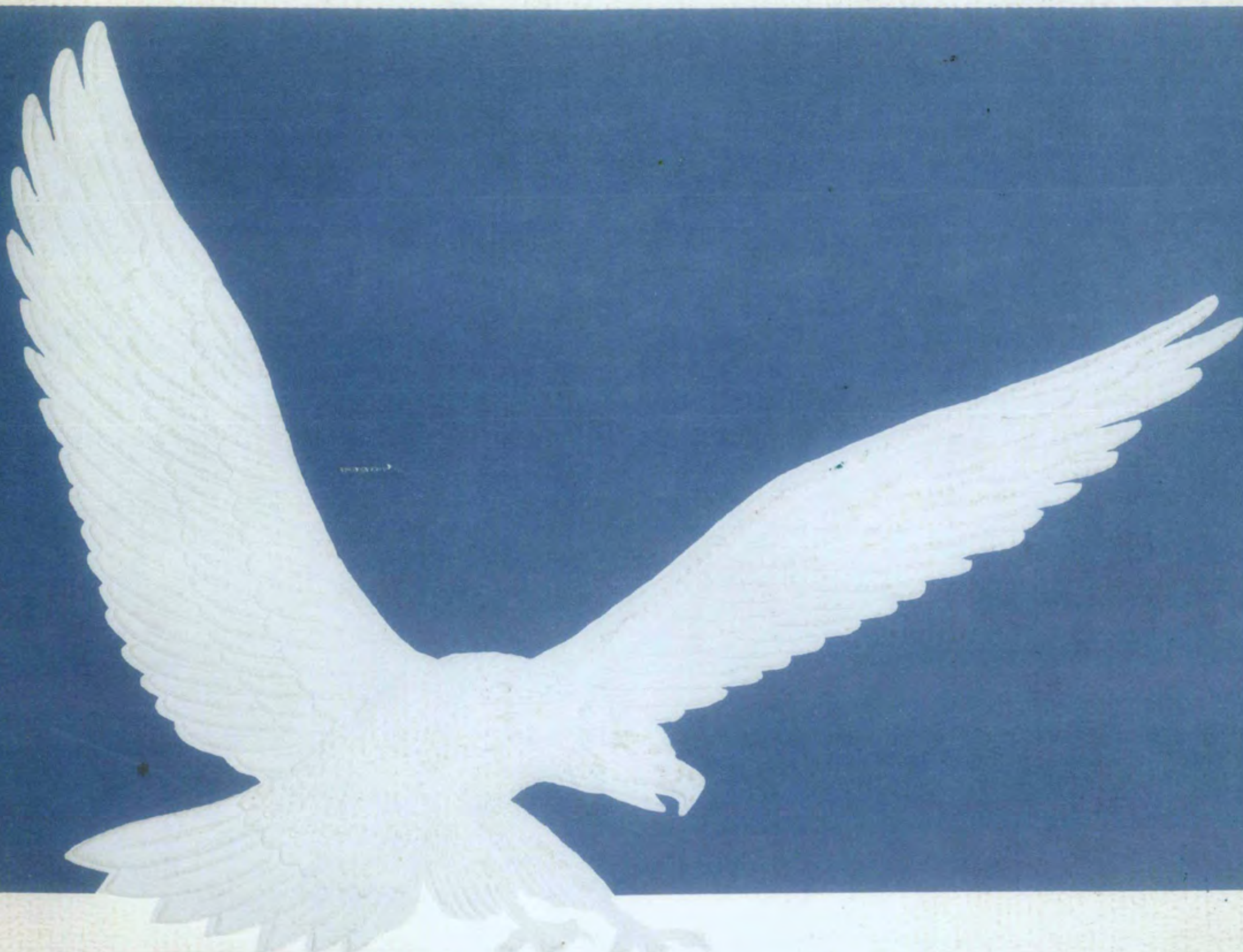

INSTRUCTION MANUAL

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MODEL TU-74-SA
2200-2300 MHz RF TUNER

DEI

PRODUCERS OF NEMS CLARKE EQUIPMENT

INSTRUCTION MANUAL

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MODEL TU-74-SA
2200-2300 MHz RF TUNER

March 1970

Defense Electronics
PRODUCERS OF
DEI AND NEMS-CLARKE
EQUIPMENT
DIVISION OF DEI INDUSTRIES
Rockville, Maryland 20854

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Figure 1-1. Model TU-74-SA RF Tuner

SECTION I
GENERAL DESCRIPTION

The Model TU-74-SA RF Tuner is designed for use with the Model TMR-74 Telemetry Receiver. It is a front-panel plug-in module that provides reception of signals in the 2200-2300 MHz frequency range.

Front-panel pushbutton switches allow selection of three modes of operation; variable frequency oscillator, crystal oscillator, or external oscillator. A front-panel tuning control and frequency dial allow precise tuning over the entire frequency range.

A model CO-65 proportional oven containing an X-65 crystal plugs into the front panel of the rf tuner for crystal oscillator operation. Also available is a CA-74 crystal adapter which utilizes an X-52 crystal without oven.

The rf tuner provides a 55 MHz first i-f output, a spectrum display unit output, and a first l-o monitor output.

The electrical and mechanical specifications for the rf tuner are given in table 1-1 and the transistor complement is given in table 1-2. A functional block diagram is shown in figure 4-1.

Table 1-1. Specifications

Input Impedance	50 ohms, nominal.
Noise Figure	10 dB maximum.
Dynamic Range	noise threshold to -7 dBm.
Bandwidth	6 MHz.
IF Output Frequency	55 MHz.
Rejection and Emission:	
Image Rejection	80 dB minimum.
IF Rejection	90 dB minimum.
EMC	certified compliant to MIL-STD-461.
LO Conducted to Antenna	-73 dBm maximum.
First Local Oscillator:	
Modes	crystal, VFO, external.

continued

Table 1-1, continued

First Local Oscillator, continued	
Stability - VFO	±0.001%/°C.
- Crystal	±0.005% without oven; ±0.0005% with oven (proportional type).
First LO Output	-7 dBm into 50 ohms at submultiple of mixer injection frequency.
First LO Input	-13 dBm into 50 ohms at submultiple of mixer injection frequency (see page 3-1).
Mixer Injection Frequency	55 MHz above rf input.
Size	4-29/32" high by 4-5/8" wide by 16-21/32" deep overall.

Table 1-2. Transistor Complement

Chassis	Reference Designation	Type	Function
Mixer, A3	CR1 CR2	HP 5082-2401	Mixer
IF Preamplifier/ AGC, A4	A1Q1	3N159	Amplifier
	A1Q2	2N3933	Amplifier
	A2A1	LM-301A	AGC Shaper
	A2Q1	2N2218	AGC Shaper
Diode Multiplier, A6	Q1	2N3933	Amplifier
	Q2	2N3866	Amplifier
	CR1	5082-0152	X6 Frequency
X4 Multiplier, A8	Q1	2N3933	Frequency Doubler
	Q2	2N3933	Frequency Doubler
VFO Assembly, A9	A1Q1	2N708	VFO Amplifier
	A1Q2	2N3933	VFO
	A1Q3	2N4919	Series Current Regulator
	A3Q2	2N2270	Series Current Regulator
	A2Z1	LM-301A	Voltage Regulator
	A2Q1	2N2270	Voltage Regulator
	A2Q2	2N5089	Buffer Amplifier
	A3Z1	CA-3028A	Differential Amplifier
	A3Q1	2N3251	Amplifier

continued

Table 1-2, continued

Chassis	Reference Designation	Type	Function
Oscillator/Combiner Assembly, A10	A1Q1	2N708	Crystal Oscillator
	A1Q2	2N3933	Frequency Doubler
	A1Q3	2N3933	XTAL Oscillator Output
	A1Q4	2N3933	External LO Output
	A1Q5	2N3933	VFO Output
	A2Z1	CA-3028A	Differential Amplifier
	A2Q1	2N3251	Amplifier
	A2Q2	2N2270	Series Current Regulator
	A2Q3	2N4919	Series Current Regulator

SECTION II
PREPARATION FOR USE

2.1 GENERAL

The Model TU-74-SA RF Tuner is shipped fully assembled, with all internal subassemblies installed, and in operating condition. Consequently, preparation for use procedures are reduced essentially to checks of the physical condition of the equipment, and a referenced performance check. Also discussed in this section are mechanical installation data and crystal oven installation.

2.2 UNPACKING AND INSPECTION

The following checks should be made upon unpacking the rf tuner:

a. Check for any mechanical damage to the chassis.

b. Check the connectors on the rear of the chassis, examining them for loose or damaged pins.

c. Check the front panel of the tuner for damage to knobs, pushbuttons, and the tuning dial.

d. Operate the controls examining them for looseness.

2.3 INSTALLATION

The rf tuner is a plug-in module to the TMR-74 telemetry receiver. All electrical connections are made through a type N coaxial connector and a multipin (with coaxial inserts) connector on the rear of the module. There are no cables to connect during installation or to disconnect during removal.

To install the rf tuner, insert it through the opening on the right side of the receiver until the front panel is flush against the front panel of the receiver. Tighten the two adjustable fasteners on the front panel of the tuner. To remove the module, unscrew the two fasteners and slide the unit out of the receiver.

To install either the crystal oven assembly (CO-65), or the crystal adapter assembly (CA-74), insert the assembly into the opening on the front panel of the tuner until the front panel is flush against the front panel of the tuner. Tighten the adjustable fastener on the front panel of the assembly. To remove the assembly, unscrew the fastener and slide the unit out of the tuner.

An X-65 crystal plugs into the CO-65 crystal oven assembly and an X-52 crystal plugs into the CA-74 crystal adapter assembly. The received frequency may be written on the strip provided on the front panel of the assembly with any pen or magic marker. (Refer to Section III, Operation, for crystal frequency/signal frequency formula.)

2.4 PERFORMANCE CHECK

When installation is completed, it is suggested that the performance of the rf tuner be checked using the procedures given in Section V of the Receiver Instruction Manual.

SECTION III
OPERATION

The complete and meaningful operating procedure for the rf tuner, including all controls and indicators thereon, is an integral part of the operating procedure for a functioning receiver given in Section III of the receiver instruction manual. For this reason, only general operating information is given in this instruction manual.

The operating controls and indicators of the rf tuner are all located on the front panel. These controls and indicators, and their functions are given below.

FIRST LO MODE	Pushbutton switches select the mode of operation for the first local oscillator; XTAL, VFO, or EXT.
TUNING	Control used to tune the rf preselector in all modes and the variable frequency oscillator in the VFO mode.
Frequency Dial	Tape dial indicates tuned frequency.

The crystal oven socket on the front panel is provided for a model CO-65 proportional oven containing an X-65 crystal. If desired, a CA-74 crystal adapter, which holds an X-52 crystal without oven, may be used.

For crystal-controlled operation, depress the XTAL switch and adjust the TUNING control for the desired frequency as viewed on the Frequency Dial. Then insert the crystal oven, containing a crystal of the proper type and frequency, into the crystal oven socket. Crystal frequency is determined by the following formula:

$$f_c = \frac{f_r + 55}{48}$$

where: f_c = crystal frequency

f_r = signal frequency

For vfo operation, depress the VFO switch and adjust the TUNING control for the proper frequency, as viewed on the frequency dial. The TUNING meter of the receiver is utilized for precise tuning and indication of the received signal.

For external oscillator operation, depress the EXT switch and connect the external oscillator source to the proper rear apron connector of the receiver. (Refer to table 1-1, Specifications, for proper signal level and frequency.) Then tune the receiver as in the vfo mode.

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL

The TU-74-SA rf tuner accepts an rf input signal in the 2200-2300 MHz frequency range, and provides a 55 MHz first i-f output signal for the receiver. It also provides a 55 MHz output for application to a spectrum display unit and an l-o output at one twenty-fourth the local oscillator injection frequency for monitoring purposes. The output amplifier circuitry of the tuner is gain controlled by receiver agc. Three modes of operation are featured; crystal oscillator, vfo, or external oscillator. A block diagram of the rf tuner is shown in figure 4-1 and the main chassis schematic diagram is shown in figure 7-2.

The rf input signal at J1 is applied through a preselector assembly, A1, which is a four-pole tunable cavity filter. The preselector provides a maximally flat type response with a bandwidth of approximately 15 MHz, giving greater than 80 dB of attenuation to the image frequency. The tunable cavity filter is gear driven by the front panel tuning knob. The output of A1 is applied through isolator A2 to the rf input of the first mixer, A3J1.

Mixer A3 is a 90° hybrid balanced mixer utilizing strip-line techniques in its construction. The mixer comprises a 3 dB square 90° hybrid coupler, a pair of HPA hot-carrier diodes, and a low pass output filter (see figure 7-1). The l-o signal, applied to the mixer at J2, is 55 MHz above the received rf frequency which results in a 55 MHz first i-f output signal at J3. The output of the mixer is coupled via A4W1 to the i-f preamplifier/agc assembly, A4, which is a low-noise, medium-gain i-f amplifier module.

Subassembly A4 contains an i-f preamplifier and an agc shaping amplifier. The i-f preamplifier provides the proper interface between the mixer output and the i-f output of the tuner, containing the necessary tuned circuits and amplifiers to give a bandwidth of 6 MHz with an overall tuner transfer gain of 17 dB. The 55 MHz i-f output of A4 is coupled by A4W2 to J2A1 on the rear apron of the tuner. A sample of the i-f output is coupled by A4W3 to J2A2 as the SDU output of the tuner.

The receiver agc input at J2-7 is applied to the agc shaping amplifier of A4. The agc shaping amplifier pre-shapes the linear receiver agc signal for application to the gate 2 of the FET i-f preamplifier input stage to provide logarithmic gain control of the i-f preamplifier.

The front-panel first l-o mode switch assembly, S1-A, S1-B, and S1-C, determines which oscillator signal will be applied to the multiplier chain, A5 through A8, and hence to the first mixer, A3. This is done by applying a -15V operating voltage to the applicable oscillator circuitry. The other two oscillator circuits remain inoperative.

Switch S1-A (XTAL) applies the -15V operating voltage to the crystal oscillator and the crystal oscillator-doubler, both contained in A10, the oscillator/combiner assembly. The frequency-determining element is the crystal utilized in the front-panel plug-in crystal oven or crystal adapter assembly. The crystal oscillator output signal (47-49 MHz) is frequency doubled and then applied through the combiner to A10W3 which couples it to A8J1 of the X4 multiplier assembly, the input of the multiplier chain.

Switch S1-B (VFO) applies the -15V operating voltage to the VFO oscillator in the VFO assembly, A9, and to the vfo output amplifier in A10. The vfo signal from A9 at 94-98 MHz is amplified by the vfo amplifier in A10 and applied to the combiner in the same manner as the crystal oscillator signal. The vfo is a free-running voltage-variable capacitance-diode-tuned lc oscillator. The tuning voltage is derived from a reference voltage supply and is controlled by potentiometer R1 which is driven by the tuning gear train. Resistors R2 and R3 in series with R1 are factory selected to provide precise control of the oscillator over its entire tuning range.

Switch S1-C (EXT) applies the +15V operating voltage to the external l-o amplifier in A10. The external l-o input signal at J2A4 is then amplified and applied to the combiner for application to the multiplier chain. A sample of the combiner output is coupled by A10W4 to J2A5 as a sample of the l-o output at 1/10 the l-o injection frequency.

The multiplier chain consists of a broadband-tuned X4 multiplier assembly, A8, a bandpass filter, A7, a broadband-tuned X6 diode multiplier assembly, A6, and another bandpass filter, A5. The l-o input to A8, in the frequency range of 94-98 MHz, is multiplied times four to produce an output in the frequency range of 375-390 MHz. This signal is then applied through bandpass filter A7. The output of A7 is amplified and multiplied times six by diode multiplier A6. The output of A6, in the frequency range of 2255-2355 MHz, is applied through the final bandpass filter, A5, to the l-o injection input of the mixer, A3J2.

A crystal oven temperature regulator circuit is located in the oscillator/combiner assembly, A10. It operates from the output signal of a thermistor, located in the front-panel plug-in crystal oven assembly. The output of this regulator varies the voltage applied to the oven heater to provide a constant temperature for the plug-in crystal utilized by the crystal oscillator.

4.2 IF PREAMPLIFIER/AGC (Refer to Figure 7-4)

The 55 MHz input signal coupled in through W1 is applied to the signal input circuit of A1Q1, the primary of tuned transformer, A1T1. A1Q1 is a dual-gate MOS-FET with a 55 MHz signal applied to gate 1 and a pre-shaped agc signal applied to gate 2. Agc is derived from agc shaping amplifier, A2, which pre-shapes the linear receiver to provide low noise gain control of A1Q1 by applying a logarithmic agc signal to gate 2.

The output of A1Q1 is direct-coupled to amplifier A1Q2, a bi-polar transistor connected in a grounded base configuration. A1Q2 features high overload capabilities as well as high gain. The output circuit of A1Q2 is a double-tuned inductance-coupled bandpass filter (A1C6-A1L1-A1L2-A1L3-A1C8-A1C9) that establishes the 6 MHz bandwidth of the i-f preamplifier. In addition to performing the bandpass selectivity function, the output network also satisfies the requirement of an impedance matching network with its parallel-tuned-primary and series-tuned-secondary configuration.

The 55 MHz output signal is coupled by W2 to J2A1 on the rear apron of the tuner as the i-f output of the rf tuner. A sample of the output is taken from voltage divider A1R8-A1R9 and coupled by W3 to J2A2 on the rear apron of the tuner as the SDU output.

