INSTRUCTION MANUAL

FOR

TYPE TH-480A 4-8 GHz TUNING HEAD

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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.

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Table 1-1. Type TH-480A Tuning Head Specifications

Electrical	
Tuning Range	4-8 GHz
Input Impedance	50 ohms, nominal
Noise Figure	16 dB, typical; 20 dB maximum
Tuner Gain	14 dB, nominal
IF Rejection	80 dB, minimum
Image Rejection	60 dB, minimum
Input VSWR	3:1, maximum
Local Oscillator Output Frequency	$F_{LO} = F\frac{Tuned}{2} + 80$ MHz
Antenna Conducted LO Radiation	70 microvolts, maximum
LO OUTPUT Level	-20 dBm, minimum into 50 ohms
ANALOG OUTPUT Level	-10V to +10V
Varactor Tuning Range	±500 kHz, minimum
External AFC Tuning Range	±500 kHz, minimum
RF AGC Range, MAN GAIN Control	15 dB, minimum
Dial Calibration	±1%
Dial Resetability	±0.5%
Power Supply Voltages Required for Operation	+150 vdc, regulated +28 vdc, regulated +15 vdc, regulated -15 vdc, regulated +6 vdc, regulated 5 vac
Mechanical	
Size	3.15 inches high, 7.75 inches wide, 14.9 inches deep
Weight	7 lbs, approximately

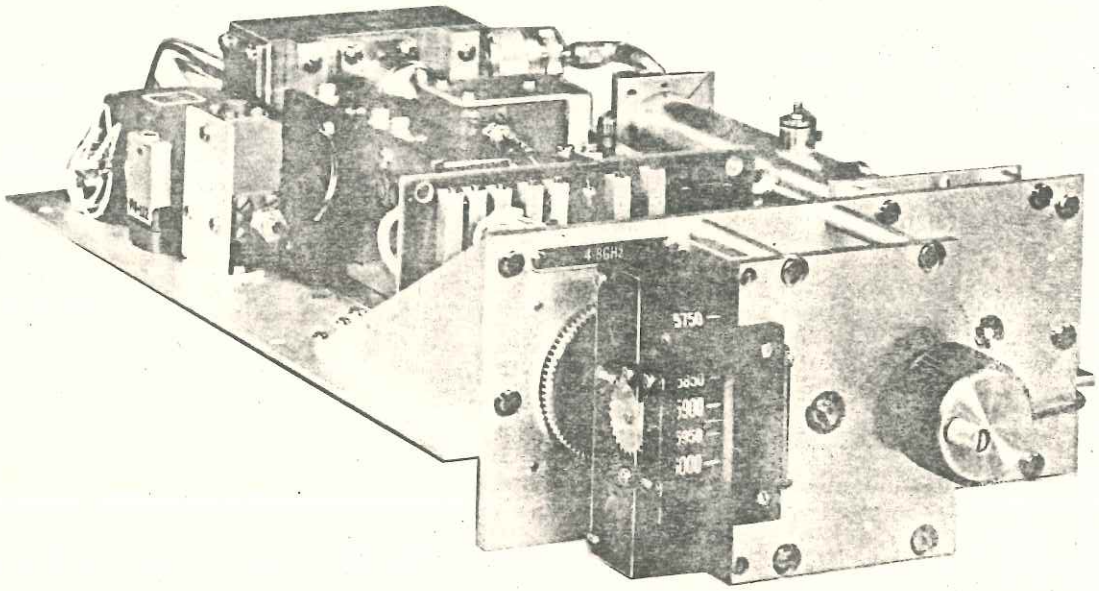


Figure 1-1. Type TH-480A 4-8 GHz Tuning Head, Front View

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 The TH-480A Tuning Head tunes the 4-8 GHz range. It is designed to be installed in any one of several equipments. These parent equipments furnish power supply and control (AGC, AFC) voltages to the tuning head which provides a 160-MHz IF output signal. As examples, the TH-480A will operate in the Type 112-( ) Microwave Receiver, and the combination of Types MTF-100/MTF-101 Microwave Tuning Frame(s) and Type DM-112 Demodulator.

1.1.2 The RF stage is passive and consists of two double-tuned, electrically ganged YIG filters in a single mechanical assembly. A tuning knob on the front panel mechanically tunes the variable frequency oscillator and electrically tunes the YIG filters. It also drives a tape dial which numerically displays the tuned frequency. Isolators and decouplers are used between the various microwave components to reduce unwanted circuit loading over the frequency range. A 160-MHz preamplifier amplifies the intermediate frequency output of the mixer which is then applied to the parent equipment.

1.1.3 The parent equipment supplies the tuning head with power supply voltages and routes the antenna input to the YIG preselector. A local oscillator output from the tuning head is also made available for external routing to LO OUTPUT connectors. The tuning head receives two control voltages: AGC voltages with a range of approximately 15 dB, and AFC voltage. AFC voltage is supplied to a varactor in the local oscillator subassembly, and permits small incremental frequency adjustments in response to the fine tune or discriminator outputs as applicable from the parent equipment.

1.2 MECHANICAL CHARACTERISTICS

1.2.1 The TH-480A Tuning Head is constructed on a aluminum plate which serves as a chassis and is approximately 12 x 8 inches. At the front of the chassis is a vertical plate 3 inches high which mounts the tuning drive. The tuning control shaft and frequency dial mechanism are fixed to the vertical plate and extend through the front panel of the receiver or tuning frame when the tuning head is installed. The various subassemblies which comprise the tuning head are mounted to the chassis and interconnected in a manner which facilitates repair and/or replacement. A gear train assembly drives the tape dial, the oscillator tuning shaft, and the YIG driver potentiometer.

1.2.2 The tuning head is mounted in the parent equipment with eight screws. A short cable with a multipin plug and three rigidly mounted coaxial connectors provide the electrical interconnections to the various subassemblies located on the main chassis.

1.3 EQUIPMENT SUPPLIED

This equipment consists of the TH-480A Tuning Head only. The dimensions and weight are given in Table 1-1.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The TH-480A Tuning Head is designed to operate when installed in associated equipment. It is not capable of independent operation. As an aid to maintenance of the TH-480A an extender cable to supply operating voltages with the tuning head removed from the parent equipment is required.

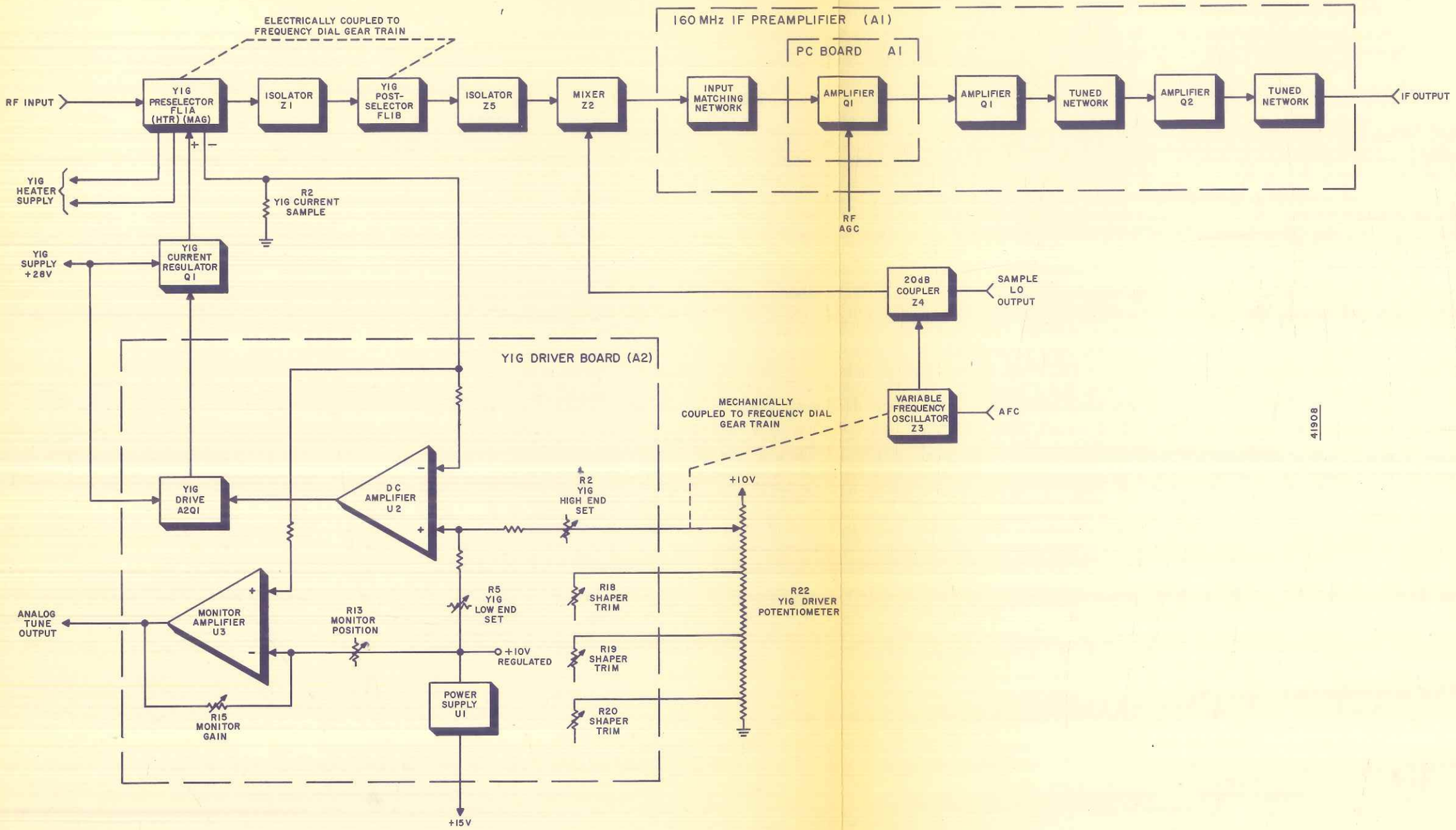


Figure 2-1. Type TH-240A 2-4 GHz Tuning Head, Functional Block Diagram

SECTION II

CIRCUIT DESCRIPTION

2.1 GENERAL

The operation of the various stages in the TH-480A are explained using the functional block diagram, Figure 2-1, and the schematic diagrams included in Section VI of this manual. To identify the subassemblies used in the tuning head consult the main chassis schematic diagram, Figure 6-3. Note also that the unit numbering system is used for the electrical components. This means that parts on subassemblies carry a prefix before the usual class letter and number of the item (such as A1R1 and A3C10). These subassembly prefixes are omitted on illustrations and in the text except in those cases where confusion might result from their omission.

2.2 FUNCTIONAL DESCRIPTION

2.2.1 The Type TH-480A Tuning Head covers the frequency range of 4 to 8 GHz in one band. Refer to the functional block diagram, Figure 2-1. Incoming signals are routed to the input of the 4 to 8 GHz filter, FL1A. This preselector as well as a ganged post-selector, FL1B, are YIG (yttrium-iron-garnet) type high Q microwave resonators tuned over the band by a variable control current. The resonant frequency of the device varies linearly with the magnetic field intensity incident on the YIG spheres. Since the resonant frequency of the filter is determined by the precise value of the tuning current passing through the field-generating electromagnet (MAG), this parameter is accurately controlled by a precision potentiometer. This potentiometer is driven from the main tuning mechanism. Also, since a superheterodyne type circuit is employed, the YIG filters must track with the local oscillator tuned cavity. The non-linear rate of change of frequency obtained with the linear displacement of the cavity tuning shaft requires shaping of the YIG tuning current over the band. This is accomplished by fixed and variable resistive shunting of the YIG drive potentiometer. Three adjustable potentiometers, R18, R19, and R20 located on the YIG driver board, A2, permit in-band tracking adjustments. Band set adjustments are accomplished by trimmer potentiometers R2 (high end) and R5 (low end), which are also located on A2.

2.2.2 The resonant frequency, bandwidth, and other parameters of YIG filter FL1 are temperature dependent. For this reason a constant temperature oven is built into the filter housing. Tuning current requirements for the YIG filter are in the order of 240-480 mA to tune the range of 4 to 8 GHz. The YIG tuning sensitivity is such that a current change of 1 mA will shift the YIG tuned frequency by 17 MHz. In order to supply the required stable current, transistor Q1, transistor A2Q1, and operational amplifier A2U2 form a differential current amplifier. Transistors Q1 and A2Q1 form a Darlington amplifier to supply the necessary current to the YIG filter from the +28V supply. The Darlington pair is controlled by A2U2. Shaped tuning voltage from the YIG drive potentiometer and a low end (band edge) offset voltage are summed and applied to the non-inverting input of

A2U1. A voltage developed across R2 which represents a sample of the YIG tuning current is applied to the inverting input of A2U2. The operational amplifier amplifies the difference between its two inputs until a loop equilibrium is reached. Thus changes in current due to temperature dependent components through the entire control loop are sensed and cancelled, thereby maintaining the stable control current.

