INSTRUCTION MANUAL

FOR

TYPE VH-107 TUNING HEAD

WATKINS-JOHNSON COMPANY
700 QUINCE ORCHARD ROAD
GAITHERSBURG, MARYLAND 20760

CWK 8/78

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Paragraph Page

SECTION V

REPLACEMENT PARTS LIST

SECTION VI

SCHEMATIC DIAGRAMS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

Table 1-1. Type VH-107 Tuning Head, Specifications

Tuning Range	100-400 MHz (2 Bands)
Input Impedance	50 ohms, nominal
Input VSWR	3.0:1, maximum
Noise Figure	7.5 dB low band, 9.0 dB high band
Gain and Noise Figure Product	30 dB, ±3 dB
3rd Order Intermod Intercept Point (Referred to input, in band)	-10 dBm minimum
Frequency Stability	LO frequency drift less than 20 kHz/hour at constant temperature after one-hour warm-up
IF Rejection	60 dB, minimum (100-200 MHz) 70 dB, minimum (200-400 MHz)
Overall Bandwidth	3 MHz, minimum
Tape Dial Accuracy	±1%
Fine Tuning Range	0.05% of tuned frequency
Image Rejection	70 dB, minimum
LO to Antenna Conduction	5 μV, maximum
Local Oscillator Output Level	50 mV, minimum across 50-ohm load
Gain Control Range	30 dB, minimum
Weight	6 lbs., approximately
Overall Size	5.0 inches wide, 3.2 inches high, and 16 inches deep

Figure 1-1. Type VH-107 Tuning Head

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The type VH-107 Tuning Head is a dual-band double-conversion unit designed as a plug-in accessory for receivers such as the 560, 565 and 566 Series Receivers. The VH-107 provides coverage of the 100-400 MHz frequency range in two bands with a 3 MHz overall bandwidth. It converts RF signals within this range down to a 21.4 MHz IF output which is processed by the associated receiver. The 560 Receiver is designed to demodulate AM, FM and CW signals whereas the 565, 566 Series Receivers demodulate AM, FM, CW and pulse signals. Initial conversion of incoming signals is from the RF frequency down to 60 MHz. This frequency is translated down to the 21.4 MHz output by a separate subassembly on the tuning head.

Operating power for the VH-107 Tuning Head and signal inputs and outputs are made through multipin and coaxial receptacles on the rear of the unit. These connectors mate with "floating" jacks which are mounted in the rear of the tuner housing on the associated receiver.

The VH-107 provides for a DAFC input so that the tuned frequency when used in conjunction with the 560 or 565 Series Receiver, can be controlled with an optional external frequency counter. The digital automatic frequency control circuits in the frequency counter lock the LO in the tuner to the counter pre-set. When the DAFC is used, it counteracts LO drift resulting in greater receiver stability.

1.2 MECHANICAL CHARACTERISTICS

The front panel and main chassis of the VH-107 are constructed of aluminum. Grey enamel is used to finish the front panel which is overlaid with a black-anodized etched bezel that contains the control markings. Mounted on the front panel are the Main Tuning Knob and tape dial, the FINE TUNING control, the BAND SELECT switch and two black knobs used to lock the tuning head housing in the receiver.

On the rear apron of the tuning head (Figure 5-2) are mounted two multi-pin Deutsch connectors plus two push-on coaxial plugs. The two rods which are used to lock the tuning head in place in the receiver also protrude from the rear apron. A pair of alignment holes located above the locking rods mate with pins that are hardmounted on the rear of the tuning head housing in the receiver. This ensures that the tuning head is properly aligned before the connectors are mated.

All of the subassemblies mounted on the main chassis of the VH-107 constitute a 100-400 MHz RF tuning assembly. This assembly consists of a Type 71452 100-400 MHz Tuner, a Type 71453 60/21.4 MHz Converter Assembly and a Type 7794

Oscillator/Gear Train Assembly. The RF tuner and converter are constructed on Teflon fiberglass printed circuit boards mounted in brass chassis which have been plated with precious metals to prevent tarnishing and to increase conductivity. Overall dimensions of the VH-107 are 5 inches wide, 3.2 inches high, and 16 inches deep. The tuner weighs approximately 6 pounds.

1.3 EQUIPMENT SUPPLIED

This equipment consists of the VH-107 Tuning Head only.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The VH-107 is incapable of independent operation and requires a compatible receiver. The receiver will supply the required operating power and signal connections. If digital automatic frequency control (DAFC) is desired, a compatible frequency counter having DAFC capability must be used.

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

2.1.1 Examine the shipping carton for damage before the equipment is unpacked. If the carton has been damaged, try to have the carrier's agent present when the equipment is unpacked. If not, retain the shipping cartons and padding material for the carrier's inspection if damage to the equipment is evident after it has been unpacked.

2.1.2 See that the equipment is complete as listed on the packing slip. Contact Watkins-Johnson Company, CEI Division, or your Watkins-Johnson representative with details of any shortage.

2.1.3 The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. It is, therefore, ready for use upon receipt. After uncrating and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. Inspect the internal components for apparent damage. Check the internal cables for loose connections.

2.2 INSTALLATION

The VH-107 Tuning Head is a plug-in unit designed to operate exclusively with the Types 560, 565 and 566 Series Receivers. Operating voltages as well as RF input and output signals are applied to the tuning head through rear-apron connectors that mate with receptacles in the tuning head housing in the receiver. To install the tuning head, insert it into the housing in the receiver and slide it all the way back until the connectors are fully seated. Tighten the two locking knobs by rotating them fully clockwise.

2.3 OPERATION

Selection of the desired frequency is made with the BAND SELECT switch and Main Tuning Knob. Vernier adjustment of the frequency can be made with the FINE TUNING control. The tape dial is illuminated when the receiver is turned on, and it displays the frequency selected in easy-to-read white numerals for each band.

2.4 PREPARATION FOR RESHIPMENT AND STORAGE

2.4.1 If the unit must be prepared for reshipment, the packaging methods should follow the pattern established in the original shipment. If retained, the original materials can be reused to a large extend or will, at a minimum, provide guidance for the repackaging effort.

2.4.2 If time permits, contract packing and packaging firms can be found in many cities. Based on an examination of the equipment and the proposed method of shipment, these firms can usually perform a reliable repacking service.

2.4.3 As a minimum, cover the painted surface of the unit with wrapping paper. Pack the unit securely in a strong corrugated container (350 lb/sq inch bursting test) with 2-inch rubberized hair pads placed along all surfaces of the equipment. If rubberized hair is not available, use a 6-inch layer of excelsior. If neither of these filler materials are available, use crumpled paper, rags, or any other available materials to provide as much cushioning as possible.

2.4.4 Conditions during storage and shipment should normally be limited as follows:

(1) Maximum humidity: 95% (no condensation)

(2) Temperature range: -30°C to +85°C

Figure 2-1. VH-107 Tuning Head Critical Dimensions Drawing

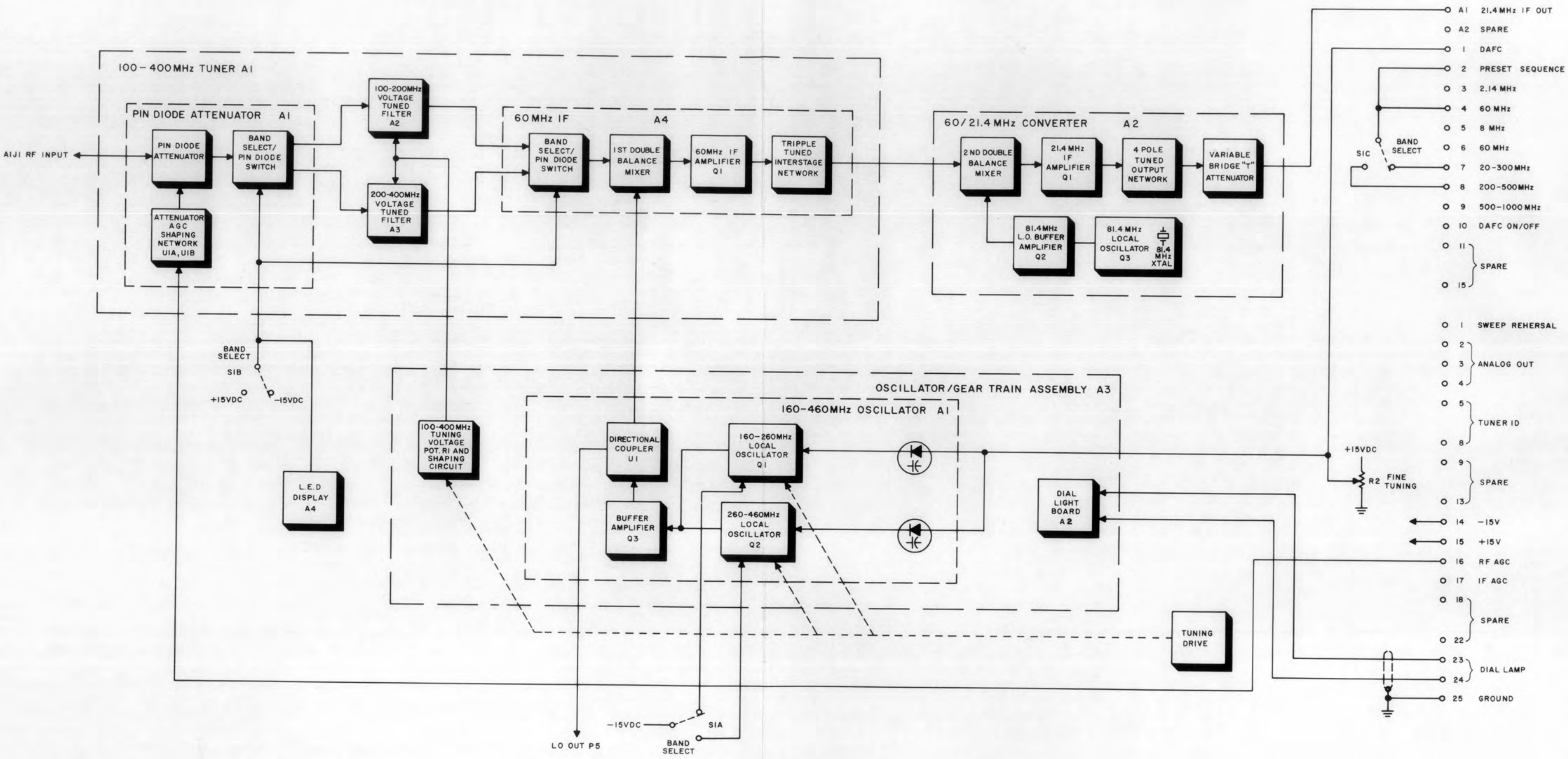


Figure 3-1. VH-107 Tuning Head
Functional Block Diagram 43778

SECTION III

CIRCUIT DESCRIPTION

3.1 GENERAL

The following paragraphs contain functional and electrical descriptions of the circuits in the Type VH-107 Tuning Head. The functional description is orientated to the block diagram level, whereas the detailed circuit descriptions are orientated to the schematic diagram level. A functional block diagram of the VH-107 is shown in Figure 3-1. The schematic diagrams for the tuning head are shown in Figure 6-1 through 6-4. Note that the unit numbering method is used for all electrical components. This means that parts on the sub-assemblies in the tuning head carry a prefix before the usual class letter and number of the item (such as A1A1U1 and A1A1C3). These prefixes are omitted in the detailed descriptions and in the illustrations except in some cases where confusion might result from their omission.

3.2 FUNCTIONAL DESCRIPTION

The Type VH-107 Tuning Head is a double-conversion, super heterodyne unit designed to select, amplify, and convert RF signals in the 100-400 MHz frequency range down to a 21.4 MHz IF output. This tuning head is used with receivers such as the Types 560, 565 and 566 Series Receivers which demodulate the IF output from the tuner.

3.2.1 Incoming RF signals to the tuning head are obtained from an RF limiter sub-assembly located in the associated receiver. These signals are connected to P2 on the tuning head through a mating coaxial connector in the tuner housing. The RF signals are coupled through A1A1C1 to the Pin Diode Attentuator. The Pin Diode Attenuator controls the level of the RF signals entering the tuning circuits relative to the Automatic Gain Control (AGC) voltage at A1C3. The Pin Diode Attenuator network is designed to maintain a 50Ω input and output impedance over the 0-30 dB attenuation range. To achieve constant input and output impedances, the series RF resistance branch established by A1A1CR1 bias, and the shunt RF resistance branch established by A1A1CR2 and A1A1CR3 bias, must change in opposite directions in a non-linear manner. The attenuator shaping network controls the biases on the pin diodes to produce the non-linear change. Since the resistance vs. forward bias current relationship of a pin diode is non-linear, it is necessary to shape the AGC voltage to the pin diode attenuator. The Attenuator Shaping Network converts a single AGC voltage into two shaped voltages to bias the pin diodes and produce a linear attenuation of the RF signals relative to the magnitude of the AGC voltage. The RF signals leave the pin diode attenuator and, through a micro-strip transmission line, enter the Band Select/Pin Diode Switch. The RF signals enter the pin diode switch at the anode of CR7 and the cathode of CR4. Depending on the bias present across the switch diodes, the signals are fed either to the 100-200 MHz tuning circuit or to the 200-400 MHz tuning circuit through diodes CR5 and CR8 respectively. The front panel BAND SELECT switch S1B controls the bias applied to the diodes.

3.2.2 The RF signals enter either the 100-200 MHz band or the 200-400 MHz band Tuning Circuit from the pin diode switch. The tuning voltage for the varactors is fed to each circuit at E2 from the tuning voltage shaping circuit located in the Oscillator/Gear Train Assembly (A3). The tuning potentiometer A3R1 is adjusted by the front panel Main Tuning Knob. Each tuning board has an RF amplifier U1 after the first varactor tuning network followed by a buffer amplifier Q1 to isolate the local oscillator frequency from the RF input stages. The RF tuned signal leaves the last varactor tuning network and is fed to the second Band Select/Pin Diode Switch.

3.2.3 The second Band Select/Pin Diode Switch is identical to the switch at the input to the tuning circuits. It serves to terminate, by grounding, the output of the tuning circuit that is not being used. The direction of the switch is controlled by the BAND SELECT switch S1B on the front panel. The RF signal enters the First Mixer A1A4U1 on pin R where it is beat with the local oscillator frequency. The mixer supresses the sum, local oscillator and RF frequencies and produces predominantly the difference frequency. The local oscillator supplies a LO frequency of 60 MHz above the tuned RF frequency to pin L producing an IF frequency of 60 MHz at the output pin I of the mixer. The 60 MHz IF frequency is coupled to the first IF amplifier Q1. The collector of Q1 is connected to a triple tuned filter with a center frequency of 60 MHz to provide for additional selectivity and rejection of the LO frequency.

3.2.4 The Oscillator/Gear Train Assembly supplies the first LO frequency to the First Mixer A1A4U1 pin L. The first local oscillator contains two oscillator circuits, and has a frequency range of 160-260 MHz in one circuit and 260-460 MHz in the other. The BAND SELECT switch selects the LO frequency range in conjunction with the RF band being used. The LO frequency is tuned to always be 60 MHz above the tuned RF frequency. The Main Tuning Knob on the front panel is used to adjust for the tuned RF frequency and the LO frequency via the gear train assembly and the tuning components. Each of the oscillators, Q1 and Q2, can be fine tuned by the front panel Fine Tuning potentiometer R1 and a varactor tuning circuit. R1 controls the reverse bias on varactor CR1 and CR2. The varactor circuits function in the same manner as those used in the 100-400 MHz tuner. The varactor bias can also be controlled by the Digital Automatic Frequency Control (DAFC) voltage, when the associated receiver is being used in conjunction with an optional external frequency counter. The DAFC voltage from the counter is applied to varactors CR1 and CR2 at E1 and E5 respectively. The buffer amplifier Q3 receives the oscillator outputs through coupling capacitor C10 or C18 at its base. The buffer amplifier isolates the LO from spurious RF signals from the tuner entering the LO circuitry, and matches the LO circuit output impedance to the input impedance of the directional coupler. The directional coupler feeds a portion of the LO frequency to the LO OUT monitor jack P5, and the main portion of the LO frequency to A3J2 where it is connected to the LO input to the first mixer at A4J1.

3.2.5 The second mixer A2A1U1 converts the 60 MHz IF to 21.4 MHz by beating the 60 MHz IF frequency with the output of an 81.4 MHz oscillator Q3, to produce a difference frequency of 21.4 MHz. The double balance mixer is a sealed unit. It suppresses the second LO and the 60 MHz IF. The 81.4 MHz oscillator Q3 is a crystal controlled Colpitts type. Its output is fed to a buffer amplifier A2A1Q2. The 21.4 MHz IF frequency is coupled by C3 from the second mixer to the base of the 21.4 MHz IF amplifier. After amplification the IF signal is fed through a four pole tuned filter. The filter is tuned to a center frequency of 21.4 MHz and has a bandwidth of 3.5 MHz. The second IF then passes through a variable bridge "T" attenuator A2A1R10 by which the overall tuner gain from RF-in to IF-out is set. The 21.4 MHz signal then leaves the VH-107 tuner head through P7A1 into the associated receiver in which the VH-107 is mounted.

3.3 DETAILED CIRCUIT DESCRIPTION

The detailed circuit description in the following paragraphs is orientated to the schematic diagram level. Reference should be made to the schematic diagrams, Figures 6-1 through 6-4. The unit numbering prefixes are omitted in the circuit description except where confusion might result from their omission.

3.3.1 100-400 MHz TUNER (A1)

The 100-400 MHz Tuner has a reference designation of A1. This assembly contains four subassemblies as follows. The Pin Diode Attenuator, reference designation (A1). 100-200 MHz RF Tuner, reference designation (A2). 200-400 MHz RF Tuner, reference designation (A3). 60 MHz IF, reference designation (A4). The schematic diagram for this assembly is Figure 6-1.

3.3.1.1 PIN DIODE ATTENUATOR (A1A1)

The reference designation prefix for components described in this subassembly is A1A1. The RF signals enter the board from RF input A1J1 and coupling capacitor C1 to the pin diode pi-attenuator. The Pin Diode Attenuator network is designed to maintain a 50 Ω input and output impedance over the 0-30 dB attenuation range. The attenuation of the RF signal is affected by the level of AGC voltage fed to the Pin Diode Attenuator Shaping Network (described in paragraph 3.3.1.1.1) and the shaped voltage level applied to the Pin Diode Attenuator from the Shaping Network. An increase in RF signal strength results in an increased negative AGC voltage level and thereby an increase in the attenuation of the RF signal through the Pin Diode Attenuator. For maximum attenuation to the RF signal, CR1 must be a high RF resistance path and CR2 and CR3 must be a low RF resistance path. For minimum attenuation the opposite is true. To maintain an overall 50Ω impedance characteristic for the network all three diodes must change their RF resistance in the same relationship. Refer to simplified diagram Figure 3-2. Pin diodes exhibit an inverse RF resistance vs. forward bias current relationship. As the forward bias increases, the RF resistance decreases; or if the forward bias decreases the RF resistance increases. Pin diode CR1 bias current is supplied by operational amplifier U1B through R5 and L1 to

CR1 anode and returned through L2 to ground. Pin diodes CR2 and CR3 bias current is supplied by operational amplifier U1A through R1 and R2 to the anodes of CR2 and CR3 respectively, and returned directly to ground. For a condition of minimum attenuation to the RF signal, CR1 is forward biased with approximately 5.8 volts and CR2 and CR3 are biased at approximately 0.0 volts. For increased attenuation to the RF signal the bias on CR1 is decreased from 5.8V towards 0.0 volts, and the voltage on diodes CR2 and CR3 increased towards 5.8 volts. Thus the bias voltages from the operational amplifiers U1A and U1B control the overall attenuation of the pin diode network but a 50Ω characteristic impedance is maintained.

