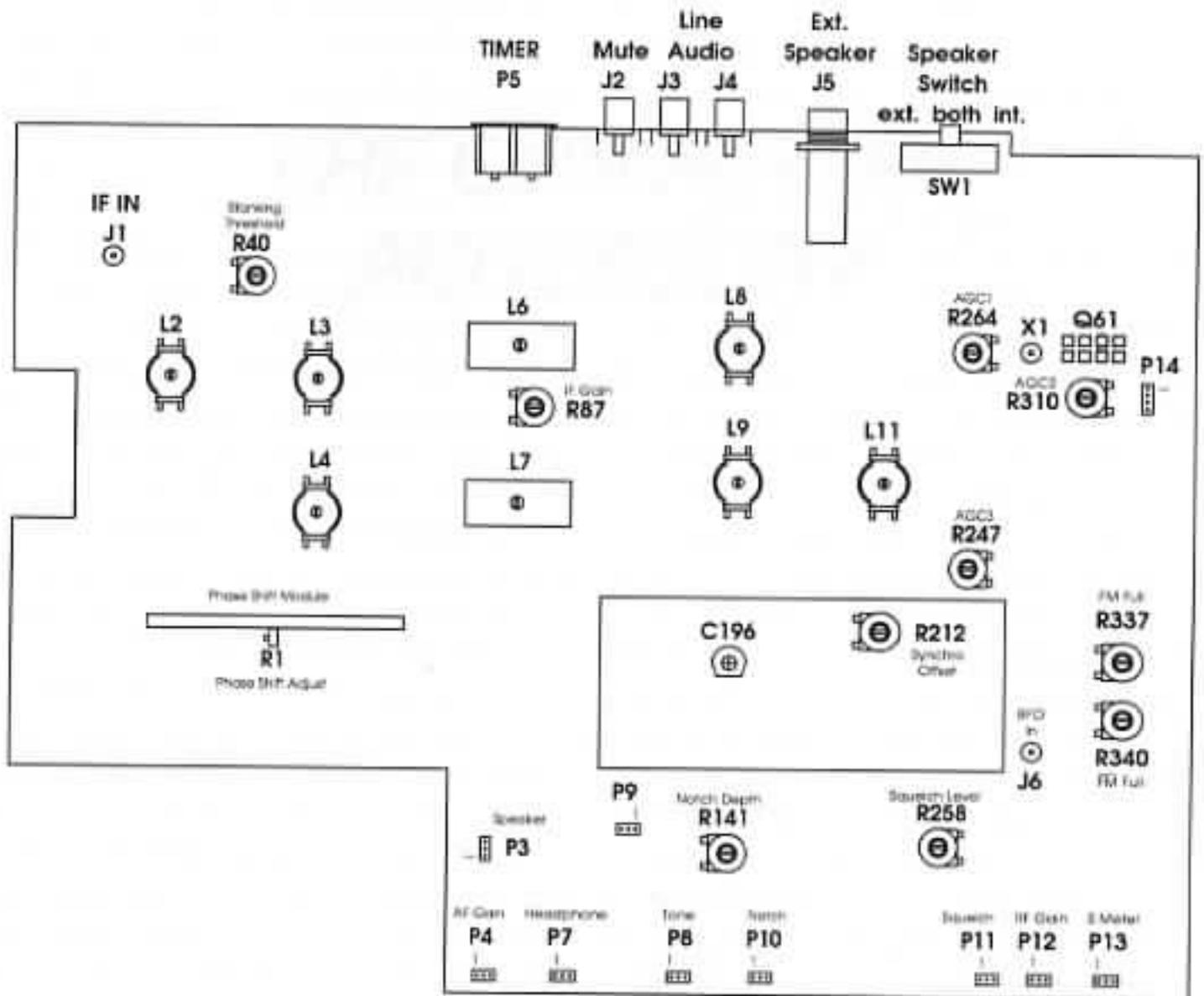


Figure 8: 2nd IF / Audio / Power Supply Board Adjustments

*VHF CONVERTER
ACCESSORY*

VHF BLOCK CONVERTER THEORY OF OPERATION

RF Section

The signal input from the CONV ANT terminal is amplified and filtered as it passes through the preselector. The preselection filters divide the frequencies into two bands: low band and high band. Low band is a fixed band pass filter that passes 35 thru 54 MHz. High band is a voltage tuned band pass filter that covers 108 thru 174 MHz in 15 discrete steps. Both bands share the same amplifiers: Q110 and Q107. The signals mix (MX101; DBM50A) with one of six fixed local oscillator frequencies. This divides the covered RF frequency range into six RF blocks. The RF blocks are:

35 - 54.000 MHz
108 - 124.999 MHz
125 - 138.999 MHz
139 - 151.999 MHz
152 - 163.999 MHz
164 - 174.000 MHz

The converted IF block is passed on to the Receiver front end board.