The receiver agc signal input at C1 is applied to operational amplifier A2A1. Potentiometer A2R2, in conjunction with A2CR1, sets the diode break point of the agc input signal to effect the proper slope change at the input to A2A1. The output of A2A1 is applied to buffer amplifier A2Q1 whose output is applied to gate 2 of A1Q1 of the i-f preamplifier. Potentiometer A2R6 is the feedback loop adjustment used to set the agc slope. Potentiometer A2R4 operates as the agc threshold adjustment by controlling the current injection of the feedback loop.

4.3 VFO ASSEMBLY (Refer to Figure 7-5)

The vfo assembly, A9, comprises three separate subassemblies; the vfo inner box, A1, the shaper/regulator board, A2 (which is actually mounted in the inner box), and the temperature regulator board, A3.

The vfo inner box, A1, contains the variable frequency oscillator, A1Q2, which is connected in a modified Colpitts type configuration. A1Q2 is a free-running voltage-variable capacitance-diode-tuned lc oscillator. The voltage-variable tuning element is varactor diode A1CR2. The voltage control is derived from tuning-gear-driven potentiometer R1 on the main chassis. The voltage control from R1 is pre-shaped in the A2 subassembly to counteract the nonlinear capacitance-versus-voltage characteristics of A1CR2. Variable capacitors A1C3 and A1C7 are used for alignment of the oscillator. Forward-biased diode A1CR1, connected across the tank circuit, provides temperature compensation.

The oscillator signal is applied through buffer amplifier A1Q1 to J1 as the vfo output signal of the vfo assembly. A1C8 tunes the input circuit of A1Q1.

The vfo inner box is wrapped in a heater winding, A1HR1 to increase oscillator stability by placing the vfo in a proportional controlled oven. Thermistor A1RT1 is connected to one input of differential amplifier A3Z1 which is connected in a balanced bridge configuration. Zener diode A3CR1 provides a reference level at the input to the differential amplifier. Any change in temperature in the vfo inner box thus produces a corresponding output signal from A3Z1. This signal is amplified by A3Q1 and applied to current regulator A3Q2-A1Q3 connected in series with the heater winding. The loop is thus closed, providing current control of heater winding A1HR1 by the thermistor A1RT1 and the temperature regulator circuit A3.

A fail-safe feature is provided to turn off the vfo heater if anything in the oven control circuitry fails. This feature is a snap-action thermostat, A1S1, connected in series with the heater winding to open the circuit if the temperature in the vfo inner box becomes too high.

The voltage regulator and the shaping network for the vfo tuning voltage are contained on the shaper regulator board, A2. The regulator circuit is connected across the -15V and +15V supply feeding the vfo assembly. Operational amplifier A2Z1 and buffer amplifier A2Q1 are connected in a closed loop feedback arrangement and zener diode A2CR1 sets the reference level of the operational amplifier. The output of the regulator, taken from the emitter of A2Q1, is a well-regulated +24.5V coupled to C5 as the vfo reference voltage. This reference voltage is utilized in the vfo circuits of A1 and by the control voltage shaping network of A2.

The tuning voltage from the wiper of R1 on the main chassis is applied to buffer amplifier A2Q2 which drives the diode shaping network A2CR2, A2CR3, A2CR4. This voltage divider network, containing three diode breakpoints, bend the tuning voltage ramp to provide the pre-shaped control voltage required by the varactor-tuned vfo. The output of the shaping network is coupled from A2E5 to A1C5 in the vfo circuit.

4.4 OSCILLATOR/COMBINER ASSEMBLY (Refer to Figure 7-7)

The oscillator/combiner assembly, A10 comprises two subassemblies, the oscillator/combiner board, A1, and the crystal oven temperature regulator board, A2.

The oscillator/combiner board, A1, contains the crystal oscillator/doubler circuits and the combiner/bandpass filter circuits. The crystal oscillator, A1Q1, is a modified Colpitts configuration with the crystal in the plug-in front panel crystal oven/adapter assembly as the frequency determining element. The broadband crystal oscillator operates at one forty-eighth the l-o injection frequency, with variable capacitor A1C3 as the tuning elements. The output of A1Q1 is applied to common emitter amplifier, A1Q2. The output circuit of A1Q2 is a double-tuned network tuned to twice the frequency as the input, or one twenty-fourth the l-o injection frequency. This signal is applied to the input of amplifier A1Q3.

The combiner network consists of three common-emitter amplifiers, A1Q3, A1Q4, and A1Q5 whose collectors are tied together, feeding a common bandpass output filter.

A1Q3 is the crystal oscillator output amplifier, and is switched on by the application of -15V switching voltage; A1Q1 and A1Q2 are also operated from this line. A1Q5 is the vfo output amplifier and with the application of -15V(s), it amplifies the vfo input signal coupled in through W2 and applies this signal to the bandpass output filter. A1Q4 is the external oscillator output amplifier and with the application of -15V(s), it amplifies the external oscillator signal coupled in through W1 and applies this signal to the bandpass output filter. Diodes CR1 through CR4 are utilized to ensure that no external signal leakage occurs when the -15V(s) is removed from Q4.

The switching voltage is derived from the first l-o mode switch of the tuner and only one of the three oscillator circuits on the oscillator/combiner board, A1, can operate at one time. The output of the bandpass filter is coupled through W3 to the multiplier chain as the l-o drive output signal.

The crystal oven temperature regulator board, A2, provides proportional control of the crystal oven heater in the front-panel crystal oven assembly. It accomplishes this function by controlling a current amplifier in series with the oven heater connected across the +20V and -20V lines. The control signal is derived from a negative temperature coefficient resistor (thermistor) in the front panel oven assembly.

The thermistor is connected through J1-8 to the control input of integrated-circuit differential amplifier, A2Z1. Zener diode A2CR1 is used to set the reference level of the input circuit. As the instantaneous temperature of the oven varies, the resistance of the thermistor varies, and A2Z1, configured as a balanced bridge, provides an output signal proportional to the change in the resistance of the thermistor. This signal is amplified by A2Q1 which drives the current amplifier A2Q2-A2Q3 which controls the current flow through the oven heater connected across J1-6 and J1-7. For example, as the temperature rises, the resistance of the negative temperature coefficient resistor (thermistor) decreases and the current through the oven heater decreases, lowering the oven temperature. Thus, true proportional control of the oven temperature is achieved.

4.5 X4 MULTIPLIER ASSEMBLY (Refer to Figure 7-8)

The oscillator input signal in the frequency range of 94-98 MHz at J1 is applied to Q1, connected in a common-emitter configuration. The output circuit of Q1 is a double-tuned circuit, L1-C5 and L2-C7, tuned to twice the frequency of the input signal. This signal is then applied through the second common-emitter stage, Q2, which has a single-tuned output circuit, L3-C11, again tuned to twice its input frequency. This signal, 375-390 MHz, is coupled through J2 to a bandpass filter whose input circuit becomes part of the tuned load into which Q2 operates.

4.6 DIODE MULTIPLIER ASSEMBLY (Refer to Figure 7-9)

The 375-390 MHz signal at J1 is amplified by limiting amplifier Q1 and applied through the double-tuned output circuit (L1, C5, C8) to power amplifier Q2. The output of power amplifier Q2 is applied to a broadband bandpass matching network, L2 through R8, which matches the input impedance of varactor diode CR1 to the output of the power amplifier. The 375-390 MHz signal is then applied to varactor diode multiplier, CR1. Tuned circuit C14-C15 provides a low impedance path for harmonic currents and inductor L5 provides a low impedance path at the fundamental frequency. Tuned circuit L5-C16 is tuned to 2255-2355 MHz, which is X6 the fundamental frequency. This signal is coupled through J2 to a tuned bandpass filter in the tuner which becomes part of the tuned load into which the diode multiplier operates.

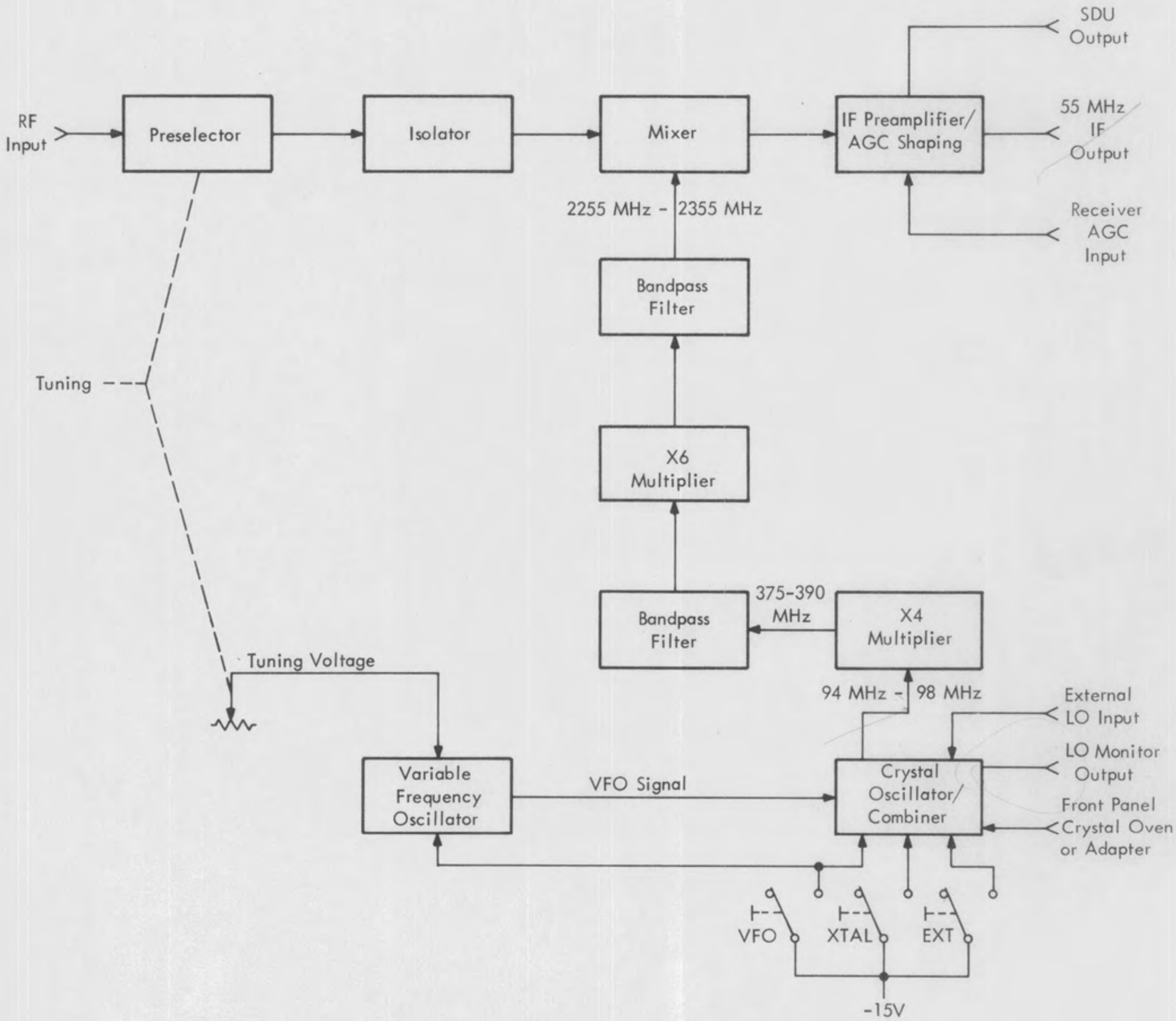


Figure 4-1. Model TU-74-SA RF Tuner, Block Diagram

SECTION V
MAINTENANCE

5.1 GENERAL

The Model TU-74-SA RF Tuner is designed to give long and troublefree performance with a minimum of maintenance. During normal operation, no periodic adjustments are required; unnecessary adjustments should be avoided as they may degrade the performance of the unit. The TU-74-SA should be kept clean, relatively dustfree, and in good mechanical condition. Lubrication is not required and should be avoided as damage to the unit could result.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of both physical and electrical checks, which are designed to detect and prevent physical and performance deterioration. These checks are usually conducted at regular intervals.

Physical Checks

The regularly scheduled physical checks (weekly, monthly, or quarterly, as dictated by environmental conditions and the station preventive maintenance program) consist of blowing out the dust from the interior of the unit using low pressure air and making a visual inspection checking:

a. Resistors for blistering, discoloration, and other evidence of overheating.

b. Wiring for cut, cracked, or frayed insulation.

c. Machine screws and nuts for looseness.

d. Rear apron connectors for corrosion and loose connections.

e. Finish for scratches and bare spots.

Burned or discolored resistors and defective wiring should be replaced. When plugs or wiring have been replaced, refer to the schematic diagrams to ensure that the proper connections have been made. Bare spots and scratches should be covered using an available touch-up paint.

Performance Checks

It is recommended that the performance checks be conducted: 1) when the unit is installed; 2) prior to any major operational run; 3) as a semiannual preventive maintenance check; 4) after any major repair, realignment, or replacement of the subassemblies or components.

Since any valid performance checks must be performed in an operating TMR-74 receiver, the performance checks for the TU-74-SA are included as an integral part of the performance checks for the overall receiver. Refer to paragraph 5.2.2 of the TMR-74 receiver instruction manual for details.

5.3 CORRECTIVE MAINTENANCE

The corrective maintenance for the TU-74-SA consists of troubleshooting, repair and replacement, and alignment. These are given in paragraphs 5.3.1, 5.3.2, and 5.3.3.

5.3.1 TROUBLESHOOTING

Troubleshooting should be based upon the performance of the equipment. The principles of operation, block diagram, and schematic diagrams given in this instruction manual should provide the data necessary for a trained maintenance technician to isolate the malfunction. If troubleshooting procedures for the receiver (as listed in Section V of the appropriate instruction manual) indicate that the rf tuner is inoperative or operating improperly, the cause should be isolated within the rf tuner by applying logical effect-to-cause reasoning.

Isolating the trouble to a module level can be accomplished quite easily in this all-modularized unit. Referring to the block diagram, figure 4-1 and the module location drawing, figure 5-1, it can be seen that the rf tuner has been modularized on a functional level. Add to this the fact that all internal signal coupling is accomplished with coaxial cables, all using SMA connectors, and the trouble isolating procedure becomes quite easy.

For example, the input to the tuner is normal, the voltages applied to J1 are normal, however there is no i-f or sdu output at J2-A1 and J2-A2. It is a simple matter to check the 55 MHz input to the preamplifier, A4 by merely disconnecting A4W1 from the mixer at A3J3. If no signal is available at that point, the l-o drive can be checked at A3J2; if none, the l-o monitor output can be checked at J2A5 to determine if the oscillators and combiner are operating. If they are, the fault must be in the multiplier chain which is located, as a functional group, under the top dust cover of the unit. Checking each input and output will then quickly isolate the defective subassembly.

Normal signal tracing techniques should be used to isolate the malfunction to the defective stage.

5.3.2 REPAIR AND REPLACEMENT

The rf tuner has been designed with a goal toward achieving ease and speed of maintenance. The disassembly and assembly of the unit should pose no problem to servicing personnel. All components are considered nonrepairable and should be replaced when defective. The replaceable components are listed in Section VI.

Access to the tuner circuitry is gained by removing the two side dust covers and then the top dust cover. Each side cover is held in place by nine Phillips head machine screws while the top cover is held in place by four of the same type screws. The multiplier chain (A5, A6, A7, and A8) is mounted to the bottom of the top cover, while the remaining assemblies and circuitry are mounted to the main chassis.

The following is a list of the assemblies and the manner in which each is secured. (Refer to figure 5-1.)

A6, X6 multiplier - secured to top cover with two Phillips head machine screws.
A8, X4 multiplier - secured to top cover with two Phillips head machine screws.
A5, bandpass filter - held in place between A6 and A8 by connecting coaxial cables.
A7, bandpass filter - held in place between A6 and A8 by connecting coaxial cables.

A1, Preselector - secured to bottom of chassis with three Phillips head machine screws.
A2, Isolator - held in place atop A1 by coupling adapter CT1.
A3, Mixer - mounted on four metal spacers, secured to bottom of chassis by four Phillips head machine screws.
A4, IF Preamplifier/AGC - mounted on two metal legs, secured to bottom of chassis by two Phillips head machine screws.
A9, VFO Assembly - mounted to rear gear plate on four metal spacers, secured by four Phillips head machine screws.
A10, Oscillator/Combiner - mounted to bottom of chassis on two metal legs, secured by two Phillips head machine screws; also secured to rear gear plate by one Phillips head machine screw.

Assemblies A1, A2, A3, A5, and A7 are not considered field repairable and must be replaced if found defective.

Assemblies A4, A6, A8, and A10 contain one or more pc board assemblies mounted on spacers. The top covers of these assemblies are held in place by the following number of Phillips head machine screws:

A4 - 4 screws
A6 - 7 screws
A8 - 4 screws
A10 - 6 screws

The vfo assembly, A9, is configured in a dual box arrangement as shown in figure 7-5. The top cover of the outer assembly is secured by four Phillips head machine screws. The outer assembly contains the inner box, mounted on four metal spacers, secured by four Phillips head machine screws and a pc board mounted to the side by two metal spacers and two screws. The inner box is wrapped in a heater winding; its top cover is secured by four screws. The inner box contains point-to-point circuitry and one pc board mounted on four spacers, secured by four screws.

The main chassis switches, wiring, controls, and other mechanical components are removed and replaced in a straightforward manner, readily evident to a technician when viewing the tuner; thus their replacement is not detailed in this manual. The two main chassis selectable components, R2 and R3 are mounted on a phonelic board which is mounted to the bottom of the chassis (beneath R1) on two metal spacers, secured with two Phillips head machine screws.

The plastic caps on the front panel pushbutton switches are friction fit type, i.e., they can be removed by grasping the cap firmly and sliding off.