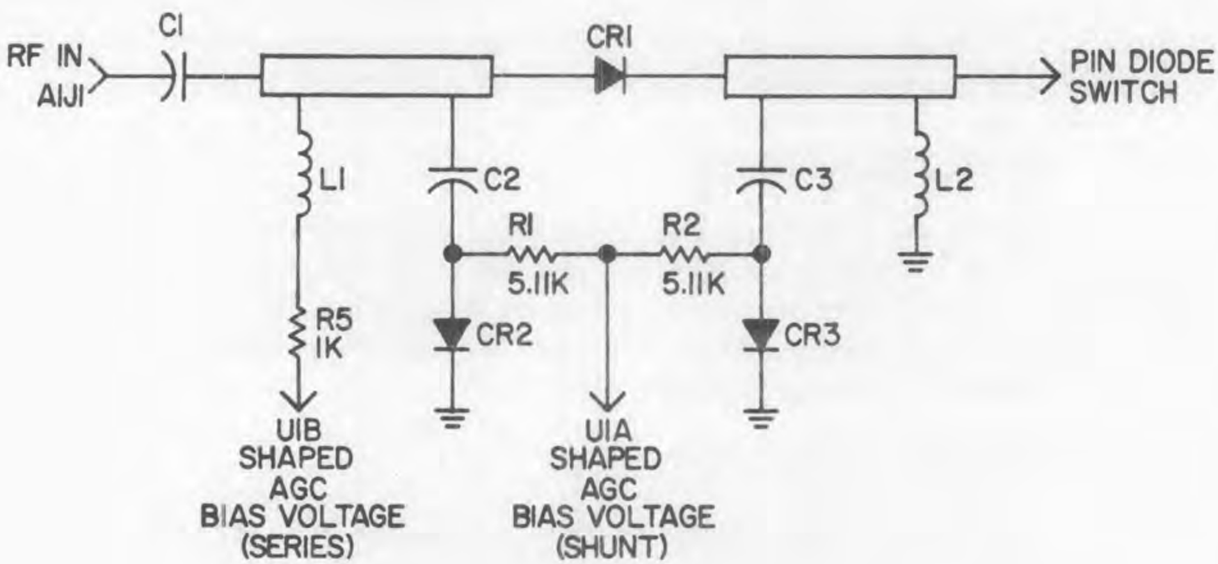


Figure 3-2. Pin Diode Attenuator Simplified

3.3.1.1.1 The Pin Diode Attenuator Shaping Circuit is located on the Pin Diode Attenuator subassembly. Since the RF resistance vs. forward bias current relationship of a pin diode is non-linear it is necessary to shape the AGC voltage to the Pin Diode Attenuator. As can be seen from the simplified schematic diagram (Figure 3-3), circuits on this board can be conveniently divided into two stages, U1A and U1B. U1A and U1B and their associated circuitry convert the single AGC voltage into two shaped voltage signals. U1B provides the bias voltage to the series pin diode CR1 and U1A to the shunt pin diodes CR2 and CR3. Note that the output of stage U1A drives stage U1B. Voltage regulator diode VR1 and thermistor RT1 provide DC voltage stability for the two stages. Stage U1A receives AGC voltage at E4. Under no-signal conditions the AGC voltage will be at zero. Under strong-signal conditions the AGC voltage will be at or approaching its maximum - 10 Vdc. If diode CR12 were not in the circuit, AGC voltage applied to the inverting input of U1A would cause the output to go positive in a linear relationship. Having CR12 in the circuit however, modifies that relationship. The anode of CR12 is held at -1.5 Vdc by R23 and R24, maintaining a reverse bias on the diode. Not until the cathode becomes more negative than the anode does CR12 conduct. When that occurs, further increase in AGC voltage is attenuated by CR12, and the slope of the voltage curve at U1A pin 1 is reduced. This effect gives

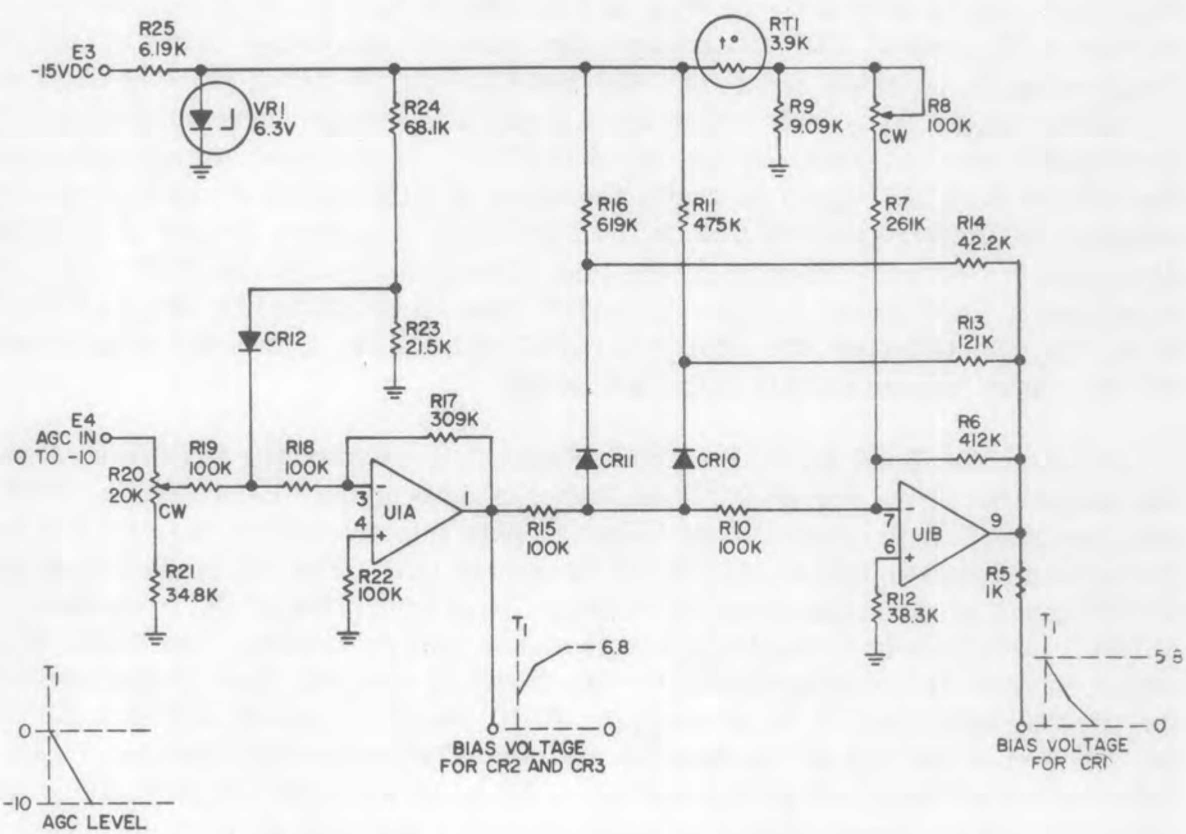


Figure 3-3. Pin Diode Attenuator Shaping Circuit Simplified

an output voltage curve at U1A pin 1 similar to that shown in Figure 3-3 as "bias voltage for CR2 and CR3." Therefore, as AGC voltage goes negative due to increased RF signal strength, so the output of U1A follows a positive going curve forward biasing CR2 and CR3 in the Pin Diode Attenuator, thereby shunting some of the RF signal to ground. Stage U1B receives the shaped voltage from the output of U1A. If diodes CR10 and CR11 were not in the circuit, the output from U1B would be a negative-going voltage having a single break point from the effect of CR12. CR10 and CR11 however, produce two additional break points in the output signal at U1B pin 9 shown in Figure 3-3 as "bias voltage for CR1." When the input voltage to R15 rests at zero volts, the inverting input of U1B is biased slightly negative through R7, so that the output is at +5.8 volts. With +5.8 volts at the output of U1B, the cathode of CR10 is biased at about +3.35 volts, and the cathode of CR11 is biased at +5.0 volts. Under this condition the two diodes are reverse biased and therefore block the two parallel feedback circuits through R13 and R14 from U1B pin 9 to U1B pin 7. As the input voltage to R15 moves from zero volts towards +5.8 volts, the output of U1B moves from +5.8 volts towards zero volts. In doing so, first CR10 and then CR11 becomes forward biased. This effect places first R13 and then R14 in parallel with feedback resistor R6. This decreases the gain of U1B and reduces the slope of the output curve at U1B pin 9. Combined with the break points of CR10 and CR11 is the break point of CR12 in the preceeding stage, U1A. The effect of the diodes is a voltage curve consisting of three break points and four slopes at the output of U1B. As the AGC voltage goes negative due to increasing RF signal strength, the output of U1B follows a negative going curve reducing the forward bias on CR1 in the Pin Diode Attenuator, thereby attenuating the RF signal. The non-linearity in the bias signals from U1A and U1B are designed to produce a linear result to the relationship between pin diode bias and its RF resistance. The potentiometer R20 adjusts the AGC gain and R8 adjusts the balance between the two shaped voltage signals to the pin diodes.

3.3.1.1.2 The Band Select/Pin Diode Switch is located on the Pin Diode Attenuator sub-assembly. There are two Pin Diode Switch circuits in the VH-107 Tuner. Both circuits are identical in operation and therefore only this one will be described in detail. The other is located on the 60 MHz IF sub-assembly (A4). The Pin Diode Switch applies the RF signal to the required tuning circuit. It is controlled by the front panel BAND SELECT switch which is used to select the tuner band to be used. The BAND SELECT switch controls the bias applied to the pin diodes in the Pin Diode Switch circuit. If the 100-200 MHz band is to be used, the BAND SELECT switch applies a +15 Vdc to the junction of R3 and R4 as shown in the simplified schematic diagram Figure 3-4. Thus CR4 is forward biased through L2, CR5 is forward biased through the ground connection on the micro-strip resonator in, A1A2 and CR6 is reverse biased since its anode is tied to ground. Under this bias condition the three diodes CR4, CR5 and CR6 are biased such that the RF signal is fed through CR4 and CR5 to the 100-200 MHz tuner.

The same +15 Vdc bias level reverse biases CR7 through L2 and CR8 through the ground connection on the micro-strip resonator in A1A3. CR9 is forward biased

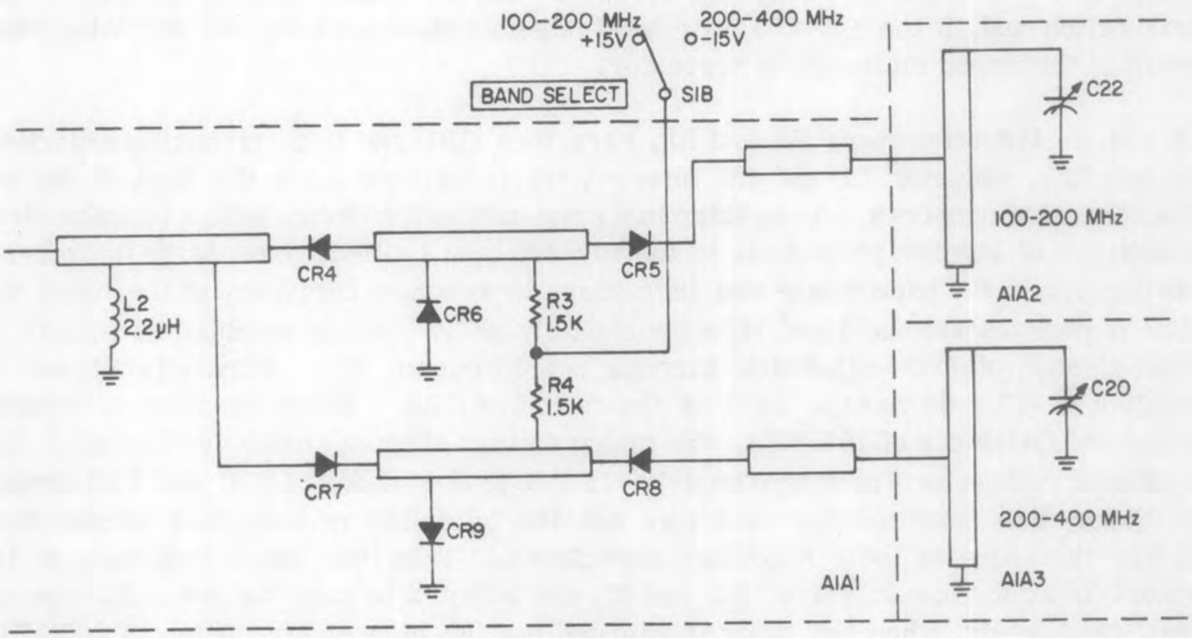


Figure 3-4. Band Select/Pin Diode Switch, Simplified

as its cathode is tied to ground. Therefore the RF signal is blocked by CR7 and CR8 from entering the 200-400 MHz tuner. CR9 shorts to ground any signal leakage in the circuit and terminates the input to the 200-400 MHz tuner when it is not being used. If the 200-400 MHz band is to be used the BAND SELECT switch applies a -15 Vdc to the junction of R3 and R4, and therefore the opposite biasing condition exists on all the diodes. The RF signal is then blocked from entering the 100-200 MHz tuner by CR4 and CR5, now reverse biased and CR6, now forward biased, terminates the signal to the 100-200 MHz tuner. The -15 Vdc forward biases CR7 and CR8 and reverse biases CR9 so that the RF signal is passed through to the 200-400 MHz tuner.

3.3.1.2 100-200 MHz TUNER CIRCUIT (A1A2)

The reference designation prefix for components described in this subassembly is A1A2. There are two tuning circuits in the VH-107 Tuner. A 100-200 MHz circuit described in this paragraph and a 200-400 MHz circuit. The 200-400 MHz circuit is identical in operation to the 100-200 MHz circuit except for two minor differences described in paragraph 3.3.1.3. The RF signal leaves the band select diode switch and, if the 100-200 MHz band is selected, enters the 100-200 MHz Tuner circuit at the tapped micro-strip resonator.

3.3.1.2.1 Potentiometers R4 and R5, varactors CR1 and CR2, trimming capacitors C22 and C23, inductor L1 and the micro-strip resonators form the first of the two varactor tuning networks. A varactor is a semi-conductor device with a characteristic capacitance of inverse proportion to the reverse bias applied. Increasing the reverse bias decreases the capacitance and increases the resonant frequency of the tuned circuit. A positive voltage level of approximately +13.5 Vdc is established across R1 on the cathode of CR1 adjustable through potentiometer R4. Similarly R5 and R6 establish a +13.5 dc voltage level on the cathod of CR2. When the tuner is adjusted for the end frequency of 100 MHz, the tuning voltage shaping circuit (paragraph 3.3.3) provides a voltage level of approximately +12 Vdc to the anodes of CR1 and CR2 through E2. Under this condition the varactors see the minimum reverse bias across them and are therefore at their maximum capacitance. Thus the tuned frequency of the network is at its lowest value. R4 and R5 are adjusted to trim the low end frequency level. Conversely, when the tuner is adjusted for the high end frequency of 200 MHz, the tuning voltage shaping circuit provides a voltage level of approximately -12 Vdc to the anodes of CR1 and CR2. Under this condition the varactors see the maximum reverse bias across them and are therefore at their minimum capacitance. Thus the tuned frequency of the network is at its highest value. C22 and C23 are adjusted to trim the high end frequency level. Components C2, C3 and C4 are decoupling capacitors to isolate the dc biasing voltage from the RF signal and provide an RF ground for varactor CR1 and CR2.

3.3.1.2.2 The tuned frequency is then fed to pin 2 of RF amplifier U1. It is then taken from pin 4 of U1 through coupling capacitor C9 to the gate of a buffer amplifier FET Q1. The DC bias for Q1 is established across R7, L8 and C10 forming a a de-coupling network for the bias circuit. The buffer amplifier Q1 produces a 6 dB gain to the RF signal but provides for a 40 dB isolation to minimize the conducted local oscillator frequency from the RF amplifier. The five section low pass matching network between the output gate of Q1 and the second tuning circuit performs as a 400 Ω to 50 Ω impedance matching network. Capacitors C12 and C14 are adjusted to trim the filter.

Potentiometers R16 and R17, varactors CR3 and CR4, trimming capacitors C24 and C25, inductor L12 and the micro-strip resonators form the second varactor tuning network. It is identical in operation to the first. The tuned RF signal is then fed to the Band Select/Pin Diode Switch network at the output of the tuning circuits.

This circuit is identical in operation to the pin diode circuit described in paragraph 3.3.1.1.2. Its function at this point in the tuner is described in paragraph 3.3.1.4.1.

3.3.1.3 200-400 MHz TUNER CIRCUIT (A1A3)

The reference designation prefix for components described in this sub-assembly is A1A3. The 200-400 MHz tuning circuit is electrically identical to the 100-200 MHz circuit described in paragraph 3.3.1.2 with the exception that it is triple tuned, and the buffer amplifier is built around a transistor Q1 instead of a FET. The varactor tuning network of CR3, R19 and C22 operates identically to the tuning circuit described in paragraph 3.3.1.2.1, as do the other tuning networks in this sub-assembly. Buffer amplifier Q1 produces a 6 dB gain to the tuned RF signal but provides for a 20 dB isolation to minimize the conducted local oscillator frequency from the RF amplifier. C10, R10, R11 and R12 form a two section low pass matching network between the buffer amplifier stage and the second tuning circuitry. R11 is selected during alignment to balance the gain between the 100-200 MHz and 200-400 MHz tuner circuits. The tuned RF signal is then fed from the triple tuned network to the input on the Pin Diode Switch described in paragraph 3.3.1.1.2. Its function at this point in the tuner is described in paragraph 3.3.1.4.1.

3.3.1.4 60 MHz IF AMPLIFIER (A1A4)

The reference designation prefix for components described in this sub-assembly is A1A4. This sub-assembly contains one of the Band Select/Pin Diode Switches, a double balance mixer and the 60 MHz IF Amplifier Q1.

3.3.1.4.1 The Band Select/Pin Diode Switch consisting of diodes CR1 through CR6 and resistors R1 and R2 is identical in operation to the pin diode circuit located on the Pin Diode Attenuator board described in paragraph 3.3.1.1.2. Its function at this point in the tuner circuitry is to terminate to ground the output of the RF tuning circuit not being used and feed the output of the other tuning circuit to the first mixer. Inductor L1 provides the DC return for the diode switch biasing current.

3.3.1.4.2 The double-balance mixer A1A4 U1 beats the local oscillator frequency applied through A4J1 LO IN (which is 60 MHz above the tuned RF signal), with the tuned RF signal. The mixer suppresses the LO and RF frequencies and passes the 60 MHz IF signal through the coupling capacitor C1 to the IF amplifier Q1. IF amplifier Q1 receives its bias from -15 Vdc at E1 and resistors R3, R4, R5 and R6. The amplifier is of common emitter configuration and provides a 10 dB gain to this IF signal. C9 is an emitter bypass capacitor and capacitors C10, C11 and inductor L3 form a decoupling network for the dc bias circuit. The output of Q1 is connected to a triple-tuned filter of 60 MHz center frequency. The filter is tuned to center frequency by L4, L5 and L6. The overall bandwidth of the filter is 4 MHz. The filter provides for additional selectivity and rejection of the LO frequency. The output of the filter is then fed to the 60 to 21.4 MHz Converter (A2).

3.3.2 60/21.4 MHz CONVERTER (A2)

The 60/21.4 MHz Converter has a reference designation of A2. The main circuit components to this module are contained on a circuit board subassembly A1. The reference designation prefix for components described in this subassembly is A2A1. The schematic diagram for the module is Figure 6-2. The board contains the double balance mixer U1, the second local oscillator Q3, buffer Q2, 21.4 MHz IF amplifier Q1 and a four pole tuned filter circuit. The crystal controlled 81.4 MHz local oscillator is of the modified Colpitts type with feedback through Y1 and C24 to sustain oscillation. The tuned tank for the LO consists of L9, C20, C21, C22, C24 and C25. The output of the LO is applied to the base of Q2. The network produces a thirteen dB gain to the LO signal. R12, R13 and R14 form a 3 dB attenuation pad prior to feeding the LO to pin 2 of the mixer U1. The 60 MHz IF is fed through a low pass filter L1 and C2 to pin 5 of the mixer U1. The low pass filter provides additional rejection of the first LO signal harmonics from the second mixer. The second mixer is identical to the first except that it is designed to beat the 81.4 MHz second LO frequency with the 60 MHz IF signal producing a difference frequency of 21.4 MHz at pin 4. The mixer suppresses the other components in the mixing process. The second IF amplifier Q1 amplifies the 21.4 MHz IF signal. R3 and C4 couple an out-of-phase feedback from the collector to emitter of Q1 to improve the stability and dynamic range of the amplifier. The four pole tuned filter on the collector of Q1 is tuned to a center frequency of 21.4 MHz and has a bandwidth of 3.5 MHz. Inductors L3, L4, L6 and L7 are used to tune the filter to center frequency. The filter rejects spurious signals and provides additional selectivity in the second IF bandpass from the second LO and first IF frequencies. R9, R11 and R10 comprise a bridge "T" attenuator to adjust the overall gain of the tuner. R10 is adjusted at the time the tuner is initially aligned. The 21.4 MHz IF signal is then fed through A1J2 to A1P7 on the back of the tuner chassis to be fed into the associated receiver.

3.3.3 OSCILLATOR/GEAR TRAIN ASSEMBLY (A3)

The Oscillator/Gear Train assembly has a reference designation of A3. The assembly contains two subassemblies, the 160-460 MHz Local Oscillator (A1) and Light Board (A2), and a Tuning Voltage Shaping Circuit which is contained on the main assembly chassis. The schematic diagram for this assembly is Figure 6-4.

The tuning resistor R1 is gang coupled with tuning capacitors A3A1C1 and A3A1C2 to the main tuning knob on the front panel. The wiper of this potentiometer is connected to the tuning voltage input at A1C6 and A1C8, and provides the bias adjustment to the varactors in the 100-400 MHz tuner through the shaping network. See paragraph 3.3.1.2.1 for a description of the varactor tuning circuits. Resistors R1 through R7 and diode CR1 are the components that make up the tuning voltage shaping network. This network provides a +12 Vdc to -12 Vdc level to the varactors in the 100-400 MHz tuner circuits. The shaping network produces a break point at approximately +9 Vdc in the tuning voltage level curve. This is necessary to compensate for the non linearity in the capacitance to reverse bias relationship of the tuning varactors. When the wiper of potentiometer R1 is fully counterclockwise it is at the +15 Vdc end of the winding. At this point, the anode of CR1 is more positive with respect to ground and therefore forward biased. Since CR1 is forward biased, R2 forms a voltage divider and establishes a +12 Vdc tuning voltage level at E4. R3 and R4 bias the diode cathode at +9 Vdc. As R1 is adjusted in the clockwise direction, the forward bias on CR1 decreases, and the tuning voltage level decreases. When the voltage level at E4 reaches +9 Vdc CR1 starts to become reverse biased since its cathode is at +9 Vdc. R2 is now effectively out of the circuit and from this point the tuning voltage level at E4 decreases at a more acute angle. The shaped tuning voltage level compensates for the non-linearity in the varactor tuning network and produces a near linear frequency change.

