NAVSHIPS 0967-282-0010

CHANGE 1

TECHNICAL MANUAL
FOR
RECEIVER, COUNTERMEASURES R-1524(P)/WRR
WITH
TUNING UNITS, RADIO FREQUENCY
TN-488/WRR AND TN-489/WRR

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
SEPTEMBER 1967

DIRECTIONS
Change and/or insert the following data with ink as directed below.

TABLE OF CONTENTS ERRATA

1. Page iv and v

Correct the following page numbers as indicated:

Paragraph	Old	New
3. B	4-4	4-5
C	4-5	4-6
D	4-5	4-6
E	4-5	4-6
F	4-6	4-7
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H	4-7	4-8
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O	4-10	4-11
P	4-10	4-11
Q	4-10	4-11
R	4-11	4-12
S	4-11	4-12
4.	4-12	4-13
A	4-12	4-13
B	4-12	4-13

2. Page vii

Change page reference "4-3" to "4-4" for figure 4-2.
Change page reference "4-4" to "4-5" for figure 4-3.

3. Page ix/x

After table 5-7 add the following:

SECTION II, SPECIFICATIONS ERRATA

1. Page 2-2, Audio and Video Outputs:

   Change "Power Output for (S+N)/N.........." to read as follows:
   "Power Output for a 10 db (S+N) /N ratio
   in AM and signals 4 uv or more in FM....................................10 mw minimum into 600 ohm load

2. Page 2-2, Intermediate Frequency:

   Add the following information after "-50 dbm nominal noise level into 50±5 ohms load impedance":
   "This noise level is sufficient to drive an automatic noise figure meter. Conversion gain between the RF input and the IF output is approximately 40 db".

SECTION III, INSTALLATION AND OPERATION ERRATA

1. Page 3-4, paragraph 4.A

   Change step (4) of the FM operating procedure to read as follows: "Set AFC switch to OFF.".

   Change "step (9)" to read "(10)".

   Add a new step (9) as follows: "Set AFC switch to ON.".

2. Page 3-5/3-6, paragraph 4.B

   Delete the following from step (6) of the CW operating procedure:
   "while observing SIGNAL STRENGTH meter. Tune for maximum indication."

   Delete the word "desired" from step 5 and substitute "20 Kc or 75 Kc".

SECTION IV, THEORY OF OPERATION ERRATA

1. Page 4-0, figure 4-1

   Change the labelling of TUNER switch S5 to read as follows:
   Reading from top-to-bottom; "+24VDC, -12VDC, and +12VDC".

2. Page 4-1, paragraph 2,A, last paragraph

   Delete "and the first to" from the end of the 7th line.

   Delete "second IF converters" from the beginning of the 8th line.

   Delete "thru SQUELCH SENS control R4 with MODE switch S3 in FM." from the end of the last line and replace with "to the squelch amplifier which senses RF signal application or removal by a change in AGC voltage when mode switch S3 is in the FM position."

3. Page 4-10, paragraphs 3; M; (3), (4) and (5)

   Add an asterisk, indicating factory adjustment, to L8, L10, L11 and L17 in all places.

   Change "R18" in line 4 of paragraph (5) to "R22".

4. Page 4-11, paragraph 3, Q., (1)

Add an asterisk, indicating factory adjustment; to L1, L3, L5, L8, L9, L10, L11, L12, and L19 in all places.

5. Page 4-12, paragraph 3, Q., (3)

Add an asterisk, indicating factory adjustment, to L8, L9, L10, L11, and L19 in all places.

SECTION V, MAINTENANCE ERRATA

1. Page 5-6, table 5-5 and 5-6

Change "J2A2" to "J5A2" in all places.

Change "J5A2" to "J2A2" in all places.

2. Page 5-7, table 5-6 and 5-7

Change "J2A2" to "J5A2" in all places.

Change "J5A2" to "J2A2" in all places.

Add the following data to table 5-7:

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1a	Connect a 608D signal generator tuned to 200 mc to antenna input J4. Set the modulation to 30% at 400 cps. Set the output level to 200 uv. Place the tuning unit in operation at 200 mc.	Place TUNER selector in RIGHT position and the IF BANDWIDTH in position number 2. Place mode selector in AM/AGC position.	Connect scope to XA5B2. The scope should display a sinewave of 1.6 volts peak-to-peak at a frequency of 400 cps. Adjust AGC threashold adjustment (R14) to achieve desired output levels.

Add "Check output with oscilloscope at XA5B2." after the second sentence of table 5-7, step 1 Procedure.

3.. Page 5-8, table 5-7

Replace the information given in step 6 under Minimum Acceptable Performance with the following: "Audible noise should be heard in phones. Rotate SQUELCH control rapidly clockwise. Time delay in squelch circuit will activate and noise level will diminish in about three seconds. If time delay is unsatisfactory, adjust R30 until suitable delay is achieved."

4. Page 5-8

Insert new page 5-8.1 after page 5-8. New page 5-8.1 is attached at the end of the errata pages. Page 5-8.1 includes table 5-7.1 which was omitted during initial printing of NAVSHIPS 0967-282-0010.

5. Page 5-13, paragraph F

In the last sentence of the first paragraph delete "alignment procedure" and replace with "module voltage and resistance chart".

6. Page 5-13,paragraph F, (1)

Step "a", change "1.0 volts/cm" to "0.5 volts/cm".
Step "b", change "5 centimeters" to "4 centimeters".

7. Page 5-14, figure 5-2

Replace amplitude of "5.0 volts" with "2.0 volts".

8. Page 5-16, paragraph C, Step (3)

Delete "lowest mark" and replace with "highest mark".

Add the following Caution after step (3)

CAUTION
"When rotating the front panel tuning crank, do not wind tape more than one inch beyond last tape mark."

9. Page 5-21, paragraph C

Last line of paragraph C, delete "right hand" and replace with "left hand".

10. Page 5-22, table 5-17 and 5-18

Under the NOTES, delete "note 12" and change "note 13" to "note 12".

11. Page 5-23, table 5-19

Under the NOTES, delete "note 12" and change "note 13" to "note 12".

12. Page 5-23

Under the receiver switch and control settings, change TUNER switch position to "LEFT".

13. Page 5-25, paragraph m

Change "2 mc" to "3 mc".

14. Page 5-25, figure 5-9

Change "2.0 mc" to "3.0 mc".

15. Page 5-25, paragraph (3)

Line 3, change "-4.0 db" to "4.0 db" and "Loss" to "Gain".
Last line, change "more than" to "less than".

16. Page 5-28, table 5-23

Under the NOTES, delete "note 12" and change "note 13" to "note 12".

17. Page 5-29, tables 5-24 and 5-25

Under the <u>NOTES</u>, delete "note 12" and change "note 13" to "note 12".

18. Page 5-31, figure 5-14

Change bandwidth from "2.0 mc" to "3.0 mc".

19. Page 5-32, paragraph (3)

Line 3, change "-4.0 db" to "4.0 db" and "Loss" to "Gain".

Line 4, change "More" to "Less".

Line 5, delete "loss".

20. Page 5-32, paragraph m

Change "2 mc wide" to "3 mc wide".

SECTION VI, ILLUSTRATIONS AND SCHEMATICS ERRATA

1. Page 7-5, figure 7-4B

Delete "-12V" at pin B10 and replace with "GRD".
Delete "+12V TO S.R. EMITTER" at pins A10 and A11 and replace with "GRD".

Table 5-7.1: Isolation Amplifier, ISA-203 Minimum Performance Standards

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect 606A signal generator to J5A2 on the receiver main chassis. Set the modulation to 50% at 400 cps. Set the generator frequency to 21.4 mc. Connect 50 ohm detector to J10 (IF output). Connect output of detector to vertical input of Tektronic 503 scope.	Place TUNER selector switch or switch to RIGHT position. Place IF BANDWIDTH in position 1. Set vertical sensitivity of scope to 1.0 mv/cm. Adjust output level of signal generator to achieve 4.0 cm of deflection. NOTE: Setting of signal generator in db. Connect output of generator directly to input of detector. Increase generator output to obtain the same signal on scope as above. NOTE: Setting of signal generator output in db.	The difference of the two signal generator output setting in db is the gain of isolation amplifier 1-A7. The gain should be 3 db minimum.

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Figure 1-1. Receiver Countermeasures R-1524(P)/WRR with Tuning Unit, Radio Frequency TN-488/WRR and TN-489/WRR

SECTION I

GENERAL DESCRIPTION

1. Electrical Characteristics.

The Astro Communications Laboratory, Inc. (ACL) Receiver, Countermeasures R-1524(P)/WRR, Figure 1-1, is a solid state modular constructed main receiver chassis. Continuous tuning from 30 to 300 megacycles (mc) is provided by the Tuning Unit, Radio Frequency TN-488/WRR (30 to 100 mc) and TN-489/WRR (90 to 300 mc) which plug into the main receiver chassis. In this manual the main chassis is referred to as the receiver and the plug in modules are referred to as tuning units. The common name of tuner is used throughout for the RF tuner, a sub-chassis in the tuning unit.

The receiver provides for the selection, control, demodulation and processing of frequency modulated (FM), continuous wave (CW), and amplitude modulated (AM) signals. Initial selection of FM, CW, or AM signal reception is accomplished by a front panel MODE selector switch.

For FM reception the receiver provides automatic gain control (AGC) with the option for automatic frequency control (AFC) selected by a front panel AFC switch. During this mode of operation, an FM SQUELCH control permits a reduction in audio gain in the absence of signal. Manual gain control is provided during CW reception by adjusting the front panel RF GAIN control. A crystal controlled beat frequency oscillator (BFO) is operative during CW reception. During AM reception, the MODE selector permits manual AM/MAN and automatic gain control (AM/AGC) of the receiver gain. In the AM/MAN position, as for CW reception, the RF GAIN control provides receiver gain adjustment. When positioned to AM/AGC, as for FM reception, automatically the receiver gain is controlled to provide a nearly constant output level over a 60 decibel (DB) radio frequency (RF) input signal range. In addition, the option for AFC is also provided.

An IF BANDWIDTH switch permits bandwidth selection. Identification of the bandwidth in operation is provided on the IF BANDWIDTH plate.

A PHONE jack permits audio monitoring with a headset. The output into the headset is adjusted by the VOLUME control.

A TUNING meter and a SIGNAL STRENGTH meter provide observation of received signal information. The TUNING meter indicates when the signal is centered in the intermediate frequency (IF) passband and the SIGNAL STRENGTH meter indicates the relative amplitude of the received signal.

Selection of the tuning unit covering the desired frequency range of operation is accomplished by the TUNER switch. The TUNER switch is labeled LEFT-RIGHT and supplies power to the tuning units in those locations and the IF signal path from the tuning unit to the receiver.

Coarse tuning is accomplished by rotating a turn crank beneath a calibrated tape dial with final tuning by a FINE TUNING control. An LO OUTPUT connector terminated in a 50 ohm load is provided on the tuning unit front panel. With the cap removed, test equipment may be connected for local oscillator (LO) monitoring.

Delayed and normal AGC voltage is supplied to the amplifier stages in the operating tuning unit. This control voltage extends the gain control range of the receiving system for high level signal reception while keeping the noise figure to a minimum for low level signal reception.

The integral power supplies are regulated to maintain circuit stability and provide optimum performance. The maximum power consumption is 12 watts.

2. Mechanical Characteristics.

A. Receiver

The receiver may be mounted in a standard 19 inch electrical equipment rack or on a table top by brackets which attach to the chassis. Its dimensions are 5-7/32 inches high, 19 inches wide and 18-3/4 inches deep. The weight of the receiver is 26 pounds.

The front, back, side panels and main deck of the receiver are constructed of aluminum. Markings, labeling the front panel controls and switches, are mechanically engraved on the front panel and filled with enamel.

The aluminum top and bottom covers may be removed for maintenance and troubleshooting. With the top cover removed the plug-in printed circuit modules are exposed. Removal of the bottom cover permits access to the plug-in module receptacles, the wiring harness and the power transformer.

Switches, controls, meters, jacks and fuses mounted on the front panel include the following: POWER, AFC, MODE, FM SQUELCH, IF BANDWIDTH and TUNER switches, RF GAIN and VOLUME controls, TUNING and SIGNAL STRENGTH meters, PHONE jack and two 1/4 AMP FUSE holders.

With the exception of the PHONE jack all inputs to and outputs from the receiver main chassis are through connectors and a terminal board on the rear panel. Included are J1, RF INPUT (R), J4, RF INPUT (L), type N, J9 SDU, J10, IF OUTPUT, J11 VIDEO OUTPUT NO. 2, J12 VIDEO OUTPUT NO. 1, type TNC and AUDIO OUTPUT 600 OHMS, terminals 1 and 2 of TB1. The power input connector is an MS3102A-10SL-3P with mating cable fitting MS3106A-10SL-3S. The connector will accept cable TCOP4 per Mil-C-915.

All switches, controls, meters, fuseholders and connectors are sealed to provide a drip-proof front and rear panel.

B. Tuning Units

Mechanically the construction of the tuning units are identical therefore only one will be described.

Aluminum is used for construction of the front, back and main deck of the tuning unit. The front and back panels are held rigidly in place by four aluminum rods which serve as positioning guides when installing the plug-in unit into the receiver chassis. A metal pin on the rear panel aligns the tuning unit in the receiver chassis for proper mating of connectors. Three thumbscrews secure the tuning unit in the receiver.

The tuning unit includes three brass subchasses which are silver plated and gold flashed to prevent radio frequency leakage. Each active circuit within the subchassis is contained in its own brass compartment to minimize circuit interaction. Copper foil and a resilient foam pad are cemented to the tuner subchassis cover to provide an RF tight enclosure. Major component placement within the subchassis are silk screened on the bottom cover. Adjustments and test points are silk screened on the top of the subchassis. All markings on the front panel are mechanically engraved and filled with black enamel.

Two connectors are on the rear panel of the tuning unit which mate with connectors in the receiver chassis. One connector provides power supply voltages from the receiver and the IF signal from the tuning unit. The other connector applies the antenna input signal to the tuning unit.

Front panel controls include a turn crank for coarse tuning and a FINE TUNING control. The turn crank is mechanically connected to a direct reading frequency indicating tape dial which is recessed behind a transparent protective window. The LO OUTPUT connector is terminated in a 50 ohm load assuring proper termination of this signal path when the output is not in use. Gaskets used around the window, controls and LO OUTPUT provide a drip-proof front panel. Handles on the front provide a grip for installation as well as protecting the controls from damage.

The tuning unit whose dimensions are 3-1/2 inches height, 4-3/4 inches wide and 13-3/4 inches deep weighs 5-1/2 pounds.

SECTION II

SPECIFICATIONS

1. Technical Characteristics.

A. Receiver, Countermeasures R-1524(P)/WRR

Modes of Reception	FM, CW and AM
Intermediate Frequency	21.4 mc
Input Impedance	50 ohms nominal
IF Bandwidths	20 ±2 kc and 75 +15 kc-0 kc bandwidth
AFC Control Range	
20 kc Bandwidth	10 kc maximum change in IF for 80 kc change in RF
75 kc Bandwidth	18 kc maximum change in IF for 100 kc change in RF
AGC Manual Gain Control	AGC nominal threshold at a 10 db (S+N)/N ratio
Dynamic Range	
AM/AGC	60 db minimum above AGC threshold
AM/MAN	25 db minimum above noise level with maximum RF gain
Output Stability	
AM/AGC	10 db maximum output change over 60 db input dynamic range
AM/MAN	1 db maximum gain compression for 25 db input dynamic range
FM	2 db maximum output change for inputs above 4 microvolts
FM Quieting (maximum cw signal required for 20 db quieting):	
20 kc Bandwidth	1.5 microvolts
75 kc Bandwidth	3 microvolts
FM Squelch:	
Audio Reduction	30 db in absence of signal
Squelch Threshold	Continuously adjustable from noise level to 20 db above noise level

Squelch Response Time	Squelch circuit inoperative 2 milliseconds after application of RF carrier and remains inoperative 3 seconds after removal of RF carrier
BFO	Crystal Controlled BFO operative in CW mode
Audio and Video Outputs	
3 db Bandwidth	100 cps to 16 kc
Power Output for (S+N)/N	10 db for AM at 1 kc, 30% modulation or for FM at input signals greater than 4 microvolts
Harmonic Distortion	2% maximum at 10 milliwatts
Intermediate Frequency	-50 dbm nominal noise level into 50 ±5 ohms load impedance
Signal Display Unit	10 db gain into 50 ±5 ohms load impedance
Power Requirements:	
External	115 ±11.5 vac, 60 ±3 cps single phase
Internal	±12 and +24 vdc
Power Consumption	12 watts maximum with tuning unit installed
Dimensions	19 inches wide by 18-3/4 inches deep, by 5-7/32 inches high
Weight	26 pounds

NOTE

Tuning units, items B and C use the superheterodyne technique. The weight of each is 5.5 pounds and the dimensions are 3-1/2 inches high, 4-3/4 inches wide and 13-3/4 inches deep.

B. Tuning Unit, Radio Frequency TN-488/WRR

Frequency Range	30 to 100 mc
Tuning Dial Accuracy	±1% maximum error
Input Impedance	50 ohms, vswr 3:1 maximum
Intermediate Frequency (IF)	21.4 mc ±20 kc

Noise Figure	4.5 db maximum into 50 ohms
IF Rejection (first IF)	60 db minimum
Image Rejection	60 db minimum
LO Radiation	15 uv maximum into 50 ohms at RF INPUT
LO Output	100 mv rms minimum into 50 ohms at front panel LO OUTPUT
SDU Bandwidth	3 mc minimum at 3 db points

C. Tuning Unit, Radio Frequency TN-489/WRR

Frequency Range	90 to 300 mc
Tuning Dial Accuracy	±1% maximum error
Input Impedance	50 ohms, vswr 3:1 maximum
Intermediate Frequency (IF)	21.4 mc ±20 kc
Noise Figure	6.5 db maximum into 50 ohms
IF Rejection (first IF)	60 db minimum
Image Rejection	60 db minimum
LO Radiation	15 uv maximum into 50 ohms at RF INPUT
LO Output	100 mv rms minimum into 50 ohms at front panel LO OUTPUT
SDU Bandwidth	3 mc minimum at 3 db points

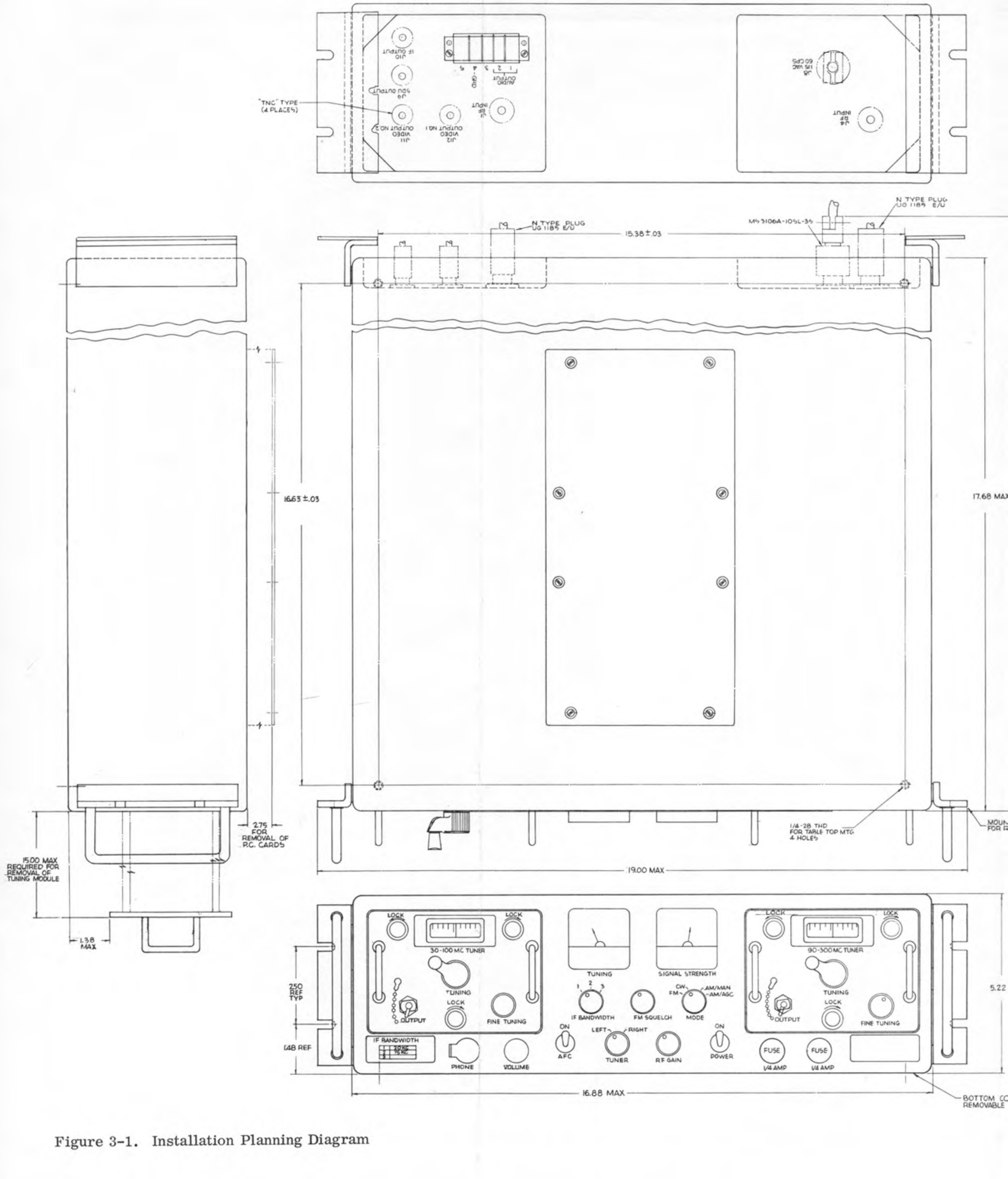
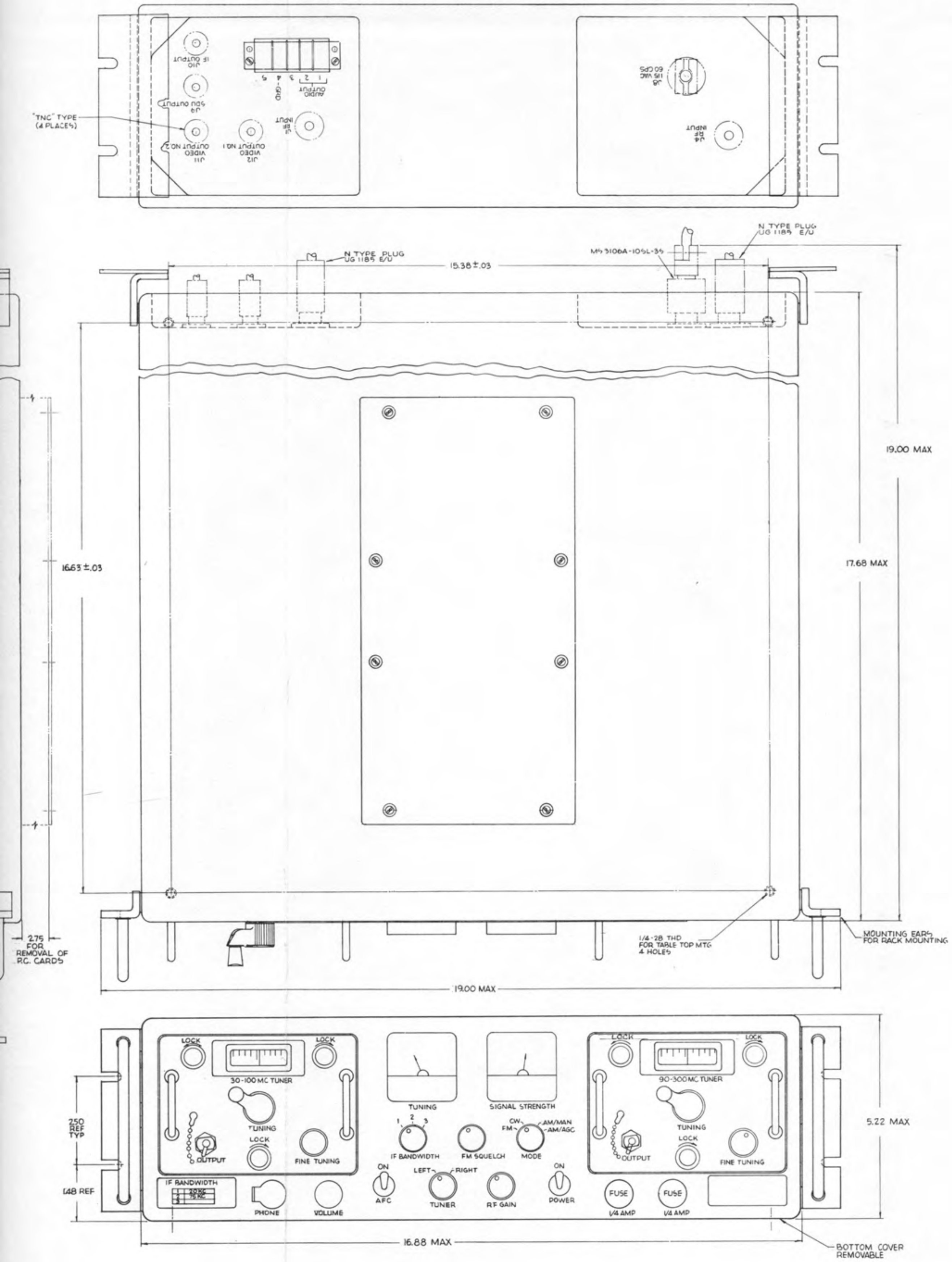


Figure 3-1. Installation Planning Diagram



n Planning Diagram

SECTION III

INSTALLATION AND OPERATION

1. General.

The receiver may be mounted in a standard 19 inch electrical equipment rack or on a table top which is located convenient to an external power source. The input power requirements are 115 ± 11.5 volts ac, 60 ± 3 cycles per second single-phase. Figure 3-1 is an envelope drawing providing planning data for the installation. Factors to consider are as follows:

A. Choose a location for easy operator access and monitoring.

B. Install the equipment as close to the antennas as possible to minimize cable loss.

C. Measure the vertical clearance in the rack, a minimum of 5-1/4 inches is required.

D. Measure behind the rack. Allow enough room for cable connections.

2. Installation Procedures.

The receiver is shipped with the mounting brackets removed. Prior to installation, attach these brackets to the receiver. Brackets are supplied to permit standard electrical equipment rack or table top mounting. No special mounting tools or test equipment is required. With the location for mounting selected, the receiver is installed as follows:

A. Electrical Equipment Rack Installation

(1) Locate and remove from their card board shipping container the four brackets for receiver rack mounting. The rack mounting brackets have handles.

(2) Align each bracket with its receiver mounting hole and screw it to the side of the receiver.

(3) Grasp the receiver by the bracket handles and lift into the rack space provided.

(4) Secure the receiver to the equipment rack with the rack mounted fasteners which will align with the slots in the front and rear mounting brackets.

NOTE

> When the tuning units are installed care should be taken to prevent damage to the rear panel connectors and cross-threading of the front panel thumbscrews.

(5) Install the tuning units in the receiver.

(6) Grasp the plug-in tuning unit and align it with the receiver compartment opening. Install the 30 to 100 mc tuning unit on the left and the 90 to 300 mc tuning unit on the right.

(7) Push the tuning unit forward into the receiver opening until the rear panel connector, Figure 3-2, is firmly seated in its receiver mating connector.

(8) Lock the three front panel thumbscrews.

(9) Connect the power cable to a 115 vac 60 cps power source.

B. Table Top Installation

(1) Locate and remove from their shipping container the four brackets (feet) for table top mounting.

(2) Align each bracket with its receiver mounting holes and screw it to the side of the receiver.

(3) Position the receiver to its desired location on the table top.

(4) Secure the mounting brackets to the table top using bolts or screws.

(5) Refer to paragraph 2A steps 5 through 9 for the remaining installation procedures.

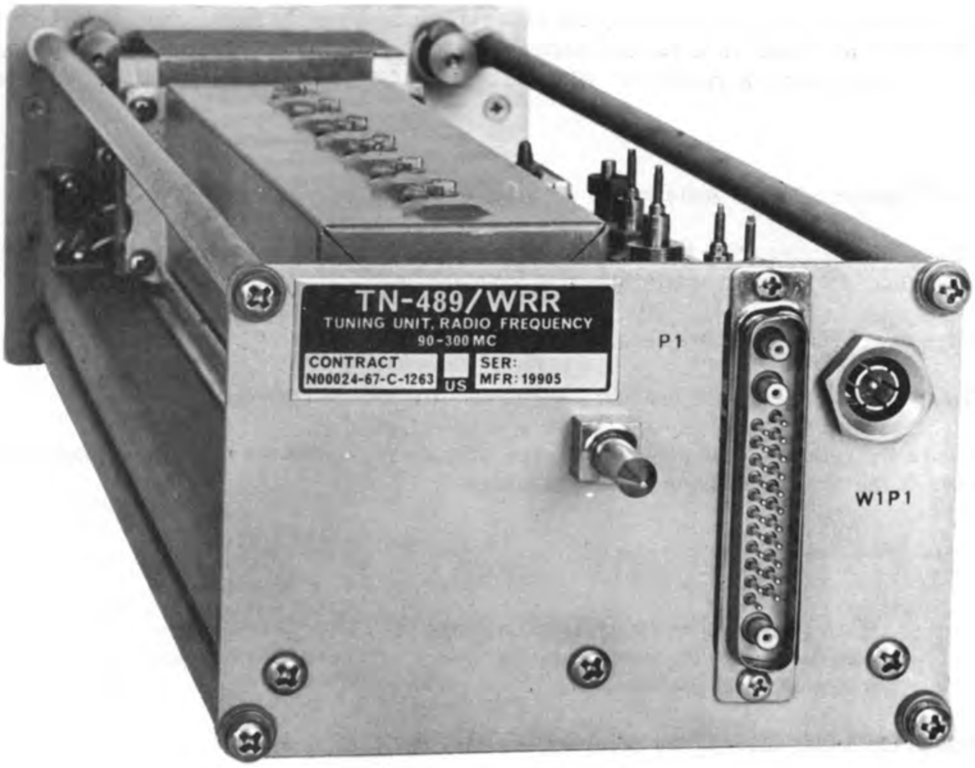


Figure 3-2. Typical Tuning Unit Showing Rear Panel Mating Connectors

3. Connections.

With the exception of the PHONE jack and LO OUTPUT monitoring connector, all cable connections are made at the receiver rear panel, Figure 3-3. Cable connections are as follows:

(A) Power Input: Connect the power cable to a 115 vac external power source.

(B) J4, RF INPUT: Connect the 90 to 300 mc antenna to this N type connector using RG-8A/U or RG-214/U coaxial cable.

(C) J1, RF INPUT: Connect the 30 to 100 mc antenna to this type connector using RG-8A/U or RG-214/U coaxial cable.

(D) J9, SDU OUTPUT: Connect the signal display unit (panoramic indicator) to this TNC type connector using RG-58/U coaxial cable.

(E) J10, IF OUTPUT: Typically, a pre-detection recorder or a noise figure meter may be connected to this TNC type connector using RG-58/U coaxial cable.

(F) J11, Video OUTPUT NO. 2: Connect video monitor NO. 1 to this TNC type connector using RG-58/U coaxial cable.

(G) J12, Video OUTPUT NO. 1: Connect video monitor NO. 2 to this TNC type connector using RG-58/U coaxial cable.

(H) AUDIO OUTPUT: Connect a 600 ohm speaker to terminals 1 and 2 of TB1.

Figure 3-3. Receiver, Rear Panel View

(I) PHONE: Connect a headset to this front panel jack.

(J) LO OUTPUT: Remove the 50 ohm termination and connect frequency monitoring equipment to this tuning unit front panel BNC type connector using RG-58/U coaxial cable.

NOTE

The captive 50 ohm termination or an external 50 ohm load must be connected to the LO OUTPUT for proper operation.

4. Operation.

Figure 3-4 shows the operators controls and indicators. After all connections have been made, paragraph 3, the equipment is operated as follows:

A. FM Operation

(1) Select the frequency range. Position TUNER switch to LEFT (30 to 100 mc) or RIGHT (90 to 300 mc).

(2) Place POWER switch to ON. The dial lamp of the energized tuning unit will light.

(3) Set MODE selector switch to FM.

(4) Set AFC switch to ON.

(5) Set IF BANDWIDTH selector switch to the desired bandwidth position as indicated on the IF BANDWIDTH identification plate.

(6) With no input signal, turn FM SQUELCH control switch on and adjust for minimum audio noise.

(7) Tune receiver to desired frequency with coarse TUNING crank while observing SIGNAL STRENGTH meter. Tune for maximum indication.

(8) Adjust FINE TUNING control for more accurate tuning. Tune for center scale indication on TUNING meter and maximum indication on SIGNAL STRENGTH meter.

(9) Adjust VOLUME control for the desired headset audio level.

B. CW Operation

(1) Select the frequency range. Position TUNER switch to LEFT (30 to 100) mc or RIGHT (90 to 300 mc).

(2) Place POWER switch to ON. The dial lamp of the energized tuning unit will light.

(3) Set MODE selector switch to CW.

(4) Set AFC switch to down (off) position.

(5) Set IF BANDWIDTH selector switch to the desired bandwidth positions as indicated on the IF BANDWIDTH identification plate. The beat frequency oscillator (BFO) is now in operation.

Figure 3-4. Operators Controls and Indicators

(6) Tune receiver to desired frequency with coarse TUNING crank while observing SIGNAL STRENGTH meter. Tune for maximum indication.

(7) Adjust RF GAIN control to prevent receiver saturation.

(8) Adjust FINE TUNING control to vary pitch of audio beat note.

(9) Adjust VOLUME control for the desired headset audio level.

C. AM Operation

(1) Select the frequency range. Position TUNER switch to LEFT (30 to 100 mc) or RIGHT (90 to 300 mc).

(2) Place POWER switch to ON, the dial lamp of the energized tuning unit will light.

(3) Set MODE selector switch to AM/MAN or AM/AGC. In AM/MAN position, the RF GAIN control will have to be adjusted to prevent receiver saturation.

(4) AFC switch may be ON or OFF.

(5) Set IF BANDWIDTH selector switch to the desired bandwidth position as indicated on the IF BANDWIDTH identification plate.

(6) Tune receiver to desired frequency with coarse TUNING crank while observing SIGNAL STRENGTH meter. Tune for maximum indication.

(7) Adjust FINE TUNING control for more accurate tuning. Tune for center scale indication on TUNING meter and maximum indication on SIGNAL STRENGTH meter.

(8) Adjust VOLUME control for the desired headset audio level.

D. Turn-Off Procedure: Place the POWER switch to the down (off) position.

SECTION IV

THEORY OF OPERATION

1. General.

The receiver is designed for the demodulation and processing of FM, CW, and AM signals which are received by two tuning units which plug into the receiver. The receiver consists of two IF amplifiers, an AFC/AGC/squelch/ audio amplifier, a power supply and an isolation amplifier. Figure 4-1 shows an overall functional block diagram of the receiver. The tuning units, which cover the frequency range of 30 to 100 and 90 to 300 mc respectively, consist of a tuner, a preamplifier and an isolation amplifier. The heavy lines show the path and processing of the received signal; lighter lines show receiver control and power distribution functions. Complete schematic diagrams are provided in Section VII. On the apron, is a photograph of the subassembly or module for the schematic. Note that the unit numbering method is used to identify electrical parts. The receiver is unit 1, the 30 to 100 mc tuning unit is unit 2 and the 90 to 300 mc tuning unit is unit 3. Following the unit number is the subassembly prefix. The unit number and subassembly number prefix the part symbol letter and number (such as 1A2R1, 1A2C1). Use of the unit numbering method provides a cross reference in the numbering system between the schematic diagrams and the parts list.

2. Functional Description.

A. Receiver.

An amplified 21.4 mc IF signal from the tuning unit is supplied through TUNER switch S5 and IF BANDWIDTH switch S2 to one of two IF amplifiers. The position of S5 determines which tuning unit is operable. In LEFT position the IF signal is supplied from the 30 to 100 mc tuning unit and in RIGHT position the IF signal is supplied from the 90 to 300 mc tuning unit. The IF signal is also coupled to Isolation Amplifier ISA-203, subassembly A7 whose output is applied to rear panel IF OUTPUT jack J10. Switch S2, connects the IF signal to the 20 or 75 kc IF amplifier and demodulator modules A2 and A3 respectively according to its position.

When applied to the 20 kc IF amplifier, the 21.4 mc IF signal bandwidth is immediately established by an input 20 kc bandpass crystal filter. From the filter, the 21.4 mc IF signal is mixed with a 19.75 mc signal from the crystal controlled oscillator and converted to a final IF of 1.65 mc. The mixer output is then amplified and fed to the FM limiter and the AM detector. From the limiter, the 1.65 mc signal is fed to the FM demodulator whose output is applied through an emitter follower and MODE switch S3 to the AFC/AGC/squelch/audio amplifier module A5. Additionally, the FM output is applied to TUNING meter M2 for indications of center frequency tuning. From the detector, the demodulated AM signal is applied through an emitter follower and MODE switch S3 to the AFC/AGC/ squelch/audio amplifier module A5. CW signal demodulation is provided by a 1.65 mc beat frequency oscillator whose output is applied to the AM detector. An identical signal path is provided when the 21.4 mc IF is applied to the 75 kc IF amplifier. However, the input crystal filters and the frequencies of the local oscillator and beat frequency oscillator are different for this bandwidth, Figure 4-1.

During FM operation AFC is provided. This control voltage is derived from the demodulated FM output of the operating IF amplifier. With MODE switch S3 in the FM position and AFC switch S4 ON the demodulated output is applied to the AFC circuits on module A5. AFC circuits provide filtering, isolation and the control voltage to the local oscillator in the tuner through an emitter follower output. When MODE switch S3 is in the FM or AM/AGC position the AM output of the operating IF amplifier is applied to the AGC amplifier circuits on module A5. For CW and AM/MAN positions a manually adjustable voltage from RF GAIN control R1 provides adjustment of receiver gain. The AGC input signal is amplified for normal AGC and applied to the 21.4 mc preamplifier and the first to second IF converters in the tuning unit. A portion of the normal AGC voltage is sampled and applied to SIGNAL STRENGTH meter M1. Normal AGC voltage is applied thru SQUELCH SENS control R4 with MODE switch S3 in FM.

In this position a manually adjustable dc voltage from R4 establishes the threshold of operation for the squelch amplifier and control circuits. An extension of the normal AGC circuit includes a zener diode and an emitter follower which supplies the delayed AGC to the tuner. For low level signals the delayed AGC output prevents the deterioration of the signal to noise ratio.

Audio and video output signals are derived from the AM or FM detector output of the operating IF bandwidth amplifier. These outputs are applied to the video and audio circuits of module A5 according to the position of MODE switch S3. The audio and video circuits provide gain and impedance matching to externally connected equipment. Gain is provided by two stages of audio/video amplification prior to separation and application of these signals to their respective outputs. The audio output is derived from a squelch controlled audio driver which drives parallel emitter follower outputs. One output is transformer coupled to terminals 1 and 2 of TB1 and the other is applied through the VOLUME control to the front panel PHONE jack. Audio outputs provide connections for 600 ohm loads. Parallel emitter follower outputs also supply the video signals to rear apron connectors J12, VIDEO OUTPUT NO. 1 and J11, VIDEO OUTPUT NO. 2. These outputs are designed to operate into a 600 ohm load.

Circuits supplying the regulated voltages for receiver and tuning unit operation are contained on power supply module A6. An external 115 volt ac source provides inputs to the power supply circuits through two low pass filters, POWER switch S1, line fuses and common power input transformer T1. This module, Figure 4-2, includes three separate circuits which provide +12, -12, and +24 volt dc outputs. The +12 and -12 volt circuits are identical except for the ground point connection to the chassis each consisting of a bridge rectifier, a control amplifier, a driver and a chassis mounted series regulator. The +24 volt dc power supply employs a bridge rectifier, an emitter follower, two zener diode regulators and a chassis mounted series regulator. Each power supply bridge rectifier output includes a 1/2 ampere fuse for transistor protection.

B. 30 to 100 MC Tuning Unit

The 30 to 100 tuning unit, Figure 4-3, amplifies the received signal, converts to a 21.4 mc IF, and provides two stages of pre-amplification prior to IF amplification and demodulation in the receiver. Coarse frequency tuning is accomplished by rotating the front panel turn crank which varies the inductance of the tuned circuits at the input and output of the radio frequency amplifier. Conversion to 21.4 mc is obtained by mixing the input signal with a high beat local oscillator. Fine frequency tuning is accomplished by changing the frequency of the local oscillator by rotating the FINE TUNING control. In CW mode the FINE TUNING control is adjusted for an audible beat note. AFC voltage, to control local oscillator drift is also applied through the FINE TUNING control. The local oscillator frequency is made available at the front panel LO OUTPUT jack through an isolation amplifier. This jack should be terminated with the 50 ohm captive cap when not in use. From the mixer, the 21.4 mc IF signal is coupled to the preamplifier where it is amplified by two gain controlled amplifier stages. At the preamplifier input, a resistive isolation network provides a 21.4 mc signal path to a signal display unit (SDU). Delayed and normal AGC voltages, from the receiver, are applied to the RF amplifier and the preamplifier. Operating voltage is obtained from the dc power supply in the receiver.

C. 90 to 300 MC Tuning Unit

The 90 to 300 mc tuning unit is functionally the same as the 30 to 100 mc tuning unit. Their main differences are in circuit values and in the method of RF tracking. Figure 4-3 and the functional description in sub-paragraph B. is applicable for the 90 to 300 mc tuning unit.

3. Functional Circuit Analysis.

A. Receiver, 1

The receiver consists of IF amplifiers IF-220-20 and IF-221-75, Figures 7-1 and 7-2, AFC/AGC/Squelch/Audio amplifier AASA-201, Figure 7-3, power supply PS-211-1, Figure 7-4, and isolation amplifier ISA-203, Figure 7-5. Figure 7-6 is the receiver interconnecting wiring diagram.

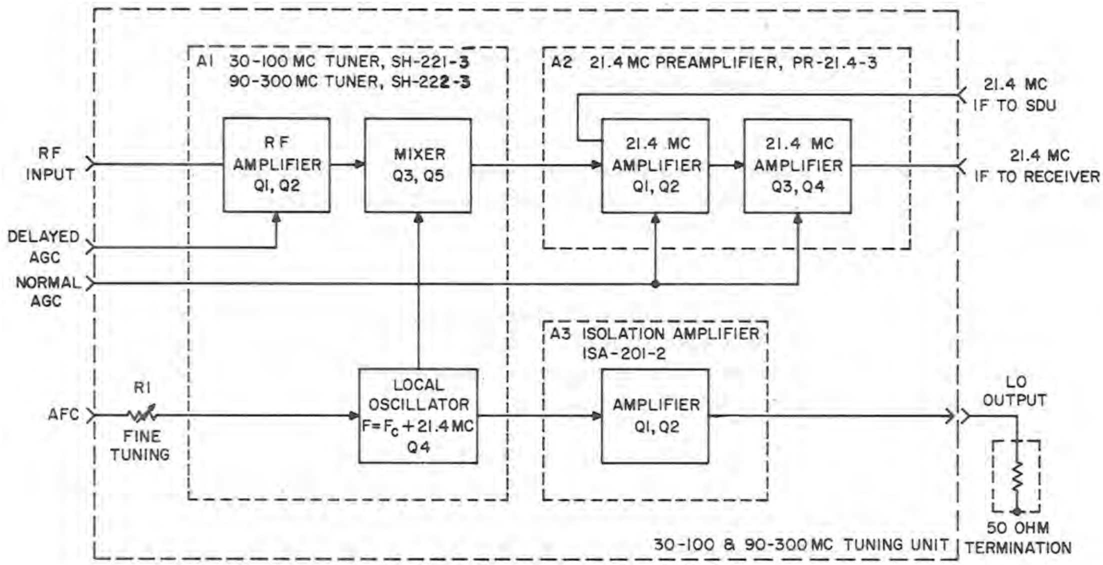


Figure 4-3. Tuning Unit Functional Block Diagram

B. IF Amplifier IF-220-20, A2

(1) Crystal Filter and Mixer: The input to the 20 kc IF amplifier is applied to Q2 through resistive divider R1 and R2 and a crystal filter Y3. Tuned to 21.4 mc, crystal filter Y3 establishes the bandwidth of the IF amplifier. A cascode mixer is formed by Q2 a common emitter and by Q3 a common base stage. The incoming 21.4 mc signal and the 19.75 mc signal from crystal controlled oscillator Q1 are simultaneously applied to Q2 base input to produce the final 1.65 mc IF signal for demodulation. Q3 collector is coupled to Q4 base via a 1.65 mc center frequency single tuned circuit. Alignment is by L3 which is shunted by R42 for adequate loading. The output from this circuit is applied through attenuator R12 to the 1.65 mc amplifier Q4.

(2) 19.75 MC Crystal Controlled Local Oscillator: To convert the incoming 21.4 mc signal to the final IF of 1.65 mc, a 19.75 local oscillator signal is generated by Q1 and applied to the mixer input for heterodyning action. Y1 is a parallel mode fundamental crystal and is connected across C6 and C7. The ratio of C6 to C7 determines the amount of feedback to sustain oscillation. The oscillator output is coupled to the base input of mixer Q2 through C9.

(3) 1.65 MC IF Amplifier and AM Detector: The 1.65 mc IF signal is applied to the base of cascode amplifier Q4 and Q5. The output of Q5 is developed across a single tuned circuit consisting of L5 and resonating capacitor C19. Input to the AM detector is derived from the high side of L5 through C13; input to the FM limiter is from the junction of C23 and C24. When the receiver is operated in the CW mode, a beat frequency oscillator signal is applied to the AM detector through C22. Diode CR2 is the AM detector with filtering provided by C28, R20 and C31. L7 in parallel with C29 resonates at the IF frequency of 1.65 mc assuring that the IF signals are not coupled into the video amplifier circuits. The detected output of the AM detector is applied to the input of Q7.

(4) 1.65 MC Beat Frequency Oscillator: Q6, the beat frequency oscillator is crystal controlled at 1.65 mc. Y2 is a parallel mode fundamental crystal and is connected across C25 and C26. The ratio of C25 and C26 determines the amount of feedback to sustain oscillation. With the MODE selector switch positioned to CW, +12 volts is applied to the collector of Q6 through CR3 and the oscillator becomes energized. At this time, CR1 is reverse biased and does not affect the operation. In other operating modes -12 volts is applied to the diode. CR3 now becomes reverse biased and protects Q6. At the same time CR1 becomes forward biased, which effectively shorts out Y1, and thereby prevents the crystal from creating a "hole" in the passband of the signal path. Since the beat frequency oscillator is crystal controlled, the audible beat note is obtained by varying the first local oscillator in the tuner using the front panel FINE TUNING control.

(5) AM Video Amplifier: AM video amplifier Q7 operates as a dc coupled emitter follower. The output from the AM detector CR2 is coupled directly to the base. Q7 collector is bypassed by C33. From Q7 emitter, the low impedance output is coupled through switching circuits to the AGC, audio and video amplifier circuits on AASA-201 module A5.

(6) FM Limiter, Demodulator and Video Amplifier: The 1.65 mc signal tapped from the junction of C23 and C24 in Q5 collector circuit is fed to the input of the limiter, which consists of Q8 and Q9 in a cascode configuration. Q8 and Q9 are biased to provide limiting action when the incoming signal to the tuning units barely rises above noise level. Regardless of the input level, the output of the limiter delivers a constant drive to the FM demodulator at all times. The FM demodulator is of the Travis type, a slight variation from the popular Foster-Seely discrimator. Q9 output is developed across a tuned circuit centered at 1.65 mc and is simultaneously coupled to two secondary circuits via C38 and C39. L8 tunes to 1.65 mc, and L9 and L10 tune to the two peaks of the demodulator "S" curve. The separation between the two peaks is about 50 kc. CR4 and CR5 are employed for phase detection. The output of the FM demodulator is coupled to the FM video amplifier via a filtering network consisting of L11, C44, R32 and C46. L11 in parallel with C44 resonates at the IF frequency to avoid application of the IF signal to the video circuits. Q10 operates as an emitter follower. Direct coupled FM dc video output is applied from the emitter of Q10 through switching and control circuits to the AFC/AGC/squelch, and audio amplifier circuits on AASA-201 module A5.

C. 75 KC IF Amplifier IF-221-75, A3

The 75 kc IF amplifier and the 20 kc IF amplifier employ an identical number of stages and reference part symbol numbers. Different part values are used in these stages, however to provide the different bandwidth and a different conversion frequency for the 75 kc IF amplifier. The 21.4 mc input is converted to a final IF of 2.5 mc which requires the frequencies of Y1 and Y2 on the 75 kc amplifier to be 18.9 and 2.5 respectively. The functional operation for the 20 kc IF amplifier paragraph 3B, describes the 75 kc IF amplifier.

D. AFC/AGC/Squelch/Audio Amplifier AASA-201, A5

This printed circuit module contains the AFC, AGC, squelch, audio and video amplifiers.

E. AFC Amplifier

With front panel AFC switch S4 ON, the demodulated FM signal is applied to the base of Q1. An input filter consisting of R1 and C1 filter the input signal to remove any ac component. When the FM discriminator input signal is at center frequency, the voltage at the emitter of the FM output emitter follower is -0.6 volts dc. When switch S4 is off, the -0.6 volts dc bias is maintained by the forward voltage drop across CR3. Q1 and Q2 are a cascode connected emitter follower pair. Q2 emitter is coupled to Q3 base through 15 volt zener diode CR1. This arrangement permits Q2 emitter voltage to swing from positive to negative while Q3 base will see only a positive voltage. AFC voltage from Q3 emitter is applied through the front panel FINE TUNING control to the local oscillator in the operating tuner. Normally the AFC voltage is approximately +13 volts dc but will vary from +12 to +15 with local oscillator frequency drift. During CW operation, place AFC switch S4 in down (off) position.

F. AGC Amplifier

(1) First AGC Amplifier and Modulation Filter: The output from the AM detector is dc coupled to the base of Q4. Q4 and Q5 are connected in a cascaded emitter follower configuration, commonly known as a Darlington circuit. This configuration provides high power gain with extremely high input impedance to reduce the effects of loading on the previous circuit. Coupling from the emitter of Q5 to the base of phase inverter Q6 is through zener diode CR2. A zener diode, when properly biased, maintains a constant voltage drop across its terminals. This permits a voltage difference between the emitter of Q5 and the base of Q6. The output of Q5 is applied directly to the base of Q6. Q6 operates as a common emitter amplifier whose output is applied to the modulation filter. The modulation filter consists of R12, C2 and R13. Essentially, the filter removes the ac component from the detected AM video output and provides a dc voltage corresponding to the carrier level for FM and AM modes of operation. This dc voltage from the modulation filter is coupled to the base of high gain amplifier Q7.

(2) Second AGC amplifier and Modulation Filter: Q7 is operated as a high gain common emitter amplifier. R14 is connected across the plus and minus 12 volt power supply and the wiper arm is coupled to the base of Q7. The dc input to Q7 therefore consists of a dc level from the modulation filter and a dc level set by R14. These voltages combine and provide the base input to Q7, with R14 providing an AGC threshold adjustment. Q7 collector output is coupled to the front panel MODE switch S3 through another modulation filter consisting of R17, R18, C5 and C6. During AM and FM operation with AGC, Q7 output is applied to all gain controlled stages of the receiving system via Q9, Q10, and Q11.

(3) Normal and Delayed AGC Output Circuits: In the AGC mode, Q7 collector output is applied to Q8 base through MODE switch S3. When operating in the manual mode, the voltage applied to Q8 is derived from a resistive divider consisting of chassis mounted components R1, R2 and R3. R1, the RF GAIN potentiometer is in operation only when the receiver is operating in AM/MAN or CW mode of operation. It has no gain control affects during the FM operating mode. Q8 and Q9 operate in a cascaded emitter follower configuration to provide high input and low output impedance. The collectors of both transistors are returned to the +24 volt supply. The emitter output of Q9 is the normal AGC voltage. A portion of this voltage is sampled through R19 and applied to the front panel SIGNAL STRENGTH meter. Normal AGC voltages are also applied to the 21.4 preamplifier circuits in the tuning unit. Delayed AGC voltage is provided by zener diode CR5, series connected to the base of emitter follower Q10. CR5 normally operates with a constant 3 volt potential across its terminals. Therefore, no drive is applied to Q10 until the normal AGC rises above this potential. Delayed AGC voltage is taken from the emitter of Q10 across R23 and applied directly to the RF amplifier circuits in the tuning unit.

G. Squelch Control

Q11 and Q12 are grounded emitter dc amplifiers and provide the correct relation between RF signal application and squelch operation. Q13 is in series with the collector circuit of audio driver Q18 and affects the gain of that stage by controlling the current through it. A dc voltage from SQUELCH SENS control R4 establishes Q11 base bias to control the squelch threshold of operation. When the FM SQUELCH SENS control is maximum clockwise the bias voltage is maximum negative and the squelch circuit is set for maximum sensitivity. In OFF position, the bias voltage is maximum positive, Q11 is biased on and the audio output is maximum. Normal AGC voltage is also connected to Q11 base which senses the input signal application or removal by the change in AGC voltage. When an input signal is applied to the receiver, positive AGC voltage biases on Q11. Q11 collector voltage then drops turning off Q12 whose collector rises to +24 volts. C7 charges to this value through CR6 and R28 in approximately 20 milliseconds, biasing on Q13 and affecting full audio gain. When the input signal is removed, Q11 is biased off which causes the collector of Q12 to approach ground, back baising CR6. C7 discharges through R29 and R30 in approximately 3 seconds; discharge time is adjusted by R30. When C7 is discharged, Q13 is again biased toward cutoff, restricting the current flow through Q18 and reducing the audio gain.

H. Audio and Video Amplifier

(1) Audio Video Amplifiers: Depending on the MODE switch position, video signals from either the AM or FM detector output of the operating IF amplifier are applied to the base of video amplifier Q14. Base circuit capacitor is large to provide adequate low frequency response while R31 provides a signal attenuation adjustment for gain control. The audio video amplifier, consisting of Q14 and Q15 is of the feedback type. Q14 operates as a high gain common emitter amplifier. Coupling to amplifier Q15 is through zener diode CR7 which permits a difference in potential between the collector of Q14 and the base of Q15. R34 is the series feedback resistor. A phase inversion takes place between the base and collector of Q14, while the signals between the base and emitter of Q15 are in phase. As a result, the feedback established is negative. It reduces distortion and improves the frequency response of the amplifier. Q15 collector output drives the video output emitter followers Q16 and Q17 and the squelch controlled audio driver Q18 through C18. Q16 and Q17 outputs are ac coupled to rear panel connectors and provide VIDEO OUTPUT NO. 1 and VIDEO OUTPUT NO. 2 respectively.

(2) Audio Driver and Emitter Follower Output: Q18 drives the two audio output emitter followers Q19 and Q20. The base input to audio driver Q18 is derived from the collector of Q15 through zener diode CR9. Main chassis transformer T2 forms the emitter load for Q19, and provides a 600 ohm output on its secondary. This output is available on the rear panel at terminals 1 and 2 of TB1. Q20 provides audio to front panel PHONE jack J3 through VOLUME control R5.

I. Power Supply PS-211-1, A6

The internal power supply is voltage regulated and consists of a plus and minus 12 volt power supply and a plus 24 volt power supply. A separate filter capacitor and series regulator for each power supply section are mounted on the main chassis. The chassis mounted power transformer T1 is common to all three power supplies.

(1) ±12 Volt Power Supply: The plus and minus 12 volt power supplies are identical except for the point of connection to the chassis, therefore, a discussion is provided only for the plus 12 volt power supply. C7 and Q1 on the main chassis are the filter capacitor and the series regulator for the plus 12 volt supply. Power is applied to the input of the transformer and is consequently coupled to rectifier CR7. CR7 contains a full wave bridge rectifier circuit whose output is approximately 18 volts unregulated. Regulation to plus 12 volts is obtained in the circuits consisting of a control amplifier, Q5, a driver, Q4 and chassis mounted series regulator, Q1. Resistive divider network R13, R14, R15 and R16 form the sensing circuit for the regulator. R14 is initially adjusted to provide plus 12 volts at the supply output under full load conditions. With a change in either load or line condition, any increase in voltage is transmitted to the base of Q5 by the sensing network. As the potential between its base and the referenced emitter rises, the current through Q5 increases and is accompanied by a voltage drop at the collector. Since the collector of Q5 is connected to the base of Q4, the collector current of Q4 is decreased at the same time. Because the emitter of Q4 is connected to the base of the series regulator, the series regulator, the series regulator is driven toward cut-off. As a result, the voltage drop across the regulator increases and the supply output voltage is brought back to plus 12 volts. A 1/2 ampere fuse is provided between the output of the bridge rectifier and the collector of Q4 to protect the chassis mounted series regulator from overloading or high current surges.

(2) +24 Volt Power Supply: The plus 24 volt power supply is a simple zener controlled circuit with no error voltage amplification included. CR6 is a full wave bridge rectifier. Chassis mounted filter capacitor, C6, together with board mounted components R8, R9, and C6 provides the filtering action. The combination of zener diodes CR2 and CR3 provides a 25 volt reference source and is connected directly to the

base of current driver emitter follower, Q3. The emitter of Q3 is then clamped at 24.4 volts which in turn is the base voltage of the chassis mounted series regulator Q3. The 24.4 volt base voltage subtracts the base to emitter drop of the series regulator to establish the plus 24 volts output from the supply. Like the plus and minus 12 volt power supply sections, a 1/2 ampere fuse, F2, is provided at the output of the rectifier to protect the circuit.

J. Isolation Amplifier ISA-203, A7

From the operating tuning unit, the 21.4 mc IF signal is applied to Q1 through J1 and C1. Input circuit components R1, R2 and R3 form a 10 db resistive attenuator. Q1 operates in a common emitter configuration. Its collector circuit contains a fixed tuned circuit consisting of C3, L1 and C4. R7 is a damping resistor. The output of the isolation amplifier is applied to rear panel 21.4 MC IF OUTPUT jack J10. The isolation provided is approximately 40 db.

K. Power Line Filter

From an external power source, power is applied through the input power cable to the power line filter. The power line filter consists of a three terminal plug J8 and two identical low pass filter networks. L1, FL-LP-1 and C4 form the network on one line and L2, FL-LP-2 and C3 form the network on the other line. Terminal B of the plug is grounded and terminals A and C outputs are applied to terminals 1 and 4 of power transformer T1 through the low pass filters. The filter network suppresses all conducted interference signals in and out of the receiver.

L. 30 to 100 MC Tuning Unit, 2

The 30 to 100 mc tuning unit includes tuner SH-221-3, Figure 7-7, pre-amplifier PR-21.4-3, Figure 7-8 and isolation amplifier ISA-201-2, Figure 7-9. An interconnecting wiring diagram is shown in Figure 7-10. Tuner stages include a cascode RF amplifier, a mixer and a local oscillator. Frequency selective circuit elements for input signal tuning are ganged by a six section inductuner which is mechanically connected to the front panel coarse tuning control through a gear train assembly. Drive for the tape deck assembly is provided by the gear train for direct frequency indication of the received signal. Preamplifier circuits include two gain controlled amplifier stages, each stage being separated by a double tuned circuit. The isolation amplifier consists of a cascode connected amplifier.