The suggested procedure for removing components located on the printed circuit boards found in the receiver is given below; the procedure requires the use of the following material and equipment:

Liquid soldering flux	1/8 inch, #18 AWG flat braid
Liquid flux remover	Medium wattage soldering iron.

Apply a thin coat of soldering flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the solder joint for long periods of time as excess heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and pry the component loose. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover. After repairs have been made, the affected unit should be realigned following the procedure referenced in paragraph 5.3.3.

5.3.3 ALIGNMENT

Alignment procedures for the TU-74-SA include an overall adjustment procedure for the assembled tuner, and individual, independent alignment procedures for each major subassembly.

The overall adjustment procedure is given first, and is based on the premise that all individual subaseemblies of the tuner are operating normally. Alignment procedures for the subassemblies follow the overall procedure.

5.3.3.1 OVERALL ADJUSTMENTS.

Recommended Equipment:

Marker Generator	HP 608D
Sweep Generator	Jerrold 900B
Oscilloscope, with X-Y Amplifiers	HP 130C
Crystal Detector	HP 423A
50 ohm Termination	HP 908A
Directional Coupler, 2-4 GHz	HP 777D
Sweep Generator	HP 8690B/8692A
10 dB, 50 ohm Attenuator	HP 8491A Op. 10
20 dB, 50 ohm Attenuator	HP 8491A Op. 20
Step Attenuator	HP 355C
Signal Generator	HP 8614A
Spectrum Analyzer	HP 851B/8551B
Power Supplies (two)	HP 721A
Power Supply	Harrison Labs. 6205B
Test Set	Defense Electronics (TP 3979)

a. Connect the test set to the power supplies; the supply voltage leads are color-coded as follows: +20V, red and black; -20V, red-white and black; +15V, orange and black; -15V, violet and black. (Black is in all cases ground.) Set the 15V power supplies to exactly plus and minus 15V, respectively (short circuit current to 100 mA), and the 20V supply to plus and minus 20V.

b. Multiplier Adjustment.

(1) Set up equipment as shown in figure 5-2. Set controls as follows:

Oscilloscope Vertical	5 mV/cm
Oscilloscope Horizontal	as required for full trace
Sweep Generator Output	-10 dBm
Sweep Frequency	90 MHz to 102 MHz

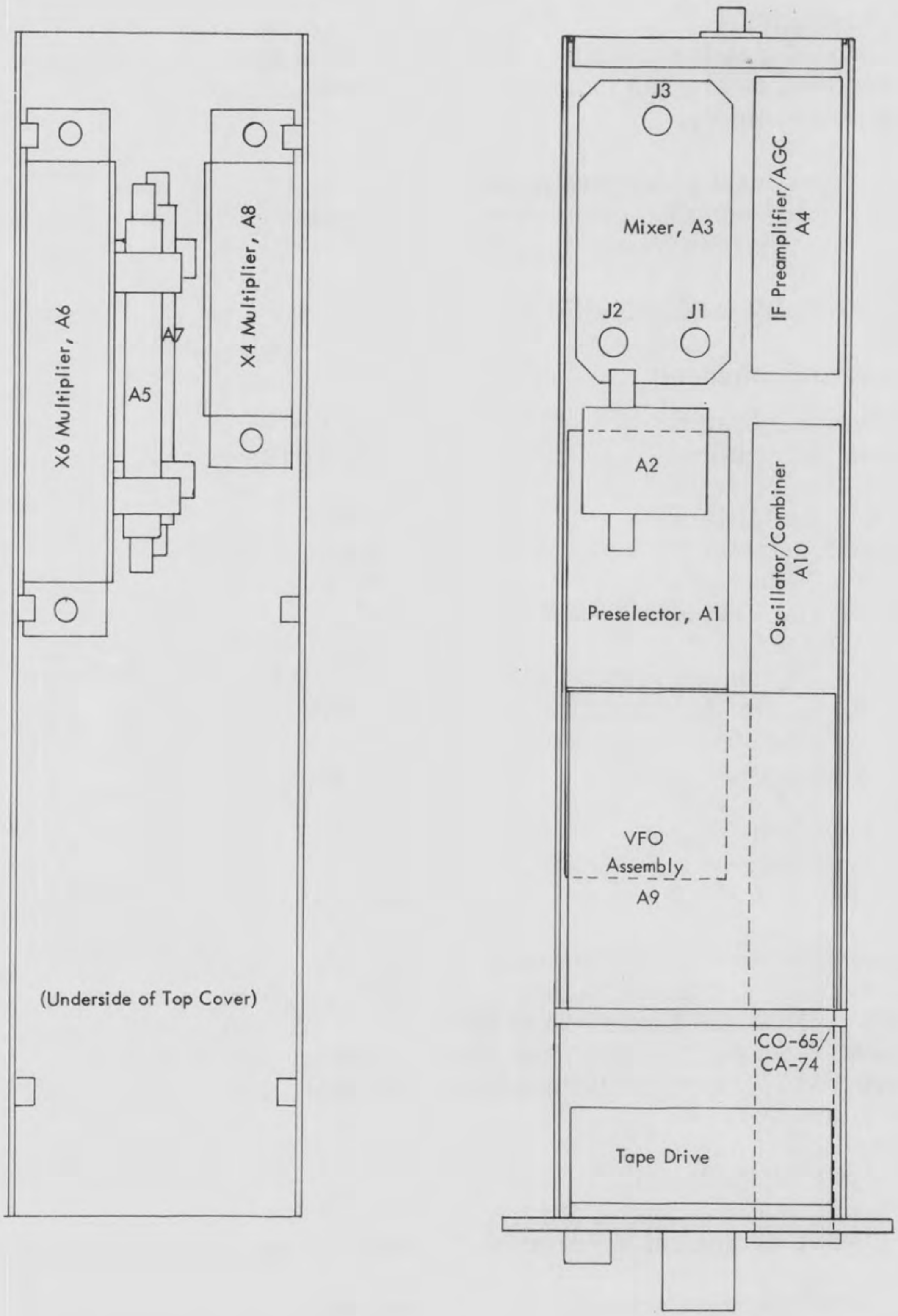


Figure 5-1. RF Tuner Assembly Location

(2) Establish a +15 dBm reference level on the oscilloscope at 6 cm of deflection.

(3) Adjust C5, C7, and C11 of A8 and C5, C8, C11, C13, C15 and C16 of A6 for a power level of approximately +5 dBm between 94 MHz and 98 MHz. The response should have a minimum level of +3 dBm.

NOTE

An iterative tuning technique is necessary to obtain the desired multiplier output characteristics, in that adjustments interact and no predetermined sequence of adjustment.

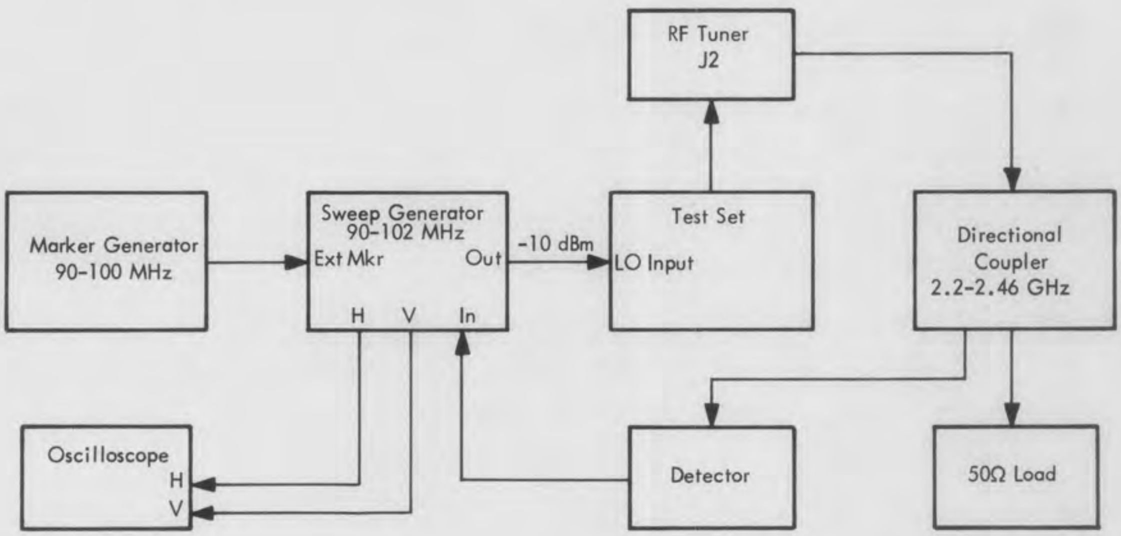


Figure 5-2. Multiplier Response, Test Equipment Setup

c. Transfer Bandwidth Adjustment.

(1) Set up test equipment as shown in figure 5-3. Set controls as follows:

Sweep Generator Output	approximately +10 dBm
Sweep Generator Frequency	2240 MHz to 2260 MHz
Oscilloscope Vertical	5 mV/cm
Oscilloscope Horizontal	as required for full trace
TU-74-SA :2250 MHz, VFO Mode; AGC	0V
Step Attenuator	0 dB

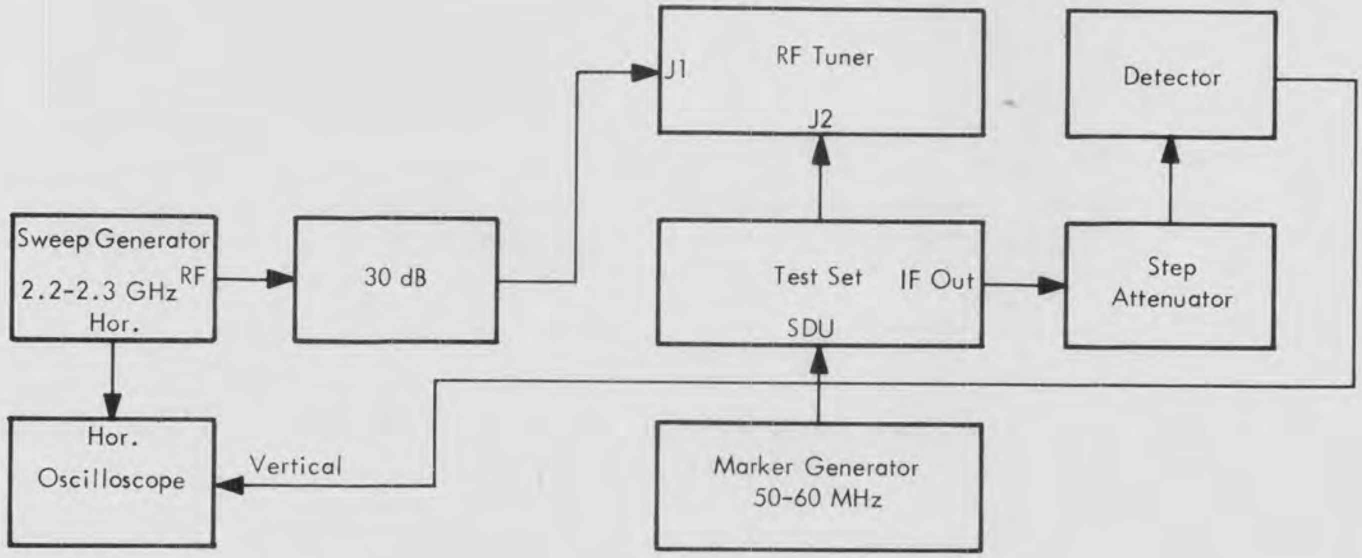


Figure 5-3. Transfer Gain and Bandwidth, Test Equipment Setup

(2) Connect detector to sweep generator output through a 20 dB pad and adjust sweep generator output for a 6 cm display on oscilloscope.

(3) Connect detector to output of step attenuator and adjust attenuator for 6 cm display on oscilloscope.

(4) Tune T1 in i-f preamplifier (A4) for flat response. Tune 2200 to 2300 MHz. Adjust C6, C8 and T1 as needed for minimum tilt across entire tuning range. Remove cover if necessary to make these adjustments.

(5) Calculate gain by adding 10 dB to step attenuator reading. Gain should be 17 dB minimum.

d. AGC Slop Adjustment.

(1) Set up test equipment as shown in figure 5-4. Set controls as follows:

(a) Spectrum Analyzer:

Frequency: 55 MHz.
Spectrum Width: 3 MHz/cm.
IF Bandwidth: 100 kHz.
Display Mode: Log
IF Gain: 60 dB.
Input Attenuator: 10 dB.

(b) Signal Generator:

ALC Mode
Attenuator: 60 dB.
Frequency: 2250 MHz.

(c) TU-74-SA:

VFO Mode
Dial: 2250 MHz.
AGC: 0V.

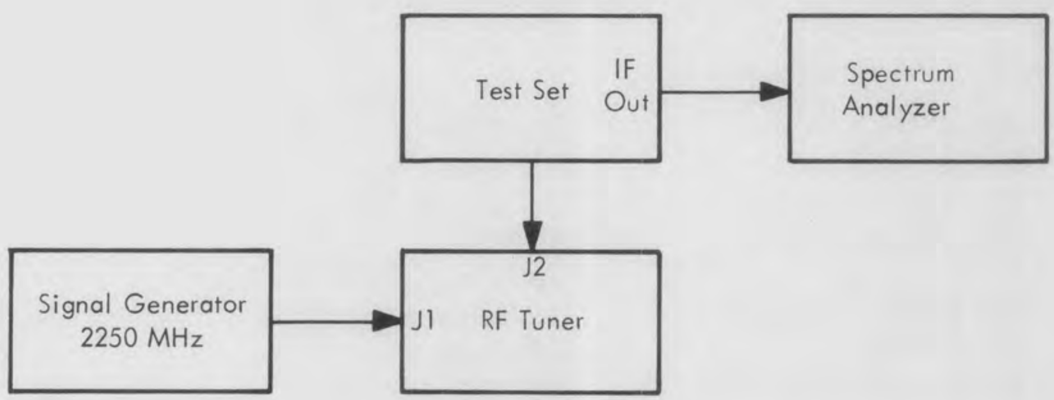


Figure 5-4. AGC Slope Adjustment, Test Equipment Setup

(2) Establish a reference level on the spectrum analyzer by adjusting the IF GAIN switch.

(3) Increase agc to -1V.

(4) Increase power from signal generator by means of the attenuator until the reference level from step (2) is reached.

(5) Calculate gain change by subtracting the attenuator reading from 60 dB. Gain reduction should be 3.75 (±0.25) dB.

(6) Repeat steps (3) through (5) for -2, -3, -4, -5, -6, -7, -8, -9 and -10V. (Although there are no test limits for the -9 and -10V points, tuner gain should continue to decrease.) Adjust R6 at -1.0V and/or R2 at -4.0V as needed to match agc reduction to specifications. Gain reduction should be as shown on the following page.

AGC (V)	Gain Reduction (dB)
-2:	7.50 (±0.50) dB
-3:	11.25 (±0.75) dB
-4:	15.00 (±1) dB
-5:	18.75 (±1.25) dB
-6:	22.50 (±1.5) dB
-7:	26.25 (±1.75) dB
-8:	30.00 (±2) dB
-9:	No Limits
-10:	No Limits

5.3.3.2 IF PREAMPLIFIER/AGC ASSEMBLY, A4.

Recommended Equipment:

Signal Generator	HP 606A
Sweep Generator	Jerrold 900B
50 ohm Detector	Jerrold D-50
Step Attenuator	HP 355C
Oscilloscope	Tektronix 503
RF Millivoltmeter	HP 411A
DC VTVM	HP 412A
Power Supplies (two)	HP 721A
Test Set	Defense Electronics (TP 3979)

a. Connect the test set to the power supplies, set for +15V and -15V, short circuit current to 100 mA.

b. AGC Threshold Adjustment.

(1) Connect test equipment as shown in figure 5-5. Set the test set AGC control to zero.

(2) Connect dc vtvm between ground and A1E3 of A4.

(3) Adjust A2R4 for a +3V indication on the vtvm.

c. IF Alignment Procedure.

(1) Connect test equipment as shown in figure 5-6. Set AGC control to zero.