3.3.3.1 <u>160-460 MHz OSCILLATOR (A1)</u>

The reference designation for this subassembly is A1. The reference designation prefix for components contained in this subassembly is A3A1. The 160-460 MHz Oscillator board contains two Colpitts oscillator circuits with tapped capacitive feedback. One with a frequency range of 160-260 MHz and the other with a frequency range of 260-460 MHz. The BAND SELECT switch places the appropriate oscillator in the circuit by switching the -12 Vdc bias voltage to the emitter of the transistor in the oscillator being used. The BAND SELECT switch places the appropriate oscillator in the circuit by switching the -12 Vdc bias voltage from A3E5 to the emmiter of the transistor in the oscillator being used. The bias voltage stabilizing and filtering circuit consists of the components A3R8, A3VR1 and A3C8. A3R8 and A3C8 filter out power supply ripple and any voltage transients in the -15 Vdc supply. A3VR1 stabilizes the bias voltage at A3E5 to -12 Vdc. The two oscillator circuits operate in identical fashion, only the 160-260 MHz oscillator will be described in detail. When the 100-200 MHz tuner range is to be used the BAND SELECT switch applies -12 Vdc bias voltage to Q1. C1, C3, C4, C7 and the micro-strip resonator form the resonant tank for the circuit. C4 couples the regenerative feedback from the emitter to the collector of Q1. C1 is the main tuning component of the tank circuit and is part of the ganged tuning assembly driven by the front panel Main Tuning Knob. As the tuner is adjusted throughout the 100-400 MHz RF range the LO frequency is always 60 MHz above the tuner frequency. The LO can also be fine tuned through the varactor tuning circuit of CR1. The operation of this circuit is identical to the varactor tuning circuit described in paragraph 3.3.1.2.1, with the exception that the bias on CR1 can also be controlled by the -4 V to +4 Vdc level of the DAFC input at E1. The DAFC input is only used in conjunction with the 560 or 565 series receiver and an optional external frequency counter. The optional counter monitors the associated receiver's operating frequency through the LO monitor output at A3J1, and an error voltage is produced in comparing the actual frequency against the preset frequency programed into the counter. If the LO frequency decreases below the correct level an error voltage in the negative going direction is applied through E1. This signal causes the anode of CR1 to go more negative, increasing the reverse bias on CR1 thus decreasing its capacitance and thereby increasing the tuned frequency of the LO. The front panel fine tuning potentiometer R1 manually adjusts the LO frequency for fine tuning by varying the positive potential on the cathode of CR1. A3A1C7 is a trim capacitor for high end frequency adjustment.

3.3.3.1.1 The buffer amplifier Q3 serves to isolate the LO from spurious RF signals from the tuner entering the LO circuitry and to match the impedance between the LO and the input port of the directional coupler. An out-of-phase feedback is coupled from the emitter to base of Q3 by R16 and C22 to improve the stability of the stage. C19, C20 and C21 are decoupling capacitors for the DC bias circuit to Q3. The Directional Coupler U1 extracts a portion of the LO signal that is connected to A3J1 to monitor the LO frequency. The main portion of the LO signal is fed to A3J2 and to the LO input on the 100-400 MHz tuner.

3.3.3.2 LIGHT BOARD (A2)

This subassembly contains the tuner dial lights. These lamps are powered through the associated receiver supply.

SECTION IV

MAINTENANCE

4.1 GENERAL

The Type VH-107 Tuning Head has been designed to operate for long periods of time with little or no routine maintenance. An occasional cleaning and inspection are the only preventive maintenance operations recommended and should be performed when similar procedures are performed on the associated receiver. The intervals for the operations should be based on the operating environment but should not exceed 1000 hours. Should trouble occur, repair time will be minimized if the maintenance technician is familiar with Section III of this manual in which the circuits are described, and with the schematic diagrams found in Section VI. Reference should also be made to the troubleshooting and maintenance procedures contained in the receiver manual. A complete electrical parts list and illustrations showing part locations are included in Section V.

4.2 CLEANING AND LUBRICATION

The tuning head should be kept free of dust, grease, moisture, and foreign matter to ensure troublefree operation. If available, use low-pressure compressed air to remove accumulated dust from the interior and exterior. A clean dry cloth, a soft-bristled brush or a cloth saturated with a cleaning compound may be used. Refer to paragraph 4.4 for tuning drive lubrication.

4.3 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing troubles can be detected by a visual inspection of the unit. For this reason, a complete visual inspection should be made for indications of mechanical and electrical defects, on a periodic basis or whenever the unit is being checked for a previously reported trouble. Electronic components that show signs of deterioration should be checked, and a thorough investigation of the associated circuitry should be made to verify proper operation. Mechanical parts should be inspected for excessive wear, looseness, misalignment, corrosion and other signs of deterioration.

4.4 TUNING DRIVE MAINTENANCE

Figures 5-12 and 5-13 illustrate the tuning drive assembly. The tuning drive requires little maintenance except for the occasional application of a few drops of light oil to the shaft bearings and removal of any accumulated dust or dirt.

4.5 TROUBLESHOOTING AND REPAIR

The signal substitution method should be used in troubleshooting the equipment by inserting an RF signal into the input and checking for the correct output at each stage. Signal tracing should be started at the output and terminated at the input. Once the faulty stage is found, detailed circuit analysis will pinpoint the defective part.

NOTE

The dress of leads and the placement of components in the tuner is extremely critical. When making repairs or adjustments care should be taken to duplicate the exact physical placement of the original part. Do not move leads or wires to remove a component unless absolutely necessary.

4.5.1 TEST EQUIPMENT REQUIRED

The following test instruments or a suitable equivalent are required to align and test the VH-107 Tuning Head.

Table 4-1. Test Equipment Required

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED INSTRUMENTS
Sweep Generator	0-1000 MHz Frequency Range 0-100 MHz Sweep Width	RF Alignment	Wavetek 501
Signal Generator	10 MHz to 480 MHz	External Marker	Hewlett-Packard HP-608E
Low Impedance Detector	50 ohm	RF to DC Conversion	Telonic XD-3A
High Impedance Filter	100 MHz	Impedance Match	See paragraph 4.5.1.1
Oscilloscope	500 kHz vertical bandwidth minimum	Trouble-shooting alignment	Tektronix 503
Frequency Counter	Six digits with four place accuracy	Trouble-shooting alignment	Fluke 1920A
FM Signal Generator	10 MHz to 270 MHz frequency range	Performance checks	Booton 202J

Table 4-1. Test Equipment Required (Continued)

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED INSTRUMENTS
AC VTVM	-60 to +50 dB and .001 to 300 V rms ranges	Performance checks	Hewlett-Packard HP-400L
Termination	50 ohm; BNC or N-Type Connector	Performance checks	Microlab TA5MN Telonic TRM-2
Receiver	Provide Demodulation and power for tuning head	Alignment	WJ-types 560, 565, 566
RF Voltmeter	.001-3.0 V; -50 to +20 dBm	LO output measurement	Boonton 90B
Pulse Generator	Standard	Pulse Sensitivity Test	Rutherford B16
Mixer	DC-1000 MHz	Pulse Sensitivity Test	Relcom M1A
Attenuator, Variable	0-12 dB, 1 dB steps and 0-120 dB, 10 dB steps	Pulse Sensitivity Test	Hewlett-Packard 355C and 355 D
Extender Cable	Mate UH-107 Tuning Head to WJ-560, 565, 566 series receiver	Alignment and test	WJ-EC-560
Adapter	50 ohm input impedance	N-BNC	Boonton 91-8B
D.C. Power Supply	0-10 Vdc Regulated -4 to +4 Vdc regulated	Alignment	Hewlett-Packard HP-6216A

4.5.1.1 100 MHz OHM LOW PASS FILTER

It will be necessary to construct a high impedance low pass filter as shown in Figure 4-1.

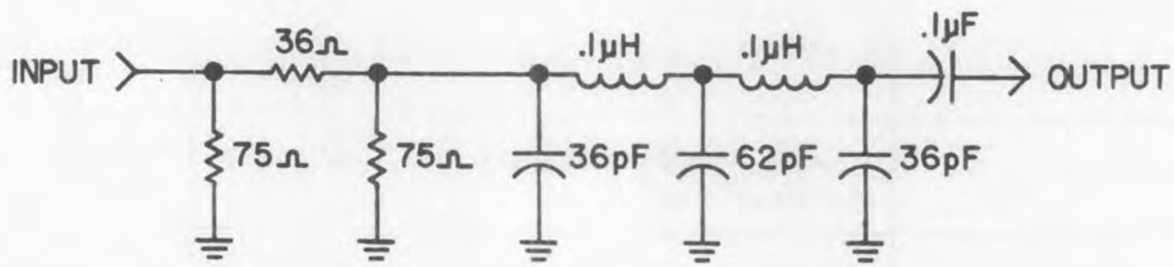


Figure 4-1. 100 MHz Low Pass Filter; Schematic Diagram

4.6 PERFORMANCE CHECKS

The tests outlined in the following paragraphs provide a means of checking the relative performance of the VH-107 Tuning Head. The equipment required to perform these tests is listed in Table 4-1. These checks should be performed after an alignment or after the replacement of a transistor in the RF or oscillator networks. The tuning assembly is assumed to be installed in a WJ-CEI Type 565 Receiver for these checks.

4.6.1 AM SENSITIVITY

Proceed as follows:

(1) Connect equipment as shown in Figure 4-2.

(2) Place the receiver controls in the following positions:

a. Mode - AM MAN

b. IF BANDWIDTH - 50 kHz

c. RF/IF GAIN - fully clockwise

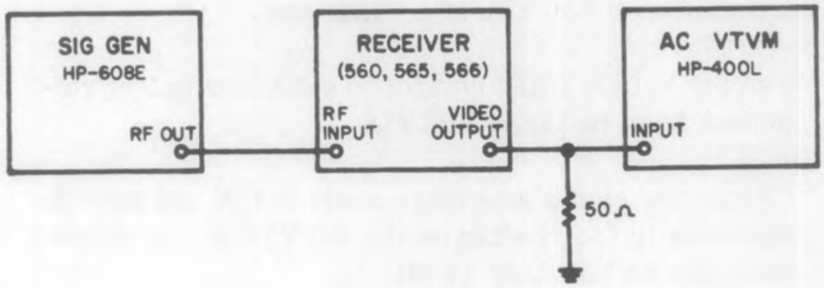


Figure 4-2. Equipment Setup; Performance Checks 4.6.1 through 4.6.5

(3) Tune the assembly to 100 MHz.

(4) Tune the signal generator to 100 MHz and adjust the controls for 50% modulation at a 1 kHz rate; set the output level to -99 dBm (2.5 μV).

(5) Using the VIDEO GAIN control on the receiver, set a convenient reference level on the AC VTVM.

(6) Remove the modulation from the input signal and note the reading on the AC VTVM. It should decrease no less than 10 dB.

4.6.2 FM SENSITIVITY

Proceed as follows:

(1) Connect equipment as shown in Figure 4-2 except that the Boonton 202J FM signal generator should be substituted for the HP-608E.

(2) Change the receiver mode switch to FM and the IF BANDWIDTH switch to 1 MHz.

(3) Set the tuning assembly dial to 314 MHz.

(4) Tune the signal generator to 157 MHz and adjust the controls for an output level of -86 dBm (11.5 μV) and a deviation of 150 kHz at a 1 kHz rate.

(5) Use the VIDEO GAIN control to set a convenient reference level on the AC VTVM.

(6) Change the signal generator mode to CW and note the decrease in the reading on the AC VTVM. It should decrease no less than 17 dB.

4.6.3 IF REJECTION

Proceed as follows:

(1) Connect equipment as shown in Figure 4-2.

(2) Tune the signal generator and tuning assembly to 314 MHz.

(3) Adjust the signal generator controls for 50% modulation at 1 kHz rate and a level of -99 dBm (2.51 μV).

(4) Set the receiver controls as described in 4.6.1 step (2) and rotate the VIDEO GAIN control fully clockwise.

(5) Adjust the RF/IF GAIN control on the receiver for a convenient reference level on the AC VTVM.

(6) Tune the signal generator to 60 MHz and increase the output level to again obtain the reading set in step (5). Note the signal generator output level. It should be at least 60 dBm (band 1), and 70 dBm (band 2), above the level set in step (3).

4.6.4 IMAGE REJECTION

Proceed as follows:

(1) Connect equipment as shown in Figure 4-2.

(2) Repeat paragraph 4.6.3 steps (2) and (3).

(3) Adjust the RF/IF GAIN control for a convenient reference level on the AC VTVM.

(4) Tune the signal generator to 374 MHz and increase the output level to obtain the reading on the AC VTVM set in step (3). Note the signal generator output level. It should be 70 dB above the level set in step (3).

4.6.5 LOCAL OSCILLATOR OUTPUT LEVEL CHECK

Proceed as follows:

(1) Connect the RF VTVM to the LO output jack on the receiver, using the 50 ohm adapter.

(2) Energize the equipment and tune from one end of the band to the other while observing the RF VTVM. The LO output level should not be less than 50 mV at any point in the band.

4.6.6 PULSE MODE SENSITIVITY

Proceed as follows:

(1) Connect equipment as shown in Figure 4-3.

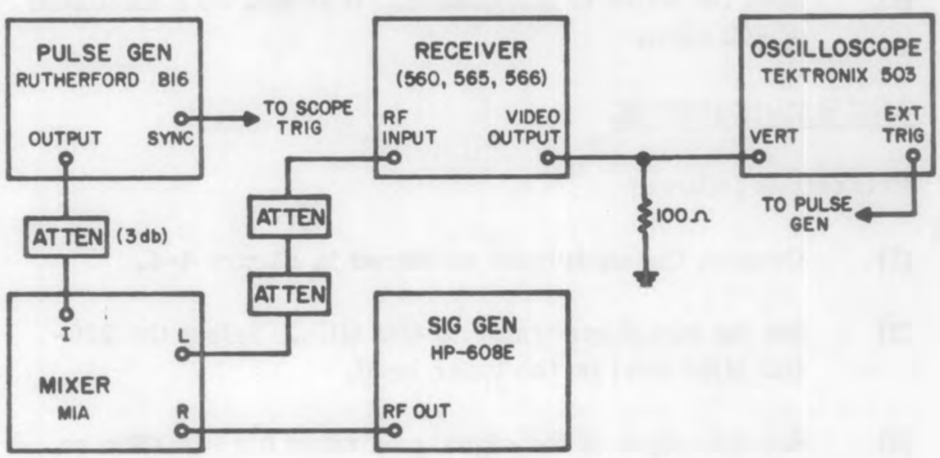


Figure 4-3. Equipment Setup; Pulse Mode Sensitivity Test 4.6.6

(2) Tune the HP-608E signal generator and tuning head to 300 MHz.

(3) Set the receiver controls as follows:

a. IF BANDWIDTH - 1 MHz

b. Mode - Pulse

c. VIDEO GAIN - Fully clockwise

(4) Adjust the signal generator controls for a CW output at a level of 0 dB (225 mV).

(5) Set the attenuator connected between the pulse generator and mixer to 3 dB, and do not change it during the remainder of the test.

(6) Adjust the pulse generator controls for a pulse width of 2 μ Sec at a repetition rate of 3 kHz, positive polarity, 1.5 V peak.

(7) Vary the two series-connected attenuators to achieve tangential sensitivity.

(8) Note the value of attenuation. It should be a minimum of -92 dBm.

4.6.7 AGC RANGE CHECK

Proceed as follows:

(1) Connect the equipment as shown in Figure 4-4.

(2) Set the signal generator to 400 MHz. Select the 200-400 MHz band on the tuner head.

(3) Set the output of the signal generator for -10 dBm on the RF voltmeter.

(4) Measure and note the RF gain with the RF voltmeter at the tuner head output A1J2 at 400 MHz.

(5) Insert a -10 Vdc level at A1C3 AGC and again measure the gain at the tuner head output. It should be 30.0 dB, minimum.

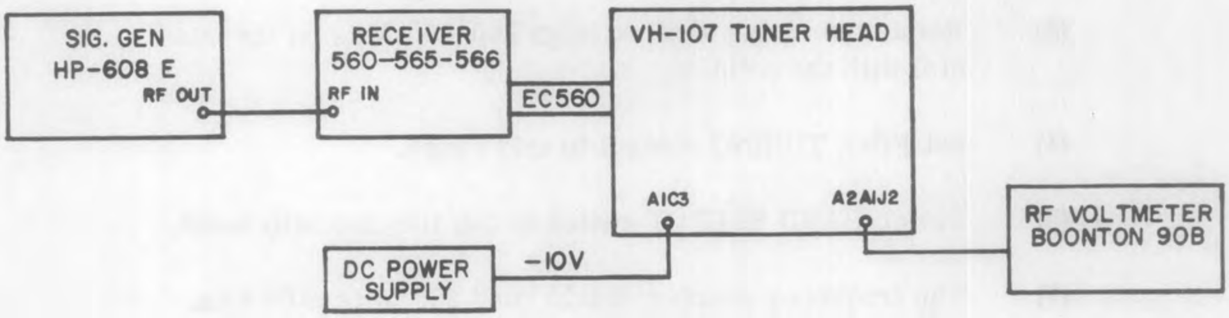


Figure 4-4. Equipment Setup; AGC Range Check 4.6.7

4.7 ALIGNMENT AND ADJUSTMENT PROCEDURES

The following alignment and adjustment procedures should be followed if any repairs have been made that the technician feels might affect the alignment of the Tuning Head. An extender cable EC-560 is required in order that the tuning head may be operated outside the associated receiver.

4.7.1 160-460 OSCILLATOR ALIGNMENT

Proceed as follows:

(1) Connect equipment as shown in Figure 4.5

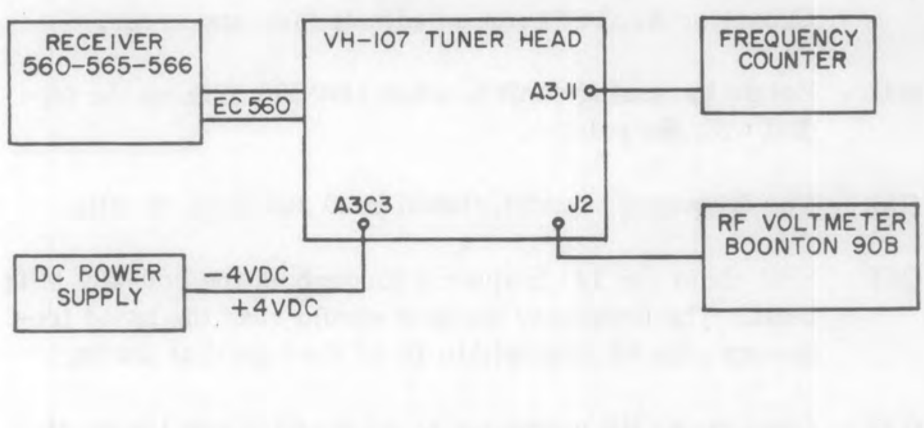


Figure 4-5. Equipment Setup; 160-460 MHz Oscillator Alignment, DAFC Range and Fine Tuning Range Adjustment 4.7.1 through 4.7.1.2

(2) Connect the frequency counter to A3J1 and set range to 20-300 MHz.

(3) Rotate the tuning shaft to align 200/400 MHz on the tape dial with the pointer.

(4) Set FINE TUNING control to mid range.

(5) Switch BAND SELECT switch to the 100-200 MHz band.

(6) The frequency counter should read 260 MHz ±100 kHz. Trimmer capacitor A3A1C7 can be adjusted to compensate for any error.

(7) Rotate the tuning shaft to align 100/200 MHz on the tape dial with the pointer.

(8) The frequency counter should now read 160 MHz ± 1 MHz.

(9) Spot check the LO frequency throughout the 100-200 band. The frequency counter should read the tuner frequency plus 60 MHz within 1% of the tape dial setting.

(10) Switch the BAND SELECT switch to the 200-400 MHz band.

(11) Set the counter range to 200-500 MHz.

(12) Rotate the tuning shaft to align 200/400 MHz on the tape dial with the pointer.

(13) The frequency counter should read 460 MHz ± 200 kHz. Capacitor A3A1C17 can be adjusted for any error.

(14) Rotate the tuning shaft to align 100/200 MHz on the tape dial with the pointer.

(15) The frequency counter should read 260 MHz ±2 MHz.

(16) Spot check the LO frequency throughout the 200-400 MHz band. The frequency counter should read the tuned frequency plus 60 MHz within 1% of the tape dial setting.

(17) Connect the RF voltmeter to A3J2 and verify the oscillator output remains within the limits of +5 dBm to +12 dBm throughout each band.

4.7.1.1 DAFC RANGE

Connect the equipment as shown in Figure 4-5 and proceed as follows:

(1) Connect the frequency counter to A3J1 to measure 100 MHz. Set fine tuning control to mid range.

(2) Connect the variable DC power supply to A3C3 and adjust power supply output for -4 Vdc.

(3) Set the tuner dial to 100/200 MHz on the 100-200 MHz band.

(4) Note the frequency counter reading.

(5) Set the power supply output for +4 Vdc.

(6) Note the frequency counter reading and subtract from that noted in step (4). This is the DAFC range and should be greater than 75 kHz.

(7) Repeat steps (1) through (6) at 200 MHz band 1, 200 MHz band 2 and 400 MHz band 2. DAFC range should be a minimum of .075% of tuned frequency.

4.7.1.2 FINE TUNING RANGE

Connect the equipment as shown in Figure 4-5 and proceed as follows:

(1) Connect the frequency counter to A3J1 to measure 200 MHz.

(2) Set the tuner dial to 100/200 MHz on the 100-200 MHz band.

(3) Set the FINE TUNING control fully CCW.

(4) Note the frequency counter reading.

(5) Set the FINE TUNING control fully CW.

(6) Note the frequency counter reading and subtract from that noted in step (4). This is the fine tuning range and should be greater than 100 kHz.

(7) Repeat steps (1) through (6) at 200 MHz band 1, 200 MHz band 2 and 400 MHz band 2. Fine tuning range should be a minimum of .05% of tuned frequency.

4.7.2 100-200 MHz TUNING CIRCUIT ALIGNMENT AND GAIN CHECK

(1) Connect equipment as shown in Figure 4-6.