2.2.3 The YIG current sample voltage can also be used to indicate on external monitoring equipment the approximate frequency to which the TH-480A is tuned. To facilitate this monitoring, a variable gain operational amplifier, A2U3, is employed. The sampled voltage is amplified to an extent dependent on the setting of MONITOR GAIN control R15. To set the base line reference for the external monitor, a MONITOR POSITION control, R13, is provided. Both of these controls are located on subassembly A2. The output of the monitor amplifier, A2U3, may be brought out to a connector located on the rear apron of the parent equipment into which the TH-480A is installed. This connector is labeled ANALOG OUTPUT.

2.2.4 The output of the preselector is routed to isolator Z1. The isolator is a ferrite device that offers little input attenuator to incident waves but affords a relatively high degree of attenuation to reflected waves. Effective absorption of possible reflected waves due to line mismatch results in the optimized operation of FL1A over the frequency range. The output of Z1 is applied to the preselector, FL1B. The postselected is isolated by Z5 and the output applied to Z2, a balanced mixer.

2.2.5 The variable frequency oscillator is designated Z3. It employs a ceramic electron tube in a tuned cavity. The LO is maintained 80 MHz above one-half the RF signal and is ganged tuned with the YIG driver potentiometer. In addition, the oscillator frequency may be incrementally tuned from the parent equipment via an AFC voltage applied to a varactor in Z3. This voltage is, for instance, supplied from the Type 112-( ) Receiver in three modes. The mode, as selected by the AFC switch located on the receiver front panel, provides AFC voltage as furnished: (a) by the receiver discriminator, (b) from a FINE TUNE potentiometer located on the front panel of the receiver or from, (c) an AFC voltage external to the receiver itself, routed via a receiver rear apron connector labeled EXT AFC.

2.2.6 The output of the variable frequency oscillator is applied to a passive 20 dB directional coupler, Z4. Two outputs are provided, one of which is attenuated 20 dB and furnished as the LO OUTPUT. The other output is applied to passive frequency doubler Z6. The 4.160 to 8.160 GHz band from Z6 is coupled through isolator Z7 to one input of balanced mixer module A2. This high level oscillator frequency is mixed with the RF signal which is also applied to Z2.

2.2.7 The primary output signals from the balanced mixer (Z2) are the sum and difference of its two inputs. Tuned circuits in the IF preamplifier (A1) select the 160-MHz difference frequency.

2.2.8 The IF preamplifier, A1, employs a cascode amplifier input stage consisting of A1Q1 and a grounded base amplifier A1Q2. RF AGC is applied to the base of A1Q1. A 160-MHz double-tuned circuit is used between the output of the cascode amplifier and Q2.

The output amplifier A1Q2, employs an additional tuned circuit. The amplified 160-MHz signal at a bandwidth of 20 MHz is matched to 50 ohms and is then supplied to the parent equipment via connector A1J2.

SECTION III

INSTALLATION AND OPERATION

3.1 UNPACKING AND INSPECTION

3.1.1 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.

3.1.2 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 for any shortage.

3.1.3 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.

3.2 INSTALLATION

3.2.1 The TH-480A tuning head is designed to be installed in and operate with several different parent equipments. Installation of the tuning head is specified in the instruction manual for the parent equipment.

3.2.2 Tuning Head Removal. - As an example, to remove a TH-480A Tuning Head from the Type 112-( ) Receiver proceed as follows:

(1) Remove the receiver from the equipment rack and place it on its side on the work surface.

(2) Loosen the two screw fasteners at the rear of the top dust cover and slide the cover off.

(3) Loosen the two screw fasteners at the rear of the bottom dust cover and slide the cover off.

(4) Remove the largest of the three allen wrenches mounted on the underside of the chassis. Remove the tuning knob from the tuning shaft by loosening the two setscrews with the allen wrench. Return the allen wrench to its mounting clip.

(5) Disconnect the interconnecting cables between the tuning head and the receiver chassis as follows:

(a) Disconnect the multipin power connector from the multipin jack J9 on the main chassis.

(b) Disconnect the LO coaxial cable connector from LO coupler Z4 of the tuning head.

(c) Disconnect the subminiature plug from jack J2 of 160-MHz IF Preamplifier A1 located on the tuning head.

(d) Disconnect the semi-rigid tubing with its RF input connector from YIG filter FL1 which is located on the left corner of the tuning head. Carefully move the semi-rigid tubing and connector away from the jack on the YIG filter.

(6) Remove the eight screws which hold the tuning head to the main chassis. The screws are removed from the top side of the chassis.

(7) Working from the bottom side of the receiver move the rear of the tuning head down and away from the main chassis.

(8) Remove the tuning head by moving it down and away from the main chassis so that the tuning shaft clears the front panel.

(9) To install a tuning head reverse the above procedure. It is not necessary to remove any of the subassemblies, modules or cables which are permanently affixed to the tuning head. Make certain that there are no cables pinched between the tuning head and main chassis when tightening the eight screws which secure the tuning head to the main chassis.

3.3 OPERATION

Operation of the TH-480A Tuning Head is controlled entirely by the parent equipment into which it is installed with the exception of the front-panel manual tuning knob.

3.4 PREPARATION FOR RESHIPMENT AND STORAGE

3.4.1 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 extent or will at a minimum provide guidance for the repackaging effort.

3.4.2 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 repackaging service.

3.4.3 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.

3.4.4 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

SECTION IV

MAINTENANCE

4.1 GENERAL

The TH-480A Tuning Head has been conservatively designed to operate for extended periods of time with little or no routine maintenance. An occasional cleaning and inspection are the only preventive maintenance operations recommended. The intervals for these operations should be based on the operating environment. Should trouble occur, repair time will be minimized if the maintenance technician is familiar with the circuit descriptions found in Section II. Reference should also be made to the block diagram, Figure 2-1, and to the schematic diagrams found in Section VI. A complete parts list and part location illustrations can be found in Section V.

4.2 CLEANING AND LUBRICATION

The unit should be kept free of dust, moisture, grease, and foreign matter to ensure trouble-free operation. If available, use clean, low velocity compressed air to blow accumulated dust from the unit. A clean dry cloth, soft bristled brush, or a cloth saturated with cleaning compound may also be used. The gear train assembly bearings should be lubricated with a small amount of light machine oil annually. Care should be taken to avoid accidental lubrication of the clutch plates.

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 inoperative. 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. Damage to parts due to heat is often the result of other less apparent troubles in the circuit. It is essential that the cause of over-heating be determined and corrected before replacing the damaged parts. Mechanical parts should be inspected for excessive wear, looseness, misalignment, corrosion, and other signs of deterioration.

4.4 MAINTENANCE OF GEAR TRAIN ASSEMBLY

Figure 5-6 is an exploded view of the gear train assembly. The gear train assembly requires little maintenance except for the occasional removal of any dust or dirt that may accumulate.

4.4.1 To replace a burned-out dial lamp, proceed as follows:

(1) Remove the two screws that hold the light bar to the gear train (refer to Figure 5-6).

(2) Gently pull the light bar and printed circuit light board away from the gear train.

(3) Remove the two screws that hold the light board to the light bar.

(4) Unsolder the burned out lamp and replace it with a new lamp. It is advisable to replace all lamps if parts are available because if one lamp burns out, it is likely that the other lamps are nearing the end of their lives.

(5) Reassembly the unit by reversing steps (1) through (3).

CAUTION

All maintenance work within this unit should be kept to a minimum and performed only by trained and experienced personnel. The placement of components and the dress of leads in the equipment (especially within the IF preamplifier) have been carefully engineered to give optimum performance. In replacing any components, great care should be exercised to duplicate the exact physical layout of the original assembly.

4.5 TROUBLESHOOTING

4.5.1 Most troubles will be caused by semiconductor failure or a failure of the ceramic electron tube in the variable frequency oscillator. If the oscillator tube fails the entire tuning head should be returned to Watkins-Johnson, CEI for repair. However, if a spare oscillator unit is available refer to paragraph 4.7 for removal, installation and alignment instructions. The procedures are quite complex and must be precisely followed to obtain satisfactory results.

4.5.2 In the event of failure, the various power supply voltages should be checked. The test procedure and test equipment recommended in paragraph 4.6 will enable overall signal tracing to the output of the mixer and through the IF preamplifier. Substitution of spare subassemblies, if available, will facilitate the location of failures.

4.5.3 Operation of the YIG filters (see Figure 5-5 and 6-2) can be ascertained by monitoring the voltage at the ANALOG TUNE output connector, the voltage across the YIG driver potentiometer slider arm and the sample voltage across R2. If a loss in large signal handling capability of the tuning head occurs, it is probable that the YIG heater or its supply has failed.

4.6 ALIGNMENT INSTRUCTIONS

The alignment procedures in this book are suitable for performance in the field after replacing components. The alignment of this unit should be performed only with suitable equipments and by technicians thoroughly familiar with their use. If the limits

and tolerances specified in the following steps cannot be obtained during a field alignment, a factory alignment is necessary. Allow at least 15 minutes for warm-up before beginning the work.

4.6.1 Equipment Required. - The following equipment, or their equivalents, are required to perform the complete tuner alignment.

(1) Oscilloscope, Tektronix Type 503

(2) Sweep Generator, Telonic SM-2000

(3) Sweep Generator Plug-in Head, Telonic SH-1

(4) Signal Generator, Hewlett Packard 608D

(5) Sweep Oscillator, Hewlett Packard Type 8690A

(6) Sweep Head, Hewlett Packard Type 8693B (4-8 GHz)

(7) Microwave Marker Generator, Telonic TMS-1

(8) Signal Sampler, Telonic TSS-1

(9) Power Meter, Hewlett Packard Type 432A

(10) 50-ohm detector, Hewlett Packard Type 423A

(11) 50-ohm isotee, Micro Labs HM-10N

(12) Directional Coupler, Narda Microline Model 3024 (4-8 GHz)

(13) Slide Attenuator, Weinschel Engineering Type 953-10

(14) Step Attenuator, Hewlett Packard Type 354A

(15) Assorted Pads, Connectors, Cables and Alignment Tools

4.6.2 160-MHz IF Amplifier. - Alignment of the Type 72297-1, 72297-2, 72297-3 IF Preamplifiers are identical except for the additional output circuit in the two latter units. Proceed as follows:

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

(2) Set the sweep generator for 160, ±15 MHz using the output of the HP-608D generator as a marker source.

(3) Adjust A1C9, A1C11 and A1C16 for maximum amplitude, symmetrical response centered on the 160-MHz marker signal. A typical response curve is shown in Figure 4-2. Use the HP-608D signal generator to check for a minimum bandwidth of 20 MHz at the 3 dB points. The preamplifier overall gain should be approximately 28-32 dB.