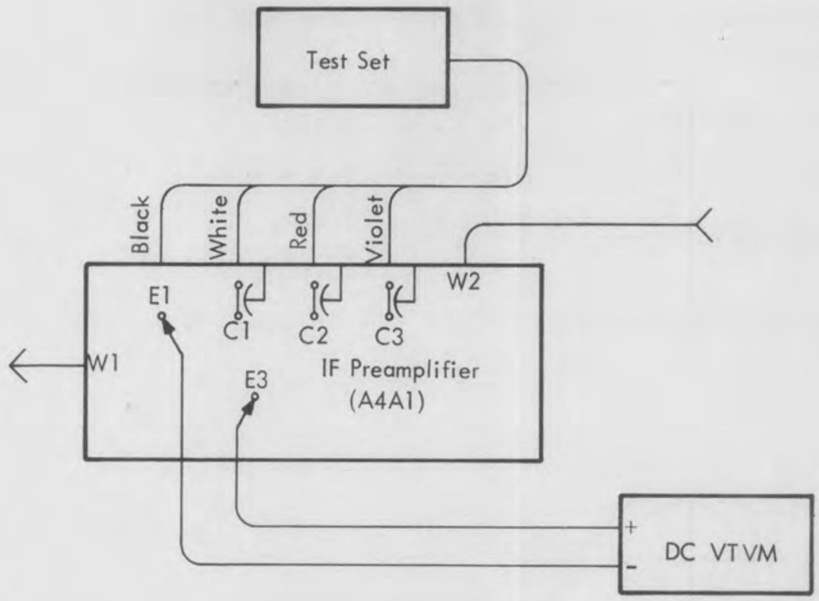


Figure 5-5. AGC Threshold Adjustment Setup

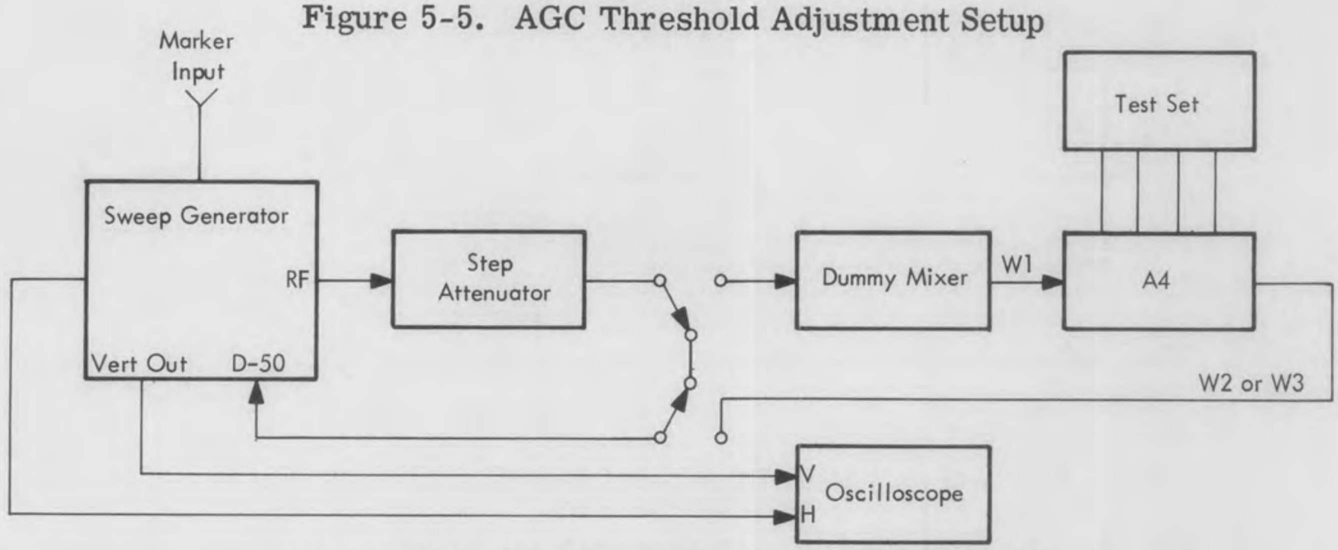


Figure 5-6. IF Alignment, Gain and Bandwidth

(2) Adjust test equipment as follows:

Oscilloscope Vertical: 5 mV/cm.
Oscilloscope Horizontal: as required for full trace.
Step Attenuator: 0 dB.
Sweep Generator Attenuator: 10 dB.

(3) Connect step attenuator output directly to detector and adjust sweep generator for a six cm display on oscilloscope.

(4) Connect step attenuator output to dummy mixer and i-f output W2 to detector.

(5) Adjust sweeper generator attenuator and step attenuator for 6 cm display on oscilloscope.

(6) Adjust T1, C6 and C8 for a symmetrical response centered at 55 MHz with a minimum 1 dB bandwidth of 6.0 MHz.

d. AGC Slope Adjustment.

(1) Connect test equipment as shown in figure 5-7. Adjust AGC control to zero.

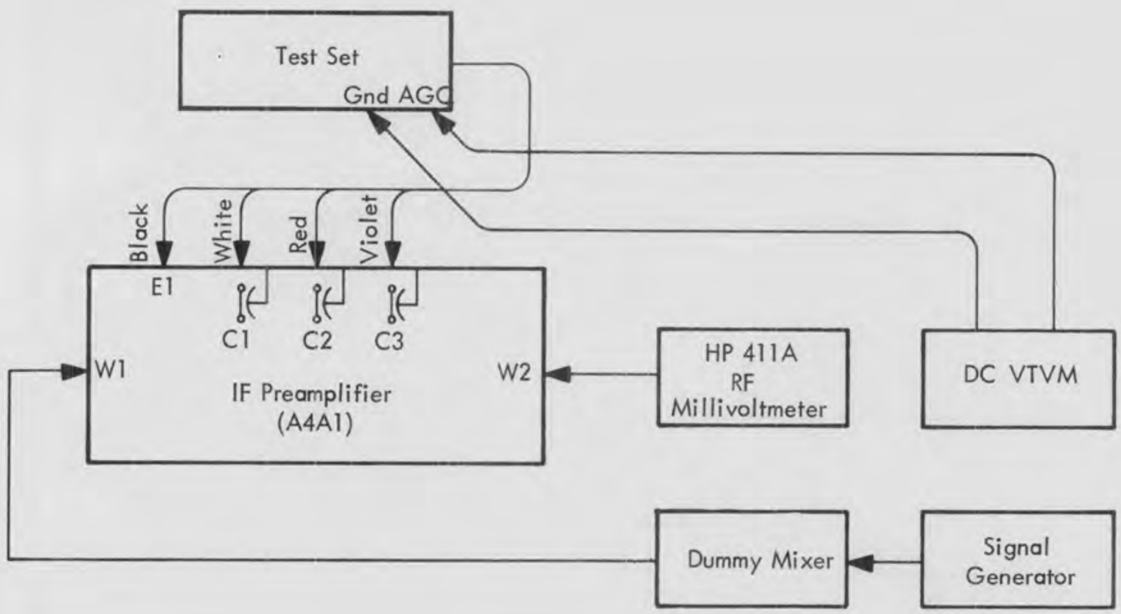


Figure 5-7. AGC Adjustment and Measurement Setup

(2) Set signal generator to 55 MHz and adjust output level for a 0 dBm indication on the rf millivoltmeter.

(3) Set AGC control on test set for a -1.0V indication on the dc vtvm. Adjust R6 on agc board (A4A2) for a -3.75 dB gain reduction below the reference level of 0 dBm.

(4) Set AGC control on test set for a -4.0V indication on the dc vtvm. Adjust R2 on agc board for a -15 dB gain reduction below 0 dBm reference level.

(5) Reset AGC control on test set to 0 and verify 0 dBm reference level output. Readjust signal generator output if necessary to establish reference.

(6) Repeat steps (3) and (4) above as necessary to satisfy gain reduction versus agc voltage requirements as specified. Do not repeat step (5). Do not alter setting of R4 on agc board.

5.3.3.3 VFO ASSEMBLY, A9.

Recommended Equipment:

Counter	HP 5245L, with 5253B plug-in
Dual Power Supplies (two)	Harrison Labs. 6205B
Precision Power Supply	Power Designs 2005

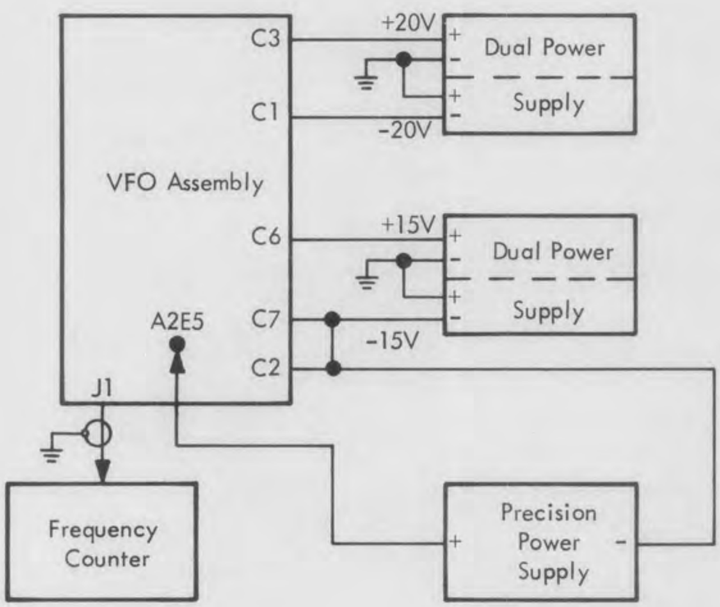


Figure 5-8. Oscillator Alignment

<u>Oscillator Alignment</u>

a. Connect vfo assembly as shown in figure 5-8. Tack solder the wire to terminal E5 of the shaper/regulator assembly (A9A2). Thread this wire through the hole in the test cover and connect it to the positive terminal of the precision power supply.

b. Set ±15V and ±20V power supplies to 15(°0.01)V and 20(±0.1)V.

c. Set precision power supply to +8.000V.

d. Set frequency counter to Frequency, Plug-in, 0.1 sec, and converter to 90 MHz.

e. Apply power, observing for shorts, and observe frequency meter for indication that the oscillator is oscillating. It may be necessary to retune frequency converter to get an indication.

f. If the oscillator is working, tune C3 for 93.958 MHz.

g. Switch the precision supply to +16.000V.

h. Tune C7 for 98.125 MHz.

i. Repeat steps f and g until +8.000V and +16.000V yield 93.958 MHz and 98.125 MHz respectively. (C8 is a vernier adjustment which can be used with C7 to achieve end points with an accuracy of ±1 kHz).

NOTE

It is important that the oven is up to temperature and that the lid is on tight as the ranging is completed.

5.3.3.4 OSCILLATOR/COMBINER ASSEMBLY, A10.

Recommended Equipment:

Sweep Generator	Telonic SM-2000
Oscilloscope	HP 130C
Signal Generator	HP 608D
Variable Attenuator	Kay
Detector	HP 423A
Dual Power Supplies (two)	Harrison Labs. 6205B
Crystals (46.562500, 49.84375, approx. 48.1 MHz)	Piezo CR-52A/U or CR-65A/U

a. Connect test equipment as shown in figure 5-9.

b. Referring to figure 7-6, connect the power supplies as follows: +20V to C6; -20V to C7; +15V to C4; -15V to C5 (ground common). Adjust power supplies for exactly plus and minus 15V and plus and minus 20V, as appropriate.

c. Set the sweep output level to -10 dBm. Using the HP 608 to provide a marker, calibrate the sweep bandedges for 93 MHz to 100 MHz. Turn on the 1 MHz internal marker.

d. Connect a temporary lead from the -15V terminal to terminal C2. Connect W3 to the detector input cable of the test setup.

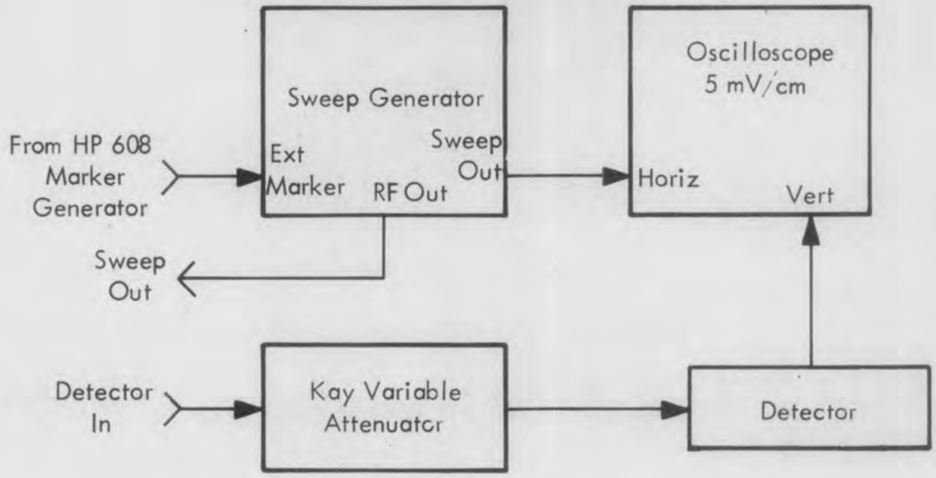


Figure 5-9. Test Equipment Setup for Oscillator Alignment

e. VFO Alignment.

(1) Connect the sweep output cable of the test setup to W2.

(2) Set the variable attenuator to 16 dB. Adjust C23 and C20 to obtain a response trace as shown in figure 5-10. If a response trace is difficult to obtain, decrease the variable attenuator and try again. When the response trace is present, reset the variable attenuator to 16 dB and finish the alignment of C23 and C20.

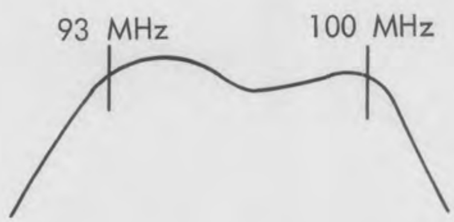


Figure 5-10. Response No. 1

f. Crystal Oscillator Alignment.

(1) Remove the jumper from terminal C2 and connect it to C1. Set the sweep output to -15 dBm.

(2) Set the sweep frequency for a bandedge-to-bandedge sweep of 46.5 MHz to 50 MHz. Connect the center conductor of the sweep output cable to pin 1 of the crystal socket (see figure 5-11) and the shield to pin 9 or ground.

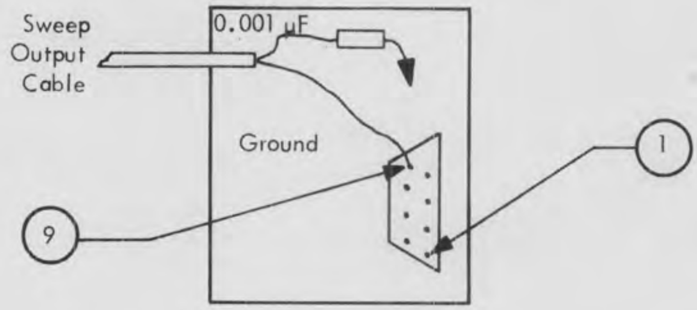


Figure 5-11. Crystal Socket

(3) Switch the attenuator to 23 dB and adjust C3, C8 and C12 for the response shown in figure 5-12.

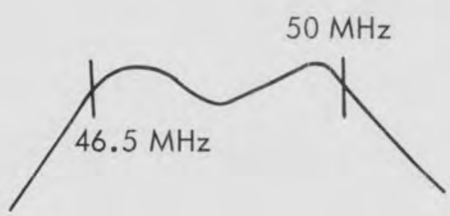


Figure 5-12. Response No. 2

5.3.3.5 X4 MULTIPLIER ASSEMBLY.

Recommended Equipment:

Sweep Generator	Telonic SM-2000, with LH-2M plug-in
Signal Generator	HP 608D
Oscilloscope	HP 130C
Detector	HP 423A
10 dB Pad	HP 8419 Op. 10
Bandpass Filter (370-400 MHz)	Defense Electronics 203557
Power Supply	HP 721A

a. Connect the power supply, set for +15V, short circuit current at 100 mA, to FL1 and ground (see figure 7-8).

b. Connect test equipment as shown in figure 5-13. Set controls as follows:

Sweep Generator Output: 90-103 MHz, 1 mW.
Oscilloscope: vert. sensitivity 10 mV/cm.
Signal Generator: 96.5 MHz; level as required.

c. Adjust C5, C7, and C11 for low ripple response having a bandwidth of 93-100 MHz. An iterative tuning procedure is required for optimum response.

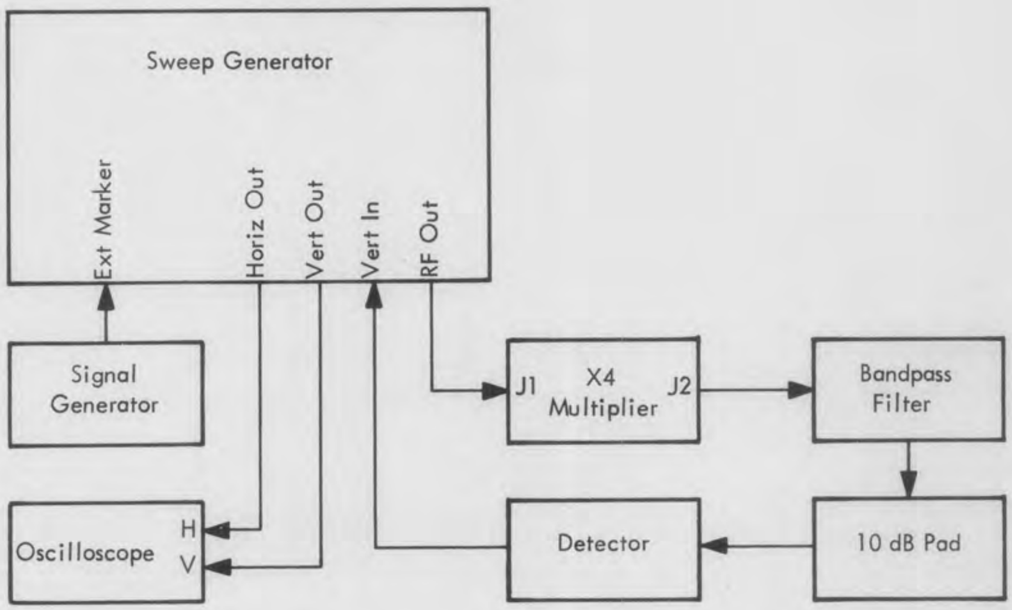


Figure 5-13. Bandwidth Adjustment, X4 Multiplier

5.3.3.6 DIODE MULTIPLIER.

Recommended Equipment:

Sweep Generator	Telonic SM-2000, with S-4 plug-in
Signal Generator	HP 608D
Oscilloscope	HP 130C
Detector	HP 423A
Bandpass Filter (2.2-2.4 GHz)	Defense Electronics 203554
Directional Coupler (2.2-2.4 GHz)	HP 777D
50 ohm Load	HP 908A
Power Supply	HP 721A

a. Connect the power supply, set for +15V, short circuit current to 100 mA, to FL1 and ground.

b. Connect test equipment as shown in figure 5-14. Set controls as follows:

Sweep Generator Output: 370-400 MHz, 1 mW.
Oscilloscope: vert. sensitivity 10 mV/cm.
Signal Generator: 385 MHz; level as required.

c. Adjust C5, C8, C11, C13, C15, and C16 for a low ripple response having a bandwidth of 375-393 MHz. An iterative tuning procedure is required for optimum response.