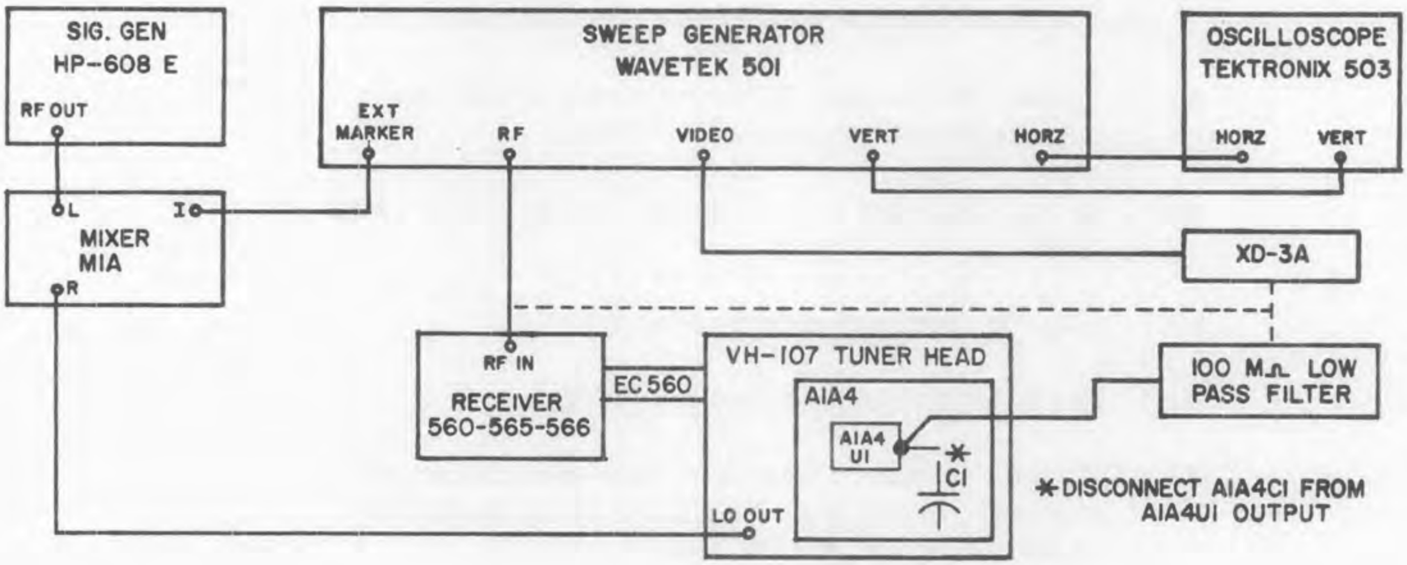


Figure 4-6. Equipment Setup; 100-200 MHz and 200-400 MHz Tuning Circuit Alignment 4.7.2 and 4.7.3.

(2) Select the 100-200 MHz band with the Tuner Head BAND SELECT switch.

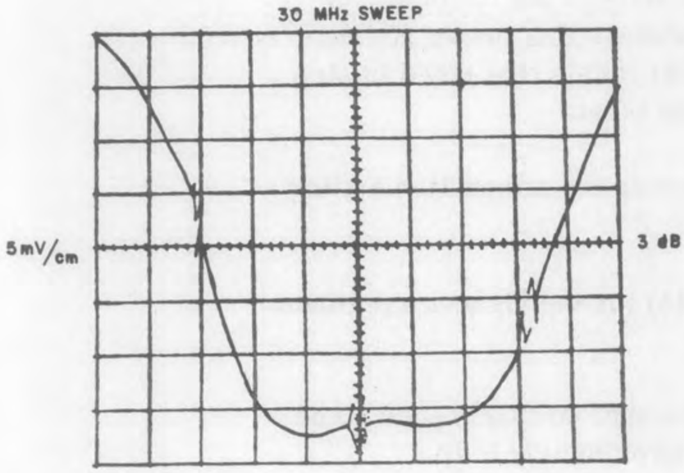
(3) Set the HP-608E signal generator to 60 MHz CW mode.

(4) Tune the sweep generator and tuning head to 100 MHz Adjust the sweep generator and scope controls to display a response curve.

(5) Adjust A1A2R4, A1A2R5, A1A2R16 and A1A2R17 for maximum amplitude of the response curve and symmetrical to the center frequency marker, similar to Figure 4-7a.

(6) Tune the sweep generator and tuning head to 200 MHz.

(7) Adjust A1A2C22, A1A2C23, A1A2C24 and A1A2C25 for maximum amplitude of the response curve and symmetrical to the center frequency marker.



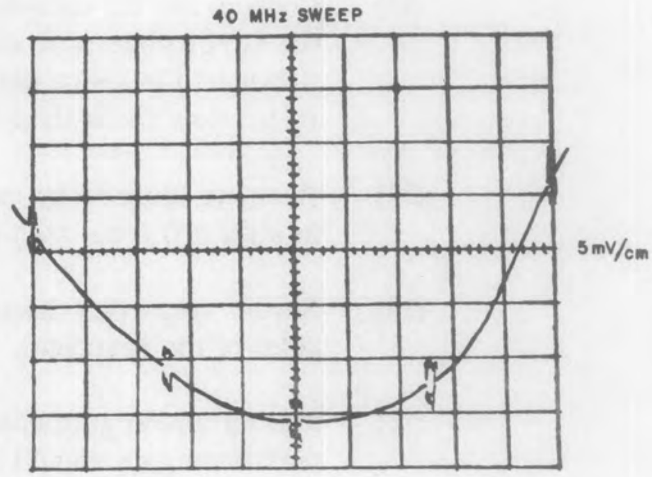


Figure 4-7a. Response Curve at 100 MHz Figure 4-7b. Response Curve at 200 MHz

100-200 MHz Tuning Circuit Alignment

(8) Adjust A1A2C12 and A1A2C14 also for maximum amplitude and symmetry of the response curve, similar to Figure 4-7b.

(9) Repeat steps (4) through (8) for optimum response across the tuning range 100-200 MHz.

(10) Tune the sweep generator and the tuner head slowly through the band frequency range. The marker should remain within the 3 dB points on the response curve throughout the tuning range.

(11) To check the gain of the tuning circuit, note the response amplitude at the marker while tuning the sweep generator and tuner slowly across the 100-200 MHz band. Note the lowest amplitude point at the 60 MHz marker, and set the sweep generator and tuner to this frequency.

(12) Note the attenuator setting on the sweep generator output at this point.

(13) Connect the RF detector directly to the RF output of the sweep generator and decrease this output attenuation until the scope deflection equals that noted in step (11). Note the setting at this point.

(14) Compute the gain by subtracting the attenuation setting in step (13) from step (12).

(15) Repeat steps (11) through (14) for the highest amplitude point of the response.

(16) The minimum gain should be approximately 0 dB. The maximum gain should be approximately 5 dB.

4.7.3 200-400 MHz TUNING CIRCUIT ALIGNMENT

Proceed as follows:

(1) Connect equipment as shown in Figure 4-6.

(2) Select the 200-400 MHz band with the Tuner Head BAND SELECT switch.

(3) Set the HP-608E signal generator to 60 MHz CW mode.

(4) Tune the sweep generator and tuning head to 200 MHz. Adjust the sweep generator and scope controls to display a response curve.

(5) Adjust 1A3R5, A1A3R6, A1A3R19, A1A3R20 and A1A3R21 for maximum amplitude of the response curve and symmetrical to the center frequency marker, similar to Figure 4-8a.

(6) Tune the sweep generator and tuning head to 400 MHz.

(7) Adjust A1A3C20, A1A3C21, A1A3C22, A1A3C23 and A1A3C24 for maximum amplitude of the response curve, similar to Figure 4-8b.

(8) Repeat steps (4) through (8) for optimum response across the frequency range 200-400 MHz.

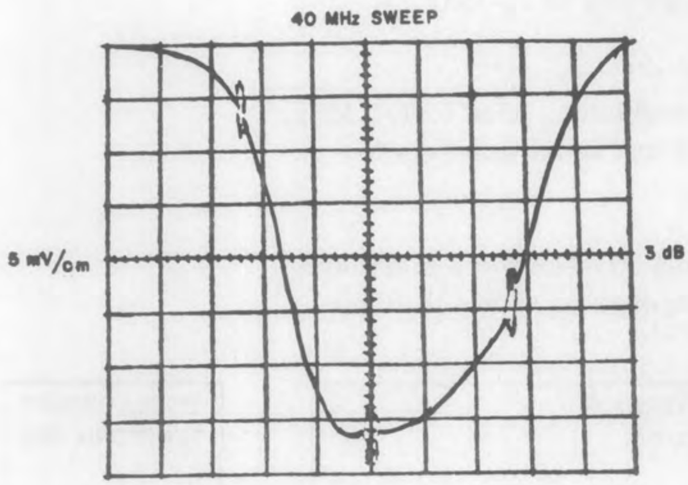


Figure 4-8a. Response Curve at 200 MHz

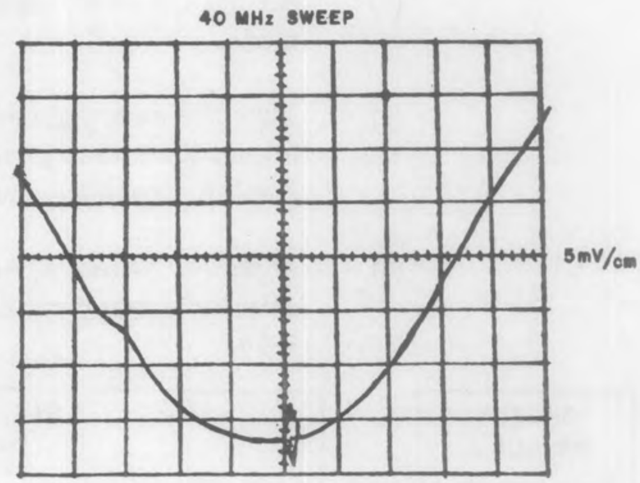


Figure 4-8b. Response Curve at 400 MHz

200-400 MHz Tuning Circuit Alignment

(9) Tune the sweep generator and the tuner head slowly through the band frequency range. The marker should remain within the 3 dB points of the response throughout the tuning range.

(10) To check the gain of the 200-400 MHz tuning circuit, repeat steps (11) through (15) in paragraph 4.7.2.

(11) The minimum gain should be approximately 0 dB. The maximum gain should be approximately 7 dB.

4.7.4 60 MHz IF AMPLIFIER ALIGNMENT

Proceed as follows:

(1) Connect the equipment as shown in Figure 4-9. Connect detector XD-3A to 60 MHz IF output at A1A4J2.

(2) Select the 200-400 MHz band with the Tuner Head BAND SELECT switch.

(3) Set the HP-608E signal generator to 60 MHz CW mode.

(4) Tune the sweep generator and tuning head to 400 MHz. Adjust the sweep generator and scope controls to display a response curve.

(5) Adjust A1A4L4, A1A4L5 and A1A4L6 for a maximum amplitude symmetrical response as shown in Figure 4-10.

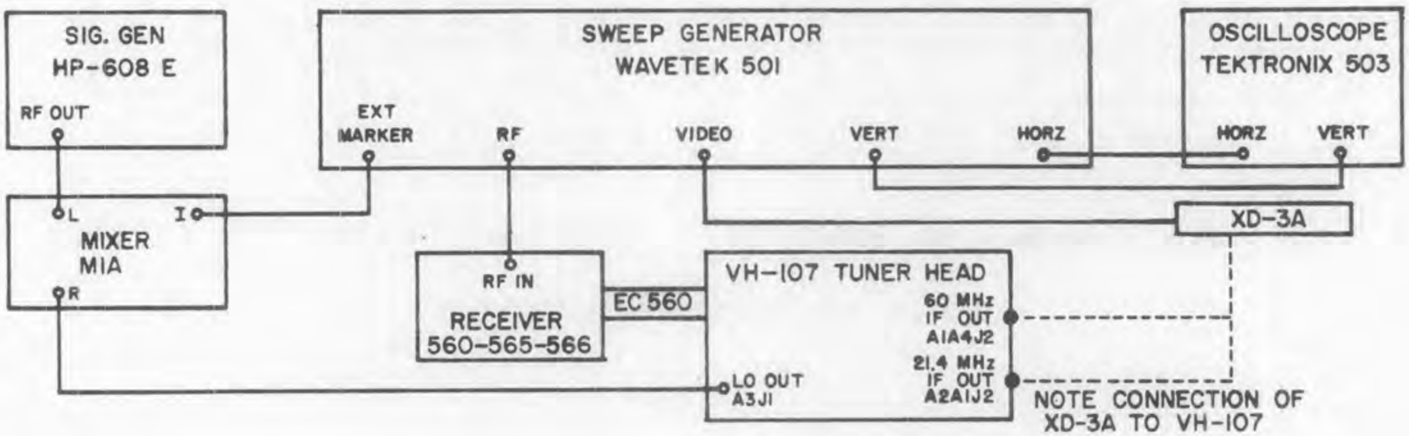


Figure 4-9. Equipment setup; 60 MHz IF Amplifier and 21.4 MHz IF Alignment

(6) Select the 100-200 MHz band with the Tuner Head BAND SELECT switch.

(7) To check the gain from RF into 60 MHz output, note the response amplitude at the marker while tuning the sweep generator and tuner slowly across the 100-200 MHz band. Note the lowest amplitude point at the 60 MHz marker, and set the sweep generator and tuner to this frequency.

(8) Note the attenuator setting on the sweep generator output at this point.

(9) Connect the RF detector directly to the RF output of the sweep generator and decrease the output attenuation until the scope deflection equals that noted in step (7). Note the setting at this point.

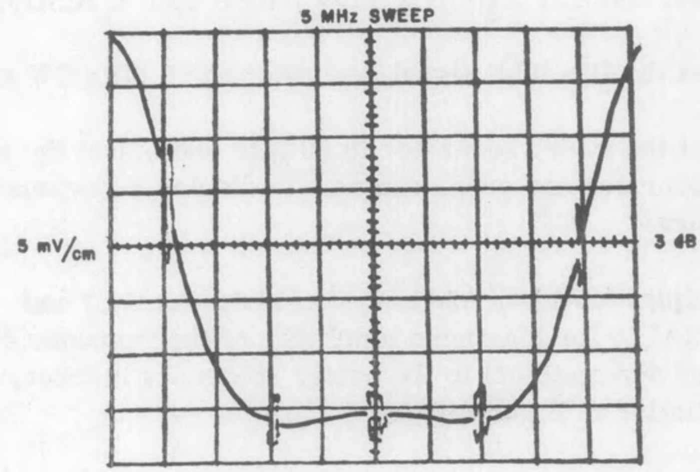


Figure 4-10. Response Curve, 60 MHz IF Amplifier

(10) Compute the gain by subtracting the attenuation setting in step (9) from step (8).

(11) Repeat steps (7) through (10) for the highest amplitude point of the response.

(12) Repeat steps (7) through (11) for the 200-400 MHz band. (Throw Band Select Switch)

(13) The gain for the 100-200 MHz band should be 12 dB minimum, 18 dB maximum.

(14) The gain for the 200-400 MHz band should be 11 dB minimum, 19 dB maximum.

4.7.5 21.4 MHz IF OUTPUT ALIGNMENT

Proceed as follows:

(1) Connect the equipment as shown in Figure 4-9. Connect detector XD-3A to 21.4 MHz output at A2A1J2.

(2) Set the HP-608E signal generator to 60 MHz CW mode.

(3) Set the sweep generator to 60 Mhz and adjust the sweep generator and scope controls to display a response curve.

(4) Adjust A2A1L3, A2A1L4, A2A1L6, A2A1L7 and A2A1L9 for maximum amplitude of the response curve and symmetrical to the center frequency marker, similar to Figure 4-11.

(5) To check the overall gain of the tuner head, note the response amplitude at the marker while tuning the sweep generator and tuner slowly across the 100-200 MHz band. Note the lowest amplitude point at the 60 MHz marker, and set the sweep generator and tuner to this frequency.

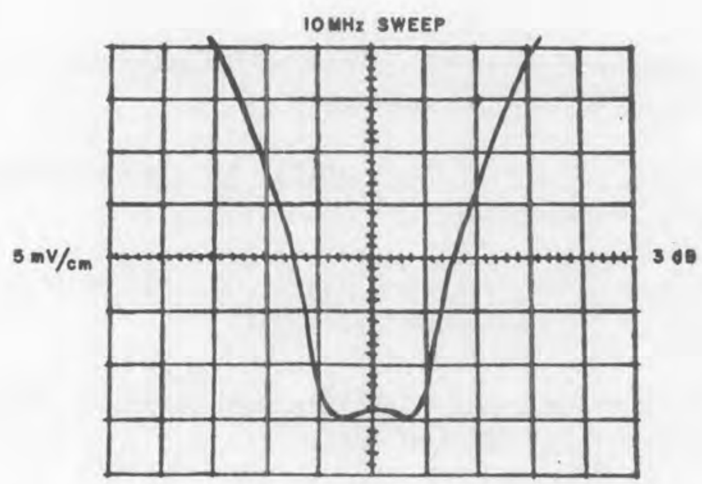


Figure 4-11. Response Curve, 21.4 MHz Overall

(6) Note the attenuator setting on the sweep generator output at this point.

(7) Connect the RF detector directly to the RF output of the sweep generator and decrease the output attenuation until the scope deflection equals that noted in step (5). Note the setting at this point.

(8) Compute the gain by subtracting the attenuation setting in step (7) from step (6).

(9) Repeat steps (5) through (8) for the highest amplitude point of the responses.

(10) Repeat steps (5) through (9) for the 200-400 MHz band.

(11) The gain for the 100-200 MHz band should be 19 dB minimum, 25 dB maximum.

(12) The gain for the 200-400 MHz band should be 18 dB minimum, 24 dB maximum.

5.1 UNIT NUMBERING METHOD

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify assemblies, subassemblies (and modules) and parts. An example of the unit method follows:

Subassembly Designation A1	R1 Class and No. of Item
Identify from right to left as:	First (1) resistor (R) of first (1) subassembly (A)

As shown on the main chassis schematic, components which are an integral part of the main chassis have no subassembly designation.

5.2 REFERENCE DESIGNATION PREFIX

Partial reference designations have been used on the equipment and on the illustrations in this manual. The partial reference designations consist of the class letter(s) and identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Reference Designation Prefixes are provided on drawings and illustrations in parenthesis within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, WI 53204
01351	Dynamic Gear Co., Inc. 175 Dixon Avenue Amityville, NY 11701
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
04713	Motorola, Incorporated Semiconductor Products Div. 5005 East McDowell Road Phoenix, AZ 80058
05972	Loctite Corporation 705 North Mountain Road Newington, CT 06111
07263	Fairchild Camera & Instr, Corp. Semiconductor Division 464 Ellis Street Mountin View, CA 94040

Mfr. Code	Name and Address
12475	Circul-Air Corporation Detroit, MI
14632	Watkins-Johnson Company 700 Quince Orchard Road Gaithersburg, MD 20760
15454	Rodan Industries, Inc. 2905 Blue Star Street Anaheim, CA 92806
17856	Siliconix, Inc. 2201 Laurelwood Road Santa Clara, CA 95050
18736	Voltronics Corporation West Street Hanover, NJ 07936
19505	Applied Engineering Products Co. Division of Samarius, Inc. 300 Seymour Avenue Derby, CT 06418
20484	Read Plastics Inc. 12331 Wilkins Avenue Rockville, MD 20852
21604	The Buckeye Stamping Co. 555 Marion Road Columbus, OH 43207
23480	Electronic Hardware Corp. 180-08 Liberty Avenue Jamaica, NY 11433

Mfr. Code	Name and Address
25088	Siemens America, Inc. 186 Wood Avenue S. Iselin, NJ 08830
27956	Relcom 3333 Hillview Avenue Palo Alto, CA 94304
28480	Hewlett-Packard Co. Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
28733	Ceramic Magnetics, Inc. 87 Fairfield Road Fairfield, NJ 07006
33095	Spectrum Control, Inc. 152 E. Main Street Fairview, PA 16415
56289	Sprague Electric Co. Marshall Street North Adams, MA 01247
56878	Standard Pressed Steel Company Box 608 Benson East Jenkintown, PA 19046
70417	Chrysler Corporation Amplex Division 6501 Harper Avenue Detroit, MI 48211
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138

Mfr. Code	Name and Address
71468	ITT Cannon Electric 666 East Dyer Road Santa Anna, CA 92702
71744	Chicago Mintr. Lamp Works 4433 Ravenswood Avenue Chicago, IL 60640
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, CT 06226
72653	GC Electronics Company Div. of Hydrometals, Inc. 400 S. Wyman Street Rockford, IL 61101
72982	Erie Tech. Products, Inc. 644 West 12th Street Erie, PA 16512
73138	Beckman Instr., Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634
74868	Bunker Ramo Corp. The Amphenol RF Division 33 East Franklin Street Danbury, CT 06810
75042	TRW Electronic Comp. IRC Fixed Resistors 401 North Broad Street Philadelphia, PA 19108
78189	Illinois Tool Works, Inc. Shakeproof Division St. Charles Road Elgin, IL 60120
79136	Waldes Kohinoor, Inc. 47-16 Austel Place Long Islan City, NY 11101
79963	Zierick Manufacturing Co. Radio Circle Mt. Kisco, NY 10549
80031	Electra-Midland Corp. MEPCO Division 22 Columbia Road Morristown, NJ 07960
80058	Joint Electronic Type Designation System
80131	Electronic Industries Association 2001 Eye Street, N.W. Washington, D.C. 20006
80205	Natl. Aerospace Stds. Committee Aerospace Ind. Assoc. of America 1725 DeSales, N.W. Washington, D.C. 20036
81349	Military Specifications
84048	St. Petersburg Div. of Vernitorn Corp. P.O. Box 44000 2801 72nd Street North, St. Petersburg, FL 33743
86928	Shreveport Paint & Varnish Co., Inc. Shreveport, LA

Mfg. Code	Name and Address
91418	Radio Materials Company 4242 West Bryn Mawr Avenue Chicago, IL 60646
93332	Sylvania Electric Products, Inc. Semiconductor Products Div. 100 Sylvan Road Woburn, MA 01801
94144	Raytheon Company Components Division Industrial Components Operation 465 Centre Street Quincy, MA 02169
95146	Alco Electronics Prod. Inc. P.O. Box 1348 Lawrence, MA 01842
95712	Bendix Corporation The Electrical Components Div. Microwave Devices Plant Hurricane Road Franklin, IN 46131
96906	Military Standards Promulgated by Military Dept. Under Authority of Defense Standardization Manual 4120 3-M
99800	American Precision Industries Delevan Electronics Division 270 Quaker Road East Aurora, NY 14052

5.4 PARTS LIST

The parts list which follows contains all electrical parts used in the equipment and certain mechanical parts which are subject to unusual wear or damage. When ordering replacement parts from Watkins-Johnson Company, specify the type and serial number of the equipment and the reference designation and description of each part ordered. The list of manufacturers provided in paragraph 5.3 and the manufacturer's part number for components are included as a guide to the user of the equipment in the field. These parts may not necessarily agree with the parts installed in the equipment; however, the parts specified in this list will provide satisfactory operation of the equipment. Replacement parts may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original indicated part. In the case of components defined by a military or industrial specification, a vendor which can provide the necessary component is suggested as a convenience to the user.