M. 30 to 100 MC Tuner, A1

(1) Input Network: Signals from the antenna are applied to the input network of the tuner through connector J1. A static discharge path to ground for the input coaxial line is through R1. Impedance stepup to 50 ohms is by capacitive divider C1 and C2. The first inductuner section L2A and L1 form the primary of the double tuned input network. The secondary windings is formed by L2B and L4. Impedance matching to the base of RF amplifier Q1 is by capacitive divider C8 and C9. Inductuner sections L2A and L2B are ganged to other tuning sections in the interstage network and to the collector circuit of the local oscillator. L1 and L4* provide adjustment of the double tuned input network at the high end of the tuning range and C3 and C7 provide adjustment at the low end of the tuning range. After bandpass filtering by the double tuned input network, the received signal is applied to the RF amplifier stage.

(2) RF Amplifier: The RF amplifier consists of Q1 and Q2 connected in a cascode configuration. The signal from the input network is applied to the base of Q1. Q1 is a gain controlled amplifier operating in a common emitter configuration. The base of Q1 is returned through R12 to the delayed gain control source in the receiver. After amplification by Q1, the signal is applied to the base of Q2, a common base stage. Impedance matching and coupling for the cascode connected pair is by C18 and C54. From the collector of Q2 the amplified signal is applied to a triple tuned interstage network.

Note: * Indicates factory adjustment

(3) Interstage Network: The interstage network includes section 3, 4 and 5 of the six section inductuner. The third section, part of Q2 collector circuit consists of L2C and L8. These inductors are resonated by variable capacitor C20 and fixed tank capacitor C21. Coupling to the fourth section containing L2D and L10, is by C23 and C26. At the high end of the tuning range, coupling is mostly by C23 since L2C is practically out of the circuit. Intersection coupling at the low end of the tuning range is by both C23 and C26. The fourth section inductors L2D and L10 are resonated by variable capacitor C24 and fixed tank capacitor C41. Section five consists of L2E and L11. Coupling to section five is through C25 and C32. L2E and L11 are resonated by variable capacitor C27 and fixed tank capacitor C28. R14, R15, R18 and R35 provide adequate loading. The interstage network is tuned by L2C, L2D and L2E which are ganged to other inductuner sections in the input network and the local oscillator. C20, C24 and C27 provide an alignment adjustment for the low end of the tuning range. High tuning range alignment is performed by adjusting L8, L10 and L11. TP1 permits connection of test equipment to perform these alignment adjustments as well as alignment of the input network. After bandpass filtering the received signal is applied through C29 to the mixer.

(4) Local Oscillator: Local oscillator energy is generated by Q4, an npn transistor operating in a common base Colpitts configuration. Base bias conditions are established by resistive divider R26 and R27. The emitter stabilizing resistor is R28. Circuit tuning is by L2F and L17. L2F is the sixth inductuner section and is ganged to the input and interstage networks. Feedback for oscillation is provided by C48. The oscillators frequency range is from 51.4 to 121.4 mc which is 21.4 mc higher than the received signal. The frequency range of the oscillator is set at the high end by adjustment of L17 and at the low end by adjusting C49. L16 across L2F is preset for the operating frequency range. An output for use with an external frequency counter is coupled through C40, resistive attenuator R31, R32, and R33 and isolation amplifier A3 to the front panel LO OUTPUT jack. Fine tuning of the local oscillator is provided by an AFC or fixed dc voltage which is applied to variable capacitive diode C52 in Q4 collector circuit. A change in the voltage applied to C52 causes a change in the diodes capacitance resulting in correction of the local oscillator frequency. Since the capacitance of the diodes varies as the reciprocal of the square root of the voltage applied, any increase in voltage causes an increase in oscillator frequency because the capacitance of the diode which is connected in the local oscillator tank circuit decreases. The local oscillator output to the mixer is through C34.

(5) Mixer: Like the RF amplifier, the mixer is also connected in a cascode configuration. The signal from the RF amplifier is coupled through C29 to the base of common emitter stage Q3. Local oscillator signal, which is at all times 21.4 mc above the RF signal is applied to the base of Q3 through C34. Bias conditions for Q3 are determined in the base by R18 and R19 and in the emitter by R20. The output of Q3 is coupled to the emitter of Q5, a common base stage by peaking coil L12. After mixing, the IF signals are selected by the double tuned collector circuit which has a center frequency of 21.4 mc. L14 and L15 provide the alignment adjustment. R21 across L14 is to provide a near flat response for the output signal. TP1 is connected to the collector of Q5 through C31. A low impedance detector connected to this point permits a check of the RF response of the tuner. The low impedance effectively shorts the IF tuned circuits thereby permitting observation of the response of the preceding RF amplifier. From the tuner, the 21.4 mc IF output is applied to the 21.4 mc preamplifier.

N. 21.4 MC Preamplifier, A2

(1) Input Network and 21.4 Mc Amplifier: The 21.4 mc IF from the tuner is applied to the base of amplifier Q1 through J1 and C1. A resistive network containing R1, R2, R4 and R5 in the preamplifier input provides isolation between low level IF outputs J2 and J4. J2 provides a 21.4 input to a signal display unit and J4 terminates at this point because its output is not required in a linear receiving system. The 21.4 mc amplifier consists of common emitter stage Q1 and common base stage Q2. Q1 is a gain controlled amplifier whose base is returned through R7 to the normal gain control source in the receiver. After amplification, the signal is applied to the emitter of Q2 through C3. R11 provides damping to prevent any possible regeneration. From Q2 collector, the signal is developed across a double tuned circuit; L1 is resonated by C5 and L2 is resonated by C7 and C8. Both inductors provide an alignment adjustment. From the tuned circuit the signal is attenuated a small amount by R15 and applied to the base of Q3.

(2) 21.4 MC Amplifier and Output Network: Gain controlled amplifier Q3 and common base amplifier Q4 are identical to gain controlled amplifier Q1 and common base amplifier Q2 in the input 21.4 mc amplifier circuit. From Q4 collector, the output is coupled to 21.4 mc IF output J3 via a double tuned circuit. L3 and L4, the primary and secondary windings, provide an alignment adjustment. CR1 and CR2 across L3 provide clipping of any extremely high level signals that may overload succeeding stages of the receiver. The secondary output includes a pi matching network consisting of L4, C15 and C16. From the preamplifier, the IF signal is applied to rear panel 21.4 MC IF OUTPUT connector J10 through isolation amplifier ISA-203 module A7 and to circuits in the receiver for demodulation and further signal processing.

O. Isolation Amplifier, A3

Like the RF amplifier and mixer, Q1 and Q2 are also connected in a cascode configuration. Local oscillator Q4 emitter output is coupled to the base of Q1 through J1 and C1. Bias for Q1 is established in the base circuit by resistive divider R1 and R2 and in the emitter circuit by R3. After amplification, the LO signal is direct coupled to the emitter of Q2, a common base stage. Q2 collector circuit contains a single tuned circuit with L1 providing the alignment adjustment. From the isolation amplifier the signal is applied to the front panel LO OUTPUT connector which is terminated in a 50 ohm load.

P. 90 to 300 MC Tuning Unit, 3

The 90 to 300 mc tuning unit includes tuner SH-222-3, Figure 7-11, preamplifier PR-21.4-3, Figure 7-8 and isolation amplifier ISA-201-2, Figure 7-9. An interconnecting wiring diagram is shown in Figure 7-12. Tuner stages include a cascode RF amplifier, a mixer and a local oscillator. Frequency selective circuit elements, for input signal tuning are ganged by a six section inductuner which is mechanically connected to the front panel coarse tuning control through a gear train assembly. Drive for the tape deck assembly is provided by the gear train for direct frequency indication of the received signal. Preamplifier circuits include two gain controlled amplifier stages, each stage being separated by a double tuned circuit. The isolation amplifier consists of a cascode connected amplifier.

Q. 90 to 300 MC Tuner, A1

(1) Input Network: The received signal from the antenna is applied to the tuner through connector J1. R1 provides a static discharge path to ground for the input coaxial cable. From J1, the input signal is coupled to the RF amplifier through capacitive divider C1 and C2 and a double tuned bandpass filter. Although similar in other respects to the double tuned circuit used in the 30 to 100 mc tuner, note the addition of shunt padding inductors L3 and L5. These inductors are in parallel with the first two inductuner sections, L2A and L2B, to provide control of the required tuning range; circuit coupling is by C5. Inductuner sections L2A and L2B are ganged to other inductuner sections in the interstage network and in the collector circuit of the local oscillator. L1 and L4* provide adjustment of the input tuned network at the high end of the tuning range and C3 and C7 provide adjustment at the low end of the tuning range. After bandpass filtering by the double tuned input network, the received signal is applied through C8 to the RF amplifier stage.

(2) RF Amplifier: The RF amplifier consists of Q1 and Q2 connected in a cascode configuration. The signal from the input network is applied to the base of Q1. Q1 is a gain controlled amplifier operating in a common emitter configuration. Gain control is provided by returning the base circuit through bias resistor R12 to the delayed gain control source in the receiver. Emitter bias is by R8. After amplification, the signal is applied to the emitter of common base amplifier Q2. From the collector of Q2 the signal is developed across a triple tuned interstage network.

Note: * Indicates factory adjustment

(3) Interstage Network: The interstage network contains sections three, four and five of the six section inductuner. The primary, connected to Q2 collector consists of L2C and L8 resonated by variable capacitor C20. Coupling to the fourth section containing L2D and L10 is by C21 and C23. Like the primary, L2D and L10 are resonated by a variable capacitor, C24. Section five consists of L2E and L11 resonated by variable capacitor, C27. Coupling to section five is through C22 and C25. L9, L12 and L19 are shunt padding inductors. R16 provides adequate loading. The interstage network is tuned by L2C, L2D and L2E which are ganged to other inductuner sections in the input network and the local oscillator. The response of the interstage network is observed by connection of test equipment to TP1. L8, L10 and L11 provide alignment adjustments for the high end of the tuning range. Low end tuning range alignment is performed by the adjustment of C20, C24 and C27. After bandpass filtering the received signal is applied through C29 to the mixer.

(4) Local Oscillator: Local oscillator energy is generated by Q4 connected in a grounded base Colpitts configuration. Base bias conditions are established by resistive divider R26 and R27. The emitter stabilizing resistor is R28. Q4 is tuned by L2F and L17, the sixth inductuner section which is ganged to other inductuner sections in the input and interstage networks. Feedback for oscillation is through C44. Oscillator frequency of operation is 21.4 mc higher than the received signal (111.4 to 321.4 mc). The frequency range of the oscillator is set at the high end by adjustment of L17 and at the low end by the adjustment of C40. Shunt inductor L16 is preset for the operating frequency range and RF tracking. For local oscillator frequency monitoring, Q4 emitter circuit is coupled through C49, resistive attenuator R31, R32 and R33 and isolation amplifier A3 to the front panel LO OUTPUT jack. Fine tuning of the local oscillator is provided by an AFC or fixed dc voltage which is applied to the collector of Q4. A change in the collector voltage, caused by the AFC source or by adjustment of the front panel FINE TUNING control results in a correction of the local oscillator frequency. Oscillator output for mixing is through C39 to the base of mixer Q3.

(5) Mixer: Like the RF amplifier, the mixer is also connected in a cascode configuration. The signal from the RF amplifier is coupled through C29 to the base of common emitter stage Q3. Local oscillator signal, which is at all times 21.4 mc above the RF signal is applied to the base of Q3 through C39. Base bias for Q3 is established by R18 and R19, a resistive voltage divider. R20 is the emitter biasing resistor. Q3 collector is coupled to Q5 emitter by peaking coil L13. After mixing, the IF signals are selected by the double tuned circuit in Q5 collector which has a center frequency of 21.4 mc. L14 and L15 provide the alignment adjustment. R21 across L14 is to provide a near flat response for the output signal. TP1 is connected to the collector of Q5 through C31. A low impedance detector connected to this point permits a check of the RF response of the tuner. This low impedance effectively shorts the 21.4 mc IF tuned circuits thereby permitting observation of the response of the preceding RF amplifier. The 21.4 mc IF output of the tuner is applied to the 21.4 mc preamplifier.

R. 21.4 MC Preamplifier, A2

The 21.4 mc preamplifier, used in the 90 to 300 mc tuning unit is identical to the 21.4 mc preamplifier used in the 30 to 100 mc tuning unit, paragraph 3, N.

S. Isolation Amplifier, A3

The isolation amplifier used in the 90 to 300 mc tuning unit is identical to the isolation amplifier used in the 30 to 100 mc tuning unit, paragraph 3, O.

4. Functional Operation of Mechanical Assemblies.

A. General

Mechanical functions are limited to the tuning unit gear train subassemblies. Each gear train serves to mechanically adjust its associated tuner to the desired frequency.

B. Gear Train Subassemblies

The 30 to 100 and 90 to 300 mc gear trains are identical each consisting of a gear train and a tape deck assembly. All bearings are prelubricated and factory sealed eliminating the need for lubrication and servicing. The gear train incorporates a friction clutch design to minimize maintenance and adjustments for tuner dial accuracy. Specifically, if the operator turns the tuning control into the tuner stops, the clutch will slip preventing damage to components and keeping the tuning tape from unwinding on the tape spools. The tuning control crank is secured to the input drive shaft with set screws. This shaft is fed through the front panel and supported by a combination bearing and support housing. Two adjustable shaft collars serve to compress springs located on each side of two shaft mounted friction clutch plates. A clutch disc is centered between the two clutch plates to provide the friction drive to the tuner and tape deck. Torque from the tuning control crank is transferred to the output shaft via this clutch. The clutch disc is located on the output drive shaft and supplies torque directly to the tape deck by a shaft mounted Bevel gear and to the tuners through a pinion gear. The pinion gear extends from the rear of the gear train housing to mesh with the tuner mounted anti-backlash gear. Tape deck drive is taken from a Bevel gear to provide tape tracking to the tuned frequency. The tape feed system is simply a series of guide spools and spring loaded sprocket spools to maintain tape tension and smooth feed from end to end.

SECTION V

MAINTENANCE

1. General.

The purpose of this section of the manual is to provide instructions which, if carefully followed, will result in minimizing operational failures. In addition, should an operational failure occur, information is provided in an organized manner which will assist in effecting speedy and efficient repair. The maintenance instructions have been separated into those tasks which are suitable for performance by the equipment operator and those tasks which are more appropriately assigned to a technician. It is suggested that the operator preventive maintenance operations be performed on a bi-monthly or monthly basis while the minimum performance standards should be checked by a technician on a semiannual or annual basis. How often maintenance operations are performed will depend largely on the extent of equipment usage and on the desired confidence level.

With the increasing use of modular design, as in the receiver, troubleshooting and repair operations have been greatly simplified. If a supply of plug-in modules is assured, the technician simply replaces the suspected module thus confirming the trouble source. The defective module may then be carefully repaired while the receiver is replaced in immediate service. To facilitate this type of maintenance and repair, an inspection of the receiver will reveal that the most critical parts are plug-in and therefore easily replaceable. Both tuning units are plug-in modules, while the IF amplifiers, power supplies, and audio and video circuits are mounted on plug-in printed circuit board subassemblies.

2. Test Equipment.

The electronic test equipment listed in Table 5-1, is required to perform the minimum standards tests on the various modules and to effect efficient troubleshooting and repair.

Table 5-1. Required Test Equipment Characteristics.

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Sweep Generator	SM-2000	Telonic	Sweep Rate: 0.01 to 1000 cps
			RF Attenuation: 0 to 60 db in 1 db steps
			Mkr System: Birdy-by-pass, Ext. marker in, plug-in crystal markers, rectified markers
			Output Impedance: 50 ohms
			Scope Horizontal Output: 15 volts p-to-p
Plug-In Head	L4	Telonic	Frequency Range: 10 to 40 mc
			Sweep Width: 0.1 to 80% of C. F.
Plug-In Head	SH-1	Telonic	Frequency Range: 0.5 to 460 mc
			Sweep Width: 200 kc to 200 mc

Table 5-1. Required Test Equipment Characteristics. (Cont)

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Signal Generator	606A	Hewlett-Packard	Frequency Range: 50 kc to 65 mc in six bands RF Output: 0.1μv to 3 volts Modulation: AM, 0 to 100%, 400 and 1000 cps; external 0 to 100%, dc to 20 kc Output Impedance: 50 ohms
Signal Generator	608D	Hewlett-Packard	Frequency Range: 10 to 420 mc in five bands RF Output: -125 dbm to +4 dbm Modulation: AM, 0 to 100%, 400 and 1000 cps Output Impedance: 50 ohms
Oscilloscope	503	Tektronix	Frequency Range: dc to 450 kc Vertical Sensitivity: 1 mv/cm to 20 volt/cm Sweep Range: 1 microsecond/cm to 5 sec/cm Input Impedance: 1 meg ohm shunted by 47 pf
VTVM	WV-98C	RCA	Range: 0 to 1500 volts, ac and dc, 0 to 1000 meg ohms Input Resistance: 11 meg ohms dc Frequency Range: 30 cps to 3 mc Accuracy: ±3%
Accessories			Cables, connectors, adapters, loads, attenuators, and other fixtures as required by individual procedures

3. Operator Preventive Maintenance.

The equipment operator may assist in maintaining the equipment by performing certain monthly checks, table 5-2, and noting the results. Undesirable trends in the operational checks and measurements should be reported to the appropriate maintenance personnel in order that timely corrective measures may be initiated.

Table 5-2. Monthly Operational Maintenance Checks.

Sequence Number	Item	Procedure
1	Exterior Surfaces	Clean front and rear panels of the receiver. Check all knobs and controls for tightness and signs of improper indexing.
2	Cables and Connectors	Check cables and connectors for proper fit, clearance, and wear.
3	Fuses	Check front panel FUSE F1 and F2 for burn out and tightness.
4	Controls, Dials and Switches	In performing operational checks, observe the mechanical action of each control and switch. They should operate easily and free of binding.
5	POWER Switch	Set to ON. Observe that: a. Selected tuning unit dial lamp lights b. TUNER selector operates to light dial lamp on opposite tuning unit c. TUNING meter stays at or near zero when IF BANDWIDTH selector is placed in any position in which the IF amplifier is installed d. With MODE selector in the AM/AGC position, noise output is achieved at PHONE output which can be varied by VOLUME control e. Noise level changes when IF BANDWIDTH selector is placed in different position
6	RF GAIN & MODE Selector	Set the RF GAIN control maximum clockwise. Place the MODE selector in AM/MAN position. Vary the RF GAIN control to its maximum counterclockwise position and observe that the SIGNAL STRENGTH meter goes from zero to full scale condition.
7	Operation	Refer to Section III, paragraph 4 and operate the receiver in the normal manner with all antennas connected. Check for normal reception of signals which may be present in the area. Operate all controls and ancillary equipment, reporting irregularities to appropriate maintenance personnel.

4. Receiver.

Paragraph 3 of this section outlines certain duties of the equipment operator for the purpose of noting trends of receiver performance that may ultimately require corrective maintenance. The following paragraphs contain information which will assist the technician in performing further preventive maintenance operations as well as correcting deficiencies noted in the performance of the receiver.

A. Preventive Maintenance

At semiannual intervals, or less often in the event of reduced equipment usage, each tuning unit and receiver should be thoroughly cleaned and inspected.

(1) Tuning Units: To remove the tuning units, loosen the front panel thumbscrews and pull the unit forward. Use a soft brush to remove dust and other foreign material from the tuning units and the inside of the receiver. Dry compressed air at a pressure not exceeding 60 psi may also be used. Look for bent or broken pins, loose connectors, frayed wiring or other signs of deterioration.

(2) Receiver: Remove the cables connected to the rear apron of the receiver and the power cord. Remove the fasteners which retain the receiver in its mounting. Remove the covers from the receiver. Clean the inside of the receiver using a soft brush and compressed air. Do not remove the plug-in printed circuit modules for cleaning unless they are exceptionally dirty. Inspect the receiver chassis, wiring, and connectors. Make sure each module is firmly seated in its receptacle.

(3) Overall Maintenance: Check all connections at the rear of the receiver for tightness and frayed or worn insulation on the cables. See that all mounting hardware is complete and adequately tightened. Check all external surfaces for damage and signs of corrosion applying paint where applicable after cleaning. Inspect all operating line fuses and spare fuses for signs of corrosion and correct value.

(4) D.C. Voltages: The DC voltage output of the power supply should be measured and, where applicable, adjusted in accordance with Table 5-3.

Table 5-3. DC Voltages and Adjustments.

Measure At	Voltage	Adjustment
XA6A3	-12 VDC	R5
XA6B15	+12 VDC	R14
XA6A14	+24 VDC	None

B. Troubleshooting

Visual inspection and operational tests provide a systematic method of localizing a fault to a stage or module. The trouble symptoms listed in the Troubleshooting Chart, Table 5-4, will assist in fault localization. The minimum performance standards will assist in further isolation of a circuit or part that is causing difficulty.

C. Minimum Performance Standards

When faulty receiver operation has been traced to the main chassis of the receiver, the following minimum performance standards charts will assist in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate receiver performance, check power supplies in accordance with paragraph 4.A.(4).

Table 5-4. Receiver Troubleshooting Chart.

Sequence	Symptom	Cause	Remedy
1	Tuning unit dial lamp not lit	No power input	Check main circuit breaker
		POWER switch OFF	Place ON
		Open line fuse	Replace F1, F2
		Defective lamps	Replace DS1
		Defective POWER switch	Replace S1
		Blown fuse in +24 vdc power supply	Replace F2 on A6
2	Tuning unit dial lamps do not light as TUNER selector switch is rotated	Defective dial lamp	Replace DS1
		Defective TUNER selector switch	Check switch S5 and leads, repair if broken
		No 24 vdc power	Replace fuse F2 on A6 and check supply output voltage
3	No signals received in any MODE switch position with antennas properly connected	Defective antenna input cables or connectors	Check and repair cables between antennas and inputs to receiver
		Defective interconnecting cables	Check all cables on tuning units and for complete insertion of tuning unit in receiver
		No -12 vdc voltage	Replace F1 on A6
		No +12 vdc voltage	Replace F3 on A6
4	No manual gain control, MODE switch in AM/MAN or CW	Defective RF GAIN potentiometer	Check leads to R1. Repair or replace as required.
		Defective MODE selector switch	Check leads to switch S3 and switch assembly. Repair or replace as required.
5	No AGC, SIGNAL STRENGTH meter does not deflect FM or AM/AGC positions	Defective AGC circuit	Inspect AGC module A5. Replace module with known good board, repair defect.
		Defective SIGNAL STRENGTH meter	Check leads to M1. Replace meter if defective.
6	No beat note in CW mode with signal present	Defective BFO circuit on 20 or 75 kc IF bandwidth module	Inspect BFO circuit on A2 or A3. Replace with known good board, repair defect.
7	No indication on TUNING meter, but FM audio and video output normal	Defective TUNING meter	Check leads to M2. Replace meter if defective.

Testing of the module's performance is achieved by inserting signals of suitable amplitude, and modulation where applicable, and observing the results either with the receiver's meters, an external meter, or an external oscilloscope. Performance standards for the various modules are given in tables 5-5 through 5-7.

Table 5-5. 20 KC IF Amplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect 606A signal generator to J2A2 on the receiver main chassis. Set the modulation to 50% at 400 cps. Set the output level of the signal generator to 750μv. Set the generator frequency to 21.4 mc using the generator frequency calibrator. NOTE: Connect signal to J5A2 and place TUNER selector in LEFT position to check wiring and selector switch, S5.	Place TUNER selector in RIGHT position and IF BANDWIDTH in position number 1. Place MODE in AM/MAN. Check output with scope at XA5B2.	The scope should display a sine wave of 2 volts peak-to-peak minimum at a frequency of 400 cps. Adjust the output level of the signal generator until the desired amplitude is achieved. The output of the signal generator should be less than 1.3 mv
2	Same as Step 1	Reduce signal generator output level about 20 db and note the indication of the TUNING meter	The TUNING meter should indicate a zero tuning condition within about two divisions if the signal generator is at 21.4 mc. Shift the signal generator frequency above and below 21.4 mc and the TUNING meter should indicate the relative frequency of the signal. The TUNING meter swing above and below the zero tuning condition should be equal within about two divisions.

Table 5-6. 75 KC IF Amplifier Minimum Performance Specifications.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect 606A signal generator to J2A2 on the receiver main chassis. Set the modulation to 50% at 400 cps. Set the output level of the signal generator to 1000μv. Set the generator frequency to 21.4	Place TUNER selector in RIGHT position and IF BANDWIDTH in position number 2. Place MODE in AM/MAN. Check output with scope at XA5B2.	The scope should display a sine wave of 2 volts peak-to-peak minimum at a frequency of 400 cps. Adjust the output level of the signal generator until the desired amplitude is achieved. The output level

Table 5-6. 75 KC IF Amplifier Minimum Performance Standards. (Cont)

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	mc using the generator frequency calibrator. NOTE: Connect signal to J5A2 and place TUNER selector in LEFT position to check wiring and selector switch, S5.		of the signal generator should be less than 2.0 mv.
2	Same as Step 1	Reduce the output level of the signal generator about 20 db and note the indication of the TUNING meter.	The TUNING meter should indicate a zero tuning condition within about two divisions if the signal is at 21.4 mc. Shift the signal generator frequency above and below 21.4 mc and the TUNING meter should indicate the relative frequency of the signal. The TUNING meter swing above and below the zero tuning condition should be equal within about two divisions.

Table 5-7. AFC/AGC/Squelch/Audio Amplifier Circuit Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 606A signal generator to J2A2 on the receiver main chassis. Set the generator output frequency accurately to 21.4 mc using the generator frequency calibrator. Modulate the generator 50% at 400 cps. Set the output level of the generator at 2.0 mv.	Place TUNER selector in RIGHT position and the IF BANDWIDTH in position number 2. Place MODE selector in AM/MAN position. Adjust the output level of the signal generator to achieve a 1.6 volt peak-to-peak display at 400 cps.	Connect scope to XA5B11. The output from the video amplifier should be 7.0 volts peak-to-peak minimum with a 600 Ω load connected to J12 on rear of receiver. Connect the 600Ω load to J11 and check output at XA5B12. Adjust R31 if necessary to achieve desired output levels.
2	Same as Step 1.	Same as Step 1. Connect 600 Ω load between terminals 1 and 2 of TB1.	Check output across load with scope. Output should be 7.0 volts peak-to-peak. Adjust R48 if necessary to achieve desired output level.
3	Same as Step 1.	Same as Step 1. Insert headphones into PHONE jack J3.	Adjust VOLUME control to convenient level. Tone should be clear and free of distortion.

Table 5-7. AFC/AGC/Squelch/Audio Amplifier Circuit Minimum Performance Standards. (Cont)

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
4	Same as Step 1.	Place TUNER selector in the RIGHT position and IF BANDWIDTH in position number 2. Place MODE selector in AM/AGC position. TUNING meter should indicate zero tuning.	Adjust the output level of the signal generator until the SIGNAL STRENGTH meter just begins to indicate. The generator output should be less than 2.0 mv. Place MODE selector in AM/MAN position and rotate RF GAIN control to maximum CCW position. SIGNAL STRENGTH meter should indicate full-scale.
5	Same as Step 1.	Place TUNER selector in RIGHT position and IF BANDWIDTH in position number 2. Place MODE selector in FM position. TUNING meter should indicate zero tuning. Connect DC VTVM to XA5A1 and place AFC selector in ON position.	The voltage indicated on the meter should be about -0.4 vdc. Shift the frequency of the signal about 21.4 mc and the DC voltage should swing about -0.4 vdc and the TUNING meter should indicate. Connect the DC VTVM to XA5A5 and the indication should be about +12 vdc. Shift the frequency of the signal about 21.4 mc and the DC voltage should swing about +12 vdc in the same manner as before.
6	Insert phones into PHONE jack J3 and insert tuning unit of any type in right hand position	Place TUNER selector in RIGHT position and IF BANDWIDTH in position number 2. Place MODE selector in FM position. Rotate SQUELCH control to OFF position. Rotate VOLUME control to maximum clockwise position.	Audible noise should be heard in phones. Rotate SQUELCH control clockwise until noise is eliminated. Rotate SQUELCH control to OFF position. Time delay in squelch circuit will activate and noise level will return to phones in about five seconds. If time delay is unsatisfactory, adjust R30 until suitable delay is achieved.

D. Voltage and Resistance Measurements (Tables 5-8 through 5-13)

After a fault has been localized to a particular circuit or module with the assistance of the preceding paragraphs of this section of the manual, voltage and resistance measurements on the suspected components should reveal the faulty part. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. In addition, a plug-in printed circuit card extender was used in performing all measurements for the purpose of extending the printed circuit board above the confines of the receiver, thus allowing access to the transistors. The front panel control and switch positions are listed with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and one set for meters utilizing a positive ground lead. The RCA meter referenced above has a negative ground lead when measuring resistance. With each entry of either voltage or resistance, the meter range used is included within parentheses.

Table 5-8. Receiver Main Chassis Voltage and Resistance Chart.

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 2
3. AFC selector ON
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	12.0 (50 V)	3.1K Ω (R x 1 K)	800 Ω (R x 100)	13.0 (50 V)	10 K Ω R x 1 K)	90 K Ω (R x 10 K)	24.8 (50 v)	10 M Ω (R x 1 Meg)	10 K Ω (R x 1 K)
Q2	0 V	0 Ω	0 Ω	0.7 (1.5 V)	10 Ω (R x 1)	85 K Ω (R x 10 K)	12.8 (50 V)	9.3 Meg Ω (R x 1 Meg)	10 K Ω (R x 1 K)
Q3	24.8 (50 V)	6.3 K Ω (R x 1 K)	1.08 K Ω (R x 100)	25.2 (50 V)	62 K Ω (R x 10 K)	135 K Ω (R x 10 K)	41 (150 V)	8 Meg Ω (R x 1 Meg)	12 K Ω (R x 1 K)

Table 5-9. Power Supply Voltage and Resistance Chart, Type PS-211-1.

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 2
3. AFC selector ON
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	0.68 (1.5 V)	10.5 Ω (R x 1)	80 K Ω (R x 10 K)	1.3 (5 V)	9.5 Meg Ω (R x 1 Meg)	7.5 K Ω (R x 1 K)	12.0 (50 V)	10 Meg Ω (R x 1 Meg)	10 K Ω (R x 1 K)
Q2	-5.6 (15 V)	1.5 K Ω (R x 100)	1.1 K Ω (R x 100)	-4.9 (15 V)	1.3 K Ω (R x 100)	1.8 K Ω (R x 100)	1.3 (5 V)	9.5 Meg Ω (R x 1 Meg)	7.5 K Ω (R x 1 K)
Q3	24.9 (50 V)	60 K Ω (R x 10 K)	170 K Ω (R x 100 K)	25.2 V (50 V)	6.0 Meg Ω (R x 1 Meg)	85 K Ω (R x 10 K)	41.0 V (150 V)	1.0 Meg Ω (R x 100 K)	83 K Ω (R x 10 K)
Q4	12.8 V (50 V)	9.5 K Ω (R x 1 K)	83 K Ω (R x 10 K)	13.2 V (50 V)	9.0 Meg Ω (R x 1 Meg)	8.0 K Ω (R x 1 K)	24.2 V (50 V)	10.0 Meg Ω (R x 1 Meg)	10 K Ω (R x 1 K)
Q5	6.8 V (15 V)	4.5 K Ω (R x 1 K)	7.8 K Ω (R x 1 K)	7.3 V (15 V)	2.5 K Ω (R x 100)	2.0 K Ω (R x 100)	13.2 V (50 V)	9.0 Meg Ω (R x 1 Meg)	8.0 K Ω (R x 1 K)

Table 5-10. AFC/AGC/SQUELCH/AUDIO Amplifier Voltage and Resistance Chart, Type AASA-201.

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 2
3. AFC selector ON
4. RF GAIN maximum CW
5. MODE selector AM/AGC
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.5 V (5 V)	8.9 KΩ (R x 1 K)	98 KΩ (R x 10 K)	-0.95 V (1.5 V)	10.3 KΩ (R x 1 K)	95 KΩ (R x 10 K)	12.0 V (50 V)	4.0 KΩ (R x 1 K)	800 Ω (R x 100)
Q2	-2.1 V (5 V)	3.7 KΩ (R x 1 K)	3.4 KΩ (R x 1 K)	-1.5 V (5 V)	8.9 KΩ (R x 1 K)	98 KΩ (R x 10 K)	12.0 V (50 V)	4.0 KΩ (R x 1 K)	800 Ω (R x 100)
Q3	12.0 V (50 V)	10 KΩ (R x 1 K)	7.6 KΩ (R x 1 K)	12.9 V (50 V)	10.0 KΩ (R x 1 K)	4.7 KΩ (R x 1 K)	24.0 V (50 V)	5.8 KΩ (R x 1 K)	6.0 KΩ (R x 1 K0
Q4	-1.3 V (5 V)	11.0 KΩ (R x 1 K)	7.4 kΩ (R x 1 K)	-0.84 V (1.5 V)	7.8 KΩ (R x 1 K)	7.6 KΩ (R x 1 K)	12.0 V (50 V)	4.0 KΩ (R x 1 K)	800 Ω (R x 100)
Q5	-1.9 V (5 V)	∞ (R x 1 Meg)	5.6 KΩ (R x 1 K)	-1.3 V (5 V)	11.0 KΩ (R x 1 K)	7.4 KΩ (R x 1 K)	12.0 V (50 V)	4.0 KΩ (R x 1 K)	800 Ω (R x 100)
Q6	-8.5 V (15 V)	4.6 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)	-8.0 V (15 V)	9.0 KΩ (R x 1 K)	12.0 KΩ (R x 1 K)	14.5 V (50 V)	13.0 KΩ (R x 1 K)	9.3 KΩ (R x 1 K)
Q7	GND	GND	GND	0.6 V (1.5 V)	5.5 KΩ (R x 1 K)	57.0 KΩ (R x 10 K)	0.1 V (0.5 V)	65 KΩ (R x 10 K)	45 KΩ (R x 10 K)
Q8	-0.05 V (0.5 V)	14 KΩ (R x 1 K)	49.0 KΩ (R x 10 K)	0.1 V (0.5 V)	18.0 KΩ (R x 1 K)	150 KΩ (R x 10 K)	24.0 V (50 V)	5.8 KΩ (R x 1 K)	6.0 KΩ (R x 1 K)
Q9	-0.35 V (0.5 V)	12.0 KΩ (R x 1 K)	440 Ω (R x 100)	-0.05 V (0.5 V)	14.0 KΩ (R x 1 K)	49.0 KΩ (R x 10 K)	24.0 V (50 V)	5.8 KΩ (R x 1 K)	6.0 KΩ (R x 1 K)
Q10	0.0 V (0.5 V)	2.1 KΩ (R x 100)	1.8 KΩ (R x 100)	-0.05 V (0.5 V)	7.1 KΩ (R x 1 K)	65.0 MegΩ (R x 1 Meg)	12.0 V (50 V)	4.0 KΩ (R x 1 K)	800 Ω (R x 100)
Q11	GND	GND	GND	0.65 V (1.5 V)	5.7 KΩ (R x 1 K)	55.0 KΩ (R x 10 K)	0.15 V (0.5)	12.5 KΩ (R x 1 K)	14.2 KΩ (R x 1 K)
Q12	GND	GND	GND	0.15 V (0.5 V)	5.7 KΩ (R x 1 K)	41.0 KΩ (R x 10 K)	24.0 V (50 V)	15.0 KΩ (R x 1 K)	15.5 KΩ (R x 1 K)
Q13	23.5 V (50 V)	95.0 KΩ (R x 10 K)	63.0 KΩ (R x 10 K)	24.0 V (50 V)	17.0 KΩ (R x 1 K)	59.0 KΩ (R x 10 K)	24.0 V (50 V)	5.8 KΩ (R x 1 K)	6.0 KΩ (R x 1 K)
Q14	-12.0 V (50 V)	1.2 KΩ (R x 100)	1.0 KΩ (R x 100)	-11.4 V (50 V)	4.0 KΩ (R x 1 K)	3.8 KΩ (R x 1 K)	-4.4 V (15 V	6.0 KΩ (R x 1 K)	5.5 KΩ (R x 1 K)
Q15	-11.3 V (50 V)	1.25 KΩ (R x 100)	1.05 KΩ (R x 100)	-10.6 V (15 V)	8.0 KΩ (R x 1 K)	∞ (R x 1 Meg)	3.0 V (5.0 V)	3.6 KΩ (R x 1 K)	3.4 KΩ (R x 1 K)
Q16	3.7 V (15 V)	2.7 KΩ (R x 1 K)	2.6 KΩ (R x 1 K)	4.4 V (15 V)	4.4 KΩ (R x 1 K)	4.4 KΩ (R x 1 K)	12.0 V (50 V)	3.2 KΩ (R x 1 K)	800 Ω (R x 100)
Q17	3.7 V (15 V)	2.7 KΩ (R x 1 K)	2.6 KΩ (R x 1 K)	4.4 V (15 V)	4.4 KΩ (R x 1 K)	4.4 KΩ (R x 1 K)	12.0 V (50 V)	3.2 KΩ (R x 1 K)	800 Ω (R x 100)
Q18	11.8 V (50 V)	6.0 MegΩ (R x 1 Meg)	6.0 MegΩ (R x 1 Meg)	12.2 V (50 V)	49.0 KΩ (R x 10 K)	46.0 KΩ (R x 10 K)	22.5 V (50 V)	76.0 KΩ (R x 10 K)	62.0 KΩ (R x 10 K)
Q19	-3.5 V (15 V)	2.5 KΩ (R x 1 K)	2.4 KΩ (R x 1 K)	-2.8 V (5 V)	5.9 KΩ (R x 1 K)	10.3 KΩ (R x 1 K)	12.0 V (50 V)	3.1 KΩ (R x 1 K)	800 Ω (R x 100)
Q20	-3.5 V (5 V)	2.1 KΩ (R x 100)	1.0 KΩ (R x 100)	-2.8 V (5 V)	5.7 KΩ (R x 1 K)	10.0 KΩ (R x 1 K)	12.0 V (50 V)	3.1 KΩ (R x 1 K)	800 Ω (R x 100)

Table 5-11. 20 KC IF Amplifier Voltage and Resistance Chart, Type IF-220-20.

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 1
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Q6 measurements performed with MODE selector in CW position
11. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	5.6 V (15 V)	10.0 KΩ (R x 1 K)	9.1 KΩ (R x 1 K)	5.4 K (15 V)	8.9 KΩ (R x 1 K)	12.0 Meg Ω (R x 1 Meg)	9.8 V (15 V)	3.5 KΩ (R x 1 K)	3.1 KΩ (R x 1 K)
Q2	-5.6 V (15 V)	6.8 KΩ (R x 1 K)	6.8 KΩ (R x 1 K)	-5.2 V (15 V)	5.6 KΩ (R x 1 K)	5.6 KΩ (R x 1 K)	-0.61 V (1.5 V)	1000 Meg Ω (R x 1 Meg)	94.0 Ω (R x 10)
Q3	-0.61 V (1.5 V)	1000 Meg Ω (R x 1 Meg)	94.0 Ω (R x 10)	GND	GND	GND	9.9 V (15 V)	3.6 KΩ (R x 1 K)	80.0 Ω (R x 10)
Q4	-5.9 V (15 V)	4.1 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)	-5.3 V (15 V)	5.6 KΩ (R x 1 K)	5.6 KΩ (R x 1 K)	-0.65 V (1.5 V)	1000 Meg Ω (R x 1 Meg)	91.0 Ω (R x 10)
Q5	-0.65 V (1.5 V)	1000 Meg Ω (R x 1 Meg)	91.0 Ω (R x 10)	GND	GND	GND	10.0 V (15 V)	3.4 KΩ (R x 1 K)	3.1 KΩ (R x 1 K)
Q6	5.3 V (15 V)	10.0 KΩ (R x 1 K)	9.1 KΩ (R x 1 K)	5.2 V (15 V)	6.3 KΩ (R x 1 K)	3.0 KΩ (R x 1 K)	11.5 V (50 V)	500 Meg Ω (R x 1 Meg)	9.6 KΩ (R x 1 K)
Q7	-1.0 V (1.5 V)	6.7 KΩ (R x 1 K)	7.2 KΩ (R x 1 K)	-0.34 V (0.5 V)	9.0 KΩ (R x 1 K)	17.0 KΩ (R x 1 K)	10.0 V (15 V)	3.5 KΩ (R x 1 K)	3.2 KΩ (R x 1 K)
Q8	-2.6 V (5 V)	4.1 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)	-1.9 V (5 V)	3.4 KΩ (R x 1 K)	3.4 KΩ (R x 1 K)	-0.68 V (1.5 V)	150 Meg Ω (R x 1 Meg)	92.0 Ω (R x 10)
Q9	-0.68 V (1.5 V)	150 Meg Ω (R x 1 Meg)	92.0 Ω (R x 10)	GND	GND	GND	4.9 V (15 V)	4.8 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)
Q10	-0.7 V (1.5 V)	12.0 KΩ (R x 1 K)	10.5 KΩ (R x 1 K)	0.13 V (0.5 V)	8.5 KΩ (R x 1 K)	83.0 KΩ (R x 10 K)	11.1 V (15 V)	3.2 KΩ (R x 1 K)	3.0 KΩ (R x 1 K)

E. Repairs

When a fault has been localized to a component part, it is usually necessary to unsolder and remove the part in order to effect repair. The removal of parts on the main chassis of the receiver may be achieved using normal techniques. Replacing parts mounted on printed circuit boards, however, involves special techniques to avoid damage to the printed circuit and surrounding components. The following instructions, although intended primarily for the replacement of parts on printed circuit boards, are applicable to parts replacement in any location.

(1) Soldering Irons: Do not use an iron any larger than necessary to unsolder the part in question. An iron rated at 47 1/2 watts is adequate for all parts removal on printed circuit boards and for the removal of many parts located on the receiver main chassis and tuning unit assemblies. As a general rule, only parts having one terminal soldered to the chassis will require the use of a larger soldering iron.

(2) Solder Removal: The solder should be removed from the terminal in question before attempting to loosen the part mechanically. The most commonly used method of solder removal is the application of a hot iron and wire braid to the joint in question. If a small amount of resin flux has been applied to the braid beforehand, "wetting" action will cause the solder from the junction to flow into the wire braid, thus removing the solder from the junction.

Table 5-12. 75 KC IF Amplifier Voltage and Resistance Chart, Type IF-221-75.

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Q6 measurements performed with MODE selector in CW position
11. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	5.2 V (15 V)	10.0 KΩ (R x 1 K)	9.7 KΩ (R x 1 K)	5.4 V (15 V)	8.7 KΩ (R x 1 K)	13.0 MegΩ (R x 1 Meg)	9.8 V (15 V)	3.6 KΩ (R x 1 K)	3.4 KΩ (R x 1K)
Q2	-5.5 V (15 V)	7.0 KΩ (R x 1 K)	6.8 KΩ (R x 1 K)	-5.1 V (15 V)	5.7 KΩ (R x 1 K)	5.7 KΩ (R x 1 K)	-0.58 V (1.5 V)	∞ (R x 1 Meg	89.0 Ω (R x 10)
Q3	-0.58 V (1.5 V)	∞ (R x 1 Meg)	89.0 Ω (R x 10)	GND	GND	GND	9.9 V (15 V)	3.6 KΩ (R x 1 K)	80.0Ω (R x 10)
Q4	-6.1 V (15 V)	4.2 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)	-5.4 V (15 V)	5.7 KΩ (R x 1 K)	5.7 KΩ (R x 1 K)	-0.67 V (1.5 V)	∞ (R x 1 Meg)	94.0Ω (R x 10)
Q5	-0.67V (1.5 V)	∞ (R x 1 Meg)	94.0Ω (R x 10)	GND	GND	GND	10.0 V (15 V)	3.5 KΩ (R x 1 K)	3.2 KΩ (R x 1 K)
Q6	7.4 V (15 V)	10.2 KΩ (R x 1 K)	9.7 KΩ (R x 1 K)	7.3 V (15 V)	61.5 KΩ (R x 10 K)	93.0Ω (R x 10)	11.4 V (50 V)	500 MegΩ (R x 1 Meg)	10.0 KΩ (R x 1 K)
Q7	-0.94 V (1.5 V)	6.9 KΩ (R x 1 K)	7.7 KΩ (R x 1 K)	-0.3 V (0.5 V)	9.0 KΩ (R x 1 K)	18.0 KΩ (R x 1 K)	10.0 V (15 V)	3.5 KΩ (R x 1 K)	3.2 KΩ (R x 1 K)
Q8	-2.4 V (5 V)	4.2 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)	-1.75 V (5 V)	3.5 KΩ (R x 1 K)	3.5 KΩ (R x 1 K)	-0.7 V (1.5 V)	500 MegΩ (R x 1 Meg)	91.0Ω (R x 10)
Q9	-0.7 V (1.5 V)	500 Meg Ω (R x 1 Meg)	91.0Ω (R x 10)	GND	GND	GND	4.4 V (15 V)	4.9 KΩ (R x 1 K)	4.1 KΩ (R x 1 K)
Q10	-.05 V (1.5 V)	12.0 KΩ (R x 1 K)	8.0 KΩ (R x 1 K)	0.22 V (0.5 V)	8.5 KΩ (R x 1 K)	5.9 KΩ (R x 1 K)	11.1 V (50 V)	3.2 KΩ (R x 1 K)	750Ω (R x 100)

(3) Component Replacement: After the solder has been removed from the joint, the component should be loosened. If the solder has been adequately removed, loosening the component may be achieved with a small soldering aid or a small pair of needle-nose pliers. Remove the component and replace it with the new part. Use only enough heat and solder to effect a good electrical connection. The use of excessive solder may cause deterioration of circuit performance especially in the more critical tuner circuits.

(4) Realignment: Parts may be replaced in the majority of circuits in this equipment without the necessity for realignment. In cases where it appears necessary, refer to the following alignment instructions for the necessary procedures.

Table 5-13. IF Isolation Amlifier Voltage and Resistance Chart, Type ISA-203

NOTES:
1. No tuning unit installed
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Cables at J1 and J2 connected
11. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-8.5 V (15 V)	3.0 K Ω (R x 1 K)	1.75 K Ω (R x 100)	-7.8 V (15 V)	3.5 K Ω (R x 1 K)	3.7 K Ω (R x 1 K)	-1.7 V (5 V)	460 Ω (R x 100)	450 Ω (R x 100)

F. Alignment

The alignment of the receiver portion of this equipment is limited to the IF amplifiers, the isolation IF amplifier being fixed tuned. The receiver should be placed on a workbench adjacent to the test equipment being used for alignment facilitating the use of short cables and test leads. Remove the bottom cover and the top access cover from the receiver. Use printed circuit card extenders to position the module to be aligned above the receiver main chassis. Preset the front panel switches and controls in accordance with the instructions of the individual alignment procedure.

(1) IF-220-20: Connect the test equipment as illustrated in Figure 5-1.

a. Adjust the vertical sensitivity of the scope to 1.0 volts/cm. Adjust the horizontal sensitivity as required to achieve full scale deflection.

b. Adjust the sweep generator output frequency to 21.4 mc. Adjust the sweep rate of the generator to a frequency comfortably above the flicker rate. Adjust the output level of the sweep generator as required to achieve a scope deflection of about 5 centimeters.

c. Calibrate the signal generator frequency at 21.4 mc and adjust its output amplitude as required to achieve a small marker "birdie" on the response. Adjust the external marker input control on the sweep generator if necessary. Adjust the marker frequency response, if necessary, to prevent the marker from obscuring the response.

d. Adjust L3 and L5 for maximum symmetrical response centered around 21.4 mc. This IF amplifier uses a crystal filter to establish the bandpass of the amplifier and, consequently, L3 and L5 will affect primarily the amplitude of the response and will have only a minor effect on the shape of the response. The AM response of the IF-220-20 IF amplifier is illustrated in Figure 5-2.

e. Maintain the test equipment setup and control settings established to achieve the 2.0 volt AM response.

f. Change the connection from the AM to the FM output terminal at XA2B10 as illustrated in Figure 5-1.

g. Adjust L8, L9, and L10 for the response indicated in Figure 5-3.

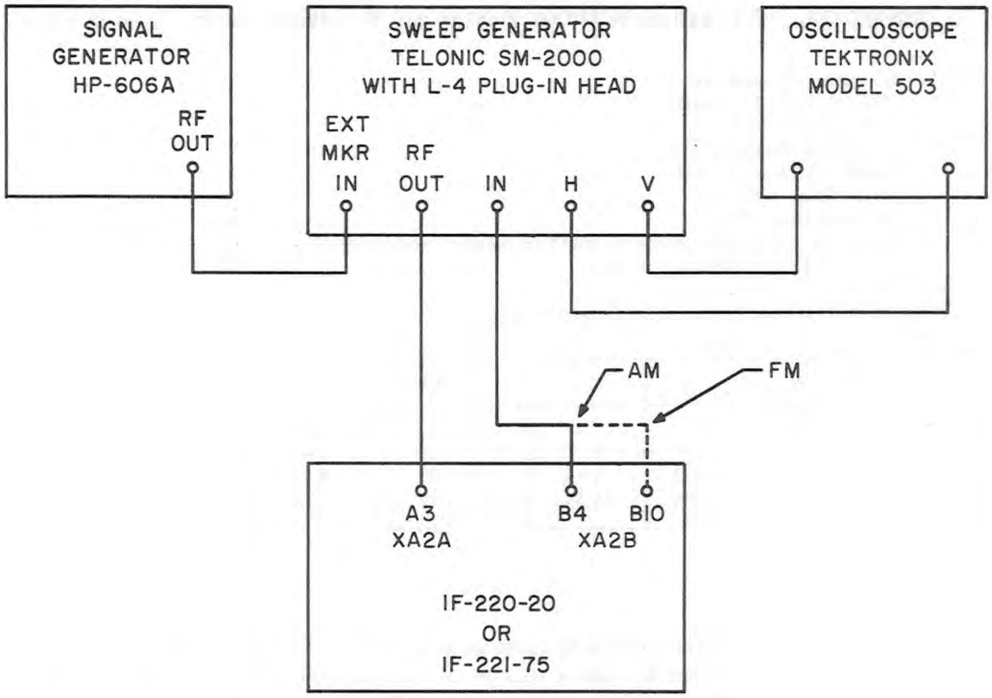


Figure 5-1. IF Amplifier Test Set-Up

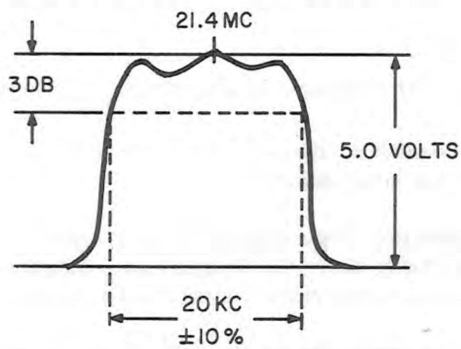


Figure 5-2. IF-220-20 AM Response

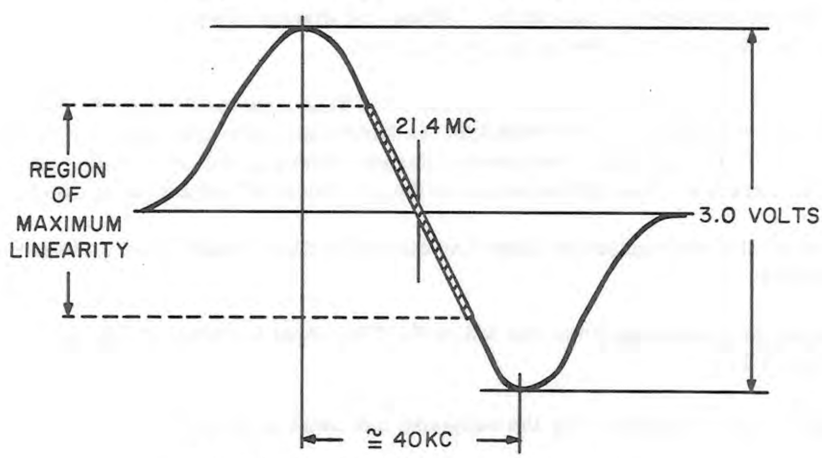


Figure 5-3. IF-220-20 FM Response

(2) IF-221-75: The alignment procedures for the 75 kc IF amplifier are the same as those given for the 20 kc IF amplifier above with the exception of the following items.

a. The AM 3 db bandwidth is 75 kc +20% -0%.

b. The FM peak-to-peak bandwidth is about 150 kc.

c. The FM peak-to-peak output voltage is about 4.0 volts peak-to-peak.

5. Tuning Unit Mechanical Adjustments.

A. General

The tuning units used in this receiver are ruggedly designed and manufactured and should require little, if any, mechanical adjustment. Periodically, mounting and set screws should be checked for tightness to avoid deterioration of performance, especially when the receiver is operated in an environment which results in the application of vibrations or shocks. Other than these operations, mechanical maintenance is limited to clutch adjustment to eliminate slippage, frequency tape adjustments, and gear train parts replacement.

B. Friction Clutch Adjustments

Friction clutch adjustments should be made on an as required basis. Adjustment of the friction clutch should be made if the tuning control crank turns excessively hard or if clutch slippage is evident while tuning.

(1) Refer to Figure 5-4 and locate the clutch adjustment points on the gear train.

(2) Loosen the two set screws in both retaining collars.

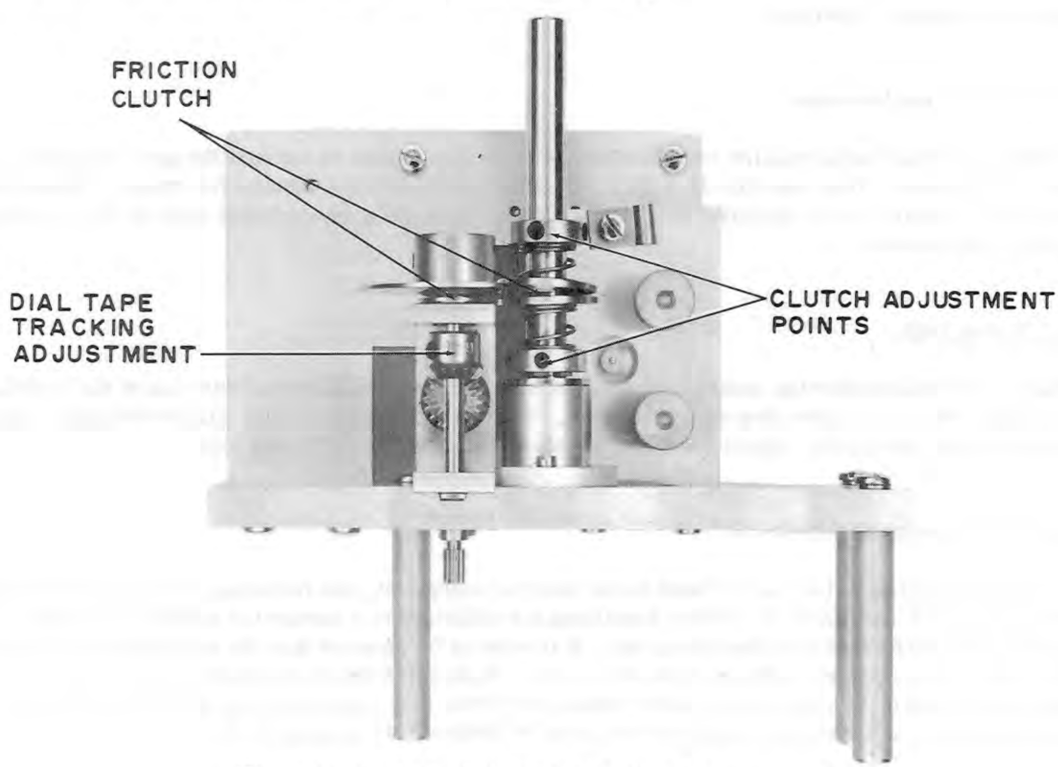


Figure 5-4. Typical Gear Train Clutch Adjustment Points.

(3) Move the collars closer to the clutch plates (increased spring compression) for increasing torque and reducing clutch slippage. Reduce spring compression by moving the two retaining collars away from the clutch plates for easier tuning. The distance from the retaining collar to the clutch plate on each end of the shaft should be the same.

(4) Tighten the set screws in each retaining collar.

(5) Rotate the tuning crank throughout the tuning range and note performance. Repeat steps 1 through 4, if required.

C. Dial Tape Adjustments

In the event that the tuning tape appears to have a large error, or if the gear train has been replaced, the tuning dial tape will require adjustment. This may be achieved by using the following procedures.

(1) Rotate the turn crank clockwise until the motion of the tuning tape is restrained by the inductuner stops at or near the last mark on the tape.

(2) Loosen the two allen head set screws securing the large gear to the inductuner shaft. Care should be exercised to assure that the large gear on the inductuner shaft does not disengage from the small drive gear on the gear train or the tension in the antibacklash springs may be released.

(3) While preventing movement of the inductuner from its stop with a screwdriver or other tool, rotate the front panel tuning crank until the lowest mark on the tuning tape lines up with the hairline.

(4) Tighten the allen head set screws on the large gear.

(5) Rotate the tuning crank over the entire tuning range and note that the tuning action is smooth and free of any signs of binding.

D. Gear Train Parts Replacement

In the event that gear train parts require replacement, it is usually easier to replace the gear train and place the tuning unit back in service. This permits the gear train to be returned to the factory for repair. Should this not be feasible however, Figure 5-5 is provided for the purpose of illustrating an exploded view of the gear train and facilitating parts replacement.

6. <u>30 to 100 MC Tuning Unit.</u>

The maintenance and troubleshooting sections of the receiver portion of this manual will assist the technician in the isolation of faults which lie in the plug-in tuning units. This section of the manual will accordingly deal with minimum performance standards, repair, and alignment of the 30 to 100 mc tuning unit.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts should be of assistance in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, it is wise to be assured that the receiver's power supplies are functioning normally in accordance with paragraph 4.A.(4). Figure 5-6 shows an illustration of a power extender cable which must be used to apply power to the tuning unit while it is removed from the receiver housing. The performance standards for the various modules are given in Tables 5-14 through 5-16.