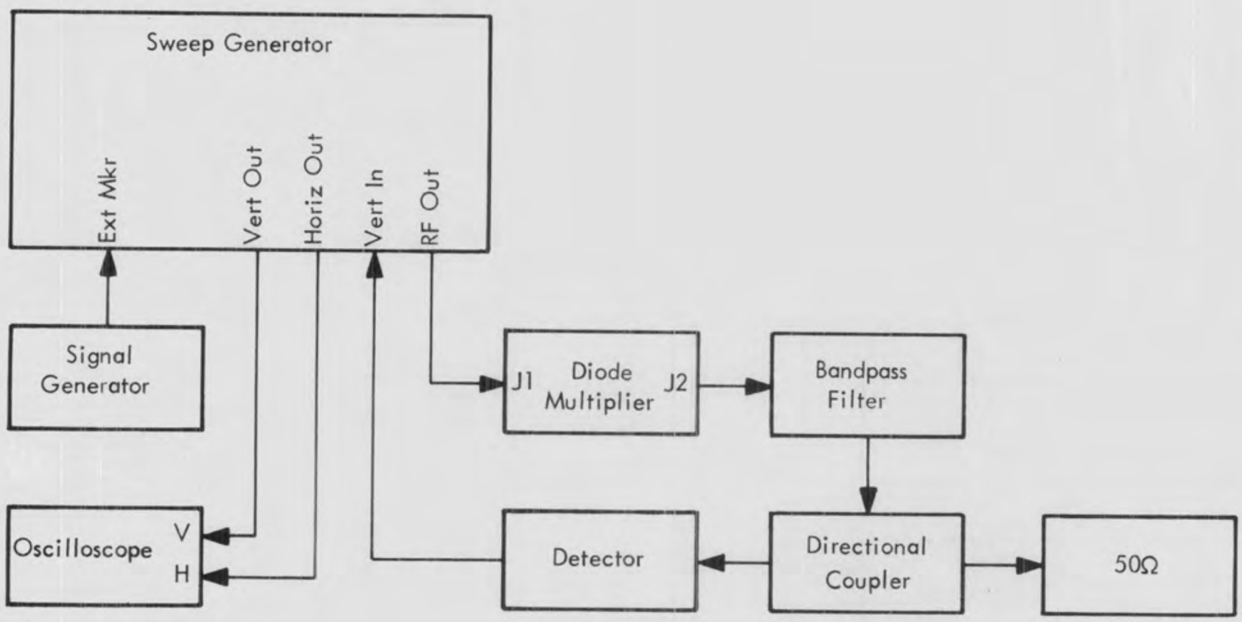


Figure 5-14. Bandwidth Adjustment, Diode Multiplier

SECTION VI
ELECTRICAL PARTS LIST

This section of the manual contains the electrical parts list for the TU-74-SA including subassemblies A1 through A10. The electrical parts for subassemblies A3, A4, A6, A8, A9, and A10 are listed separately in this section. Subassemblies A1, A2, A5, and A7 are considered non-repairable in the field and are thus treated as components.

MAIN CHASSIS (See Figures 5-1 and 7-2)

Reference Designation	Description
A1	Preselector assembly, Defense Electronics 303356-90
A2	Isolator, Defense Electronics 203558
A3	Mixer assembly, Defense Electronics 303171-90
A4	IF Preamplifier/AGC assembly, Defense Electronics 203550-90
A5	Filter-bandpass, Defense Electronics 203554
A6	Diode multiplier assembly, Defense Electronics 203338-90
A7	Filter-bandpass, Defense Electronics 203557
A8	X4 multiplier assembly, Defense Electronics 203497-90
A9	VFO assembly, Defense Electronics 303355-90
A10	Oscillator/combiner assembly, Defense Electronics 303354-90
FL1 through FL4	Filtercon, feedthru, 1500 pF, 200V, Erie 1201-052
J1	Connector, type N, Americon 3004-7941
J2	Connector, Cannon DCM-17W5P
J2A1	Coaxial Insert, Cannon DM53740-1, integral part of A4W2
J2A2	Coaxial Insert, Cannon DM53740-1, integral part of A4W3
J2A3	Not assigned
J2A4	Coaxial Insert, Cannon DM53740-1, integral part of A10W1
J2A5	Coaxial Insert, Cannon DM53740-1, integral part of A10W4

Main Chassis, continued

Reference Designation	Description
R1	Potentiometer, vfo tuning, 10k ±10%, Bourns 3551S-1-103
S1	Switch, pushbutton assembly, 1st l-o mode, Defense Electronics 203239

Miscellaneous:

Pushbutton, engraved (VFO), Defense Electronics 105842-1

Pushbutton, engraved (XTAL), Defense Electronics 105842-2

Pushbutton, engraved (EXT), Defense Electronics 105842-3

MIXER ASSEMBLY, A3 (See Figure 7-1)

Reference Designation	Description
CR1 and CR2	Diodes, matched pair, HP 5082-2401
J1 through J3	Connector, Americon 2066-1402

IF PREAMPLIFIER/AGC ASSEMBLY, A4 (See Figure 7-3)

Reference Designation	Description
A1	IF Preamplifier Board, Defense Electronics 203739-90
A2	AGC Shaping Network, Defense Electronics 203277-90
C1	Capacitor, ceramic, feedthru, 470 pF, 500V, Allen Bradley FA5C471W
C2	Capacitor, ceramic, feedthru, 470 pF, 500V, Allen Bradley FA5C471W
C3	Capacitor, ceramic, feedthru, 470 pF, 500V, Allen Bradley FA5C471W
C4	Capacitor, disc, 0.005 μF, -40%+60%, 150V, Centralab DDM-502
W1	Cable assembly, Defense Electronics 105873-1
W2	Cable assembly, Defense Electronics 105873-2
W3	Cable assembly, Defense Electronics 105873-3

IF PREAMPLIFIER BOARD, A4A1 (See Figure 7-3)

Reference Designation	Description
C1	Not assigned
C2	Capacitor, ceramic, standoff, 470 pF, Allen Bradley SS5A-471W
C3	Not assigned
C4	Capacitor, ceramic, standoff, 470 pF, Allen Bradley SS5A-471W
C5	Capacitor, ceramic, standoff, 470 pF, Allen Bradley SS5A-471W
C6	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C7	Capacitor, ceramic, standoff, 470 pF, Allen Bradley SS5A-471W
C8	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C9	Capacitor, ceramic, tubular, 6.8 pF ±0.5 pF, Erie NPO-301-000

IF Preamplifier Board, A4A1, continued

Reference Designation	Description
E1 through E5	Terminal, feedthru, Sealectro FT-SM1
L1	Inductor, fixed, 1.0 μH ±10%, Nytronics WEE-1.0
L2	Inductor, fixed, 0.22 μH ±10%, Nytronics WEE-.22
L3	Inductor, fixed, 0.56 μH ±10%, Nytronics WEE-.56
Q1	Transistor, MOS-FET, RCA/MOT 3N159
Q2	Transistor, silicon, RCA 2N3933
XQ1	Socket, transistor, Robinson-Nugent 18-42
R1	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R2	Resistor, fixed composition, 62Ω ±5%, 1/4W, Allen Bradley CB6205
R3	Resistor, fixed composition, 12Ω ±5%, 1/4W, Allen Bradley CB1205
R4	Resistor, fixed composition, 15k ±5%, 1/4W, Allen Bradley CB1535
R5	Not assigned
R6	Resistor, fixed composition, 6.8k ±5%, 1/4W, Allen Bradley CB6825
R7	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R8	Resistor, fixed composition, 220Ω ±5%, 1/4W, Allen Bradley CB2215
R9	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
T1	Transformer assembly, Defense Electronics 203752

AGC SHAPING NETWORK BOARD, A4A2 (See figure 7-3)

Reference Designation	Description
A1	Integrated circuit, LM-301A
C1	Capacitor, ceramic, 30 pF ±5%, Erie NPO-308
C2	Capacitor, ceramic, monolithic, 0.01 μF ±20%, 25V, Sprague 3C023103X025A3
CR1	Diode, silicon, 1N914A
Q1	Transistor, silicon, 2N2218
R1	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R2	Resistor, variable, 1.0k ±10%, Bourns 3009P-1-1K
R3	Resistor, fixed composition, 68k ±5%, 1/4W, Allen Bradley CB6835
R4	Resistor, variable, 100k ±10%, Bourns 3009P-1-100K
R5	Resistor, fixed composition, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R6	Resistor, variable, 10k ±10%, Bourns 3009P-1-10K
R7	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R8	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005

VFO ASSEMBLY, A9 (See Figure 7-5)

Reference Designation	Description
A1	Inner Box assembly, Defense Electronics 303374-90
A2	Shaper/Regulator assembly, Defense Electronics 203501-90
A3	Temperature Regulator, Defense Electronics 105834-90
C1 through C7	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C8 through C15	Not assigned
C16	Capacitor, dipped mica, 1000 pF ±5%, Elmenco DM15F102J
J1	Connector, type SMA, bulkhead, Americon 2056-0000

A9A1, INNER BOX ASSEMBLY (See Figure 7-5)

Reference Designation	Description
C1	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C2	Capacitor, standoff, 470 pF, Allen Bradley SS5A-471W
C3	Capacitor, variable, glass piston, 0.8-8.5 pF, JFD VC20GYCE
C4	Capacitor, ceramic, tubular, 50 pF ±1%, Erie NPO 308-000
C5	Capacitor, button, mica, 0.001 μF ±10%, Erie CB11RD102K
C6	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C7	Capacitor, variable, glass piston, 0.8-8.5 pF, JFD VC20GYCE
C8	Capacitor, variable, glass piston, 0.8-8.5 pF, JFD VC20GYCE
C9	Capacitor, ceramic, tubular, 2.2 pF ±0.1 pR, Erie NPO-301
C10	Capacitor, ceramic, tubular, 47 pF ±5%, Erie NPO-308
C11	Capacitor, ceramic, tubular, 8.2 pF ±0.25 pF, Erie NPO-301

A9A1, Inner Box Assembly, continued

Reference Designation	Description
C12	Capacitor, standoff, 470 pF, Allen Bradley SS5A-471W
C13	Capacitor, ceramic, tubular, 47 pF ±5%, Erie NPO-308
C14	Capacitor, ceramic, tubular, 22 pF ±5%, Erie NPO-301
C15	Capacitor, ceramic, tubular, 10 pF ±5%, Erie NPO-301
C16	Not assigned
C17	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
CR1	Diode, 1N914B
CR2	Diode, varactor, 1N5472B
E1	Terminal, turret, CTC 4894-1-04-16
E2	Terminal, feedthru, Sealectro FT-SM-1
E3 through E5	Terminal, standoff, Sealectro ST-SM-1
E6	Terminal, turret, CTC 4894-1-05-16
HR1	Heater wire, resistance, #33, nom. wire, dia .0071, alloy 45 (55% cu & 45% N) with double nylon wrap 16 ft.
L1	Inductor, fixed, 0.10 μH, JFD LF1P010
L2	Inductor, fixed, 0.22 μH ±10%, Nytronics WEE-.22
Q1	Transistor, 2N708
Q2	Transistor, 2N3933
Q3	Transistor, 2N4919
R1	Resistor, fixed film, 15k ±1%, 1/8W, RN55D1502F
R2	Resistor, fixed film, 10k ±1%, 1/8W, RN55D1002F

A9A1, Inner Box Assembly, continued

Reference Designation	Description
R3	Resistor, fixed film, 2.43k ±1%, 1/8W, RN55D2431F
R4	Resistor, fixed film, 5.11k ±1%, 1/8W, RN55D5111F
R5	Resistor, fixed film, 20k ±1%, 1/8W, RN55D2002F
R6	Resistor, fixed film, 20k ±1%, 1/8W, RN55D2002F
R7	Resistor, fixed film, 5.11k ±1%, 1/8W, RN55D5111F
R8	Resistor, fixed film, 392Ω ±1%, 1/8W, RN55D3920F
R9	Resistor, fixed film, 3.65k ±1%, 1/8W, RN55D3651F
R10	Resistor, fixed film, 47.5Ω ±1%, 1/8W, RN55D47R5F
RT1	Thermistor, Yellow Springs Inst. #44008
S1	Thermostat Chatham Controls PD-S-SORP

A9A2, SHAPER/REGULATOR ASSEMBLY (See Figure 7-5)

Reference Designation	Description
C1	Capacitor, ceramic, monolythic, 2.2 μF ±20%, 25V, Sprague C023225X0250B3
C2	Capacitor, ceramic, tubular, 30 pF ±5%, Erie NPO-308
C3	Capacitor, ceramic, disc, 0.01 μF, -20%+100%, Erie 805-000-X5V0-103Z
CR1	Diode, 1N936A
CR2 through CR4	Diode, 1N914B
Q1	Transistor, 2N2270
Q2	Transistor, 2N5089

A9A2, Shaper/Regulator Assembly, continued

Reference Designation	Description
XQ1	Transipad, Defense Electronics B18214
XQ2	Transipad, Defense Electronics B18214
R1	Resistor, fixed film, 10.0k ±1%, 1/8W, RN55D1002F
R2	Resistor, fixed film, 15.8k ±1%, 1/8W, RN55D1582F
R3	Resistor, factory selected
R4	Resistor, fixed film, 2.00k ±1%, 1/8W, RN55D2001F
R5	Resistor, fixed film, 4.22k ±1%, 1/8W, RN55D4221F
R6	Resistor, fixed film, 10.0k ±1%, 1/8W, RN55D1002F
R7	Resistor, fixed film, 51.1k ±1%, 1/8W, RN55D5112F
R8	Resistor, fixed film, 75.0k ±1%, 1/8W, RN55D7502F
R9	Resistor, fixed film, 29.4k ±1%, 1/8W, RN55D2942F
R10	Resistor, fixed film, 28.7k ±1%, 1/8W, RN55D2872F
R11	Resistor, fixed film, 48.7k ±1%, 1/8W, RN55D4872F
R12	Resistor, fixed film, 36.5k ±1%, 1/8W, RN55D3652F
Z1	Integrated circuit, National Semiconductor LM301A

A9A3, TEMPERATURE REGULATOR (See Figure 7-5)

Reference Designation	Description
C1	Capacitor, ceramic, monolythic, 0.01 μF ±20%, 25V, Sprague 3C023103X0250A3
C2	Capacitor, ceramic, monolythic, 0.01 μF ±20%, 25V, Sprague 3C023103X0250A3
CR1	Diode, zener, 1N753A

A9A3, Temperature Regulator, continued

Reference Designation	Description
Q1	Transistor, 2N3251
Q2	Transistor, 2N2270
XQ1	Transipad, Defense Electronics B18214
XQ2	Transipad, Defense Electronics B18214
R1	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R2	Resistor, fixed film, 6.49k ±1%, 1/8W, RN55D6491A
R3	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R4	Resistor, fixed film, 18.7k ±1%, 1/8W, RN55D1872F
R5	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R6	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R7	Resistor, fixed composition, 1.8k ±5%, 1/8W, Allen Bradley CB1825
R8	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
Z1	Integrated circuit, RCA CA3028A

OSCILLATOR/COMBINER ASSEMBLY, A10 (See Figure 7-6)

Reference Designation	Description
A1	Oscillator/combiner board, Defense Electronics LM203301-90
A2	Temperature Regulator, Defense Electronics LM105727-90
C1 through C7	Capacitor, ceramic, feedthru, 470 pF, Allen Bradley FA5C-471W
C8	Capacitor, ceramic, disc, 0.005 μF, -40%+60%, 150V, Centralab DDM-502
J1	Connector, Cannon DEMF-9S
W1	Cable assembly, Defense Electronics 105867-1
W2	Cable assembly, Defense Electronics 105867-2
W3	Cable assembly, Defense Electronics 105867-3
W4	Cable assembly, Defense Electronics 105867-4

A10A1, OSCILLATOR/COMBINER (See Figure 7-6)

Reference Designation	Description
C1	Capacitor, dipped mica, 470 pF ±5%, Elmenco DM15-471J
C2	Capacitor, dipped mica, 470 pF ±5%, Elmenco DM15-471J
C3	Capacitor, variable, air, 1.7-11 pF, E.F. Johnson 187-106-5
C4	Capacitor, ceramic, tubular, 13 pF ±0.5 pF, Erie NPO-301
C5	Capacitor, dipped mica, 470 pF ±5%, Elmenco DM15-471J
C6	Capacitor, dipped mica, 160 pF ±5%, Elmenco DM15-161J
C7	Capacitor, ceramic, disc, 0.005 μF, -40%+60%, 150V, Centralab DDM-502
C8	Capacitor, variable, air, 1.7-11 pF, E.F. Johnson 187-106-5
C9	Capacitor, ceramic, tubular, 33 pF ±5%, Erie NPO-308