NOTE

As improved semi-conductors become available, it is the policy of Watkins-Johnson to incorporate them in proprietary products. For this reason some transistors, diodes and integrated circuits installed in the equipment may not agree with those specified in the parts list and schematic diagrams of this manual. However, the semi-conductors designated in the manual may be substituted in every case with satisfactory results.

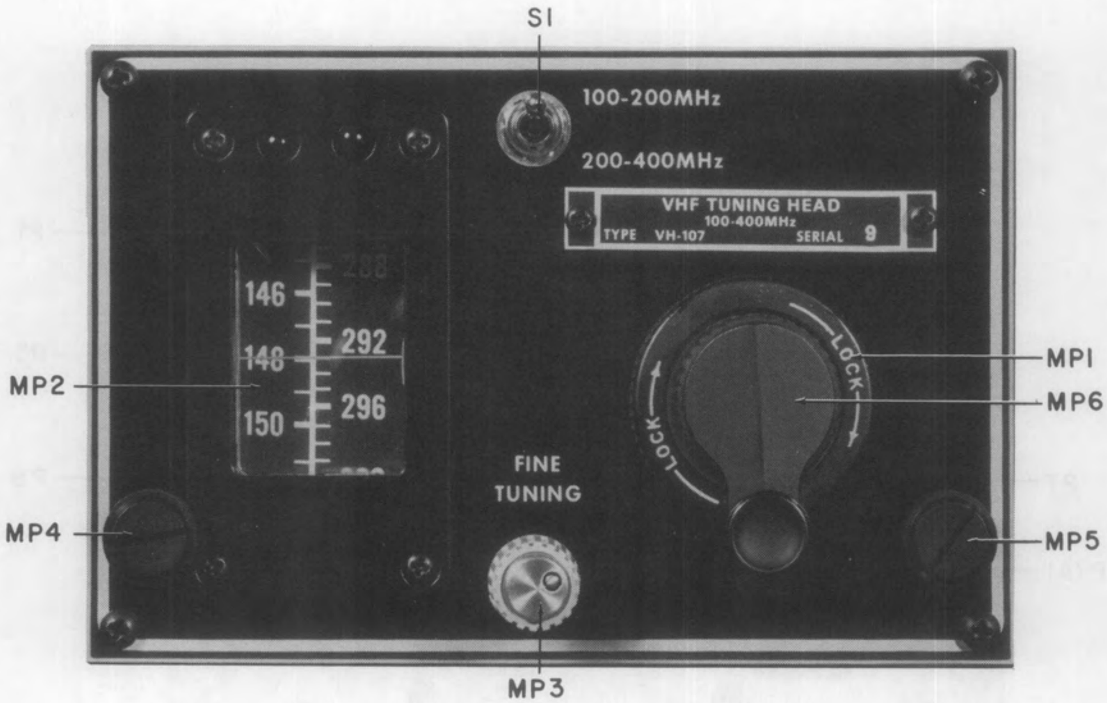


Figure 5-1. Type VH-107 Tuning Head, Front View, Location of Components

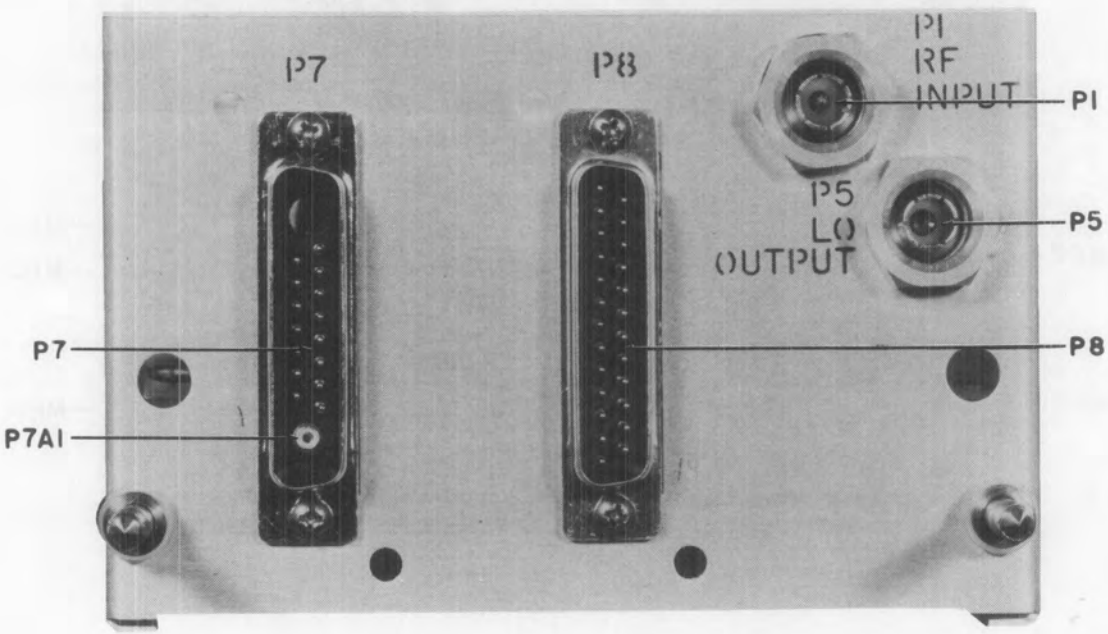


Figure 5-2. Type VH-107 Tuning Head, Rear View, Location of Components

5.5 TYPE VH-107 VHF TUNING HEAD MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	100-400 MHz Tuner	1	71452	14632	
A2	60/21.4 MHz Converter Assembly	1	71453	14632	
A3	Oscillator, Gear Train Assembly	1	7794	14632	
A4	Led Display	1	18620	14632	
C1	Capacitor, Electrolytic, Tantalum: 100 μF, 20%, 20 V	1	196D107X0020TE4	56289	
MP1	Knob, Lock	1	KL901G1B	94144	
MP2	Window	1	11448-5	14632	
MP3	Knob, Round, Indicator Dot	1	PS50D1/LG	21604	
MP4	Knob	2	16203-1	14632	
MP5	Same as MP4				
MP6	Knob, Spinner	1	2S2B	23480	
P1	Connector, Plug: Push on	2	33699-4	95712	
P2	Connector, Plug: SMC Series	6	UG1466/U	80058	19505
P3	Connector, Plug: SMC Series	1	UG1465/U	80058	19505
P4	Same as P2				
P5	Same as P1				
P6	Same as P2				
P7	Connector, Plug: Multipin	1	DBM17W-2P	71468	
P7A1	Connector, Receptacle	1	DM53743-5001	71468	
P8	Connector, Plug: Multipin	1	DBM25P	71468	
P9	Same as P2				
P10	Same as P2				
P11	Same as P2				
R1	Resistor, Variable, Composition: 2.5 kΩ, 10%, 1/2 W	1	RV6NAYSD252A	81349	01121
R2	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R3	Resistor, Fixed, Composition: 3.6 kΩ, 5%, 1/4 W	1	RCR07G362JS	81349	01121
S1	Switch, Toggle: 3PDT	1	MTA306D	95146	
W1	Cable Assembly	1	17300-157-1	14632	
W2	Cable Assembly	1	17300-157-2	14632	
W3	Cable Assembly	1	17300-157-3	14632	
W4	Cable Assembly	1	17300-157-4	14632	
W5	Cable Assembly	1	17300-157-5	14632	

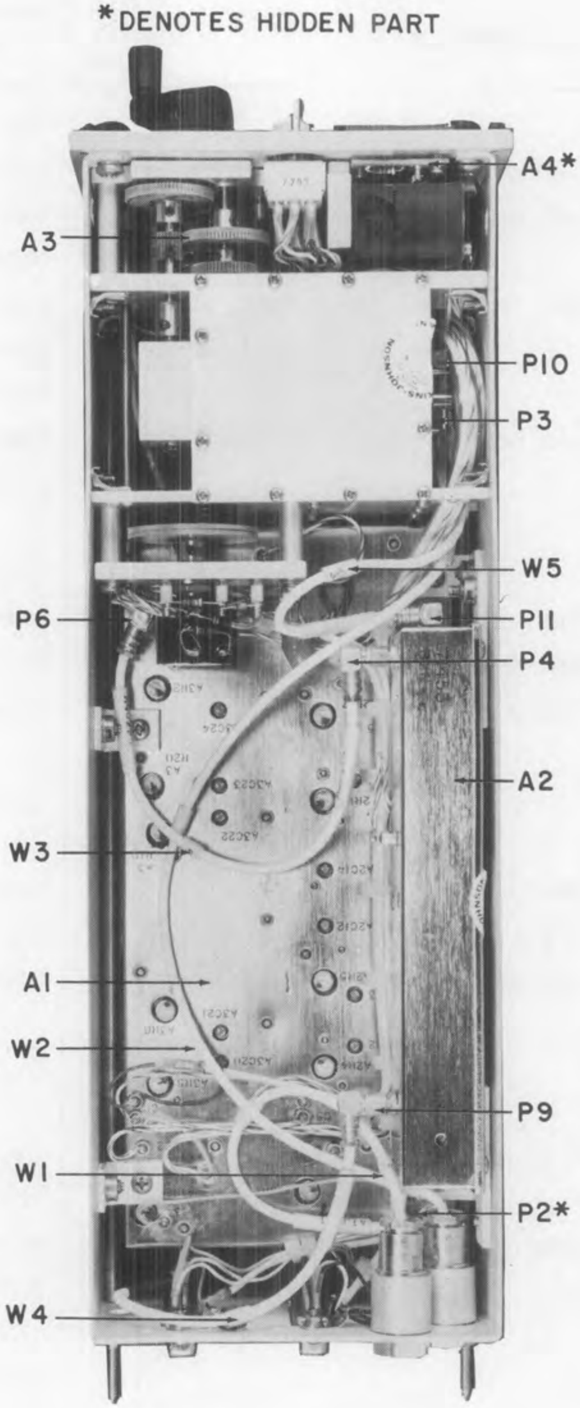


Figure 5-3. Type VH-107 Tuning Head, Top View, Location of Components

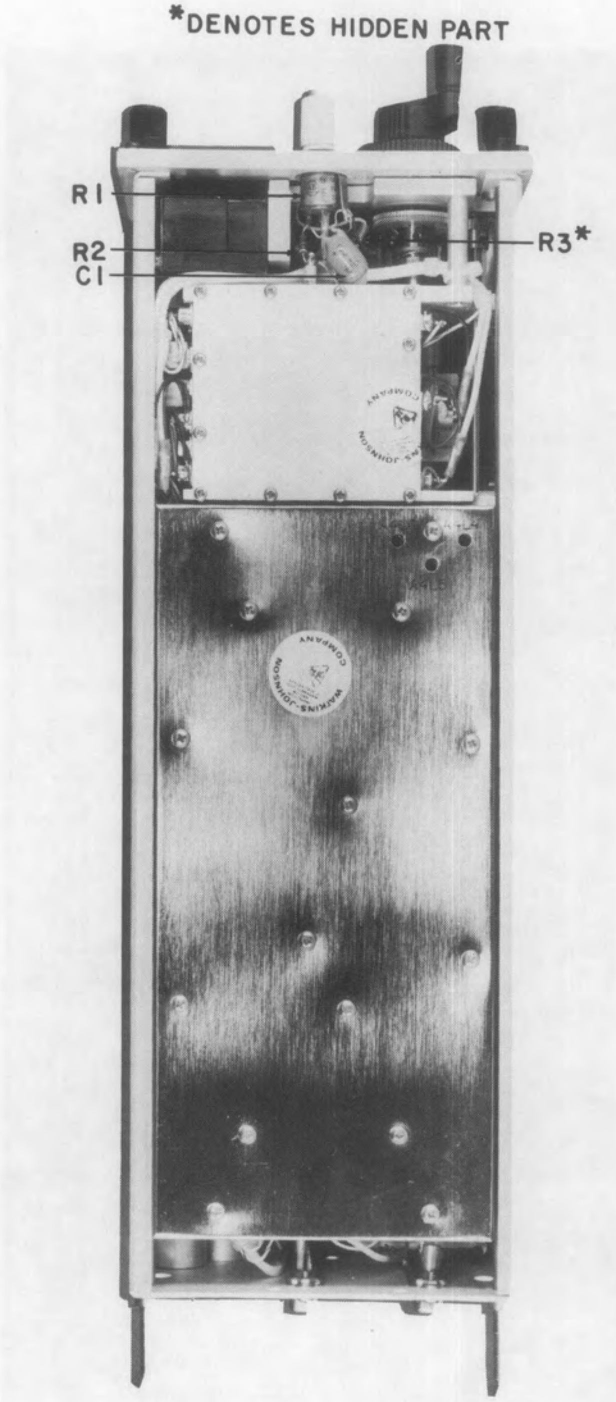


Figure 5-4. Type VH-107 Tuning Head, Bottom View, Location of Components

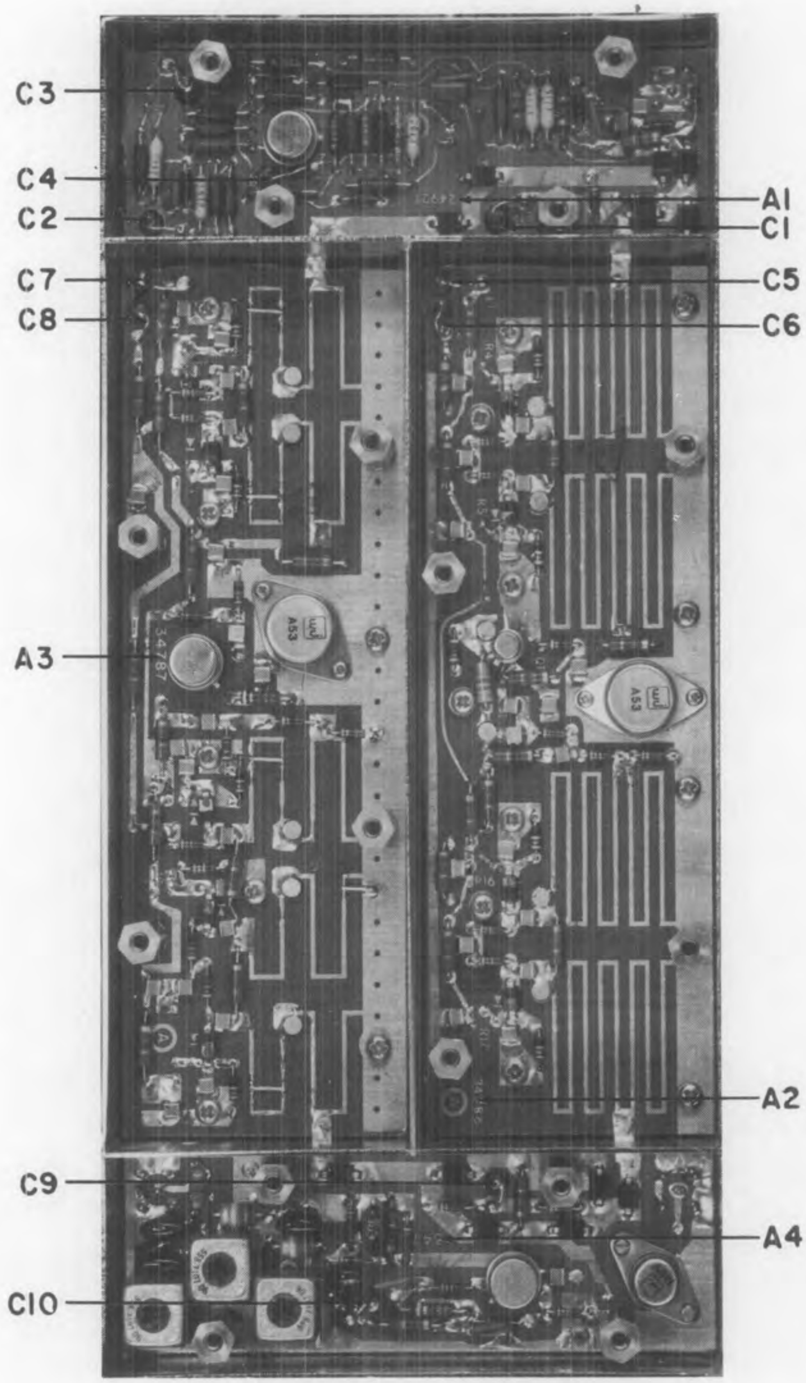


Figure 5-5. Type 71452 100-400 MHz Tuner (A1), Location of Components

5.5.1 TYPE 71452 100-400MHz TUNER REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	Pin Diode Attenuator	1	24921	14632	
A2	100-200 MHz VTF	1	34786	14632	
A3	200-400 MHz VTF	1	34787	14632	
A4	60 MHz IF	1	34788	14632	
C1	Capacitor, Ceramic, Feedthru: 0.05 μF, GMV, 300 V	10	54-785-002-503P	33095	
C2 Thru C10	Same as C1				

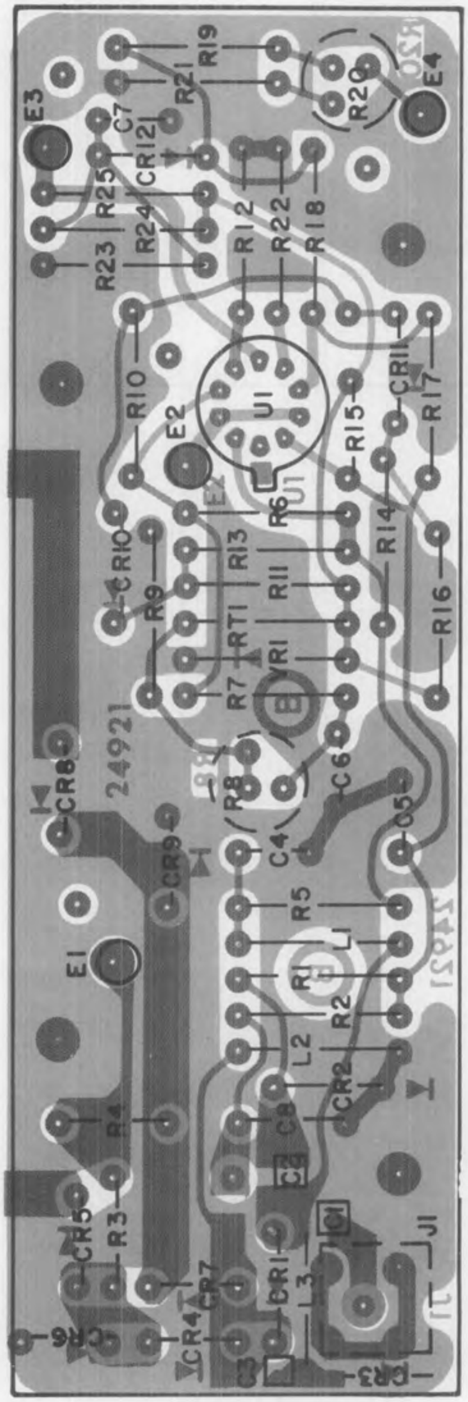


Figure 5-6. Part 24921 Pin Diode Attenuator (A1A1), Location of Components

5.5.1.1 Part 24921 Pin Diode Attenuator REF DESIG PREFIX A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, 10%, 50 V	3	M17CG102K50T	28733	
C2	Same as C1				
C3	Same as C1				
C4	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	5	8131A200Z5U103M	72982	
C5 Thru C8	Same as C4				
CR1	Diode	1	5082-3039	28480	
CR2	Diode	2	5082-3080	28480	
CR3	Same as CR2				
CR4	Diode	6	MPN3401	04713	
CR5 Thru CR9	Same as CR4				
CR10	Diode	3	5082-2800	28480	
CR11	Same as CR10				
CR12	Same as CR10				
E1	Terminal, Forked	4	140-2089-03	71279	
E2	Same as E1				
E3	Same as E1				
E4	Same as E1				
J1	Connector, Receptacle: SMC Series	1	27-800	74868	
L1	Coil, Fixed: 1 μH	2	1025-20	99800	
L2	Coil, Fixed: 2.2 μH	1	1025-28	99800	
L3	Same as L1				
R1	Resistor, Fixed, Film: 5.11 kΩ, 1%, 1/10 W	2	RN55C5111F	81349	75042
R2	Same as R1				
R3	Resistor, Fixed, Composition: 1.5 kΩ, 1%, 1/8 W	2	RCR05G152JS	81349	01121
R4	Same as R3				
R5	Resistor, Fixed, Film: 1 kΩ, 1%, 1/10 W	1	RN55C1001F	81349	75042
R6	Resistor, Fixed, Film: 412 kΩ, 1%, 1/4 W	1	CC4123F	01121	
R7	Resistor, Fixed, Film: 261 kΩ, 1%, 1/4W	1	MF4C/261K/F	80031	
R8	Resistor, Variable, Film: 100 kΩ, 10%, 1/2 W	1	62PR100K	73138	
R9	Resistor, Fixed, Film: 9.09 kΩ, 1%, 1/10 W	1	RN55C9091F	81349	75042
R10	Resistor, Fixed, Film: 100 kΩ, 1%, 1/10 W	5	RN55C1003F	81349	75042
R11	Resistor, Fixed, Film: 475 kΩ, 1%, 1/4 W	1	CC4753F	01121	
R12	Resistor, Fixed, Film: 38.3 kΩ, 1%, 1/10 W	1	RN55C3832F	81349	75042