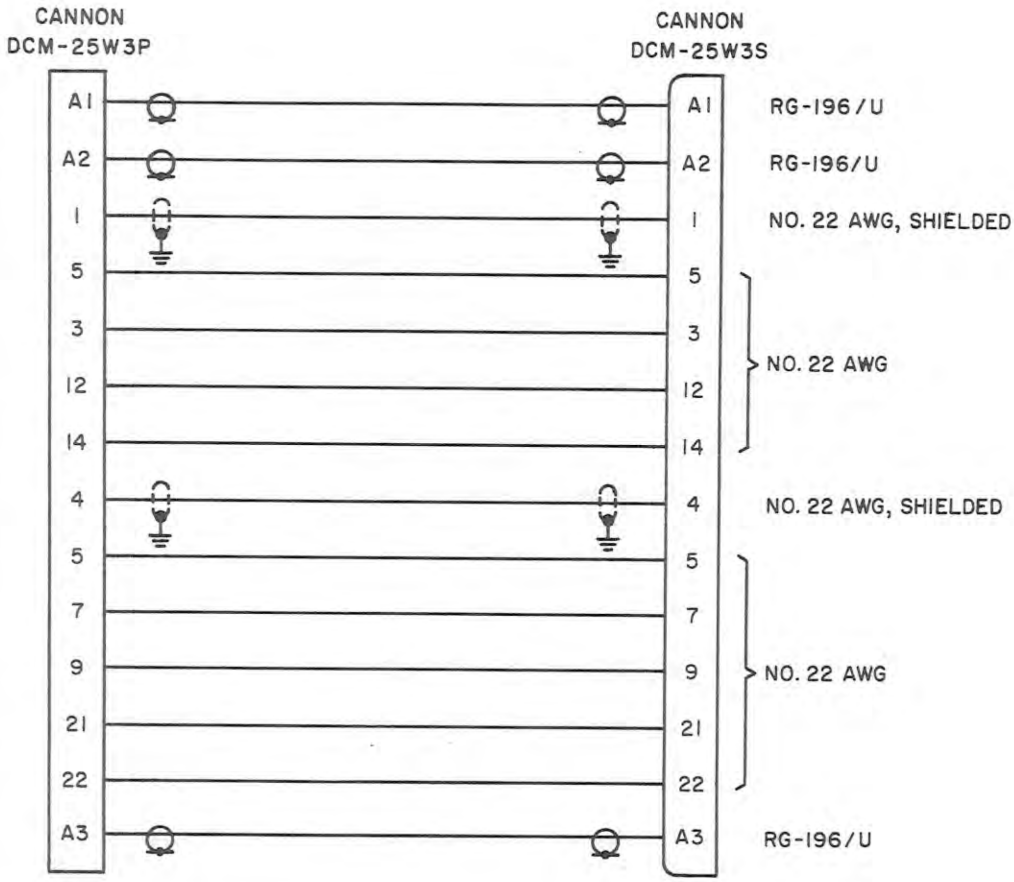


Figure 5-6. Power Extender Cable

When performing the minimum standards tests, the tuning unit should be removed from the receiver and connected with the power extender cable. The receiver front panel switches should be placed in the following positions.

POWER	ON
TUNER	RIGHT or LEFT (as required)
RF GAIN	Maximum clockwise
AFC	OFF
IF SELECTOR	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	Midrange
Tuning Tape	100 Mc
VOLUME	Midrange

Table 5-14. PR-21.4-3 Preamplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 606A signal generator to J1 on PR-21.4-3 preamplifier. Connect 50 Ω detector to J3 on preamplifier. Connect output of detector to vertical input of Tektronix 503 scope. Calibrate output of generator at 21.4 mc using internal calibrator. Set modulation at 400 cps, 50% AM.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust output level of signal generator to achieve 4.0 cm of deflection. The signal should be a 400 cps sine wave. Note setting of signal genertor output in db. Connect output of generator directly to input of detector. Increase generator output to get same signal on scope as above. Note setting of signal generator output in db.	The difference between the two signal generator output settings in db is the gain of the PR-21.4-3 to the IF output. The gain should be 34 db minimum.
2	Same as Step 1, except connect the 50 Ω detector to J2, the SDU output.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust the output level of the signal generator about 40 db above that used in Step 1.	If signal is present at an output level at the generator about 40 db above that used in Step 1, the circuit is functioning normally.
3	Same as Step 1, except connect the 50 Ω detector to J4, the LOG IF output.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust the output level of the signal generator about 6 db above that used in Step 2.	If signal is present at an output level at the generator about 6 db above that used in Step 2, the circuit is functional normally.

Table 5-15. ISA-201-2 Isolation Amplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 608D signal generator to J1 on the ISA-201 isolation amplifier. Connect a 50 Ω detector to J1 on the front panel of the tuning unit. Connect the output of the detector to the vertical input of the Tektronix 503 scope. Set the signal generator output frequency to 90 mc. Set the modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the scope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the scope. The signal should be a 400 cps sine wave. Note the setting of the signal generator output in db. Connect the output of the signal generator directly to the input of the detector. Increase the output of the signal generator until a 4.0	The difference between the two signal generator settings noted, in db, is the gain of the ISA-201-2. The gain should be about 4.0 db minimum.

Table 5-15. ISA-201-2 Isolation Amplifier Minimum Performance Standards. (Cont)

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
		cm deflection is again achieved. Note the setting of the generator output in db.	

Table 5-16. SH-221-3 Tuner Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 608D signal generator to J1, antenna input, of the SH-221-3 tuner. Connect a 50 Ω detector to J2, the IF output, of the tuner. Place the tuning unit in operation at 65 mcs. Adjust the signal generator output frequency to 65 mc. Connect the output of the detector to the vertical input of the Tektronix oscilloscope. Set the modulation of the signal generator to 400 cps at 50% AM.	Set the vertical sensitivity of the scope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the scope. The signal should be a 400 cps sine wave. Note the output of the signal generator in db. Connect the output of the signal generator directly to the input of the detector. Increase the output of the signal generator until a 4.0 cm deflection is again achieved and note the output of the generator in db.	The difference between the two signal generator settings noted, in db, is the gain of the SH-221-3. The gain should be about 20 db minimum.

B. Voltage and Resistance Measurements (Tables 5-17 through 5-19)

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the faulty components. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. The front panel control and switch positions are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and one set for meters using a positive ground lead. The RCA meter referenced above has a negative ground lead when measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

C. 30 to 100 MC Tuning Unit Alignment

The alignment of the 30 to 100 mc tuning unit is divided into tuner alignment and 21.4 mc preamplifier alignment. The receiver and tuning unit should be placed on a workbench adjacent to the equipment being used for alignment facilitating the use of short cables and test leads. The power extender cable illustrated in Figure 5-6 should be connected between the rear of the tuning unit and the right hand connector J2 on the main chassis of

Table 5-17. SH-221-3 Tuner Voltage and Resistance Chart.

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 60 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-0.94 V (1.5 V)	5.4 KΩ (R x 1 K)	5.0 KΩ (R x 1 K)	-0.18 V (1.5 V)	6.2 KΩ (R x 1 K)	5.8 KΩ (R x 1 K)	5.3 V (15 V)	6.0 KΩ (R x 1 K)	4.6 KΩ (R x 1 K)
Q2	-0.74 V (1.5 V)	5.6 KΩ (R x 1 K)	4.6 KΩ (R x 1 K)	GND	GND	GND	5.95 V (15 V)	5.8 KΩ (R x 1 K)	4.2 KΩ (R x 1 K)
Q3	-9.0 V (15 V)	2.2 KΩ (R x 1 K)	1.4 KΩ (R x 100)	-8.4 V (15 V)	3.0 KΩ (R x 1 K)	2.6 KΩ (R x 100)	-0.72 V (1.5 V)	∞ (R x 1 Meg)	750 Ω (R x 100)
Q4	-7.1 V (15 V)	2.9 KΩ (R x 1 K)	1.8 KΩ (R x 100)	-7.8 V (15 V)	5.4 KΩ (R x 1 K)	4.0 KΩ (R x 1 K)	0 V (1.5 V)	Continuity (R x 1)	Continuity (R x 1)
Q5	-0.72 V (1.5 V)	∞ (R x 1 Meg)	750 Ω (R x 100)	GND	GND	GND	6.2 V (15 V)	5.0 KΩ (R x 1 K)	600 Ω (R x 100)

Table 5-18. PR-21.4-3 Preamplifier Voltage and Resistance Chart.

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements.
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 60 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.5 V (5 V)	3.8 KΩ (R x 1 K)	1.6 KΩ (R x 100)	-0.76 V (1.5 V)	7.6 KΩ (R x 1 K)	6.6 KΩ (R x 1 K)	7.8 V (15 V)	4.0 KΩ (R x 1 K)	1.7 KΩ (R x 100)
Q2	-0.68V (1.5 V)	4.7 KΩ (R x 1 K)	750 Ω (R x 100)	GND	GND	GND	7.0 V (15 V)	4.6 KΩ (R x 1 K)	80 Ω (R x 10)
Q3	-1.55 V (5 V)	3.8 KΩ (R x 1 K)	1.6 KΩ (R x 100)	-0.82 V (1.5 V)	7.6 KΩ (R x 1 K)	6.8 KΩ (R x 1 K)	7.2 V (15 V)	4.2 KΩ (R x 1 K)	1.8 KΩ (R x 100)
Q4	-0.68 V (1.5 V)	4.8 KΩ (R x 1 K)	93 Ω (R x 10)	GND	GND	GND	6.6 V (15 V)	4.7 KΩ (R x 1 K)	78 Ω (R x 10)

Table 5-19. ISA-201-2 Isolation Amplifier Voltage and Resistance Chart.

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 60 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-7.6 V (15 V)	3.4 KΩ (R x 1 K)	1.3 KΩ (R x 100)	-6.8 V (15 V)	5.4 KΩ (R x 1 K)	4.3 KΩ (R x 1 K)	-0.8 V (1.5 V)	∞ (R x 1 Meg)	900Ω (R x 100)
Q2	-0.8 V (1.5 V)	∞ (R x 1 Meg)	900 Ω (R x 100)	GND	GND	GND	11.4 V (15 V)	3.8 KΩ (R x 1 K)	900Ω (R x 100)

the receiver. The receiver front panel switches and controls should be placed in the following positions while performing the alignment unless otherwise indicated in the procedure.

POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	100 mc
VOLUME	Midrange

(1) SH-221-3 Tuner: Connect the test equipment as illustrated in Figure 5-7.

a. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the horizontal sensitivity as required to achieve full scale deflection. The detector should be connected to TP1.

b. Adjust the sweep generator output frequency to 100 mc. Adjust the output level of the sweep generator as required to achieve a scope deflection of about 4.0 cm.

c. Calibrate the signal generator frequency at 21.4 mc and adjust its output amplitude as required to achieve a small marker "birdie" on the response. Adjust the external marker input control on the sweep generator, if necessary, to get a marker "birdie" of the desired amplitude at 100 mc.

d. Turn the internal 10 mc markers of the sweep generator ON. Adjust the sweep generator marker amplitude control as required to achieve a 100 mc marker.

e. With the tuning unit set at 100 mc, the sweep generator internal 100 mc marker and the 100 mc marker generated by the LO output and the signal generator should be superimposed.

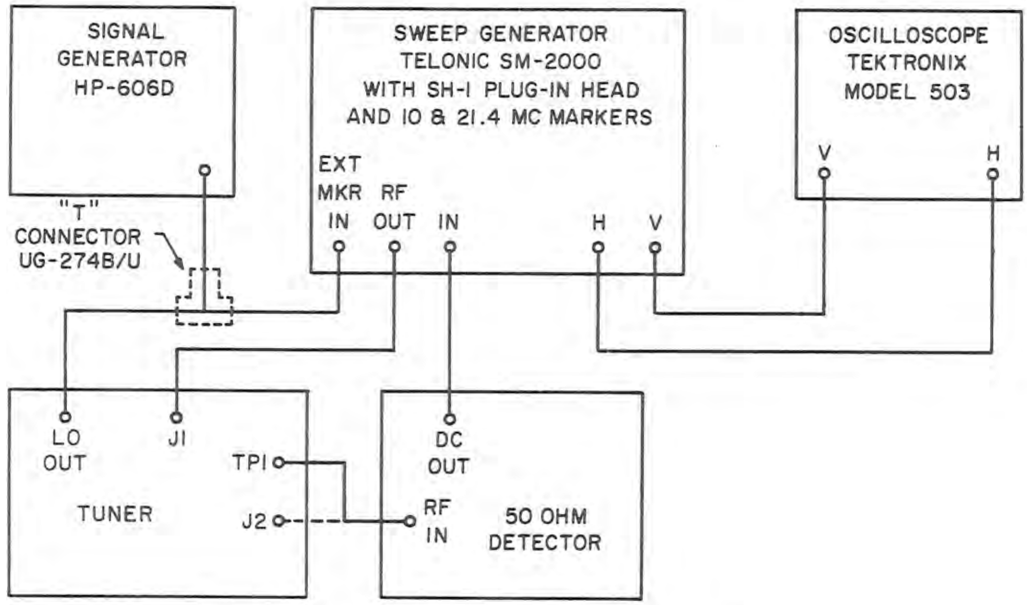


Figure 5-7. Tuner Alignment Test Set-Up

f. If an error exists in the LO frequency causing the two markers to have a different frequency, adjust C49 on the tuner until the markers are superimposed.

g. The RF response displayed on the scope should have the characteristics illustrated in Figure 5-8.

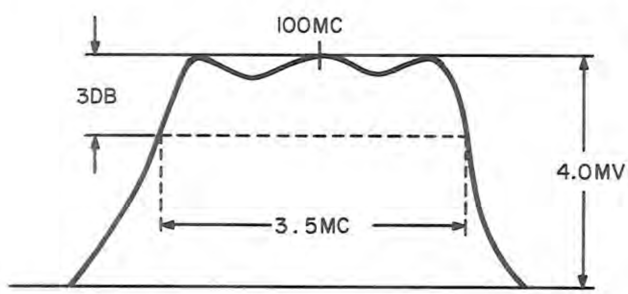


Figure 5-8. RF Response of 30 to 100 mc Tuner

h. Adjust C3, C7, C20, C24, and C27 for maximum symmetrical response centered around the 100 mc marker.

i. Rotate the tuning crank over the tuning range, adjusting the sweep generator output frequency as required to maintain the response on the scope. Adjust the generator output level as required to maintain a scope deflection of about 4.0 cm.

j. The marker should remain on the top of the response over the tuning range of the tuning unit. The response shape should remain essentially as indicated in Figure 5-8. Further slight readjustment of the capacitors in Step h may be necessary to obtain a suitable response over the entire tuning range.

k. Disconnect the detector from TP1 and connect it to J2 on the tuner. The generator output level should be readjusted as required to achieve a 4.0 cm deflection on the scope at 100 mc.

l. The response at the IF output should have the shape indicated in Figure 5-9.

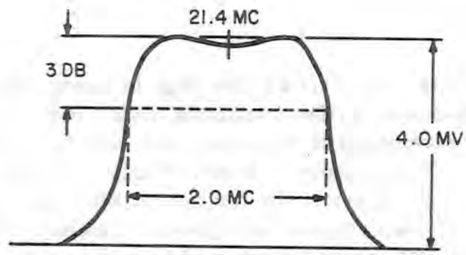


Figure 5-9. IF Response of 30 to 100 mc Tuner

m. Adjust L14 and L15 for maximum symmetrical response centered around the 21.4 mc marker. The response at the 3 db points will be approximately 2 mc wide.

(2) PR-21.4-3 Preamplifier:

a. Connect the test equipment as shown in Figure 5-7 with the RF output of the sweep generator connected to preamplifier input jack J1. The LO OUTPUT from the tuner is not used and therefore the output of the 606D signal generator is connected directly to the EXT. MKR. connector on the sweep generator.

b. Connect a 50 Ω detector to the IF output jack, J3, on the preamplier.

c. Set the output frequency of the signal generator to 21.4 mc using the internal frequency calibrator of the signal generator.

d. Set the output frequency of the sweep generator to 21.4 mc.

e. Set the oscilloscope vertical sensitivity to 2.0 mv/cm and the sweep generator output level as required to display a 4 centimeter preamplifier response.

f. Adjust the output level of the signal generator and the marker SIZE control on the sweep generator as required to achieve a small 21.4 mc marker on the response.

g. Adjust L1, L2, L3, and L4 located on the top of the preamplifier subchassis for maximum symmetrical response centered around the 21.4 mc marker. The desired preamplifier response characteristics are illustrated in Figure 5-10.

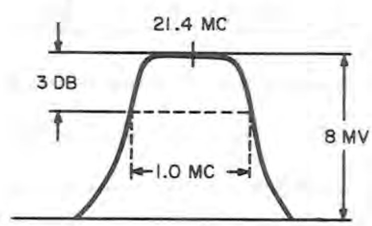


Figure 5-10. 21.4 mc Preamplifier Response

(3) ISA-201-2 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about -4.0 db over the range of frequencies from 30 mc to 130 mc and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-15 of the minimum performance standards. If the unit exhibits more than is indicated, the difficulty is likely to be a defective component and not the alignment.

7. 90 to 300 MC Tuning Unit.

The maintenance and troubleshooting sections of the receiver portion of the manual will assist the technician in the isolation of faults which lie in the plug-in tuning units. This section of the manual will accordingly deal with minimum performance standards and alignment of the 90 to 300 Mc tuning unit.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts should be of assistance in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, check that the receiver's power supplies are functioning normally in accordance with paragraph 4.A.(4). Figure 5-11 shows an illustration of a power extender cable which must be used to apply power to the tuning unit while it is removed from the receiver housing. The performance standards for the various modules are given in Tables 5-20 through 5-22. When performing the minimum standards tests, the tuning unit should be removed from the main chassis and connected with the power extender cable. The receiver front panel switches should be placed in the following positions.

POWER	ON
TUNER	RIGHT or LEFT (as required)
RF GAIN	Maximum clockwise
AFC	OFF
IF SELECTOR	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	Midrange
Tuning Tape	300 mc
VOLUME	Midrange

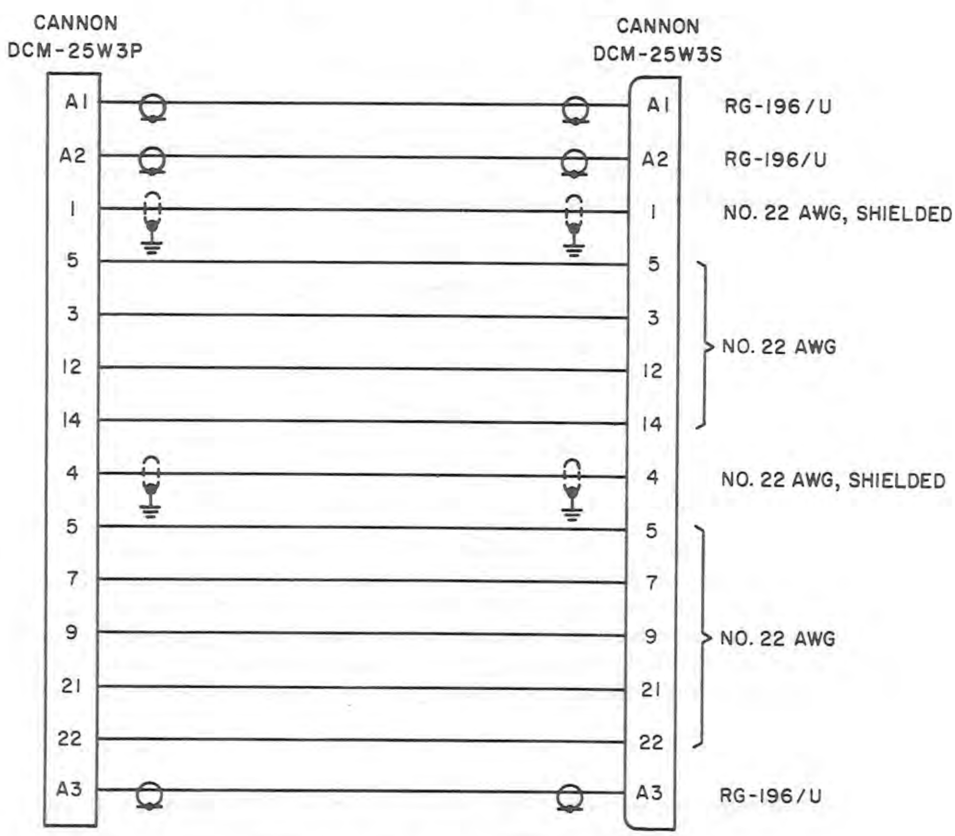


Figure 5-11. Power Extender Cable

Table 5-20. PR-21.4-3 Preamplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 606A signal generator to J1 on the PR-21.4-3 preamplifier. Connect 50 Ω detector to J3 on preamplifier. Connect output of detector to vertical input of Tektronix 503 scope. Calibrate output of generator at 21.4 mc using internal calibrator. Set modulation at 400 cps, 50% AM.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust output level of signal generator to achieve 4.0 cm of deflection. The signal should be a 400 cps sine wave. Note setting of signal generator output in db. Connect output of generator directly to input of detector. Increase generator output to get same signal on scope as above. Note setting of signal generator output in db.	The difference between the two signal generator output settings in db is the gain of the PR-21.4-3 to the IF output. The gain should be 34 db minimum.
2	Same as Step 1, except connect the 50 Ω detector to J2, the SDU output.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust the output level of the signal generator about 40 db above that used in Step 1.	If signal is present at an output level at the generator about 40 db above that used in Step 1, the circuit is functioning normally.
3	Same as Step 1, except connect the 50 Ω detector to J4, the LOG IF output.	Set vertical sensitivity of scope to 1.0 mv/cm. Adjust the output level of the signal generator about 6 db above that used in Step 2.	If signal is present at an output level at the generator about 6 db above that used in Step 2, the circuit is functioning normally.

Table 5-21. ISA-201-2 Isolation Amplifier Minimum Performance Standards

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 608D signal generator to J1 on the ISA-201-2 isolation amplifier. Connect a 50 Ω detector to J1 on the front panel of the tuning unit. Connect the output of the detector to the vertical input of the Tektronix 503 scope. Set the signal generator output frequency to 90 mc. Set the modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the scope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the scope. The signal should be a 400 cps sine wave. Note the setting of the signal generator output in db. Connect the output of the signal generator directly to the input of the detector. Increase the output of the signal generator until a 4.0 cm deflection is again achieved. Note the setting of the generator output in db.	The difference between the two signal generator settings noted, in db, is the gain of the ISA-201. The gain should be about 4.0 db minimum.

Table 5-22. SH-222-3 Tuner Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect a 608D signal generator to J1, antenna input, of the SH-222-3 tuner. Connect a 50 Ω detector to J2, the IF output, of the tuner. Place the tuning unit in operation at 90 mc. Adjust the signal generator output frequency to 90 mc. Connect the output of the detector to the vertical input of the Tektronix oscilloscope. Set the modulation of the signal generator to 400 cps at 50% AM.	Set the vertical sensitivity of the scope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the scope. The signal should be a 400 cps sine wave. Note the output of the signal generator in db. Connect the output of the signal generator directly to the input of the detector. Increase the output of the signal generator until a 4.0 cm deflection is again achieved and note the output of the generator in db.	The difference between the two signal generator settings noted, in db, is the gain of the SH-222-3. The gain should be about 20 db minimum.

B. Voltage and Resistance Measurements (Tables 5-23 through 5-25)

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the faulty components. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. The front panel control and switch positions are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and one set for meters using a positive ground lead. The RCA meter referenced above has a negative ground lead when measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

Table 5-23. SH-222-3 Tuner Voltage and Resistance Chart

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements.
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 90 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.46V (5 V)	5.2 KΩ (R x 1 K)	2.0 KΩ (R x 100)	-0.7 V (1.5 V)	8.3 KΩ (R x 1 K)	4.7 KΩ (R x 1 K)	6.1 V (15 V)	5.2 KΩ (R x 1 K)	2.5 KΩ (R x 100)
Q2	0.28 V (1.5 V)	1.9 KΩ (R x 1 K)	1.7 KΩ (R x 100)	GND	GND	GND	-8.3 V (15 V)	1.4 KΩ (R x 1 K)	3.2 KΩ (R x 1 K)
Q3	-10.0 V (15 V)	1.8 KΩ (R x 1 K)	1.4 KΩ (R x 100)	-9.3 V (15 V)	3.4 KΩ (R x 1 K)	3.2 KΩ (R x 1 K)	-0.72 V (1.5 V)	∞ (R x1 Meg)	900 Ω (R x 100)
Q4	-9.2 V (15 V)	5.2 KΩ (R x 1 K)	5.0 KΩ (R x 1 K)	-8.8 V (15 V)	4.1 KΩ (R x 1 K)	3.8 KΩ (R x 1 K)	9.6 V (15 V)	9.5 KΩ (R x 1 K)	6.6 KΩ (R x 1 K)
Q5	-0.72 V (1.5 V)	∞ (R x 1 Meg)	900 Ω (R x 100)	GND	GND	GND	7.9 V (15 V)	4.1 KΩ (R x 1 K)	850Ω (R x 100)

Table 5-24. PR-21.4-3 Preamplifier Voltage and Resistance Chart.

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 60 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.5 V (5 V)	3.8 KΩ (R x 1 K)	1.6 KΩ (R x 100)	-0.76 V (1.5 V)	7.6 KΩ (R x 1 K)	6.6 KΩ (R x 1 K)	7.8 V (15 V)	4.0 KΩ (R x 1 K)	1.7 KΩ (R x 100)
Q2	-0.68 V (1.5 V)	4.7 KΩ (R x 1 K)	750 Ω (R x 100)	GND	GND	GND	7.0 V (15 V)	4.6 KΩ (R x 1 K)	80 Ω (R x 10)
Q3	-1.55 V (5 V)	3.8 KΩ (R x 1 K)	1.6 KΩ (R x 100)	-0.82 V (1.5 V)	7.6 KΩ (R x 1 K)	6.8 KΩ (R x 1 K)	7.2 V (15 V)	4.2 KΩ (R x 1 K)	1.8 KΩ (R x 100)
Q4	-0.68 V (1.5 V)	4.8 KΩ (R x 1 K)	93 Ω (R x 10)	GND	GND	GND	6.6 V)15 V)	4.7 KΩ (R x 1 K)	78 Ω (R x 10)

Table 5-25. ISA-201-2 Isolation Amplifier Voltage and Resistance Chart.

NOTES:
1. Tuning unit connected to right hand power plug with extender cable and RF selector in RIGHT position
2. IF BANDWIDTH in position 2
3. AFC selector OFF
4. RF GAIN maximum CW
5. MODE selector AM/MAN
6. VOLUME control CCW
7. POWER switch ON
8. Power input physically disconnected from receiver while making resistance measurements
9. FM SQUELCH control OFF (CCW)
10. Frequency set to 60 mcs
11. FINE TUNING maximum CW
12. BFO PITCH control maximum CW
13. Numbers in parentheses indicate meter range

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-7.6 V (15 V)	3.4 KΩ (R x 1 K)	1.3 KΩ (R x 100)	-6.8 V (15 V)	5.4 KΩ (R x 1 K)	4.3 KΩ (R x 1 K)	-0.8 V (1.5 V)	∞ (R x 1 Meg)	900Ω (R x 100)
Q2	-0.8 V (1.5V)	∞ (R x 1 Meg)	900 Ω (R x 100)	GND	GND	GND	11.4 V (15 V)	3.8 KΩ (R x 1 K)	900Ω (R x 100)

C. 90 to 300 MC Tuning Unit Alignment

The alignment of the 90 to 300 mc tuning unit is divided into tuner alignment and 21.4 mc preamplifier alignment. The receiver and tuning unit should be placed on a workbench adjacent to the equipment being used for alignment facilitating the use of short cables and test leads. The power extender cable illustrated in Figure 5-11 should be connected between the rear of the tuning unit and right hand connector J2 on the main chassis of the receiver. The receiver front panel switches and controls should be placed in the following positions while performing the alignment unless otherwise indicated in the procedure.

POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	100 mc
VOLUME	Midrange

(1) SH-222-3 Tuner. Connect the test equipment as illustrated in Figure 5-12.

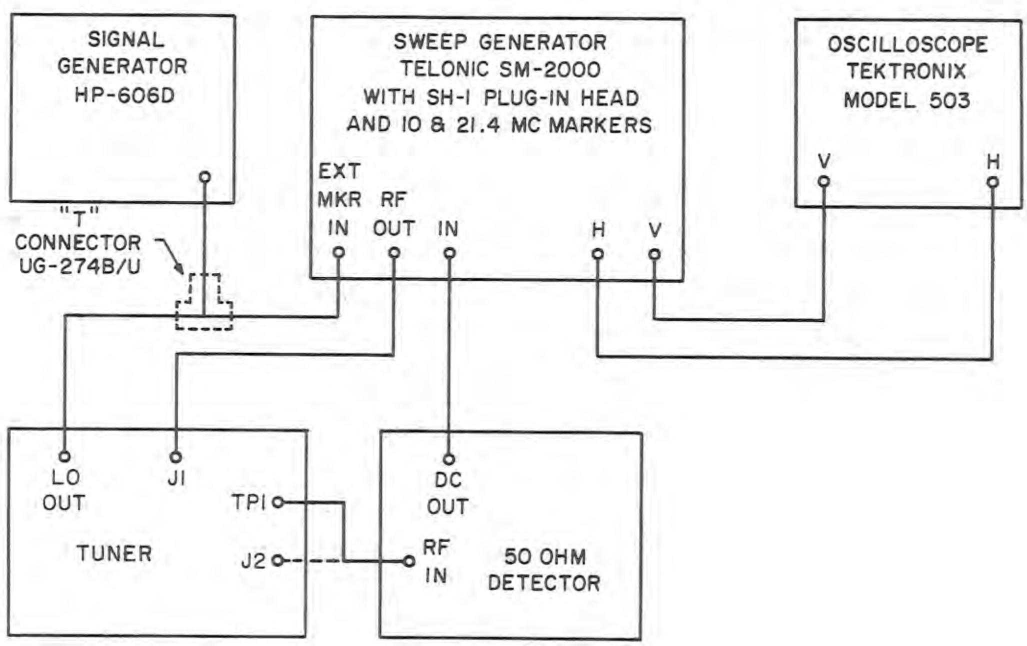


Figure 5-12. Tuner Alignment Test Set-Up

a. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the horizontal sensitivity as required to achieve full scale deflection. The detector should be connected to TP1.

b. Adjust the sweep generator output frequency to 300 mc. Adjust the output level of the sweep generator as required to achieve a scope deflection of about 4.0 cm.

c. Calibrate the signal generator frequency at 21.4 mc and adjust its output amplitude as required to achieve a small marker "birdie" on the response. Adjust the external marker input control on the sweep generator, if necessary, to get a marker "birdie" of the desired amplitude at 300 mc.

d. Turn the internal 10 mc markers of the sweep generator ON. Adjust the sweep generator marker amplitude control as required to achieve a 300 mc marker.

e. With the tuning unit set at 300 mc, the sweep generator internal 300 mc marker and the 300 mc marker generated by the LO output and the signal generator should be superimposed.

f. If an error exists in the LO frequency causing the two markers to have a different frequency, adjust C40 on the tuner until the markers are superimposed.

g. The RF response displayed on the scope should have the characteristics illustrated in Figure 5-13.

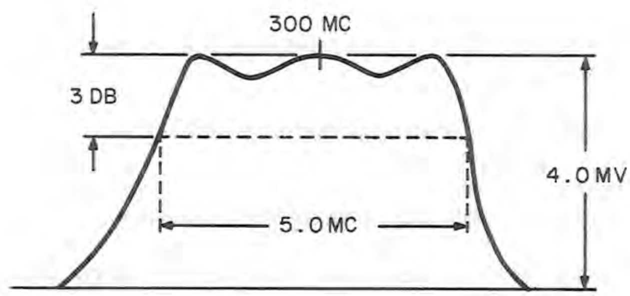


Figure 5-13. RF Response of 90 to 300 mc Tuner

h. Adjust C3, C7, C20, C24, and C27 for maximum symmetrical response centered around the 300 mc marker.

i. Rotate the tuning crank over the tuning range, adjusting the sweep generator output frequency as required to maintain the response on the scope. Adjust the generator output level as required to maintain a scope deflection of about 4.0 cm.

j. The marker should remain on the top of the response over the tuning range of the tuning unit. The response shape should remain essentially as indicated in Figure 5-13, above. Further slight readjustment of the capacitors in Step h may be necessary to obtain a suitable response over the entire tuning range.

k. Disconnect the detector from TP1 and connect it to J2 on the tuner. The generator output level should be readjusted as required to achieve a 4.0 cm deflection on the scope at 100 mc.

l. The response at the IF output should have the shape indicated in Figure 5-14.

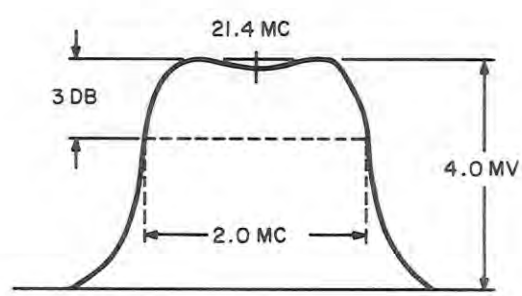


Figure 5-14. IF Response of 90 to 300 mc Tuner

m. Adjust L14 and L15 for maximum symmetrical response centered around the 21.4 mc marker. The response at the 3 db points will be approximately 2 mc wide.

(2) PR-21.4-3 Preamplifier

a. Connect the test equipment as shown in Figure 5-12 with the RF output of the sweep generator connected to preamplifier input jack J1. The LO OUTPUT from the tuner is not used and therefore the output of the 606D signal generator is connected directly to the EXT. MKR. connector on the sweep generator.

b. Connect a 50 Ω detector to the IF output jack, J3, on the preamplifier.

c. Set the output frequency of the signal generator to 21.4 mc using the internal frequency calibrator of the signal generator.

d. Set the output frequency of the sweep generator to 21.4 mc.

e. Set the oscilloscope vertical sensitivity to 2.0 mv/cm and the sweep generator output level as required to display a 4 centimeter preamplifier response.

f. Adjust the output level of the signal generator and the marker SIZE control on the sweep generator as required to achieve a small 21.4 mc marker on the response.

g. Adjust L1, L2, L3, and L4 located on the top of the preamplifier subchassis for maximum symmetrical response centered around the 21.4 mc marker. The desired preamplifier response characteristics are illustrated in Figure 5-15.

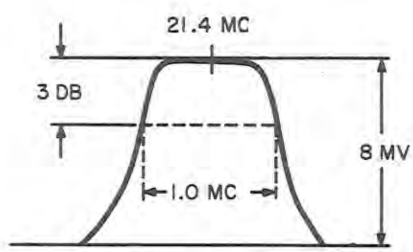


Figure 5-15. 21.4 mc Preamplifier Response

(3) ISA-201-2 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about -4.0 db over the range of frequencies from 90 to 330 mc and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-21 of the minimum performance standards. If the unit exhibits more loss than is indicated, the difficulty is likely to be a defective component and not the alignment.

SECTION VI

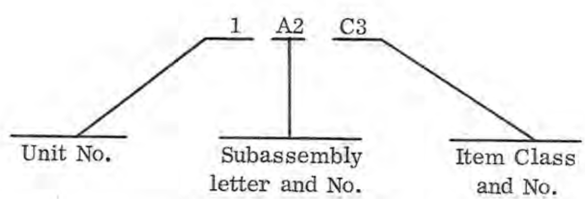
PARTS AND MANUFACTURER'S LIST

1. Introduction.

This section contains the parts list for the receiver and for the tuning units which plug into the receiver. The parts list includes a complete tabulation of the component parts which are maintenance significant. Paragraph 3 lists the name to code cross reference for each part manufacturer. The parts list was compiled using the unit numbering method.

A. Unit Numbering Method

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify units, subassemblies (and modules) and parts. Use of the unit numbering method provides a cross reference in the numbering system between the parts lists and the schematic diagrams. An example of the unit numbering method follows:



Read as: Third (3) capacitor (C) of second (2) subassembly (A) of unit 1

Components which are an integral part of a main chassis have no subassembly designation. Refer to the receiver and tuning unit interconnecting wiring diagrams Figure 7-6, 7-10 and 7-12.

B. Reference Designation Prefix

Partial reference designations have been used on the equipment and on the schematic diagrams 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 included on the schematic diagram following the notation "REF DESIG PREFIX".

2. Parts List.

The parts list presented on the following pages lists the repair parts for the receiver and the tuning units.

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	RECEIVER, CM	19905	R-1524(P)/WRR	1	1
C1	NOT USED				
C2	NOT USED				
C3	CAP., FXD, CER DL 0.001 uf, ± 20%, 500 vdc	81349	CK70AW102M	2	2
C4	CAP., FXD, CER DL		SAME AS 1C3	REF	REF
C5	CAP., FXD, ELECT 350 uf, +100-10%, 50 vdc	81349	CE41C351G	3	3
C6	CAP., FXD, ELECT		SAME AS 1C5	REF	REF
C7	CAP., FXD, ELECT		SAME AS 1C5	REF	REF
C8	CAP., FXD, ELECT 22 uf, ± 10%, 35v	81349	CS13AF220K	1	3
C9	CAP., FXD, CER DL 0.01 uf, ± 80-20%, 1000 wvdc	81349	CK63AY103X	2	2
C10	CAP., FXD, CER DL		SAME AS 1C9	REF	REF
F1	FUSE, CARTRIDGE 0.250 amp, 125 v	81349	F02B250V1-4A	2	2
F2	FUSE, CARTRIDGE		SAME AS 1F1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
FL-LP1	FILTER, LOW PASS 50 db from 100 mc to 2000 mc min attenuation, 2000 pf min at 1 kc capacitance, 500 wvdc	72982	1202-052	2	2
FL-LP2	FILTER, LOW PASS		SAME AS 1FL-LP1	REF	REF
J1	CONN, RECP, ELEC N series, 50 ohm impedance, bulkhead type, teflon insulation, female contact	74868	UG556B-U	2	2
J2	CONN, RECP, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCMF25W3SNMB	2	2
J2A1	NOT USED				
J2A2	CONN, RECP, ELEC Right angle solder type, gold over silver plated contact, nylon insulator	71468	DM53743-5000	4	4
J2A3	CONN, RECP, ELEC		SAME AS 1J2A2	REF	REF
J3	JACK, TIP Telephone-jack type, tip and sleeve connection, bushing mounted	81349	JJ134	1	1
J4	CONN, RECP, ELEC		SAME AS 1J1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
J5	CONN, RECP, ELEC		SAME AS 1J2	REF	REF
J5A1	NOT USED				
J5A2	CONN, RECP, ELEC		SAME AS 1J2A2	REF	REF
J5A3	CONN, RECP, ELEC		SAME AS 1J2A2	REF	REF
J6	CONN, RECP, ELEC Bulkhead mounted teflon insulation, beryllium copper outer contact fingers	91737	8212B	2	2
J7	CONN, RECP, ELEC		SAME AS 1J6	REF	REF
J8	CONN, RECP, ELEC Box mounting type, solid shell, 3 male type contacts	96906	MS3102A10SL3P	1	1
J9	CONN, RECP, ELEC Bulkhead mounting type, with seal, pressurized, Dielectric material-teflon	91836	KA71-04	4	4
J10	CONN, RECP, ELEC		SAME AS 1J9	REF	REF
J11	CONN, RECP, ELEC		SAME AS 1J9	REF	REF
J12	CONN, RECP, ELEC		SAME AS 1J9	REF	REF
L1	COIL, RF 18 turns no. 20 awg wire closewound, covered with sleeving	19905	AB548-1	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L2	COIL, RF		SAME AS 1L1	REF	REF
M1	METER, RI Panel type, 0-100 uadc range, white dial background; black markings and pointer, ruggedized	81349	MR13W100DCUAR	1	1
M2	METER, RI Panel type, 100-0-100 uadc range of inscription, white dial background; black markings and pointer, ruggedized	81349	MR13W1H1DCUAR	1	1
P1	CONN, PLUG, ELEC 50 ohm impedance, screw-on type, teflon insulation, gold plated male contacts	74868	5116-037475	2	2
P2	CONN, PLUG, ELEC		SAME AS 1P1	REF	REF
P3	CONN, PLUG, ELEC 50 ohm impedance, teflon insulation, gold plated male contacts, weatherproof	74868	77175	4	4
P4	CONN, PLUG, ELEC		SAME AS 1P3	REF	REF
P5	CONN ,PLUG, ELEC		SAME AS 1P3	REF	REF
P6	CONN, PLUG, ELEC		SAME AS 1P3	REF	REF
P7	CONN, PLUG, ELEC Solid shell, 3 female type contacts	96906	MS3106A10SL3S	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
P8	CONN, PLUG, ELEC N series; 50 ohm impedance, teflon insulation, male contact	74868	UG1185A-U	2	2
P9	CONN, PLUG, ELEC		SAME AS 1P8	REF	REF
Q1	TRANSISTOR NPN, silicon type, screw mounted, 3 radial wire lead terminals	01295	TI487	3	3
Q2	TRANSISTOR		SAME AS 1Q1	REF	REF
Q3	TRANSISTOR		SAME AS 1Q1	REF	REF
R1	RESISTOR, VAR 10K ohms, ± 10%, 2W	81349	RV4NAYSD103A	2	2
R2	RES., FIXED, COMP 4.7K ohms, ± 5%, 1/4 w	81349	RC07GF472J	1	9
R3	RES., FIXED, COMP 330 ohms, ± 5%, 1/4 w	81349	RC07GF331J	1	2
R4	RESISTOR, VAR		SAME AS 1R1	REF	REF
R5	RESISTOR, VAR 5K ohms, ± 10%, 1/2 w	81349	RV6NAYSD502A	1	1
R6	RES., FIXED, COMP 8.2K ohms, ± 5%, 1/4 w	81349	RC07GF822J	1	3

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R7	RES., FIXED, COMP 1.5K ohms, ± 5%, 1/4 w	81349	RC07GF152J	1	6
R8	RES., FIXED, COMP 30K ohms, ± 5%, 1/4 w	81349	RC07GF303J	1	1
R9	RES., FIXED, COMP 560K ohms, ± 5%, 1/4 w	81349	RC07GF564J	1	1
S1	SWITCH, TOGGLE DPST, 10 amp at 115 vac, 20 amp at 28 vdc, screw type terminals	96906	MS35059-22	1	1
S2	SWITCH, ROTARY 6 pole, 3 section, 3 position	76854	259962A3	1	1
S3	SWITCH, ROTARY 6 pole, 3 section, 4 position	76854	259963A3	1	1
S4	SWITCH, TOGGLE SPDT, 10 amp at 115 vac, 20 amp at 28 vdc, screw type terminals	96906	MS35058-23	1	1
S5	SWITCH, ROTARY 6 pole, 3 section, 2 position	76854	265482A3	1	1
T1	XMFR, PWR, STEPDN Fully enclosed, metal case, 115/230v, 50-400 cps, primary input 12 terminals mtd by 4 thd studs	19905	B004	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
T2	TRANSFORMER, AF Fully enclosed, metal case, 50 cps to 20 kc, 300 ohms primary impedance, 4 and 600 ohms secondary impedance, 25 ma dc rated	19905	A215	1	1
TB1	TERMINAL BOARD Molded, 5 screw type terminals, barrier type, 4 mtg holes	81349	40TB5	1	1
XA1A	NOT USED				
XA1B	NOT USED				
XA2A	CONN, RECP, ELEC Printed circuit card type, 12 contacts, low-loss plastic dielectric, taper tab terminations, 2 mtg holes	91662	00-5009-012-163-001	6	6
XA2B	CONN, RECP, ELEC		SAME AS 1XA2A	REF	REF
XA3A	CONN, RECP, ELEC		SAME AS 1XA2A	REF	REF
XA3B	CONN, RECP, ELEC		SAME AS 1XA2A	REF	REF
XA4A	CONN, RECP, ELEC		SAME AS 1XA2A	REF	REF
XA4B	CONN, RECP, ELEC		SAME AS 1XA2A	REF	REF
XA5A	CONN, RECP, ELEC Printed circuit card type, 16 contacts, low-loss plastic dielectric, taper tab terminations, 2 mtg holes	91662	00-5009-016-163-001	4	4

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
XA5B	CONN, RECP, ELEC		SAME AS 1XA5A	REF	REF
XA6A	CONN, RECP, ELEC		SAME AS 1XA5A	REF	REF
XA6B	CONN, RECP, ELEC		SAME AS 1XA5A	REF	REF
XF1	FUSEHOLDER Panel type, non-indicating, bayonet knob type, for 3 ag fuses	81349	FHN20G	2	2
XF2	FUSEHOLDER		SAME AS 1XF1	REF	REF
MP1	COV, TEL JACK Steel, 0.810 in. dia, spring action	19905	B1213-1	1	1
MP2	KNOB Skirted round with dot, plastic, black, 0.125 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E1B	1	1
MP3	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E2B	5	5
MP4	KNOB		SAME AS 1MP3	REF	REF
MP5	KNOB		SAME AS 1MP3	REF	REF
MP6	KNOB		SAME AS 1MP3	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1 RECEIVER, COUNTERMEASURES R-1524(P)/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP7	KNOB		SAME AS 1MP3	REF	REF
MP8	BOOT, MOIST SEAL Bushing mtd, silicone rubber boot, brass nut 15/32-32 thd size, 0.875 in. h, 0.625 in. across flats o/a dim	97539	N1030	2	2
MP9	BOOT, MOIST SEAL		SAME AS 1MP8	REF	REF
MP10	SEAL SHAFT Grey silicone rubber boot, brass nut, 3/8-32 thd size, 1/4 in. shaft size, 7/32 in. depth, 1/2 in. across flats o/a dim	97539	N9030-1-4	5	5
MP11	SEAL SHAFT		SAME AS 1MP10	REF	REF
MP12	SEAL SHAFT		SAME AS 1MP10	REF	REF
MP13	SEAL SHAFT		SAME AS 1MP10	REF	REF
MP14	SEAL SHAFT		SAME AS 1MP10	REF	REF
MP15	SEAL SHAFT Grey silicone rubber boot, brass nut, 1/4-32 thd size, 1/8 in. shaft size, 7/32 in. depth, 3/8 in. across flats o/a dim	97539	N9040-1-8	1	1
MP16	GASKET Neoprene, 0.031 in. thk, 1.750 in. square, 1.490 in. dia hole centrally located	94916	14216-1	2	2
MP17	GASKET		SAME AS 1MP16	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE					
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM

SUB-ASSY 1A1 NOT USED

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPLIFIER, IF	19905	IF 220-20	1	1
C1	CAP., FXD, CER DL 1000 pf, ± 20%, 1000 vdcw	81349	CK60AW102M	1	5
C2	CAP., FXD, MICADL 62 pf, ± 5%, 500 vdcw	84171	DM10-620J	3	5
C3	CAP., FXD, MICADL	81349	DM15-621J	1	1
C4	NOT USED				
C5	CAP., FXD, CER DL	56289	19C214	16	39
C6	CAP., FXD, MICADL		SAME AS 1A2C2	REF	REF
C7	CAP., FXD, MICADL	84171	DM10-430J	2	4
C8	NOT USED				
C9	CAP., FXD, COMP 2.2 pf, ± 10%, 500 vdcw	95121	MC2.2	1	2
C10	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C11	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C12	CAP., FXD, ELECT 0.47 uf, ± 10%, 35 vdcw	81349	CS13AFR47K	2	2
C13	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C14	NOT USED				
C15	NOT USED				
C16	NOT USED				
C17	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C18	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C19	CAP., FXD, ELECT		SAME AS 1A2C12	REF	REF
C20	NOT USED				
C21	NOT USED				
C22	CAP., FXD, CER DL 3.3 pf, ± 0.25 pf, NPO ± 120 ppm	81349	CC20CJ3R3C	1	3
C23	CAP., FXD, MICADL 68 pf, ± 5%, 500 vdcw	84171	DM10-680J	1	1
C24	CAP., FXD, MICADL 160 pf, ± 5%, 500 vdcw	84171	DM10-161J	1	1
C25	CAP., FXD, MICADL 220 pf, ± 5%, 500 vdcw	84171	DM10-221J	1	2
C26	CAP., FXD, MICADL		SAME AS 1A2C7	REF	REF
C27	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C28	CAP., FXD, MICADL 22 pf, ± 5%, 500 vdcw	84171	DM10-220J	1	3
C29	CAP., FXD, MICADL 10 pf, ± 5%, 500 vdcw	84171	DM10-100J	2	3
C30	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C31	CAP., FXD, MICADL 470 pf, ± 5%, 500 vdcw	84171	DM15-471J	1	1
C32	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C33	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C34	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C35	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C36	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C37	CAP., FXD, MICADL		SAME AS 1A2C2	REF	REF
C38	CAP., FXD, CER DL 4.7 pf, ± 0.25 pf, NPO ± 120 ppm	81349	CC20CJ4R7C	2	2
C39	CAP., FXD, CER DL		SAME AS 1A2C38	REF	REF
C40	CAP., FXD, MICADL 91 pf, ± 5%, 500 vdcw	84171	DM10-910J	1	5

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C41	CAP., FXD, MICADL 82 pf, ± 5%, 500 vdcw	84171	DM10-820J	1	3
C42	CAP., FXD, MICADL 47 pf, ± 5%, 500 vdcw	84171	DM10-470J	2	2
C43	CAP., FXD, MICADL		SAME AS 1A2C42	REF	REF
C44	CAP., FXD, MICADL		SAME AS 1A2C29	REF	REF
C45	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C46	CAP., FXD, MICADL 510 pf, ± 5%, 500 vdcw	84171	DM15-511J	1	1
C47	CAP, FXD, CER DL		SAME AS 1A2C5	REF	REF
C48	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
CR1	SEMICONDDEV, DIO Silicon, 50 PIV, 2 axial wire lead terminals	81349	1N3064	2	6
CR2	SEMICONDDEV, DIO Germanium, 100 PIV, 2 axial wire lead terminals	81350	JAN1N933	3	6
CR3	SEMICONDDEV, DIO		SAME AS 1A2CR1	REF	REF
CR4	SEMICONDDEV, DIO		SAME AS 1A2CR2	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
CR5	SEMICONDDEV, DIO		SAME AS 1A2CR2	REF	REF
L1	NOT USED				
L2	NOT USED				
L3	COIL, RF Max ind 150 uh, min 65 uh, Q max 70, min 30, 108 turns no. 38 awg wire universally wound on nylon bobbin	19905	AC257-8-1	5	6
L4	NOT USED				
L5	COIL, RF		SAME AS 1A2L3	REF	REF
L6	NOT USED				
L7	COIL, RF 1,000 uh, ± 10%, Q min 65, min self-resonant freq. 3.8 mc, max DC resistance 17.5 ohms	81349	LT4K290	2	4
L8	COIL, RF		SAME AS 1A2L3	REF	REF
L9	COIL, RF		SAME AS 1A2L3	REF	REF
L10	COIL, RF		SAME AS 1A2L3	REF	REF
L11	COIL, RF		SAME AS 1A2L7	REF	REF
Q1	TRANSISTOR NPN, silicon, 4 radial wire lead terminals	19905	A395	9	19

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q2	TRANSISTOR NPN, silicon type, 3 radial wire lead terminals	81349	2N918	1	2
Q3	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q4	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q5	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q6	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q7	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q8	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q9	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q10	TRANSISTOR		SAME AS 1A2Q1	REF	REF
R1	RES., FIXED, COMP		SAME AS 1R3	1	REF
R2	RES., FIXED, FILM 750 ohms, ± 5%, 1/4 w	81349	RL07S751J	1	1
R3	RES., FIXED, COMP 820 ohms, ± 5%, 1/4 w	81349	RC07GF821J	1	2
R4	RES., FIXED, COMP 10K ohms, ± 5%, 1/4 w	81349	RC07GF103J	9	26

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R5	RES., FIXED, COMP 1K ohms, ± 5%, 1/4 w	81349	RC07GF102J	1	2
R6	RES., FIXED, COMP 220K ohms, ± 5%, 1/4 w	81349	RC07GF224J	2	4
R7	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R8	RES., FIXED, COMP 68 ohms, ± 5%, 1/4 w	81349	RC07GF680J	5	11
R9	RES., FIXED, COMP		SAME AS 1R2	3	REF
R10	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R11	RES., FIXED, COMP 100 ohms, ± 5%, 1/4 w	81349	RC07GF101J	7	16
R12	RES., FIXED, COMP 1.8K ohms, ± 5%, 1/4 w	81349	RC07GF182J	1	7
R13	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R14	RES., FIXED, COMP 2.2K ohms, ± 5%, 1/4 w	81349	RC07GF222J	2	6
R15	RES., FIXED, COMP		SAME AS 1A2R6	REF	REF
R16	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R17	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R18	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R19	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R20	RES., FIXED, COMP		SAME AS 1R2	REF	REF
R21	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R22	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R23	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R24	RES., FIXED, COMP 3.9K ohms, ± 5%, 1/4 w	81349	RC07GF392J	1	3
R25	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R26	RES., FIXED, COMP		SAME AS 1A2R14	REF	REF
R27	RES., FIXED, COMP		SAME AS 1R7	1	REF
R28	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R29	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R30	RES., FIXED, COMP 82K ohms, ± 5%, 1/4 w	81349	RC07GF823J	2	2
R31	RES., FIXED, COMP		SAME AS 1A2R30	REF	REF
R32	RES., FIXED, COMP		SAME AS 1R2	REF	REF
R33	RES., FIXED, COMP 1 Meg ohms, ± 5%, 1/4 w	81349	RC07GF105J	1	5

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R34	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R35	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R36	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R37	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R38	RES., FIXED, COMP 22K ohms, ± 5%, 1/4 w	81349	RC07GF223J	1	3
R39	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R40	NOT USED				
R41	RES., FIXED, COMP 10 ohms, ± 5%, 1/4 w	81349	RC07GF100J	1	1
R42	RES., FIXED, COMP 100K ohms, ± 5%, 1/4 w	81349	RC07GF104J	1	6
Y1	XTAL UNIT, QTZ 19.75 mc, ± 0.005%, -55 deg C to +105 deg C operating temp range	81349	CR64U19.75MC	1	1
Y2	XTAL UNIT, QTZ 1.65 mc, ± 0.005%, -55 deg C to +85 deg C operating temp range	19905	SC597-1	1	1
Y3	FILTER, BANDPASS 20KC-21.4 mc	23759	ERXF4600	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A2 AMPLIFIER, IF IF220-20

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP1	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk	17069	88001	10	23
MP2	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP4	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP5	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP6	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP7	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP8	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP9	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP10	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPLIFIER, IF	19905	IF221-75	1	1
C1	CAP., FXD, MICADL		SAME AS 1A2C29	1	REF
C2	CAP., FXD, MICADL 33 pf, ± 5%, 500 vdc	84171	DM10-330J	1	1
C3	CAP., FXD, MICADL 12 pf, ± 5%, 500 vdc	84171	DM10-120J	1	1
C4	CAP., FXD, MICADL		SAME AS 1A2C41	2	REF
C5	CAP., FXD, CER DL		SAME AS 1A2C5	18	REF
C6	CAP., FXD, MICADL		SAME AS 1A2C2	2	REF
C7	CAP., FXD, MICADL		SAME AS 1A2C7	2	REF
C8	NOT USED				
C9	CAP., FXD, COMP		SAME AS 1A2C9	1	REF
C10	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C11	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C12	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C13	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C14	NOT USED				

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C15	NOT USED				
C16	NOT USED				
C17	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C18	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C19	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C20	NOT USED				
C21	NOT USED				
C22	CAP., FXD, CER DL		SAME AS 1A2C22	2	REF
C23	CAP., FXD, MICADL		SAME AS 1A2C40	4	REF
C24	CAP., FXD, MICADL 430 pf, ± 5%, 500 vdc	81349	DM15-431J	1	1
C25	CAP., FXD, MICADL		SAME AS 1A2C2	REF	REF
C26	CAP., FXD, MICADL		SAME AS 1A2C7	REF	REF
C27	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C28	CAP., FXD, MICADL		SAME AS 1A2C28	2	REF
C29	CAP., FXD, CER DL		SAME AS 1A2C22	REF	REF
C30	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C31	CAP., FXD, MICADL 250 pf, ± 5%, 500 vdcw	84171	DM10-251J	1	1
C32	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C33	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C34	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C35	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C36	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C37	CAP., FXD, MICADL		SAME AS 1A2C28	REF	REF
C38	CAP., FXD, COMP 2.0 pf, ± 10%, 500 vdcw	95121	MC2.0	1	1
C39	CAP., FXD, COMP 2.7 pf, ± 10%, 500 vdcw	95121	MC2.7	1	1
C40	CAP., FXD, MICADL		SAME AS 1A2C40	REF	REF
C41	CAP., FXD, MICADL		SAME AS 1A2C41	REF	REF
C42	CAP., FXD, MICADL		SAME AS 1A2C40	REF	REF
C43	CAP., FXD, MICADL		SAME AS 1A2C40	REF	REF
C44	CAP., FXD, COMP 3.3 pf, ± 10%, 500 vdcw	95121	MC3.3	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C45	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C46	CAP., FXD, MICADL		SAME AS 1A2C25	1	REF
C47	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C48	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
CR1	SEMICONDDEV, DIO		SAME AS 1A2CR1	2	REF
CR2	SEMICONDDEV, DIO		SAME AS 1A2CR2	3	REF
CR3	SEMICONDDEV, DIO		SAME AS 1A2CR1	REF	REF
CR4	SEMICONDDEV, DIO		SAME AS 1A2CR2	REF	REF
CR5	SEMICONDDEV, DIO		SAME AS 1A2CR2	REF	REF
L1	COIL, RF Max ind 4 uh, min 1.7 uh, Q max 85, min 50, 19 turns no. 34 awg wire closewound on nylon bobbin	19905	AC257-3-1	2	2
L2	COIL, RF		SAME AS 1A3L1	REF	REF
L3	COIL, RF Max ind 70 uh, min 26 uh, Q max 75, min 30, 65 turns no 38 awg wire universally wound on nylon bobbin	19905	AC257-7-1	4	4
L4	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L5	COIL, RF		SAME AS 1A3L3	REF	REF
L6	NOT USED				
L7	COIL, RF		SAME AS 1A2L7	2	REF
L8	COIL, RF		SAME AS 1A2L3	1	REF
L9	COIL, RF		SAME AS 1A3L3	REF	REF
L10	COIL, RF		SAME AS 1A3L3	REF	REF
L11	COIL, RF		SAME AS 1A2L7	REF	REF
Q1	TRANSISTOR		SAME AS 1A2Q1	9	REF
Q2	TRANSISTOR		SAME AS 1A2Q2	1	REF
Q3	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q4	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q5	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q6	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q7	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q8	TRANSISTOR		SAME AS 1A2Q1	REF	REF
Q9	TRANSISTOR		SAME AS 1A2Q1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q10	TRANSISTOR		SAME AS 1A2Q1	REF	REF
R1	RES., FIXED, COMP		SAME AS 1R2	4	REF
R2	RES., FIXED, COMP 18K ohms, ± 5%, 1/4 w	81349	RC07GF183J	1	1
R3	RES., FIXED, COMP 12K ohms, ± 5%, 1/4 w	81349	RC07GF123J	1	1
R4	RES., FIXED, COMP		SAME AS 1A2R4	9	REF
R5	NOT USED				
R6	RES., FIXED, COMP		SAME AS 1A2R6	2	REF
R7	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R8	RES., FIXED, COMP		SAME AS 1A2R8	5	REF
R9	RES., FIXED, COMP		SAME AS 1R2	REF	REF
R10	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R11	RES., FIXED, COMP		SAME AS 1A2R11	7	REF
R12	RES., FIXED, COMP 220 ohms, ± 5%, 1/4 w	81349	RC07GF221J	1	1
R13	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R14	RES., FIXED, COMP		SAME AS 1A2R14	2	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R15	RES., FIXED, COMP		SAME AS 1A2R6	REF	REF
R16	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R17	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R18	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R19	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R20	RES., FIXED, COMP		SAME AS 1R2	REF	REF
R21	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R22	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R23	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R24	RES., FIXED, COMP		SAME AS 1A2R24	1	REF
R25	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R26	RES., FIXED, COMP		SAME AS 1A2R14	REF	REF
R27	RES., FIXED, COMP		SAME AS 1R7	1	REF
R28	RES., FIXED, COMP		SAME AS 1A2R8	REF	REF
R29	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R30	RES., FIXED, COMP 47K ohms, ± 5%, 1/4 w	81349	RC07GF473J	2	6