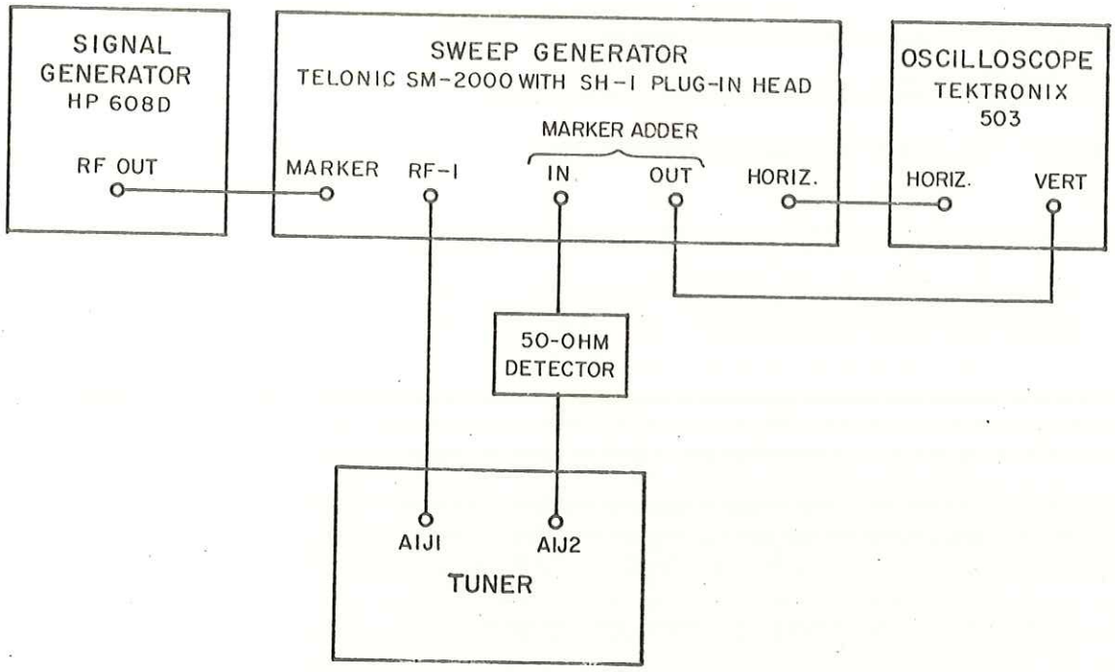


Figure 4-1. Test Setup, 160 MHz IF Preamplifier

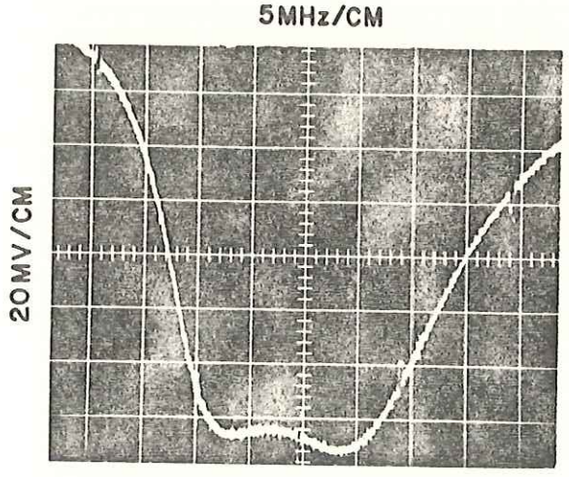


Figure 4-2. Typical Response Curve, 160 MHz IF Preamplifier

4.6.3 YIG - Oscillator Tracking Adjustment. - The procedures which follow may be used to check and adjust the tracking of the YIG to the oscillator if it is suspected that the oscillator has drifted due to aging or vibration. Do not attempt to adjust the oscillator unless it is a replacement unit. Refer to paragraph 4.7.

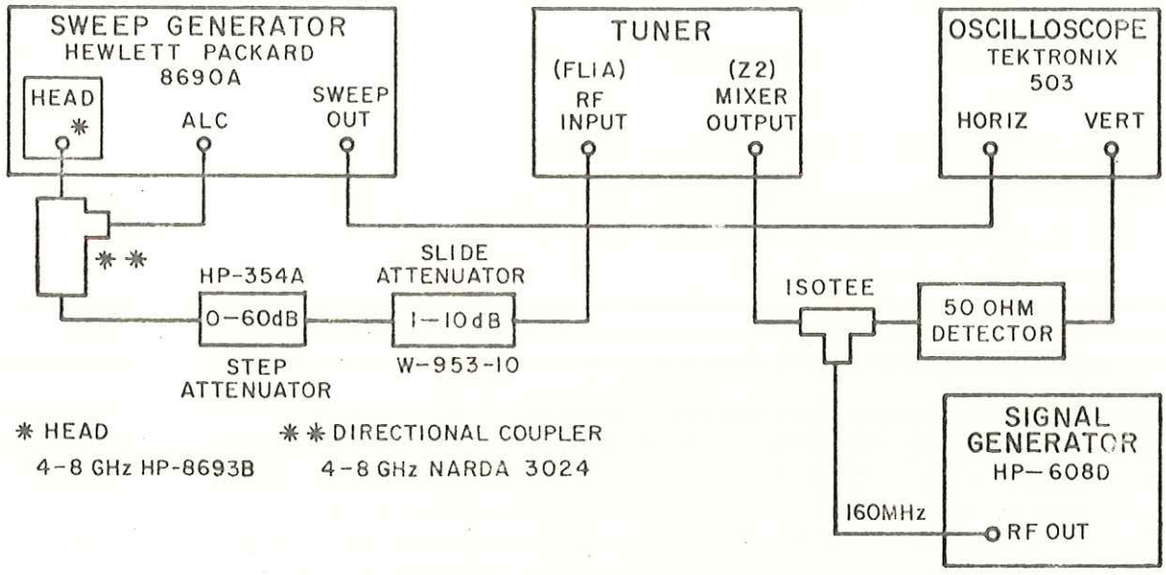


Figure 4-3. Test Setup, YIG-Oscillator Tracking Adjustment

(1) Connect the equipment as shown in Figure 4-3. Use the appropriate sweep head and detector for the frequency range of the tuning head under test.

(2) Tune the head across its band observing the response displayed on the oscilloscope and the 160 MHz marker. The marker must fall within the ±10 MHz passband of the displayed response across the band. If it does not, the following adjustments are to be made on the YIG driver board (A2).

(3) Refer to Table 4-1. This table shows the potentiometers to adjust for the TH-480A tuning head. The frequency of adjustment in MHz is given immediately below the potentiometer designation.

(4) Tune the TH-480A the frequency indicated for the adjustment of A2R1 (8000 MHz) and adjust it to place the marker at the center of the response as displayed on the oscilloscope. A typical response is shown in Figure 4-4.

(5) Repeat step (4) for A2R5, A2R2, A2R3, and A2R4 in that order.

(6) It may be necessary to repeat steps (4) and (5) several times to obtain proper tracking of the YIG filter to the oscillator.

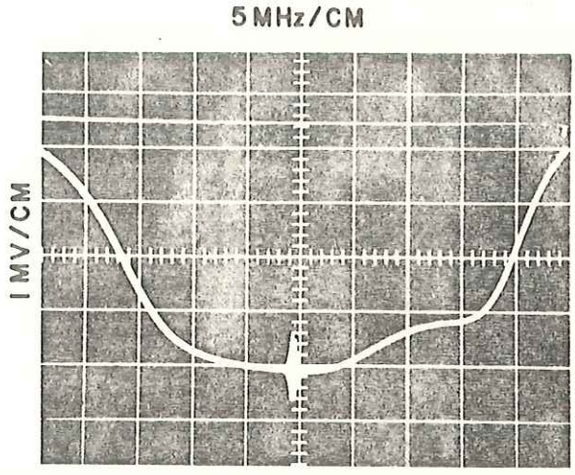


Figure 4-4. Typical Response Curve, YIG-Oscillator Tracking

Table 4-1. YIG Alignment Chart

Tuning Unit	A2R1	A2R2	A2R3	A2R4	A2R5
TH-120A	2000	1700	1180	1000	1000
TH-240A	4000	3450	2450	2400	2000
TH-245A	4500	3800	2650	2200	2000
TH-480A	8000	6900	5000	4325	4000
TH-812A	1200	11400	9500	8500	8000

4.7 VARIABLE FREQUENCY OSCILLATOR (Z3)

The cavity tuned variable frequency oscillator is a critical assembly and any maintenance attempted should be kept to an absolute minimum. If a failure occurs, it is recommended that the entire tuning head be returned to Watkins-Johnson, CEI for repair. However, a replacement oscillator may be installed in the TH-480A and adjusted to provide satisfactory operation by performing the procedures in the paragraphs which follow. The procedures should be performed in the sequence given.

4.7.1 Removal. - To remove oscillator Z3 from the TH-480A proceed as follows:

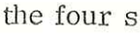
(1) Remove the TH-480A from the equipment in which it is installed as described in paragraph 3.2.2.

(2) Refer to the exploded view of the gear train assembly, Figure 5-6.

(3) Tag and unsolder the wire attached to the oscillator FIL feedthrough capacitor. Similarly tag and remove the varactor (AFC) input wire and its shield ground lead (refer to Figure 4-5).

(4) Remove the oscillator output cable (W3) by unscrewing plug P5 from the oscillator power output probe connector.

(5) Refer to Figure 5-6 and loosen the setscrews that attach gear 33 to shaft 41.

(6) Carefully remove the four screws identified as  .

(7) Slide the oscillator assembly slightly to the rear of the tuning head and tag and unsolder the B+ lead.

(8) Slide the oscillator to the rear and separate it from the remainder of the gear train. Carefully remove shaft 41, spacer 26, and gear 42 and shims as a unit.

(9) Temporarily replace the shaft 41, spacer 26, and gear 42 unit in bracket 34. Temporarily remount gear 33 in position on shaft 41.

(10) Loosen the setscrews from gear 43 and slide it off of the oscillator tuning shaft.

(11) Remove the two screws that attach the oscillator to bracket 45. Remove the oscillator.

(12) Temporarily replace all the gear train components.

4.7.2 Oscillator Preparation. - The replacement oscillator must be prepared prior to installation in the TH-480A. Proceed as follows:

(1) Refer to Figure 4-6. If the spare oscillator is fitted with a slotted screw (V) as shown, it will be necessary to replace it with the screw and ground lug from the failed oscillator. Note the position of washers on the old oscillator screw.

(2) Unsolder the wire attached to the CATH feedthrough on the old oscillator and remove the screw, ground lug, and wire. Install these items on the new oscillator. Make sure that all washers are installed as on the old oscillator.

(3) It may also be necessary to transfer the fine tuning hardware (allen head screw and locknut) located on top of the oscillator to the new unit. If required, proceed as follows:

(a) Loosen the locknut and back the screw nearly all the way out.

(b) Remove the two set screws that hold the fine tuning hardware to the oscillator and remove hardware.

(c) Install the hardware on the new oscillator. Carefully turn the adjustment screw clockwise until it just bottoms (with minimum pressure). Turn the adjustment screw four turns counter clockwise and finger tighten the locknut.