REF DESIG PREFIX A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R13	Resistor, Fixed, Film: 121 kΩ, 1%, 1/4 W	1	MF4C/121KF/F	80031	
R14	Resistor, Fixed, Film: 42.2 kΩ, 1%, 1/10 W	1	RN55C4222F	81349	75042
R15	Same as R10				
R16	Resistor, Fixed, Film: 619 kΩ, 1%, 1/4 W	1	CC6193 F	01121	
R17	Resistor, Fixed, Film: 309 kΩ, 1%, 1/4 W	1	CC3093F	01121	
R18	Same as R10				
R19	Same as R10				
R20	Resistor, Variable, Film: 20 kΩ, 10%, 1/2 W	1	62PR20K	73138	
R21	Resistor, Fixed, Film: 34.8 kΩ, 1%, 1/10 W	1	RN55C3482F	81349	75042
R22	Same as R10				
R23	Resistor, Fixed, Film: 21.5 kΩ, 1%, 1/10 W	1	RN55C2152F	81349	75042
R24	Resistor, Fixed, Film: 68.1 kΩ, 1%, 1/10 W	1	RN55C6812F	81349	75042
R25	Resistor, Fixed, Film: 6.19 kΩ, 1%, 1/10 W	1	RN55C6191F	81349	75042
RT1	Thermistor: 3.9 kΩ, 5%, 1/4 W	1	DG125-392J	15454	
U1	Integrated Circuit	1	747HC	07263	
VR1	Voltage Regulator: 6.3 V	1	.4M6.3AZ2	04713	

5.5.1.2 Part 34786 100-200 MHz Voltage Tuned Filter REF DESIG A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, 10%, 50 V	18	M17CG102K50T	28733	
C2 Thru C11	Same as C1				
C12	Capacitor, Variable, Saphire: 0.6-4.5 pF, 500 V	6	M5D	18736	
C13	Capacitor, Ceramic, Disc: 5.6 pF±0.25 pF, 500 V	1	C17AH5R6C500TL	28733	
C14	Same as C12				
C15 Thru C21	Same as C1				
C22 Thru C25	Same as C12				
CR1	Diode	4	BB109/Yellow	25088	
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Same as CR1				
E1	Terminal, Forked	2	140-2089-03	71279	
E2	Same as E1				
L1	Coil, Fixed: 0. 39 μH	1	1025-10	99800	
L2	Coil, Fixed: 2.2. μH	9	1025-28	99800	
L3 Thru L8	Same as L2				
L9	Coil, Fixed: 0.22 μH	1	1025-04	99800	
L10	Same as L2				
L11	Coil Fixed: 0.1 μH	1	1025-94	99800	
L12	Coil, Fixed: 0.47 μH	1	1025-12	99800	
L13	Same as L2				
Q1	Transistor	1	U310	17856	
R1	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/8 W	4	RCR05G104JS	81349	01121
R2	Resistor, Fixed, Composition: 56 kΩ, 5%. 1/8 W	4	RCR05G563JS	81349	01121
R3	Same as R2				
R4	Resistor, Variable Film: 100 kΩ, 10%, 1/2 W	4	62PR100K	73138	
R5	Same as R4				
R6	Same as R1				
R7	Resistor, Fixed, Composition: 51 Ω, 5%, 1/8 W	1	RCR05G510JS	81349	01121
R8	Resistor, Fixed, Composition: 470 Ω, 5%, 1/8 W	1	RCR05G471JS	81349	01121

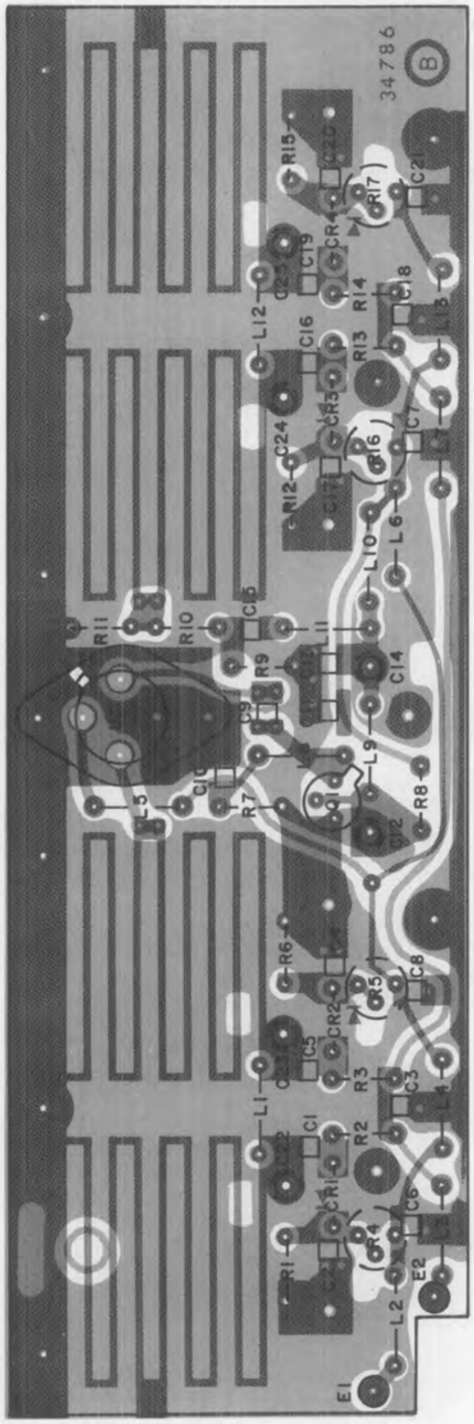


Figure 5-7. Type 34786 100-200 MHz Voltage Tuned Filter (A1A2), Location of Components

REF DESIG A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R9	Resistor, Fixed, Composition: 820 Ω, 5%, 1/8 W	2	RCR05G821JS	81349	01121
R10	Resistor, Fixed, Composition: 5.6 Ω, 5%, 1/8 W	1	RCR05G5R6JS	81349	01121
R11	Same as R9				
R12	Same as R1				
R13	Same as R2				
R14	Same as R2				
R15	Same as R1				
R16	Same as R4				
R17	Same as R4				
U1	Amplifier	1	A53	27956	

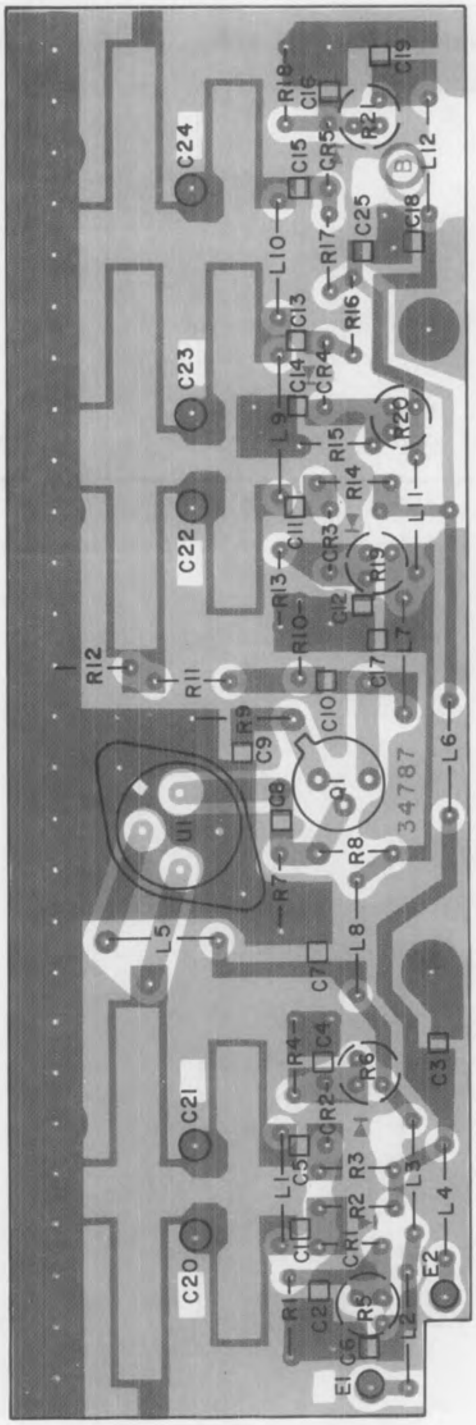


Figure 5-8. Part 34787 200-400 MHz Voltage Tuned Filter (A1A3), Location of Components

5.5.1.3 Part 34787 200-400 MHz Voltage Tuned Filter REF DESIG PREFIX A1A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, 10%	19	M17CG102K50T	28733	
C2 Thru C7	Same as C1				
C8	Capacitor, Ceramic, Disc: 24 pF±5%, 500 V	1	C17AH240J500TL	28733	
C9 Thru C19	Same as C1				
C20	Capacitor, Variable, Saphire: 0.6-4.5 pF, 500 V	5	M5D	18736	
C21 Thru C24	Same as C20				
C25	Same as C1				
CR1	Diode	5	BB105B	25088	
CR2 Thru CR5	Same as CR1				
E1	Terminal, Forked	2	140-2089-03	71279	
E2	Same as E1				
L1	Coil, Fixed: 0.27 μH	1	1025-06	99800	
L2	Coil, Fixed: 2.2 μH	8	1025-28	99800	
L3 Thru L6	Same as L2				
L7	Coil, Fixed: 0.1 μH	1	1025-94	99800	
L8	Same as L2				
L9	Coil, Fixed: 0.33 uH	2	1025-08	99800	
L10	Same as L9				
L11	Same as L2				
L12	Same as L2				
Q1	Transistor	1	2N5109	80131	02735
R1	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/8 W	5	RCR05G104JS	81349	01121
R2	Resistor, Fixed, Composition: 56 kΩ, 5%, 1/8 W	5	RCR05G563JS	81349	01121
R3	Same as R2				
R4	Same as R1				
R5	Resistor, Variable, Film: 100kΩ, 10%, 1/2 W	5	62PR100K	73138	
R6	Same as R5				
R7	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/8 W	1	RCR05G103JS	81349	01121
R8	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/8 W	1	RCR05G562JS	81349	01121

REF DESIG PREFIX A1A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R9	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R10	Resistor, Fixed, Composition: 330 Ω, 5%, 1/8 W	2	RCR05G331JS	81349	01121
R11	Resistor, Fixed, Composition: 18 Ω, 5%, 1/8 W	1	RCR05G180JS	81349	01121
R12	Same as R10				
R13	Same as R1				
R14	Same as R2				
R15	Same as R1				
R16	Same as R2				
R17	Same as R2				
R18	Same as R1				
R19	Same as R5				
R20	Same as R5				
R21	Same as R5				
U1	Amplifier	1	A53	27956	

5.5.1.4 Part 34788 60 MHz IF REF DESIG PREFIX A1A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, 10%, 50V	1	M17CG102K50T	28733	
C2	Capacitor, Mica, Dipped: 47 pF, 2%, 500 V	2	CM04ED470G03	81349	72136
C3	Same as C2				
C4	Capacitor, Composition, Tubular: 1.8 pF, 10%, 500 V	2	QC(1.8pF, K)	95121	
C5	Capacitor, Mica, Dipped: 20 pF, 5%, 500 V	1	CM04ED200J03	81349	72136
C6	Same as C4				
C7	Capacitor, Mica, Dipped: 33 pF, 2%, 500 V	1	CM04ED330G03	81349	72136
C8	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	1	CM04FD101G03	81349	72136
C9	Capacitor, Ceramic Disc: 0.01 µF, 20%, 200 V	3	8131A200Z5U103M	72982	
C10	Same as C9				
C11	Same as C9				
CR1	Diode	6	MPN3401	04713	
CR2 Thru CR6	Same as CR1				
E1	Terminal, Forked	2	140-2089-03	71279	
E2	Same as E1				
J1	Connector, Receptacle: SMC Series	2	27-800	74868	
J2	Same as J1				
L1	Coil, Fixed: 2.2. µH	1	1025-28	99800	
L2	Coil, Fixed: 10 µH	2	1025-44	99800	
L3	Same as L2				
L4	Coil, Variable	3	558-7107-06	71279	
L5	Same as L4				
L6	Same as L4				
L7	Coil, Fixed: 0.15 µH	1	1025-00	99800	
Q1	Transistor	1	2N5109	80131	02735
R1	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/8 W	2	RCR05G152JS	81349	01121
R2	Same as R1				
R3	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/8 W	1	RCR05G103JS	81349	01121
R4	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/8 W	1	RCR05G562JS	81349	01121
R5	Resistor, Fixed, Composition: 2.7 Ω, 5%, 1/8 W	1	RCR05G2R7JS	81349	01121
R6	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R7	Resistor, Fixed, Composition: 680 Ω, 5%, 1/8 W	2	RCR05G681JS	81349	01121
R8	Resistor, Fixed, Composition: 33 Ω, 5%, 1/8 W	1	RCR05G330JS	81349	01121
R9	Same as R7				
U1	Mixer	1	M6V	27956	

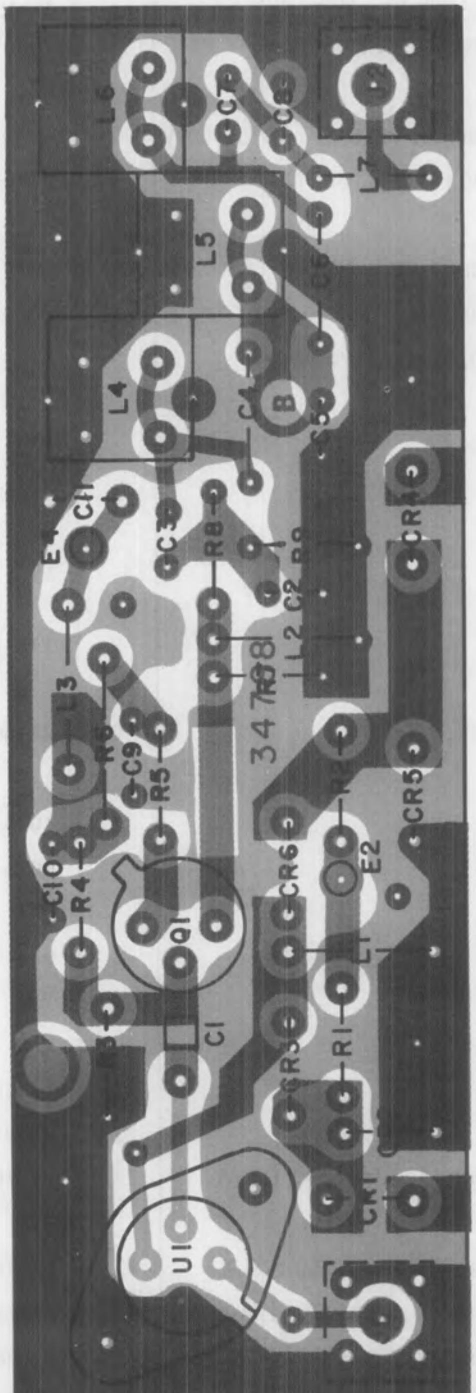


Figure 5-9. Type 34788 60 MHz IF (A1A4), Location of Components

5.5.2 TYPE 71453 60/21.4 MHz CONVERTER ASSY REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	60/21.4 MHz Converter	1	34796	14632	
C1	Capacitor, Ceramic, Feedthru: 0.05 μF, GMV, 300 V	1	54-785-002-503P	33095	

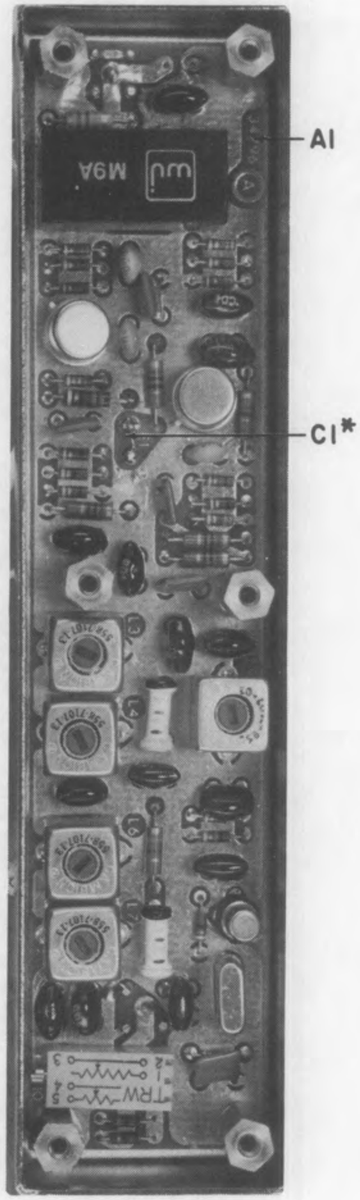


Figure 5-10. Type 71453 60/21.4 MHz Converter Assy. (A2), Location of Components

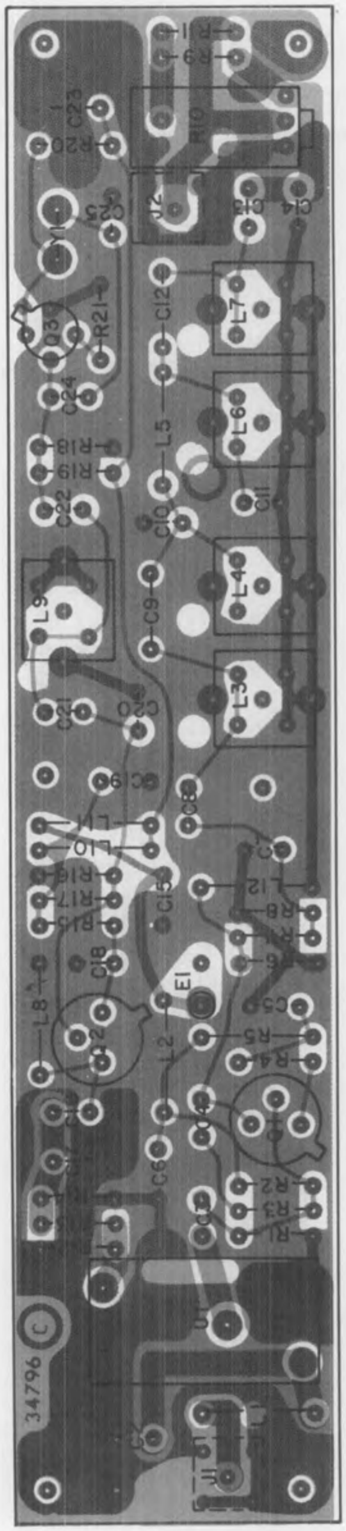


Figure 5-11. Type 34796 60/21.4 MHz Converter (A2A1), Location of Components

5.5.2.1 Part 34796 60/21.4 MHz Converter REF DESIG PREFIX A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Not Used				
C2	Capacitor, Mica, Dipped: 51 pF, 2%, 500 V	4	CM04ED51G03	81349	72136
C3	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	3	SM(1000pF, P)	91418	
C4	Same as C3				
C5	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	5	8131A200Z5U103M	72982	
C6	Same as C5				
C7	Capacitor, Mica, Dipped: 110 pF, 2%, 500 V	1	CM04FD111G03	81349	72136
C8	Capacitor, Mica, Dipped: 82 pF, 2%, 500 V	1	CM04ED820G03	81349	72136
C9	Capacitor, Composition, Tubular: 9.1 pF±0.5 pF 500 V	2	301-000C0H0919D	72982	
C10	Same as C2				
C11	Same as C2				
C12	Same as C9				
C13	Capacitor, Mica, Dipped: 68 pF, 2%, 500 V	1	CM04ED680G03	81349	72136
C14	Capacitor, Mica, Dipped: 120 pF, 2%, 500 V	2	CM04FD121G03	81349	72136
C15	Same as C5				
C16	Same as C14				
C17	Capacitor, Mica, Dipped: 39 pF, 2%, 500 V	1	CM04ED390G03	81349	72136
C18	Same as C3				
C19	Same as C5				
C20	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	1	CM04FD101G03	81349	72136
C21	Capacitor, Mica, Dipped: 18 pF, 5%, 500 V	1	CM04CD180J03	81349	72136
C22	Same as C2				
C23	Same as C5				
C24	Capacitor, Mica, Dipped: 62 pF, 2%, 500 V	1	CM04ED620G03	81349	72136
C25	Capacitor, Mica, Dipped: 56 pF, 2%, 500 V	1	CM04ED560G03	81349	72136
J1	Connector, Receptacle: SME Series	2	27-800	72982	
J2	Same as J1				
L1	Coil, Fixed: 0.15 μH	2	1025-00	99800	
L2	Coil, Fixed: 10 μH	4	1025-44	99800	
L3	Coil, Variable	4	558-7107-13	71279	
L4	Same as L3				
L5	Coil, Fixed: 8.2 μH	1	1025-42	99800	
L6	Same as L3				
L7	Same as L3				
L8	Coil, Fixed: 0.1 μH		1025-94	99800	
L9	Coil, Variable	1	558-7107-01	71279	

REF DESIG PREFIX A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
L10	Same as L2				
L11	Same as L2				
L12	Same as L2				
Q1	Transistor	2	2N5109	80131	02735
Q2	Same as Q1				
Q3	Transistor	1	2N2857	80131	02735
R1	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/8 W	2	RCR05G332JS	81349	01121
R2	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/8 W	1	RCR05G562JS	81349	01121
R3	Resistor, Fixed, Composition: 820 Ω, 5%, 1/8 W	1	RCR05G821JS	81349	01121
R4	Resistor, Fixed, Composition: 5.6 Ω, 5%, 1/8 W	1	RCR05G5R6JS	81349	01121
R5	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R6	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/8 W	3	RCR05G102JS	81349	01121
R7	Resistor, Fixed, Composition: 82 Ω, 5%, 1/8 W	1	RCR05G820JS	81349	01121
R8	Same as R6				
R9	Resistor, Fixed, Composition: 51 Ω, 5%, 1/8 W	2	RCR05G510JS	81349	01121
R10	Bridge T Attenuator	1	9950-0075	84048	
R11	Same as R9				
R12	Resistor, Fixed, Composition: 330 Ω, 5%, 1/8 W	2	RCR05G331JS	81349	01121
R13	Resistor, Fixed, Composition: 18 Ω, 5%, 1/8 W	1	RCR05G180JS	81349	01121
R14	Same as R12				
R15	Resistor, Fixed, Composition: 100 Ω, 5%, 1/8 W	1	RCR05G101 JS	81349	01121
R16	Same as R1				
R17	Same as R6				
R18	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/8 W	1	RCR05G103JS	81349	01121
R19	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/8 W	1	RCR05G472JS	81349	01121
R20	Resistor, Fixed, Composition: 430 Ω, 5%, 1/8 W	1	RCR05G431JS	81349	01121
R21	Resistor, Fixed, Composition: 22 Ω, 5%, 1/8 W	1	RCR05G220JS	81349	01121
U1	Mixer	1	M9A	27956	
Y1	Crystal, Quartz: 81.4 MHz	1	98204-3	14632	