CONTROL

A 35 bit control code is sent from the Receiver via the data line. The control code contains the information required to select the correct preselector band, the filter tune voltage, the VCO select bits and the PLL A and N words. The 35 bit control code is fed serially through U105 (74HC595), then through U103 (74HC595) and finally to the PLL chip U102 (MB1504). When all 35 bits have been clocked in, the enable is strobed to latch the data. Now U105 contains the tunable filter code and works in conjunction with RP100 (R/2R SIP) and U106 (LPC662) as a D/A converter to generate the filter tune voltage. U103 (74HC595) contains the band select bits for the preselector filters and PLL VCO's. U102 is set up for the desired LO frequency.

SYNTHESIZER

The synthesizer is a single loop design that is phased locked to the 3.5 MHz crystal reference from the Receiver. The heart of the synthesizer is U102 (MB1504). The VCO signal is fed back through the buffer Q101 to U102 where it is compared with the reference, this generates an error voltage which is sent to the loop filter. The output of the loop filter controls the VCO frequency so that it maintains lock to the crystal reference. The locked VCO signals are sent through the buffer amp Q106 to drive the LO port of MX101.

80 Notes

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VHF Converter Board Parts List 81

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
C102	3167578	CAP CHIP .10 MF X7R (1206)	C163	3167578	CAP CHIP .10 MF X7R (1206)
C103	3167578	CAP CHIP .10 MF X7R (1206)	C164	3167578	CAP CHIP .10 MF X7R (1206)
C104	3167578	CAP CHIP .10 MF X7R (1206)	C167	3167512	CAP CHIP 22 PF NPO (0805)
C105	3167578	CAP CHIP .10 MF X7R (1206)	C168	3167545	CAP CHIP 680 PF (0805)
C106	3180125	CAP ELECTRO 47@16 RADIAL	C169	3180125	CAP ELECTRO 47@16 RADIAL
C107	3167574	CAP CHIP .047 MF (1206)	C170	3167545	CAP CHIP 680 PF (1206)
C108	3167545	CAP CHIP 680 PF (0805)	C171	3167529	CAP CHIP 150 PF (0805)
C109	3167578	CAP CHIP .10 MF X7R (1206)	C172	3166120	CAP CHIP .001 MF 50V
C110	3167578	CAP CHIP .10 MF X7R (1206)	C173	3166120	CAP CHIP .001 MF 50V
C111	3166120	CAP CHIP .001 MF 50V	C174	3167539	CAP CHIP 390 PF NPO (0805)
C112	3166105	CAP CHIP .01 MF 50V (0805)	C175	3166105	CAP CHIP .01 MF 50V (0805)
C113	3180125	CAP ELECTRO 47@16 RADIAL	C176	3166105	CAP CHIP .01 MF 50V (0805)
C114	3167578	CAP CHIP .10 MF X7R (1206)	C177	3167539	CAP CHIP 390 PF NPO (0805)
C115	3166042	CAP CHIP 15 PF 50V, 5% NPO	C178	3167539	CAP CHIP 390 PF NPO (0805)
C116	3167578	CAP CHIP .10 MF X7R (1206)	C179	3166105	CAP CHIP .01 MF 50V (0805)
C117	3167522	CAP DISC 20.0 PF NPO (0805)	C180	3166105	CAP CHIP .01 MF 50V (0805)
C118	3167578	CAP CHIP .10 MF X7R (1206)	C181	3167539	CAP CHIP 390 PF NPO (0805)
C119	3166143	CAP CHIP 18 PF 50V	C182	3205199	CAP VAR TRIMMER 2.5-12PF
C120	3167578	CAP CHIP .10 MF X7R (1206)	C183	3167534	CAP CHIP 270 PF (0805)
C121	3166140	CAP CHIP 10 PF 50V	C184	3205199	CAP VAR TRIMMER 2.5-12PF