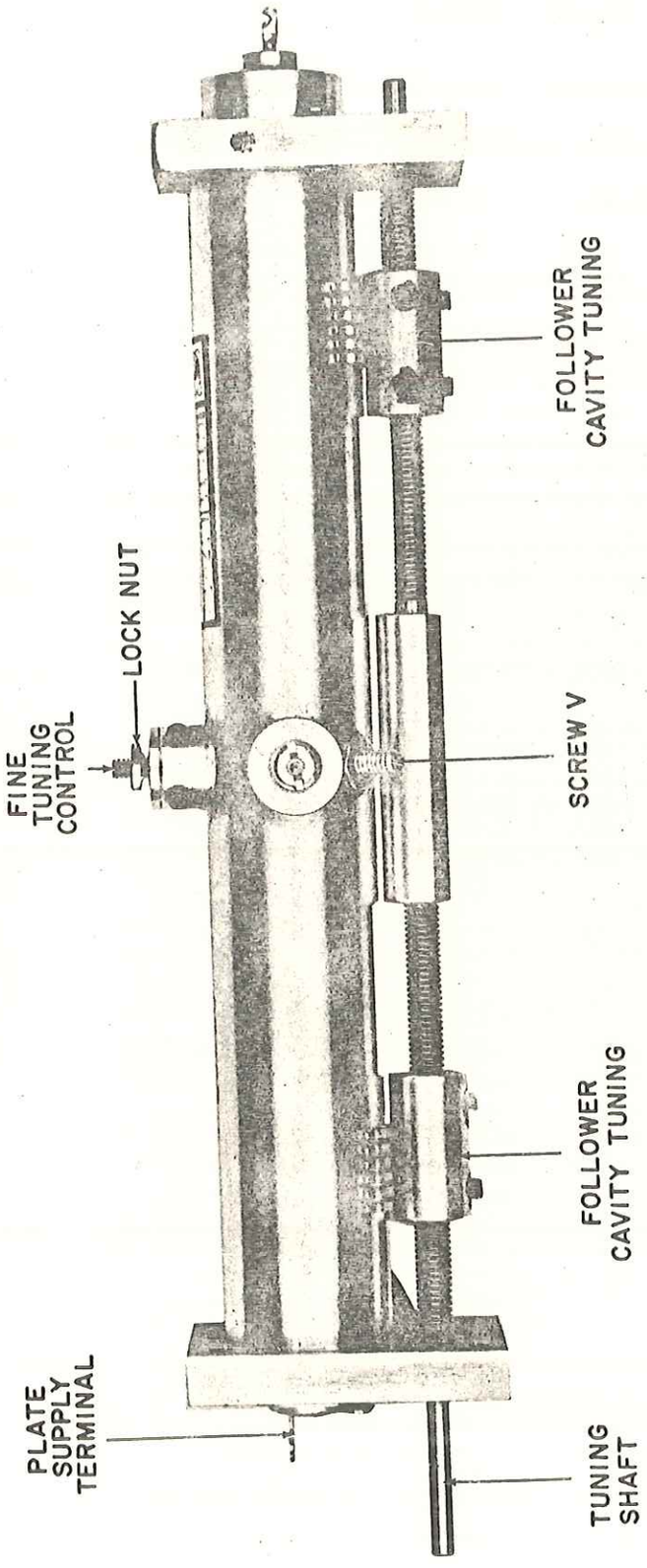


Figure 4-5. Variable Frequency Oscillator (Z3), Top View

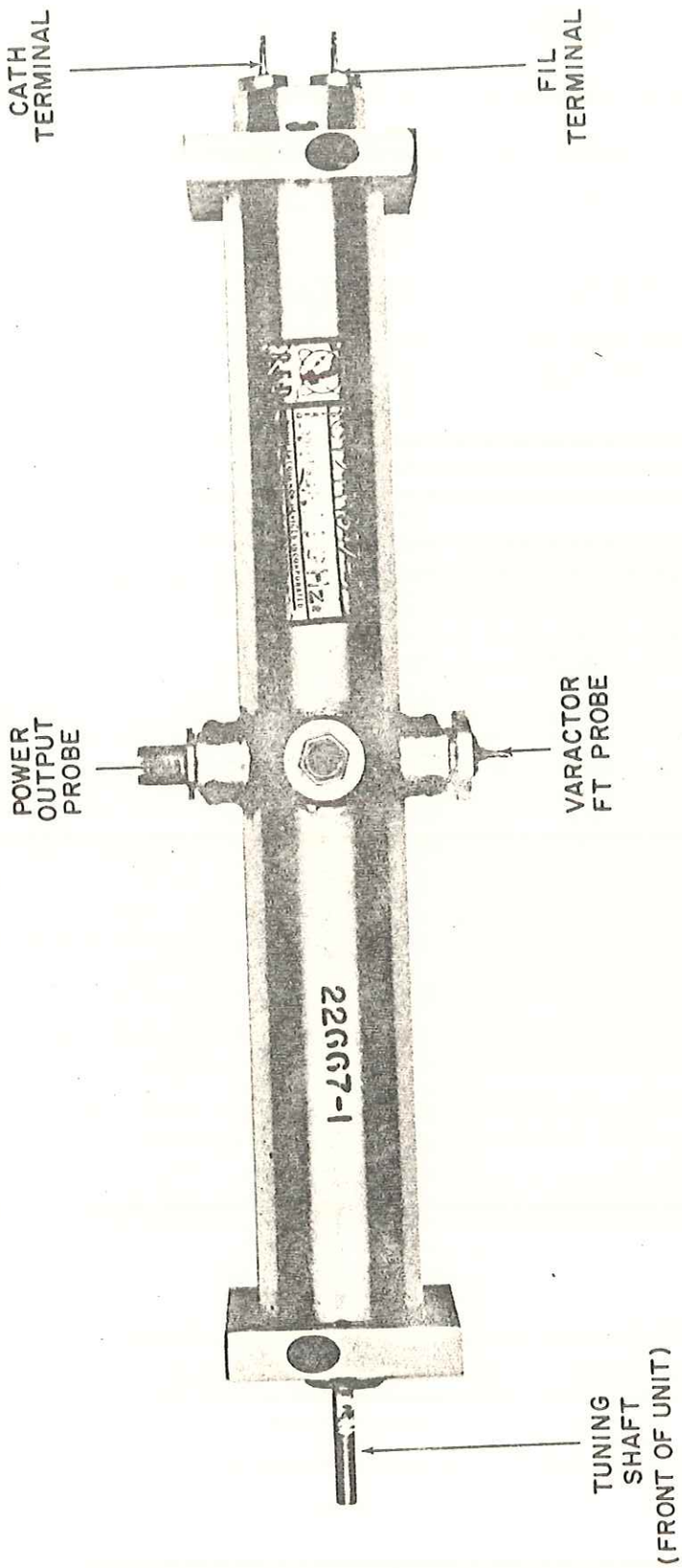


Figure 4-6. Variable Frequency Oscillator (Z3), Side View

4.7.3 Installation. - To install the new oscillator proceed as follows:

(1) Remove the gear train components temporarily replaced in 4.7.1 step (12).

(2) Mount the new oscillator to bracket 45 using screws identified as △B△.

(3) Mount anti-backlash gear 43 on the oscillator tuning shaft with 1/16-inch clearance.

(4) Tension (load) split-gear 43 approximately two teeth and replace the combination of shaft 41, washer 26, gear 42, and shims in bearing 19 so that the split gear is properly tensioned when gears 42 and 43 mesh.

(5) Slide shaft 41 partially into its bearing in plate 34 and solder the B+ wire to the oscillator. Seat the bracket and oscillator assembly.

(6) Replace screws △A△ and solder the filament wire to the oscillator FIL feed-through.

(7) Solder the varactor (AFC) wire to the oscillator and solder the wire ground lead to the ground lug on the oscillator.

(8) Turn the tuning head frequency dial to 4 GHz. The oscillator tuning mechanism is a long lead screw with two followers which adjust the dimensions of two cavities. Looking from the front of the tuning head, manually turn gear 42 counterclockwise until the end stop is reached and the two followers are the minimum distance apart. This presets the oscillator to its highest frequency limit. Turn gear 42 counter clockwise one full turn.

(9) Without disturbing the frequency dial or the oscillator tuning, carefully tension anti-backlash gear 33 and install it on shaft 41.

(10) Check the alignment of gears 25 and 33, and gears 42 and 43. Adjust the shaft positions of gears 33 and 43 if necessary. Carefully tighten all gear setscrews. Tune the TH-480A from 8-4 GHz to see that no binding occurs in the gears and that the oscillator mechanical travel is correct.

(11) Connect the oscillator power output RF cable.

4.7.4 Pre-Alignment. - Before applying power to the tuning head, it must be prealigned as follows:

(1) Refer to Figures 4-5 and 4-6 for the location of the oscillator adjustments.

(2) Loosen the varactor (AFC) probe set screws and move it out approximately 1/16 inch.

(3) Loosen the power output probe set screws and move it out approximately 1/16 inch.

(4) Tighten one set screw on each probe lightly.

4.7.5 Power Supply Checks. - Interconnect the TH-480A and its parent equipment using an extender cable to supply power. Check all power supply input voltages to the tuning head. Turn the equipment power off.

4.7.6 Oscillator Power Output. - Measure the oscillator power output as follows:

(1) Connect a HP-432A Power Meter to the oscillator output connector with a 20-dB pad in series.

(2) Turn the equipment on and after a warm-up tune the TH-480A over the 4-8 GHz range and measure the output power. The output from the oscillator should be 125-300 MW. Adjust the lateral position of the output probe as necessary to obtain the correct output and tighten the set screws.

(3) Restore the normal oscillator output connection.

4.7.7 Oscillator Frequency Limits and Fine Tuning Range. - Proceed as follows:

(1) Connect the equipment as shown in Figure 4-7.

(2) Adjust the test equipment controls to obtain a 4-8 GHz sweep response on the oscilloscope with 100-MHz markers.

(3) Tune the TH-480A to 8 GHz and identify the signal and image responses. The desired signal response is lower in frequency.

(4) Loosen the setscrews in gear 33 and manually turn the oscillator tuning mechanism to center the signal response about the 100-MHz marker representing 8 GHz. The sweep width should be narrowed to obtain the necessary resolution.

(5) Make sure that the TH-480A dial reads 8 GHz and that the signal response is centered about the 8-GHz (100-MHz) marker. Ensure that the fine tuning control on the parent equipment if activated is at center range. Tighten the setscrew in gear 33.

(6) Activate the fine tuning control on the parent equipment. Narrow the sweep width to ±10 MHz centered about 8 GHz and check the fine tuning range. It should be possible to move the response approximately 1.5 MHz. If insufficient range is obtained, adjust the fine tuning (AFC) probe on the oscillator). Repeat the 8-GHz frequency setting as in steps (4) and (5).

(7) Tune the TH-480A to 4 GHz and adjust the sweep generator to display the signal response. Check the signal response in relation to the 4-GHz (100-MHz) marker. Adjust the fine tuning screw on the oscillator to center the response about the 4-GHz marker. Ensure that the signal response (lowest frequency response) and not the image is used.

(8) Check the fine tuning range at 4 GHz. A minimum of ±500 kHz should be obtained. If not the fine tuning probe on the oscillator will require further adjustment.

(9) Tune to 8 GHz reset the oscillator frequency by repeating steps (4) and (5) if necessary.

(10) Tune to 4 GHz and reset the oscillator using the fine tuning screw if necessary.

(11) Repeat steps (9) and (10) until the oscillator limits are correct within ±1% of the dial setting.

(12) Check the oscillator output over the entire tuning range as described in paragraph 4.7.6.

(13) Perform the YIG tracking adjustments as described in paragraph 4.6.3.

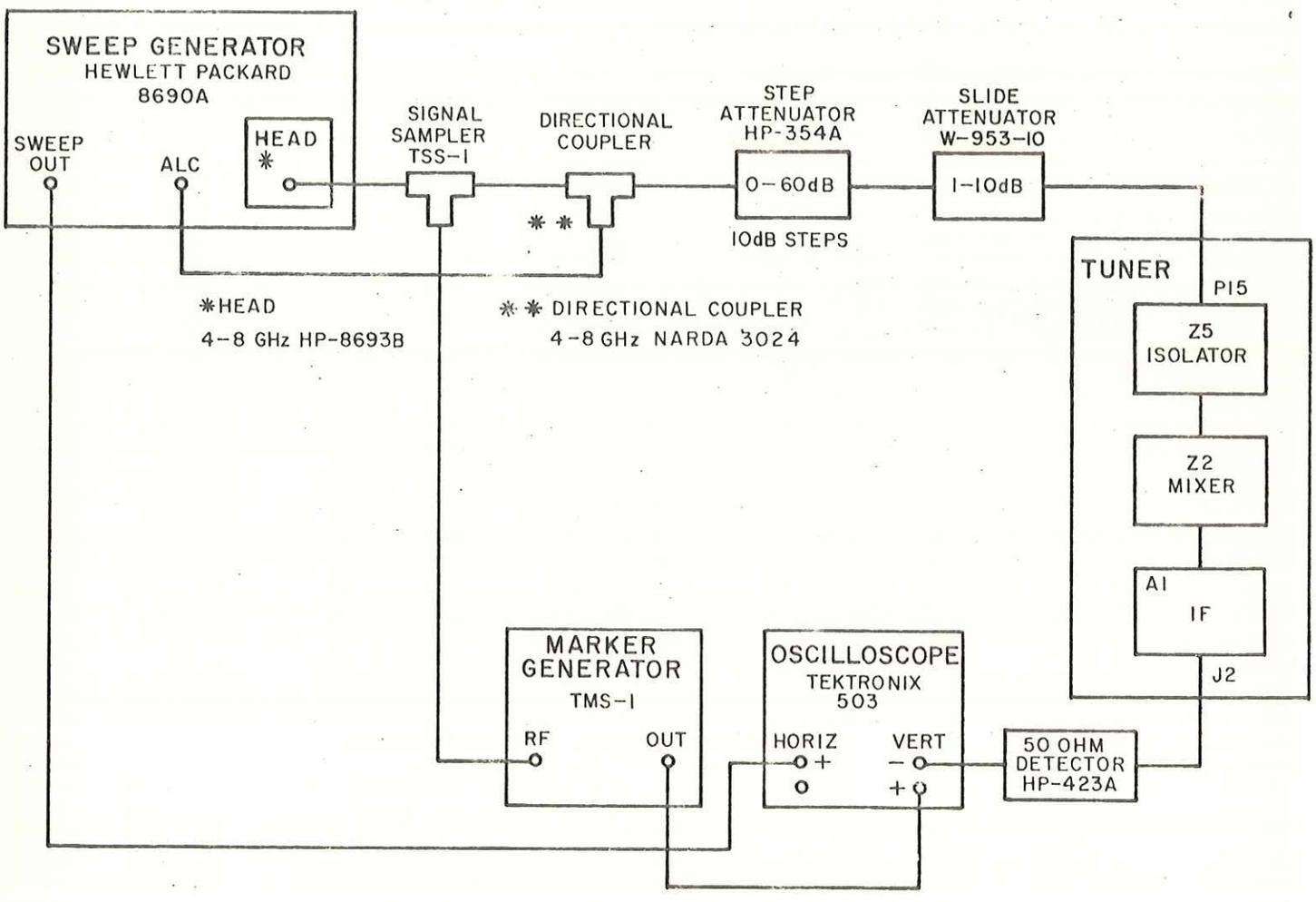


Figure 4-7. Test Setup, Variable Frequency Oscillator Alignment

SECTION V

REPLACEMENT PARTS LIST

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:

Read 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. Prefixes are provided on drawings and illustrations within parentheses in the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, Wisconsin 53204
02114	Ferroxcube Corporation P.O. Box 359 Mt. Marion Road Saugerties, N.Y. 12477
04013	Taurus Corporation 1 Academy Hill Lambertville, New Jersey 08530
07180	Sage Laboratories, Inc. 3 Huron Drive East Natick Industrial Park Natick, Mass. 01760
07263	Fairchild Semiconductor A Division of Fairchild Camera and Instrument Corporation 464 Ellis Street Mountain View, California 94040
10110	Scientificatlanta, Inc. P.O. Box 13654 Atlanta, Georgia 30324