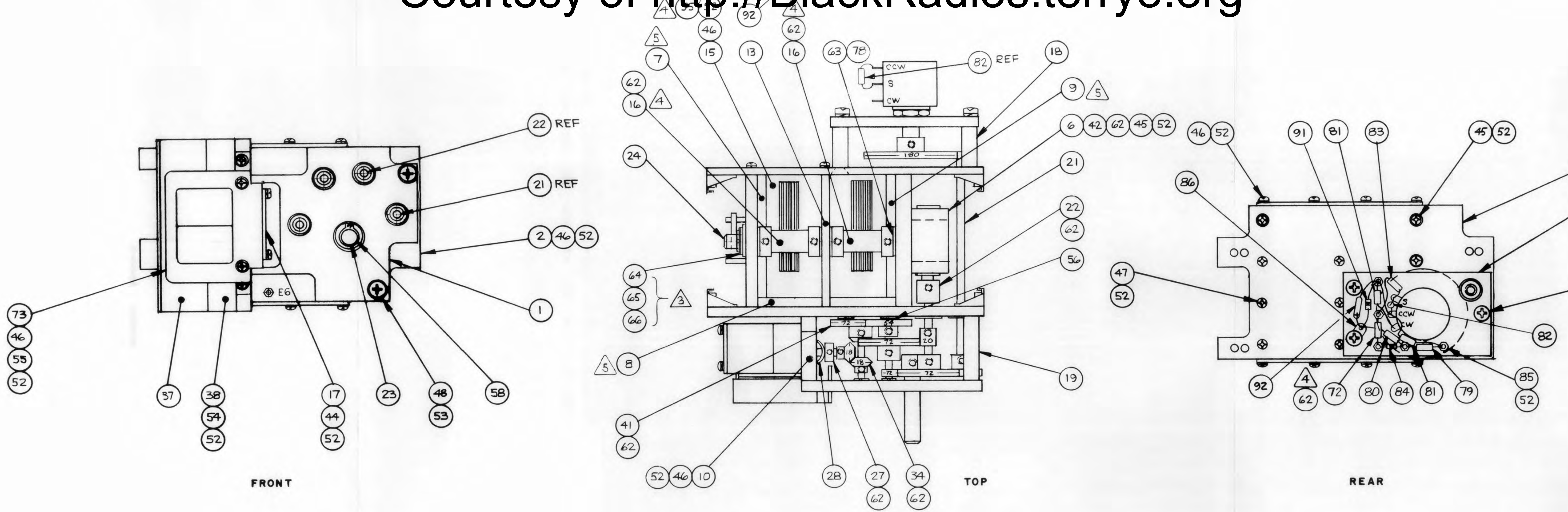


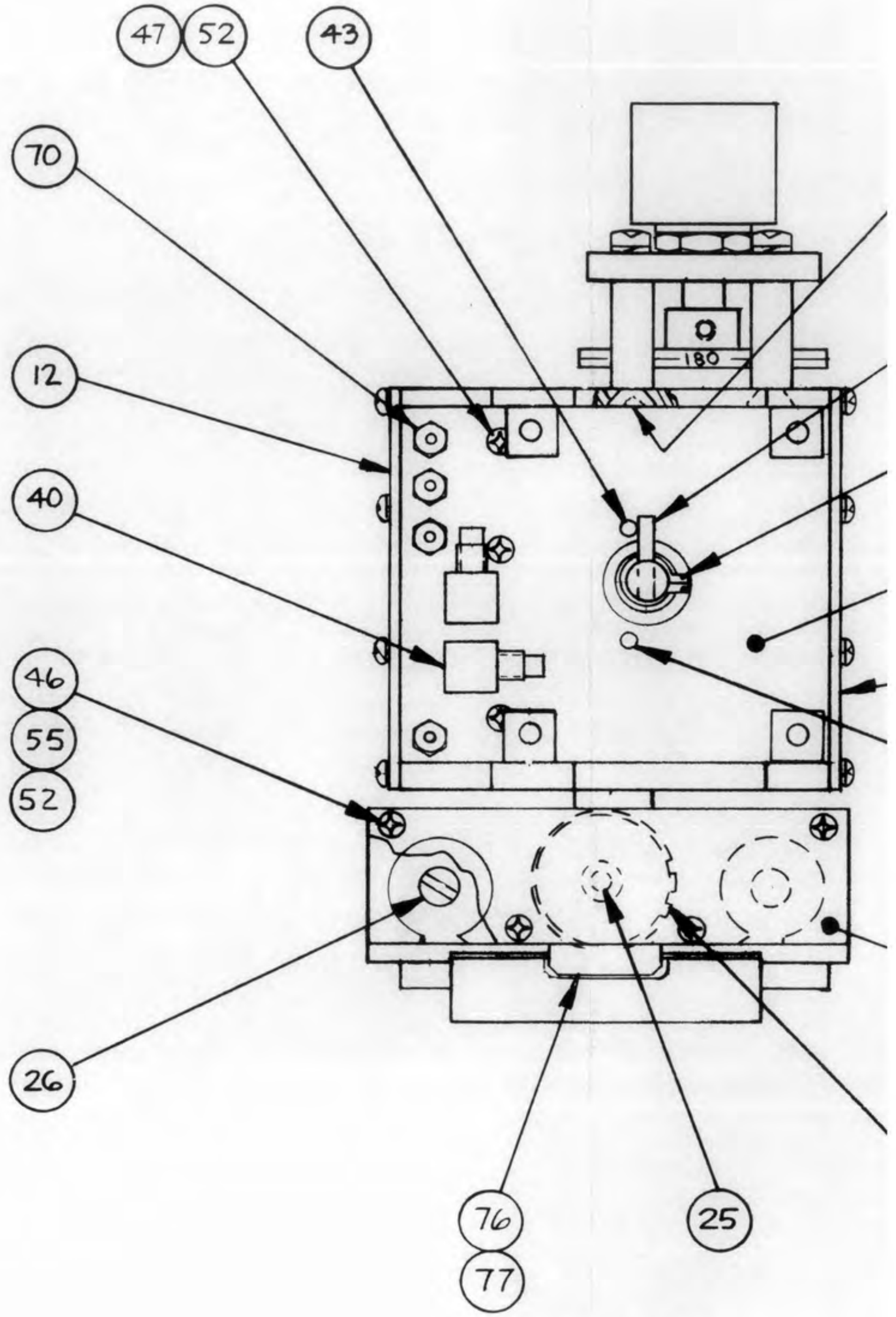
Figure 5-12. Type 7794 Oscillator Gear Train (A3), Location of Components, Part I, 43663

5.5.3 TYPE 7794 OSCILLATOR GEAR TRAIN ASSEMBLY REF DESIG PREFIX A3

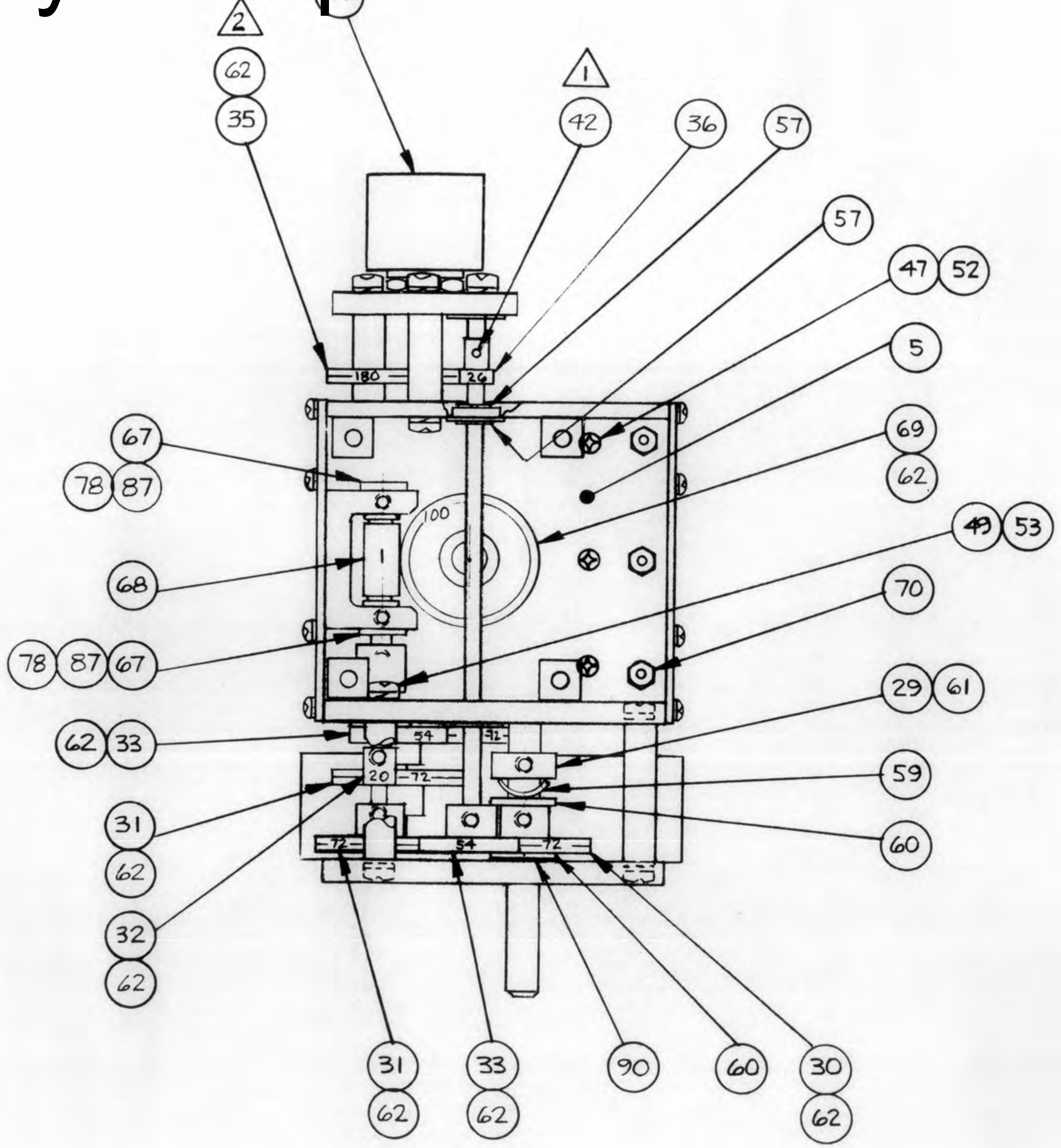
REF DESIG	DESCRIPTION		QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
1	Front Gear Plate Assembly		1	25030-1	14632	
2	Center Gear Plate Assembly		1	25019-1	14632	
3	Rear Gear Plate Assembly		1	25020-1	14632	
4	Pot Mounting Plate Assembly		1	25047-1	14632	
5	Enclosure Plate Assembly		1	25048-1	14632	
6	Worm Gear Bracket		1	24878-1	14632	
7	Support		1	24888-1	14632	
8	Support		1	24889-1	14632	
9	Support		1	24995-1	14632	
10	Tape Chamber Plate Assembly		1	25049-1	14632	
11	Tuner Cavity Cover		1	24862-1	14632	
12	Tuner Cavity Cover		1	24862-2	14632	
13	Tuner Cavity Partition		1	24863-1	14632	
14	Enclosure Plate Assembly		1	25050-1	14632	
15	160-460 MHz Oscillator	A1	1	34901	14632	
16	Rotor Assembly		2	24913-1	14632	
17	Light Board	A2	1	14004	14632	
18	Spacer, Gear Train		3	20757-39	14632	
19	Spacer, Gear Train		2	20757-44	14632	
20	Shaft		2	24884-1	14632	
21	Shaft		1	24883-1	14632	
22	Shaft, Extender		1	24885-1	14632	
23	Shaft		1	1002-108	14632	
24	Shaft		1	24886-1	14632	
25	Shaft		1	13908-11	14632	
26	Shoulder Spacer		2	15545-1	14632	
27	Collar		1	11581-5	14632	
28	Tension Spring		1	13944-1	14632	
29	Collar, 72P, 72T, 1/4 Bore		1	11581-11	14632	
30	Gear, A-B, Spur, 72P, 72T, 1/4 Bore		1	20182-22	14632	
31	Gear, A-B, Spur, 72P, 72T, 1/8 Bore		2	20182-21	14632	
32	Gear, Spur, 72P, 20T, 1/8 Bore		1	2951-17	14632	
33	Gear, Spur, 72P, 54T, 1/8 Bore		2	2951-18	14632	
34	Gear, Miter, Modified, 18T		2	12124-1	14632	
35	Gear, A-B, Spur, 120P, 180T, 1/8 Bore		1	20466-2	14632	
36	Gear, Spur, 120P, 26T, 1/8 Bore		1	20465-4	14632	

REF DESIG PREFIX A3

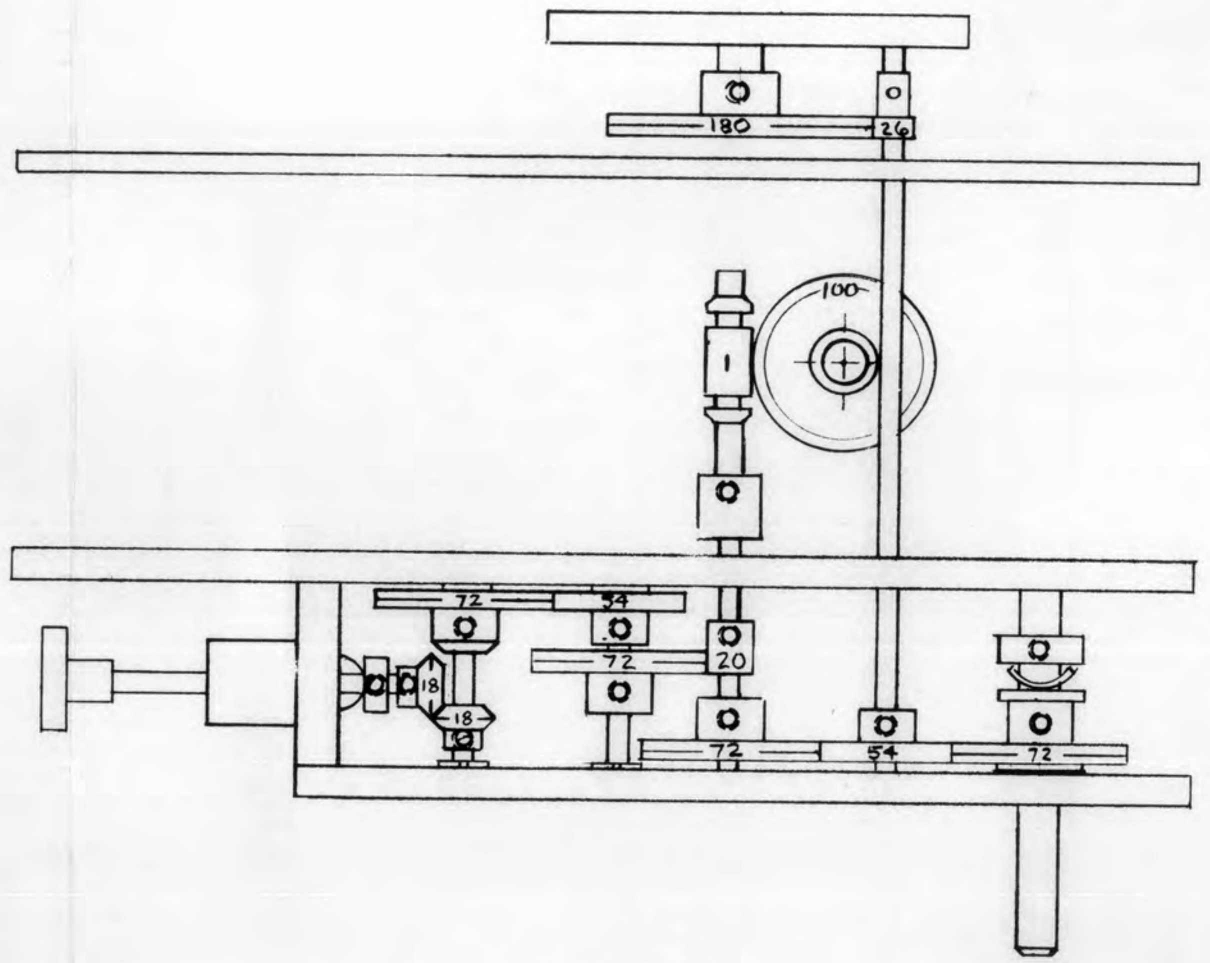
REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
37	Tape Chamber, Modified	1	25022-1	14632	
38	Tape Chamber, Modified	1	25023-1	14632	
39	Cover, Tape Chamber	1	14083-1	14632	
40	Connector, Modified J1, J2	2	25032-1	14632	
41	Gear, A-B, Spur, Modified, 72P, 72T, 1/8 Bore	1	25059-1	14632	
42	Pin, Roll, Tubular, Slotted, 1/16 D x 5/16 L	3	MS16562-191	96906	
43	Pin, Roll, Tubular, Slotted, 3/32 D x 1/2 L	3	MS16562-213	96906	
44	PHMS #2-56 x 3/16	2	MS51957-2	96906	
45	PHMS #2-56 x 1/4	7	MS51957-3	96906	
46	PHMS #2-56 x 5/16	59	MS51957-4	96906	
47	PHMS #2-56 x 3/8	12	MS51957-5	96906	
48	PHMS #6-32 x 3/8	3	MS51957-28	96906	
49	PHMS #6-32 x 7/16	1	MS51957-29	96906	
50	PHMS #6-32 x 1/2	4	MS51957-30	96906	
51	FHMS #6-32 x 3/8	2	MS24693-C26	96906	
52	Washer, Lock #2	84	MS35338-134	96906	
53	Washer, Lock #6	8	MS35338-136	96906	
54	PHMS #2-56 x 5/8	4	MS51957-8	96906	
55	Washer, Flat #2	21	NAS620C2	80205	
56	Washer, Flat #5	4	NAS620C5	80205	
57	Ring, Retaining	4	5100-12	79136	
58	Ring, Retaining	3	5100-25	79136	
59	Spring Friction Washer	1	3502-14-47	78189	
60	Thrust, Bearing	2	TT-504	70417	
61	Set Screw, #6-32 x 1/8 L	2	SSCR6-32 x 1/8 HT-TR	56878	
62	Set Screw, #4-40 x 1/8 L	34	SSCR4-40 x 1/8HT-TR	56878	
63	Spring, Washer	4	5806-16-1	86928	
64	Shim, 0.003 THK	3	SSS-21	01351	
65	Shim, 0.005 THK	3	SSS-22	01351	
66	Shim, 0.010 THK	2	SSS-23	01351	
67	Bearing Cup	2	25210-1	14632	
68	Gear, Worm	1	25211-1	14632	
69	Gear, A-B, Spur, 96P, 100T, 1/4 Bore	1	A19423	01351	
70	Capacitor, Ceramic, Feedthru: 0.05 μF, GMV, 300 V C1 thru C7	7	54-785-005-503P	33095	
71	Resistor, Variable, Precision: 10 kΩ, ±10%, 2 W R1	1	8106R10K-L.25	73138	



LEFT SIDE



RIGHT SIDE



PLAN VIEW

Figure 5-13. Type 7794 Oscillator Gear Train (A3), Location of Components, Part II, 43663

REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
72	Resistor, Fixed, Composition: 68 kΩ, ±5%, 1/4 W R2	1	RCR07G683JS	81349	01121
73	Light Bar Assembly	1	24984-1	14632	
74	Gear Tape Drive	1	14065	14632	
75	Locking & Sealing Compound	AR	GRADE C	05972	
76	Guide, Dial Tape	1	18716-1	14632	
77	REAPOXY	AR	250	20484	
78	Lubricant	AR	LUBRIPLATE	72653	
79	Resistor, Fixed, Composition: 2.2 kΩ, ±5%, 1/4 W R3	1	RCR07G222JS	81349	01121
80	Resistor, Fixed, Composition: 3.9 kΩ, ±5%, 1/4 W R4	1	RCR07G392JS	81349	01121
81	Resistor, Fixed, Composition: 56 Ω, ±5%, 1/4 W R5, R8	2	RCR07G560JS	81349	01121
82	Resistor, Fixed, Composition: 8.2 kΩ, ±5%, 1/4 W R6	1	RCR07G822JS	81349	01121
83	Resistor, Fixed, Composition: 56 kΩ, ±5%, 1/4 W R7	1	RCR07G563JS	81349	01121
84	Diode CR1	1	1N4449	80131	93332
85	Terminal, Standoff, Insulated E1 thru E6	6	572-4894-01-0511	71279	
86	Lug, Terminal	1	505-144	79963	
87	Ball, Stainless Steel, 1/16 DIA	28	MS19060-16	96906	
88	Fixture, Rotor/Stator Spacing	2	25193-1	14632	
89	Fixture, Shelf Alignment	AR	25194-1	14632	
90	Shim	1	SSS-33	01351	
91	Diode, Zener VR1	1	1N759A	80131	
92	Capacitor, Electrolytic, Tantalum: 100 μF, 20%, 20 V C8	1	196D107X0020TE4	56289	