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R31	RES., FIXED, COMP		SAME AS 1A3 R30	REF	REF
R32	RES., FIXED, COMP		SAME AS 1R2	REF	REF
R33	RES., FIXED, COMP		SAME AS 1A2R33	1	REF
R34	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R35	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R36	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R37	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R38	RES., FIXED, COMP		SAME AS 1A2R38	1	REF
R39	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
Y1	XTAL UNIT, QTZ 18.9 mc, ± 0.005%, -55 deg C to +105 deg C	81349	CR64U18.9MC	1	1
Y2	XTAL UNIT, QTZ 2.5 mc, ± 0.005%, -55 deg C to + 85 deg C	19905	C594-8	1	1
Y3	FILTER, BANDPASS 21.4 mc center freq. ± 5 KC, bandwidth 3 db at 80 KC, ± 4 KC	74306	4093583	1	1
MP1	INSULATOR, DISK		SAME AS 1A2MP1	10	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A3 AMPLIFIER, IF IF221-75

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP2	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP4	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP5	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP6	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP7	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP8	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP9	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF
MP10	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM

SUB-ASSY 1A4 NOT USED

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPLIFIER, AF	19905	AASA201	1	1
C1	CAP., FXD, CER DL 1 uf, ± 20%, 25 vdcw	81349	5C13	1	1
C2	CAP., FXD, ELECT 2.2 uf, ± 10%, 35 vdcw	81349	CS13AF2R2K	1	1
C3	CAP., FXD, ELECT		SAME AS 1C8	2	REF
C4	CAP., FXD, ELECT		SAME AS 1C8	REF	REF
C5	CAP., FXD, ELECT 0.33 uf, ± 10%, 35 vdcw	81349	CS13BF334K	1	1
C6	CAP., FXD, ELECT 1.0 uf, ± 10%, 35 vdcw	81349	CS13AF010K	1	3
C7	CAP., FXD, ELECT 4.7 uf, ± 10%, 35 vdcw	81349	CS13AF4R7K	2	2
C8	CAP., FXD, ELECT 47 uf, ± 10%, 35 vdcw	81349	CS14AF470K	1	1
C9	CAP., FXD, ELECT 100 uf, ± 10%, 20 vdcw	81349	CS13AF101K	4	4
C10	NOT USED				
C11	NOT USED				
C12	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C13	CAP., FXD, ELECT		SAME AS 1A5C9	REF	REF
C14	CAP., FXD, ELECT		SAME AS 1A5C9	REF	REF
C15	CAP., FXD, CER DL 2.2 uf, ± 20%, 25 vdcw	81349	5C15	2	2
C16	CAP., FXD, ELECT 10 uf, ± 10%, 35 vdcw	81349	CS13AF100K	1	1
C17	CAP., FXD, ELECT		SAME AS 1A5C9	REF	REF
C18	CAP., FXD, CER DL		SAME AS 1A5C15	REF	REF
C19	CAP., FXD, ELECT		SAME AS 1A5C7	REF	REF
CR1	SEMICONDDEV, DIO Zener, 15 volts, 8.5 ohms max impedance, 16 ma max current, 2 axial wire lead terminals	81349	1N965B	1	1
CR2	SEMICONDDEV, DIO Zener, 7.2 volts, 20 ohms max impedance, 7 ma max current, 2 axial wire lead terminals	81349	1N753A	2	2
CR3	SEMICONDDEV, DIO		SAME AS 1A2CR1	2	REF
CR4	SEMICONDDEV, DIO Germanium, 100 PIV, 2 axial wire lead terminals	81349	1N933	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
CR5	SEMICONDDEV, DIO Zener, 5.1 volts, 20 ohms max impedance, 17 ma max current, 2 axial wire lead terminals	81349	1N751A	1	1
CR6	SEMICONDDEV, DIO		SAME AS 1A2CR1	REF	REF
CR7	SEMICONDDEV, DIO		SAME AS 1A2CR1	REF	REF
CR8	NOT USED				
CR9	SEMICONDDEV, DIO Zener, 3.3 volts, 20 ohms max impedance, 28 ma max current, 2 axial wire lead terminals	81349	1N746A	1	1
Q1	TRANSISTOR Silicon, 75 volts collector to base, 3 radial wire lead terminals	81349	2N1613	20	23
Q2	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q3	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q4	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q5	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q6	TRANSISTOR		SAME AS 1A5 Q1	REF	REF
Q7	TRANSISTOR		SAME AS 1A5Q1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q8	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q9	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q10	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q11	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q12	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q13	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q14	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q15	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q16	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q17	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q18	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q19	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q20	TRANSISTOR		SAME AS 1A5Q1	REF	REF
R1	RES., FIXED, COMP		SAME AS 1A2R42	5	REF
R2	RES., FIXED, COMP		SAME AS 1A2R4	8	REF
R3	RES., FIXED, COMP		SAME AS 1A2R33	3	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R4	RES., FIXED, COMP		SAME AS 1A2R33	REF	REF
R5	RES., FIXED, COMP		SAME AS 1R7	1	REF
R6	RES., FIXED, COMP		SAME AS 1A2R24	1	REF
R7	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R8	RES., FIXED, COMP 330K ohms, ± 5%, 1/4 w	81349	RC07GF334J	1	1
R9	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R10	RES., FIXED, COMP 5.6K ohms, ± 5%, 1/4 w	81349	RC07GF562J	1	1
R11	RES., FIXED, COMP		SAME AS 1A2R14	2	REF
R12	RES., FIXED, COMP		SAME AS 1A3R30	4	REF
R13	RES., FIXED, COMP		SAME AS 1A3R30	REF	REF
R14	RESISTOR, VAR 50K ohms, ± 20%, 1/5 w	80294	3068P1-503	1	1
R15	RES., FIXED, COMP		SAME AS 1A2R42	REF	REF
R16	RES., FIXED, COMP		SAME AS 1A3R30	REF	REF
R17	RES., FIXED, COMP		SAME AS 1A2R42	REF	REF
R18	RES., FIXED, COMP		SAME AS 1R6	1	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R19	RES., FIXED, COMP 120K ohms, ± 5%, 1/4 w	81349	RC07GF124J	1	1
R20	RES., FIXED, COMP 47 ohms, ± 5%, 1/4 w	81349	RC07GF470J	2	2
R21	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R22	RES., FIXED, COMP		SAME AS 1A5R20	REF	REF
R23	RES., FIXED, COMP		SAME AS 1A2R12	2	REF
R24	RES., FIXED, COMP		SAME AS 1A2R42	REF	REF
R25	RES., FIXED, COMP		SAME AS 1A2R42	REF	REF
R26	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R27	RES., FIXED, COMP		SAME AS 1A2R38	1	REF
R28	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R29	RES., FIXED, COMP		SAME AS 1A2R33	REF	REF
R30	RESISTOR, VAR 1 Meg ohm, ± 20%, 1/5 w	80294	3068P1-105	1	1
R31	RESISTOR, VAR 10K, ± 10%, 1/2 w	80294	3067P1-103	2	2
R32	RES., FIXED, COMP 2.7K ohms, ± 5%, 1/4 w	81349	RC07GF272J	2	2

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R33	NOT USED				
R34	RES., FIXED, COMP		SAME AS 1A2R12	REF	REF
R35	RES., FIXED, COMP 390 ohms, ± 5%, 1 w	81349	RC32GF391J	1	1
R36	RES., FIXED, COMP 33 ohms, ± 5%, 1/4 w	81349	RC07GF330J	3	3
R37	RES., FIXED, COMP 6.8K ohms, ± 5%, 1/4 w	81349	RC07GF682J	2	2
R38	RES., FIXED, COMP		SAME AS 1A5R36	REF	REF
R39	RES., FIXED, COMP 680 ohms, ± 5%, 1 w	81349	RC32GF681J	2	2
R40	RES., FIXED, COMP		SAME AS 1A5R37	REF	REF
R41	RES., FIXED, COMP		SAME AS 1A5R36	REF	REF
R42	RES., FIXED, COMP		SAME AS 1A5R39	REF	REF
R43	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
R44	RES., FIXED, COMP		SAME AS 1A5R32	REF	REF
R45	RES., FIXED, COMP 27K ohms, ± 5%, 1/4 w	81349	RC07GF273J	1	1
R46	RES., FIXED, COMP		SAME AS 1A3$30	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R47	RES., FIXED, COMP		SAME AS 1A2R14	REF	REF
R48	RESISTOR, VAR		SAME AS 1A5R31	REF	REF
R49	RES., FIXED, COMP		SAME AS	1	REF
R50	RES., FIXED, COMP 470 ohms, ± 5%, 1/2 w	81349	RC20GF471J	1	1
R51	RES., FIXED, COMP		SAME AS 1A2R4	REF	REF
MP1	HTSKELE-ELECOMP Aluminum, 0.500 in. od, 0.318 in. id, 0.250 in. thk	07387	3AL635-2R	4	4
MP2	HTSKELE-ELECOMP		SAME AS 1A5MP1	REF	REF
MP3	HTSKELE-ELECOMP		SAME AS 1A5MP1	REF	REF
MP4	HTSKELE-ELECOMP		SAME AS 1A5MP1	REF	REF
MP5	INSULATOR, DISK Nylon, 0.340 in. dia, 0.070 in. thk	17069	88000	20	23
MP6	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP7	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP8	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP9	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A5 AMPLIFIER, AF AASA201

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP10	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP11	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP12	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP13	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP14	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP15	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP16	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP17	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP18	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP19	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP20	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP21	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP22	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP23	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP24	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A6 POWER SUPPLY PS211-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	POWER SUPPLY	19905	PS211-1	1	1
C1	CAP., FXD, ELECT 100 uf, ± 10%, 20 vdcw	81349	CS13AE101K	2	2
C2	CAP., FXD, CER DL		SAME AS 1A2C5	5	REF
C3	CAP., FXD, ELECT 150 uf, ± 10%, 15 vdcw	81349	CS13AD151K	2	2
C4	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C5	CAP., FXD, ELECT		SAME AS 1A5C6	2	REF
C6	CAP., FXD, ELECT 47 uf, ± 10%, 35 vdcw	81349	CS13AF470K	2	2
C7	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C8	CAP., FXD, ELECT		SAME AS 1A6C6	REF	REF
C9	CAP., FXD, ELECT		SAME AS 1A6C1	REF	REF
C10	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C11	CAP., FXD, ELECT		SAME AS 1A6C3	REF	REF
C12	CAP., FXD, CER DL		SAME AS 1A2C5	REF	REF
C13	CAP., FXD, ELECT		SAME AS 1A5C6	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A6 POWER SUPPLY PS211-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
CR1	SEMICONDDEV, DIO Zener, 6.8 volts, 20 ohms max impedance, 5 ma max current, 2 axial wire lead terminals	81349	IN754A	2	2
CR2	SEMICONDDEV, DIO Zener, 13 volts, 9.5 ohms max impedance, 13 ma max current, 2 axial wire lead terminals	07910	1N964B	2	2
CR3	SEMICONDDEV, DIO		SAME AS 1A6CR2	REF	REF
CR4	SEMICONDDEV, DIO		SAME AS 1A6CR1	REF	REF
CR5	RECTSEMICONDDEV Silicon, 100 PIV per cell, 1.2 v maximum forward voltage dropper cell at 500 ma, operating temp. range -50 to -175 deg C	04713	MDA920-3	3	3
CR6	RECTSEMICONDDEV		SAME AS 1A6CR5	REF	REF
CR7	RECTSEMICONDDEV		SAME AS 1A6CR5	REF	REF
F1	FUSE, CARTRIDGE 0.500 amp, 250 v, silver plated ferrules	81349	F01A250V1-2AS	3	3
F2	FUSE, CARTRIDGE		SAME AS 1A6F1	REF	REF
F3	FUSE, CARTRIDGE		SAME AS 1A6F1	REF	REF
Q1	TRANSISTOR		SAME AS 1A5Q1	3	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A6 POWER SUPPLY PS211-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q2	TRANSISTOR NPN, silicon type, 3 radial wire lead terminals	01295	2N2481	2	2
Q3	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q4	TRANSISTOR		SAME AS 1A5Q1	REF	REF
Q5	TRANSISTOR		SAME AS 1A6Q2	REF	REF
R1	RES., FIXED, FILM 1.3K ohms, ± 5%, 1/4 w	81349	RL07S132J	4	4
R2	RES., FIXED, FILM		SAME AS 1A6R1	REF	REF
R3	RES., FIXED, COMP		SAME AS 1R7	2	REF
R4	RES., FIXED, COMP		SAME AS 1A2R12	4	REF
R5	RESISTOR, VAR 1000 ohms, ± 20%, 1/2 w	80294	3067P1-102	2	2
R6	RES., FIXED, FILM 1.6K ohms, ± 5%, 1/4 w	81349	RL07S162J	2	2
R7	RES., FIXED, COMP		SAME AS 1A2R12	REF	REF
R8	RES., FIXED, FILM 510 ohms, ± 5%, 1/4 w	81349	RL07S511J	2	2
R9	RES., FIXED, FILM		SAME AS 1A6R8	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A6 POWER SUPPLY PS211-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R10	RES., FIXED, FILM		SAME AS 1A6R1	REF	REF
R11	RES., FIXED, FILM		SAME AS 1A6R1	REF	REF
R12	RES., FIXED, COMP		SAME AS 1R7	REF	REF
R13	RES., FIXED, COMP		SAME AS 1A2R12	REF	REF
R14	RESISTOR, VAR		SAME AS 1A6R5	REF	REF
R15	RES., FIXED, FILM		SAME AS 1A6R6	REF	REF
R16	RES., FIXED, COMP		SAME AS 1A2R12	REF	REF
MP1	INSULATOR, DISK		SAME AS 1A5MP5	3	REF
MP2	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP3	INSULATOR, DISK		SAME AS 1A5MP5	REF	REF
MP4	INSULATOR, DISK		SAME AS 1A2MP1	2	REF
MP5	INSULATOR, DISK		SAME AS 1A2MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A7 AMPLIFIER, IF ISA203

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPLIFIER, IF	19905	ISA203	1	1
C1	CAP., FXD, CER DL		SAME AS 1A2C1	4	REF
C2	CAP., FXD, CER DL		SAME AS 1A2C1	REF	REF
C3	CAP., FXD, MICADL 39 pf, ± 5%, 500 vdcw	81349	CM05D390J03	1	1
C4	CAP., FXD, MICADL 200 pf, ± 5%, 500 vdcw	81349	CM05D201J03	1	1
C5	CAP., FXD, CER DL		SAME AS 1A2C1	REF	REF
C6	CAP., FXD, CER DL 1000 pf, GMV	01121	FA5C102W	1	1
C7	CAP., FXD, CER DL		SAME AS 1A2C1	REF	REF
J1	CONN, PLUG, ELEC 50 ohms, screw on type, teflon insulation, gold plated female contacts	74868	5116-058350	1	1
J2	CONN, PLUG, ELEC 50 ohms, screw on printed circuit type, teflon insulation, gold plated female contacts	74868	5116-054900	1	1
L1	COIL, RF 20 turns no. 34 awg wire closewound on mineral molded form, coating applied	19905	AB024-82-1	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A7 AMPLIFIER, IF ISA203

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q1	TRANSISTOR		SAME AS 1A2Q1	1	REF
R1	RES., FIXED, COMP		SAME AS 1A2R11	2	REF
R2	RES., FIXED, COMP		SAME AS 1A2R8	1	REF
R3	RES., FIXED, COMP		SAME AS 1A2R11	REF	REF
R4	RES., FIXED, COMP		SAME AS 1R6	1	REF
R5	RES., FIXED, COMP		SAME AS 1R2	1	REF
R6	RES., FIXED, COMP		SAME AS 1A2R5	1	REF
R7	RES., FIXED, COMP 470 ohms, ± 5%, 1/4 w	81349	RC07GF471J	1	1
MP1	RETAINER, TSTR Copper, 0.220 in. dia, 0.280 in. lg, 6 contacts 0.170 in. lg for retaining transistor o/a dim	98978	TXB2P019-028B	1	1
MP2	INSULATOR, DISK		SAME AS 1A2MP1	1	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUN. UNIT, RF	19905	TN-488/WRR	1	1
DS1	LAMP, INCANDES Single contact midget flanged base, TI 3/4 bulb, 28v, 0.04 amp	96906	MS25237-327	1	1
J1	CONN, RECP, ELEC Quick crimp bulkhead type, teflon insulated, gold plated captive contacts	74868	31-369	1	1
P1	CONN, PLUG, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCM25W3PNMB	1	1
P1A1	CONN, PLUG, ELEC Right angle solder type, gold over silver plated brass contact, nylon insulator	71468	DM53741-5000	3	3
P1A2	CONN, PLUG, ELEC		SAME AS 2P1A1	REF	REF
P2	CONN, PLUG, ELEC 50 ohm screw-on type, teflon, insulated, gold plated male contacts	74868	5116-037475	9	9
P3	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P4	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P5	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P6	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RESISTOR, VAR 10K ohms, ± 10%, 2w	81349	RU4NAYSD103A	1	1
XDS1	LAMPHOLDER Chassis mounting subminiature type, for TI 3/4 incandescent lamp	72619	8-1930XP24	1	1
Z1	DUMMY LOAD, ELEC 51 ohms, ± 5%, 1/2 w	95712	534-2	1	1
MP1	WINDOW, DIAL Plastic sheet, acrylic base, transparent, 1.68 in. lg, 0.06 in. thk, 0.50 in. h, o/a dim. with engraved hair line	19905	A205	1	1
MP2	GEARSHAFT, SPUR Anodized aluminum gear, bronze hub, 0.375 in. lg, 1.027 in. dia o/a dim.	19905	A206-1	1	1
MP3	KNOB Crank type, plastic, black, 0.252 in. dia shaft, 0.58 in. thk, 0.89 in. dia o/a dim.	19905	A281	1	1
MP4	DIAL, SCALE White background, black markings, 0.004 in. thk, 0.629 in. w, 44.28 in. lg o/a dim.	19905	D470	1	1
MP5	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E2B	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUN. UNIT, RF	19905	TN-488/WRR	1	1
DS1	LAMP, INCANDES Single contact midget flanged base, TI 3/4 bulb, 28v, 0.04 amp	96906	MS25237-327	1	1
J1	CONN, RECP, ELEC Quick crimp bulkhead type, teflon insulated, gold plated captive contacts	74868	31-369	1	1
P1	CONN, PLUG, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCM25W3PNMB	1	1
P1A1	CONN, PLUG, ELEC Right angle solder type, gold over silver plated brass contact, nylon insulator	71468	DM53741-5000	3	3
P1A2	CONN, PLUG, ELEC		SAME AS 2P1A1	REF	REF
P2	CONN, PLUG, ELEC 50 ohm screw-on type, teflon, insulated, gold plated male contacts	74868	5116-037475	9	9
P3	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P4	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P5	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
P6	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 — TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RESISTOR, VAR 10K ohms, ± 10%, 2w	81349	RU4NAYSD103A	1	1
XDS1	LAMPHOLDER Chassis mounting subminiature type, for TI 3/4 incandescent lamp	72619	8-1930XP24	1	1
Z1	DUMMY LOAD, ELEC 51 ohms, ± 5%, 1/2 w	95712	534-2	1	1
MP1	WINDOW, DIAL Plastic sheet, acrylic base, transparent, 1.68 in. lg, 0.06 in. thk, 0.50 in. h, o/a dim. with engraved hair line	19905	A205	1	1
MP2	GEARSHAFT, SPUR Anodized aluminum gear, bronze hub, 0.375 in. lg, 1.027 in. dia o/a dim.	19905	A206-1	1	1
MP3	KNOB Crank type, plastic, black, 0.252 in. dia shaft, 0.58 in. thk, 0.89 in. dia o/a dim.	19905	A281	1	1
MP4	DIAL, SCALE White background, black markings, 0.004 in. thk, 0.629 in. w, 44.28 in. lg o/a dim.	19905	D470	1	1
MP5	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E2B	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP6	SEAL SHAFT Gray silicone rubber boot, brass nut, 3/8-32 thd size, 1/4 in. shaft size, 7/32 in. depth, 1/2 in. across flats o/a dim	97539	N9030-1-4	2	2
MP7	SEAL SHAFT		SAME AS 2MP6	REF	REF
MP8	TERMINAL LUG Brass, hot tin, 0.250 in. dia mtg hole, 0.062 in. dia contact hole, 0.015 in. thk, 0.296 in. h, 0.125 in. w o/a dim	79963	401	2	2
MP9	TERMINAL LUG		SAME AS 2MP8	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W1	CABLE ASSY, SP, EL RG 196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a 8205B plug, 4.000 in. lg	19905	AB1073-1	1	1
W1P1	CONN, PLUG, ELEC Bulkhead mouted push-on type, silver plated, beryllium copper contacts, teflon insulation	91737	8205B	1	1
W1P2	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
W2	CABLE ASSY, SP, EL RG 196/U coaxial cable, both ends terminated with 5116-037475 plugs, 6.000 in. lg	19905	AC076-109	1	1
W2P1	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
W2P2	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
W3	NOT USED				
W4	CABLE ASSY, SP, EL RG 196/U, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug	19905	AC801-6	1	1
W4P1	CONN, PLUG, ELEC		SAME AS 2P2	REF	REF
W4P2	CONN, PLUG, ELEC		SAME AS 2P1A1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	GEAR TRAIN ASSY Mechanical linkage for tuner and tape drive assembly	19905	GT201-7	1	1
MP1	GEAR ASSY, SPUR Hub type gear spur with a straight headless pin attached, 2.070 in. lg o/a dim	19905	AB052-1	1	1
MP2	BUSHING, ASSY Aluminum, 0.125 in. thk, 1.250 in. w, 1.780 in. h, with two retainers, 0.440 in. dia pressed fitted on plate o/a dim	19905	AB1107-4	1	1
MP3	SPROCKET ASSY Modified sprocket with a tape retainer press fitted	19905	AB522-2	1	1
MP4	DISK, CLUTCH Brass hub, 0.500 in. dia with two holes 4-40 unc-2B mated with a disk 1.235 in. dia o/a dim.	19905	AB525-2	1	1
MP5	COLLAR, SHAFT Brass, 0.14 in. thk, 0.500 in. od, 0.250 in. id, 2 holes drilled 4-40 unc-2B o/a dim.	19905	A018	2	2
MP6	COLLAR, SHAFT		SAME AS 2MP5	REF	REF
MP7	WASHER, BEVEL CRES sheet type 302, 0.090 in. thk, 0.620 in. od, 0.254 in. id o/a dim.	19905	A063	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP8	WASHER, BEVEL		SAME AS 2MP7	REF	REF
MP9	HOUSING, GEAR Aluminum alloy plate, "C" shaped, two legs 0.666 in. lg with one 0.3750 in. dia hole each leg, 0.500 in. w, 1.112 in. lg o/a dim.	19905	A078-2	1	1
MP10	HOUSING, BEARING Aluminum alloy, 0.620 in. lg, 0.060 in. thk shoulder with two mtg holes 0.104 in. dia one centrally located hole 0.500 in. dia o/a dim.	19905	A080-2	1	1
MP11	GEAR, BEVEL Brass, modified 0.312 in. dia with two holes 4-40 unc-2B o/a dim.	19905	A082	2	2
MP12	GEAR, BEVEL		SAME AS 2MP11	REF	REF
MP13	PIN, STR, HDLS CRES type 303, 0.124 in. dia, 1.380 in. lg, both ends chamfer .01X45° o/a dim.	19905	A093-1	1	1
MP14	REEL, TAPE Teflon, 0.500 in. dia ends, 0.030 in. lg 0.300 in. dia center, 0.128 in. dia centrally located hole, 0.22 in. w o/a dim.	19905	A095	2	2
MP15	REEL, TAPE		SAME AS 2MP14	REF	REF
MP16	POST, REEL Brass, 0.124 in. dia, 0.280 in. lg, flange one end 0.187 in. dia o/a dim.	19905	A097	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 — TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP17	POST, REEL		SAME AS 2MP16	REF	REF
MP18	SPACER, SLEEVE Aluminum alloy, 0.125 in. thk, 0.250 in. od, 0.135 in. id o/a dim.	19905	A153-3	2	2
MP19	SPACER, SLEEVE		SAME AS 2MP18	REF	REF
MP20	WASHER, FLAT Brass, 0.500 in. thk, 0.250 in. od, 0.125 in. id, o/a dim.	19905	A220	1	1
MP21	GUIDE, ROLLER Aluminum alloy, 0.310 in. dia, 0.690 in. lg center hole 0.140 in. dia o/a dim.	19905	A222-2	3	3
MP22	GUIDE, ROLLER		SAME AS 2MP21	REF	REF
MP23	GUIDE, ROLLER		SAME AS 2MP21	REF	REF
MP24	PIN, GROOVE, HD Brass, 0.124 in. dia, 0.720 in. lg, flange one end 0.180 in. dia, tapped 2-56 unc-2B on flanged end o/a dim.	19905	A223	3	3
MP25	PIN, GROOVE, HD		SAME AS 2MP24	REF	REF
MP26	PIN, GROOVE, HD		SAME AS 2MP24	REF	REF
MP27	BRACKET, LAMP Aluminum alloy, one leg 0.250 in. lg with two mtg holes 0.093 in. dia, other leg 0.437 in. dia, 0.620 in. w o/a dim.	19905	A236-2	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP28	SPACER Aluminum alloy, 0.118 in. thk, 0.444 in. od, 0.125 in. id o/a dim.	19905	A291-6	1	1
MP29	PIN, GROOVE, HDLS Steel, 0.124 in. dia, two grooves located 0.040 in. and 0.872 in. from one end, 1.410 in. lg o/a dim.	19905	A429	2	2
MP30	PIN, GROOVE, HDLS		SAME AS 2MP29	REF	REF
MP31	SHAFT, STRAIGHT Glass epoxy rod, 0.249 in. dia, both ends chamfer .01X45°, 2.76 in. lg o/a dim.	19905	A624-1	1	1
MP32	BUSHING, SLEEVE Teflon, 0.105 in. thk, 0.250 in. od, 0.127 in. id, chamfer .015X45° o/a dim.	19905	A689	10	10
MP33	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP34	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP35	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP36	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP37	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP38	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP39	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 — TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP40	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP41	BUSHING, SLEEVE		SAME AS 2MP32	REF	REF
MP42	PLATE, DIAL Aluminum, 0.125 in. thk, 2.62 in. lg, 1.84 in. h o/a dim.	19905	B134-3	1	1
MP43	SPOOL, DRIVE Aluminum, 0.680 in. dia ends, 0.910 in. lg, 0.510 in. dia center, 0.190 in. dia hole entire length o/a dim.	19905	B523-2	2	2
MP44	SPOOL, DRIVE		SAME AS 2MP43	REF	REF
MP45	COVER, GEAR TN Aluminum, 0.200 in. thk, 2.250 in. lg, 2.000 in. h o/a dim.	19905	B808-2	1	1
MP46	PLATE, RET., BRG Aluminum, 0.250 in. thk, 2.620 in. lg, 2.000 in. h o/a dim.	19905	C263-2	1	1
MP47	TERMFEEDTHRUIS Teflon insulation, 0.178 in. dia, brass terminals 0.040 in. dia, 0.515 in. lg o/a dim.	98291	FTSMT	1	1
MP48	SPG, SPIRAL, TOR CRES, 0.002 in. thk, 0.125 in. w, 40.00 in. lg, hole one end 0.062 in. dia o/a dim.	80545	N7443	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2 TUNING UNIT, RADIO FREQUENCY TN-488/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP49	SPG, SPIRAL, TOR		SAME AS 2MP48	REF	REF
MP50	BRG, BALLANNULAR CRES, 0.187 in. w, 0.500 in. od, 0.250 in. id, 8 balls, radial play .0001-.0005 o/a dim.	83086	SFR1883MM	3	3
MP51	BRG, BALLANNULAR		SAME AS 2MP50	REF	REF
MP52	BRG, BALLANNULAR		SAME AS 2MP50	REF	REF
MP53	BRG, BALLANNULAR CRES, 0.156 in. w, 0.375 in. od, 0.125 in. id, 7 balls, radial play .0001-.0005 o/a dim.	83086	SFR23MM	4	4
MP54	BRG, BALLANNULAR		SAME AS 2MP53	REF	REF
MP55	BRG, BALLANNULAR		SAME AS 2MP53	REF	REF
MP56	BRG, BALLANNULAR		SAME AS 2MP53	REF	REF
MP57	STRAP, RETAINING Brass, 0.020 in. thk, 0.250 in. w, 0.440 in. lg, one mtg hole 0.120 in. dia o/a dim.	79963	116H.125	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNER, RF	19905	SH221-3	1	1
C1	CAP., FXD, MICADL 27 pf, ± 5%, 500 vdcw	81349	CM05E270J03	4	4
C2	CAP., FXD, CER DL 22 pf, ± 2%, NPO ± 60 ppm	81349	CC20CH220G	1	1
C3	CAP., VAR GL DL 0.85 - 7.0 pf	73899	NBJ1A	5	5
C4	CAP., FXD, CER DL 6.8 pf, ± .25, NPO ± 60 ppm	81349	CC20CH6R8C	3	3
C5	CAP., FXD, CER DL 5.0 pf, ± .25, NPO ± 60 ppm	81349	CC20CH5R0C	1	1
C6	CAP., FXD, CER DL		SAME AS 2A1C4	REF	REF
C7	CAP., VAR, GL DL		SAME AS 2A1C3	REF	REF
C8	CAP., FXD, CER DL 47 pf, ± 2%, -750 ppm	81349	CC20UJ470G	1	1
C9	CAP., FXD, MICADL		SAME AS 2A1C1	REF	REF
C10	CAP., FXD, CER DL 1000 pf, GMV	01121	SS5A102W	6	15
C11	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C12	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C13	CAP., FXD, CER DL 8.2 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CH8R2C	1	1
C14	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C15	CAP., FXD, CER DL 3.3 pf, ± .25, NPO ± 120 ppm	81349	CC20CJ3R3C	2	2
C16	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C17	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C18	CAP., FXD, CER DL 0.001 uf, ± 20%, 1000 vdc	81349	CK60AW102M	5	10
C19	CAP., FXD, CER DL 1000 pf, GMV	01121	FA5C102W	10	15
C20	CAP., VAR, GL DL		SAME AS 2A1C3	REF	REF
C21	CAP., FXD, MICADL 22 pf, ± 5%, 500 vdc	81349	CM05E220J03	1	3
C22	CAP., FXD, MICADL 330 pf, ± 5%, 500 vdc	81349	CM05F331J03	1	1
C23	CAP., FXD, COMP 1.2 pf, ± 10%, 500 vdc	95121	MC1.2	2	2
C24	CAP., VAR, GL DL		SAME AS 2A1C3	REF	REF
C25	CAP., FXD, COMP		SAME AS 2A1C23	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C26	CAP., FXD, CER DL 3.0 pf, ± .25 pf, NPO ± 120 ppm	81349	CC20CJ3R0C	2	2
C27	CAP., VAR, GL DL		SAME AS 2A1C3	REF	REF
C28	CAP., FXD, MICADL		SAME AS 2A1C1	REF	REF
C29	CAP., FXD, CER DL 4.7 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CJ4R7C	4	4
C30	CAP., FXD, MICADL 24 pf, ± 5%, 500 vdc	81349	CM05E240J03	2	2
C31	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C32	CAP., FXD, CER DL		SAME AS 2A1C26	REF	REF
C33	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C34	CAP., FXD, CER DL		SAME AS 2A1C15	REF	REF
C35	CAP., FXD, MICADL 18 pf, ± 5%, 500 vdc	81349	CM05C180J03	1	2
C36	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C37	CAP., FXD, COMP 4.3 pf, ± 10%, 500 vdc	95121	MC4.3	1	1
C38	CAP., FXD, MICADL		SAME AS 2A1C30	REF	REF
C39	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C40	CAP., FXD, CER DL 2.2 pf ± .25 pf, NPO ± 120 ppm	81349	CC20CJ2R2C	1	1
C41	CAP., FXD, MICADL		SAME AS 2A1C1	REF	REF
C42	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C43	NOT USED				
C44	CAP., FXD, CER DL		SAME AS 2A1C29	REF	REF
C45	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C46	CAP., FXD, CER DL 100 pf, ± 10%	01121	FA5C1011	1	1
C47	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C48	CAP., FXD, CER DL		SAME AS 2A1C29	REF	REF
C49	CAP., VAR, GL DL 0.8-8.5 pf, 750 vdcw	81349	PC40J8R5	1	1
C50	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C51	NOT USED				
C52	CAPACITOR, VAR Silicon alloy varicap, 27 pf ± 5.4, Q min 7, 20 volts working	01281	V27	1	1
C53	CAP., FXD, CER DL		SAME AS 2A1C29	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C54	CAP., FXD, CER DL		SAME AS 2A1C4	REF	REF
C55	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C56	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C57	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C58	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C59	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C60	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
J1	CONN, RECP, ELEC 50 ohms, screw on type, teflon insulation, gold plated female contacts	74868	5116-058350	3	9
J2	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
J3	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
L1	COIL, RF Ind 0.124 uh, 4 turns no. 24 awg wire wound on a mineral molded form, coating applied	19905	AB024-25-1	4	4
L2	TUNING UNIT, RF Sealed unit	19905	A123-3-1	1	1
L3	NOT USED				
L4	COIL, RF		SAME AS 2A1L1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L5	NOT USED				
L6	COIL, RF Ind. 3.3 uh, ± 10%, Q min. 30, min self-resonant freq. 70 mc, max DC resistance 0.140 ohms	81349	LT4K040	2	2
L7	COIL, RF 9 turns no. 24 awg wire closewound	19905	A107-20-1	1	1
L8	COIL, RF Ind. 0.14 uh, 5 turns no. 24 awg wire wound on a mineral molded form, coating applied	19905	AB024-28-1	2	2
L9	NOT USED				
L10	COIL, RF		SAME AS 2A1L1	REF	REF
L11	COIL, RF		SAME AS 2A1L1	REF	REF
L12	COIL, RF Ind. 1.0 uh, ± 10%, Q min 40, min self-resonant freq 200 mc, max DC resistance 0.290 ohms	81349	LT4K034	1	1
L13	NOT USED				
L14	COIL, RF 22 turns no. 30 awg wire closewound on a mineral molded form, coating applied	19905	AB002-16-1	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L15	COIL, RF		SAME AS 2A1L14	REF	REF
L16	COIL, RF Ind. 0.96 uh, 21 turns no. 29 awg wire wound on a mineral molded form, coating applied	19905	AB024-27-1	1	1
L17	COIL, RF		SAME AS 2A1L8	REF	REF
L18	COIL, RF		SAME AS 2A1L6	REF	REF
Q1	TRANSISTOR Small signal NPN, silicon type, 3 radial wire lead terminals	20754	2N2857	1	1
Q2	TRANSISTOR NPN, silicon type, 3 radial wire lead terminals	81349	2N918	2	4
Q3	TRANSISTOR NPN, silicon type, stud mount, leads	01295	2N2950	1	1
Q4	TRANSISTOR		SAME AS 2A1Q2	REF	REF
Q5	TRANSISTOR NPN, silicon, 4 radial wire lead terminals	19905	A395	1	3
R1	RES., FIXED, COMP 100K ohms, ± 5%, 1/4 w	81349	RC07GF104J	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A1 — TUNER, RF SH 221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R2	RES., FIXED, COMP 100 ohms, ± 5%, 1/4 w	81349	RC07GF101J	2	6
R3	NOT USED				
R4	NOT USED				
R5	NOT USED				
R6	NOT USED				
R7	NOT USED				
R8	RES., FIXED, COMP 3.9K ohms, ± 5%, 1/4 w	81349	RC07GF392J	4	4
R9	RES., FIXED, COMP		SAME AS 2A1R2	REF	REF
R10	RES., FIXED, COMP		SAME AS 2A1R8	REF	REF
R11	RES., FIXED, COMP 33 ohms ± 5%, 1/4 w	81349	RC07GF330J	3	3
R12	RES., FIXED, COMP 4.7K ohms, ± 5%, 1/4 w	81349	RC07GF472J	1	4
R13	RES., FIXED, COMP 1.8K ohms, ± 5%, 1/4 w	81349	RC07GF182J	2	3
R14	RES., FIXED, COMP 5.6K ohms, ± 5%, 1/4 w	81349	RC07GF562J	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R15	RES., FIXED, COMP 3.3K ohms, ± 5%, 1/4 w	81349	RC07GF332J	2	4
R16	RES., FIXED, COMP		SAME AS 2A1R13	REF	REF
R17	RES., FIXED, COMP		SAME AS 2A1R8	REF	REF
R18	RES., FIXED, COMP		SAME AS 2A1R8	REF	REF
R19	RES., FIXED, COMP 6.8K ohms, ± 5%, 1/4 w	81349	RC07GF682J	1	1
R20	RES., FIXED, COMP 470 ohms, ± 5%, 1/4 w	81349	RC07GF471J	1	2
R21	RES., FIXED, COMP		SAME AS 2A1R14	REF	REF
R22	RES., FIXED, COMP		SAME AS 2A1R15	REF	REF
R23	RES., FIXED, COMP 1K ohms, ± 5%, 1/4 w	81349	RC07GF102J	1	4
R24	RES., FIXED, COMP 10K ohms, ± 5%, 1/4 w	81349	RC07GF103J	3	6
R25	RES., FIXED, COMP		SAME AS 2A1R11	REF	REF
R26	RES., FIXED, COMP		SAME AS 2A1R24	REF	REF
R27	RES., FIXED, COMP		SAME AS 2A1R24	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A1 TUNER, RF SH221-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R28	RES., FIXED, COMP 1.2K ohms, ± 5%, 1/4 w	81349	RC07GF122J	1	2
R29	RES., FIXED, COMP		SAME AS 2A1R11	REF	REF
R30	RES., FIXED, COMP		SAME AS 2A1R1	REF	REF
R31	RES., FIXED, COMP 330 ohms, ± 5%, 1/4 w	81349	RC07GF331J	2	2
R32	RES., FIXED, COMP 18 ohms, ± 5%, 1/4 w	81349	RC07GF180J	1	1
R33	RES., FIXED, COMP		SAME AS 2A1R31	REF	REF
R34	RES., FIXED, COMP 1.5K ohms, ± 5%, 1/4 w	81349	RC07GF152J	1	3
R35	RES., FIXED, COMP 15K ohms, ± 5%, 1/4 w	81349	RC07GF153J	1	1
TP1	JACK, TIP Teflon insulation, 0.218 in. dia, copper terminal 0.045 in. dia, 0.375 in. lg o/a dim.	98291	SKT12	1	1
MP1	RETAINER, TSTR Copper, 0.220 in. dia, 0.280 in. lg, 6 contacts 0.170 in. lg for retaining transistor o/a dim.	98978	TXB2P019-028B	1	7

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	PREAMPLIFIER	19905	PR21.4-3	1	1
C1	CAP., FXD, CER DL		SAME AS 2A1C18	3	REF
C2	CAP., FXD, CER DL		SAME AS 2A1C10	7	REF
C3	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C4	CAP., FXD, CER DL 1.5 pf, ± 0.25 pf, NPO ± 250 ppm	81349	CC20CK1R5C	2	2
C5	CAP., FXD, MICADL		SAME AS 2A1C35	1	REF
C6	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C7	CAP., FXD, MICADL		SAME AS 2A1C21	2	REF
C8	CAP., FXD, MICADL 68 pf, ± 5%, 500 vdcw	81349	CM05E680J03	1	1
C9	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C10	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C11	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C12	CAP., FXD, MICADL 15 pf, ± 5%, 500 vdcw	81349	CM05C150J03	1	1
C13	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C14	CAP., FXD, CER DL		SAME AS 2A2C4	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C15	CAP., FXD, MICADL		SAME AS 2A1C21	REF	REF
C16	CAP., FXD, MICADL 100 pf, ± 5%, 500 vdc	81349	CM05F101J03	1	1
C17	CAP., FXD, CER DL		SAME AS 2A1C19	3	REF
C18	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C19	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
C20	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C21	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
CR1	SEMICONDDEV, DIO Silicon, 50 PIV, 2 axial wirelead terminals	81349	1N3064	2	2
CR2	SEMICONDDEV, DIO		SAME AS 2A2CR1	REF	REF
J1	CONN, RECP, ELEC		SAME AS 2A1J1	4	REF
J2	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
J3	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
J4	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
L1	COIL, RF Ind 3.5 uh, 18 turns no. 34 awg wire closewound on a powdered iron core, coating and shielding case applied	19905	AC184-3-1	4	4

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L2	COIL, RF		SAME AS 2A2L1	REF	REF
L3	COIL, RF		SAME AS 2A2L1	REF	REF
L4	COIL, RF		SAME AS 2A2L1	REF	REF
Q1	TRANSISTOR NPN, triode, 6 radial wire lead terminals	07263	2N3337	2	2
Q2	TRANSISTOR		SAME AS 2A1Q5	2	REF
Q3	TRANSISTOR		SAME AS 2A2Q1	REF	REF
Q4	TRANSISTOR		SAME AS 2A1Q5	REF	REF
R1	RES., FIXED, COMP		SAME AS 2A1R2	4	REF
R2	RES., FIXED, COMP		SAME AS 2A1R2	REF	REF
R3	RES., FIXED, COMP 150 ohms, ± 5%, 1/4 w	81349	RC07GF151J	2	2
R4	RESISTOR, VAR 1K, ± 10%, 1/2 w	81349	RV6LAYSA102A	1	1
R5	RES., FIXED, COMP		SAME AS 2A2R3	REF	REF
R6	RES., FIXED, COMP		SAME AS 2A1R12	3	REF
R7	RES., FIXED, COMP		SAME AS 2A1R12	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 2A2

PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R8	RES., FIXED, COMP		SAME AS 2A1R24	1	REF
R9	RES., FIXED, COMP 2.7K ohms, ± 5%, 1/4 w	81349	RC07GF272J	2	2
R10	RES., FIXED, COMP		SAME AS 2A1R23	3	REF
R11	RES., FIXED, COMP		SAME AS 2A1R23	REF	REF
R12	RES., FIXED, COMP		SAME AS 2A1R15	2	REF
R13	NOT USED				
R14	RES., FIXED, COMP		SAME AS 2A1R34	2	REF
R15	RES., FIXED, COMP		SAME AS 2A1R28	1	REF
R16	RES., FIXED, COMP		SAME AS 2A1R12	REF	REF
R17	RES., FIXED, COMP		SAME AS 2A2R9	REF	REF
R18	RES., FIXED, COMP		SAME AS 2A1R23	REF	REF
R19	RES., FIXED, COMP		SAME AS 2A1R13	1	REF
R20	RES., FIXED, COMP		SAME AS 2A1R15	REF	REF
R21	RES., FIXED, COMP		SAME AS 2A1R34	REF	REF
R22	RES., FIXED, COMP 22K ohms, ± 5%, 1/4 w	81349	RC07GF223J	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A2

PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R23	RES., FIXED, COMP		SAME AS 2A1R2	REF	REF
R24	RES., FIXED, COMP		SAME AS 2A1R2	REF	REF
MP1	RETAINER, TSTR		SAME AS 2A1MP1	4	REF
MP2	RETAINER, TSTR		SAME AS 2A1MP1	REF	REF
MP3	RETAINER, TSTR		SAME AS 2A1MP1	REF	REF
MP4	RETAINER, TSTR		SAME AS 2A1MP1	REF	REF
MP5	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk.	17069	88001	4	6
MP6	INSULATOR, DISK		SAME AS 2A2MP5	REF	REF
MP7	INSULATOR, DISK		SAME AS 2A2MP5	REF	REF
MP8	INSULATOR, DISK		SAME AS 2A2MP5	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A3 — AMPLIFIER, ISOLATION ISA201-2

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPL, ISOLATION	19905	ISA201-2	1	1
C1	CAP., FXD, CER DL		SAME AS 2A1C18	2	REF
C2	CAP., FXD, CER DL		SAME AS 2A1C10	2	REF
C3	CAP., FXD, CER DL		SAME AS 2A1C10	REF	REF
C4	CAP., FXD, CER DL		SAME AS 2A1C18	REF	REF
C5	CAP., FXD, CER DL		SAME AS 2A1C19	2	REF
C6	CAP., FXD, CER DL		SAME AS 2A1C19	REF	REF
J1	CONN, RECP, ELEC		SAME AS 2A1J1	2	REF
J2	CONN, RECP, ELEC		SAME AS 2A1J1	REF	REF
L1	COIL, RF 3 turns, no. 18 awg wire closewound on a ceramic form	19905	AB764-1	1	1
Q1	TRANSISTOR		SAME AS 2A1Q2	2	REF
Q2	TRANSISTOR		SAME AS 2A1Q2	REF	REF
R1	RES., FIXED, COMP		SAME AS 2A1R24	2	REF
R2	RES., FIXED, COMP		SAME AS 2A1R24	REF	REF
R3	RES., FIXED, COMP 2.2K ohms, ± 5%, 1/4 w	81349	RC07GF222J	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 2A3 AMPLIFIER, ISOLATION ISA201-2

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R4	RES., FIXED, COMP 820 ohms, ± 5%, 1/4 w	81349	RC07GF821J	1	1
R5	NOT USED				
R6	RES., FIXED, COMP		SAME AS 2A1R20	1	REF
MP1	RETAINER, TSTR		SAME AS 2A1MP1	2	REF
MP2	RETAINER, TSTR		SAME AS 2A1MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 2A2MP5	2	REF
MP5	INSULATOR, DISK		SAME AS 2A2MP5	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUN. UNIT, RF	19905	TN-489/WRR	1	1
DS1	LAMP, INCANDES Single contact midget flanged base, TI 3/4 bulb, 28v, 0.04 amp	96906	MS25237-327	1	1
J1	CONN, RECP, ELEC Quick crimp bulkhead type, teflon insulated, gold plated captive contacts	74868	31-369	1	1
P1	CONN, PLUG, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCM25W3PNMB	1	1
P1A1	CONN, PLUG, ELEC Right angle solder type, gold over silver plated brass contact, nylon insulator	71468	DM53741-5000	3	3
P1A2	CONN, PLUG, ELEC		SAME AS 3P1A1	REF	REF
P2	CONN, PLUG, ELEC 50 ohm screw-on type, teflon insulated, gold plated male contacts	74868	5116-037475	9	9
P3	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
P4	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
P5	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
P6	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RESISTOR, VAR 10K ohms, ± 10%, 2 w	81349	RV4NAYSD103A	1	1
R2	RES., FIXED, COMP 1K ohms, ± 5%, 1/4 w	81349	RC07GF102J	1	5
XDS1	LAMPHOLDER Chassis mounting subminiature type, for TI 3/4 incandescent lamp	72619	8-1930XP24	1	1
Z1	DUMMY LOAD, ELEC 51 ohms, ± 5%, 1/2 w	95712	534-2	1	1
MP1	WINDOW, DIAL Plastic sheet, acrylic base, transparent, 1.68 in. lg, 0.06 in. thk, 0.50 in. h, o/a dim. with engraved hair line	19905	A205	1	1
MP2	GEARSHAFT, SPUR Anodized aluminum gear, bronze hub, 0.375 in. lg, 1.027 in. dia, o/a dim.	19905	A206-1	1	1
MP3	KNOB Crank type, plastic, black, 0.252 in. dia. shaft, 0.58 in. thk, 0.89 in. dia o/a dim.	19905	A281	1	1
MP4	DIAL, SCALE White background, black markings 0.004 in. thk, 0.629 in. w, 44.28 in. lg o/a dim.	19905	D472	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP5	SEAL SHAFT Grey silicone rubber boot, brass nut, 3/8-32 thd size, 1/4 in. shaft size, 7/32 in. depth, 1/2 in. across flats o/a dim.	97539	N9030-1-4	2	2
MP6	SEAL SHAFT		SAME AS 3MP5	REF	REF
MP7	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim.	96906	MS91528-1E2B	1	1
MP8	TERMINAL LUG Brass, hot tin, 0.250 in. dia mtg hole, 0.062 in. dia contact hole, 0.015 in. thk, 0.296 in. h, 0.125 in. w o/a dim.	79963	401	2	2
MP9	TERMINAL LUG		SAME AS 3MP8	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W1	CABLE ASSY, SP, EL RG 196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a 8205B plug, 4.000 in. lg	19905	AB1073-1	1	1
W1P1	CONN, PLUG, ELEC Bulkhead mounted push-on type, silver plated, beryllium copper contacts, teflon insulation	91737	8205B	1	1
W1P2	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
W2	CABLE ASSY, SP, EL RG 196/U coaxial cable, both ends terminated with 5116-037475 plugs, 6.000 in. lg	19905	AC076-109	1	1
W2P1	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
W2P2	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
W3	NOT USED				
W4	CABLE ASSY, SP, EL RG 196/U, one end terminated with a 5116-037475 plug, the other end with a DM 53741-5000 plug, 4.750 in. lg	19905	AC801-6	1	1
W4P1	CONN, PLUG, ELEC		SAME AS 3P2	REF	REF
W4P2	CONN, PLUG, ELEC		SAME AS 3P1A1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 — TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	GEAR TRAIN ASSY Mechanical linkage for tuner and tape drive assembly	19905	GT201-7	1	1
MP1	GEAR ASSY, SPUR Hub type gear spur with a straight headless pin attached, 2.070 in. lg o/a dim.	19905	AB052-1	1	1
MP2	BUSHING, ASSY Aluminum 0.125 in. thk, 1.250 in. w, 1.780 in. h, with two retainers 0.440 in. dia pressed fitted on plate o/a dim.	19905	AB1107-4	1	1
MP3	SPROCKET ASSY Modified sprocket with a tape retainer press fitted.	19905	AB522-2	1	1
MP4	DISK, CLUTCH Brass hub, 0.500 in. dia with two holes 4-40 unc-2B mated with a disk 1.235 in. dia o/a dim.	19905	AB525-2	1	1
MP5	COLLAR, SHAFT Brass, 0.14 in. thk, 0.500 in. od, 0.250 in. id, 2 holes drilled 4-40 unc-2B o/a dim.	19905	A018	2	2
MP6	COLLAR, SHAFT		SAME AS 3MP5	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP7	WASHER, BEVEL CRES sheet type 302, 0.090 in. thk, 0.620 in. od, 0.254 in. id o/a dim	19905	A063	2	2
MP8	WASHER, BEVEL		SAME AS 3MP7	REF	REF
MP9	HOUSING, GEAR Aluminum alloy plate,"C" shaped, two legs 0.666 in. lg with one 0.3750 in. dia hole each leg, 0.500 in. w, 1.112 in. lg o/a dim.	19905	A078-2	1	1
MP10	HOUSING, BEARING Aluminum alloy, 0.620 in. lg, 0.060 in. thk shoulder with two mtg holes 0.104 in. dia, one centrally located hole 0.500 in. dia o/a dim	19905	A080-2	1	1
MP11	GEAR, BEVEL Brass, modified 0.312 in. dia with two holes 4-40 unc-2B o/a dim	19905	A082	2	2
MP12	GEAR, BEVEL		SAME AS 3MP11	REF	REF
MP13	PIN, STR, HDLS CRES type 303, 0.124 in. dia, 1.380 in. lg, both ends chamfer .01X45° o/a dim	19905	A093-1	1	1
MP14	REEL, TAPE Teflon, 0.500 in. dia ends, 0.030 in. lg, 0.300 in. dia center, 0.128 in. dia centrally located hole, 0.22 in. w o/a dim	19905	A095	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP15	REEL, TAPE		SAME AS 3MP14	REF	REF
MP16	POST, REEL Brass, 0.124 in. dia, 0.280 in. lg, flange one end 0.187 in. dia, o/a dim.	19905	A097	2	2
MP17	POST, REEL		SAME AS 3MP16	REF	REF
MP18	SPACER, SLEEVE Aluminum alloy, 0.125 in. thk, 0.250 in. od, 0.135 in. id o/a dim	19905	A153-3	2	2
MP19	SPACER, SLEEVE		SAME AS 3MP18	REF	REF
MP20	WASHER, FLAT Brass, 0.500 in. thk, 0.250 in. od, 0.125 in. id o/a dim	19905	A220	1	1
MP21	GUIDE, ROLLER Aluminum alloy, 0.310 in. dia, 0.690 in. lg, center hole 0.140 in. dia o/a dim.	19905	A222-2	3	3
MP22	GUIDE, ROLLER		SAME AS 3MP21	REF	REF
MP23	GUIDE, ROLLER		SAME AS 3MP21	REF	REF
MP24	PIN, GROOVE, HD Brass, 0.124 in. dia, 0.720 in. lg, flange one end 0.180 in. dia, tapped 2-56 unc-2B on flanged end o/a dim	19905	A223	3	3

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C12	NOT USED				
C13	NOT USED				
C14	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C15	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C16	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C17	CAP., FXD, CER DL 1000 pf, GMV	01121	FA5C102W	11	16
C18	NOT USED				
C19	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C20	CAP., VAR, GL DL		SAME AS 3A1C3	REF	REF
C21	CAP., FXD, COMP 0.27 pf, ± 10%, 500 vdcw	95121	MCO.27	2	2
C22	CAP., FXD, COMP		SAME AS 3A1C21	REF	REF
C23	CAP., FXD, COMP 0.15 pf, ± 10%, 500 vdcw	95121	MCO.15	2	2
C24	CAP., VAR, GL DL		SAME AS 3A1C3	REF	REF
C25	CAP., FXD, COMP		SAME AS 3A1C23	REF	REF
C26	NOT USED				

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A1 — TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNER, RF	19905	SH222-3	1	1
C1	CAP., FXD, CER DL 8.2 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CH8R2C	2	2
C2	CAP., FXD, CER DL 4.7 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CH4R7C	2	2
C3	CAP., VAR, GL DL 0.85 - 7.0 pf	73899	NBJ1A	5	5
C4	CAP., FXD, CER DL .001 nf, ± 20%, 1000 vdc	81349	CK60AW102M	6	11
C5	CAP., FXD, COMP 0.82 pf, ± 10%, 500 vdcw	95121	MCO.82	1	1
C6	CAP., FXD, MICADL 10 pf, ± 5%, 500 vdcw	81349	CM05C100J03	1	1
C7	CAP., VAR GL DL		SAME AS 3A1C3	REF	REF
C8	CAP., FXD, CER DL 3.3 pf, ± .25 pf, NPO ± 120 ppm	81349	CC20CJ3R3C	2	2
C9	CAP., FXD, MICADL 47 pf, ± 5%, 500 vdcw	81349	CM05E470J03	1	1
C10	CAP., FXD, CER DL 1000 pf, GMV	01121	SS5A102W	7	16
C11	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 — TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP55	BRG, BALLANNULAR		SAME AS 3MP53	REF	REF
MP56	BRG, BALLANNULAR		SAME AS 3MP53	REF	REF
MP57	STRAP, RETAINING Brass, 0.020 in. thk, 0.250 in. w, 0.440 in. lg, one mtg hole 0.120 in. dia o/a dim	79963	116H.125	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP46	PLATE, RET., BRG Aluminum, 0.250 in. thk, 2.620 in. lg, 2.000 in. h o/a dim	19905	C263-2	1	1
MP47	TERMFEEDTHRUINS Teflon insulation, 0.178 in. dia, brass terminals 0.040 in. dia, 0.515 in. lg, o/a dim	98291	FTSM1	1	1
MP48	SPG, SPIRAL, TOR CRES, 0.002 in. thk, 0.125 in. w, 40.00 in. lg, hole one end 0.062 in. dia o/a dim	80545	N7443	2	2
MP49	SPG, SPIRAL, TOR		SAME AS 3MP48	REF	REF
MP50	BRG, BALLANNULAR CRES, 0.187 in. w, 0.500 in. od, 0.250 in. id, 8 balls, radial play .0001-.0005 o/a dim	83086	SFR1883MM	3	3
MP51	BRG, BALLANNULAR		SAME AS 3MP50	REF	REF
MP52	BRG, BALLANNULAR		SAME AS 3MP50	REF	REF
MP53	BRG, BALLANNULAR CRES, 0.156 in. w, 0.375 in. od, 0.125 in. id, 7 balls, radial play .0001-.0005 o/a dim	83086	SFR23MM	4	4
MP54	BRG, BALLANNULAR		SAME AS 3MP53	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP34	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP35	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP36	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP37	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP38	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP39	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP40	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP41	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF
MP42	PLATE, DIAL Aluminum, 0.125 in. thk, 2.62 in. lg, 1.84 in. h o/a dim	19905	B134-3	1	1
MP43	SPOOL, DRIVE Aluminum, 0.680 in. dia ends, 0.910 in. lg, 0.510 in. dia center, 0.190 in. dia hole entire length o/a dim	19905	B523-2	2	2
MP44	SPOOL, DRIVE		SAME AS 3MP43	REF	REF
MP45	COVER, GEAR TN Aluminum, 0.200 in. thk, 2.250 in. lg, 2.000 in. h o/a dim	19905	B808-2	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3 TUNING UNIT, RADIO FREQUENCY TN-489/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP25	PIN, GROOVE, HD		SAME AS 3MP24	REF	REF
MP26	PIN, GROOVE, HD		SAME AS 3MP24	REF	REF
MP27	BRACKET, LAMP Aluminum alloy, one leg 0.250 in. lg with two mtg holes 0.093 in. dia, other leg 0.680 in. lg with centrally located hole 0.437 in. dia, 0.620 in. w o/a dim	19905	A236-2	1	1
MP28	SPACER Aluminum alloy, 0.118 in. thk, 0.444 in. od, 0.125 in. id o/a dim	19905	A291-6	1	1
MP29	PIN, GROOVE, HDLS Steel, 0.124 in. dia, two grooves located 0.040 in. and 0.872 in. from one end, 1.410 in. lg o/a dim	19905	A429	2	2
MP30	PIN, GROOVE, HDLS		SAME AS 3MP29	REF	REF
MP31	SHAFT, STRAIGHT Glass epoxy rod, 0.249 in. dia, both ends chamfer .01X45°, 2.76 in. lg o/a dim	19905	A624-1	1	1
MP32	BUSHING, SLEEVE Teflon, 0.105 in. thk, 0.250 in. od, 0.127 in. id, chamfer .015X45° o/a dim	19905	A689	10	10
MP33	BUSHING, SLEEVE		SAME AS 3MP32	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A1

TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C27	CAP., VAR, GL DL		SAME AS 3A1C3	REF	REF
C28	CAP., FXD, CER DL		SAME AS 3A1C8	REF	REF
C29	CAP., FXD, CER DL 2.2 pf, ± .25 pf, NPO ± 120 ppm	81349	CC20CJ2R2C	3	3
C30	NOT USED				
C31	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C32	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C33	CAP., FXD, CER DL		SAME AS 3A1C1	REF	REF
C34	CAP., FXD, CER DL		SAME AS 3A1C2	REF	REF
C35	CAP., FXD, MICADL 22 pf, ± 5%, 500 vdcw	81349	CMO5E220J03	1	3
C36	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C37	CAP., FXD, COMP 4.3 pf, ± 10%, 500 vdcw	95121	MC4.3	1	1
C38	CAP., FXD, MICADL 24 pf, ± 5%, 500 vdcw	81349	CMO5E240J03	1	1
C39	CAP., FXD, CER DL		SAME AS 3A1C29	REF	REF
C40	CAP., VAR, GL DL 0.5 - 4.5 pf, 1000 vdcw	82872	MG1305	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A1 — TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C41	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C42	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C43	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C44	CAP., FXD, CER DL 1.0 pf, ± .25 pf, NPO ± 120 ppm	81349	CC20CK010C	1	1
C45	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C46	CAP., FXD, CER DL 100 pf, ± 10%	01121	FA5C1011	1	1
C47	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C48	NOT USED				
C49	CAP., FXD, CER DL		SAME AS 3A1C29	REF	REF
C50	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C51	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C52	NOT USED				
C53	NOT USED				
C54	NOT USED				
C55	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C56	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C57	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C58	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C59	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C60	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
J1	CONN, RECP, ELEC 50 ohms, screw on type, teflon insulation, gold plated female contacts	74868	5116-058350	3	9
J2	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF
J3	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF
L1	COIL, RF No. 18 awg wire tin plated, 2.500 in. lg	19905	B045-9	1	1
L2	TUNING UNIT, RF Sealed unit	19905	A123-3-1	1	1
L3	COIL, RF Ind 0.74 uh, 17 turns no. 29 awg wire close-wound on a mineral molded form, coating applied	19905	AB024-40-1	5	5
L4	COIL, RF No. 16 awg wire tin plated, 2.500 in. lg.	19905	B045-10	4	4

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L5	COIL, RF	19905	SAME AS 3A1L3	REF	REF
L6	COIL, RF Ind. 1.2 uh, ± 10%, Q min 30, min self-resonant freq. 180 mc, max dc resistance 0.400 ohms	81349	LT4K035	2	2
L7	COIL, RF 6 turns no. 24 awg wire	19905	A107-43-1	1	1
L8	COIL, RF		SAME AS 3A1L4	REF	REF
L9	COIL, RF		SAME AS 3A1L3	REF	REF
L10	COIL, RF		SAME AS 3A1L4	REF	REF
L11	COIL, RF		SAME AS 3A1L4	REF	REF
L12	COIL, RF		SAME AS 3A1L3	REF	REF
L13	COIL, RF Ind. 0.38 uh, 17 turns no. 30 awg wire closewound on a composition resistor, coating applied	19905	AB024-32-1	1	1
L14	COIL, RF 22 turns no. 30 awg wire closewound on a mineral molded form, coating applied	19905	AB002-16-1	2	2
L15	COIL, RF		SAME AS 3A1L14	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L16	COIL, RF Ind. 0.44 uh, 13 turns no. 26 awg wire closewound on a mineral molded form, coating applied	19905	AB024-30-1	1	1
L17	COIL, RF 2 turns no. 18 awg wire closewound	19905	A107-31-1	1	1
L18	COIL, RF		SAME AS 3A1L6	REF	REF
L19	COIL, RF		SAME AS 3A1L3	REF	REF
Q1	TRANSISTOR Small signal NPN silicon type, 3 radial wire lead terminals	20754	2N2857	1	1
Q2	TRANSISTOR Small signal PNP germanium type, 3 radial wire lead terminals	01295	2N2996	1	1
Q3	TRANSISTOR NPN silicon type, 3 radial wire lead terminals	81349	2N918	3	5
Q4	TRANSISTOR		SAME AS 3A1Q3	REF	REF
Q5	TRANSISTOR		SAME AS 3A1Q3	REF	REF
R1	RES., FIXED, COMP 100K ohms, ± 5%, 1/4 w	81349	RC07GF104J	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A1 — TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R2	RES., FIXED, COMP 100 ohms, ± 5%, 1/4 w	81349	RC07GF101J	2	6
R3	NOT USED				
R4	NOT USED				
R5	RES., FIXED, COMP 5.6K ohms, ± 5%, 1/4 w	81349	RC07GF562J	1	1
R6	NOT USED				
R7	NOT USED				
R8	RES., FIXED, COMP 3.9K ohms, ± 5%, 1/4 w	81349	RC07GF392J	3	3
R9	RES., FIXED, COMP		SAME AS 3A1R2	REF	REF
R10	NOT USED				
R11	RES., FIXED, COMP 33 ohms, ± 5%, 1/4 w	81349	RC07GF330J	3	3
R12	RES., FIXED, COMP		SAME AS 3A1R8	REF	REF
R13	RES., FIXED, COMP 2.2K ohms, ± 5%, 1/4 w	81349	RC07GF222J	2	3
R14	RES., FIXED, COMP		SAME AS 3A1R13	REF	REF
R15	NOT USED				

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R16	RES., FIXED, COMP 10K ohms, ± 5%, 1/4 w	81349	RC07GF103J	3	6
R17	NOT USED				
R18	RES., FIXED, COMP		SAME AS 3A1R16	REF	REF
R19	RES., FIXED, COMP 3.3K ohms, ± 5%, 1/4 w	81349	RC07GF332J	1	3
R20	RES., FIXED, COMP 470 ohms, ± 5%, 1/4 w	81349	RC07GF471J	1	2
R21	RES., FIXED, COMP 4.7K ohms, ± 5%, 1/4 w	81349	RC07GF472J	4	7
R22	RES., FIXED, COMP		SAME AS 3A1R21	REF	REF
R23	RES., FIXED, COMP		SAME AS 3R2	1	REF
R24	RES., FIXED, COMP		SAME AS 3A1R21	REF	REF
R25	RES., FIXED, COMP		SAME AS 3A1R11	REF	REF
R26	RES., FIXED, COMP 12K ohms, ± 5%, 1/4 w	81349	RC07GF123J	1	1
R27	RES., FIXED, COMP		SAME AS 3A1R21	REF	REF
R28	RES., FIXED, COMP		SAME AS 3A1R8	REF	REF
R29	RES., FIXED, COMP		SAME AS 3A1R11	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A1 TUNER, RF SH222-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R30	RES., FIXED, COMP		SAME AS 3A1R16	REF	REF
R31	RES., FIXED, COMP 330 ohms, ± 5%, 1/4 w	81349	RC07GF331J	2	2
R32	RES., FIXED, COMP 18 ohms, ± 5%, 1/4 w	81349	RC07GF180J	1	1
R33	RES., FIXED, COMP		SAME AS 3A1R31	REF	REF
TP1	JACK, TIP Teflon insulation, 0.218 in. dia, copper terminal 0.045 in. dia, 0.375 in. lg o/a dim	98291	SKT12	1	1
MP1	RETAINER, TSTR Copper, 0.220 in. dia, 0.280 in. lg, 6 contacts 0.170 in. lg for retaining transistor o/a dim.	98978	TXB2PO19-028B	1	7

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	PREAMPLIFIER	19905	PR21.4-3	1	1
C1	CAP., FXD, CER DL		SAME AS 3A1C4	3	REF
C2	CAP., FXD, CER DL		SAME AS 3A1C10	7	REF
C3	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C4	CAP., FXD, CER DL 1.5 pf, ± .25 pf, NPO, ± 250 ppm	81349	CC20CK1R5C	2	2
C5	CAP., FXD, MICADL 18 pf, ± 5%, 500 vdc	81349	CM05C180J03	1	1
C6	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C7	CAP., FXD, MICADL		SAME AS 3A1C35	2	REF
C8	CAP., FXD, MICADL 68 pf, ± 5%, 500 vdcw	81349	CM05E680J03	1	1
C9	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C10	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C11	CAP., FXD, CER DL		SAME AS 3A1C4	REF	REF
C12	CAP., FXD, MICADL 15 pf, ± 5%, 500 vdcw	81349	CM05C150J03	1	1
C13	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A2 PREAMPLIFIER PR21,4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C14	CAP., FXD, CER DL		SAME AS 3A2C4	REF	REF
C15	CAP., FXD, MICADL		SAME AS 3A1C35	REF	REF
C16	CAP., FXD, MICADL 100 pf, ± 5%, 500 vdc	81349	CM05F101J03	1	1
C17	CAP., FXD, CER DL		SAME AS 3A1C17	3	REF
C18	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C19	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
C20	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C21	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
CR1	SEMICONDDEV, DIO Silicon, 50 PIV, 2 axial wire lead terminals	81349	1N3064	2	2
CR2	SEMICONDDEV, DIO		SAME AS 3A2CR1	REF	REF
J1	CONN, RECP, ELEC		SAME AS 3A1J1	4	REF
J2	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF
J3	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF
J4	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L1	COIL, RF Ind. 3.5 uh, 18 turns no. 34 awg wire closewound on a powdered iron core, coating and shielding case applied	19905	AC184-3-1	4	4
L2	COIL, RF		SAME AS 3A2L1	REF	REF
L3	COIL, RF		SAME AS 3A2L1	REF	REF
L4	COIL, RF		SAME AS 3A2L1	REF	REF
Q1	TRANSISTOR NPN, triode, 6 radial wire lead terminals	07263	2N3337	2	2
Q2	TRANSISTOR NPN, silicon, 4 radial wire lead terminals	19905	A395	2	2
Q3	TRANSISTOR		SAME AS 3A2Q1	REF	REF
Q4	TRANSISTOR		SAME AS 3A2Q2	REF	REF
R1	RES., FIXED, COMP		SAME AS 3A1R2	4	REF
R2	RES., FIXED, COMP		SAME AS 3A1R2	REF	REF
R3	RES., FIXED, COMP 150 ohms, ± 5%, 1/4 w	81349	RC07GF151J	2	2
R4	RESISTOR, VAR. 1K, ± 10%, 1/2 w	81349	RV6LAYSA102A	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R5	RES., FIXED, COMP		SAME AS 3A2R3	REF	REF
R6	RES., FIXED, COMP		SAME AS 3A1R21	3	REF
R7	RES., FIXED, COMP		SAME AS 3A1R21	REF	REF
R8	RES., FIXED, COMP		SAME AS 3A1R16	1	REF
R9	RES., FIXED, COMP 2.7K ohms, ± 5%, 1/4 w	81349	RC07GF272J	2	2
R10	RES., FIXED, COMP		SAME AS 3R2	3	REF
R11	RES., FIXED, COMP		SAME AS 3R2	REF	REF
R12	RES., FIXED, COMP		SAME AS 3A1R19	2	REF
R13	NOT USED				
R14	RES., FIXED, COMP 1.5K ohms, ± 5%, 1/4 w	81349	RC07GF152J	2	2
R15	RES., FIXED, COMP 1.2K ohms, ± 5%, 1/4 w	81349	RC07GF122J	1	1
R16	RES., FIXED, COMP		SAME AS 3A1R21	REF	REF
R17	RES., FIXED, COMP		SAME AS 3A2R9	REF	REF
R18	RES., FIXED, COMP		SAME AS 3R2	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A2 PREAMPLIFIER PR21.4-3

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R19	RES., FIXED, COMP 1.8K ohms, ± 5%, 1/4 w	81349	RC07GF182J	1	1
R20	RES., FIXED, COMP		SAME AS 3A1R19	REF	REF
R21	RES., FIXED, COMP		SAME AS 3A2R14	REF	REF
R22	RES., FIXED, COMP 22K ohms, ± 5%, 1/4 w	81349	RC07GF223J	1	1
R23	RES., FIXED, COMP		SAME AS 3A1R2	REF	REF
R24	RES., FIXED, COMP		SAME AS 3A1R2	REF	REF
MP1	RETAINER, TSTR		SAME AS 3A1MP1	4	REF
MP2	RETAINER, TSTR		SAME AS 3A1MP1	REF	REF
MP3	RETAINER, TSTR		SAME AS 3A1MP1	REF	REF
MP4	RETAINER, TSTR		SAME AS 3A1MP1	REF	REF
MP5	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk	17069	88001	4	6
MP6	INSULATOR, DISK		SAME AS 3A2MP5	REF	REF
MP7	INSULATOR, DISK		SAME AS 3A2MP5	REF	REF
MP8	INSULATOR, DISK		SAME AS 3A2MP5	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 3A3 — AMPLIFIER, ISOLATION ISA201-2

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPL, ISOLATION	19905	ISA201-2	1	1
C1	CAP., FXD, CER DL		SAME AS 3A1C4	2	REF
C2	CAP., FXD, CER DL		SAME AS 3A1C10	2	REF
C3	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C4	CAP., FXD, CER DL		SAME AS 3A1C10	REF	REF
C5	CAP., FXD, CER DL		SAME AS 3A1C17	2	REF
C6	CAP., FXD, CER DL		SAME AS 3A1C17	REF	REF
J1	CONN, RECP, ELEC		SAME AS 3A1J1	2	REF
J2	CONN, RECP, ELEC		SAME AS 3A1J1	REF	REF
L1	COIL, RF 3 turns no. 18 awg wire closewound on a ceramic form	19905	AB764-1	1	1
Q1	TRANSISTOR		SAME AS 3A1Q3	2	REF
Q2	TRANSISTOR		SAME AS 3A1Q3	REF	REF
R1	RES., FIXED, COMP		SAME AS 3A1R16	2	REF
R2	RES., FIXED, COMP		SAME AS 3A1R16	REF	REF
R3	RES., FIXED, COMP		SAME AS 3A1R13	1	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 3A3 AMPLIFIER, ISOLATION ISA201-2

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R4	RES., FIXED, COMP 820 ohms, ± 5%, 1/4 w	81349	RC07GF821J	1	1
R5	NOT USED				
R6	RES., FIXED, COMP		SAME AS 3A1R20	1	REF
MP1	RETAINER, TSTR		SAME AS 3A1MP1	2	REF
MP2	RETAINER, TSTR		SAME AS 3A1MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 3A2MP5	2	REF
MP4	INSULATOR, DISK		SAME AS 3A2MP5	REF	REF

3. Manufacturers List.

Manufacturer	Code Number
Aeronautical Standards Group Department of Navy & Air Force Washington, D. C. 20000	88044
Allen-Bradley Co. 1201 South 2nd Street Milwaukee, Wisconsil 53204	01121
Amatora Electronic Hardware Co. Inc. 432 Main Street New Rochelle, New York 10800	05640
Amphenal Corp. Amphenal R F Division 33 East Franklin Street Danbury, Connecticut 06810	74867
A P M-Hex Corp. 41 Honeck Street P. O. Box 707 Englewood, New Jersey 06731	97539
Astro Communication Lab. Inc. 9125 Gaither Road Gaithersburg, Maryland 20760	19905
Augat Bros. Inc. Attleboro, Massachusetts 02703	91506
Baltimore Transformer & Coil Co. Elkridge, Maryland	85323
Belden Mfg. Co. Richmond, Indiana 47374	16428
Cambridge Thermionic Corp. 445 Concord Ave. Cambridge, Massachusetts 02138	71278
Camloc Fastener Corp. 22 Spring Valley Road Paramus, New Jersey 07652	71286

3. Manufacturers List (Cont.)

Manufacturer	Code Number
Circuit Structures Lab. 1024 West Ninth Street P. O. Box 8 Upland, California 91786	10069
Cutler-Hammer Inc. 411 North 12th Street Milwaukee 1, Wisconsin 53200	15605
Dage Electric Co. Inc. Hurricane Road Franklin, Indiana 46131	95712
Dialight Corporation 60 Stewart Avenue Brooklyn, New York 11200	72619
Drake Mfg. Co. Chicago, Illinois 60600	72765
Elco Corporation Willow Grove, Pennsylvania 19090	91662
Erie 644 West 12th Street Erie, Pennsylvania 16500	72982
Fairchild Camera & Instrument Corp. Semiconductor Division 313 Frontage Road Mountain View, California 94040	07263
Freed Transformer Co. Brooklyn, New York 11200	73386
F X R Division Amphenol-Bong Electronics Corp. Danbury, Connecticut 06810	74868

3. Manufacturers List (Cont.)

Manufacturer	Code Number
Greman Mfg. Co. Inc. 7 North Avenue Wakefield, Massachusetts 01880	91737
Herman H. Smith Inc. 2326 Nostrand Avenue Brooklyn, New York 11200	83330
Heyman Mfg. Co. Kenilworth, New Jersey 07033	28520
Hunter Spring A Division of Amtek Inc. 1 Spring Avenue Harfield, Pennsylvania 19440	80545
International Electronic Research Corp. 151 West Magnotia Avenue Burbank, California 91502	98978
I T T Cannon Electric Inc. 3208 Humbolt Street Los Angeles, California 90031	71468
James Millen Mfg. Co. Inc. 150 Exchange Street Malden, Massachusetts	76497
J F D Electronics Corp. 15th at 62nd Street Brooklyn, New York 11200	73899
Kings Electronics, Co. Inc. 40 Marblehead Road Tuckahoe, New York	91836
K M C Semiconductor Corp. Parker Road Long Valley, New Jersey 07853	20754
Littlefuse, Inc. 800 East Northwest Highway Des Plaines, Illionis 60016	75915

3. Manufacturers List (Cont.)

Manufacturer	Code Number
Military Standards	81349
Military Standards	96906
National Band & Tag Co. Newport, Kentucky 41071	91354
New Hampshire Ball Bearing Inc. Peterborough, New Hampshire 03458	83086
Penn Engineering & Mfg. Corp. Box 311 Doylestown, Pennsylvania 18901	46384
Quality Components Inc. P. O. Box 113 St. Marys, Pennsylvania 15857	95121
Raytheon Industrial Components Division 55 Chapel Street Newton, Massachusetts	81453
Sealectro Corp. 225 Hoyt Mamaroneck, New York 10555	98291
Sprague Electric Co. North Adams, Massachusetts 01247	56289
Texas Instruments, Inc. Semiconductor-Components Division Dallas, Texas 75200	01295
T R W Semiconductors Inc. 14520 Aviation Boulevard Lawndale, California 90260	01281
U. S. Engineering Co. Glendale, California 91200	88245

3. Manufacturers List (Cont.)

Manufacturer	Code Number
Wac Line Inc. 35 South Clain Street Dayton, Ohio 45400	94916
Waterman Electronic Tube Co. 1934 Hagert Street Philadelphia, Pennsylvania 19100	63982
Whitso Inc. 9330 Bynon Street Schillen Park, Illinois 60176	92825
Zierick Mfg. Corp. Beechwood & Rockdale New Rochelle, New York 10800	79963

SECTION VII

ILLUSTRATIONS AND SCHEMATICS

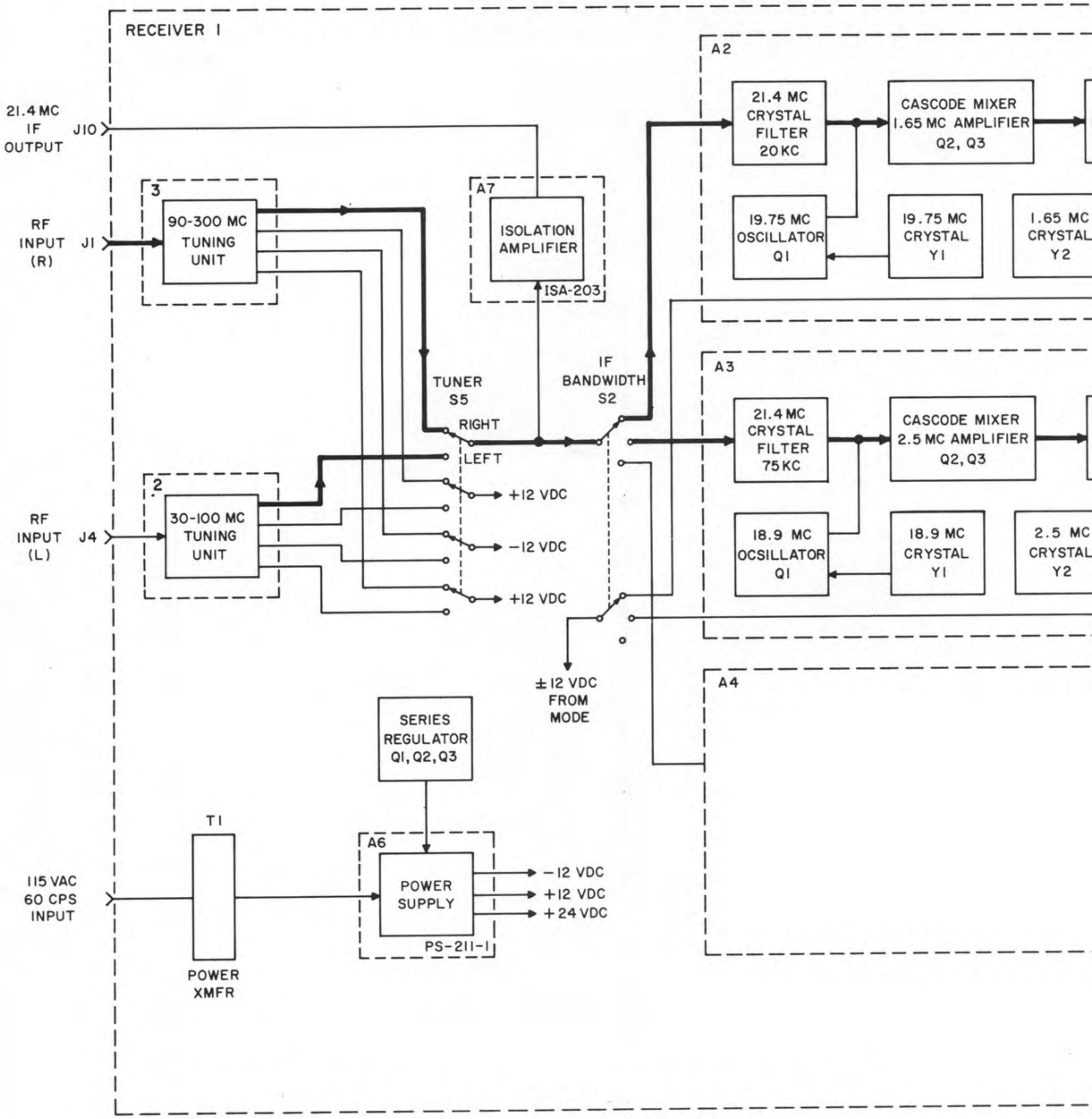
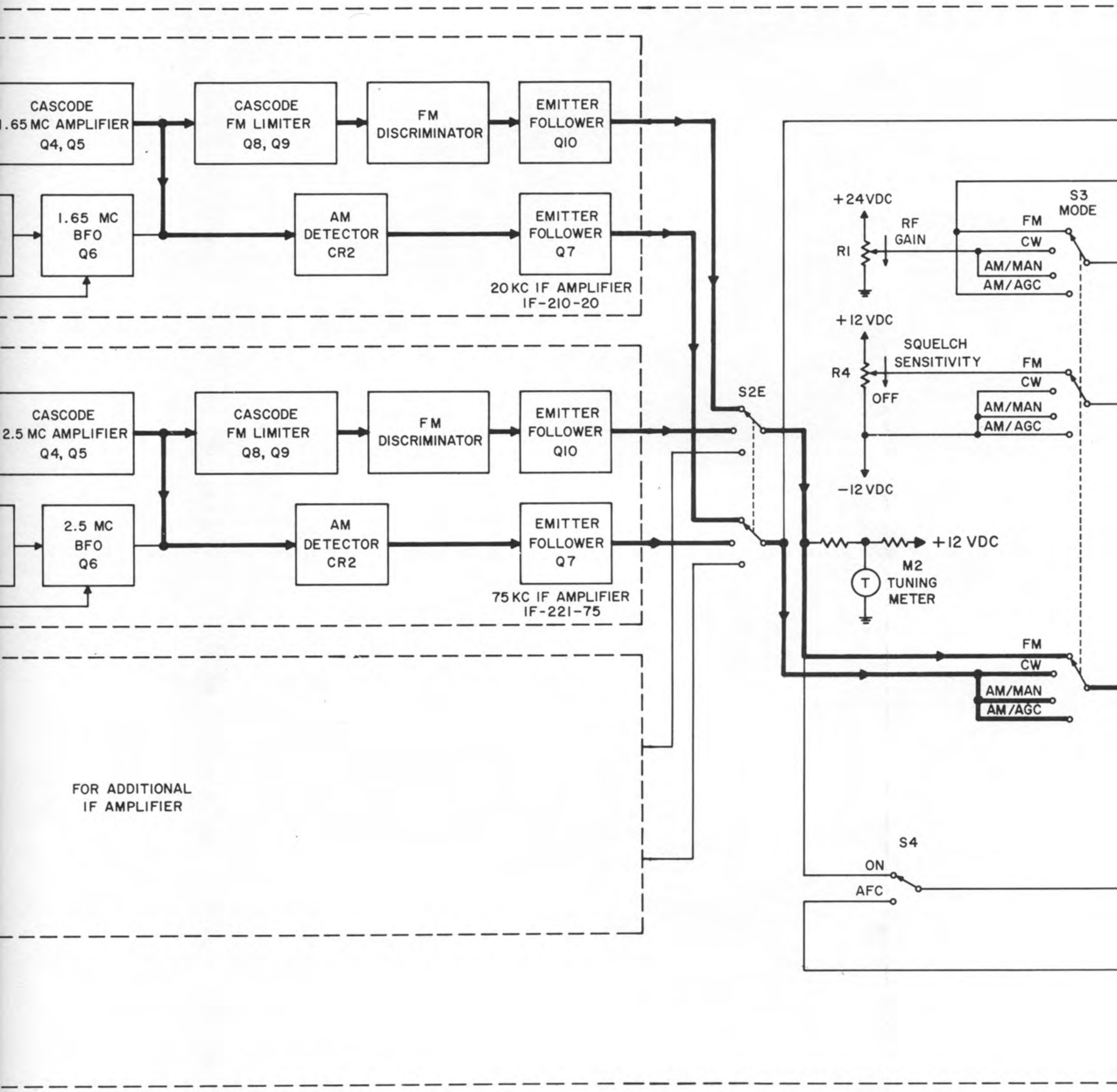


Figure 4-1. Receiver Functional Block Diagram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Q4, Q5
CASCODE
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Q8, Q9
FM
DISCRIMINATOR
EMITTER
FOLLOWER
Q10
1.65 MC
BFO
Q6
AM
DETECTOR
CR2
EMITTER
FOLLOWER
Q7
20 KC IF AMPLIFIER
IF-210-20
CASCODE
2.5 MC AMPLIFIER
Q4, Q5
CASCODE
FM LIMITER
Q8, Q9
FM
DISCRIMINATOR
EMITTER
FOLLOWER
Q10
2.5 MC
BFO
Q6
AM
DETECTOR
CR2
EMITTER
FOLLOWER
Q7
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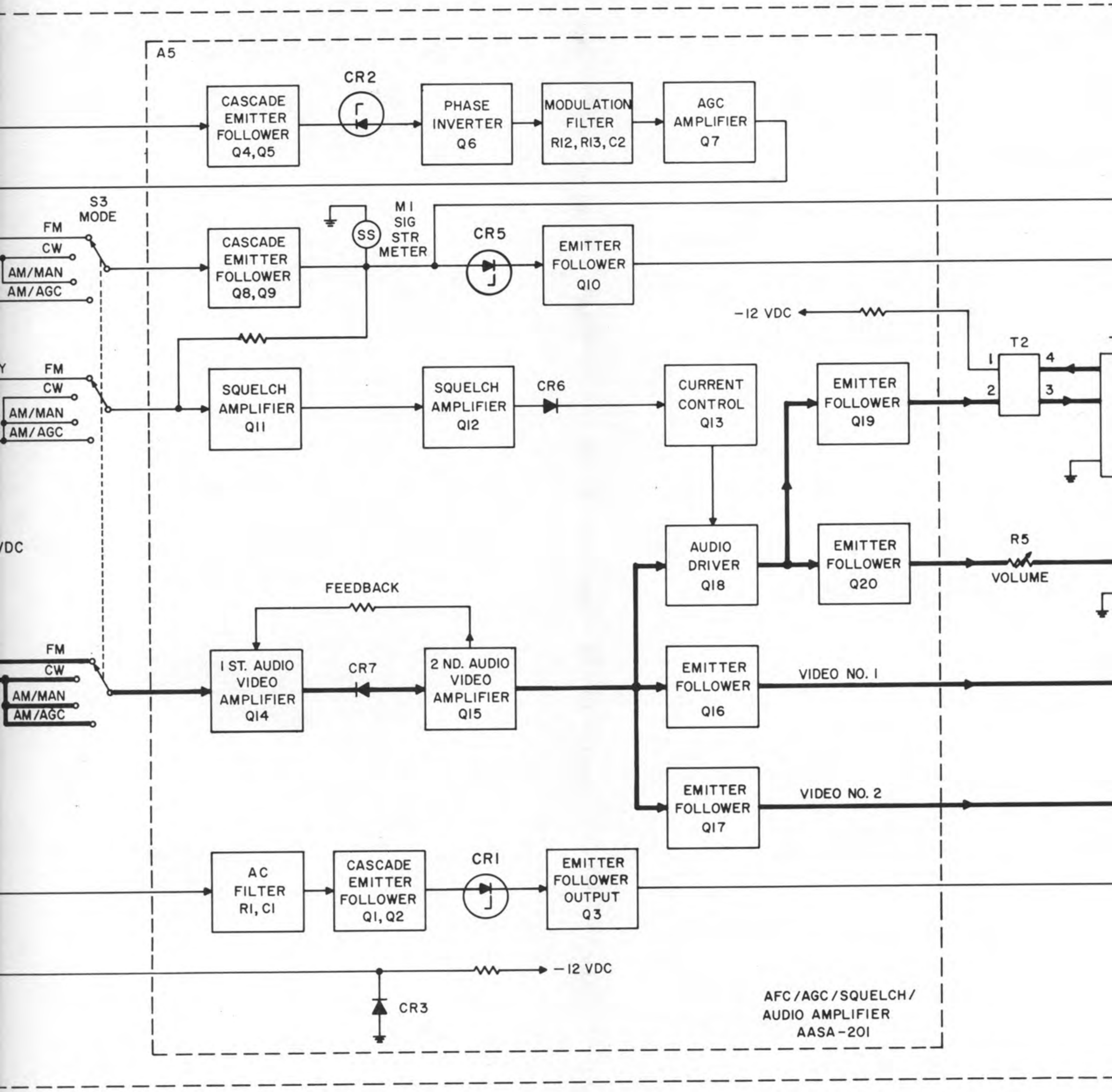
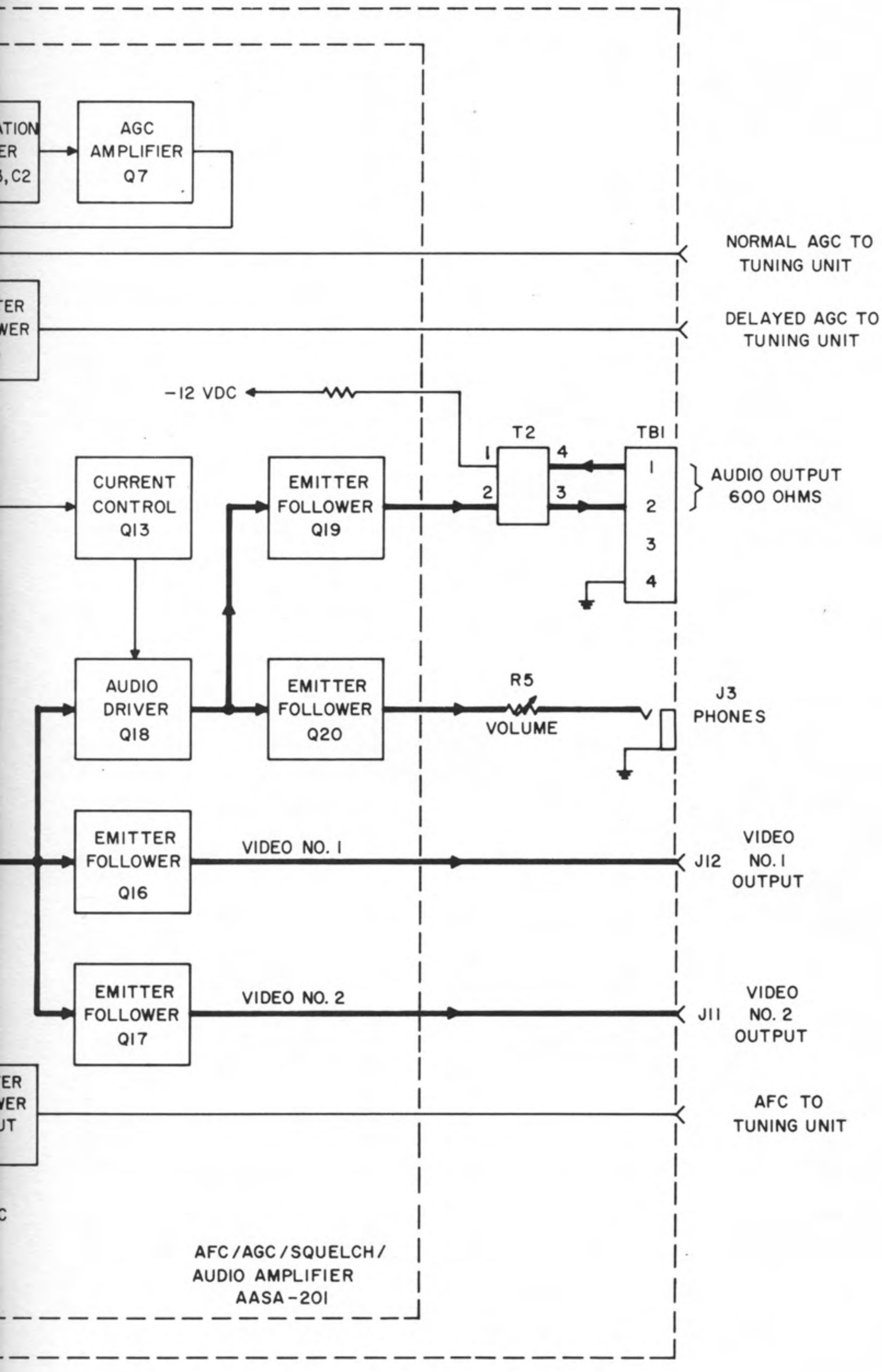
IF-221-75
FOR ADDITIONAL
IF AMPLIFIER
S2E
+24 VDC
R1
RF
GAIN
S3
MODE
FM
CW
AM/MAN
AM/AGC
+12 VDC
SQUELCH
SENSITIVITY
R4
OFF
FM
CW
AM/MAN
AM/AGC
-12 VDC
+12 VDC
M2
TUNING
METER
FM
CW
AM/MAN
AM/AGC
S4
ON
AFC


A5
CASCADE EMITTER FOLLOWER Q4, Q5
CR2
PHASE INVERTER Q6
MODULATION FILTER R12, R13, C2
AGC AMPLIFIER Q7
S3 MODE
FM
CW
AM/MAN
AM/AGC
CASCADE EMITTER FOLLOWER Q8, Q9
SS
M1 SIG STR METER
CR5
EMITTER FOLLOWER Q10
-12 VDC
T2
1
2
3
4
Y
SQUELCH AMPLIFIER Q11
SQUELCH AMPLIFIER Q12
CR6
CURRENT CONTROL Q13
EMITTER FOLLOWER Q19
VDC
AUDIO DRIVER Q18
EMITTER FOLLOWER Q20
R5
VOLUME
FEEDBACK
1 ST. AUDIO VIDEO AMPLIFIER Q14
CR7
2 ND. AUDIO VIDEO AMPLIFIER Q15
EMITTER FOLLOWER Q16
VIDEO NO. 1
EMITTER FOLLOWER Q17
VIDEO NO. 2
AC FILTER R1, C1
CASCADE EMITTER FOLLOWER Q1, Q2
CR1
EMITTER FOLLOWER OUTPUT Q3
-12 VDC
CR3
AFC/AGC/SQUELCH/ AUDIO AMPLIFIER AASA-201



ATION
ER
,C2
AGC
AMPLIFIER
Q7
NORMAL AGC TO
TUNING UNIT
TER
WER
DELAYED AGC TO
TUNING UNIT
-12 VDC
T2
TBI
AUDIO OUTPUT
600 OHMS
CURRENT
CONTROL
Q13
EMITTER
FOLLOWER
Q19
AUDIO
DRIVER
Q18
EMITTER
FOLLOWER
Q20
R5
VOLUME
J3
PHONES
EMITTER
FOLLOWER
Q16
VIDEO NO. 1
J12
VIDEO
NO. 1
OUTPUT
EMITTER
FOLLOWER
Q17
VIDEO NO. 2
J11
VIDEO
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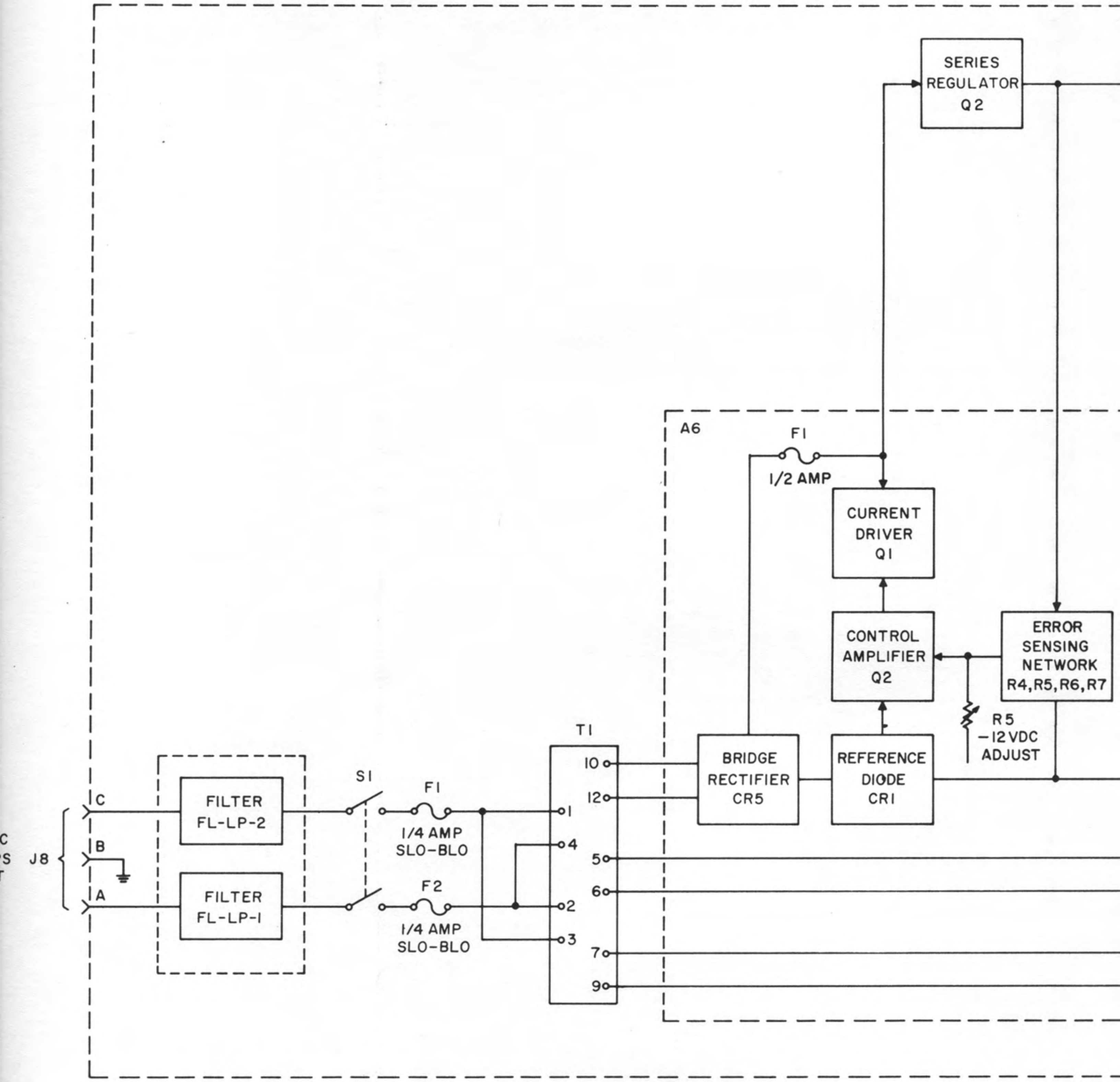
OUTPUT
ER
WER
UT
AFC TO
TUNING UNIT
AFC/AGC/SQUELCH/
AUDIO AMPLIFIER
AASA-201



SERIES
REGULATOR
Q2
A6
F1
1/2 AMP
CURRENT
DRIVER
Q1
CONTROL
AMPLIFIER
Q2
ERROR
SENSING
NETWORK
R4,R5,R6,R7
R5
−12 VDC
ADJUST
T1
BRIDGE
RECTIFIER
CR5
REFERENCE
DIODE
CR1
10
12
1
4
5
6
2
3
7
9
S1
F1
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SLO-BLO
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FILTER
FL-LP-1
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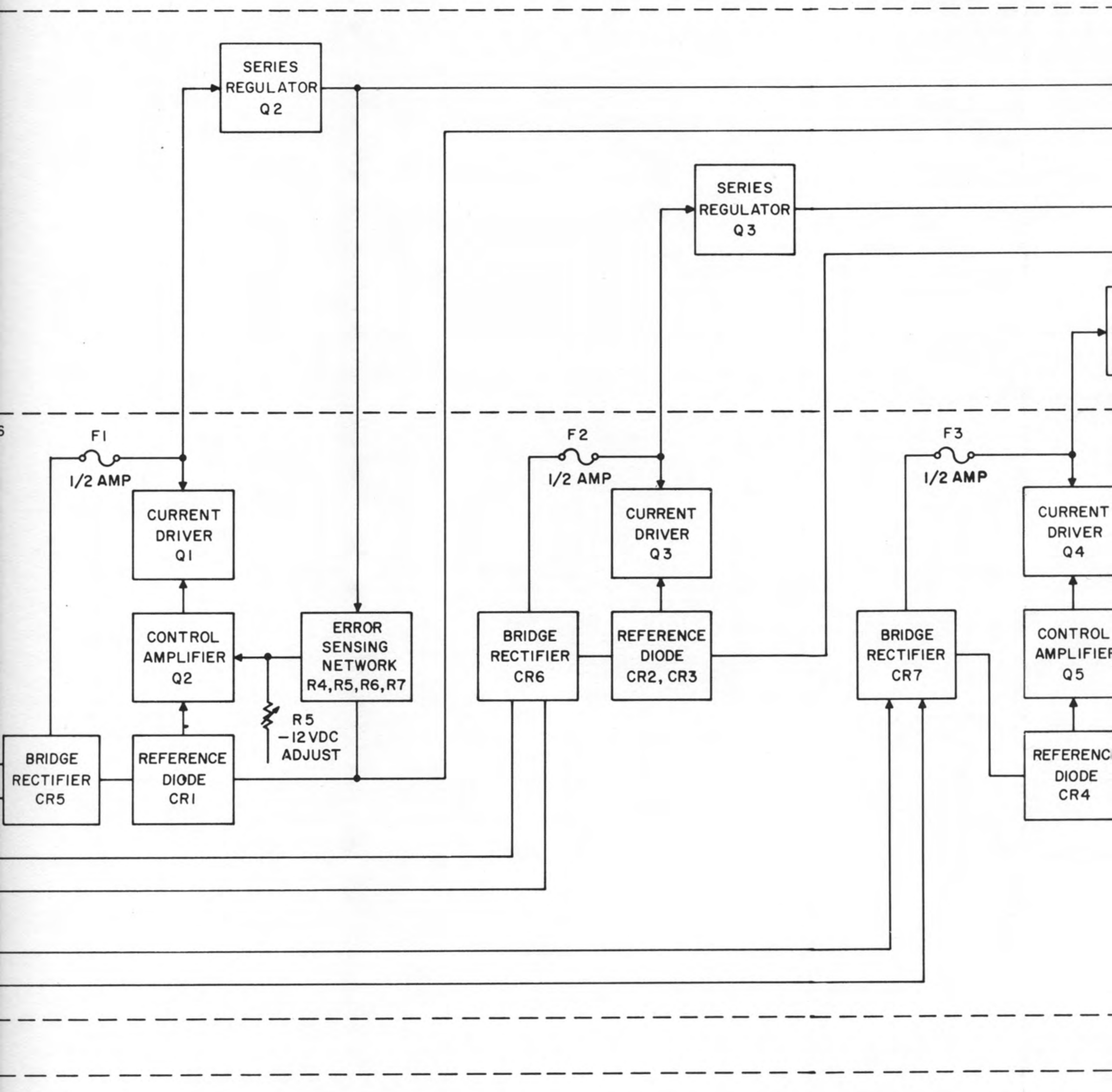
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REGULATOR
Q2
SERIES
REGULATOR
Q3
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F2
1/2 AMP
F3
1/2 AMP
CURRENT
DRIVER
Q1
CURRENT
DRIVER
Q3
CURRENT
DRIVER
Q4
CONTROL
AMPLIFIER
Q2
ERROR
SENSING
NETWORK
R4, R5, R6, R7
BRIDGE
RECTIFIER
CR6
REFERENCE
DIODE
CR2, CR3
BRIDGE
RECTIFIER
CR7
CONTROL
AMPLIFIER
Q5
R5
−12 VDC
ADJUST
BRIDGE
RECTIFIER
CR5
REFERENCE
DIODE
CR1
DIODE
CR4

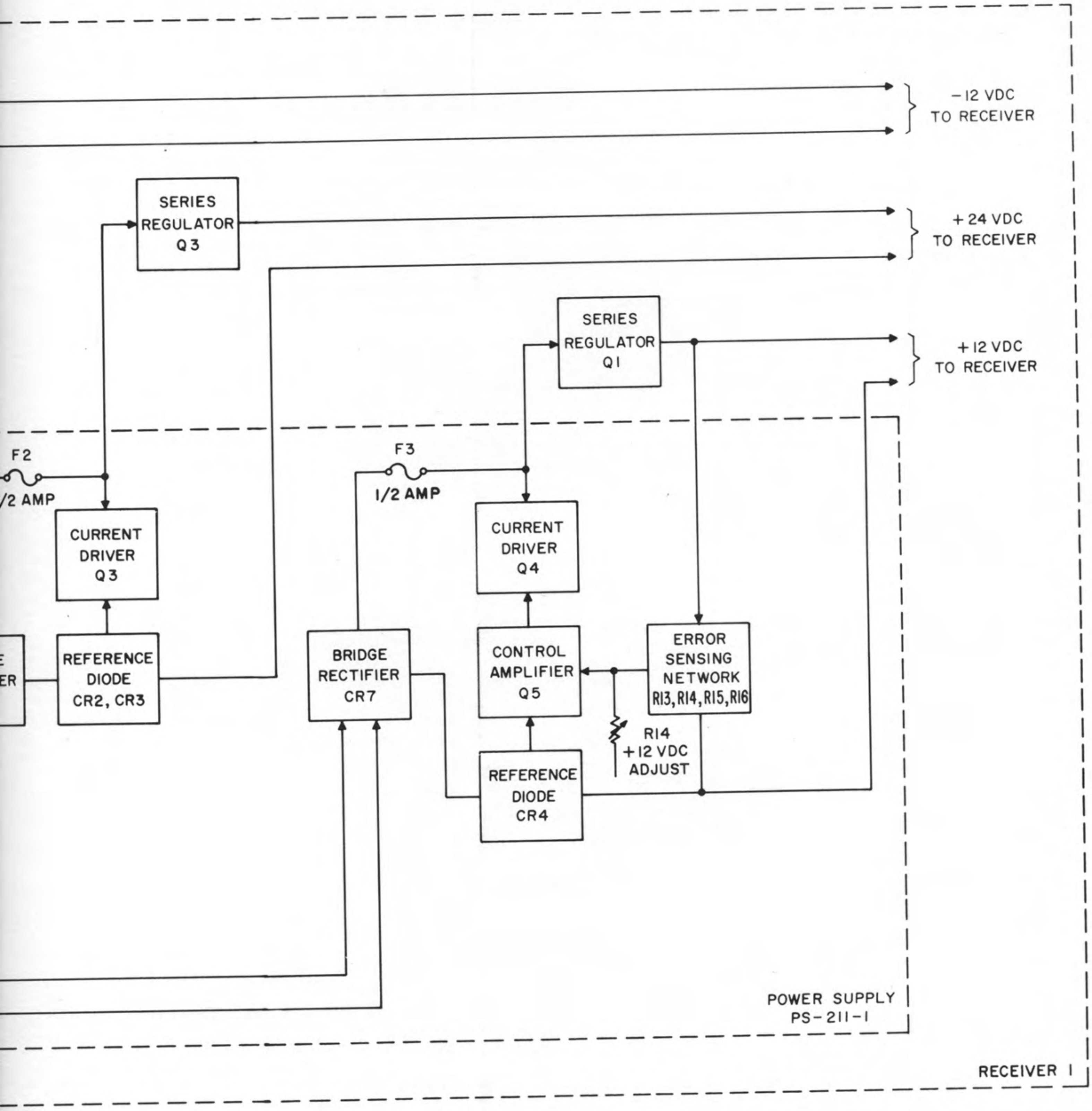
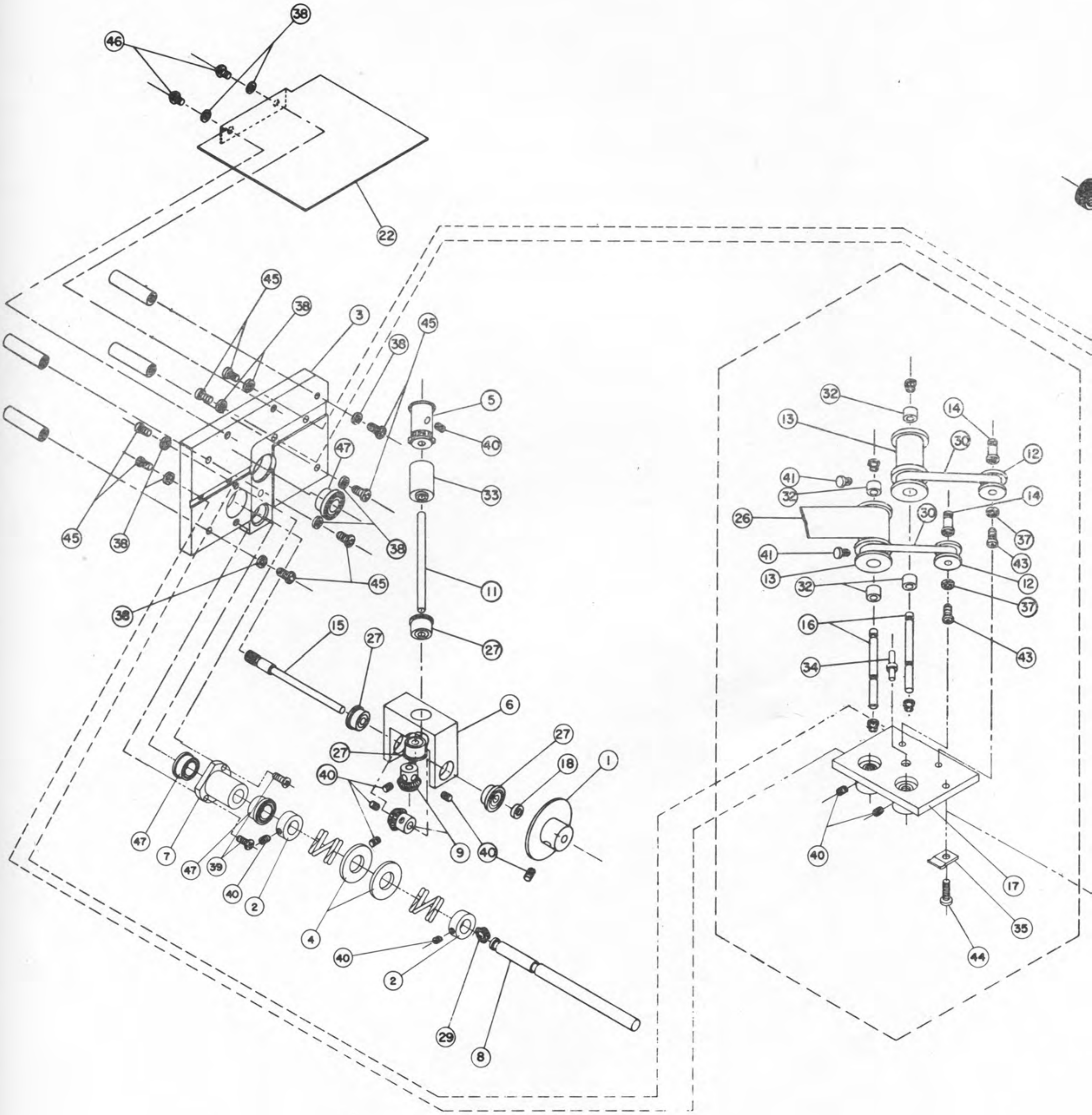


Figure 4-2. Power Supply, Functional Block Diagram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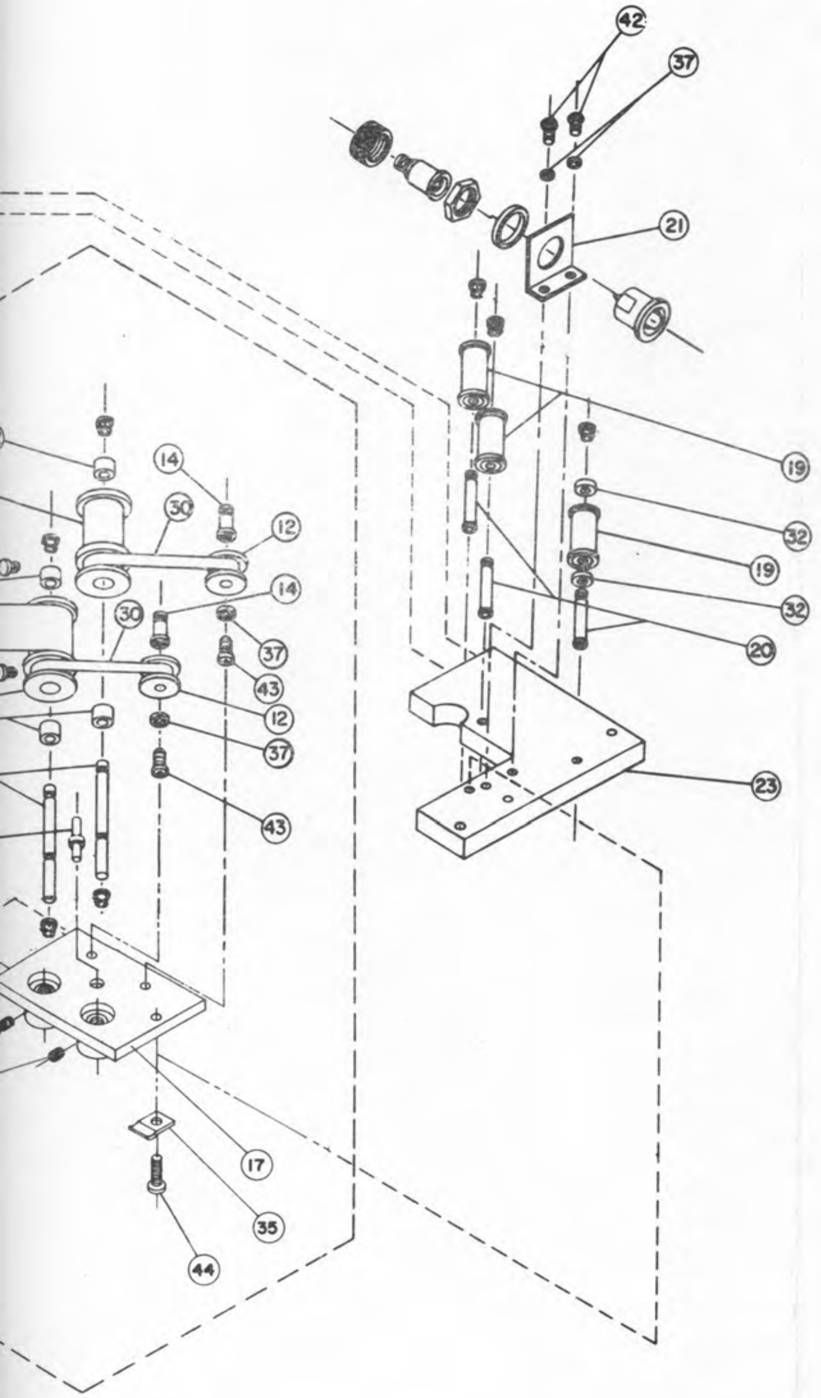


ITEM NO.	PART NO.	ITEM NAME	FEDERAL MFR CODE	QTY
48	A153-3	SPACER, SLEEVE	19905	2
47	SFR1883MM	BEARING, BALLANNULAR	83086	3
46	MS51957-13	SCR, PAN HD, 4-40 X 1/4	96906	2
45	MS51957-17	SCR, PAN HD, 4-40 X 1/2	96906	8
44	MS51957-5	SCR, PAN HD, 2-56 X 3/8	96906	1
43	MS51957-7	SCR, PAN HD, 2-56 X 1/2	96906	2
42	MS51957-2	SCR, PAN HD, 2-56 X 3/16	96906	2
41		RHMS 0-80 X 1/8	96906	2
40	MS51021-9	SCR, SET, SOC H, 4-40 X 1/8	96906	13
39	MS35275-5	SCR, FIL HD, 2-56 X 3/8	96906	2
38	MS35338-78	WASHER, LOCK, SPLIT, NO. 4	96906	10
37	MS35338-77	WASHER, LOCK, SPLIT, NO. 2	96906	4
36				
35	116H125	STRAP, RETAINING	79963	1
34	FTSM1	TERMINAL, FEEDTHRU, INS	98291	1
33	A291-6	SPACER	19905	1
32	A689	BUSHING, SLEEVE	19905	10
31		P/O ITEM 17		
30	N7443	SPRING, SPIRAL, TORQUE	80545	2
29				
28				
27	SFR23MM	BEARING, BALLANNULAR	83086	4
26	D472	DIAL, SCALE	19905	1
25				
24				
23	B134-3	PLATE, DIAL	19905	1
22	B808-2	COVER, GEAR TRAIN	19905	1
21	A236-1	BRACKET, LAMP	19905	1
20	A223	PIN, GROOVED, HD	19905	3
19	A222-2	GUIDE, ROLLER	19905	3
18	A220	WASHER, FLAT	19905	1
17	AB1107-4	BUSHING, ASSEMBLY	19905	1
16	A429	PIN, GROOVED, HEADLESS	19905	2
15	AB052-1	GEAR ASSEMBLY, SPUR	19905	1
14	A097-1	POST, REEL	19905	2
13	B523-2	SPOOL, DRIVE	19905	2
12	A095-1	REEL, TAPE	19905	2
11	A093-1	PIN, STRAIGHT, HEADLESS	19905	1
10				
9	A082-1	GEAR, BEVEL	19905	2
8	A624-1	SHAFT, STRAIGHT	19905	1
7	A080-2	HOUSING, BEARING	19905	1
6	A078-2	HOUSING, GEAR	19905	1
5	AB522-2	SPROCKET ASSEMBLY	19905	1
4	A063-1	WASHER, BEVEL	19905	2
3	C263-2	PLATE, RET, BEARING	19905	1
2	A018-1	COLLAR, SHAFT	19905	2
1	AB525-2	DISK, CLUTCH	19905	1