Mfr. Code	Name and Address
13103	Thermalloy Company 8717 Diplomacy Row Dallas, Texas 75247
14482	Watkins-Johnson Company 3333 Hillview Avenue Palo Alto, California 94304
14632	Watkins-Johnson Co., CEI Division 6006 Executive Boulevard Rockville, Maryland 20852
16179	Omni-Spectra, Incorporated 24600 Hallwood Ct. Farmington, Michigan
24539	Avantek, Inc. 2981 Copper Road Santa Clara, California 95051
27338	Addington Laboratories, Inc. 1043 Digiulio Avenue Santa Clara, California 95050
31597	Anaren Microwave, Inc. 185 Ainsley Drive Syracuse, N.Y. 13205
56289	Sprague Electric Company Marshall Street North Adams, Mass. 01247
71744	Chicago Miniature Lamp Works 4433 Ravenswood Avenue Chicago, Illinois 60640
72982	Erie Technological Products, Inc. 644 West 12th Street Erie, Pennsylvania 16512
73138	Beckman Instruments Inc. Helipot Division 2500 Harbor Boulevard Fullerton, California 92634
80131	Electronic Industries Association 2001 Eye Street, N.W. Washington, D.C. 20006
81312	Winchester Electronics Division Litton Industries, Incorporated Main Street & Hillside Avenue Oakville, Connecticut 06779
81349	Military Specifications
91293	Johanson Manufacturing Company P.O. Box 329 Boonton, New Jersey 07005
91418	Radio Materials Company 4242 West Bryn Mawr Avenue Chicago, Illinois 60646
91637	Dale Electronics, Inc. P.O. Box 609 Columbus, Nebraska 68601
95121	Quality Components, Inc. P.O. Box 113 St. Mary's Pennsylvania 15857

5.4 PARTS LIST

When ordering replacement parts from CEI Division, specify the type and serial number of the equipment, and the reference designation and description of each part ordered. The Manufacturers and Manufacturer's Part Numbers listed are included as a guide to the

user of the equipment in the field and do not necessarily agree with the parts installed in the equipment. Except in those cases specifically noted, the replacement part may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original part.

NOTE

As improved semiconductors become available it is the policy of CEI Division 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 lists and schematic diagrams of this manual. However, the semiconductors designated in the manual may be substituted in every case with satisfactory results.

5.4.1 Type TH-480A 4-8 GHz Tuning Head

REF DESIG	DESCRIPTION		QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
A1	160 MHz IF PREAMPLIFIER (20 MHz BW)		1	72297-3	14632
A2	YIG DRIVER BOARD		1	79923	14632
CP1	ADAPTER, CONNECTOR, SMA/N SERIES		1	21010	16179
CP2	ADAPTER, CONNECTOR: SMA/N SERIES		1	21040	16179
DS1	LAMP, INCANDESCENT: 0.06A, 5V		3	CM8-683	71744
DS2	Same as DS1				
DS3	Same as DS1				
F1	FUSE, 3AG, SLOW-BLOW: 1A		1	F02B250V1A	81349
FB1	FERRITE BEAD		4	56-590-65/4A	02114
FB2	Same as FB1				
FB3	Same as FB1				
FB4	Same as FB1				
FL1	YIG PRESELECTOR		1	WJ-621-37	14483
J1	CONNECTOR, RECEPTACLE, SMA/SMA SERIES		1	218	16179
J2	CONNECTOR, RECEPTACLE, MULTIPIN		1	SRE-7SNSS	81312
P1	CONNECTOR, PLUG, SMA SERIES	Part of W1	5	521-3	16179
P2	Same as P1	Part of W1			
P3	CONNECTOR, PLUG, SMA SERIES	Part of W2	8	201-2A	16179
P4	Same as P3	Part of W2			
P5	Same as P1	Part of W3			
P6	CONNECTOR, PLUG, SMA SERIES	Part of W3	1	501-3	16179

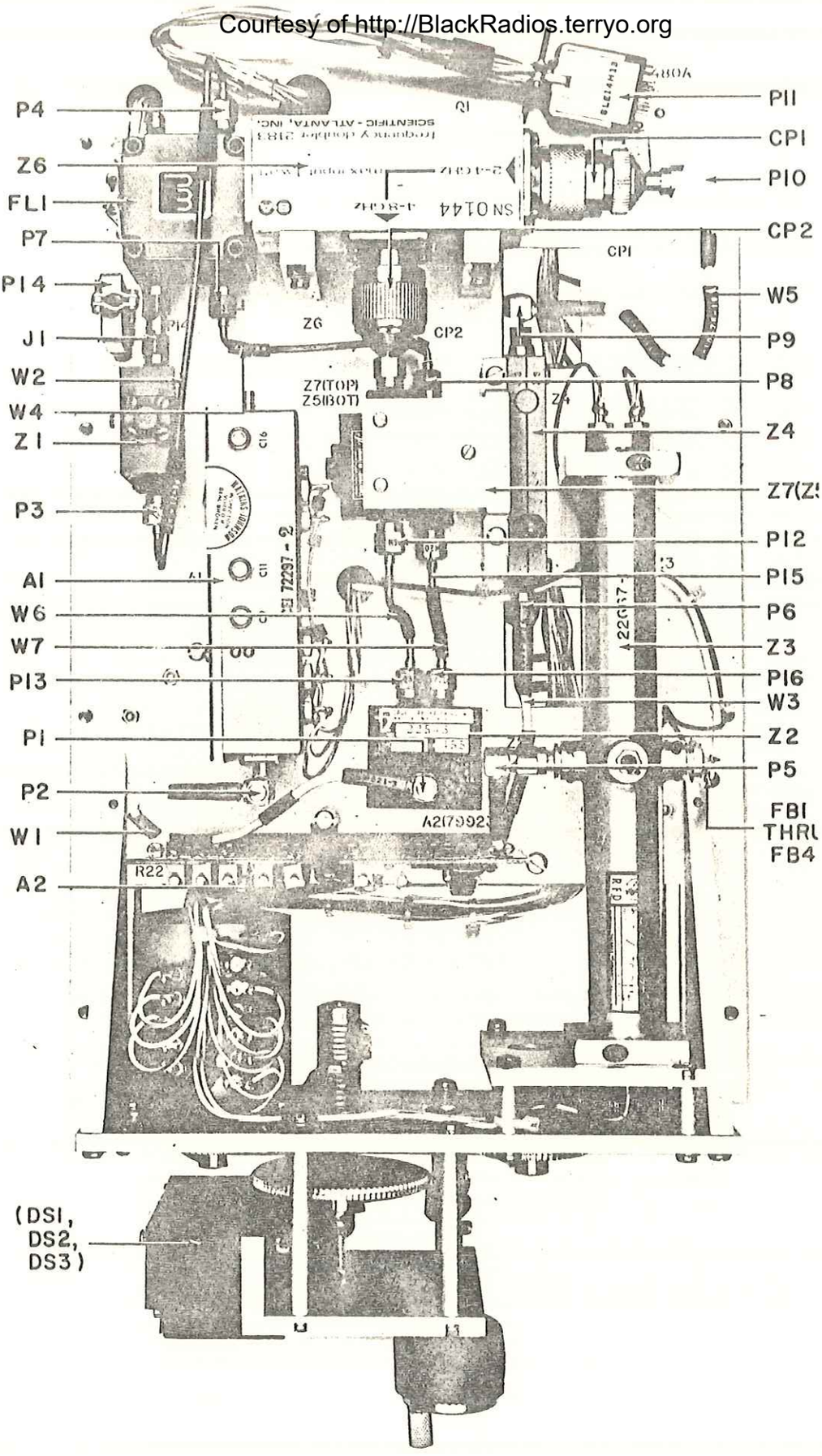


Figure 5-1. Type TH-480A 4-8 GHz Tuning Head, Top View, Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
P7	Same as P3 Part of W4			
P8	Same as P3 Part of W4			
P9	Same as P1 Part of W5			
P10	Same as P1 Part of W5			
P11	CONNECTOR, PLUG, MULTIPIN	1	SLE-14PNSSH13	8131
P12	Same as P3 Part of W6			
P13	Same as P3 Part of W6			
P14	CONNECTOR, PLUG, MULTIPIN	1	16634-1	1463
P15	Same as P3 Part of W7			
P16	Same as P3 Part of W7			
Q1	TRANSISTOR	1	2N3055	8013
R1	NOT USED			
R2	RESISTOR, FIXED, WIRE-WOUND: 2.5 Ω, 3%, 5W	1	RH-5(2.5 Ω, 3%)	9163
R3	NOT USED			
R4*	RESISTOR, FIXED, FILM: 511 Ω, 1%, 1/4W	3	RN60D5110F	81349
R5*	Same as R4			
R6*	Same as R4			
R7*	RESISTOR, FIXED, FILM: 3.92 kΩ, 1%, 1/4W	2	RN60D392IF	81349
R8*	RESISTOR, FIXED, FILM; 2 kΩ, 1%, 1/4W	1	RN50D200IF	81349
R9*	RESISTOR, FIXED, FILM: 1.82 kΩ, 1%, 1/4W	3	RN60D182IF	81349
R10*	Same as R9			
R11*	RESISTOR, FIXED, FILM: 2.74 kΩ, 1%, 1/4W	4	RN60D274IF	81349

* Nominal value. Final value to be factory selected.