5.5.3.1 Part 34901 160-460 MHz Oscillator REF DESIG PREFIX A3A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Stator Assy	2	24876-1	14632	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 8.2 pF±0.25 pF, 500 V	1	C17AH8R2C500TL	28733	
C4	Capacitor, Ceramic, Disc: 2.7 pF±0.1 pF, 500 V	1	C17AH2R7B500TL	28733	
C5	Capacitor, Ceramic, Disc: 1000 pF, 10%, 50 V	10	M17CG102K50T	28733	
C6	Same as C5				
C7	Capacitor, Variable,Dielectric: 0.6-4.5 pF, 500 V	2	M5D	18736	
C8	Capacitor, Ceramic, Disc: 0.5 pF±0.1 pF, 500 V	2	C17AH0R5B500TL	28733	
C9	Same as C5				
C10	Capacitor, Ceramic, Disc: 2.2 pF±0.1 pF, 500 V	1	C17AH2R2B500TL	28733	
C11	Same as C5				
C12	Same as C8				
C13	Capacitor, Ceramic. Disc: 1.2 pF±0.1 pF, 500 V	2	C17AH1R2B500TL	28733	
C14	Capacitor, Ceramic. Disc: 5.6 pF±0.25 pF, 500 V	1	C17AH5R6C500TL	28733	
C15	Same as C5				
C16	Same as C5				
C17	Same as C7				
C18	Same as C13				
C19 Thru C22	Same as C5				
C23	Capacitor, Ceramic Disc: 24 pF, 5%, 500 V	1	C17AH240J500TL	28733	
CR1	Diode	2	BB105B	25088	
CR2	Same as CR1				
Q1	Transistor	3	MFR901	04713	
Q2	Same as Q1				
Q3	Same as Q1				
R1	Resistor, Fixed, Composition: 560 Ω, 5%, 1/8 W	2	RCR05G561JS	81349	01121
R2	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/8 W	3	RCR05G152JS	81349	01121
R3	Resistor, Fixed, Composition: 22 Ω, 5%, 1/8 W	2	RCR05G220JS	81349	01121
R4	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/8 W	3	RCR05G332JS	81349	01121
R5	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/8 W	6	RCR05G104JS	81349	01121
R6	Same as R5				
R7	Same as R5				
R8	Same as R5				
R9	Same as R1				
R10	Same as R2				

REF DESIG PREFIX A3A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R11	Same as R3				
R12	Same as R4				
R13	Same as R4				
R14	Same as R2				
R15	Resistor, Fixed, Composition: 180 Ω, 5%, 1/8 W	1	RCR05G181JS	81349	01121
R16	Resistor, Fixed, Composition: 390 Ω, 5%, 1/8 W	1	RCR05G391JS	81349	01121
R17	Resistor, Fixed, Composition: 47 Ω, 5%, 1/8 W	1	RCR05G470JS	81349	01121
R18	Same as R5				
R19	Same as R5				
U1	Integrated Circuit Directional Coupler	1	C114	12475	

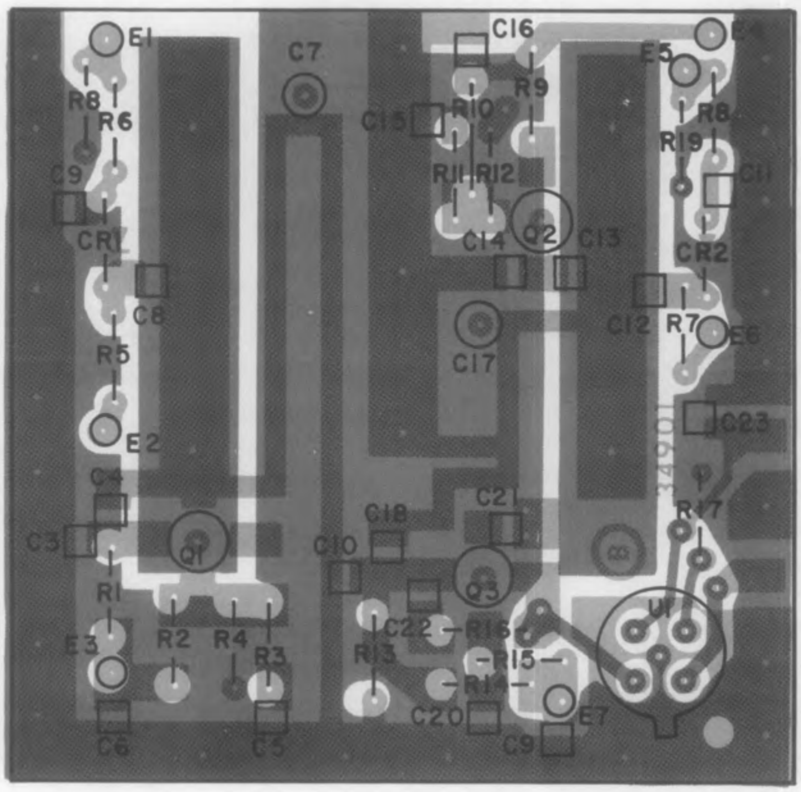


Figure 5-14. Part 34901 160-460 MHz Oscillator (A3A1), Location of Components

5.5.3.2 Part 14004 Light Board REF DESIG PREFIX A3A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
DS1	Lamp/Incandescent	3	CM8-683	71744	
DS2	Same as DS1				
DS3	Same as DS1				

5.5.4 TYPE 18620 LED DISPLAY REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	2	5082-4860	28480	
CR2	Same as CR1				
E1	Terminal	1	140-2089-02	71279	
R1	Resistor, Fixed, Composition: 620 Ω, 5%, 1/4 W	1	RCR07G621JS	81349	01121

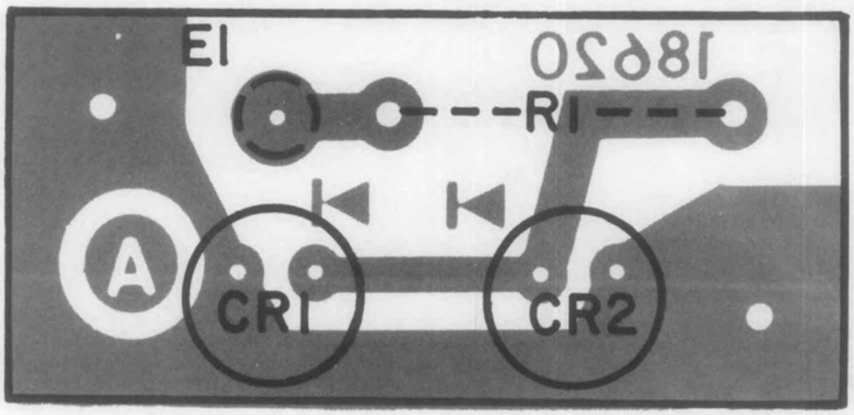
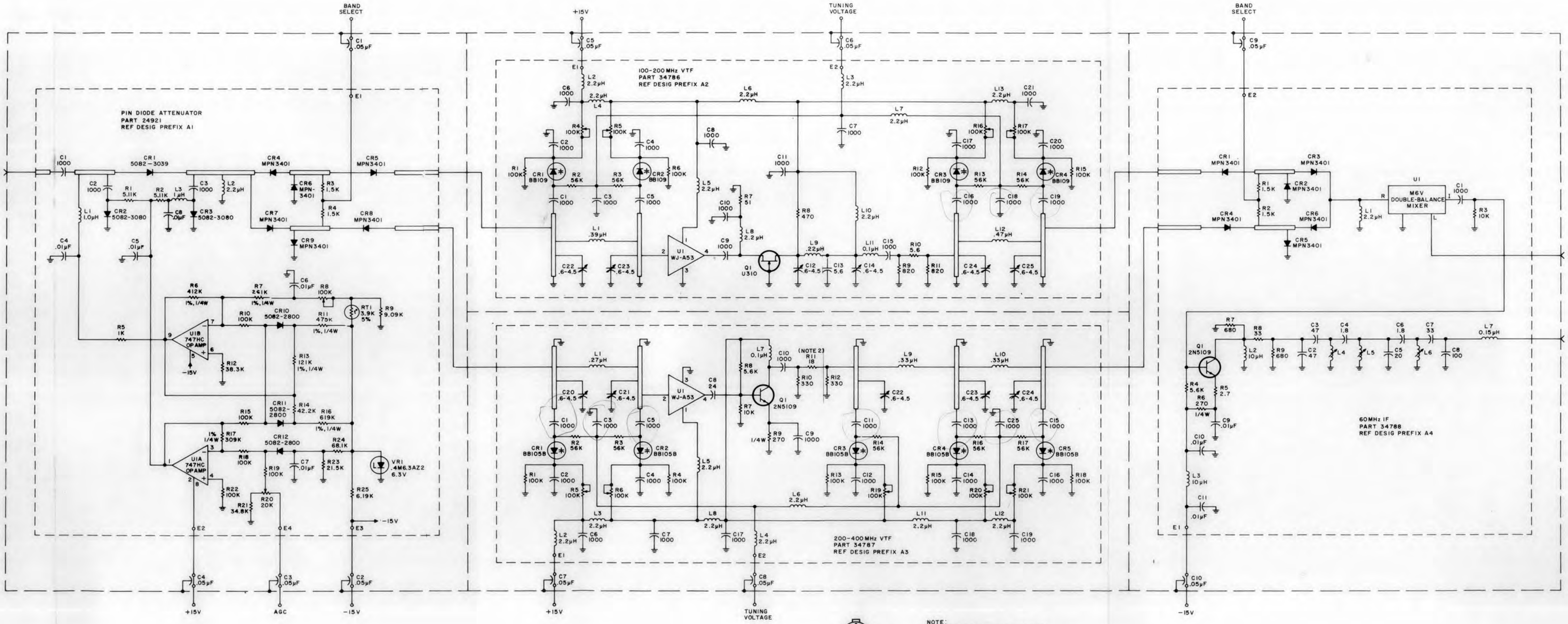


Figure 5-15. Type 18620 LED Display (A4), Location of Components

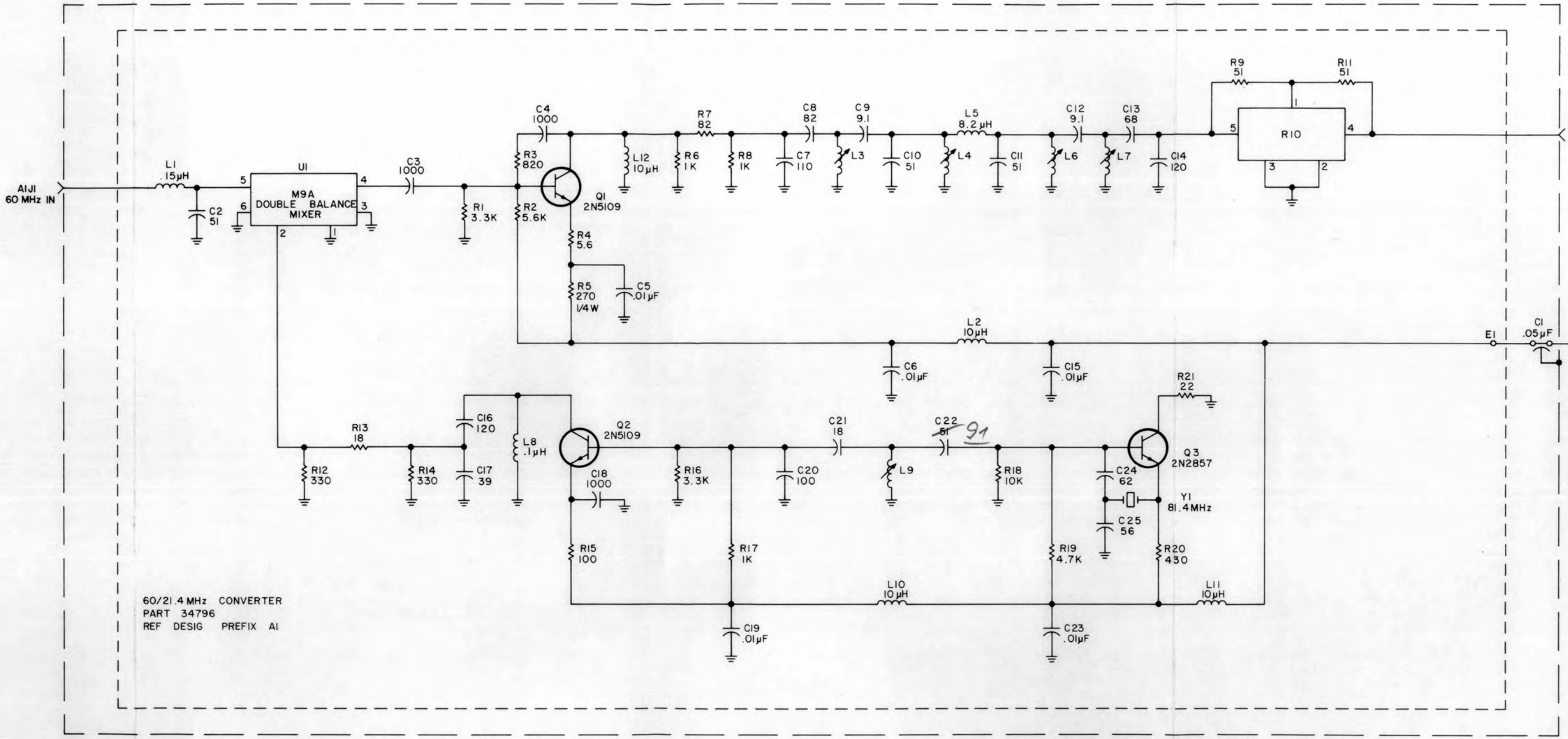
SECTION VI

SCHEMATIC DIAGRAMS



NOTE:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/8W.
b) CAPACITANCE IS IN pF.
c) RESISTANCE OF A1-R1, R2, R5, R9, R10, R12, R14, R15, R18, R19, R21 THRU R25 ARE 1%, 1/10W.
2. NOMINAL VALUE. FINAL VALUE FACTORY SELECTED.

Figure 6-1. Type 71452 100-400MHz Tuner (A1), Schematic Diagram 61317



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ± 5%, 1/8W.
b) CAPACITANCE IS IN pF.

Figure 6-2. Type 71453 60/21.4MHz Converter (A2) Schematic Diagram 43580

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/8W.
   b) CAPACITANCE IS IN pF.

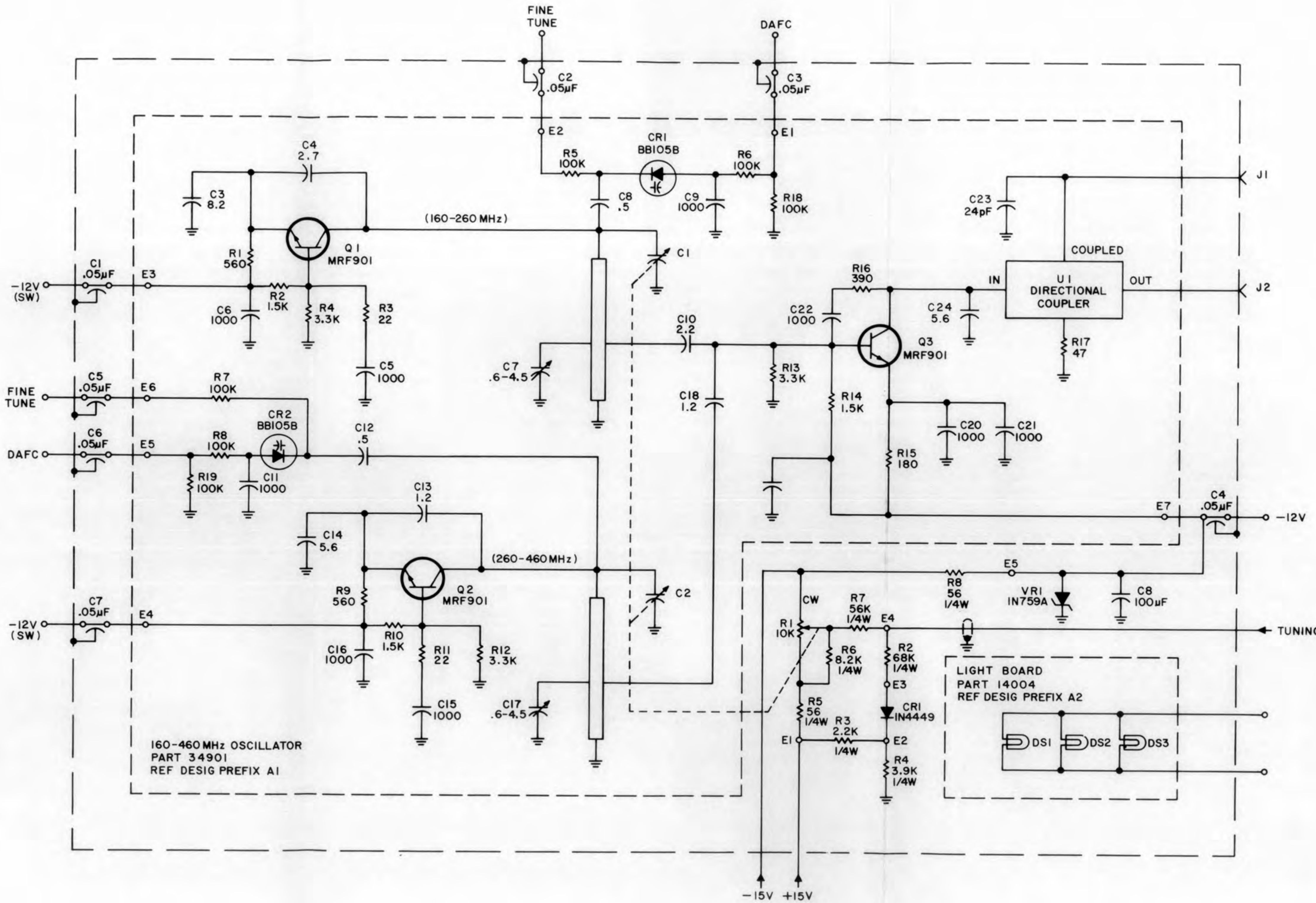


Figure 6-3. Type 7794 Oscillator/Gear Train Assembly (A3), Schematic Diagram 43675

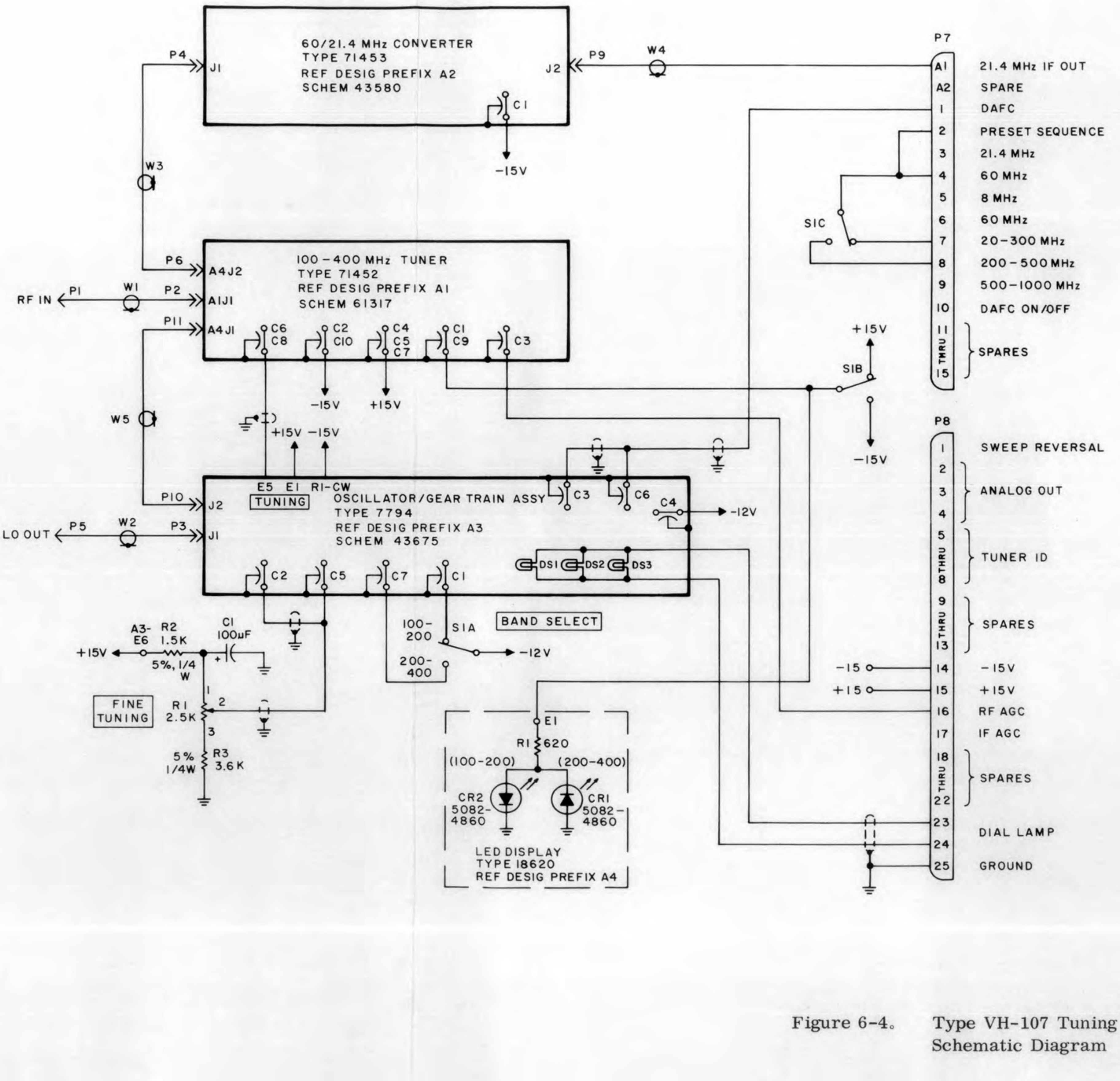


Figure 6-4. Type VH-107 Tuning Head, Schematic Diagram 43576