C122	3167512	CAP CHIP 22 PF (0805)	C185	3180125	CAP ELECTRO 47@16 RADIAL
C123	3166145	CAP CHIP 27 PF 50V (0805)	C186	3167578	CAP CHIP .10 MF X7R (1206)
C124	3166143	CAP CHIP 18 PF 50V	C187	3167578	CAP CHIP .10 MF X7R (1206)
C125	3166042	CAP CHIP 15 PF 50V, 5% NPO	C188	3167578	CAP CHIP .10 MF X7R (1206)
C126	3166143	CAP CHIP 18 PF 50V	C189	3167578	CAP CHIP .10 MF X7R (1206)
C127	3166140	CAP CHIP 10 PF 50V (0805)	C190	3166105	CAP CHIP .10 MF 50V (0805)
C128	3166039	CAP CHIP 8.2 MF NPO	C191	3167545	CAP CHIP 680 PF (0805)
C129	3166140	CAP CHIP 10 PF 50V (0805)	C192	3167545	CAP CHIP 680 PF (0805)
C130	3167503	CAP CHIP 2.7 PF (0805)	C193	3166105	CAP CHIP .01 MF 50V (0805)
C131	3166140	CAP CHIP 10 PF 50V (0805)	C194	3167578	CAP CHIP .10 MF X7R (1206)
C132	3167503	CAP CHIP 2.7 PF (0805)	C195	3166105	CAP CHIP .01 MF 50V (0805)
C133	3166141	CAP CHIP 6.8 MF 50V	C196	3167545	CAP CHIP 680 PF (0805)
C135	3166140	CAP CHIP 10 PF 50V (0805)	C197	3167545	CAP CHIP 680 PF (0805)
C136	3167578	CAP CHIP .10 MF X7R (1206)	C198	3166105	CAP CHIP .10 MF 50V (0805)
C137	3166140	CAP CHIP 10 PF 50V (0805)	C199	3205199	CAP VAR TRIMMER 2.5-12PF
C138	3167578	CAP CHIP .10 MF X7R (1206)	C200	3205199	CAP VAR TRIMMER 2.5-12PF
C139	3164140	CAP CHIP 10 PF 50V (0805)	C201	3167520	CAP CHIP 56 PF (0805)
C140	3167578	CAP CHIP .10 MF X7R (1206)	C202	3167520	CAP CHIP 56 PF (0805)
C141	3166140	CAP CHIP 10.0 PF 50V (0805)	C203	3167520	CAP CHIP 56 PF (0805)
C142	3167578	CAP CHIP .10 MF X7R (1206)	C204	3167520	CAP CHIP 56 PF (0805)
C143	3167578	CAP CHIP .10 MF X7R (1206)	C205	3167512	CAP CHIP 22 PF NPO (0805)
C144	3167545	CAP CHIP 680 PF (0805)	J102	3280042	CONN.COAX PC MT.#TMP-J01X
C145	3167578	CAP CHIP .10 MF X7R (1206)	J103	3280042	CONN.COAX PC MT.#TMP-J01X
C146	3166155	CAP CHIP 47 PF 50V (0805)	J104	3280042	CONN.COAX PC MT.#TMP-J01X
C147	3166105	CAP CHIP .01 MF 50V (0805)	L101	3526060	COIL CHIP 1008CS-471 470 NH
C148	3167529	CAP CHIP 150 PF (0805)	L102	3526029	COIL CHIP 1008CS-820 82 NH
C149	3166120	CAP CHIP .001 MF 50V	L103	3524124	COIL VAR 0.046UH BRASS COR
C150	3167522	CAP CHIP 20.0 PF NPO (0805)	L104	3524124	COIL VAR 0.046UH BRASS COR
C151	3167522	CAP CHIP 20.0 PF NPO (0805)	L105	3524155	COIL RADIAL 2.2μH
C152	3167578	CAP CHIP .10 MF X7R (1206)	L106	3524155	COIL RADIAL 2.2μH
C153	3166120	CAP CHIP .001 MF 50V	L107	3524155	COIL RADIAL 2.2μH
C154	3166155	CAP CHIP 47 PF 50V (0805)	L108	3524155	COIL RADIAL 2.2μH
C155	3166120	CAP CHIP .001 MF 50V	L109	3526050	COIL CHIP 1008CS-391 390 nH
C156	3167578	CAP CHIP .10 MF X7R (1206)	L110	3524041	COIL AIR 1-1/2T .125" I.D.
C157	3167578	CAP CHIP .10 MF X7R (1206)	L111	3526050	COIL CHIP 1008CS-391 390 nH
C158	3167530	CAP CHIP 120 PF NPO (0805)	L112	3526040	COIL CHIP 1008CS-151 150 nH
C159	3166155	CAP CHIP 47.0 PF 50V (0805)	L113	3526040	COIL CHIP 1008CS-151 150 nH
C160	3167578	CAP CHIP .10 MF X7R (1206)	L114	3524155	COIL RADIAL 2.2 μH
C161	3167530	CAP CHIP 120 PF NPO (0805)	L115	3524078	COIL AIR 5-1/2T 110 nH
C162	3167545	CAP CHIP 680 PF (0805)	L116	2510089	INDUCTOR TOROID