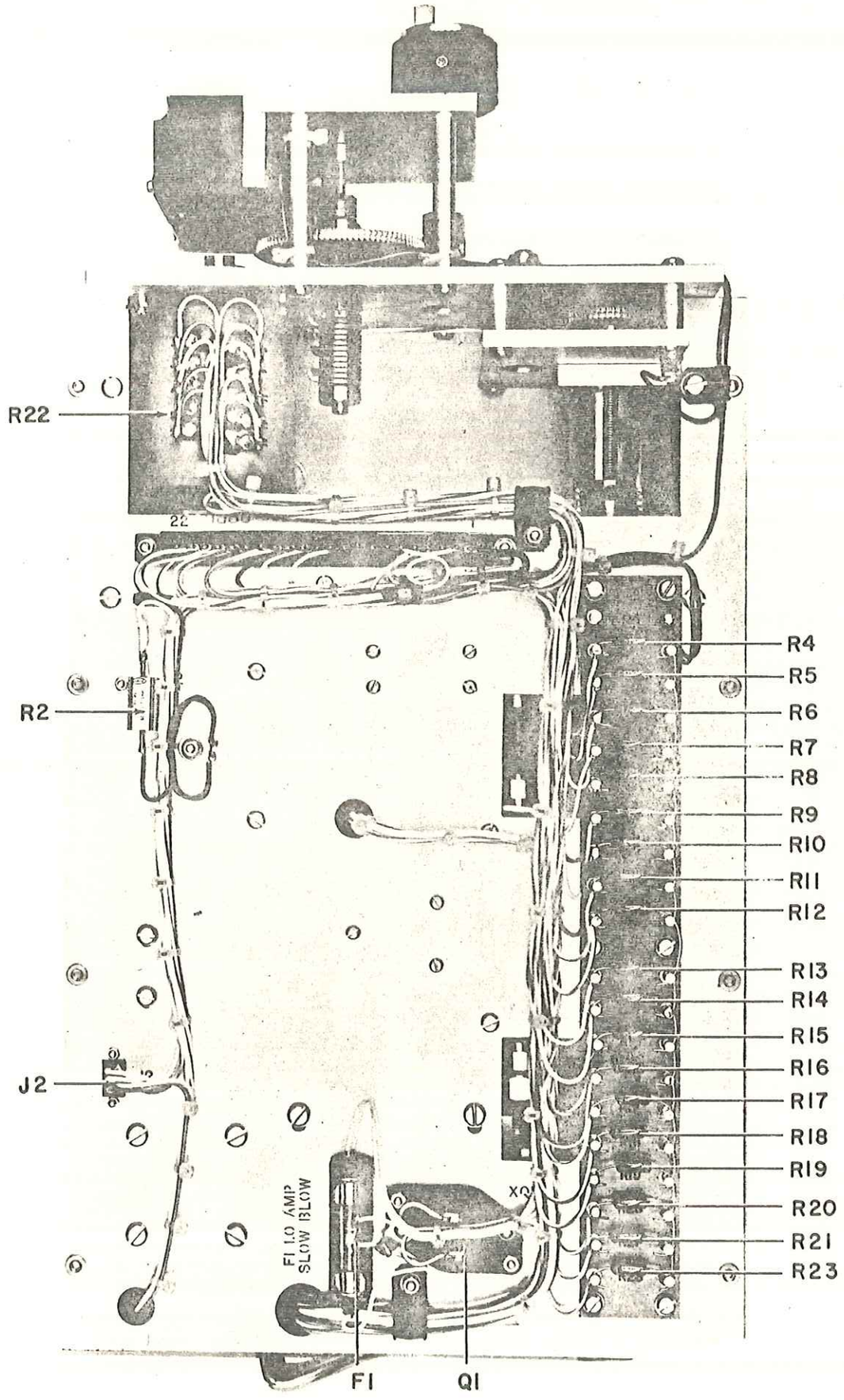


Figure 5-2. Type TH-480A 4-8 GHz Tuning Head, Bottom View, Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
R12*	Same as R7			
R13*	Same as R11			
R14*	Same as R11			
R15*	RESISTOR, FIXED, FILM: 1 kΩ, 1%, 1/4W	5	RN60D100IF	81349
R16*	Same as R11			
R17*	Same as R9			
R18*	Same as R15			
R19*	RESISTOR, FIXED, FILM: 1.5 kΩ, 1%, 1/4W	1	RN60D150IF	81349
R20*	Same as R15			
R21*	Same as R15			
R22	RESISTOR, VARIABLE, PRECISION: 500 Ω, 1%, 5W	1	7603-1519-0	73138
R23*	Same as R15			
W1	CABLE AND CONNECTOR ASSEMBLY	1	30020-1364	14632
W2	CABLE AND CONNECTOR ASSEMBLY	1	29955-12	14632
W3	CABLE AND CONNECTOR ASSEMBLY	1	30020-1359	14632
W4	CABLE AND CONNECTOR ASSEMBLY	1	29955-11	14632
W5	CABLE AND CONNECTOR ASSEMBLY	1	30020-1360	14632
W6	CABLE AND CONNECTOR ASSEMBLY	1	29955-10	14632
W7	CABLE AND CONNECTOR ASSEMBLY	1	29955-13	14632
Z1	ISOLATOR	3	217-0600	27338
Z2	MIXER	1	22543	07180

* Nominal value. Final value to be factory selected.

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
Z3	VARIABLE FREQUENCY OSCILLATOR	1	22667-1	14632
Z4	20 dB COUPLER	1	10616-20	31597
Z5	Same as Z1			
Z6	FREQUENCY DOUBLER	1	2183	10110
Z7	Same as Z1			

5.4.2 Type 72297-3 160 MHz IF Preamplifier (20 MHz BW)

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
A1	INPUT AMPLIFIER	1	15578-2	14632
C1	CAPACITOR, CERAMIC, DISC: 1000 pF, GMV, 500V	1	SM(1000 pF, P)	91418
C2	NOT USED			
C3	CAPACITOR, CERAMIC, FEEDTHRU: 470 pF, 20%, 500V	5	FA5C-4712	01121
C4	Same as C3			
C5	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 1000V	1	B(470 pF, M)	91418
C6	Same as C3			
C7	CAPACITOR, CERAMIC, DISC: .01 μF, 20%, 100V	5	C023B101F103M	56289
C8	CAPACITOR, CERAMIC, TUBULAR: 22 pF, 5%, 500V	2	301-000-C0G0-220J	95125
C9	CAPACITOR, VARIABLE, AIR: .8-10 pF, 250V	4	2954	91293
C10	CAPACITOR, CERAMIC, TUBULAR: 1.1 pF, 10%, 500V	1	QC(1.1 pF, K)	95125
C11	Same as C9			
C12	CAPACITOR, CERAMIC, TUBULAR: 3.3 pF, ±.1 pF, 500V	1	301-000-C0J0-339B	72982
C13	Same as C3			
C14	Same as C8			
C15	Same as C3			
C16	Same as C9			
C17	CAPACITOR, CERAMIC, TUBULAR: 3 pF, ±.0 pF, 500V	1	301-000-C0J0-309B	72982
C18	Same as C7			
C19	Same as C7			
C20	Same as C7			
C21	Same as C7			

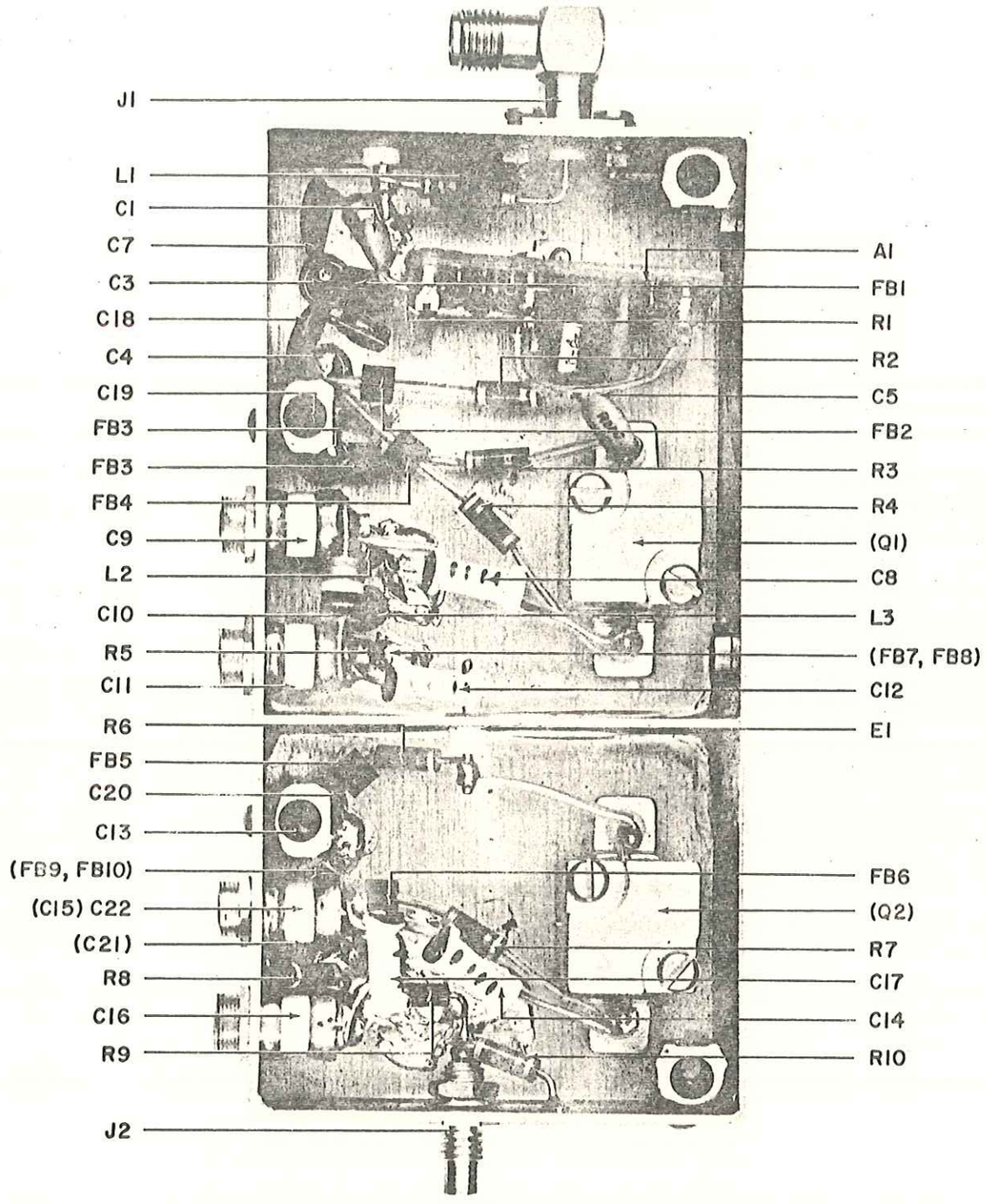


Figure 5-3. Type 72297-3 160 MHz IF Preamplifier (20 MHz BW) (A1), Component Locations

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
C22	Same as C9			
E1	TERMINAL, FEEDTHRU	1	SFU-16	04013
FB1	FERRITE BEAD	10	56-590-65/4A	02114
FB2	Same as FB1			
FB3	Same as FB1			
FB4	Same as FB1			
FB5	Same as FB1			
FB6	Same as FB1			
FB7	Same as FB1			
FB8	Same as FB1			
FB9	Same as FB1			
FB10	Same as FB1			
J1	CONNECTOR, RECEPTACLE, SMA SERIES	1	224	16179
J2	CONNECTOR, RECEPTACLE, MINIATURE SERIES	1	UG-1464/U	81349
L1	COIL, FIXED	1	21210-33	14632
L2	COIL, FIXED	3	21210-25	14632
L3	Same as L2			
L4	Same as L2			
Q1	TRANSISTOR	2	2N918	80131
Q2	Same as Q1			
R1	RESISTOR, FIXED, COMPOSITION: 1 kΩ, 5%, 1/4W	1	RCR07G102JS	81349

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
R2	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	1	RCR07G471JS	81349
R3	RESISTOR, FIXED, COMPOSITION: 5.6 kΩ, 5%, 1/4W	2	RCR07G562JS	81349
R4	RESISTOR, FIXED, COMPOSITION: 3 kΩ, 5%, 1/4W	2	RCR07G302JS	81349
R5	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/4W	1	RCR07G622JS	81349
R6	Same as R3			
R7	Same as R4			
R8	RESISTOR, FIXED, COMPOSITION: 300 Ω, 5%, 1/4W	2	RCR07G301JS	81349
R9	RESISTOR, FIXED, COMPOSITION: 18 Ω, 5%, 1/4W	1	RCR07G180JS	81349
R10	Same as R8			

5.4.2.1 Part 15578-2 Input Amplifier

REF DESIG PREFIX A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
C1	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 200V	1	CK05BX471M	81349
C2	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 1000V	1	B(470 pF, M)	91418
C3	CAPACITOR, CERAMIC, DISC: 1000 pF, GMV, 500V	1	SM(1000 pF, GMV)	91418
Q1	TRANSISTOR	1	AT17	24539
R1	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349
R2	RESISTOR, FIXED, COMPOSITION: 5.1 kΩ, 5%, 1/4W	1	RCR07G512JS	81349
R3	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	2	RCR07G471JS	81349
R4	Same as R3			

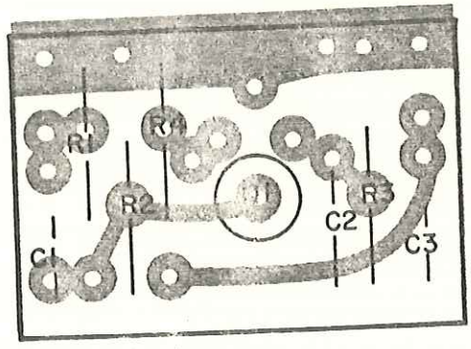


Figure 5-4. Part 15578-2 Input Amplifier (A1A1), Component Locations

5.4.3 Type 79923 YIG Driver Board

REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
C1	CAPACITOR, ELECTROLYTIC, TANTALUM: 10 μF, 10%, 20V	3	CS13BE106K	81349
C2	Same as C1			
C3	CAPACITOR, ELECTROLYTIC, TANTALUM: .22 μF, 10%, 35V	1	150D224X9035A2	56289
C4	CAPACITOR, MICA, DIPPED: 100 pF, 5%, 500V	5	CM05FD101J03	81349
C5	Same as C4			
C6	Same as C1			
C7	Same as C4			
C8	Same as C4			
C9	Same as C4			
C10	CAPACITOR, CERAMIC, DISC: .1 μF, 20%, 100V	1	8131-M100-651-104M	72982
CR1	DIODE	1	1N4449	80131
Q1	TRANSISTOR	1	2N2270	80131
R1	RESISTOR, FIXED, FILM: 26.1 kΩ, 1%, 1/4W	2	RN60D2611F	81349
R2	RESISTOR, VARIABLE, FILM: 5 kΩ, 10%, 3/4W	6	89PR5K	73138
R3	RESISTOR, FIXED, FILM; 46.4 kΩ, 1%, 1/4W	2	RN60D4642F	81349
R4	Same as R3			
R5	Same as R2			
R6	Same as R1			
R7	RESISTOR, FIXED, COMPOSITION: 7.5 Ω, 5%, 1/4W	1	RCR07G7R5JS	81349
R8	RESISTOR, FIXED, FILM: 3.24 kΩ, 1%, 1/4W	1	RN60D3241F	81349
R9	RESISTOR, FIXED, FILM: 8.06 kΩ, 1%, 1/4W	1	RN60D8061F	81349
R10	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/4W	2	RCR07G822JS	81349