A10A1, Oscillator/Combiner, continued

Reference Designation	Description
C10	Capacitor, ceramic, tubular, 1.8 pF ±0.25 pF, Erie NPO-301
C11	Capacitor, ceramic, tubular, 33 pF ±5%, Erie NPO-308
C12	Capacitor, variable, air, 1.7-11 pF, E.F. Johnson 187-106-5
C13	Capacitor, ceramic, tubular, 6.2 pF ±0.5 pF, Erie NPO-301
C14	Capacitor, ceramic, tubular, 22 pF ±5%, Erie NPO-301
C15 through C19	Capacitor, dipped mica, 470 pF ±5%, Elmenco DM15-471J
C20	Capacitor, variable, air, 1.7-11 pF, E.F. Johnson 187-106-5
C21	Capacitor, dipped mica, 470 pF ±5%, Elmenco DM15-471J
C22	Capacitor, ceramic, tubular, 1.2 pF ±0.25 pF, Erie NPO-301
C23	Capacitor, variable, air, 1.7-11 pF, E.F. Johnson 187-106-5
C24	Capacitor, ceramic, tubular, 6.2 pF ±0.5 pF, Erie NPO-301
C25	Capacitor, ceramic, tubular, 22 pF ±5%, Erie NPO-301
C26	Capacitor, ceramic, tubular, 20 pF ±5%, Erie NPO-301
CR1 through CR4	Diode, silicon, 1N914A
L1	Inductor, fixed, 0.56 µH, Nytronics WEE 0.56
L2	Inductor, fixed, 1.8 µH, Nytronics WEE 1.8
L3	Inductor, fixed, 2.7 µH, Nytronics WEE 2.7
L4	Inductor, fixed, 0.33 µH, Nytronics WEE 0.33
L5	Inductor, fixed, 0.33 µH, Nytronics WEE 0.33
L6	Inductor, fixed, 1.0 µH, Nytronics WEE 1.0
L7	Inductor, fixed, 2.7 µH, Nytronics WEE 2.7
L8	Inductor, fixed, 0.22 µH, Nytronics WEE 0.22
L9	Inductor, fixed, 0.22 µH, Nytronics WEE 0.22
L10	Inductor, Defense Electronics 105859

A10A1, Oscillator/Combiner, continued

Reference Designation	Description
L11	Inductor, fixed, 12 μH, Nytronics WEE 12
L12	Inductor, fixed, 0.10 μH, Nytronics WEE 0.10
L13	Inductor, fixed, 0.10 μH, Nytronics WEE 0.10
Q1	Transistor, silicon, 2N708
Q2 through Q5	Transistor, silicon, 2N3933
XQ1 through XQ5	Transipads, Defense Electronics B18214
R1	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R2	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R3	Resistor, fixed composition, 6.8k ±5%, 1/4W, Allen Bradley CB6825
R4	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R5	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R6	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R7	Resistor, fixed composition, 3.0k ±5%, 1/4W, Allen Bradley CB3025
R8	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R9	Resistor, fixed composition, 820Ω ±5%, 1/4W, Allen Bradley CB8215
R10	Resistor, fixed composition, 1.0k ±5%, 1/4W, Allen Bradley CB1025
R11	Resistor, fixed composition, 3.0k ±5%, 1/4W, Allen Bradley CB3025
R12	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R13	Resistor, fixed composition, 3.0k ±5%, 1/4W, Allen Bradley CB3025
R14	Resistor, fixed composition, 150Ω ±5%, 1/4W, Allen Bradley CB1515
R15	Resistor, fixed composition, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R16	Resistor, fixed composition, 150Ω ±5%, 1/4W, Allen Bradley CB1515

A10A2, TEMPERATURE REGULATOR (See Figure 7-6)

Reference Designation	Description
C1	Capacitor, ceramic, monolythic, 0.01 μF ±20%, 25V, Sprague 3C023103X025A3
C2	Capacitor, ceramic, disc, 0.005 μF, -20%+80%, 50V, Centralab CK 502
CR1	Diode, zener, 6.2V ±5%, Motorola 1N753A
Q1	Transistor, silicon, pnp, Motorola 2N3251
Q2	Transistor, silicon, npn, RCA 2N2270
Q3	Transistor, silicon, npn, power, Motorola 2N4919
R1	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R2	Resistor, fixed film, 4.12k ±1%, 1/8W, RN55D4121F
R3	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R4	Resistor, fixed composition, 18k ±5%, 1/4W, Allen Bradley CB1835
R5	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R6	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R7	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R8	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
Z1	Integrated circuit, differential amplifier, RCA CA3028A

X4 MULTIPLIER ASSEMBLY, A8 (See Figure 7-8)

Reference Designation	Description
C1	Capacitor, dipped mica, 470 pF ±5%, 500V, Elmenco DM15C471J05
C2	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C3	Capacitor, standoff, 180 pF, Allen Bradley SS5A-181
C4	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C5	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C6	Capacitor, ceramic, tubular, 1.8 pF ±0.25 pF, 500V, Erie NPO-301
C7	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C8	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C9	Capacitor, standoff, 180 pF, Allen Bradley SS5A-181
C10	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C11	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C12	Capacitor, ceramic, tubular, 2.2 pF ±0.1 pF, 500V, Erie NPO-301
FL1	Filtercon, Erie 1201-052
J1	Connector, SMA, bulkhead, female, Amer Corp. 2056-0000
J2	Connector, SMA, bulkhead, female, Amer Corp. 2056-0000
L1	Inductor, 5 turns, Defense Electronics 105830-3
L2	Inductor, 5 turns, Defense Electronics 105830-3
L3	Inductor, 2 turns, Defense Electronics 105830-2
L4	Inductor, fixed, 0.22 μH, Nytronics WEE-0.22
L5	Inductor, fixed, 0.22 μH, Nytronics WEE-0.22
Q1	Transistor, npn, RCA 2N3933
Q2	Transistor, npn, RCA 2N3933
R1	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105

X4 Multiplier Assembly, A8, continued

Reference Designation	Description
R2	Resistor, fixed composition, 3k ±5%, 1/4W, Allen Bradley CB3025
R3	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
R4	Resistor, fixed composition, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R5	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R6	Resistor, fixed composition, 3k ±5%, 1/4W, Allen Bradley CB3025
R7	Resistor, fixed composition, 270Ω ±5%, 1/4W, Allen Bradley CB2715
R8	Resistor, fixed composition, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R9	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235

DIODE MULTIPLIER ASSEMBLY, A6 (See Figure 7-9)

Reference Designation	Description
C1	Capacitor, ceramic, tubular, 15 pF ±5%, Erie NPO-301
C2	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C3	Capacitor, standoff, 47 pF, Allen Bradley SS5A-4701
C4	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C5	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C6	Capacitor, ceramic, tubular, 2 pF ±5%, Erie NPO-301
C7	Capacitor, ceramic, micromin, 10 pF ±5%, JFD UYO2-100J
C8	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C9	Capacitor, standoff, 47 pF, Allen Bradley SS5A-4701
C10	Capacitor, feedthru, 470 pF, Allen Bradley FA5C-471W
C11	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C12	Capacitor, ceramic, tubular, 3 pF ±5%, Erie NPO-301
C13	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C14	Capacitor, ceramic, micromin, 10 pF ±5%, JFD UYO2-100J
C15	Capacitor, variable, 0.8-10 pF, JFD VAM-010
C16	Capacitor, variable, 0.8-10 pF, JFD VAM-010
CR1	Diode, varactor, Hewlett-Packard 5082-0152
FL1	Filtercon, Erie 1201-052
J1	Connector, SMA, bulkhead, female, Amer. Corp. 2056-0000
J2	Connector, SMA, bulkhead, female, Amer. Corp. 2056-0000
L1	Inductor, 2 turns, Defense Electronics 105830-2
L2	Inductor, 1 turn, Defense Electronics 105830-1
L3	Inductor, fixed, 0.22 μH, Nytronics WEE-0.22
L4	Inductor, 1 turn, Defense Electronics 105830-1

Diode Multiplier Assembly, A6, continued

Reference Designation	Description
L5	Inductor, Defense Electronics 105830-1
L6	Inductor, fixed, 0.22 μH, Nytronics WEE-0.22
Q1	Transistor, npn, RCA 2N3933
Q2	Transistor, npn, RCA 2N3866
R1	Resistor, fixed composition, 180Ω ±5%, 1/4W, Allen Bradley CB1815
R2	Resistor, fixed composition, 3k ±5%, 1/4W, Allen Bradley CB3025
R3	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
R4	Resistor, fixed composition, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R5	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
R6	Resistor, fixed composition, 3k ±5%, 1/4W, Allen Bradley CB3025
R7	Resistor, fixed composition, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R8	Resistor, fixed composition, 200Ω ±5%, 1/4W, Allen Bradley CB2015
R9	Resistor, fixed composition, 5.1Ω ±5%, 1/4W, Allen Bradley CB5R15

SECTION VII
MAINTENANCE DIAGRAMS

This section contains the component location drawings and the schematic diagrams for the TU-74-SA. Unless otherwise specified, the following information applies to the schematic diagrams:

a. Capacitor values less than one are in microfarads.

b. Capacitor values greater than one are in micromicrofarads (picofarads).

c. Inductance values are in microhenries.

d. Resistance values are in ohms; k=1,000; M=1,000,000.

e.  Arrow denotes clockwise adjustment.

f. * Typical value shown, factory selected.