82 VHF Converter Board Parts List cont'd.

REFERENCE	PART NUMBER	DESCRIPTION	REFERENCE	PART NUMBER	DESCRIPTION
L117	3524041	COIL AIR 1-1/2T .125" I.D.	R137	3250839	RES CHIP 5.1 K 5% 1/10W
L118	2510099	INDUCTOR TOROID	R138	3250809	RES CHIP 220 OHM 5% 1/10W
L119	2510099	INDUCTOR TOROID	R139	3250809	RES CHIP 220 OHM 5% 1/10W
L120	2510089	INDUCTOR TOROID	R140	3250809	RES CHIP 220 OHM 5% 1/10W
L121	2510089	INDUCTOR TOROID	R141	3250813	RES CHIP 180 OHM 5% 1/10W
L122	2510089	INDUCTOR TOROID	R142	3250810	RES CHIP 100 OHM 5% 1/10W
L123	2510089	INDUCTOR TOROID	R143	3250811	RES CHIP 33 OHM 5% 1/10W
L124	3524155	COIL RADIAL 2.2 μ H	R144	3250822	RES CHIP 2.2 K 5% 1/10W
L125	3524155	COIL RADIAL 2.2 μ H	R146	3250908	RES CHIP 4.7 OHM 5% 1/10W
L126	3524155	COIL RADIAL 2.2 μ H	R148	3250822	RES CHIP 2.2 K 5% 1/10W
L127	3524155	COIL RADIAL 2.2 μ H	R149	3250831	RES CHIP 10 K 5% 1/10W
L128	3524155	COIL RADIAL 2.2 μ H	R150	3250809	RES CHIP 220 OHM 5% 1/10W
L129	3526105	COIL CHIP 100BCS-182 1.8 μ H	R151	3250809	RES CHIP 220 OHM 5% 1/10W
L130	3526105	COIL CHIP 100BCS-182 1.8 μ H	R152	3250806	RES CHIP 22 OHM 5% 1/10W
L131	3524070	COIL AXIAL 1-1/2T 14.6 nH	R153	3250828	RES CHIP 4.7 K 5% 1/10W
L132	2510089	INDUCTOR TOROID	R154	3250831	RES CHIP 10 K 5% 1/10W
P100	3280726	P.C. CONNECTOR 6 PIN	R155	3250807	RES CHIP 330 OHM 5% 1/10W
Q101	3030283	TRANSISTOR 3SK179	R156	3250803	RES CHIP 47 OHM 5% 1/10W
Q102	3030507	TRANSISTOR 2SK192	R157	3250791	RES CHIP 200 OHM 5% 1/10W
Q103	3030507	TRANSISTOR 2SK192	R158	3250847	RES CHIP 27 K 5% 1/10W
Q104	3030507	TRANSISTOR 2SK192	R160	3250825	RES CHIP 2.7 K 5% 1/10W
Q105	3030507	TRANSISTOR 2SK192	R161	3250828	RES CHIP 4.7 K 5% 1/10W
Q106	3030283	TRANSISTOR 3SK179	R162	3250825	RES CHIP 2.7 K 5% 1/10W
Q107	3030302	TRANSISTOR BFR91A	R163	3250828	RES CHIP 4.7 K 5% 1/10W
Q108	3036011	MMBT3904	R164	3250837	RES CHIP 22 K 5% 1/10W
Q109	3036011	MMBT3904	R165	3250810	RES CHIP 100 OHM 5% 1/10W
Q110	3030302	TRANSISTOR BFR91A	R166	3250810	RES CHIP 100 OHM 5% 1/10W
R101	3250828	RES CHIP 4.7 K 5% 1/10W	R167	3250837	RES CHIP 22 K 5% 1/10W
R102	3250810	RES CHIP 100 OHM 5% 1/10W	R168	3250837	RES CHIP 22 K 5% 1/10W
R103	3250846	RES CHIP 100 K 5% 1/10W	R169	3250810	RES CHIP 100 OHM 5% 1/10W