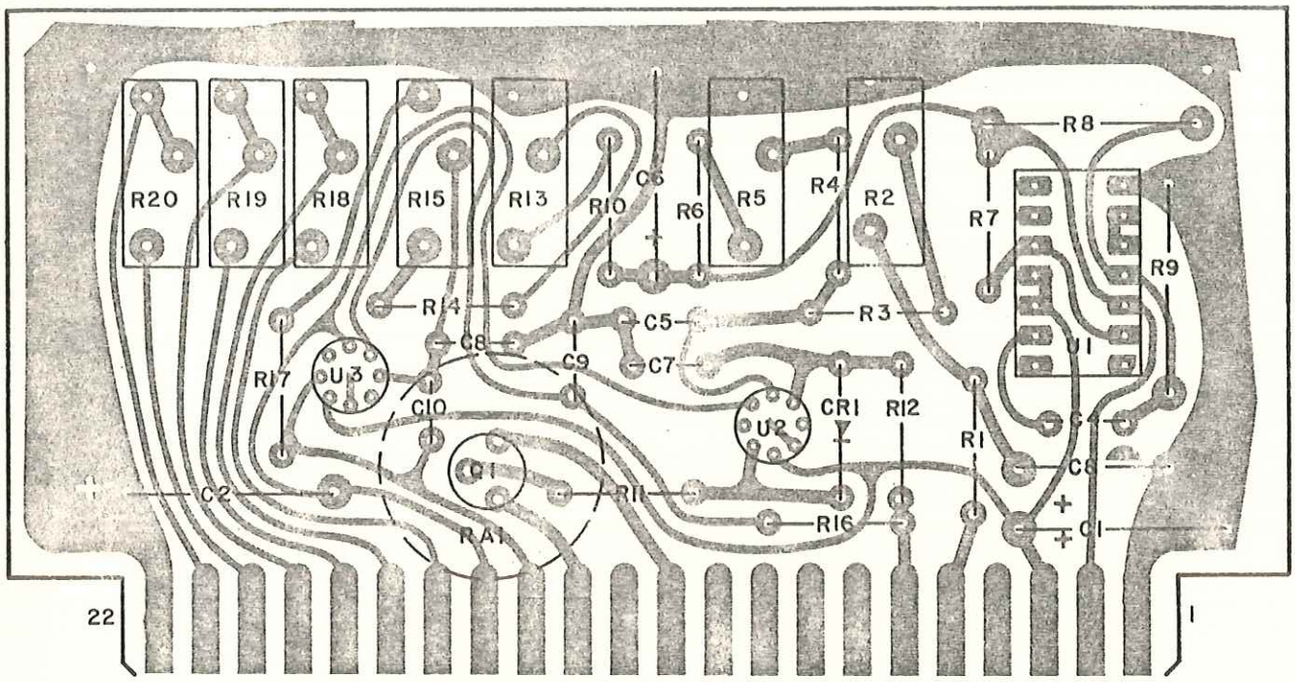


Figure 5-5. Type 79923 YIG Driver Board (A2), Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE
R11	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	1	RCR07G222JS	81349
R12	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	1	RCR07G223JS	81349
R13	Same as R2			
R14	RESISTOR, FIXED, COMPOSITION: 7.5 kΩ, 5%, 1/4W	1	RCR07G752JS	81349
R15	RESISTOR, VARIABLE, FILM: 20 kΩ, 10%, 3/4W	1	89PR20K	73138
R16	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349
R17	RESISTOR, FIXED, COMPOSITION: 470 kΩ, 5%, 1/4W	1	RCR07G474JS	81349
R18	Same as R2			
R19	Same as R2			
R20	Same as F2			
RA1	RADIATOR, TRANSISTOR	1	2225B	13103
U1	INTEGRATED CIRCUIT	1	U6A7723393	07263
U2	INTEGRATED CIRCUIT	2	U5B7741393	07263
U3	Same as U2			

5.4.4 Type 8572 Gear Train Assembly

REF DESIG	DESCRIPTION	QTY. PER ASSY	MANFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
1	FRONT GEAR PLATE	1	21612-1	14632	
2	LIGHT BAR	1	21363-1	14632	
3	LIGHT BAR WINDOW	1	14144-1	14632	
4	TAPE PRESSURE PLATE	1	14106-1	14632	
5	LIGHT BOARD	1	14004	14632	
6	INCANDESCENT LAMP (DS1, DS2, DS3)	REF	CM8-725	71744	
7	PINION BEVEL GEAR, MODIFIED	2	12124	14632	
8	COLLAR	1	11581-5	14632	
9	TENSION SPRING	1	13944	14632	
10	TAPE CHAMBER PLATE	1	14145-2	14632	
11	BEARING	1	14589-1	14632	
12	TAPE CHAMBER	1	31373-1	14632	
13	GEAR, TAPE DRIVE	1	14065	14632	
14	CALIBRATED TAPE	1	32337-1	14632	
15	SHAFT	1	13908-6	14632	
16	COVER, TAPE CHAMBER	1	14083-1	14632	
17	BALL BEARING	3	SFR63MM	83086	
18	BALL BEARING	1	SFR33MM	83086	
19	BALL BEARING	4	SFR1883MM	83086	
20	SHAFT	1	1002-79	14632	
21	RETAINING RING	2	5100-25	79136	

REF DESIG	DESCRIPTION	QTY. PER ASSY	MANFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
22	COLLAR	1	11581-2	14632	
23	SPRING FRICTION WASHER	2	7754	04941	
24	THRUST BEARING	2	TT-504	70417	
25	CLUSTER GEAR	1	15043-1	14632	
26	SHIM, SPACER	AR	SSS-33	01351	
27	SHIM, SPACER	AR	SSS-23	01351	
28	COLLAR	1	1054-3	14632	
29	ANTI-BACKLASH GEAR	1	20180-35	14632	
30	GEAR, SPUR	1	2984-48	14632	
31	SPACER	4	20757-24	14632	
32	ANTI-BACKLASH GEAR	1	20180-36	14632	
33	ANTI-BACKLASH GEAR	1	20180-37	14632	
34	REAR GEAR PLATE	1	21689-1	14632	
35	#10 FLAT WASHER	2	MS15795-807	96906	
36	STOP SHAFT	1	13884-1	14632	
37	STOP WASHER	13	13863-1	14632	
38	STOP RETAINER ASSEMBLY	1	13868	14632	
39	POTENTIOMETER (R22)	REF	7603-1519-0	73138	
40	SYNCHRO MOUNTING CLAMP	4	SC-9	19624	
41	SHAFT	1	1002-91	14632	
42	GEAR, SPUR	1	2984-54	14632	

REF DESIG	DESCRIPTION	QTY. PER ASSY	MANFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
43	ANTI-BACKLASH GEAR	1	20180-38	14632	
44	SPACER	4	20757-4	14632	
45	OSCILLATOR PLATE	1	21697-1	14632	
46	OSCILLATOR, MODIFIED (Z3)	REF	22667-1	14632	
47	#4 SET SCREW	AR	MS51021-9	96906	
48	#6 SET SCREW	AR	MS51021-21	96906	
49	#2-56 x 3/16 LONG PAN HEAD MACHINE SCREW	AR	MS35233-2	96906	
50	#2-56 x 1/4 LONG PAN HEAD MACHINE SCREW	AR	MS35233-3	96906	
51	#2-56 x 5/16 LONG FILLISTER HEAD MACHINE SCREW	AR	MS35275-11	96906	
52	#4-40 x 1/4 LONG PAN HEAD MACHINE SCREW	AR	MS35233-13	96906	
53	#6-32 x 1/4 LONG PAN HEAD MACHINE SCREW	AR	MS35233-26	96906	
54	#6-32 x 3/8 LONG PAN HEAD MACHINE SCREW	AR	MS35233-28	96906	
55	#2 LOCK WASHER (SPLIT)	AR	MS35338-134	96906	
56	#4 LOCK WASHER (SPLIT)	AR	MS35228-135	96906	
57	#6 LOCK WASHER (SPLIT)	AR	MS35338-136	96906	
58	#2 FLAT WASHER	AR	MS15795-802	96906	
59	#6 FLAT WASHER	AR	MS15795-805	96906	

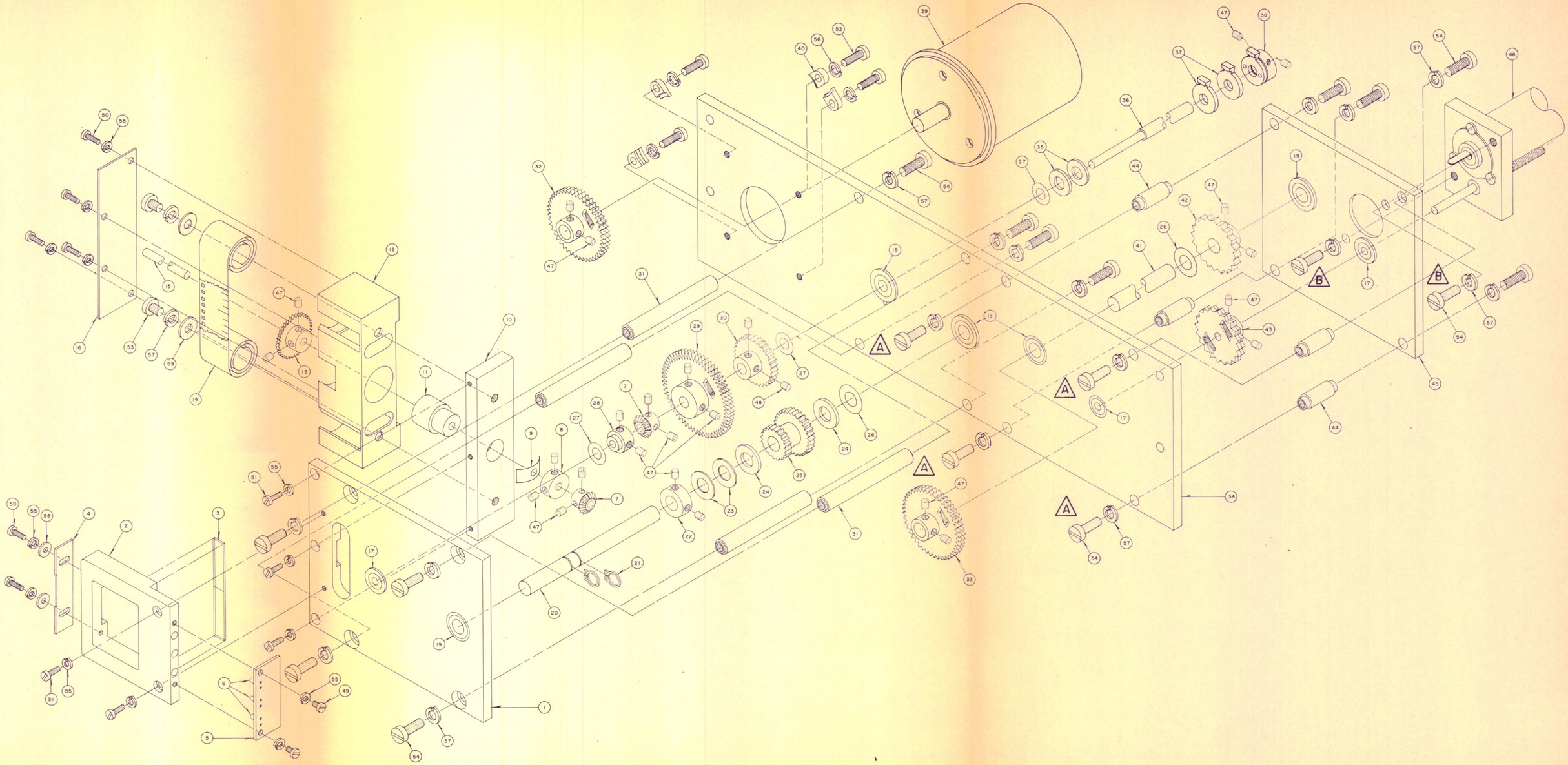
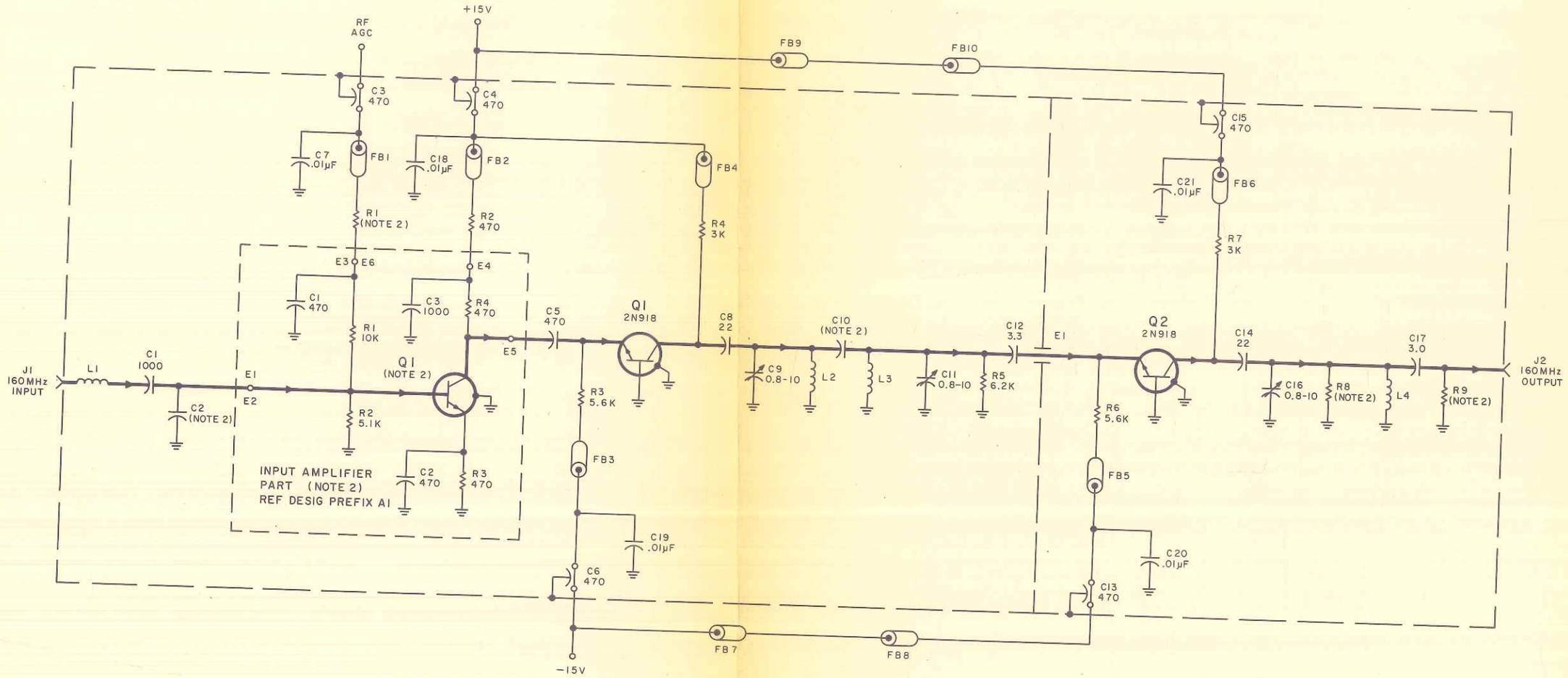