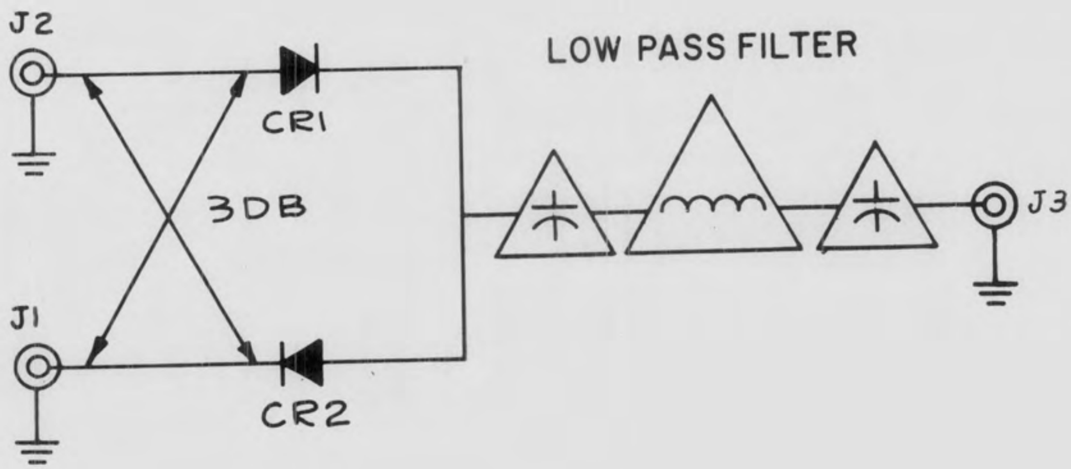


Figure 7-1. Mixer Assembly, A3
Schematic Diagram D303171

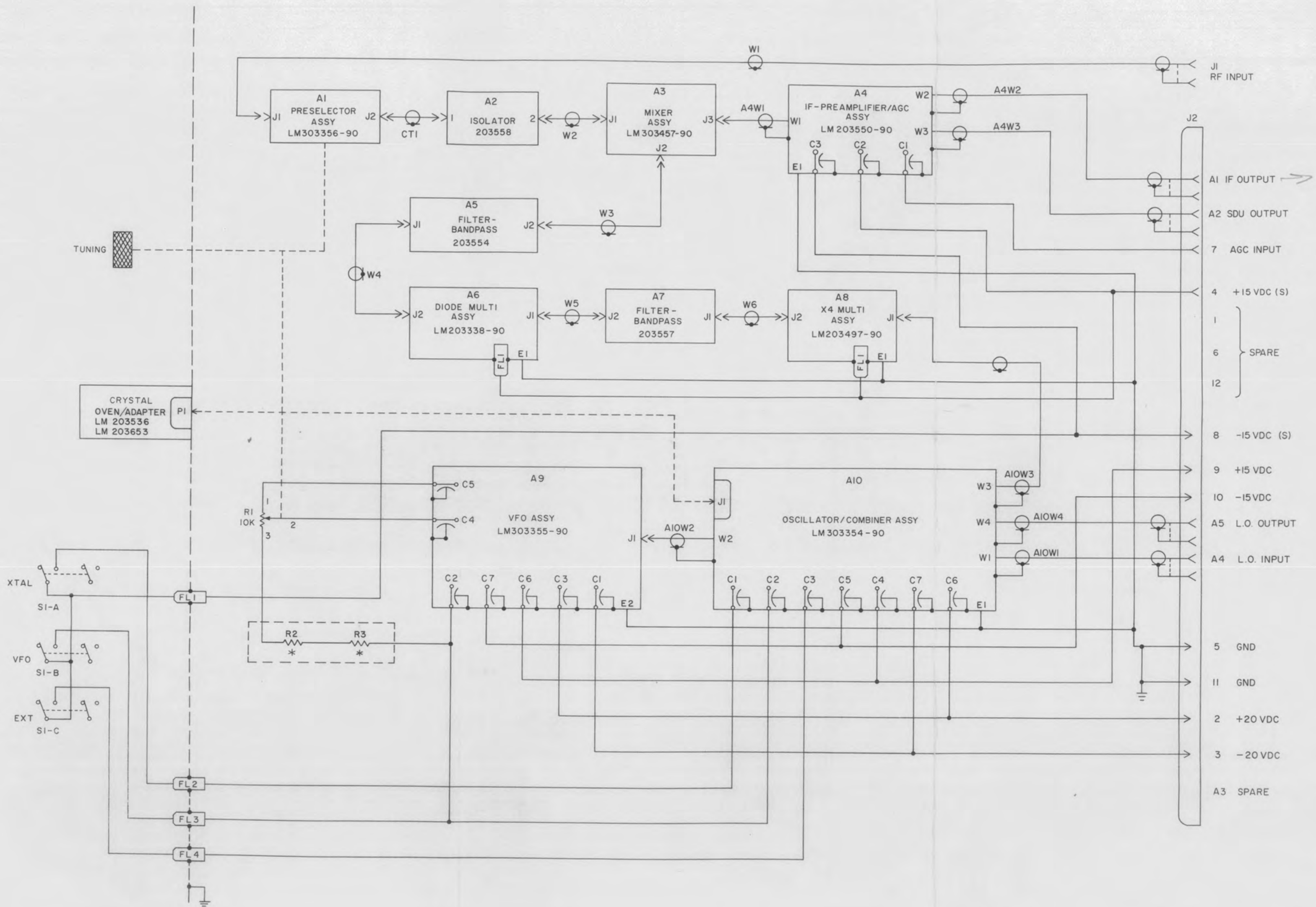


Figure 7-2. Model TU-74-SA RF Tuner Schematic Diagram E401627

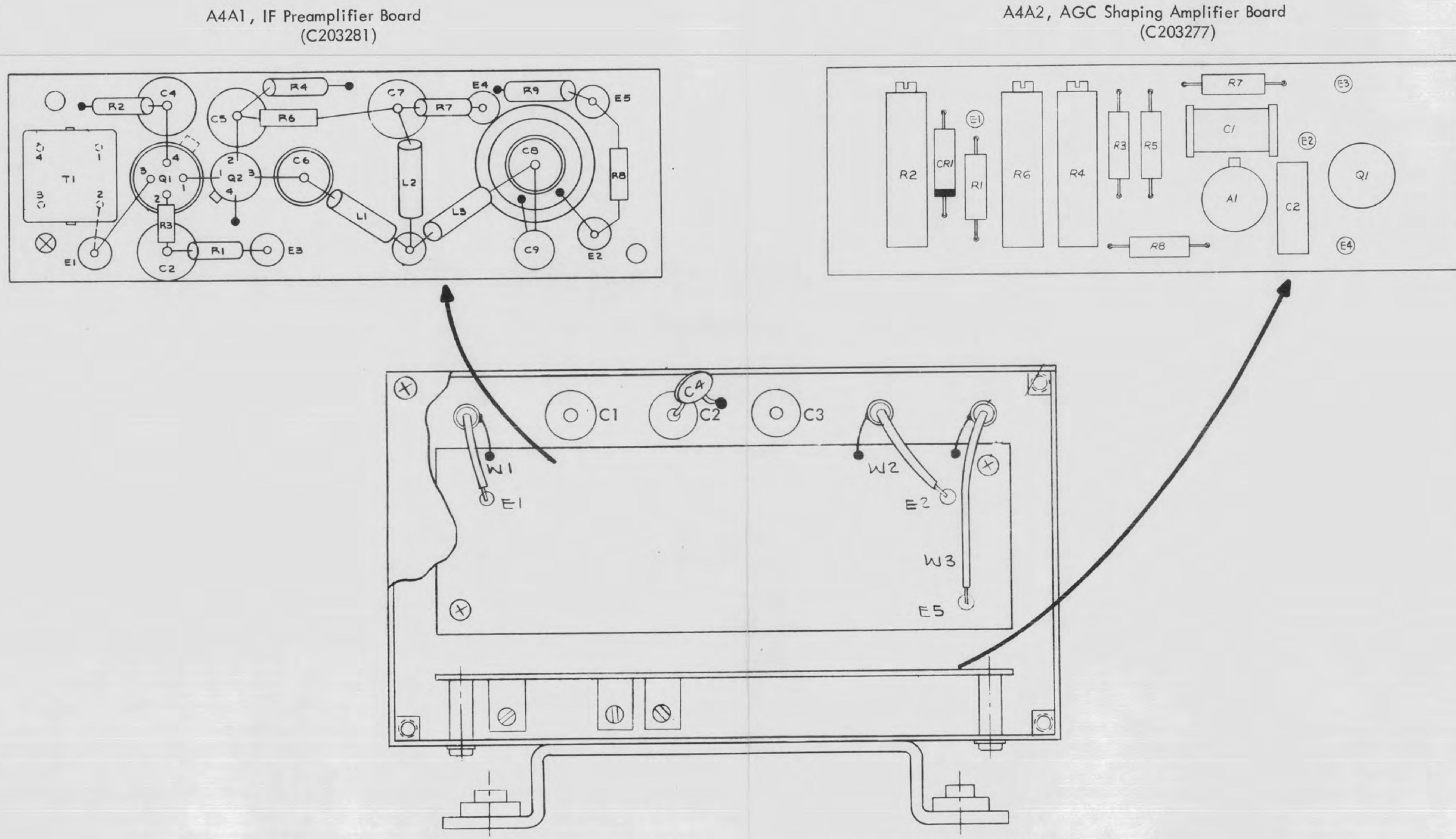


Figure 7-3. IF Preamplifier/AGC Assembly, A4
Assembly Drawing C203550

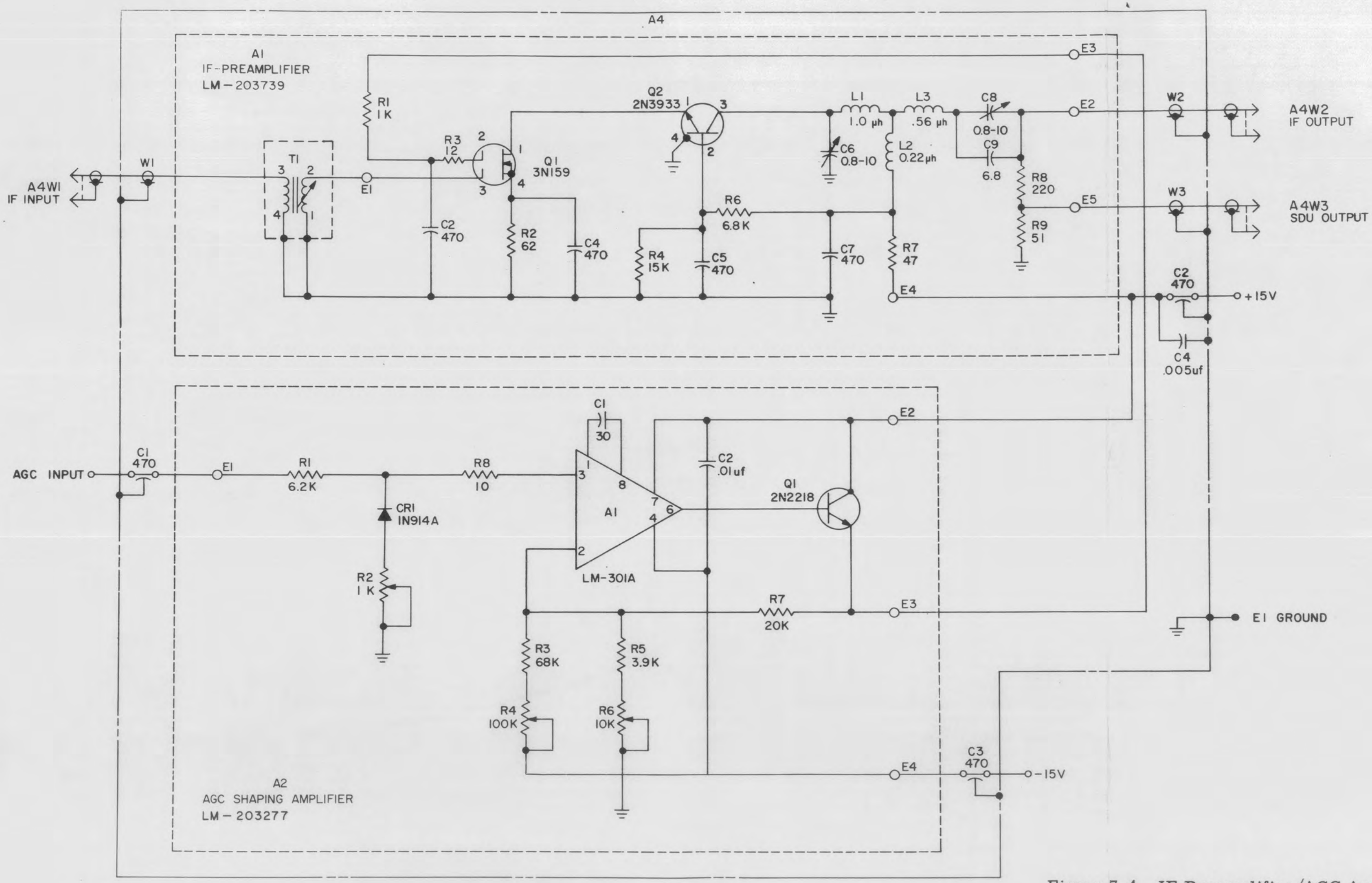
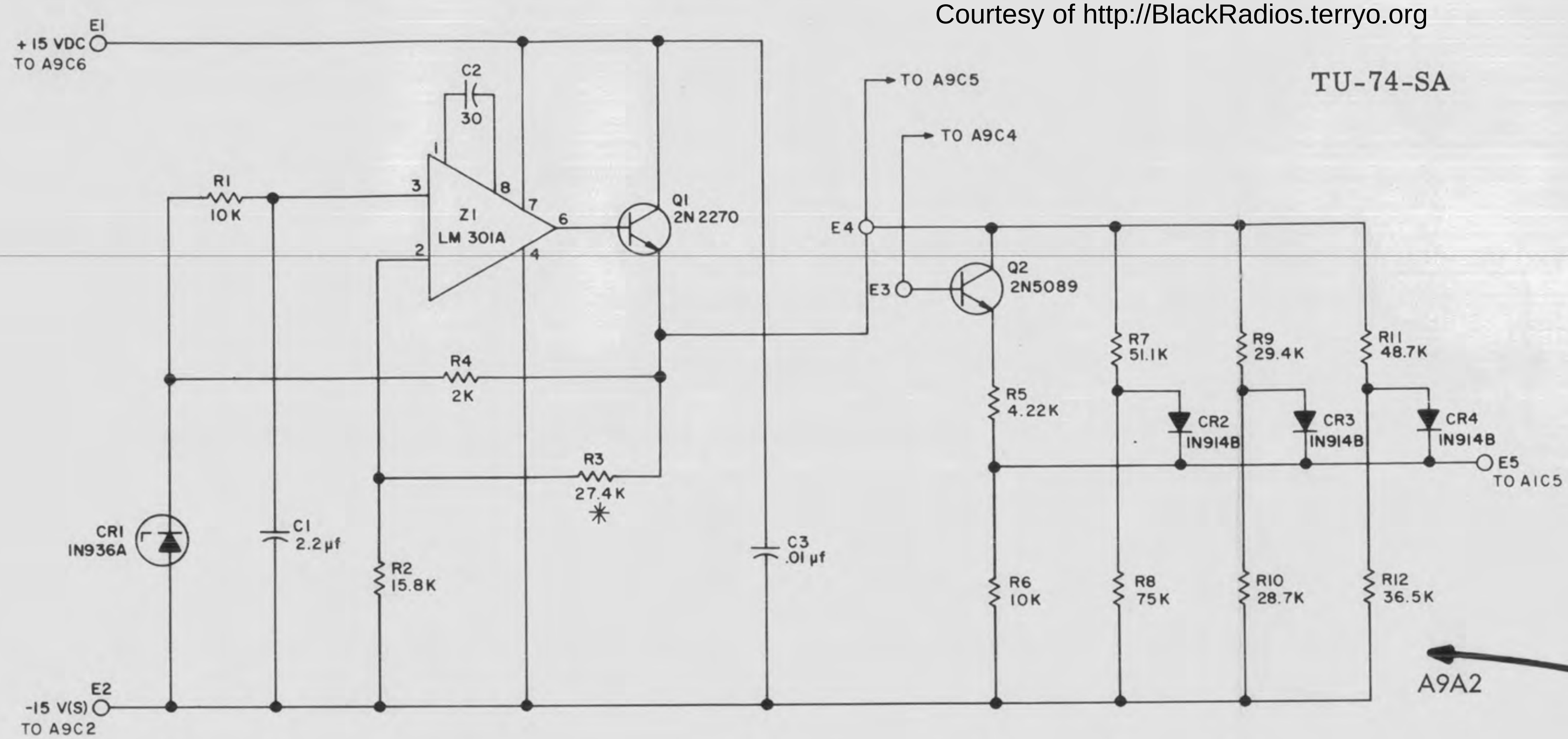
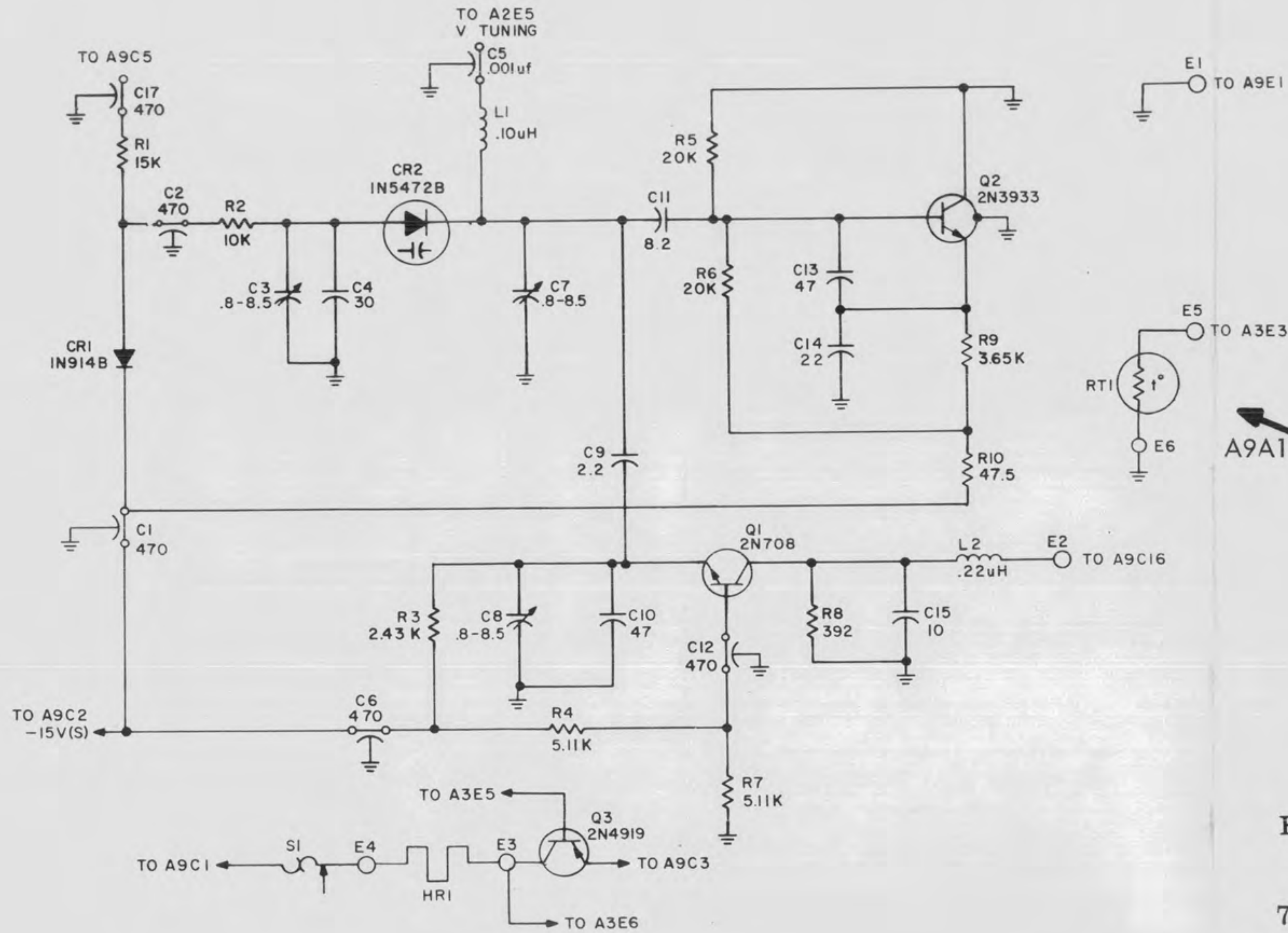


Figure 7-4. IF Preamplifier/AGC Assembly, A4
Schematic Diagram D303473





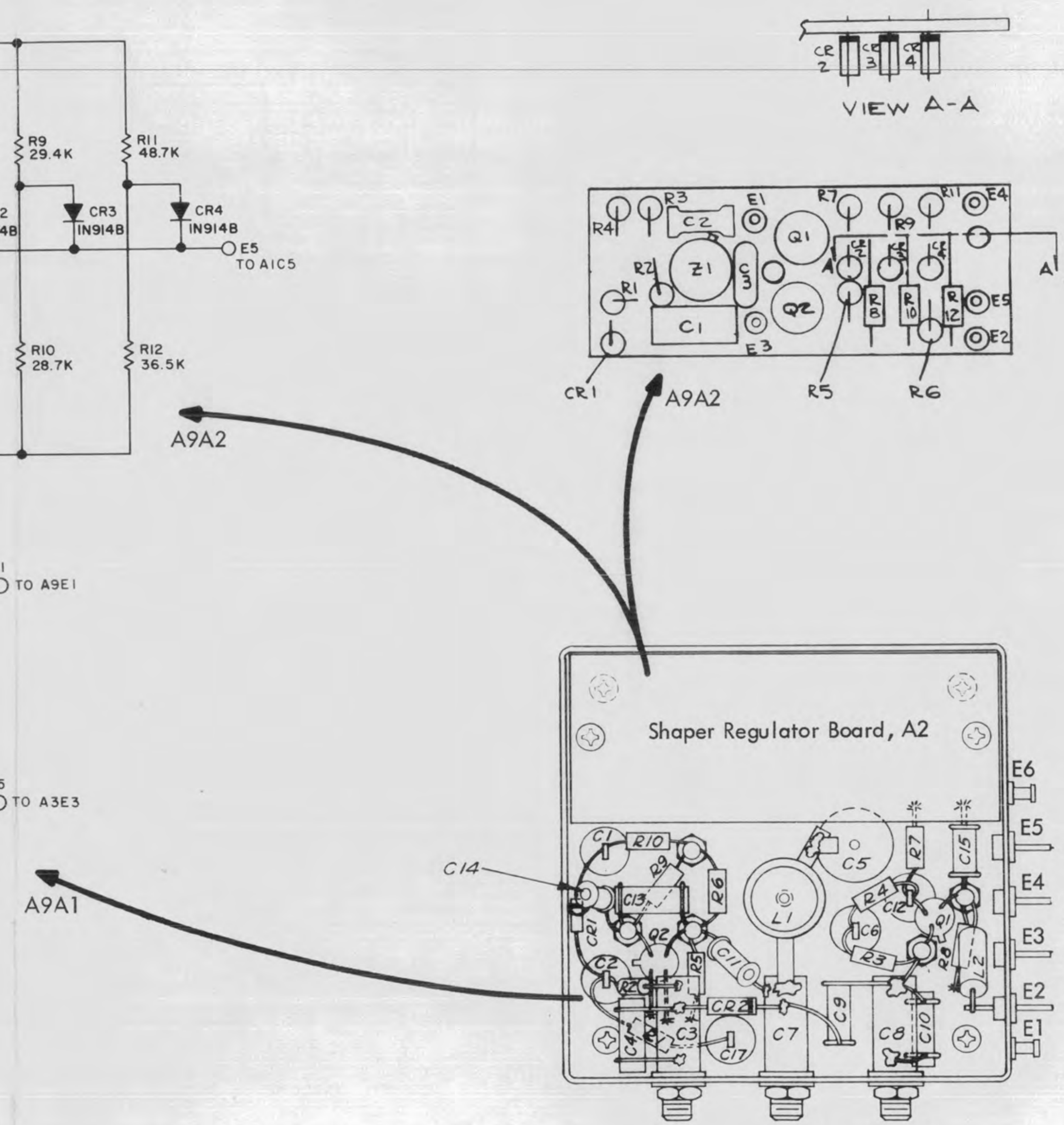


Figure 7-5. VFO Assembly A9,
Schematic and Assembly Drawings (Sheet 1 of 2)