Figure 5-5. Tuning Unit Gear Train Exploded View

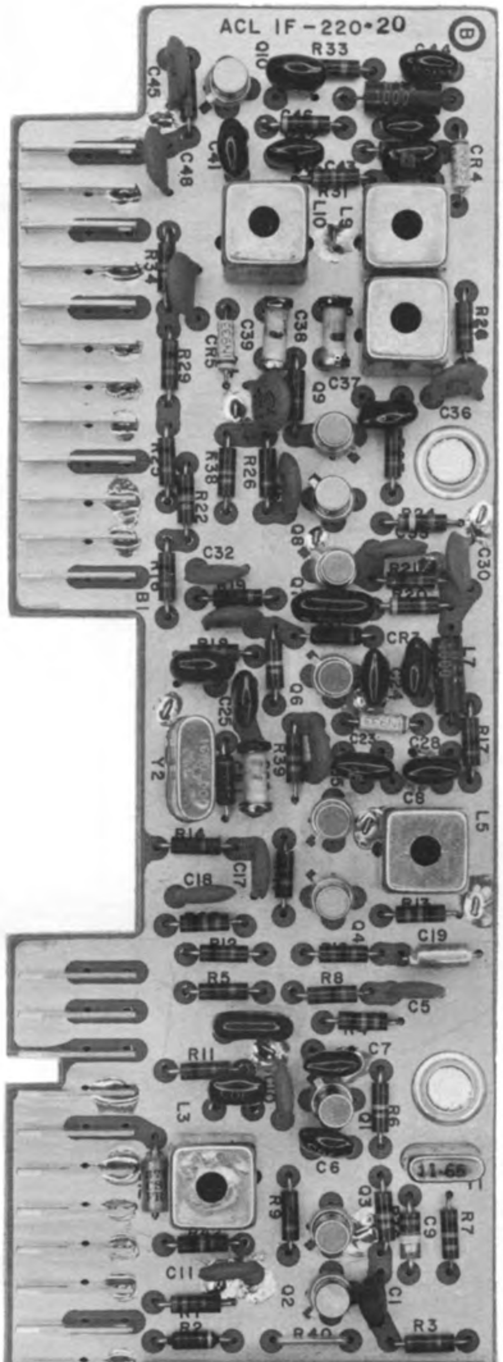
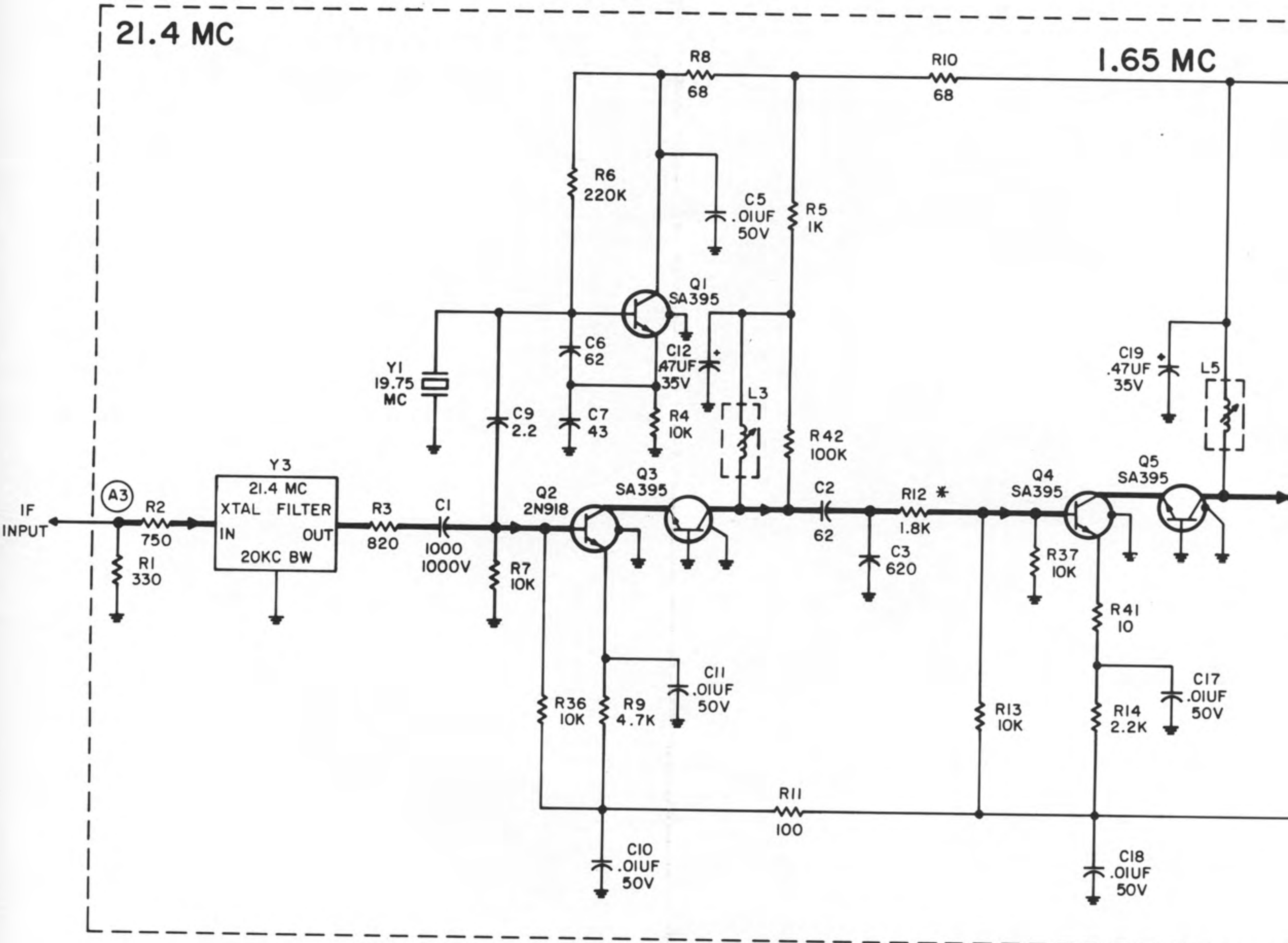
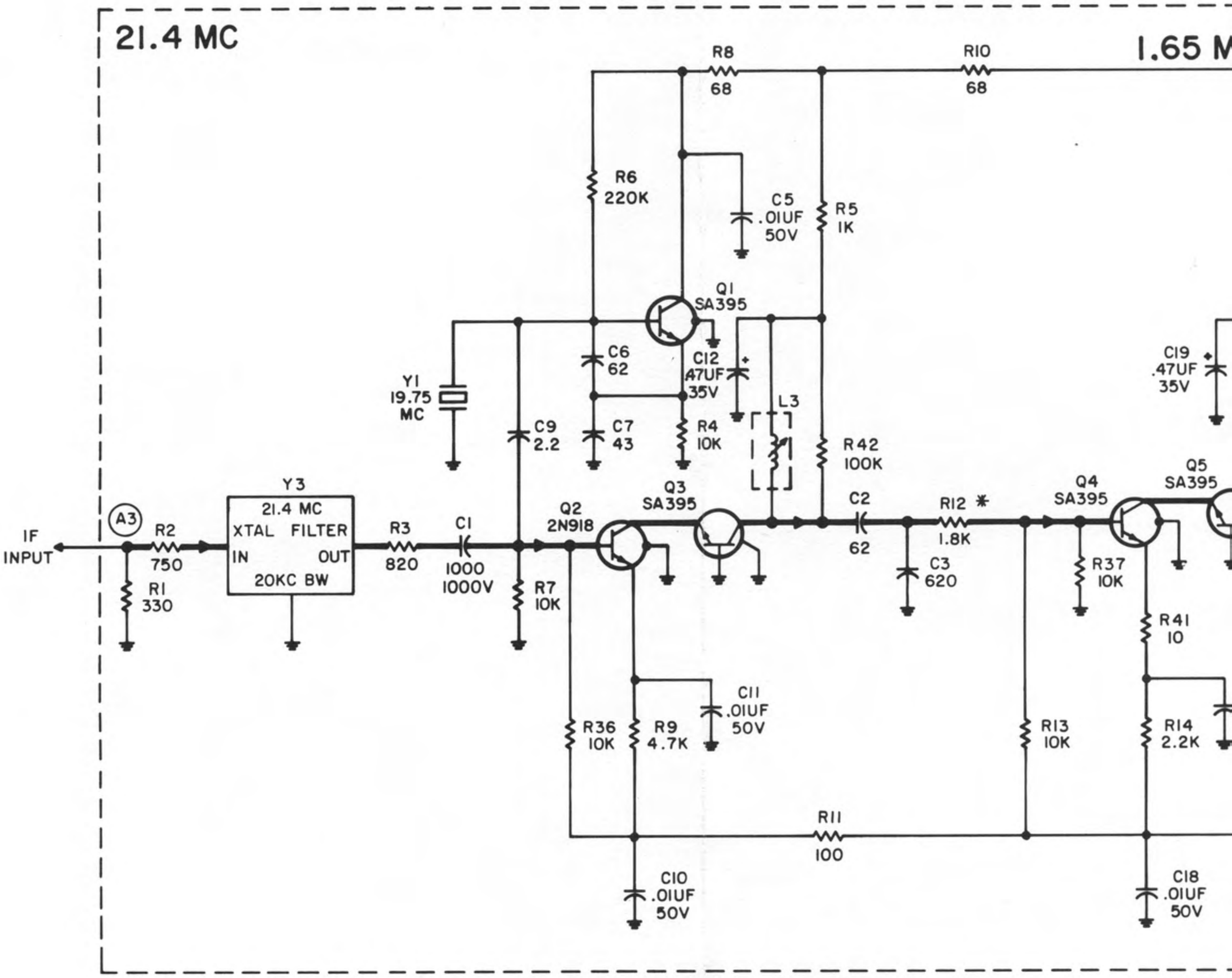


Figure 7-1A. IF-220-20 IF Amplifier



PINS A1, A2, A4, A5, A6, A7, A9, B2, B3, B5, B6, B7, B9 AND B11 ARE GROUNDED

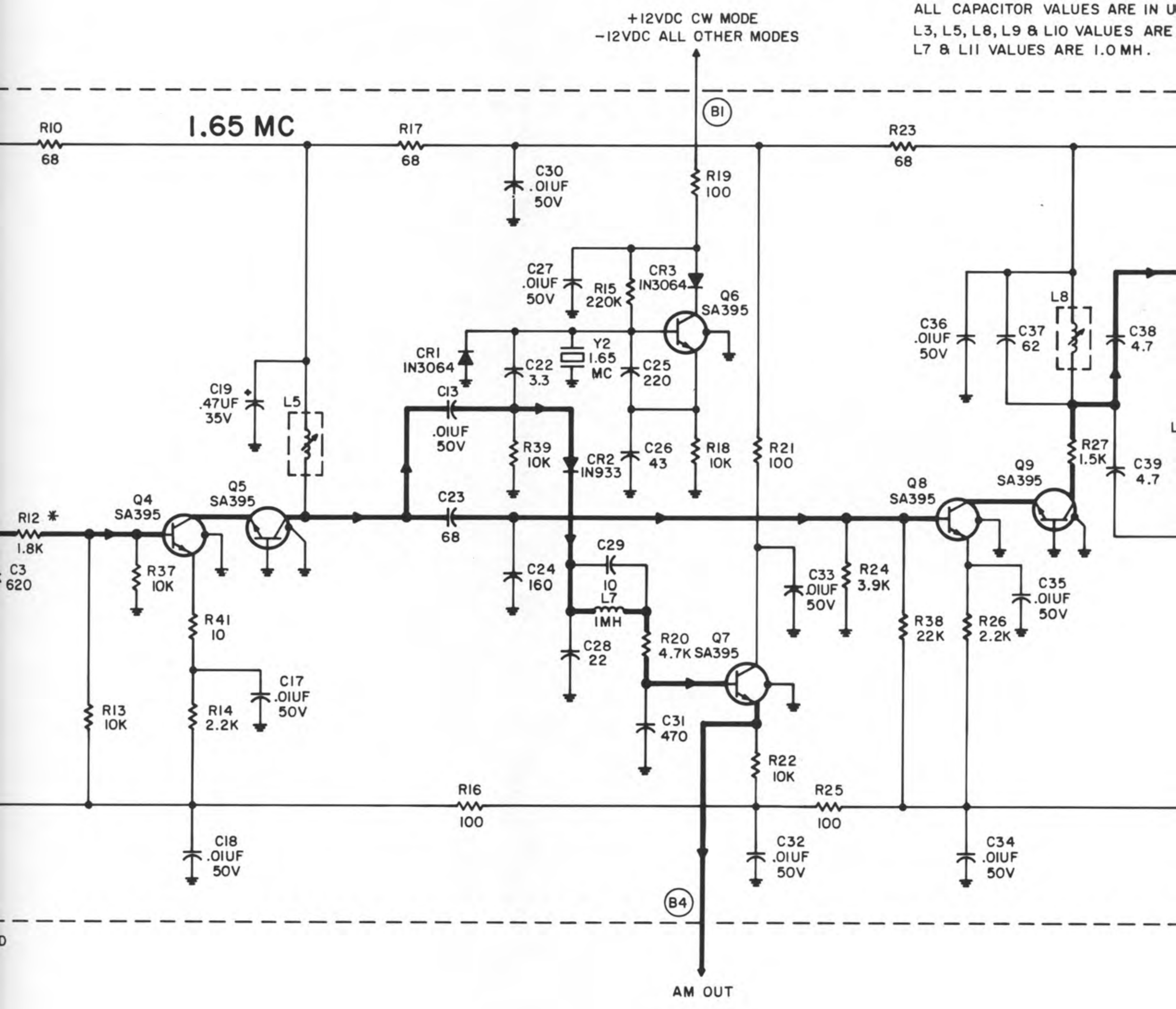
* NOMINAL



PINS A1, A2, A4, A5, A6, A7, A9, B2, B3, B5, B6, B7, B9 AND B11 ARE GROUNDED

✱ NOMINAL

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS
ALL CAPACITOR VALUES ARE IN U
L3, L5, L8, L9 & L10 VALUES ARE
L7 & L11 VALUES ARE 1.0 MH.



UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.
L3, L5, L8, L9 & L10 VALUES ARE 65-150 UH.
L7 & L11 VALUES ARE 1.0 MH.

ODES

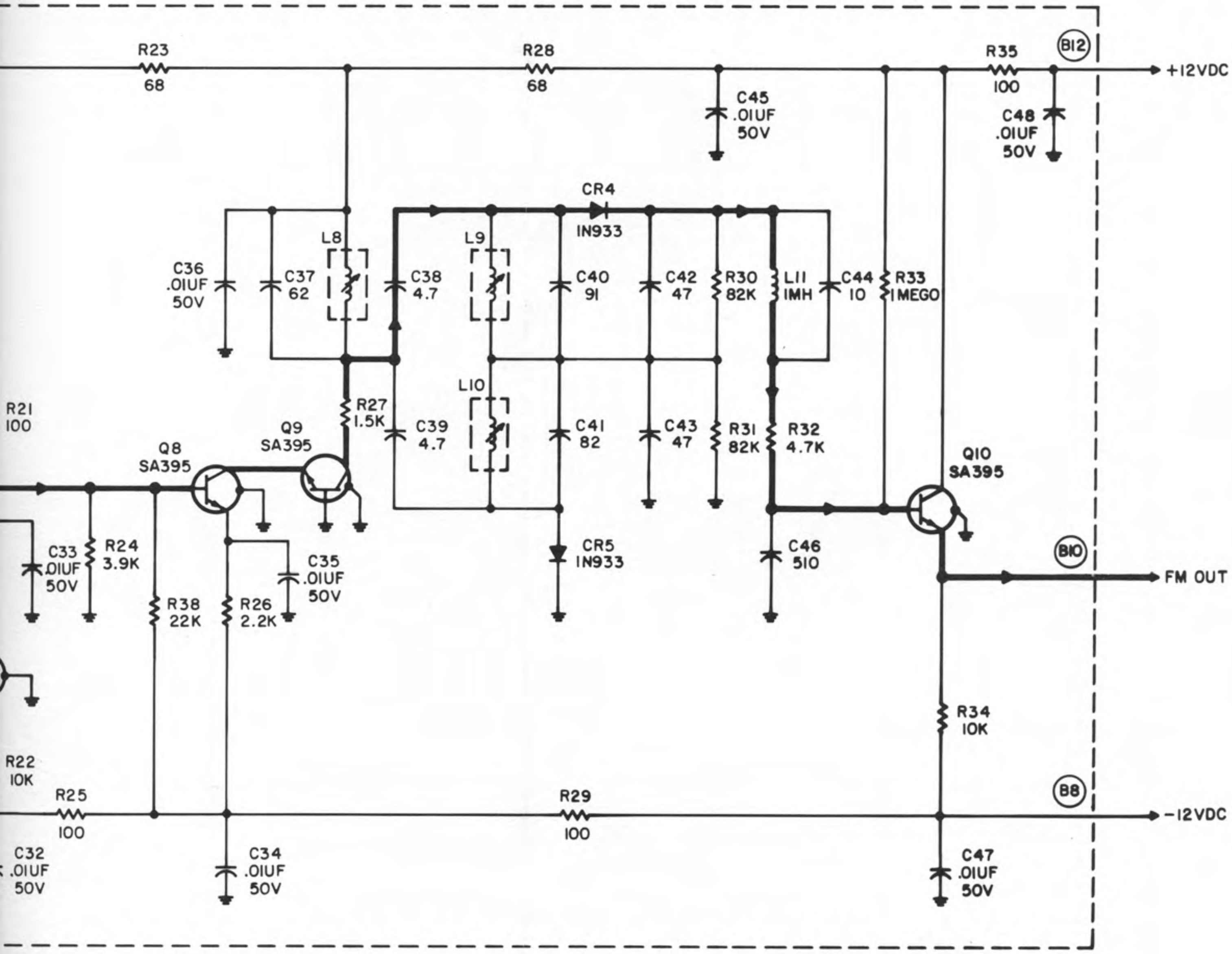


Figure 7-1B. IF-220-20, IF Amplifier, Schematic Diagram

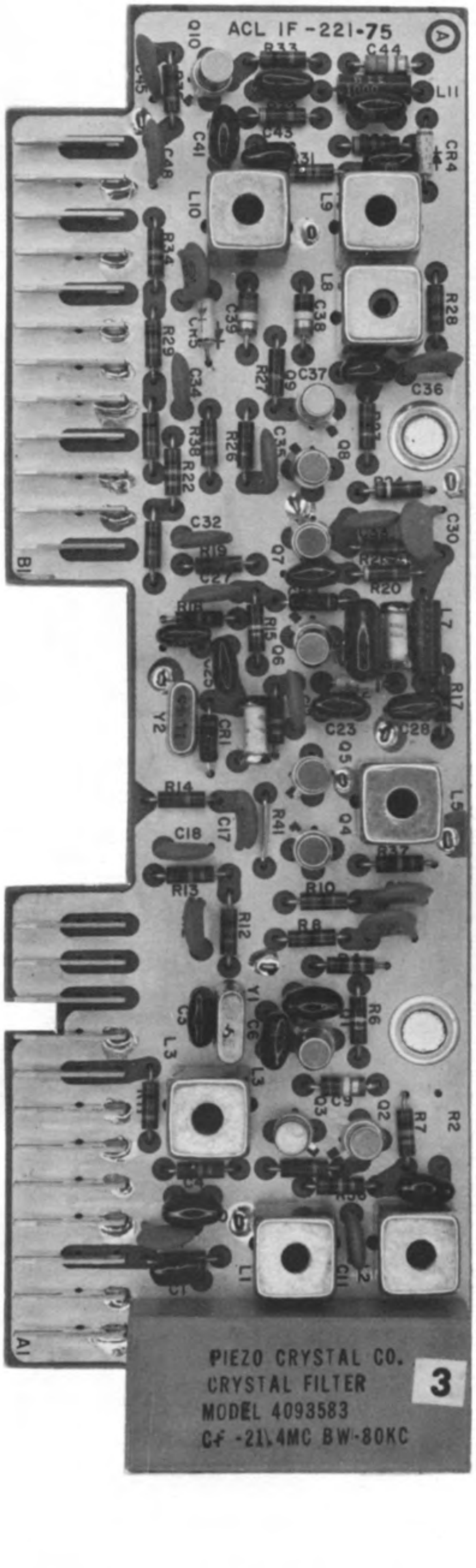
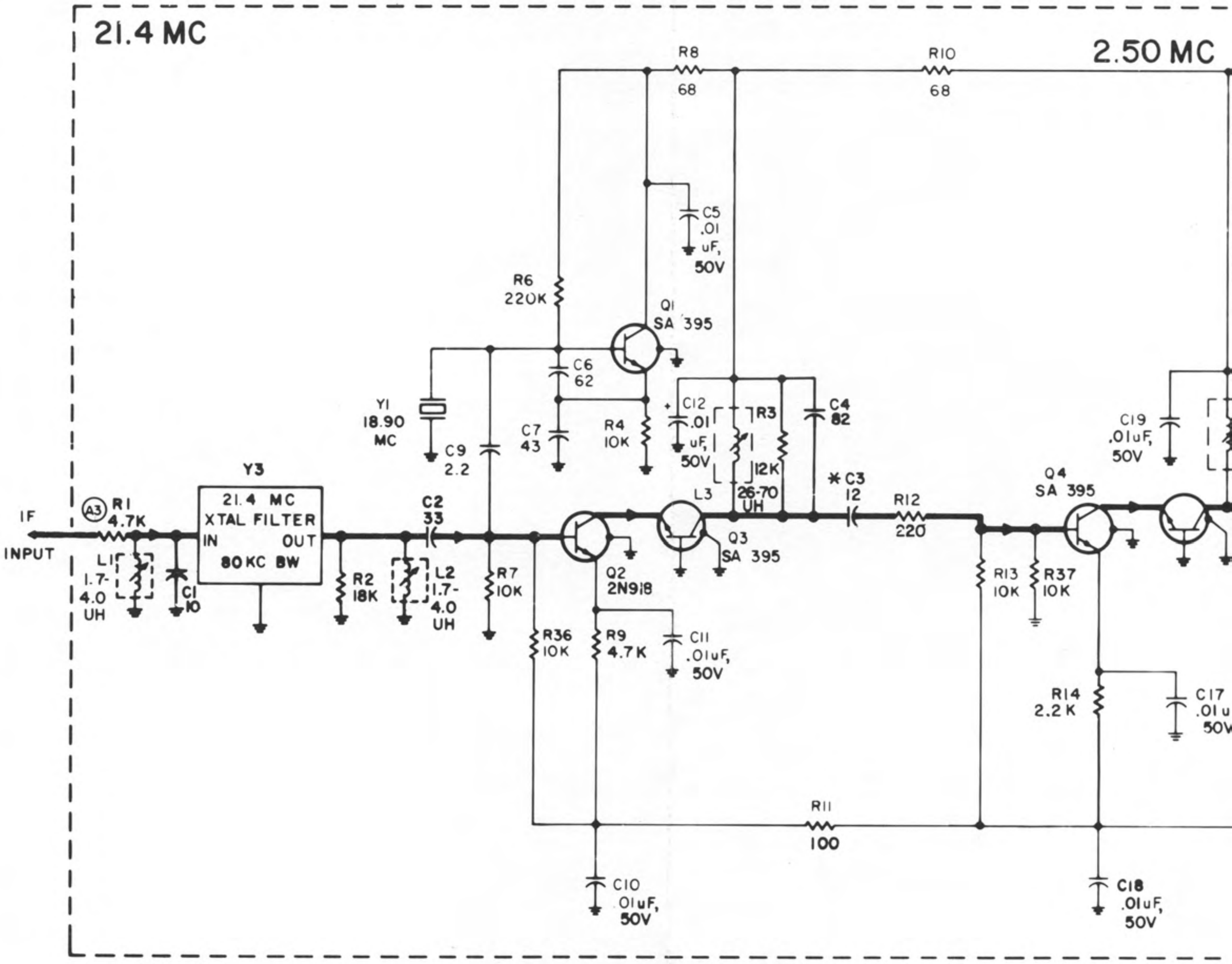
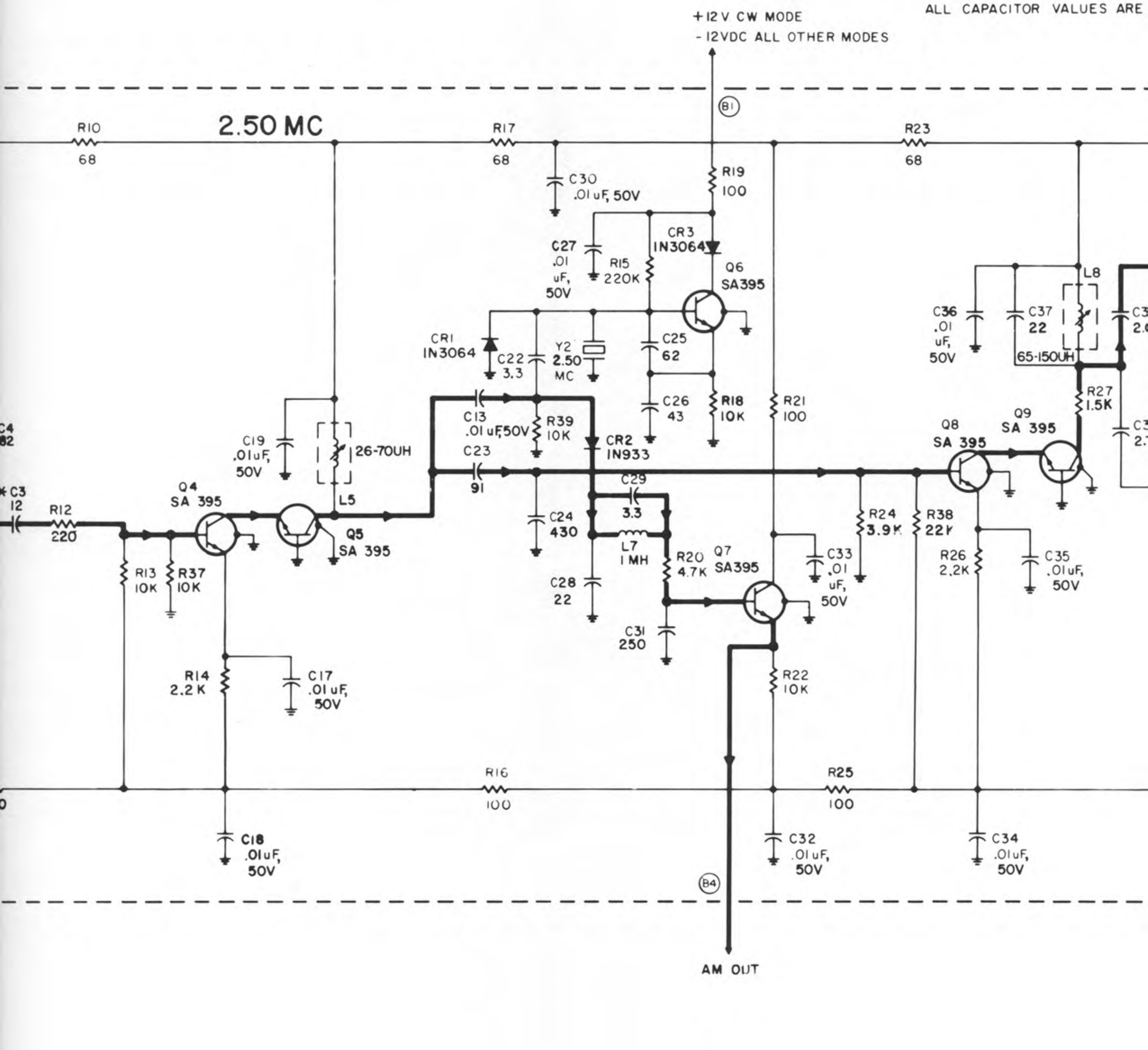


Figure 7-2A. IF-221-75 IF Amplifier



PINS. A1, A2, A4, A5, A6, A7, A9, B2, B3, B5, B6, B7, B9, B11 ARE GROUNDED
* NOMINAL

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN
ALL CAPACITOR VALUES ARE



REF DESIG PREFIX A3

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
ALL CAPACITOR VALUES ARE IN UUF, 500WVDC.

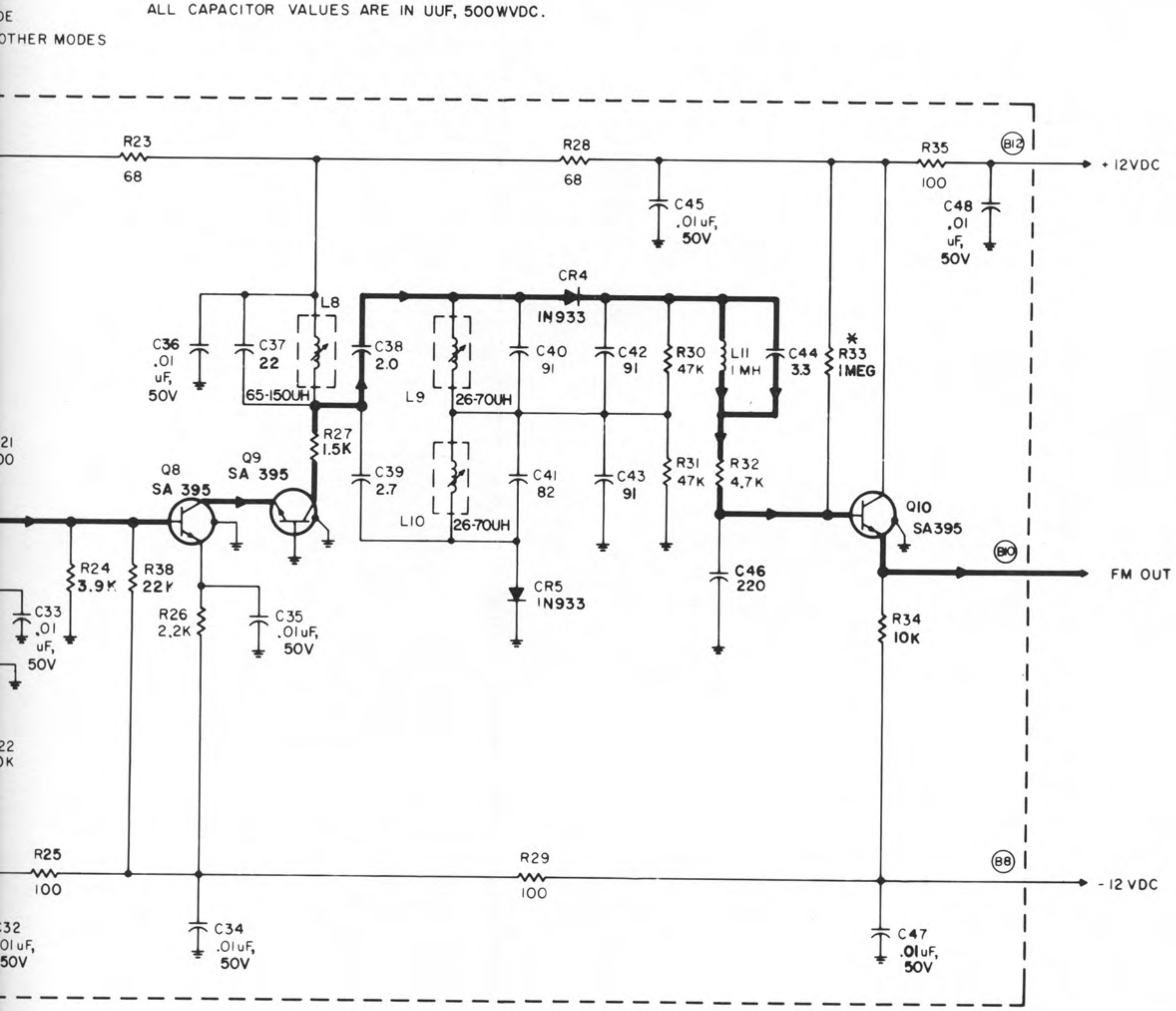


Figure 7-2B. IF-221-75, IF Amplifier, Schematic Diagram

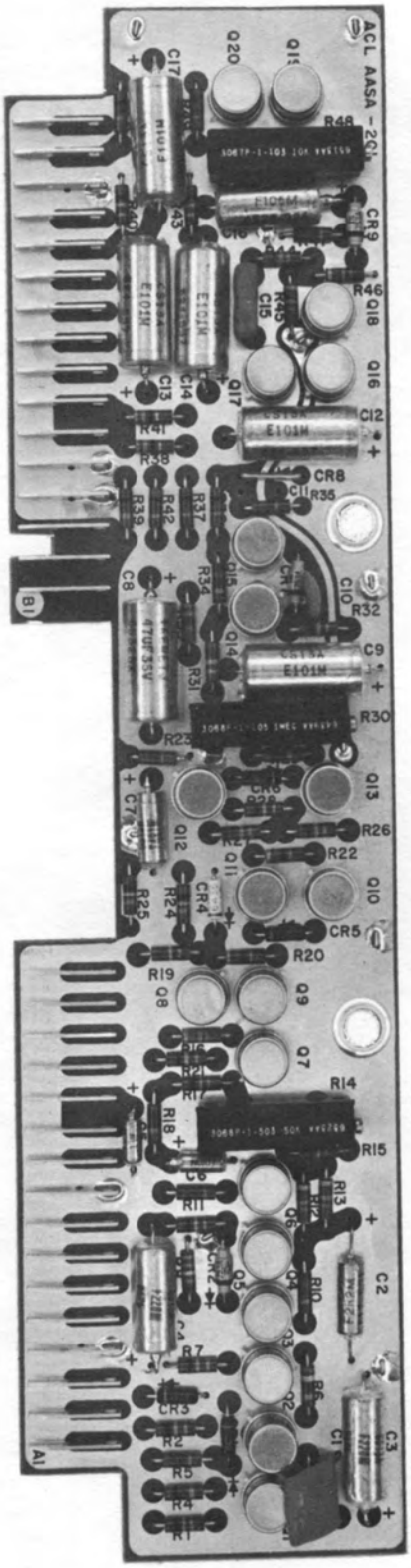
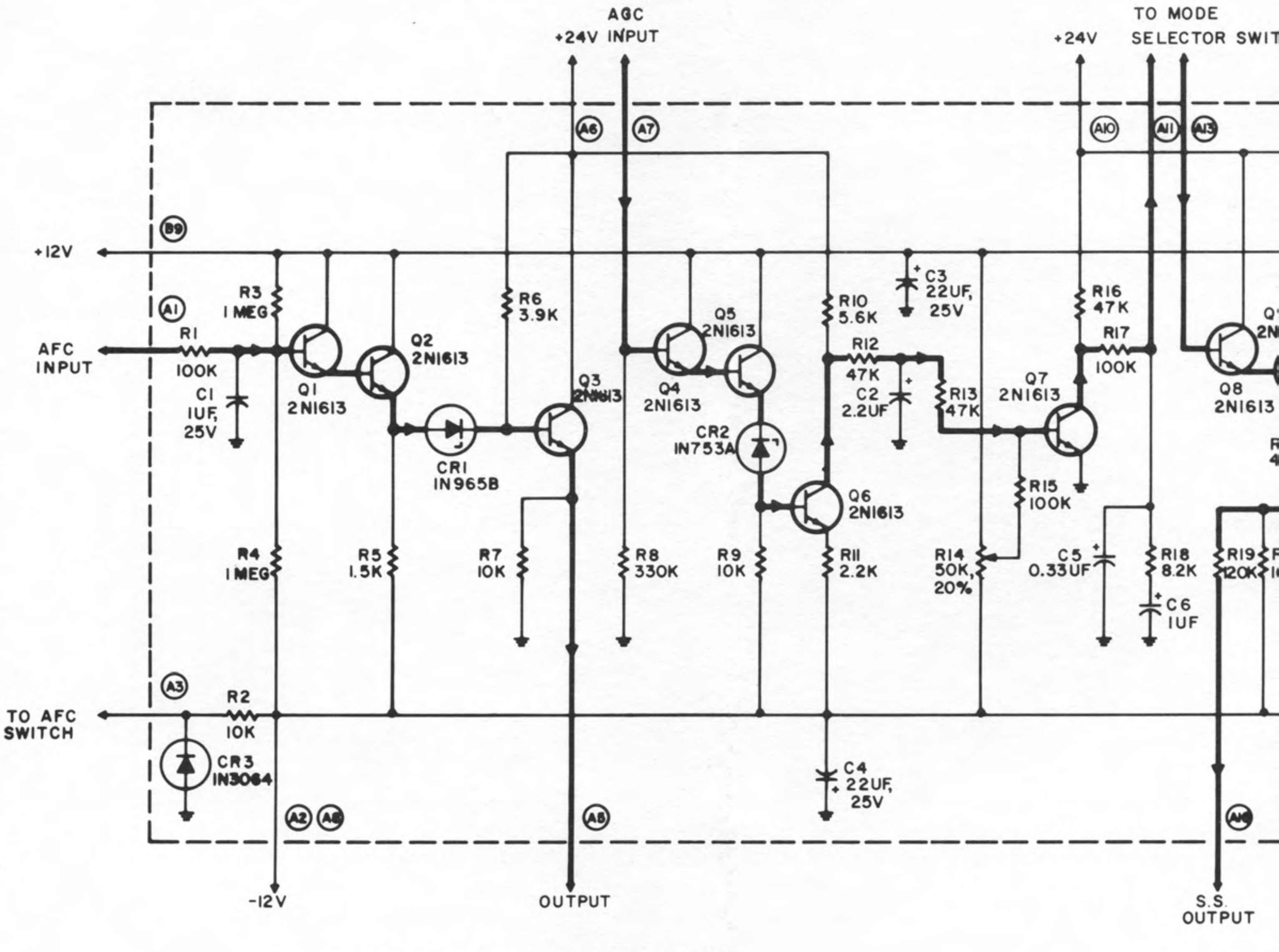
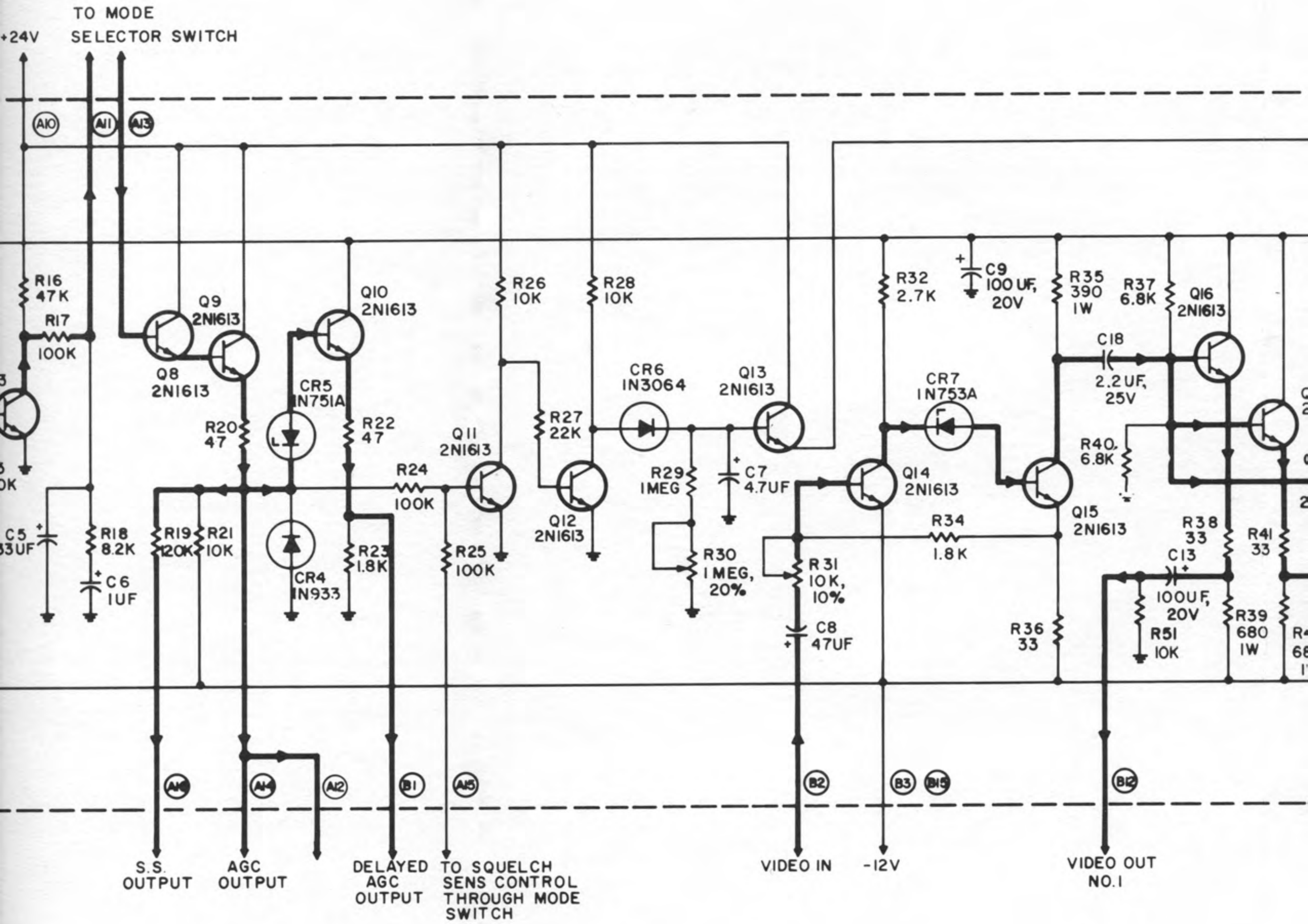


Figure 7-3A. AASA-201 AFC/AGC/Squelch/
Audio Amplifier



PINS A(4,9) B(4,5,14) ARE GROUNDED
PINS B(6,7,8) NO CONNECTION

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 35WVDC.



+24V
TO MODE
SELECTOR SWITCH
A10
A11
A13
R16
47K
R17
100K
Q8
2N1613
Q9
2N1613
Q10
2N1613
CR5
1N751A
R20
47
R22
47
C5
33UF
R18
8.2K
C6
1UF
R19
120K
R21
10K
CR4
1N933
R23
1.8K
R24
100K
R25
100K
R26
10K
R27
22K
R28
10K
Q11
2N1613
Q12
2N1613
CR6
1N3064
Q13
2N1613
R29
1MEG
C7
4.7UF
R30
1 MEG,
20%
R31
10K,
10%
C8
47UF
R32
2.7K
C9
100 UF,
20V
Q14
2N1613
CR7
1N753A
R34
1.8 K
R35
390
1W
Q15
2N1613
R36
33
R37
6.8K
Q16
2N1613
C18
2.2 UF,
25V
R40,
6.8K
R38
33
R41
33
C13
100UF,
20V
R51
10K
R39
680
1W
A16
A14
A12
B1
A15
B2
B3
B15
B12
S.S.
OUTPUT
AGC
OUTPUT
DELAYED
AGC
OUTPUT
TO SQUELCH
SENS CONTROL
THROUGH MODE
SWITCH
VIDEO IN
-12V
VIDEO OUT
NO.1

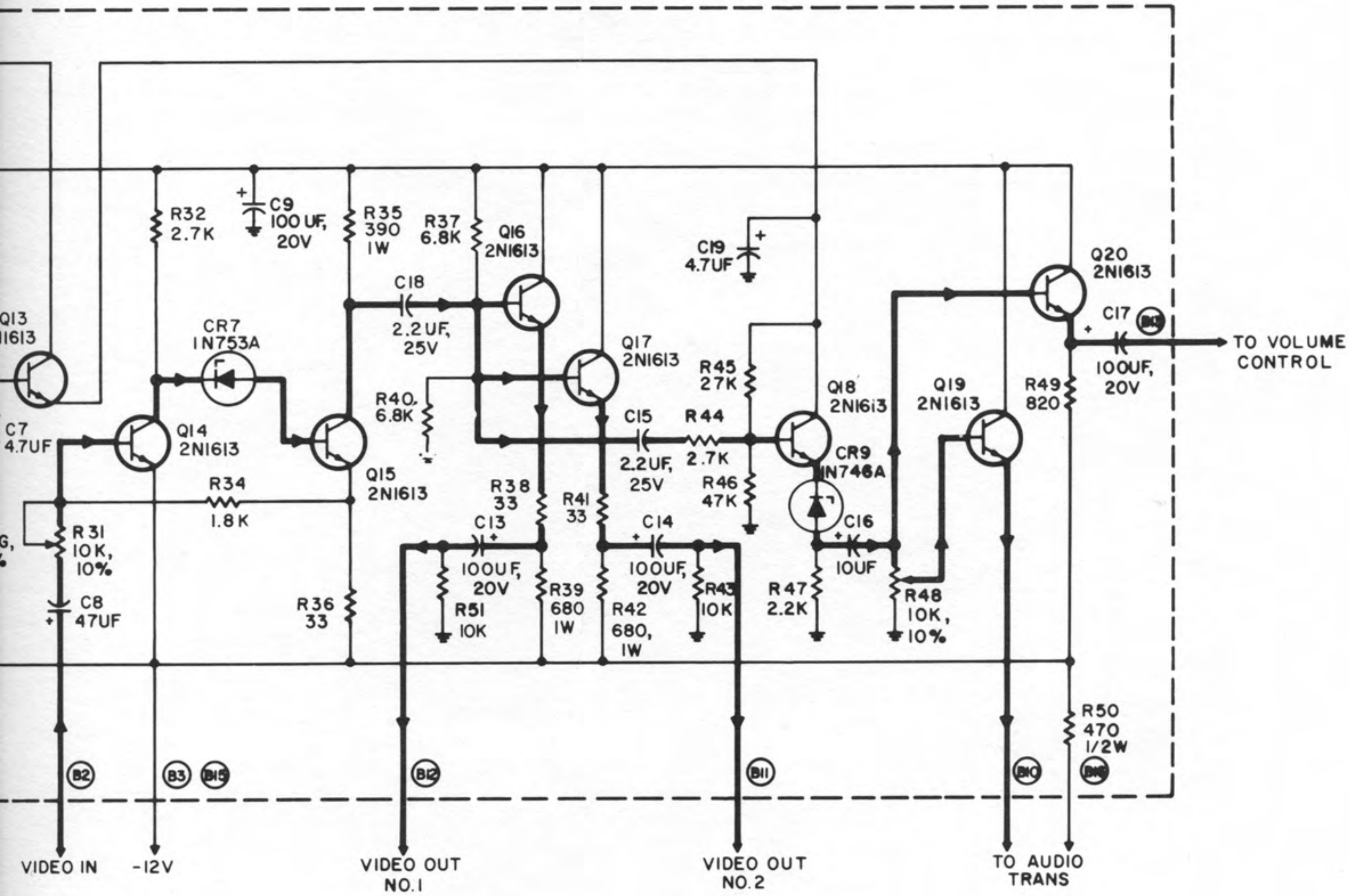


Figure 7-3B. AASA-201, AFC/AGC/Squelch/Audio Amplifier, Schematic Diagram

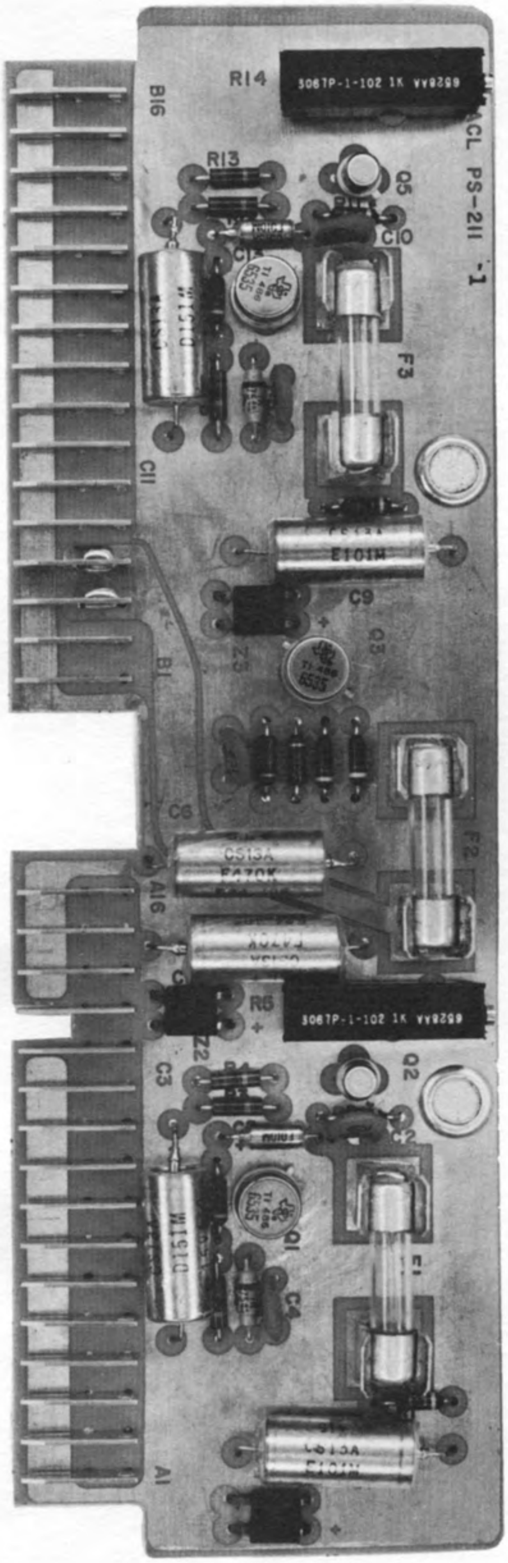
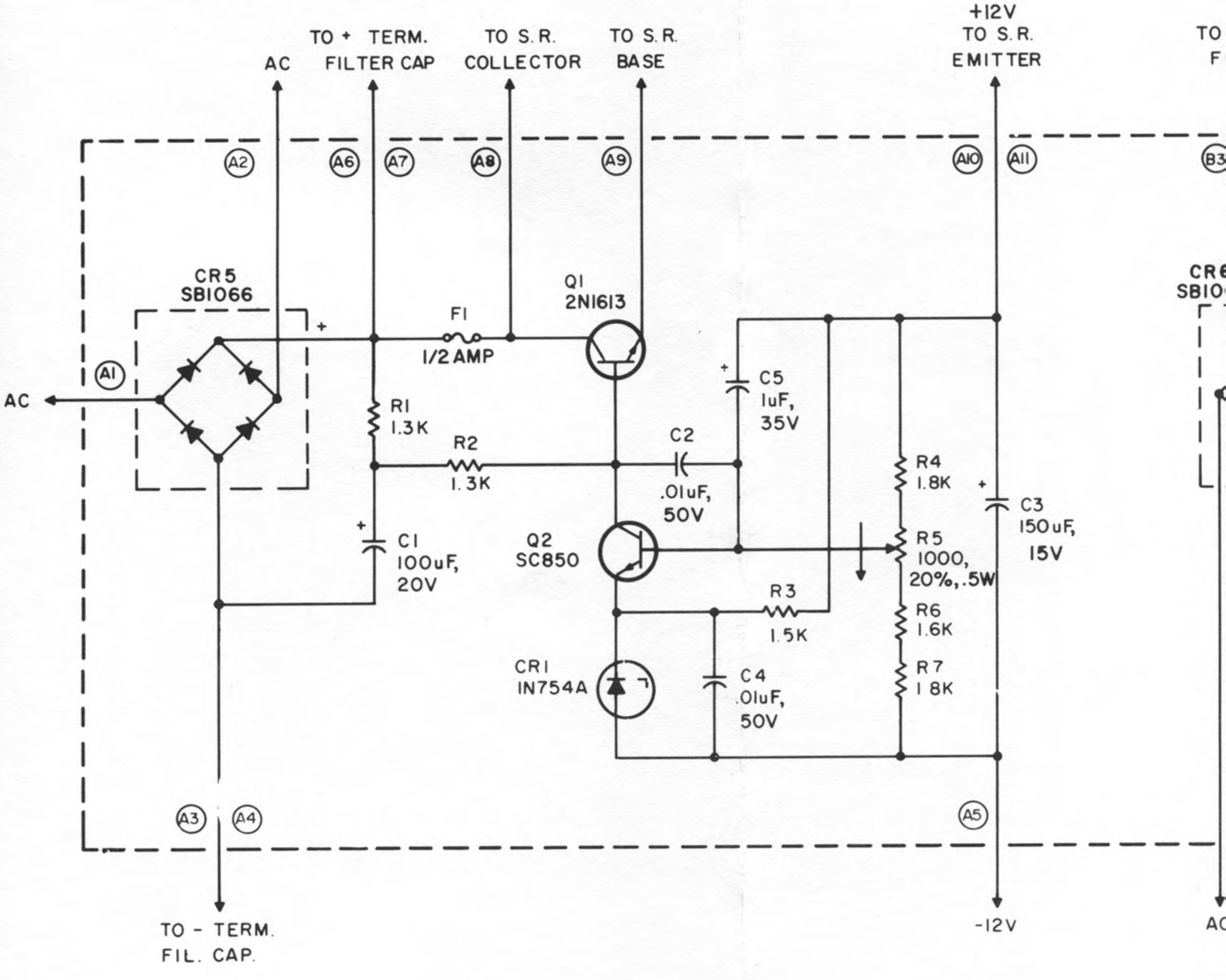
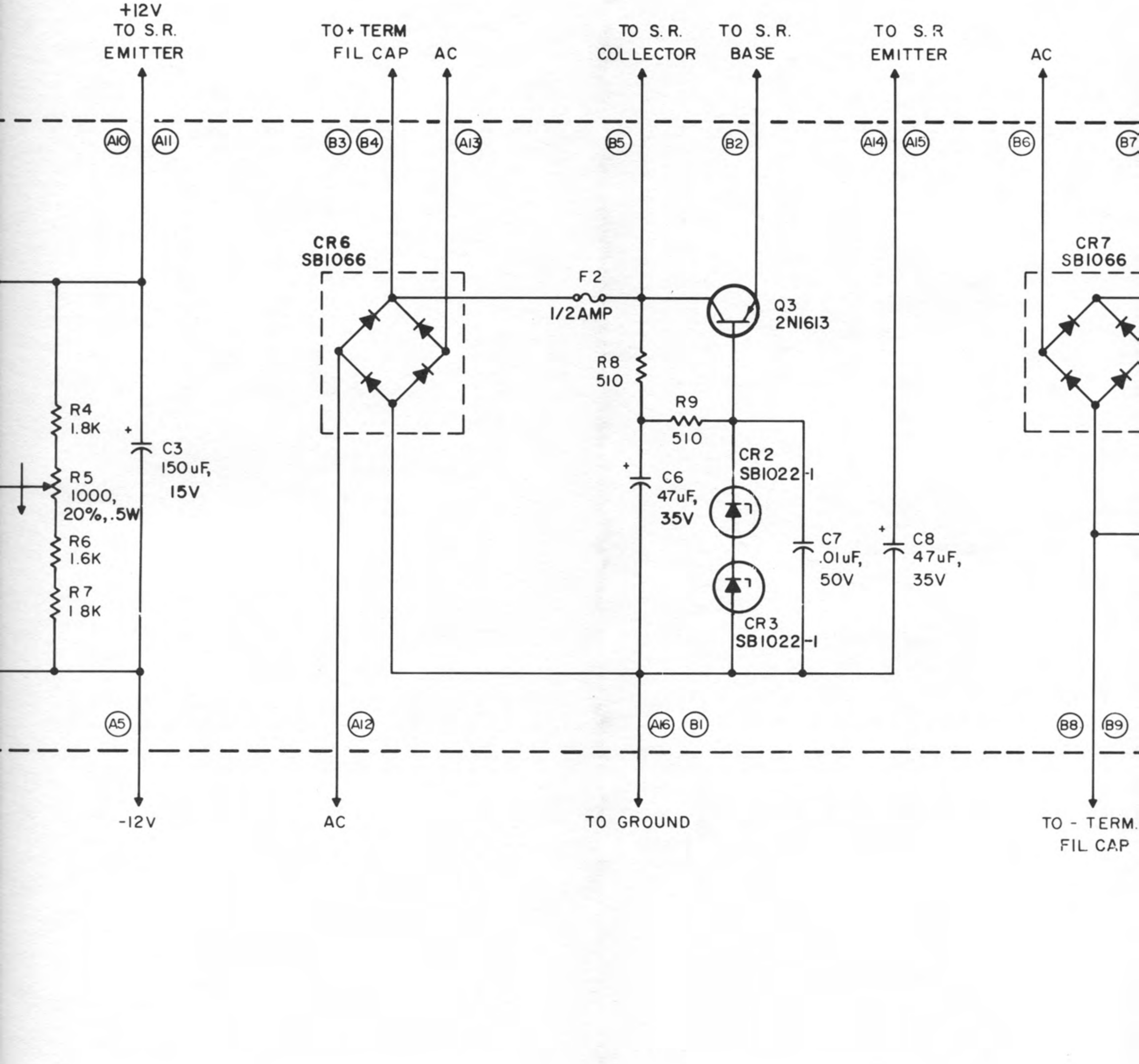


Figure 7-4A. PS-211-1 Power Supply



AC
TO + TERM. FILTER CAP
TO S.R. COLLECTOR
TO S.R. BASE
+12V TO S.R. EMITTER
TO
F
A2
A6
A7
A8
A9
A10
A11
B3
CR5
SB1066
A1
AC
F1
1/2 AMP
Q1
2N1613
R1
1.3K
R2
1.3K
C1
100uF,
20V
C2
.01uF,
50V
C5
1uF,
35V
Q2
SC850
R3
1.5K
CR1
IN754A
C4
.01uF,
50V
R4
1.8K
R5
1000,
20%, .5W
R6
1.6K
R7
1.8K
C3
150uF,
15V
CR6
A3
A4
A5
TO - TERM.
FIL. CAP.
-12V
AC

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF.



5%.