R104	3250845	RES CHIP 56 K 5% 1/10W	R170	3250810	RES CHIP 100 OHM 5% 1/10W
R105	3250806	RES CHIP 22 OHM 5% 1/10W	R171	3250837	RES CHIP 22 K 5% 1/10W
R106	3250845	RES CHIP 56 K 5% 1/10W	R172	3250791	RES CHIP 200 OHM 5% 1/10W
R107	3250811	RES CHIP 33 OHM 5% 1/10W	R173	3250792	RES CHIP 430 OHM 5% 1/10W
R108	3250835	RES CHIP 8.2 K 5% 1/10W	R174	3250792	RES CHIP 430 OHM 5% 1/10W
R109	3250824	RES CHIP 3.3 K 5% 1/10W	R175	3250844	RES CHIP 68 K 5% 1/10W
R110	3250825	RES CHIP 2.7 K 5% 1/10W	R176	3250792	RES CHIP 430 OHM 5% 1/10W
R111	3250825	RES CHIP 2.7 K 5% 1/10W	R177	3250792	RES CHIP 430 OHM 5% 1/10W
R112	3250821	RES CHIP 1.1 K 5% 1/10W	R178	3250812	RES CHIP 150 OHM 5% 1/10W
R113	3250803	RES CHIP 47 OHM 5% 1/10W	R179	3250812	RES CHIP 150 OHM 5% 1/10W
R114	3250838	RES CHIP 33 K 5% 1/10W	R180	3250810	RES CHIP 100 OHM 5% 1/10W
R115	3250838	RES CHIP 33 K 5% 1/10W	R181	3250810	RES CHIP 100 OHM 5% 1/10W
R116	3250838	RES CHIP 33 K 5% 1/10W	R182	3250812	RES CHIP 150 OHM 5% 1/10W
R117	3250838	RES CHIP 33 K 5% 1/10W	R183	3250793	RES CHIP 620 OHM 5% 1/10W
R118	3250850	RES CHIP 150 K 5% 1/10W	R184	3250812	RES CHIP 150 OHM 5% 1/8W
R119	3250850	RES CHIP 150 K 5% 1/10W	R185	3250799	RES CHIP 39 OHM 5% 1/8W
R120	3250850	RES CHIP 150 K 5% 1/10W	R186	3250812	RES CHIP 150 OHM 5% 1/10W
R121	3250850	RES CHIP 150 K 5% 1/10W	R187	3250810	RES CHIP 100 OHM 5% 1/10W
R122	3250812	RES CHIP 150 OHM 5% 1/10W	R188	3250810	RES CHIP 100 OHM 5% 1/10W
R123	3250850	RES CHIP 150 K 5% 1/10W	R189	3250812	RES CHIP 150 OHM 5% 1/10W
R124	3250850	RES CHIP 150 K 5% 1/10W	R190	3250831	RES CHIP 10K 5% 1/10W
R125	3250850	RES CHIP 150 K 5% 1/10W	R191	3250791	RES CHIP 200 OHM 5% 1/10W
R126	3250850	RES CHIP 150 K 5% 1/10W	R192	3250919	RES CHIP 0 OHM 5% 1/10W
R127	3250815	RES CHIP 270 OHM 5% 1/10W			
R128	3250803	RES CHIP 47 OHM 5% 1/10W			
R129	3250803	RES CHIP 47 OHM 5% 1/10W			
R130	3250803	RES CHIP 47 OHM 5% 1/10W			
R131	3250842	RES CHIP 47 K 5% 1/10W			
R132	3250842	RES CHIP 47 K 5% 1/10W			
R133	3250803	RES CHIP 47 OHM 5% 1/10W			
R134	3250803	RES CHIP 47 OHM 5% 1/10W			
R135	3250803	RES CHIP 47 OHM 5% 1/10W			
R136	3250803	RES CHIP 47 OHM 5% 1/10W			