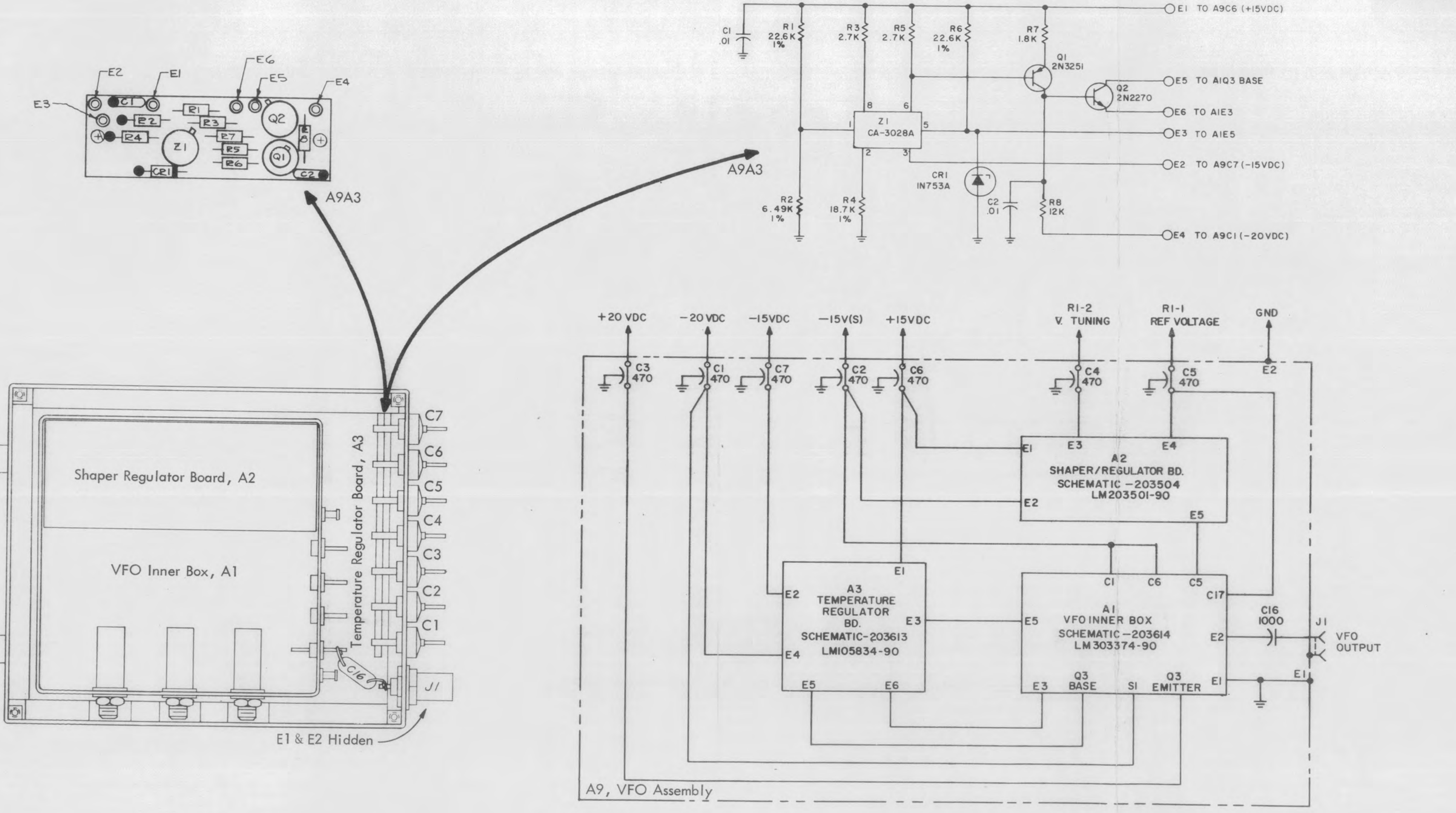


Figure 7-5. VFO Assembly A9, Schematic and Assembly Drawings (Sheet 2 of 2)

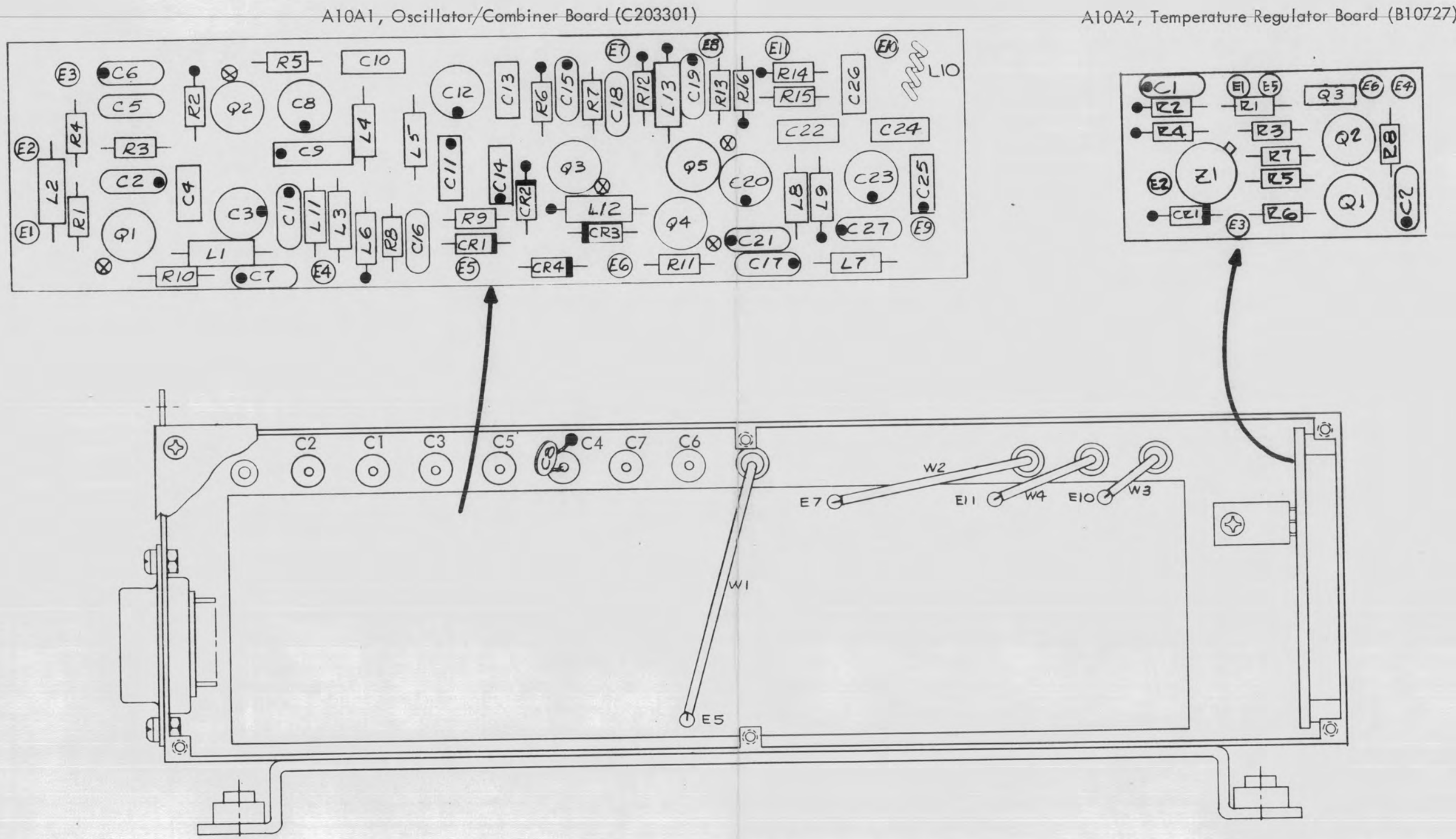


Figure 7-6. Oscillator/Combiner Assembly, A10
Assembly Drawing D303354

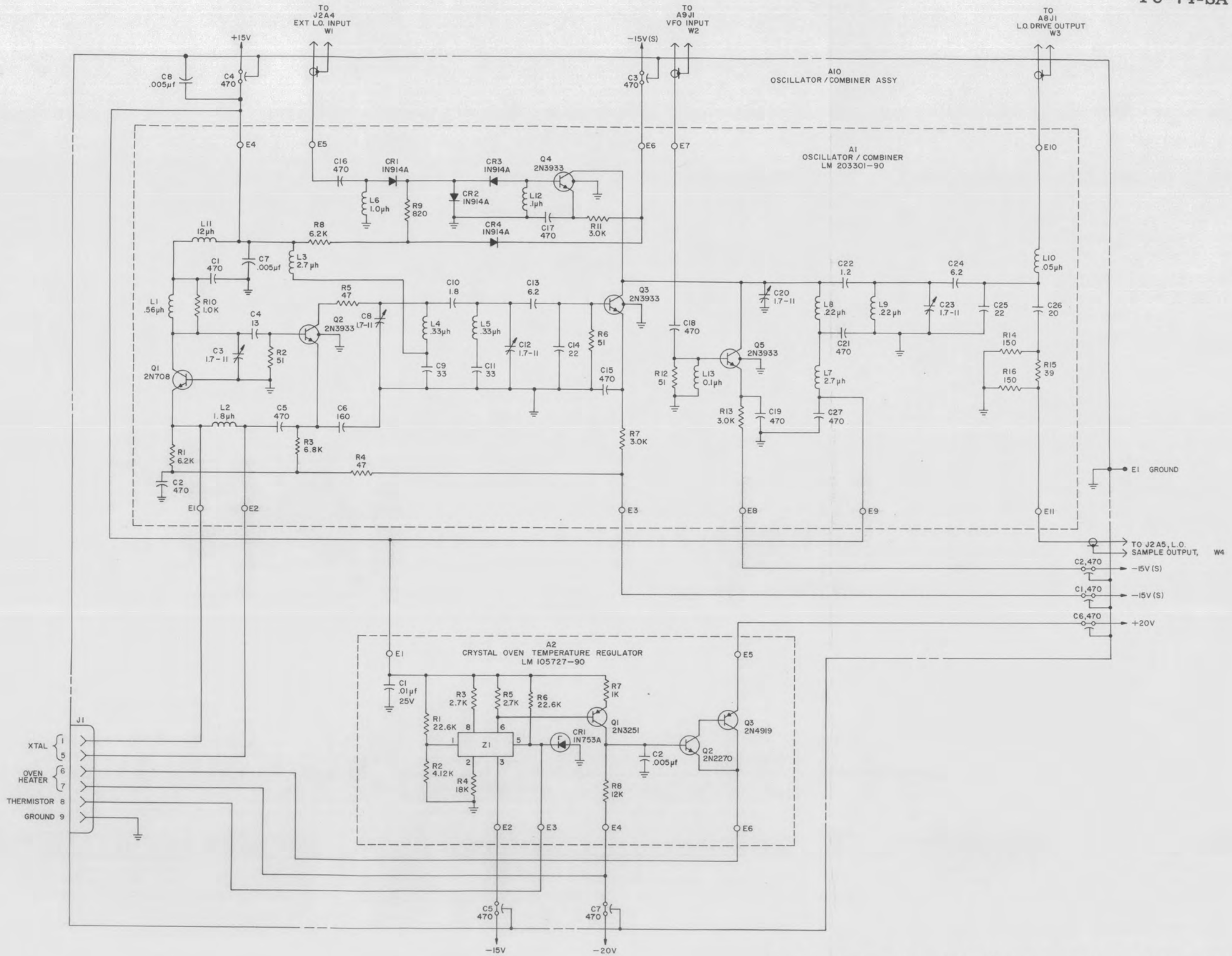


Figure 7-7. Oscillator/Combiner Assembly, A10 Schematic Diagram E401626

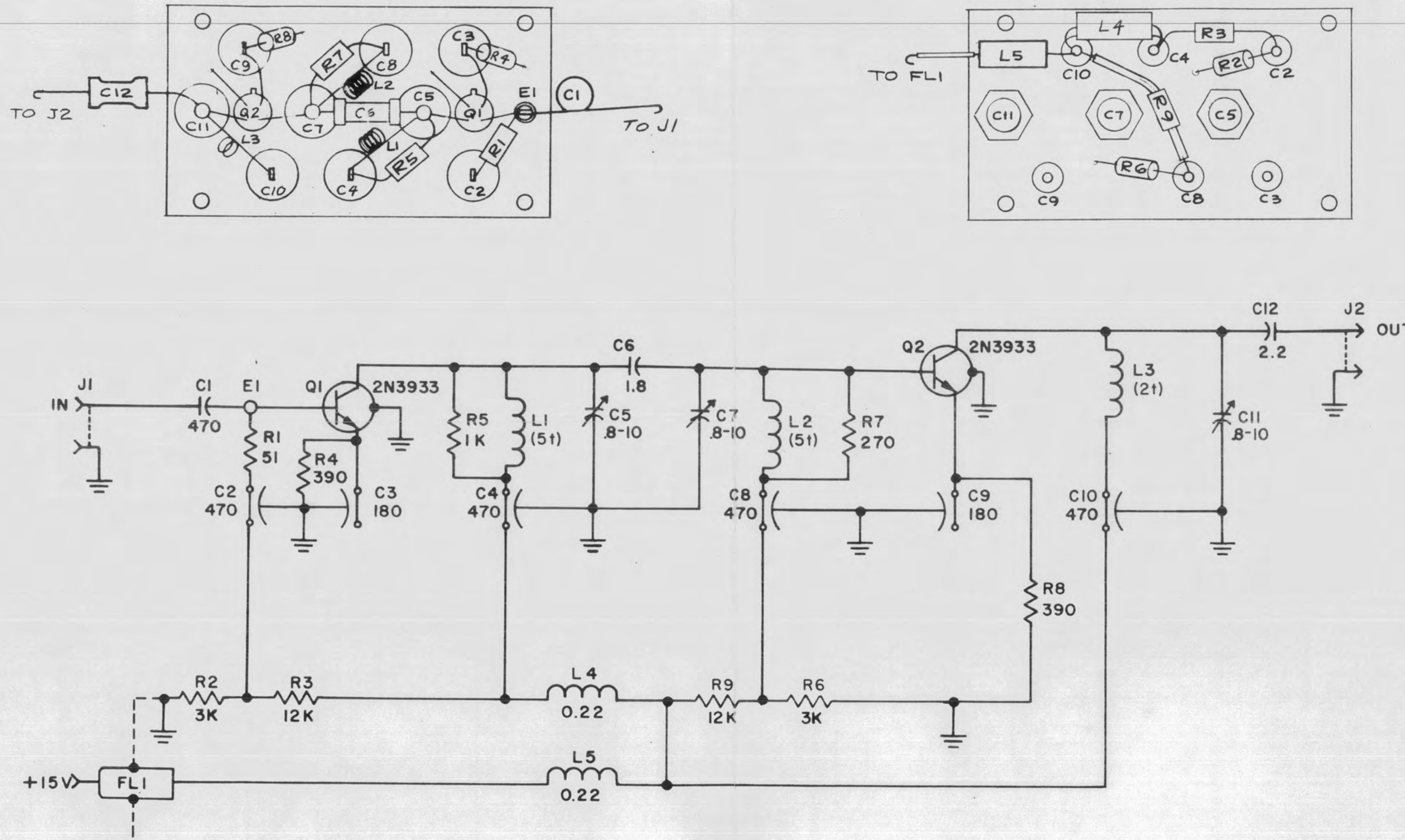


Figure 7-8. X4 Multiplier Assembly, A8
Assembly Drawing C203497 (top)
Schematic Diagram C203500 (bottom)

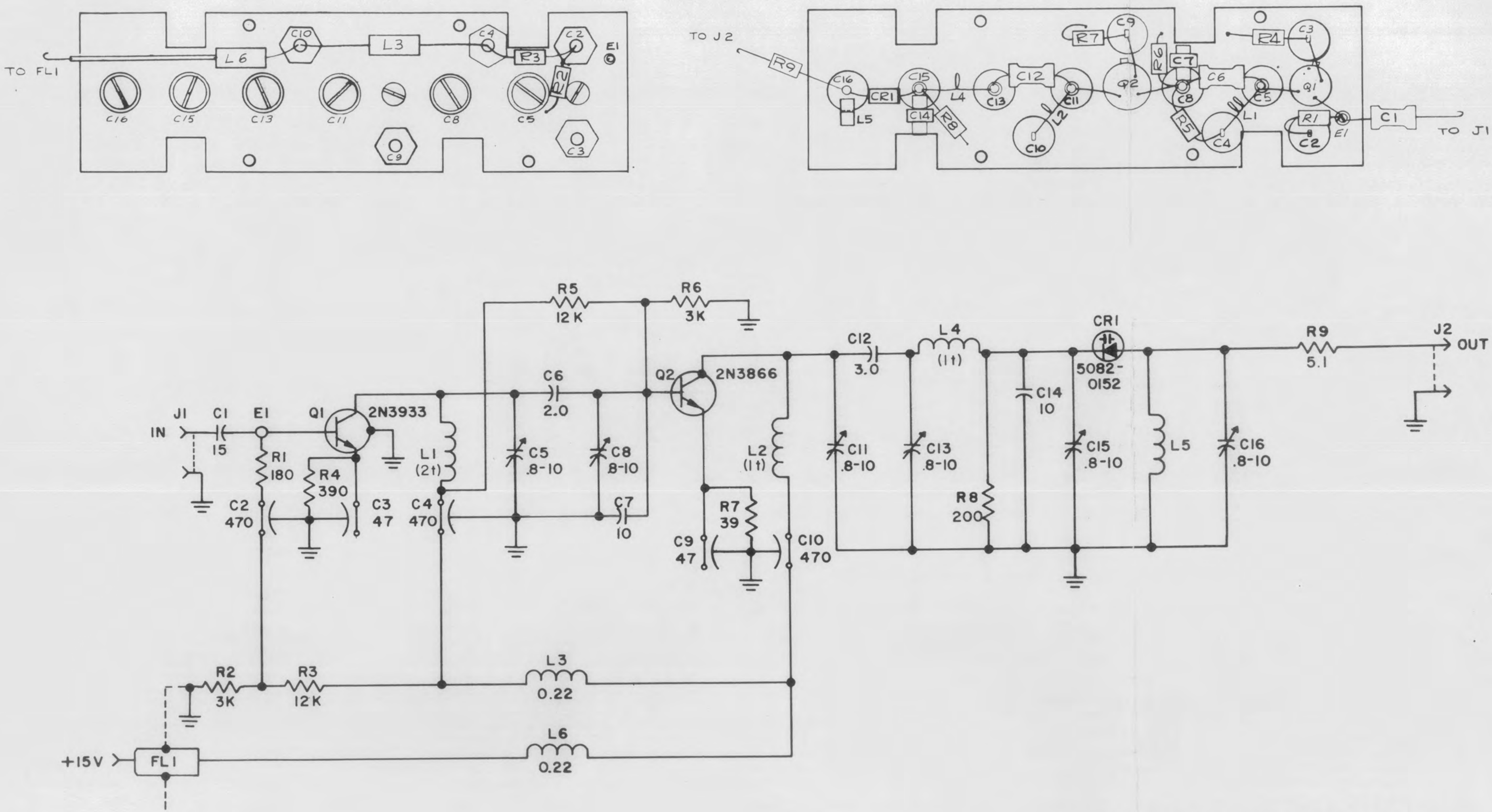


Figure 7-9. Diode Multiplier Assembly, A6
Assembly Drawing C203338 (top)
Schematic Diagram C203341 (bottom)

Defense Electronics, Inc. Rockville, Maryland