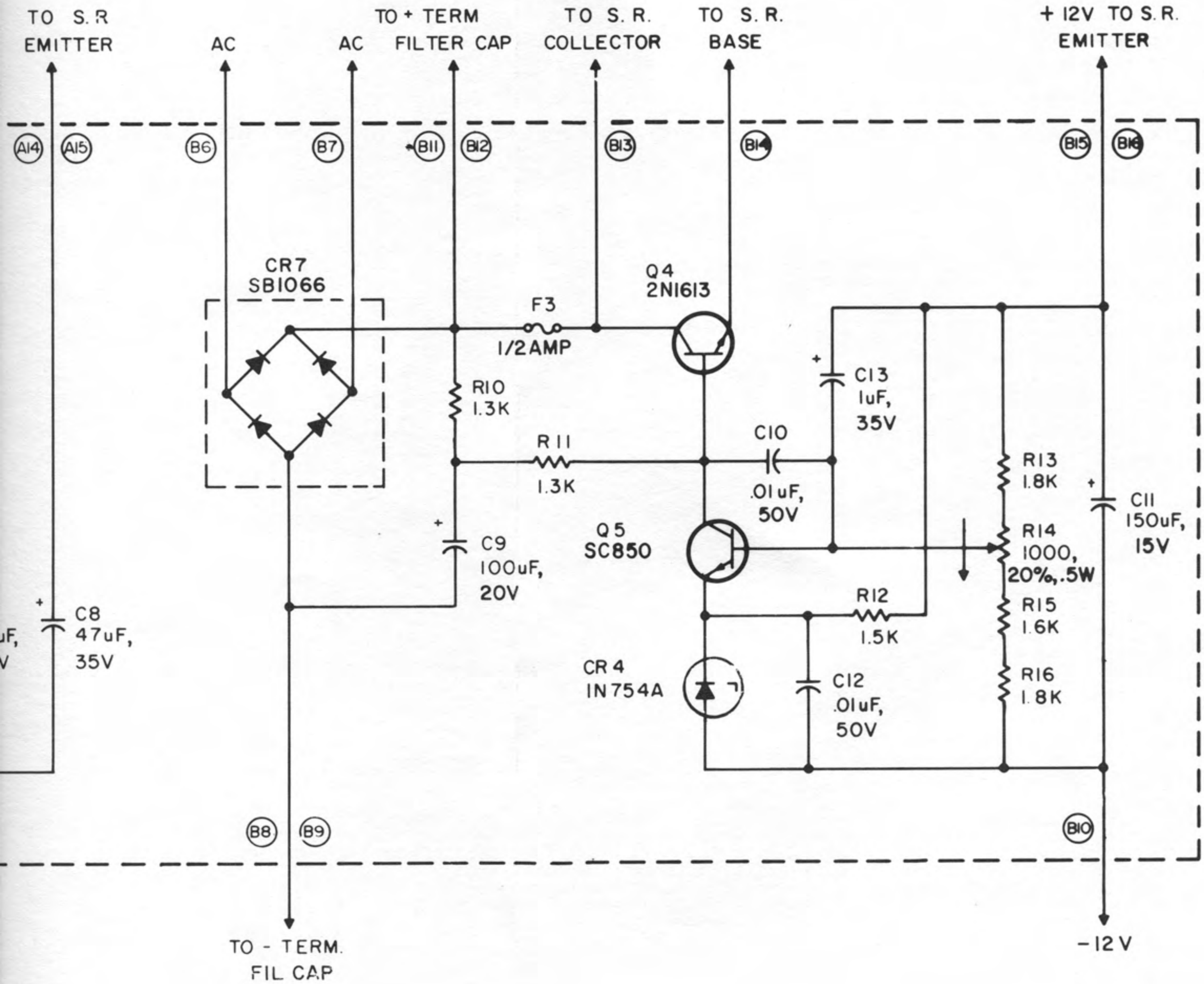


Figure 7-4B. PS-211-1, Power Supply, Schematic Diagram

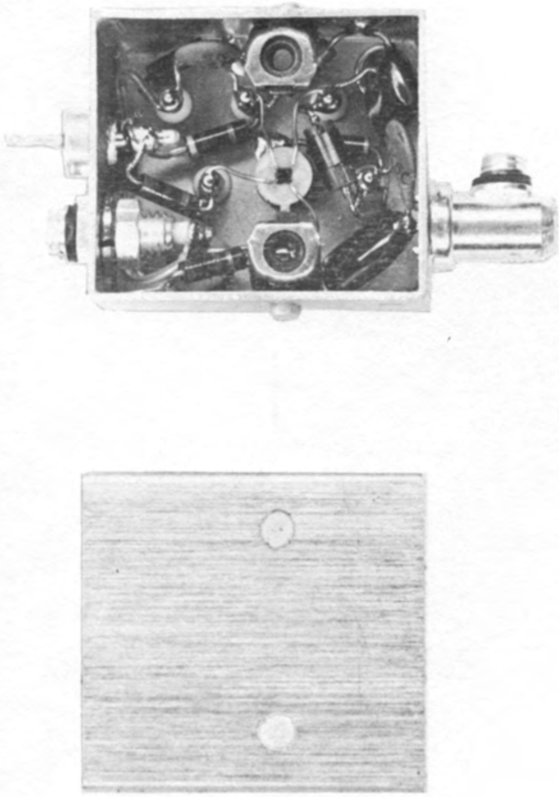


Figure 7-5A. ISA-203 Isolation Amplifier

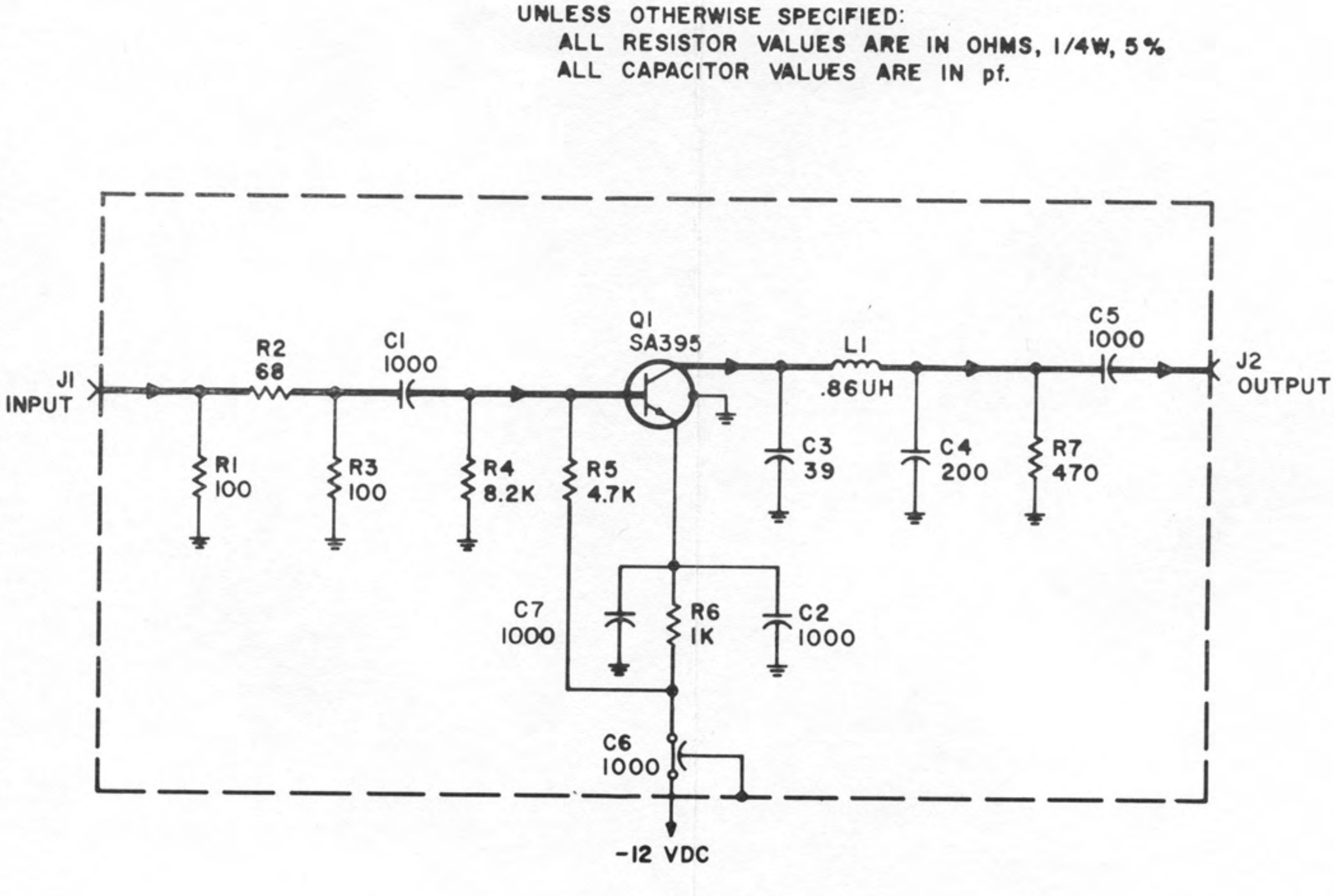
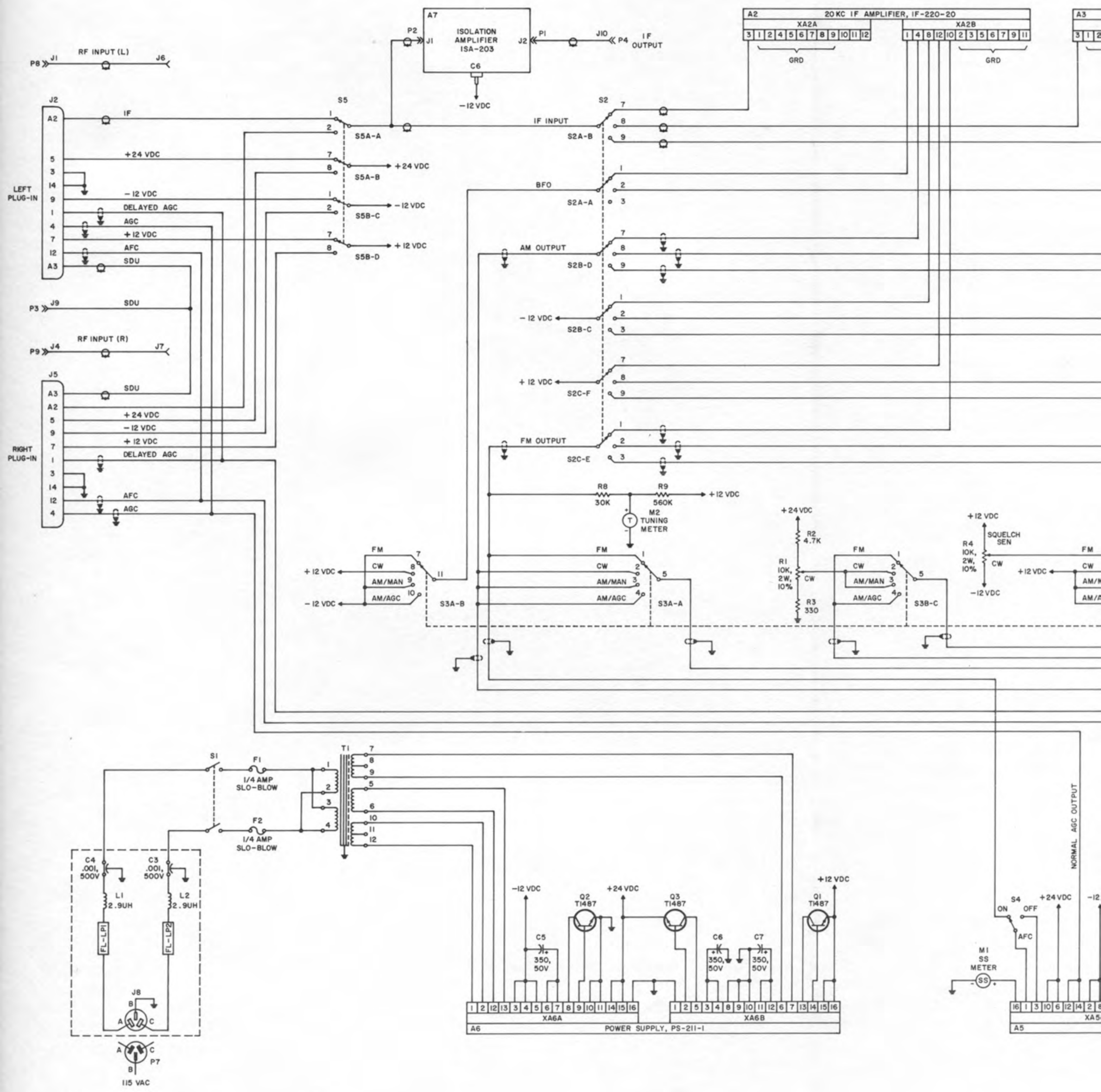
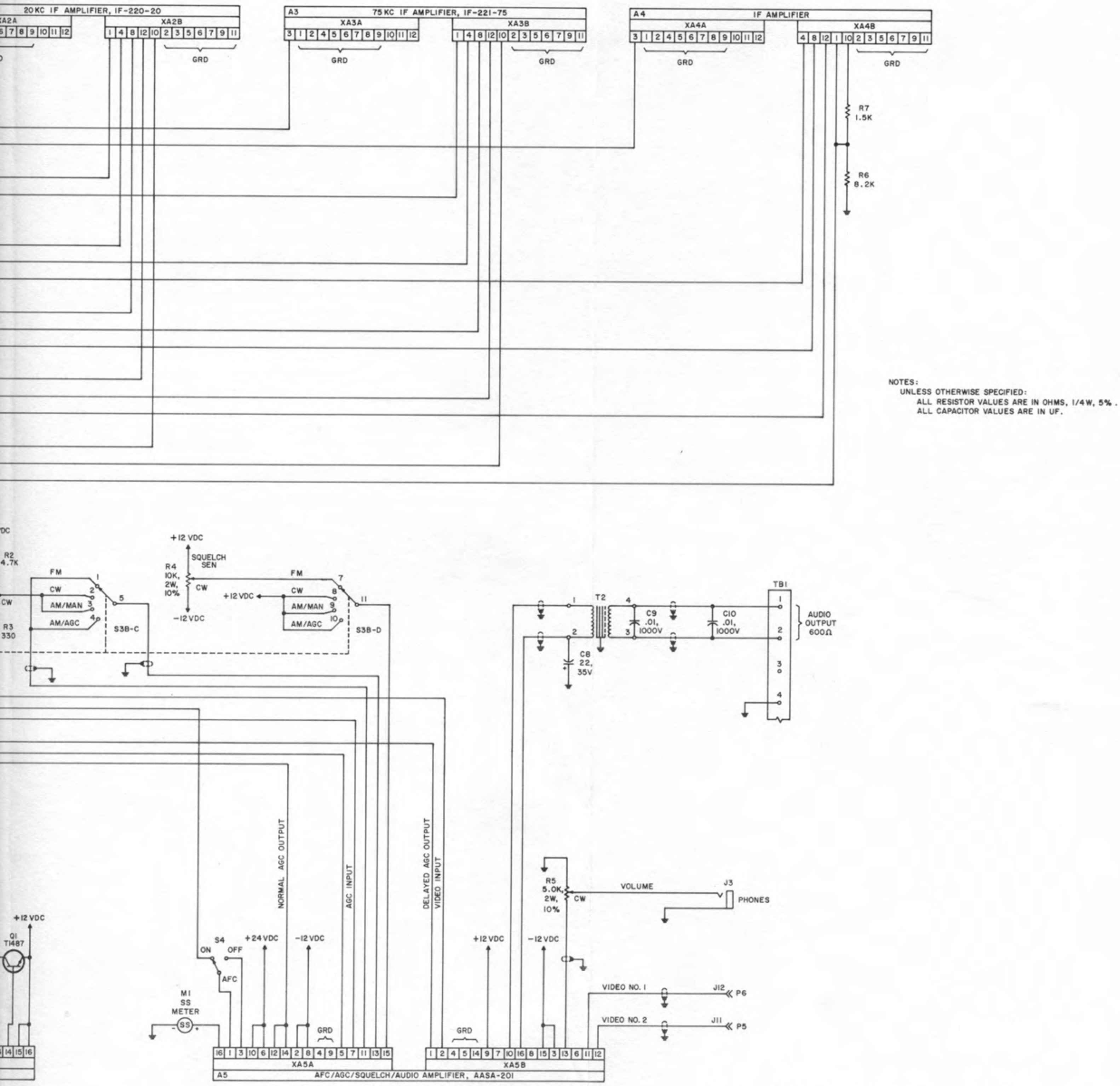


Figure 7-5B. ISA-203, Isolation Amplifier, Schematic Diagram



A7
ISOLATION AMPLIFIER ISA-203
P2
J1
J2
P1
J10
P4
IF OUTPUT
C6
-12 VDC
A2
20KC IF AMPLIFIER, IF-220-20
XA2A
XA2B
GRD
A3
P8
RF INPUT (L)
J6
J2
LEFT PLUG-IN
IF
+24 VDC
-12 VDC
DELAYED AGC
AGC
+12 VDC
AFC
SDU
S5
S5A-A
S5A-B
S5B-C
S5B-D
S2
IF INPUT
S2A-B
BFO
S2A-A
AM OUTPUT
S2B-D
S2B-C
S2C-F
FM OUTPUT
S2C-E
P3
J9
P9
J4
RF INPUT (R)
J7
J5
RIGHT PLUG-IN
R8 30K
R9 560K
M2 TUNING METER
FM
CW
AM/MAN
AM/AGC
S3A-B
S3A-A
S3B-C
R2 4.7K
R1 10K, 2W, 10%
R3 330
SQUELCH SEN
R4 10K, 2W, 10%
S1
F1 1/4 AMP SLO-BLOW
F2 1/4 AMP SLO-BLOW
T1
C4 .001, 500V
C3 .001, 500V
L1 2.9UH
L2 2.9UH
FL-LP1
FL-LP2
J8
P7
115 VAC
Q2 T1487
Q3 T1487
Q1 T1487
C5 350, 50V
C6 350, 50V
C7 350, 50V
XA6A
XA6B
A6
POWER SUPPLY, PS-211-1
NORMAL AGC OUTPUT
S4
ON
OFF
AFC
M1 SS METER
A5



NOTES:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
ALL CAPACITOR VALUES ARE IN UF.

Figure 7-6. Receiver, Interconnection Wiring Diagram

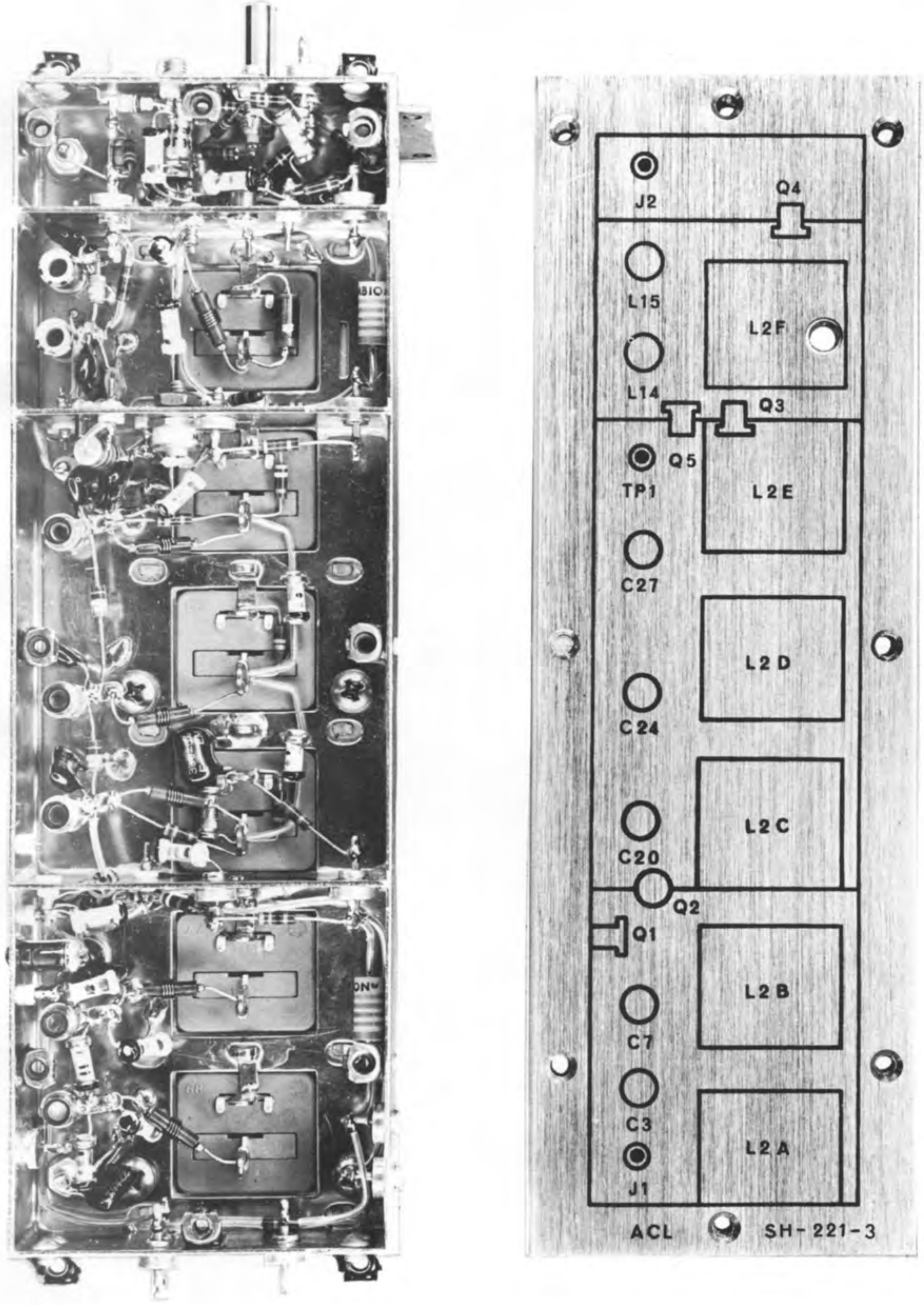
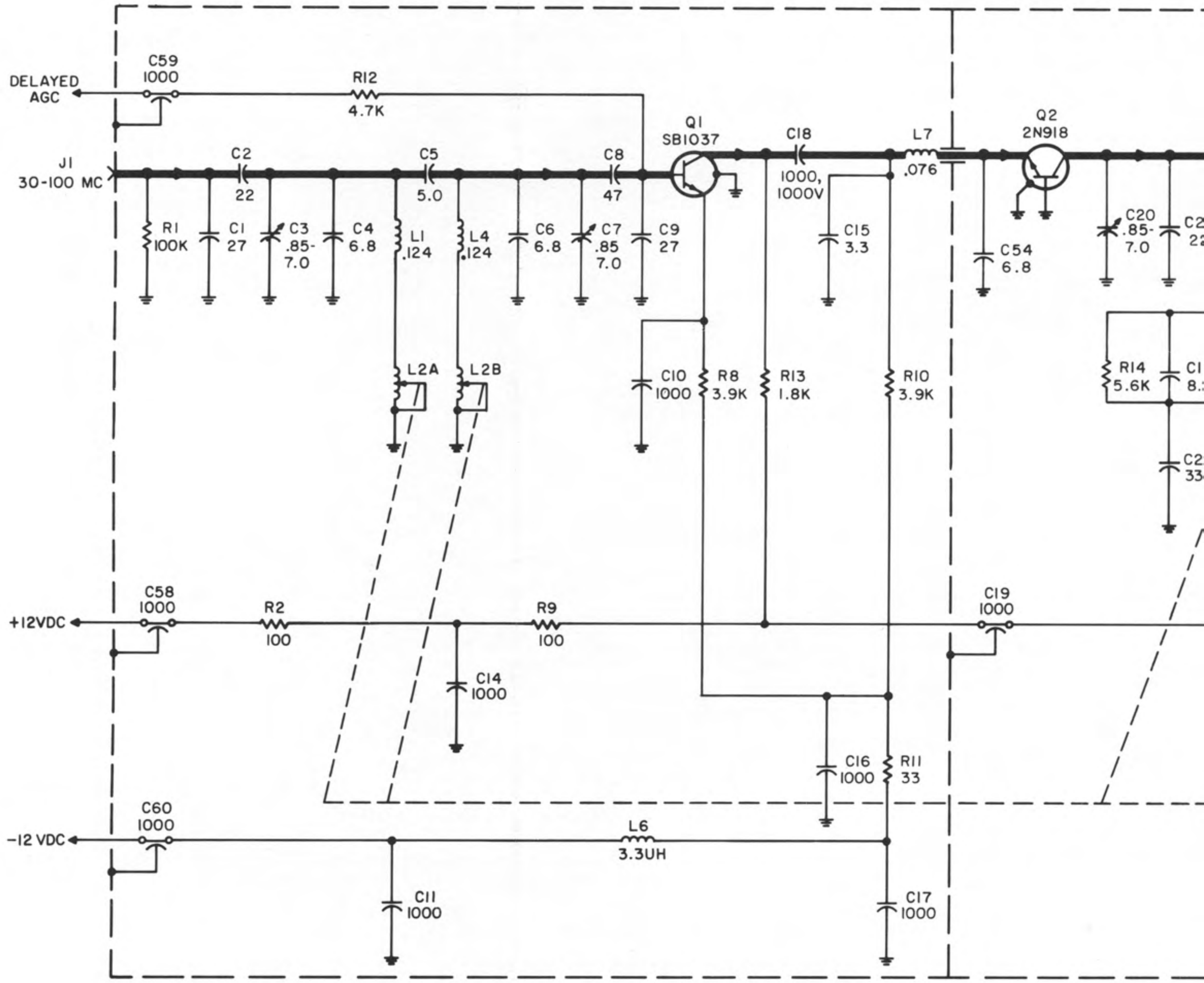
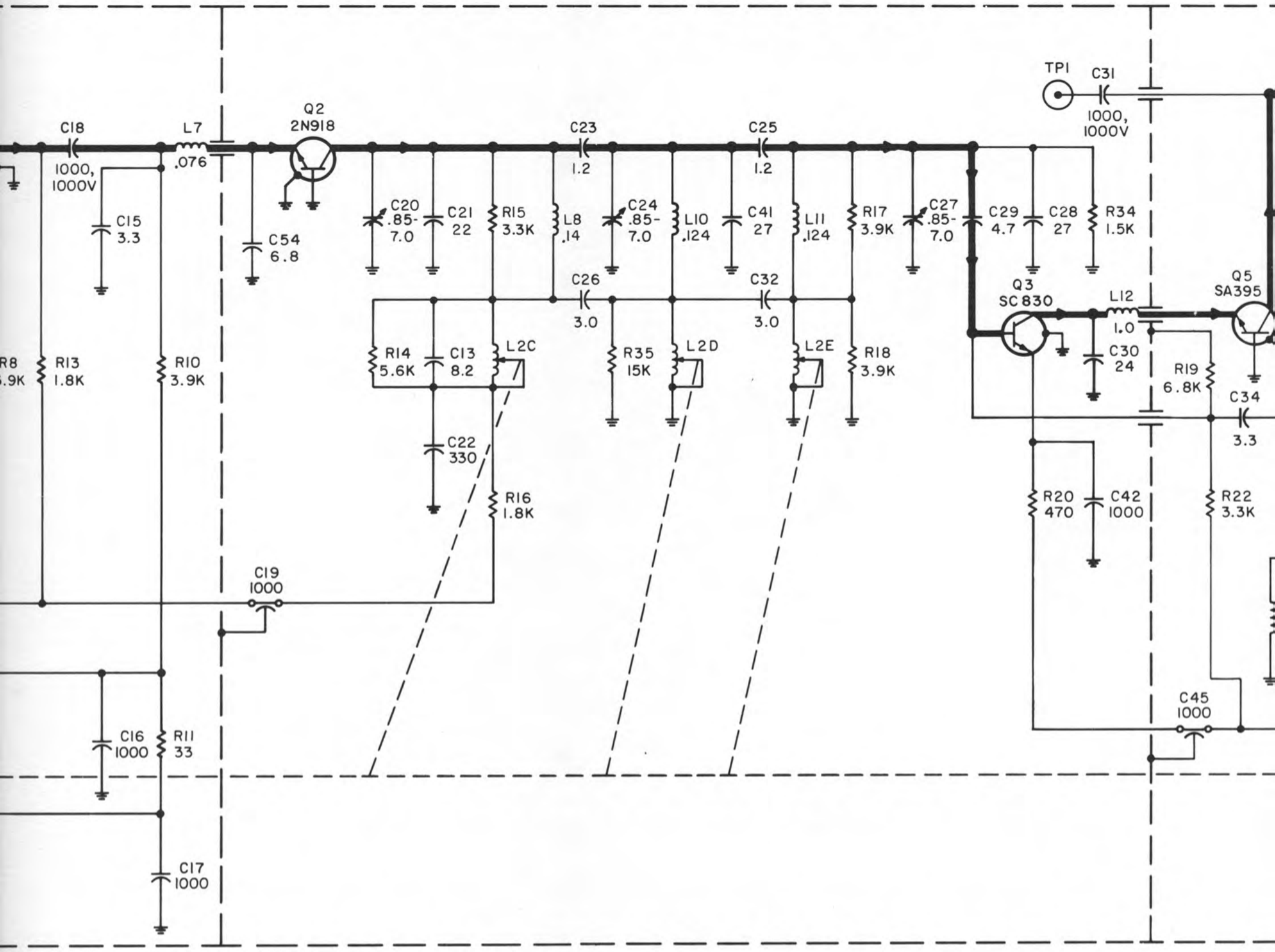


Figure 7-7A. SH-221-3 30 to 100 MC Tuner

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHM
ALL CAPACITOR VALUES ARE IN U
ALL INDUCTANCE VALUES ARE IN UH
L2 INDUCTANCE RANGE .025 – .7 UH



UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.
ALL INDUCTANCE VALUES ARE IN UH
L2 INDUCTANCE RANGE .025–.7 UH



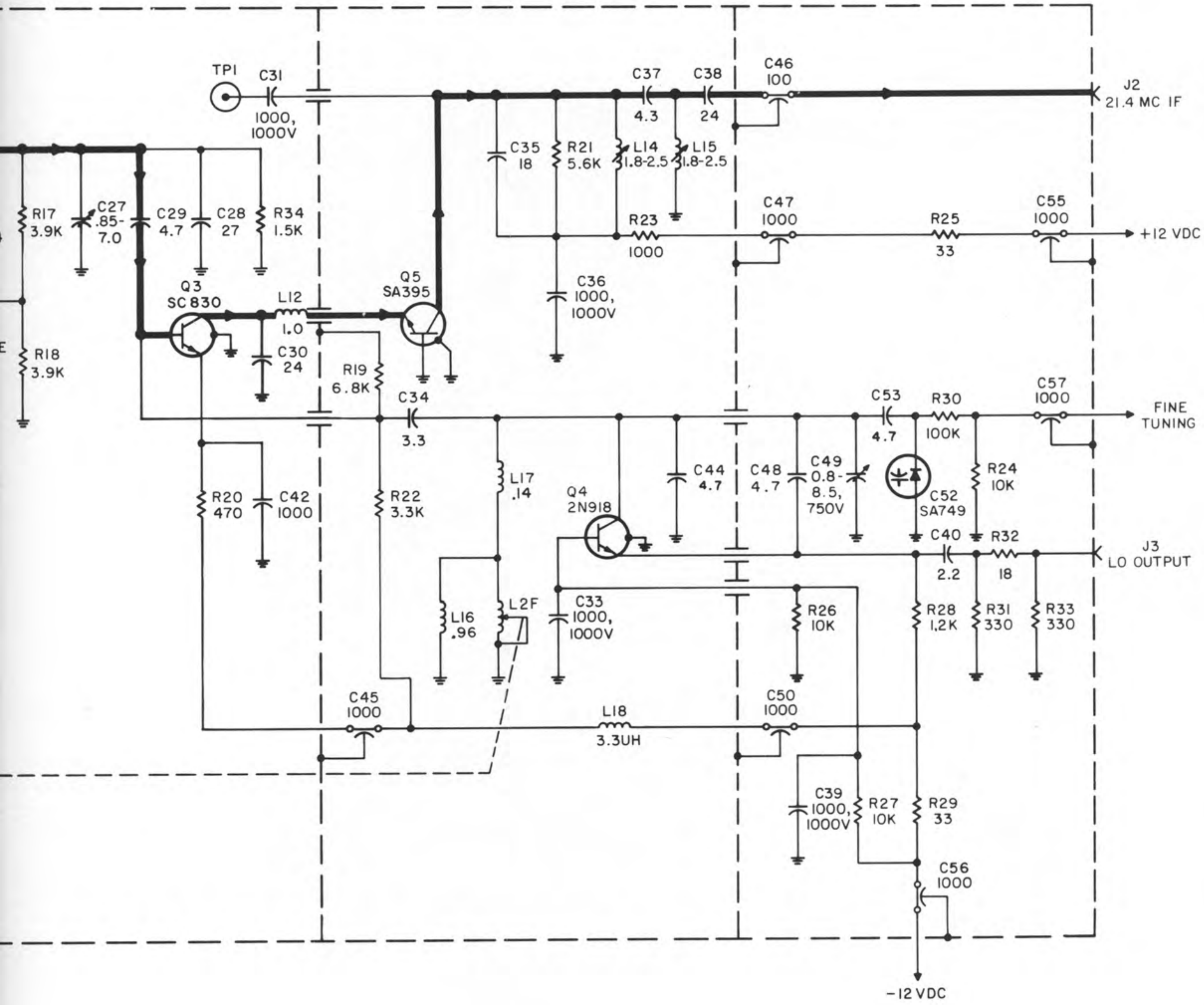


Figure 7-7B. SH-221-3, 30 to 100MC Tuner, Schematic Diagram

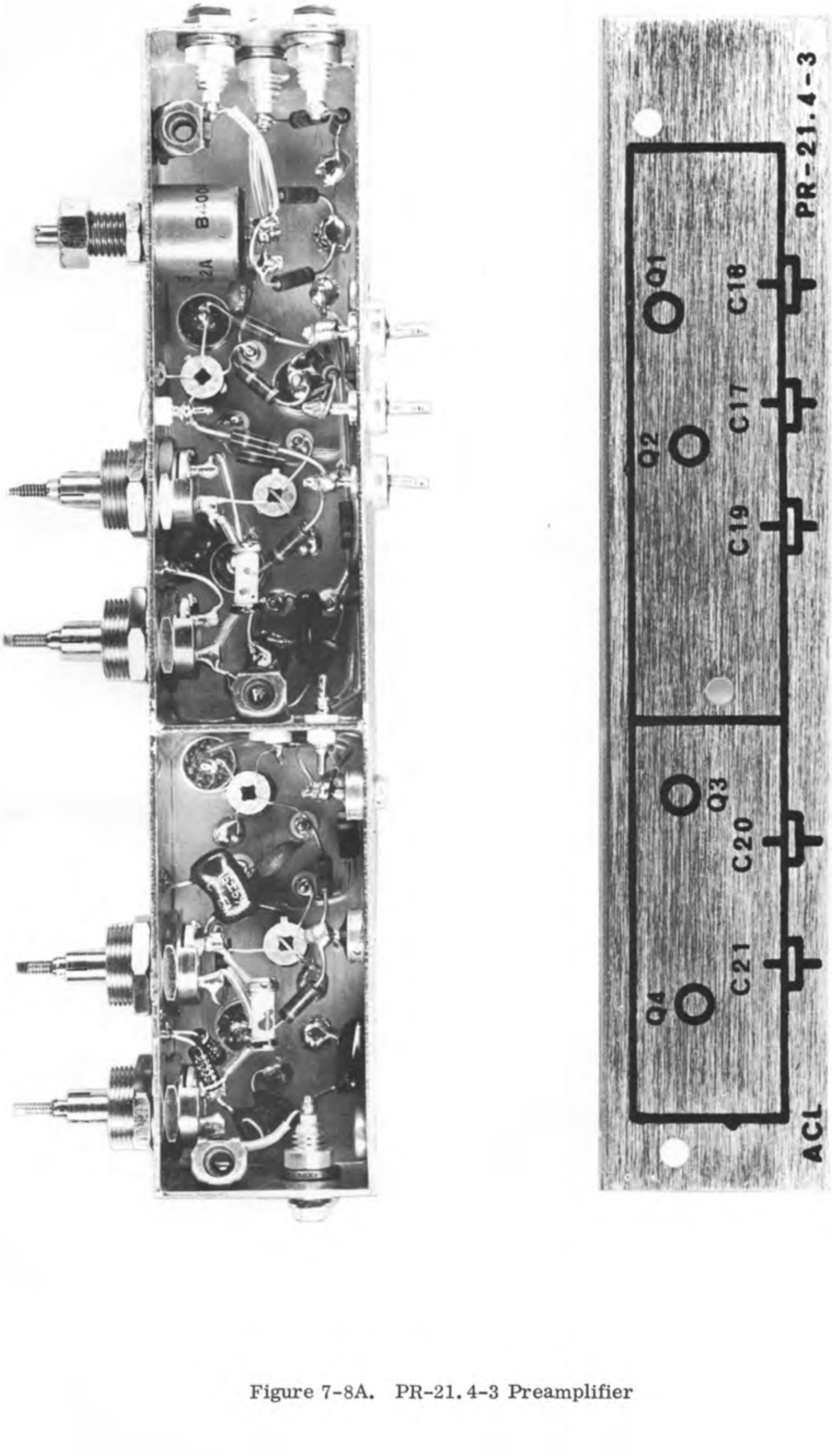
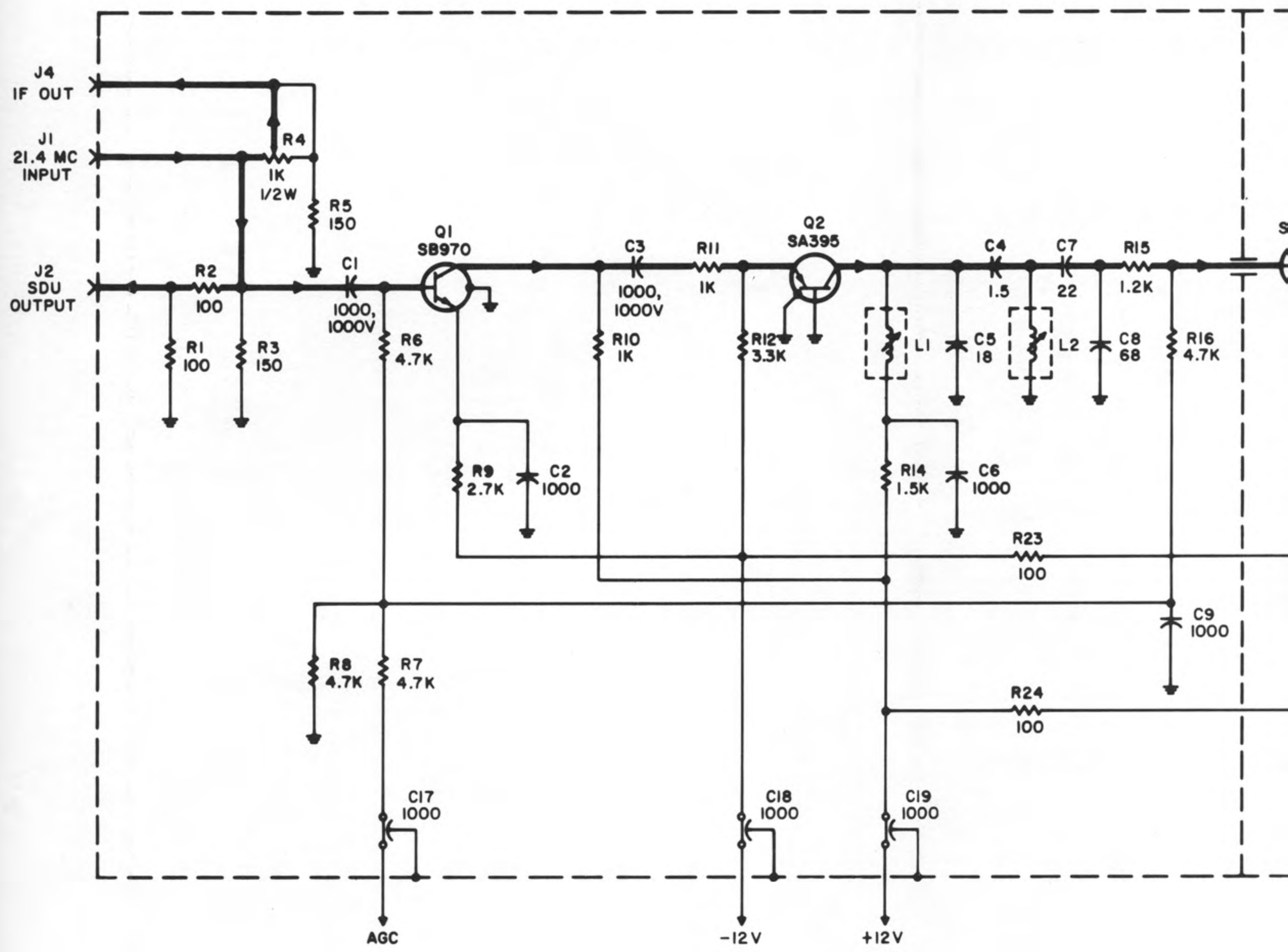


Figure 7-8A. PR-21.4-3 Preamplifier

UNLES


J4
IF OUT
J1
21.4 MC
INPUT
J2
SDU
OUTPUT
R4
1K
1/2W
R5
150
R2
100
R1
100
R3
150
C1
1000,
1000V
Q1
SB970
R6
4.7K
R9
2.7K
C2
1000
R8
4.7K
R7
4.7K
C17
1000
AGC
C3
1000,
1000V
R10
1K
R11
1K
Q2
SA395
R12
3.3K
C18
1000
-12V
C4
1.5
C7
22
R15
1.2K
L1
C5
18
L2
C8
68
R16
4.7K
R14
1.5K
C6
1000
R23
100
C9
1000
R24
100
C19
1000
+12V

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.
ALL VARIABLE INDUCTANCE RANGE 1.7-3.5UH.

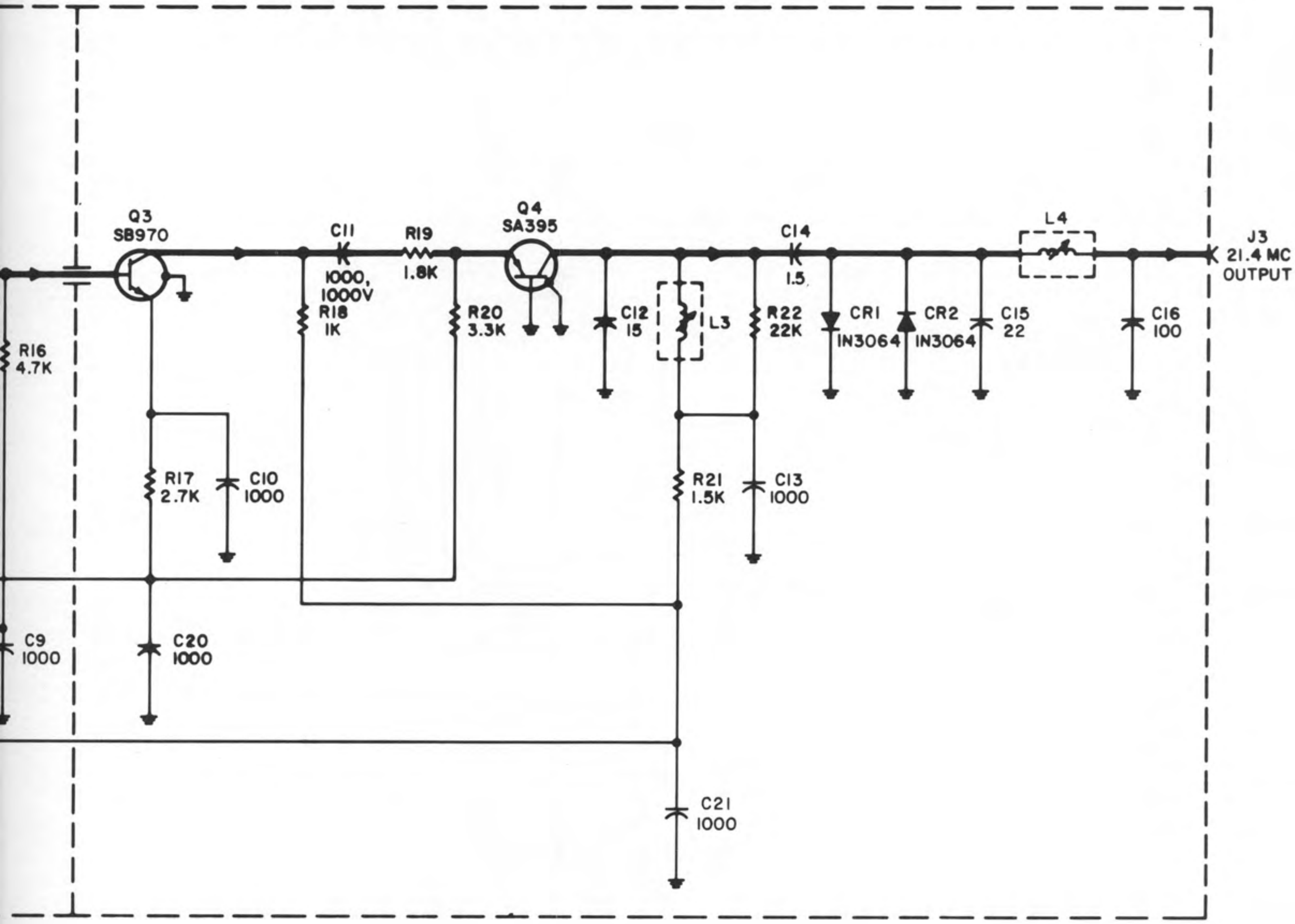


Figure 7-8B. PR-21.4-3, Preamplifier, Schematic Diagram

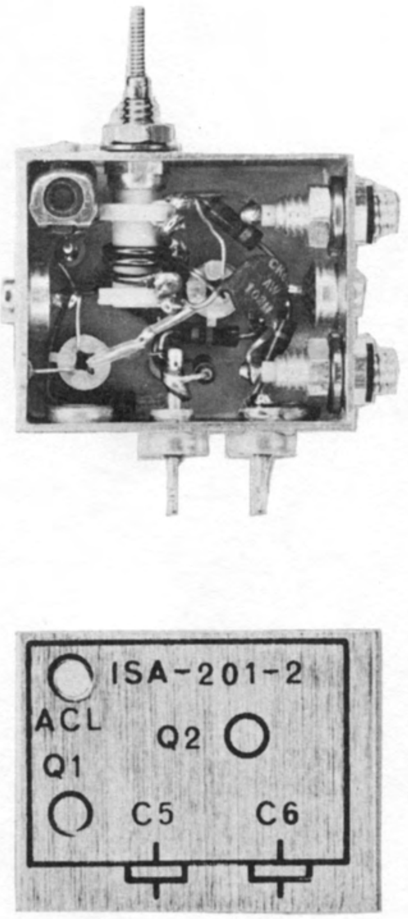


Figure 7-9A. ISA-201-2 Isolation Amplifier

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5 %.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.

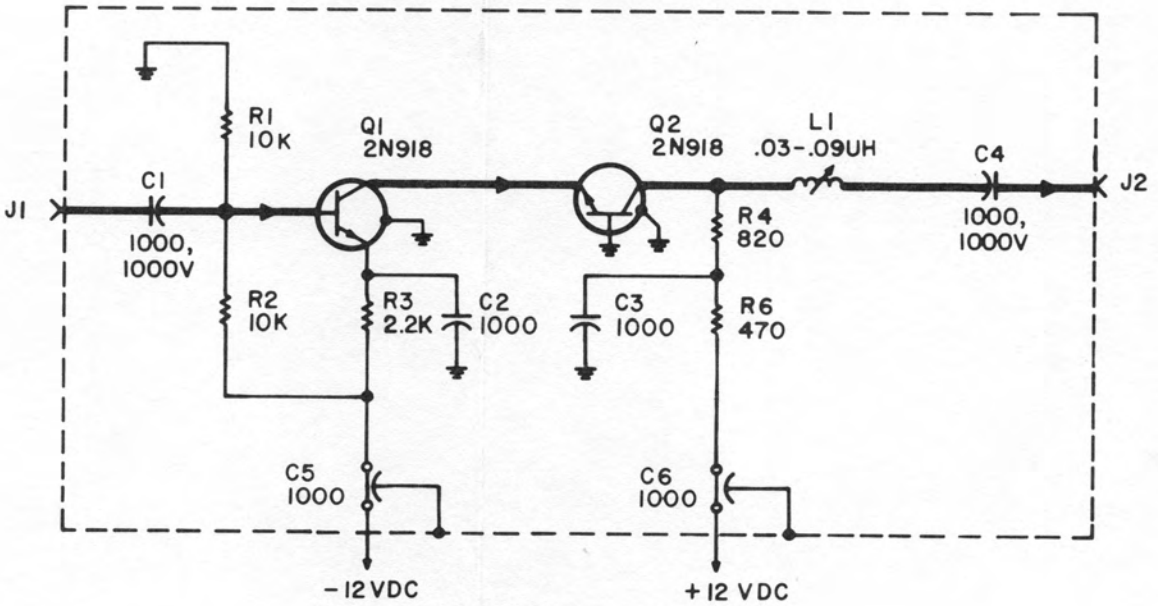
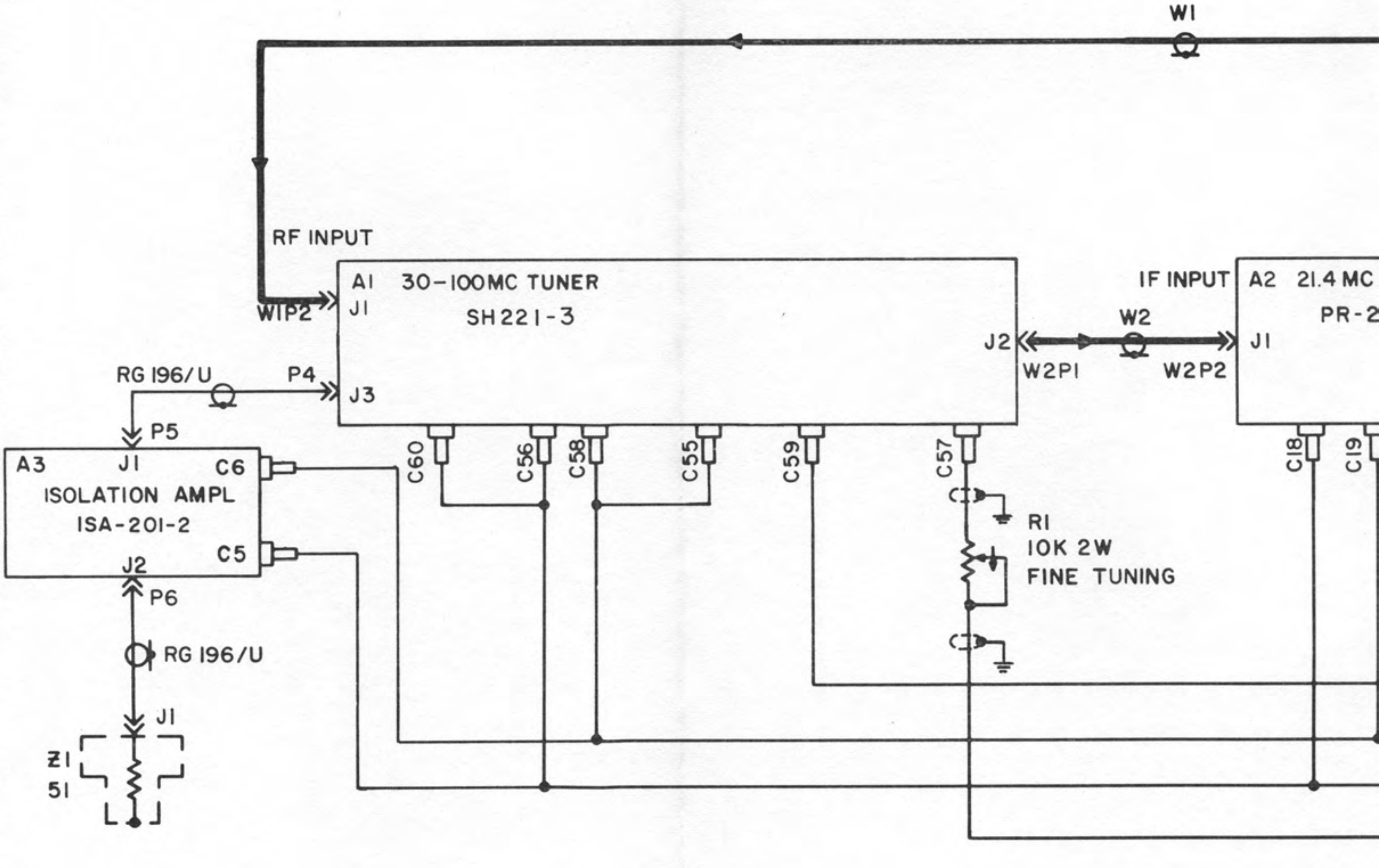


Figure 7-9B. ISA-201-2 Isolation Amplifier, Schematic Diagram

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN
2. PARTIAL REFERENCE DESIGNAT
FOR COMPLETE DESIGNATIONS



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 5%, 1/4W.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN:
   FOR COMPLETE DESIGNATIONS PREFIX WITH A1.