VHF Converter Board Parts List cont'd. 83

REFERENCE	PART NUMBER	DESCRIPTION
T101	2510100	INDUCTOR TOROID
T102	2510100	INDUCTOR TOROID
T103	2510087	INDUCTOR TOROID
T104	2510087	INDUCTOR TOROID
T105	2510087	INDUCTOR TOROID
T106	2510087	INDUCTOR TOROID
T107	2510093	INDUCTOR TOROID
T108	2510093	INDUCTOR TOROID
T109	2510093	INDUCTOR TOROID
T110	2510093	INDUCTOR TOROID
TP1	3280722	CONN P.C. JST #T2B-SQ-1
TP2	3280722	CONN P.C. JST #T2B-SQ-1
U101	3040169	I.C. LPC662AIN
U102	3045012	I.C. MB1504
U103	3040018	I.C. 74HC595N
U104	3040016	I.C. 74HC14
U105	3040018	I.C. 74HC595N
U106	3040169	I.C. LPC662AIN
CR101	3026301	15V229
CR102	3026301	15V229
CR103	3026301	15V229
CR104	3026301	15V229
CR105	3026007	MMB25231 LT1
CR106	3020335	DIODE 1S2186
CR107	3020335	DIODE 1S2186
CR108	3020335	DIODE 1S2186
CR109	3020335	DIODE 1S2186
CR110	3026101	MMB25235 6.8V
CR111	3026007	MMB25231 LT1
CR112	3026007	MMB25231 LT1
CR113	3026007	MMB25231 LT1
CR114	3024705	TT-25
CR115	3024705	TT-25
CR116	3024705	TT-25
CR117	3024705	TT-25
CR118	3026009	15S269
CR119	3026009	15S269
CR120	3026009	15S269
CR123	3026009	15S269
MX101	3045009	DBM50A
RP100	3221066	RES PACK #BLA8-154F R2R 8-BIT
VR101	3040031	I. C. 78L05-ACP
VR102	3040031	I. C. 78L05-ACP

VHF Converter Accessory cont'd. 87

VHF CONVERTER ALIGNMENT

VCO Test and Tune

1. Set the Receiver to the frequency listed in Table 1.
2. Probe pin 1 of U101A with a DVM set to measure voltage.

3. For VCO1 and VCO2 adjustment is not necessary, however, the voltage should be checked to assure that the loop is in lock.

4. VCO3 and VCO4 should be adjusted at the high end of their tuning range, then checked at the lower end for proper control voltage.

5. Proceed with tuning per Table 1.

RECEIVER FREQUENCY (MHz)	(VOM READING) ERROR	EXECUTE STEPS IN THIS ORDER	ACTION REQUIRED
VCO 1 45	4.0 ± 2.0 V	1	Check voltage at pin 1.
VCO 2 115	4.0 ± 2.0 V	2	Check voltage at pin 1.
VCO 3 145	8.0 ± 0.1 V	3	Tune L103 for desired voltage at pin 1.
VCO 4 132	3.2 ± 0.5 V	4	Check voltage at pin 1.
VCO 5 168	8.0 ± 0.1 V	5	Tune L104 for desired voltage at pin 1.
VCO 6 157	3.0 ± 0.5 V	6	Check voltage at pin 1.

Table 1

Preselector Tuning and Checks

A. Low Band (35 - 54 MHz)

1. Connect a Spectrum Analyzer and Tracking Generator to the VHF Converter so that the Tracking Generator output connects to the Converter Antenna input jack (J-103) and the Spectrum Analyzer input connects to pin 1 of mixer MX101. (See Figure 3).