Figure 5-6. Type 8572 Gear Train Assembly, Exploded View

SECTION VI

SCHEMATIC DIAGRAMS



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN pF.
2. DIFFERENCE BETWEEN TYPES IS SHOWN IN DETAIL A.
3. OUTPUT NETWORK FOR 72297-3 IS SHOWN IN DETAIL B.
4. NOMINAL VALUE. FINAL VALUE FACTORY SELECTED.
5. HEAVY LINE INDICATES MAIN SIGNAL PATH.

DETAIL A

TYPE	R10	C22	C2	R1	R8	R9	A1Q1	C10	A1 PART
72297-1	N/U	N/U	12	1K	N/U	N/U	2N2857	1.0	15578-1
72297-2	N/U	N/U	N/U	20K	8.2K	100	2N2857	1.0	15578-1
72297-3 NOTE 3	300	0.8-10	N/U	1K	300	18	AT17	1.1	15578-2

DETAIL B

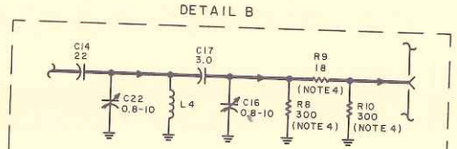
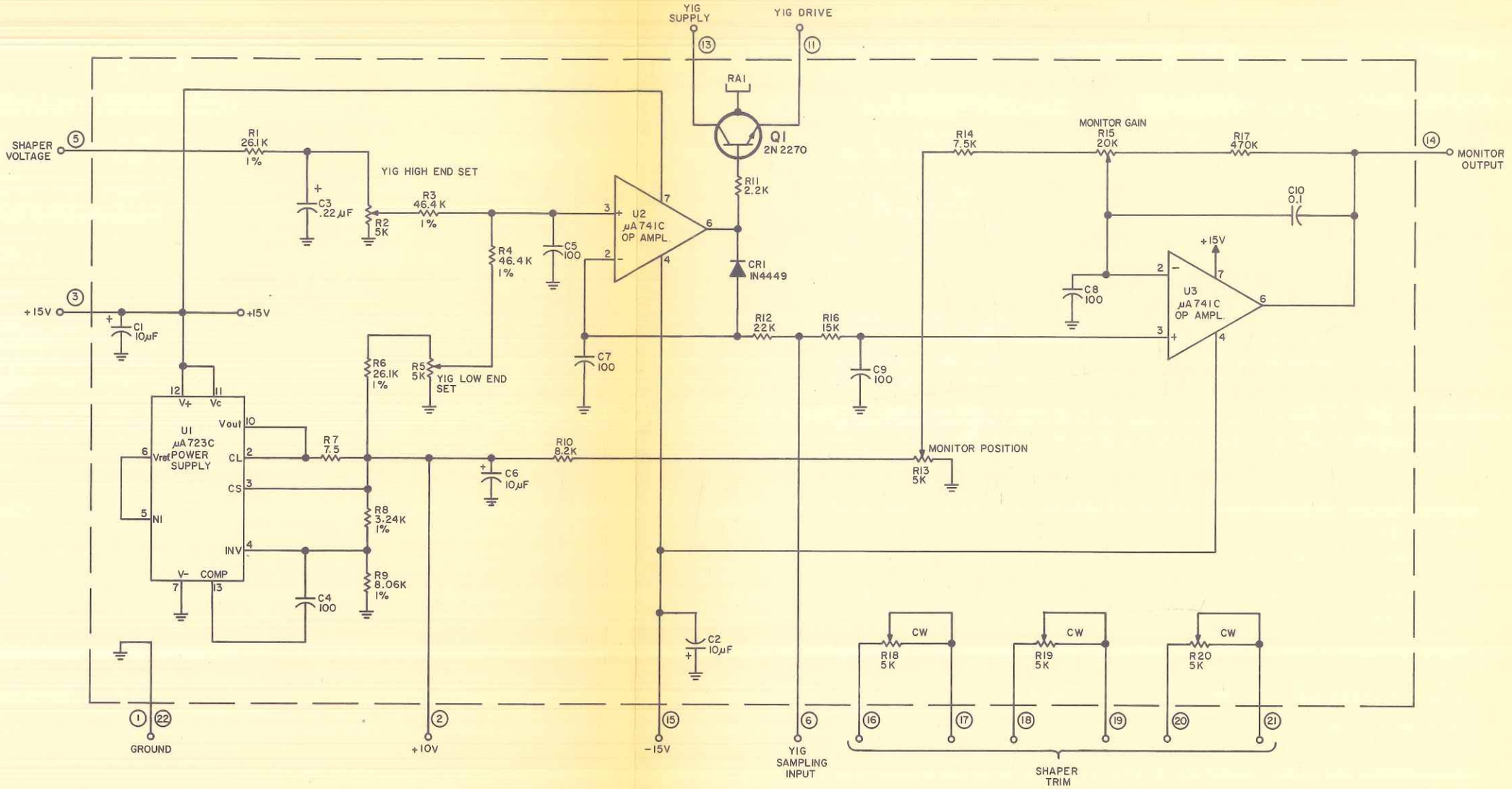


Figure 6-1. Type 72297-3 160 MHz IF Preamplifier (A1), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS MEASURED IN OHMS ±5%, 1/4W
   b) CAPACITANCE IS MEASURED IN pF
2. FOR LEAD ARRANGEMENT OF U1, SEE DETAIL "A"
3. FOR LEAD ARRANGEMENT OF U2 AND U3, SEE DETAIL "B"

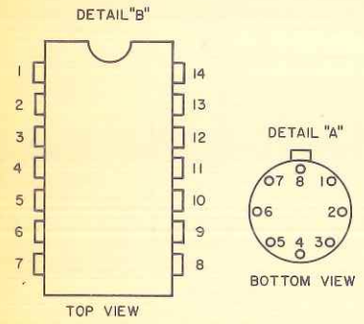
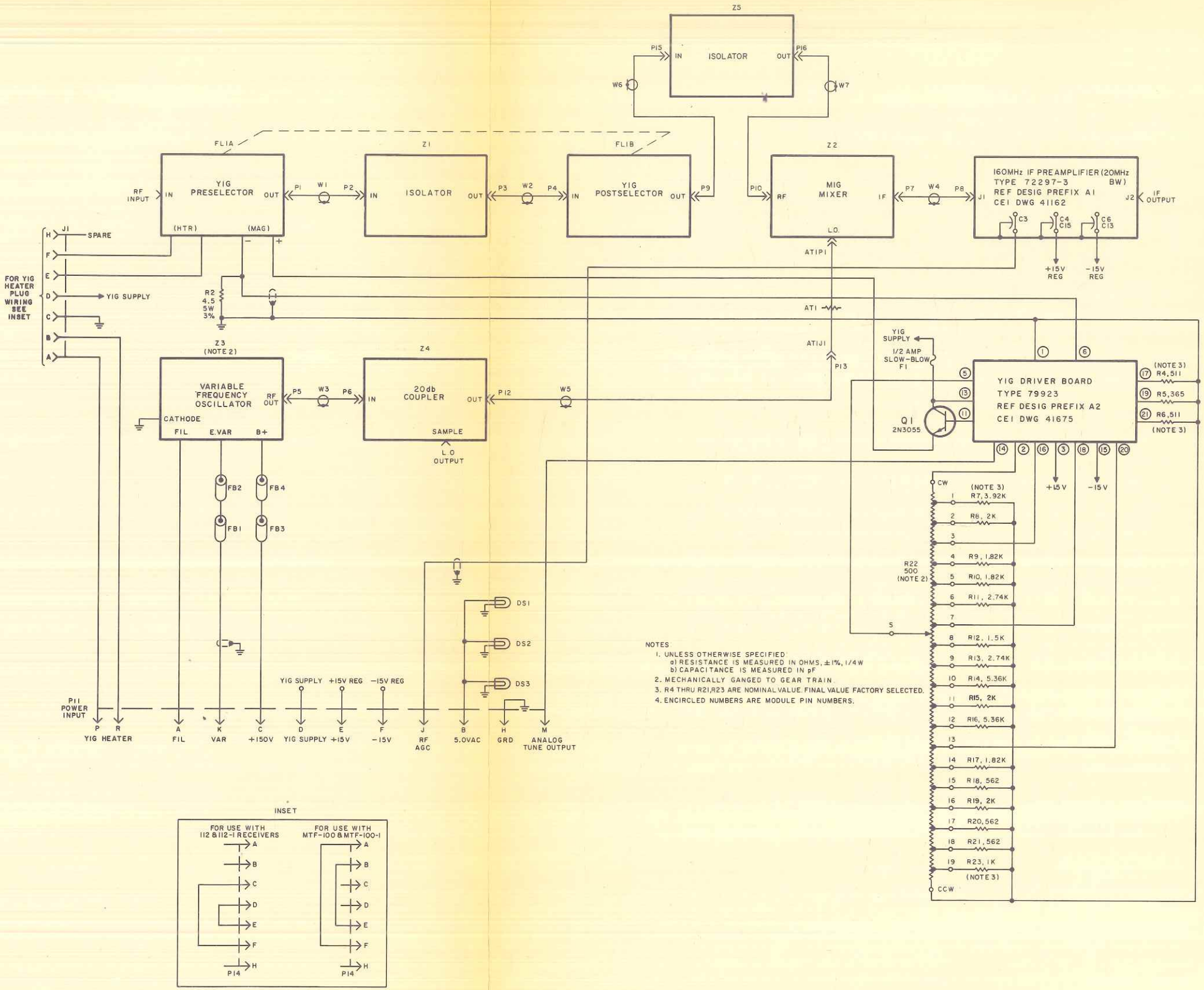


Figure 6-2. Type 79923 YIG Driver Board (A2), Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS MEASURED IN OHMS, ±1%, 1/4W
   b) CAPACITANCE IS MEASURED IN pF
2. MECHANICALLY GANGED TO GEAR TRAIN.
3. R4 THRU R21, R23 ARE NOMINAL VALUE. FINAL VALUE FACTORY SELECTED.
4. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

Figure 6-3. Type TH-240A 2-4 GHz Tuning Head, Main Chassis Schematic Diagram