- (a) Tracking Generator level should be no higher than -30 dBm.
- (b) Spectrum Analyzer settings should be as follows:

Bandwidth	=	300 kHz
Scan Width	=	5 MHz/Division - Low Band
	=	10 MHz/Division - High Band
Input Atten	=	10 dB
Center Freq	=	45 MHz
Scan Time	=	2 msec
Log Ref	=	0 dBm

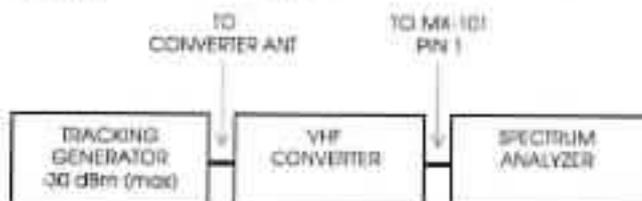


Figure 3

2. Set the Receiver to a test frequency 45 MHz. Now the low band filters will be selected and their frequency response displayed on the analyzer.

3. Adjust the trimmer caps (C199 & C200) in the two low band filters until the desired response is achieved (as shown in Figure 4).

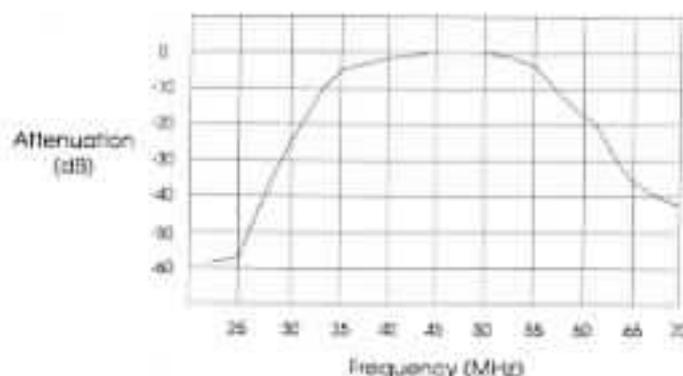


Figure 4 Low-Band FILTER RESPONSE

88 VHF Converter Accessory cont'd.

B. High Band (108 - 174 MHz)

1. Leave equipment connected as in Low Band Tuning procedure.
2. Set the Receiver to 168 MHz. Now the high band filters will be selected and their frequency response displayed on the analyzer.
3. Adjust the Trimmer caps in the two high band filters (C-182 and C-184) until the filter displays the desired response (as shown in Figure 5).

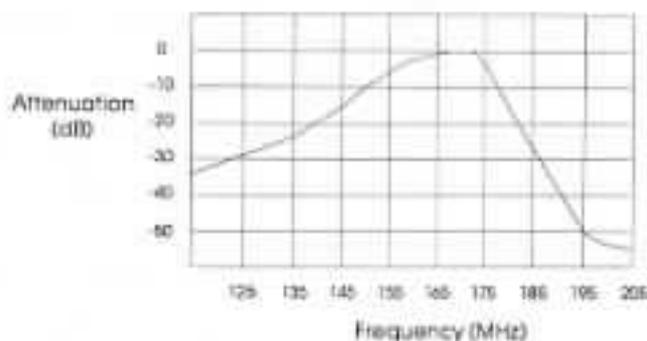


Figure 5 High-Band FILTER RESPONSE

4. Set the Receiver to 108 MHz and observe the filter response. It should be optimum without further adjustment.

Sensitivity and Microphonics Test

1. Install the converter into the Receiver. This must be done to eliminate electrical noise which would cause inaccurate results.
2. Measure 12dB SINAD at the following frequencies shown in the table using the setup shown in Figure 6. Make sure that the converter meets or exceeds the specification and that it is not microphonic at each frequency.

To check for microphonics, tap lightly on the VCO shield while noting that the recovered audio remains a clear 1 KHz tone.

Receiver Frequency	Sensitivity
45.123 MHz	Better than 12 dB SINAD
115.234 MHz	
132.345 MHz	
145.456 MHz	
157.567 MHz	
168.678 MHz	

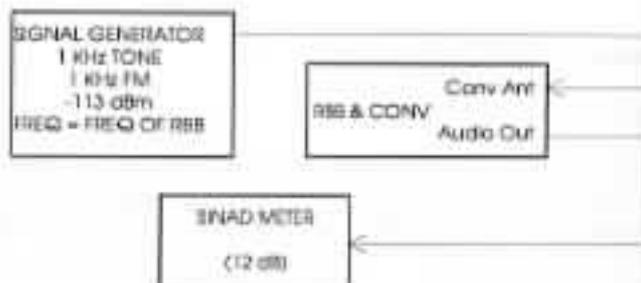


Figure 6 Sensitivity Test

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