REF DESIG PREFIX 2

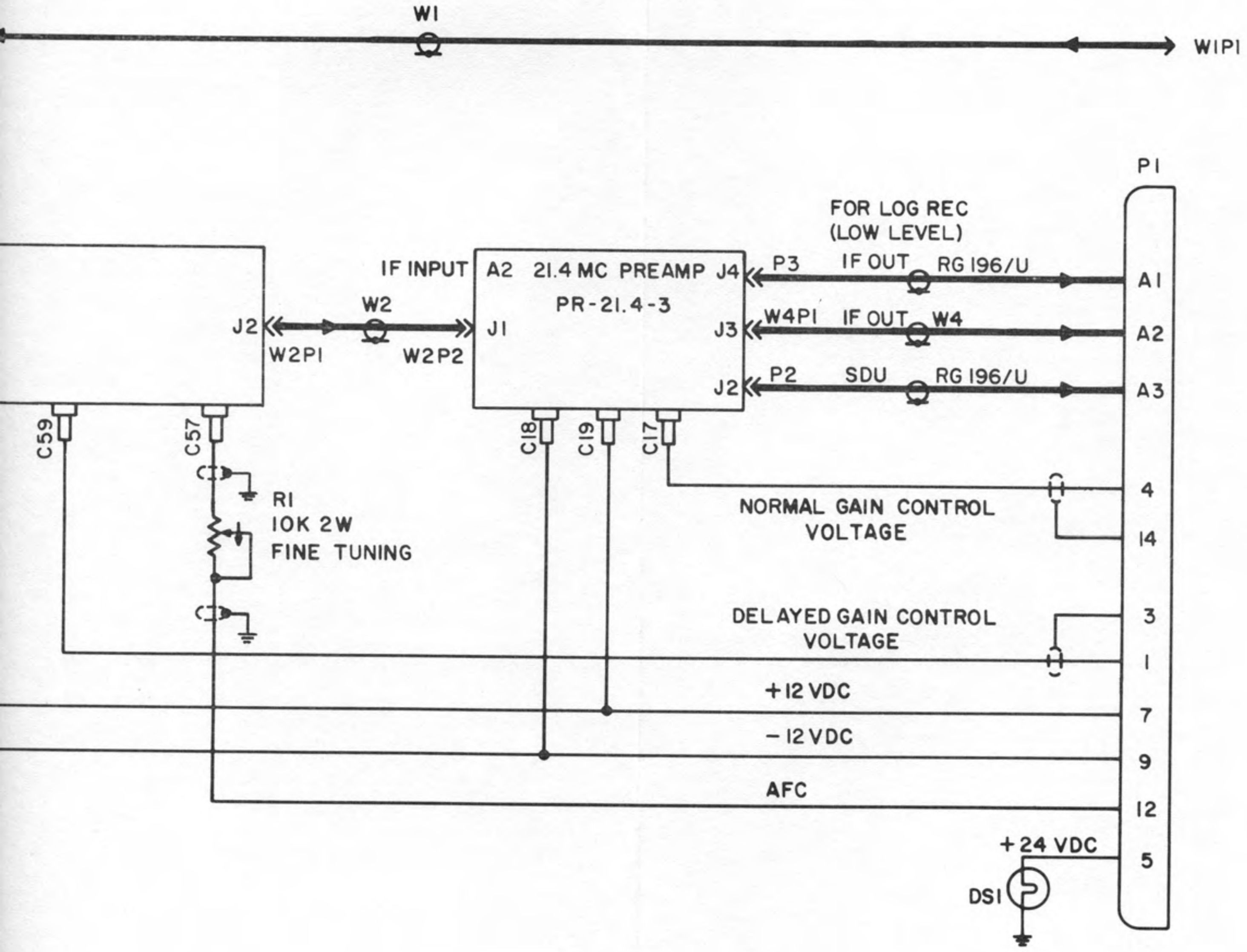


Figure 7-10. 30 to 100 MC, Tuning Unit, Interconnecting Wiring Diagram

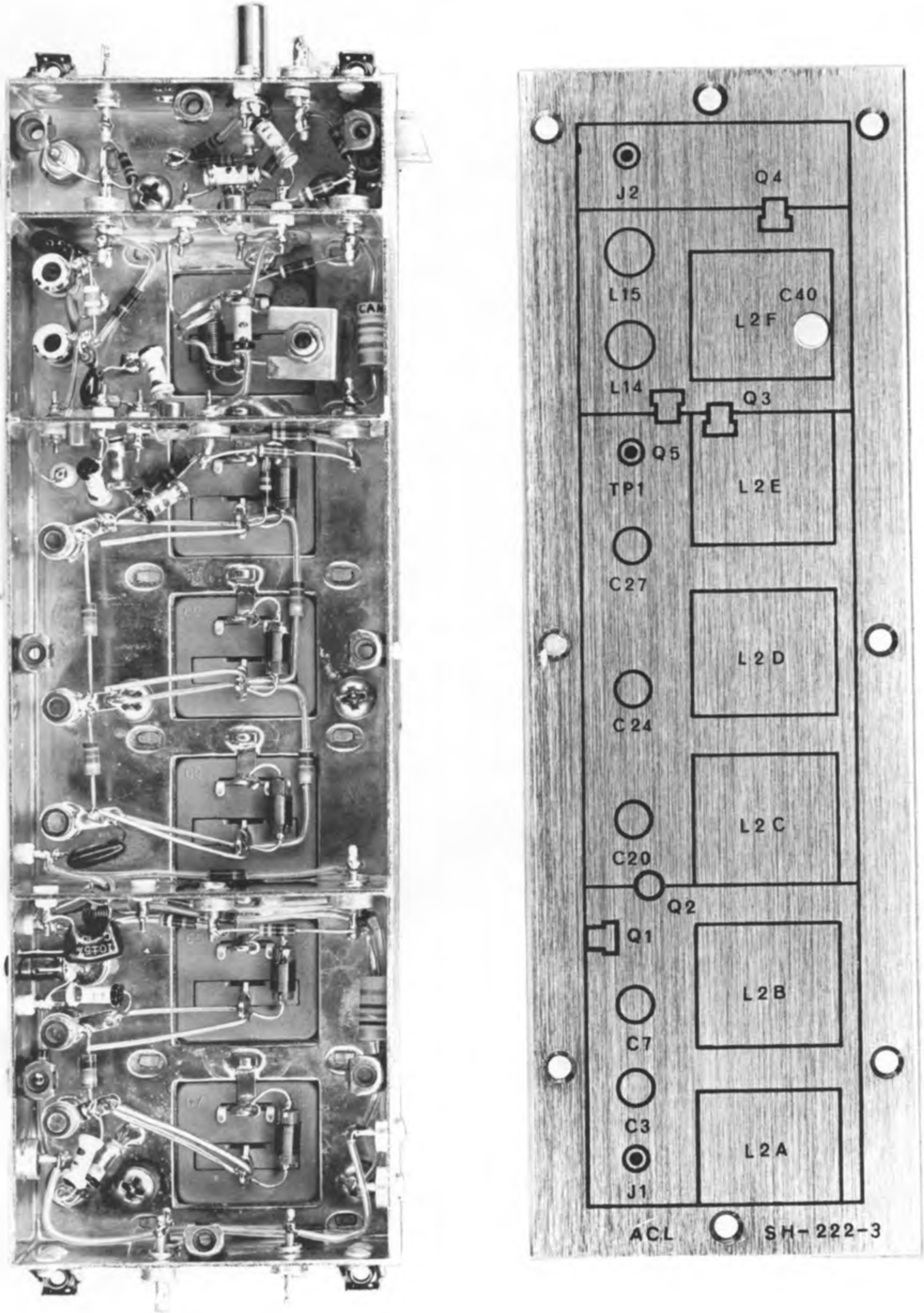
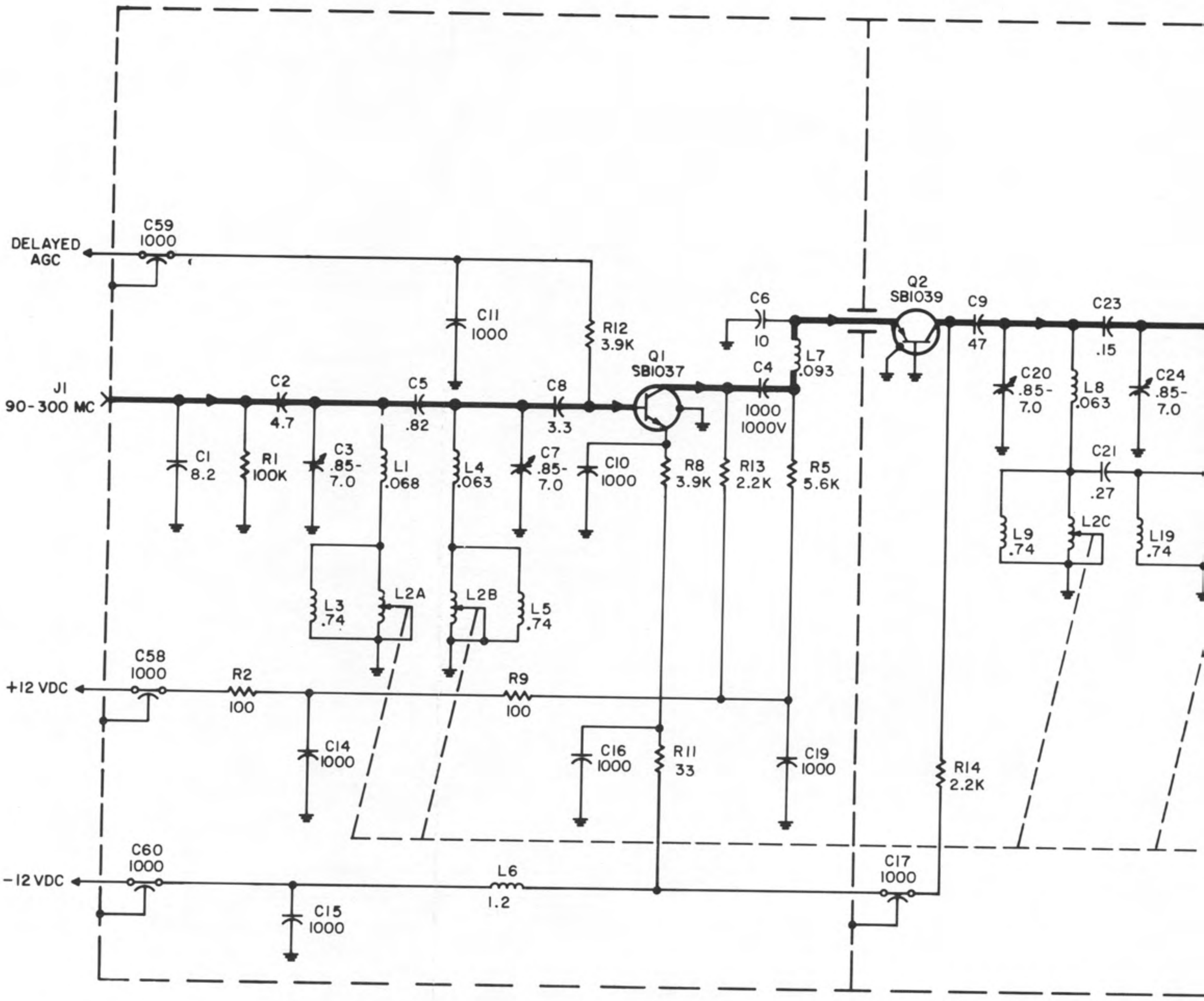


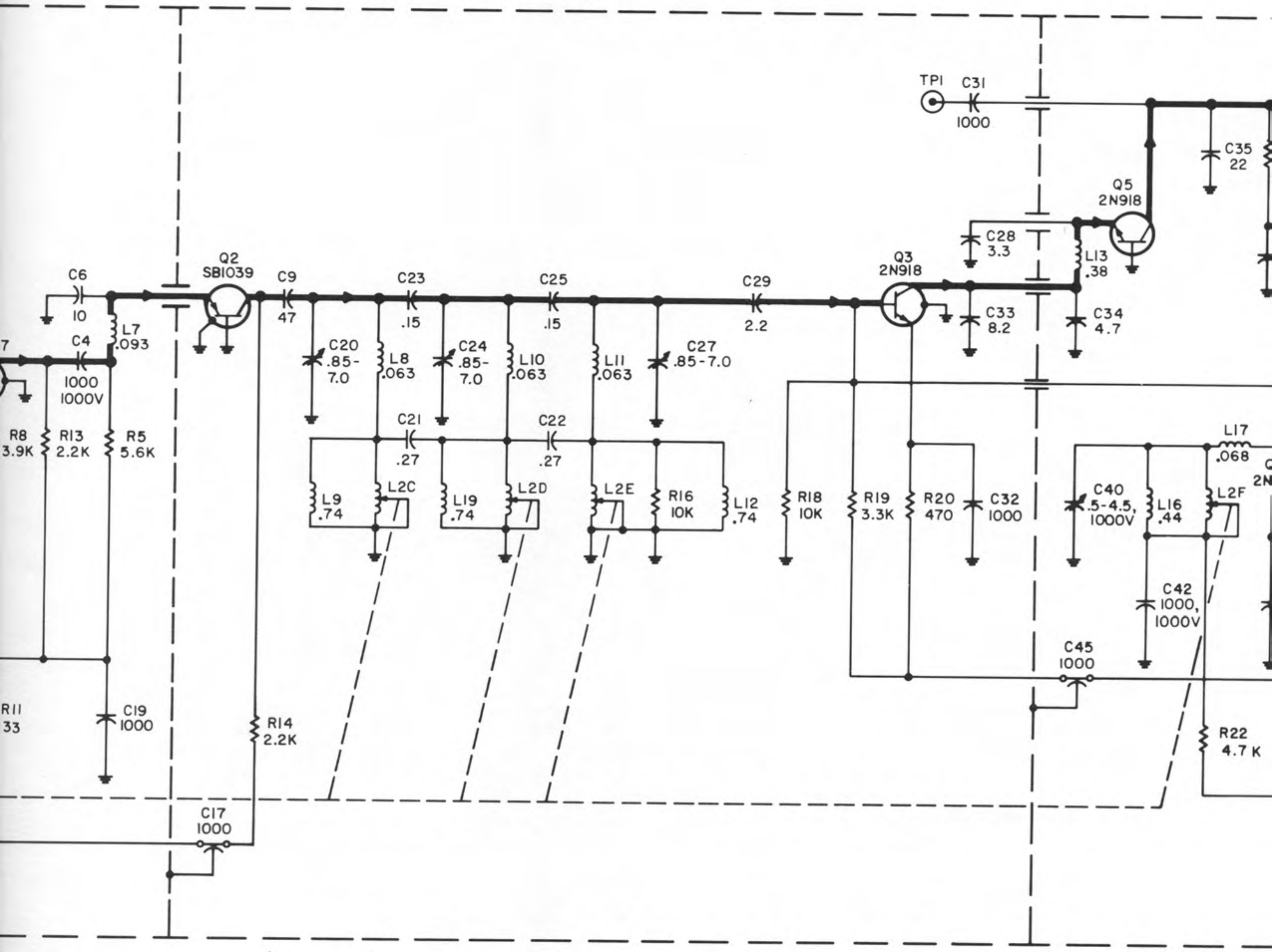
Figure 7-11A. SH-222-3 90 to 300 MC Tuner

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4
ALL CAPACITOR VALUES ARE IN UUF, 50
ALL INDUCTANCE VALUES ARE IN UH
L2 INDUCTANCE RANGE .025-.7 UH



UNLESS OTHERWISE SPECIFIED:

ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.
ALL INDUCTANCE VALUES ARE IN UH
L2 INDUCTANCE RANGE .025–.7UH



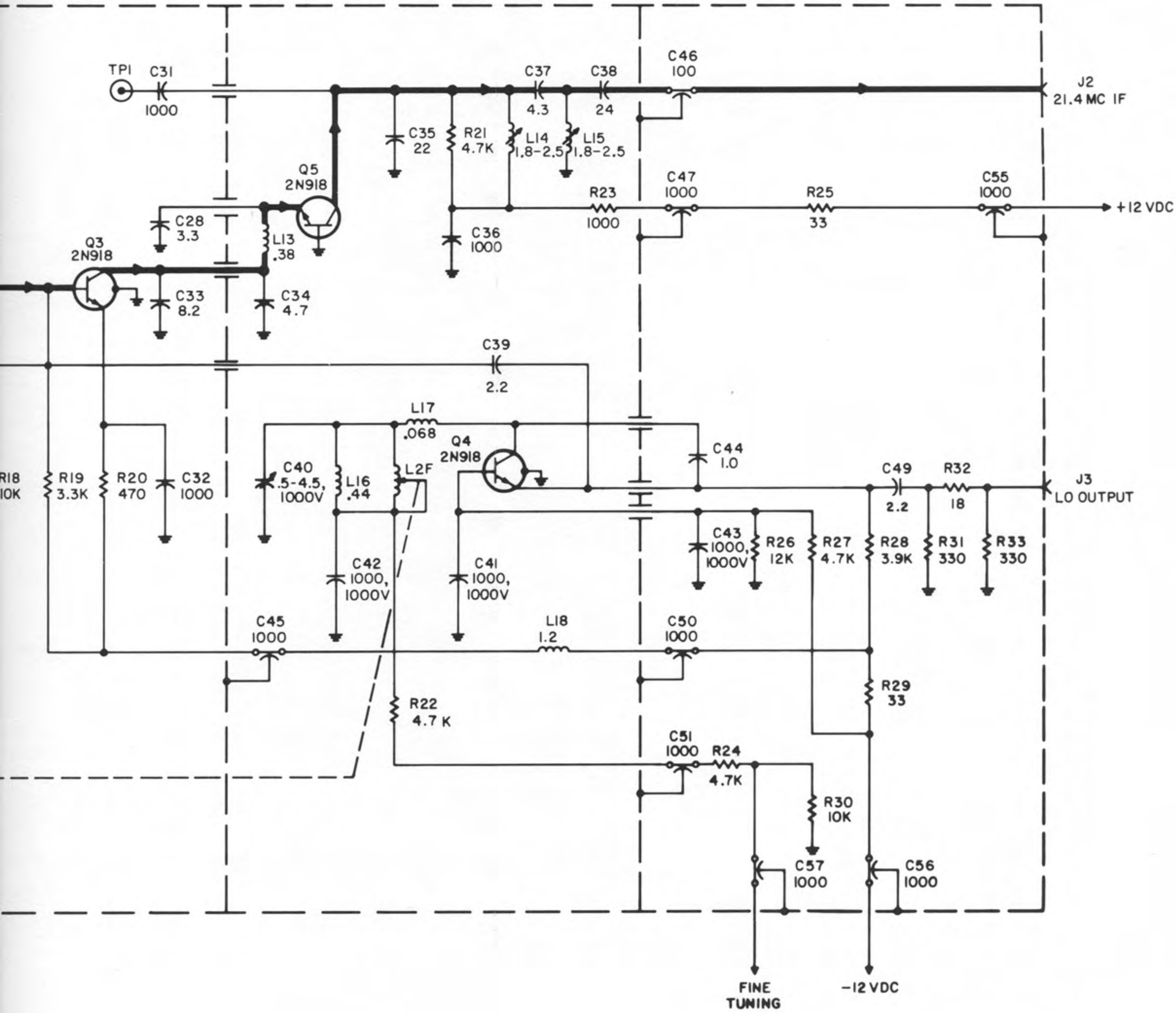
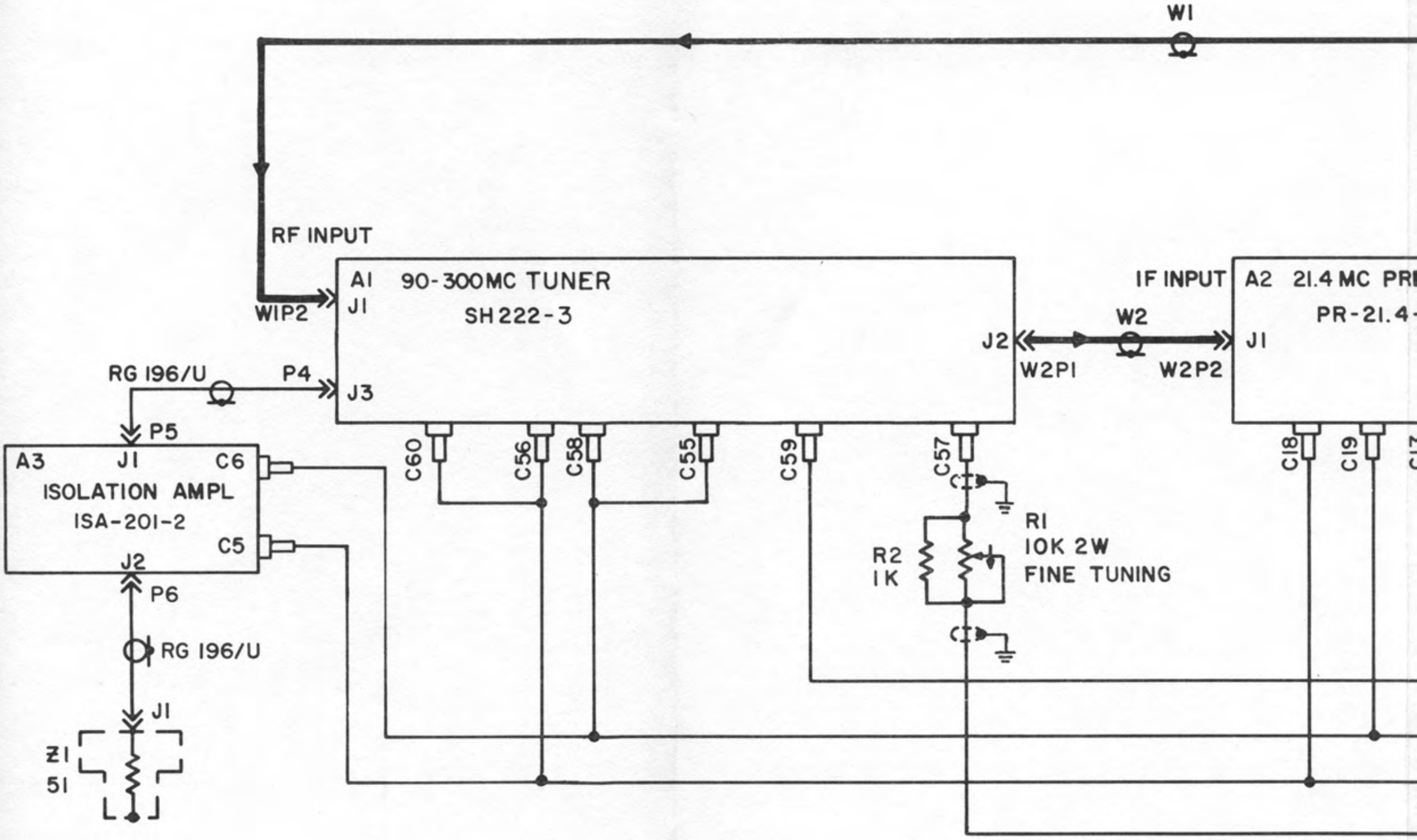


Figure 7-11B. SH-222-3, 90 to 300 MC Tuner, Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHM
2. PARTIAL REFERENCE DESIGNATIONS
   FOR COMPLETE DESIGNATIONS PR



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 5%, 1/4W.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN:
FOR COMPLETE DESIGNATIONS PREFIX WITH A1.

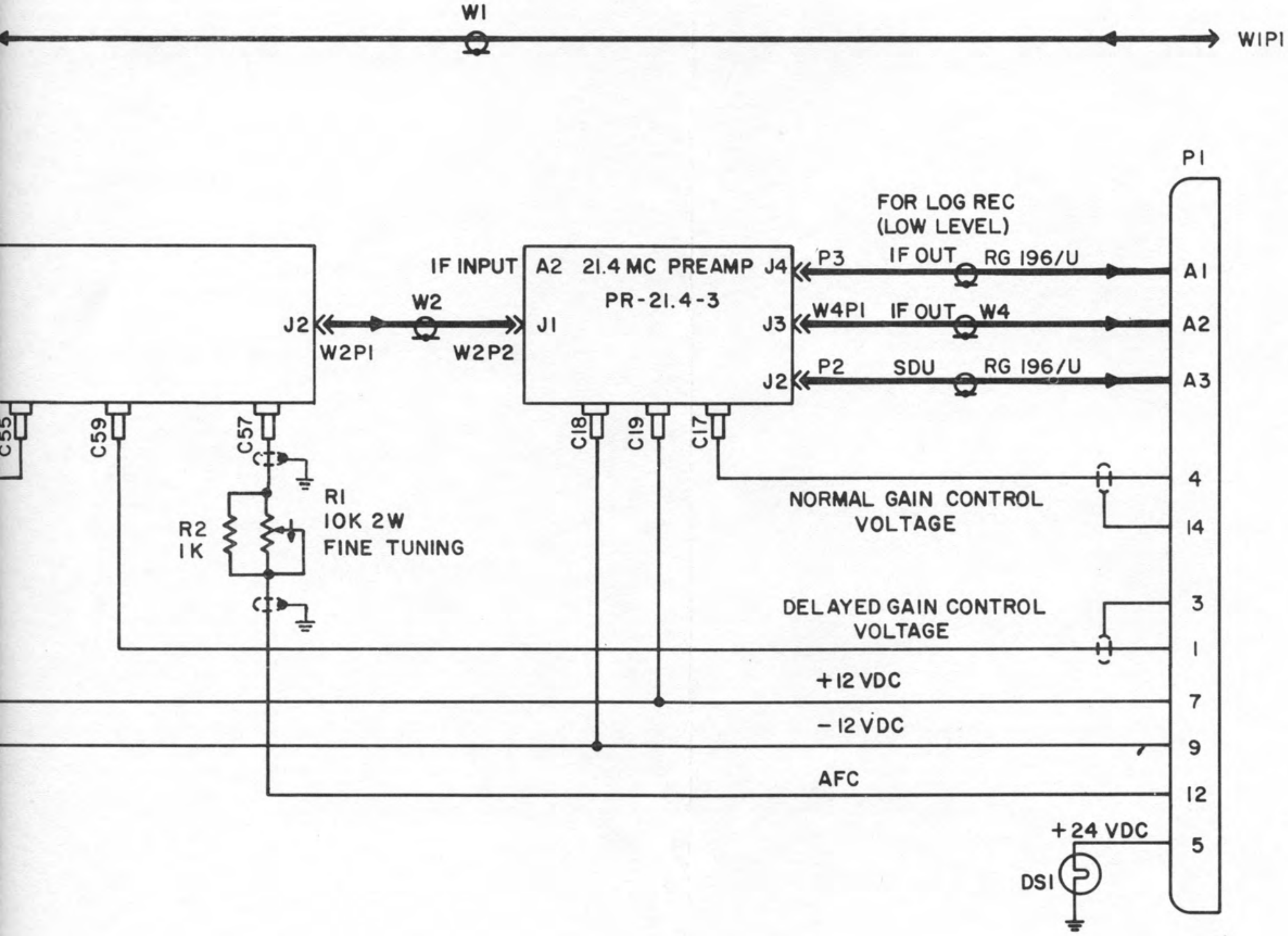


Figure 7-12. 90 to 300 MC, Tuning Unit, Interconnecting Wiring Diagram

NAVSHIPS 0967-282-0010 CHANGE 1

TECHNICAL MANUAL
FOR
AMPLIFIER, IF, IF-212-500
AND
TUNING UNITS, RADIO FREQUENCY
TN-519/WRR AND TN-520/WRR

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
NOVEMBER 1969

DIRECTIONS
Change and/or insert the following data with ink as directed below.

TABLE OF CONTENTS ERRATA

1. Page vi

After paragraph K add the following:

Paragraph		Page
L	Electronic Equipment Maintenance Kit, SK-250	6-82.1

2. Page vi

After figure 3-1 add the following:

Figure		Page
3-2	Tuner Assembly Case CY-6833/WRR, Front View	3-2

After figure 5-10 add the following:

Figure		Page
5-10.1	490-1000 Mc RF Tuning Head, SH-204-5, 60 Mc IF Amplifier, Test Setup	5-22.1

3. Page vii

Change "J3" to "CR1" and "5-22" to 5-22.1" for figure 5-11.
Change "5-22" to 5-22.2" for figure 5-12.

4. Page vii

After table 5-1 add the following:

Table		Page
5-1.1	Service Kit, SK-250	5-2.1

SECTION III, INSTALLATION AND OPERATION ERRATA

1. Page 3-1 and 3-2

Insert new page 3-1 and destroy old page. New page 3-1 is attached at the end of the errata pages.

SECTION IV, THEORY OF OPERATION ERRATA

1. Page 4-1 and 4-2

   Insert new page 4-1 and destroy old page. New page 4-1 is attached at the end of the errata pages.

2. Page 4-3, paragraph 1

   Change last line to read "Gain control (AGC or MGC) is applied to Q5 to prevent circuit overloading."

3. Page 4-7, paragraph B. (1)

   Add on asterisk, indicating factory adjustment, to L4.

4. Page 4-7, paragraph B. (3).

   Add an asterisk, indicating factory adjustment, to L10.

5. Page 4-9, paragraph F. (4).

   Change line 5 to read "Coils L12 and L13 are aligned for 6.5 mc bandwidth at 60 mc."

SECTION V, MAINTENANCE ERRATA

1. Page 5-2

   Insert new page 5-2.1 after page 5-2. New page 5-2.1 is attached at the end of the errata pages. Page 5-2.1 includes table 5-1.1 Service Kit, SK-250.

2. Page 5-3, paragraph 4.B

   Add a new step (6) under paragraph 4.B as follows: "Check for clutch slippage at stops."

3. Page 5-3, paragraph 4.C

   Paragraph 4.C, change "inductuner" to "tuner" in all places (four).

4. Page 5-10, table 5-4

   Under the column "Procedure", change "4.0 cm" to "2.0 cm" in all places (two).

5. Page 5-10, table 5-4

   Under the column "Minimum Acceptable Performance", change "35 db" to "28 db."

6. Page 5-11, table 5-5

   Under the column "Minimum Acceptable Performance", change "gain" to "loss" (two), "44.0 db" to "-7db" and "minimum" to "maximum."

7. Page 5-14, figure 5-5

   On Tuner Module A1, delete "OR J3" and below the words "LO OUT" add "LOCATED ON FRONT PANEL".

8. Page 5-14, figure 5-6

   Change "6.0 MC" to "12 MC".

9. Page 5-15, paragraph 1

Add the following line: "Rotate the tuning crank over the tuning range stopping at a point at which the RF response is relatively flat and the tracking marker "birdy" is within 2.0 mc of either skirt of the response."

10. Page 5-15, paragraph m

Delete "at 500 mc".

11. Page 5-15, paragraph (2) e

Change "2 mv/cm" to "1 mv/cm".

12. Page 5-15, paragraph (2) f

Change "5 cm" to "3 cm".

13. Page 5-15, paragraph (2) i

Add the following line: "This will cause degradation of the swept response."

14. Page 5-15, paragraph (2) j

Add the following line: "To observe this condition, it may be necessary to momentarily remove the 606D signal generator from the test setup."

15. Page 5-16, paragraph (2) l

Add the following line: "Adjust the sweep generator output level for a 3 cm response on the oscilloscope."

16. Page 5-16, paragraph (2) o

Add the following line: "Adjust the sweep generator output level for a 3 cm response on the oscilloscope."

17. Page 5-17, figure 5-9

Change "60 MC" to "21.4 MC" and "4.0 MC" to "3.0 MC".

18. Page 5-17, figure 5-10

Change "2.0 MC" to "1.0 MC".

19. Page 5-18, table 5-9

Under the column "Minimum Acceptable Performance" change "24 db" to "20 db".

20. Page 5-18, table 5-10

Under the column "Procedure", change "4.0 cm" to "2.0 CM" in all places (two).

21. Page 5-18, table 5-10

Under the column "Minimum Acceptable Performance", change "45 db" to "38 db".

22. Page 5-19, table 5-11

Under the column "Minimum Acceptable Performance", change "gain" to "loss", "4.0 db" to "6.0 db" and "or more" to "maximum".

23. Page 5-19, table 5-12

In the heading for table 5-12, change "100 Mc" to "1000 Mc".

24. Page 5-20, table 5-13

Change "Connector" to "Collector".

25. Page 5-21 and 5-22

Insert new page 5-21 and destroy old page. New page 5-21 is attached at the end of the errata pages.

26. Page 5-22

Insert new page 5-22.1 after page 5-22. New page 5-22.1 is attached at the end of the errata pages.

27. Page 5-23 and 5-24

Insert new page 5-23 and destroy old page. New page 5-23 is attached at the end of the errata pages.

28. Page 5-25, figure 5-14

Change "490 MC" to "500 MC" and "56" to ".56".

29. Page 5-26, figure 5-15

Change "950 MC" to "1 MC".

SECTION VI, PARTS AND MANUFACTURER'S LIST ERRATA

1. Page 6-18, Ref Sym No. C4

Add to item name "(NOT CONNECTED)".

2. Page 6-82

Insert new pages 6-82.1 thru 6-82.7 after page 6-82. New pages 6-82.1 thru 6-82.7 are attached at the end of the errata pages.

SECTION III

INSTALLATION AND OPERATION

1. Installation.

A. RF Tuner TN-519/WRR and TN-520/WRR

The TN-519/WRR and TN-520/WRR RF tuners are plug-in modules. The modules are designed to fit into the main chassis of Countermeasures Receiver R-1524(P)/WRR. Perform the following procedure to install the plug-in tuner.

NOTE

When installing the tuner module, care should be taken to prevent damage to the rear panel connectors. Do not force or jam the plug-in tuner into the receiver chassis. When a reasonable amount of hand pressure does not seat the module, remove the module and inspect for obstructions and/or bent connector pins.

(1) Grasp the plug-in tuner by the front panel handles and align with receiver compartment opening.

(2) Push the tuner into the receiver compartment until the rear panel connectors are firmly seated. Seating is complete when front panels are flush.

(3) Lock the three front panel thumbscrews.

(4) Installation is complete.

B. IF Amplifier, IF-212-500

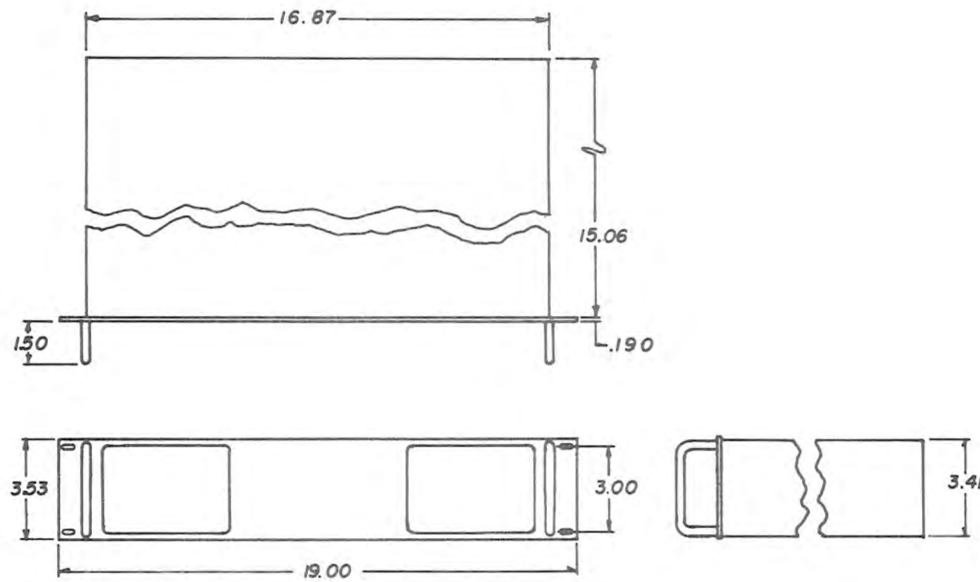
The IF amplifier module is designed to mount into main receiver chassis receptacle XA2, XA3, or XA4. Normally, main receiver chassis receptacle XA4 is a wired spare. Mount the IF amplifier in the spare receptacle when possible. When there are no spare receptacles, remove any IF amplifier from the receiver and replace with IF amplifier module IF-212-500. No special procedure is required to mount the IF amplifier module. Remove power from the receiver before installation to prevent damage to the module.

2. Operation.

All operator procedures are contained in the technical manual NAVSHIPS 0967-282-0010, Countermeasures Receiver R-1524(P)/WRR. Specifically, refer to Section III, Installation and Operation of the technical manual.

3. Storage.

The Case, Tuner Assembly CY-6833/WRR Figure 3-2 is designed to be installed in a 19 inch electrical rack. It will provide drip proof storage for two of the plug-in modules.



Outline Drawing

Figure 3-2. Tuner Assembly Case CY-6833/WRR, Front View

SECTION IV

THEORY OF OPERATION

1. General.

RF tuner TN-519/WRR and TN-520/WRR, and IF amplifier, IF-212-500 are designed for use in Countermeasures Receiver R-1524(P)/WRR. RF tuner TN-519/WRR is tunable from 250 to 500 mc and RF tuner TN-520/WRR is tunable from 490 to 1000 mc. IF module IF-212-500 will accept deviations up to 250 Kc on either side of a 21.4 mc center frequency. These plug-in modules expand the versatility of Countermeasures Receiver R-1524(P)/WRR. Complete schematic diagrams are located in Section VII of this supplement.

2. Functional Description.

A. RF tuner TN-519/WRR, Figure 4-1

RF Tuner TN-519/WRR consists of three (3) subchassis as follows:

(1) Tuning head, SH-203A-7, A1

(2) 60-21. 4 mc Converter, CV-204-4, A2

(3) Isolation amplifier, ISA-201-1, A3

(1) Tuning Head, SH-203A-7: RF signals from the antenna are routed through the main chassis of Countermeasures receiver R-1524(P)/WRR to jack J1 of tuning head SH-203A-7. RF amplifier Q1-Q2 amplifies and selects the radio frequency for receiver processing. Frequency selection is accomplished by a tunable inductor component of amplifiers Q1-Q2. A front panel TUNING crank is mechanically linked to the tunable (variable) inductor and front panel calibrated dial. Rotating the TUNING crank tunes the RF amplifiers to the required frequency. The selected frequency is indicated on the calibrated dial. Gain control applied to RF amplifier Q1 prevents overloading of this amplifier stage. The RF output of Q2 is coupled to cascode mixer Q3-Q4.

Local oscillator Q5 generates a signal which is 60 mc above the selected RF. The oscillator output frequency is determined by the setting of the front panel TUNING crank. The local oscillator output signal is coupled to cascode mixer Q3-Q4 and isolation amplifier module A3. Front panel FINE TUNING control R1 varies the oscillator output frequency ±50 Kc.

The RF output of RF amplifier Q1-Q2 and local oscillator Q5 are mixed, amplified and filtered by cascode mixer circuit Q3-Q4. The output of cascode mixer Q3-Q4 is a 60 mc IF which is coupled to 60 to 21.4 mc converter module A2. Test point TP1 is used for monitoring during calibration of the tuning head module.

(2) 60-21.4 mc Converter, CV-204-4: The 60 mc IF from tuning head module A1 is applied to input cascode IF amplifier Q1-Q2 of converter module A2. The output of Q1-Q2 is coupled to mixer/amplifier Q3-Q4. Gain control is applied to Q1 to prevent overloading.

Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer/amplifier Q3-Q4. Automatic frequency control (AFC) from the main chassis of Countermeasures Receiver R-1524(P)/WRR will cause the output of Q7 to vary. The AFC signal compensates for local oscillator or transmitting station frequency drift by maintaining the output frequency of Q7 exactly 21.4 mc above the 60 mc IF input from the tuning head module.

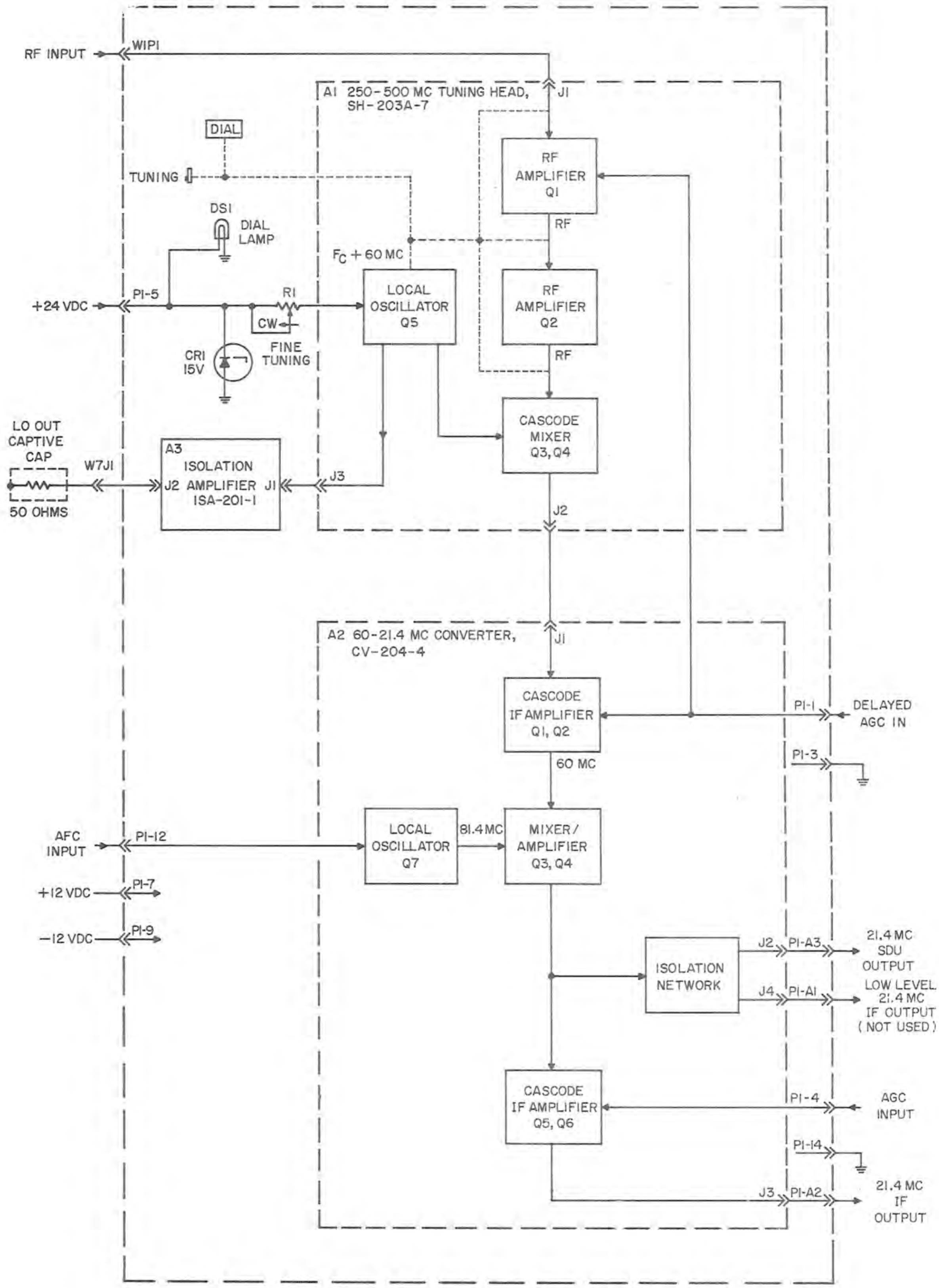


Figure 4-1. 250-500 Mc Plug-in RF Tuner, TN-519/WRR, Functional Block Diagram.

2.1 Tools.

Tools available for maintenance personnel are included in Service Kit, SK-250. Items available in this lot are listed in Table 5-1.1.

Table 5-1.1. Service Kit, SK-250.

Item	Mfr.	Part Number	Quantity
Extender, PC Board	ACL	AB482-3	1
Cable Assy, Special Purpose, Electrical	ACL	AB519	1
Extender, PC Board	ACL	AB698	2
Cable Assy, RF	ACL	AC076-102	1
Cable Assy, RF	ACL	AC076-154	1
Cable Assy, RF	ACL	AC076-84	1
Extractor, PC Board	ACL	AC1477-1	1
Alignment Tool	Micrometals	TYPE A	1
Extractor, PC Board	ACL	B699	1
Alignment Tool	Cambion	2375-1	1
Tuning Tool	ACL	A1148	1

C. 490 to 1000 Mc RF Tuner Alignment

Alignment of the 490 to 1000 mc RF tuner is divided into tuning head and 60 to 21.4 mc converter alignment. Countermeasures Receiver R-1524(P) /WRR and the tuner should be placed on a workbench adjacent to the test equipment being used for alignment to facilitate the use of short cables and test leads. The power extender cable illustrated in Figure 5-4 should be connected between the RF tuner and the right hand connector J5 on the receiver main chassis. Place the following front panel switches and controls to the positions indicated below before performing alignment.

SWITCH	POSITION
POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	As indicated in procedure
VOLUME	Midrange

(1) RF Tuning Head, SH-204-5 Alignment: The 4-pole preselector is factory aligned and can be realigned under factory conditions only. Under normal conditions, the wideband preselector will not require alignment during the life of the tuner. A periodic check of the SH-204-5 tuning head module gain will confirm proper alignment of the preselector. Generally, incorrect gain indicates the module requires alignment. Incorrect gain after alignment indicates the preselector is out of alignment or malfunctioning. Table 5-9 contains the minimum performance standards procedure for the SH-204-5 tuning head module.

a. Connect Countermeasures Receiver to a 115 vac, 60 cps power source.

b. Connect a Hewlett-Packard 5245L electronic counter with the 5254A plug-in converter installed to the RF tuner LO OUTPUT jack.

c. Tune the RF tuner to 500 mc and set the 5245L electronic counter to monitor 560 mc.

d. Adjust capacitor C9 on the SH-204-5 module until the local oscillator output is 560 mc ± 1%.

e. Tune the RF tuner to 1000 mc and set the 5245L electronic counter to monitor 1060 mc.

f. Adjust capacitor C6 on the SH-204-5 module until the local oscillator output is 1060 mc ± 1%.

g. Repeat steps "c" through "g" until both outputs of the local oscillator are within tolerance.

h. Remove the electronic counter from the tuner LO OUTPUT jack.

i. Check the local oscillator output level at the tuner LO OUTPUT jack. The LO output must be 100 mv rms minimum before proceeding. Incorrect levels are corrected by troubleshooting the local oscillator circuit of the SH-204-5 module and or isolation amplifier module A3 of the RF tuner.

j. Connect a dc milliammeter capable of reading 0.3 to 2 milliamperes to J3 on the SH-204-5 module.

k. Rotate the front panel TUNING control over the entire tuning range while observing the milliammeter. The ammeter should read a minimum of 0.3 milliamperes (0.5 milliammperes is nominal). Incorrect readings are corrected by replacing crystal diode CR1 or by repositioning inductor L6 of the SH-204-5 module.

l. Replace crystal diode CR1 and repeat steps "j" and "k". If the crystal current remains out of tolerance, perform step "m" below.

m. Increase current by moving L6 further into the tuning head local oscillator chamber; decrease current by moving L6 further out of the chamber.

CAUTION

Adjustment of L6 is very critical. Do not move L6 more than 1/32 of an inch in any direction.

n. Connect test equipment as shown in Figure 5-10.1. Calibrate the signal generator at 60 mc. Construct the lowpass filter as shown using components values specified.

o. Adjust the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the horizontal sensitivity as required for full scale deflection. Connect the lowpass filter to mixer diode CR1 as shown in Figure 5-10.1. The XD-3A detector should be disconnected from the sweep generator at this time. Adjust the RF level of the signal generator and the marker adder control of the sweep generator for a small marker on the oscilloscope.

p. Adjust the sweep generator output frequency to 750 mc. Adjust the sweep generator output level as required to achieve an oscilloscope vertical deflection of 4.0 cm.

q. Fine tune the RF tuner until the 750 mc marker is centered on the response waveform. The waveform should have the characteristics illustrated in Figure 5-11. Incorrect response can not be corrected in the field. Do not attempt alignment of the preselector. Return the tuner to the factory or proper facility for realignment. Rotate the tuning crank over the tuning range stopping at a point at which the RF response is relatively flat and the traveling marker "birdie" is within 3.3 mc of either skirt of the response.

r. Disconnect the lowpass filter and the milliammeter from the test setup and then connect the XD-3A detector as shown in Figure 5.10.1. Do not change the position of any control.

s. Adjust the sweep generator marker and output signal levels to achieve a 4.0 cm vertical deflection on the oscilloscope with a visable marker "birdy".

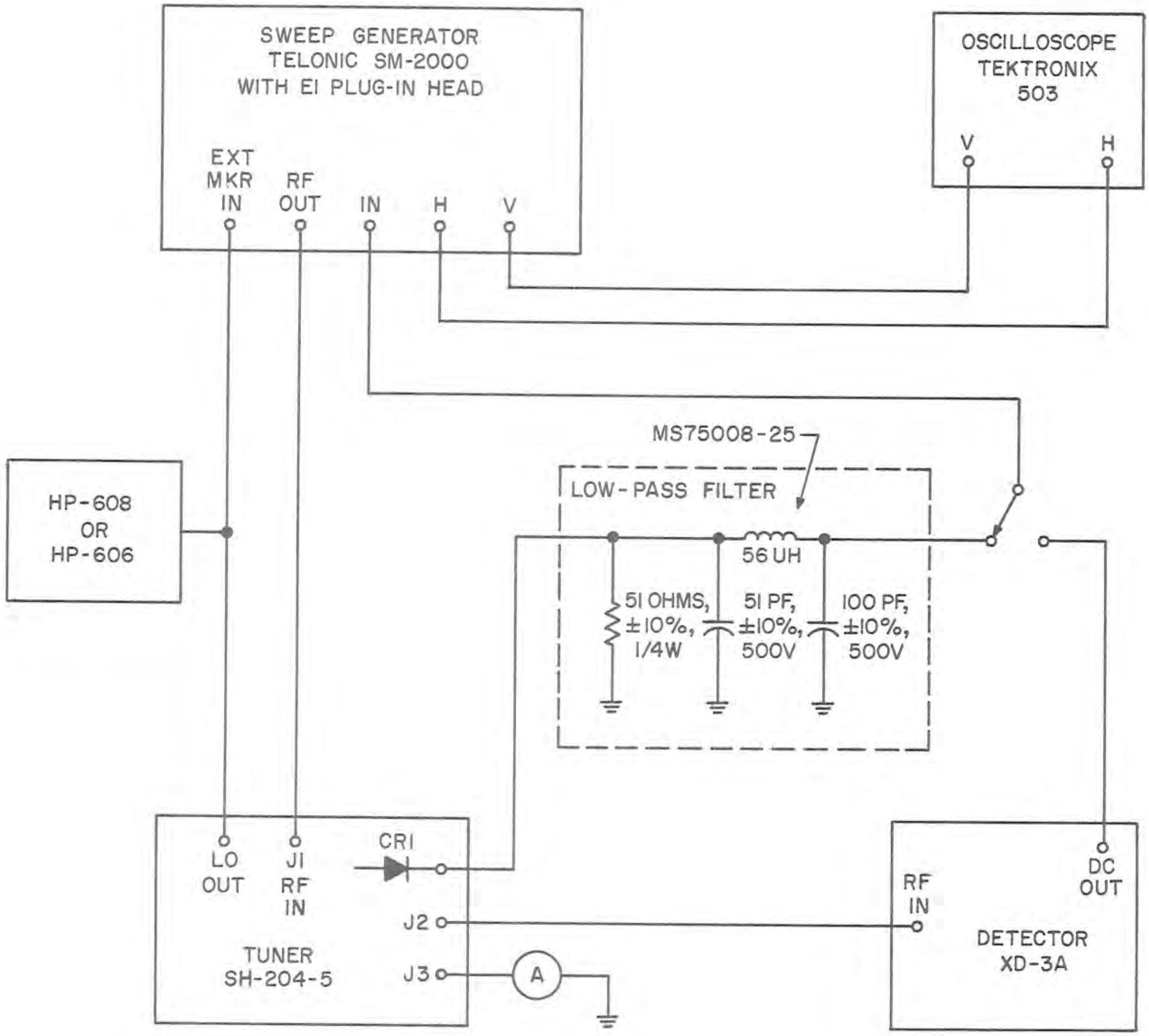


Figure 5-10.1. 490-1000 MC RF Tuning Head, SH-204-5, 60 MC IF Amplifier, Test Setup.

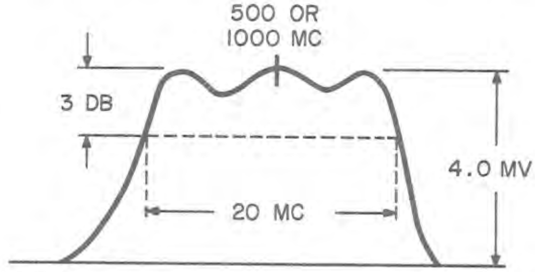


Figure 5-11. 490-1000 MC RF Tuner Response Waveform at CR1.

t. Adjust L12 and L13 on the SH-204-5 module for a maximum symmetrical response centered around the marker. Refer to Figure 5-12.

u. Adjust inductor L10 on the SH-204-5 module for maximum signal amplitude on the oscilloscope. (L10 is heavily damped and has very little effect on output).

v. Remove test equipment and replace all covers.

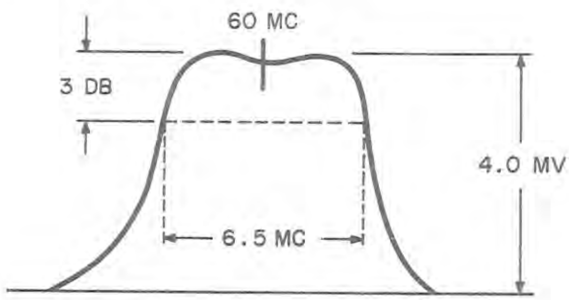


Figure 5-12. 490-1000 Mc RF Tuner, IF Response Waveform at J2.

(2) 60 to 21.4 Mc Converter, CV-205-1 Alignment: The alignment of the CV-205-1 converter is identical to the alignment of the CV-204-4 converter. Refer to Section V, paragraph 5, C (2) of this supplement for the converter alignment procedure.

(3) ISA-202 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about 6.0 db maximum over the range of frequencies from 550 to 1060 mc and effectively isolates the oscillator from variations in load impedance. Perform the test outlined in Table 5-11 of the minimum performance standards. If the unit exhibits more loss than is indicated, the difficulty is likely to be a defective component and not the alignment.

7. IF Amplifier, IF-212-500.

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in isolation of faults to the IF amplifier module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the IF-212-300 IF amplifier.

A. Minimum Performance Standards.

When faulty receiver operation has been traced to the receiver main chassis, the following minimum performance standards chart will assist in further fault isolation.

Table 5-15. 500 Kc IF Amplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Connect 606A signal generator to J5A2 on the receiver main chassis. Set the modulation to 50% at 400 cps. Set the output level of the signal generator to 7.5 mv. Set the generator frequency to 21.4 mc using the generator frequency calibrator.	Place TUNER selector in RIGHT position and IF BANDWIDTH in position number 3. Place MODE in AM/MAN. Check output with scope at XA5B2.	The scope should display a sine wave of 2 volts peak-to-peak minimum at a frequency of 400 cps. Adjust the output level of the signal generator until the desired amplitude is achieved. The output of the signal generator should be less than 7.0 mv.
2	Same as Step 1	Reduce signal generator output level about 10 db and note the indication of the TUNING meter.	The TUNING meter should indicate a zero tuning condition within about two divisions if the signal generator is at 21.4 mc. Shift the signal generator frequency above and below 21.4 mc and the TUNING meter should indicate the relative frequency of the signal. The TUNING meter swing above and below the zero tuning condition should be equal within about two divisions.

B. Voltage and Resistance Measurements.

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the faulty components. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. The front panel control and switch positions for Countermeasures Receiver, R-1524(P)/WRR are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and the other for measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

Table 5-16. 500 Kc IF Amplifier, IF-212-500 Voltage and Resistance Chart.

NOTES: 1. IF BANDWIDTH switch set to position of IF module under test.
2. POWER switch set to ON.
3. Disconnect power cord from Countermeasures Receiver R-1524(P)WRR during resistance measurements.

REF DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-5.4 V (15 V)	4.3 K (R x 1 K)	4.3 K (R x 1 K)	-4.6 V (15 V	5.7 K (R x 1 K)	5.7 K (R x 1 K)	-0.65 (1.5 V)	100 M (R x 1 M)	6.1 K (R x 1 K)
Q2	-0.65 (1.5 V)	100 M (R x 1M)	6.1 K (R x 1 K)	0	0	0	9.6 (15 V)	4.3 K (R x 1 K)	3.9 K (R x 1 K)
Q3	-5.4 V (15 V	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-4.7 (15 V)	5.7 K (R x 1 K)	5.7 K (R x 1 K)	-0.66 V (1.5 V)	200 M (R x 1 M)	94 (R x 10)
Q4	-0.66 V (1.5 V)	200 M (R x 1 M)	94 (R x 10)	0	0	0	11.0 V (15 V)	3.2 K (R x 1 K)	3.2 K (R x 1 K)
Q5	-0.72 V (1.5 V)	6.8 K (R x 1 K)	6.8 K (R x 1 K)	-0.9 (0.5 V)	8.1 K (R x 1 K)	360 (R x 100)	11.5 V (15 V)	3.3 K (R x 1 K)	3.3 K (R x 1 K)
Q6	-2.65 V (5 V)	4.1 K (R x 1 K)	4.1 K (R x 1 K)	-2.0 (5 V)	4.1 K (R x 1 K)	4.1 K (R x 1 K)	-0.68 (1.5 V)	500 M (R x 1 M)	6.2 K (R x 1 K)
Q7	0.68 V (1.5 V)	500 M (R x 1 M)	6.2 K (R x 1 K)	0	0	0	4.6 (15 V)	5.5 K (R x 1 K)	4.2 K (R x 1 K)
Q8	-2.9 V (15 V)	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-2.4 (5 V)	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-0.66 (1.5 V)	200 M (R x 1 M)	6.1 K (R x 1 K)
Q9	-0.66 (1.5 V)	200 M (R x 1 M)	6.1 K (R x 1 K)	0	0	0	8.0 V (15 V)	4.1 K (R x 1 K)	3.9 K (R x 1 K)
Q10	-1.44 V (5 V)	5.3 K (R x 1 K)	5.3 K (R x 1 K)	-0.16 V (0.5 V)	7.5 K (R x 1 K)	51.0 K (R x 10 K)	11.9 (15 V)	3.1 K (R x 1 K)	850 (R x 100)

C. IF Amplifier, IF-212-500 Alignment

Remove left hand RF tuner from Countermeasures Receiver R-1524(P)/WRR and set following switches to position indicated before proceeding.

SWITCH	POSITION
IF BANDWIDTH	To select IF module under test
POWER	ON
TUNER	LEFT

(1) AM Alignment:

a. Connect the test setup as shown in Figure 5-13.

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE: ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	MAINT KIT, EL EQ Contains special items used for maintenance	19905	SK250	1	1
	EXTENDER, PC BD 8 in. lg, 2.220 in. w; held on this board by spring clips are two H.H. Smith socket hd screw keys 341 and 343; one F01A250V1-2AS spare fuse, one CTC alignment tool 2033-1; two Elco 12 pin connectors 02-012-013-5200 are mtd on the board	19905	AB482-3	1	1
	CABLE ASSY, SP, EL One Cannon DCM25W3S receptacle and three Cannon DM53742-5006 contact termination type receptacles mounted in a Cannon DC51214-1 shell one end, one Cannon DCM25W3P plug and three Cannon DM53740-5008 contact termination type plugs mounted in a Cannon DC51214-1 shell other end, 24 in. lg	19905	AB519	1	1
	EXTENDER, PC BD 3.940 in. lg, 2.220 in. w; one F01A250V1-2AS spare fuse, one ACL A551 connector mtd on the board	19905	AB698	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE: ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CABLE ASSY, RF RG55/U coaxial cable, one Gremar 8212A receptacle one end, one MS35168-88E plug other end, 6 in. lg	19905	AC076-102	1	1
	CABLE ASSY, RF RG196/U coaxial cable, one Amphenol 31-369 receptacle one end, one Cannon D53741 plug other end, 12 in. lg	19905	AC076-154	1	1
	CABLE ASSY, RF RG196/U coaxial cable, one Amphenol 31-369 receptacle one end, one Amphenol 5116-037475 plug other end, 4.750 in. lg	19905	AC076-84	1	1
	EXTRACTOR, PC BD For use on all printed circuit boards that have two 12 pin connectors, steel rod 0.187 in. dia bent into the shape of a handle 9.75 in. lg, 1.50 in. w	19905	AC1477-1	1	1
	PRINTED WRG BD (P/OAB698) 3.940 in. lg, 2.220 in. w; mtd on board are two Littlefuse 121001 electrical clips, one Elco 02-016-013-5200 16 pin connector	19905	AC565	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE: ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNING TOOL Bent into the shape of the letter "S", 2.750 in. long, 0.111 in. dia brass rod, each end made for screwdriver type adjustment	19905	A1148	1	1
	CONN, RECP, ELEC (P/OAB482-3) printed circuit card type, 12 contacts, low-loss plastic dielectric, 2 mtg holes	19905	A349	2	2
	CONN, RECP, ELEC (P/OAB698) printed circuit card type, 16 contacts, low-loss plastic dielectric 2 mtg holes	19905	A551	2	2
	SPACER (P/OAB482-3) AL alloy, 0.187 in. od, 0.117 in. id, 0.103 in. thk	19905	A691-2	4	4
	EXTRACTOR, PC BD For use on all printed circuit boards that have two 16 pin connectors, steel rod 0.187 in. dia bent into the shape of a handle 10.75 in. lg, 1.50 in. w	19905	B699	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE

ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	PRINTED WRG BD (P/OAB482-3) 8 in. lg, 2.220 in. w; two Elco 12 pin connectors 02-012-013-5200 are mtd on the board	19905	C234	1	1
	CONN, PLUG, ELEC (P/OAB519) subminiature rectangular type, 22 brass contacts	71468	DCM25W3P	1	1
	CONN, RECP, ELEC (P/OAB519) subminiature rectangular type, 22 brass contacts	71468	DCM25W3S	1	1
	SHELL, ELEC, CONN (P/OAB519) molded plastic straight type	71468	DC51214-1	2	2
	CONN, PLUG, ELEC (P/OAB519) contact termination type	71468	DM53740-5008	3	3
	CONN, PLUG, ELEC (P/OAC076-154) right angle crimp braid type	71468	DM53741	1	1
	CONN, RECP, ELEC (P/OAB519) contact termination type	71468	DM53742-5006	3	3

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE: ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	FUSE, CARTRIDGE (Supplied with AB698 & AB482-3) 1/2 amp, 250 v	81349	F01A250V1-2AS	3	3
	CONN, PLUG, ELEC (P/OAC076-102) bnc type, weather proof, quick-disconnect	96906	MS35168-88F	1	1
	ALIGNTOOL, EL EQ Double ended ceramic blade ground to fit coil forms	12856	TYPE A	1	1
	CONTACT, ELEC (P/OC234) 12 nickel plated contacts for mounting on printed circuit board, solder mounted	91662	02-012-013-5200	2	2
	CONTACT, ELEC (P/OAC565) 16 nickel plated contacts for mounting on printed circuit board, solder mounted	91662	02-016-013-5200	2	2
	CLIP, SPRINGTENS (P/OAB482-3) 0.375 in. w, 1 in. lg, one mtg hole	79963	103	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CLIP, ELECTRICAL (P/OAB482-3 & AC565) silver plated copper clip with fuse stops on each clip	75915	121001	6	6
	ALIGNTOOL, EL EQ (Supplied with AB482-3) phenolic handle, brass tips, 4 in. lg, 0.250 in. dia	71279	2033-1	1	1
	ALIGNTOOL, EL EQ Phenolic handle, brass tips, 4 in. lg, 0.250 in. dia	71279	2375-1	1	1
	CONN, RECP, ELEC (P/OAC076-154 & AC076-84) quick crimp bulkhead type	74868	31-369	2	2
	KEY, SCH SCREW (Supplied with AB482-3) steel, hex key no.3, 4 screw size	83330	341	1	1
	KEY, SCH SCREW (Supplied with AB482-3) steel, hex key no. 8 screw size	83330	343	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE: ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CONN, PLUG, ELEC (P/OAC076-84) 150 ohm screw on type	74868	5116-037475	1	1
	CLIP, SPRINGTENS (P/OAB482-3) cadmium plate copper 2 mtg holes	91506	6008-14CC	1	1
	TOOL BOX, PORT Extra heavy full drawn seamless, rounded corners, returned edges. Removable tote tray. Metallic charcoal gray with red tray, 14.500 in. by 7.250 in. by 6.000 in.	78934	6115	1	1
	CONN, RECP, ELEC (P/O AC076-102) bulkhead mounted push-on type	91737	8212B	1	1

NAVSHIPS 0967-282-0010 SUPPLEMENT 1

TECHNICAL MANUAL
FOR
AMPLIFIER, IF, IF-212-500
AND
TUNING UNITS, RADIO FREQUENCY
TN-519/WRR AND TN-520/WRR

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
JANUARY 1969

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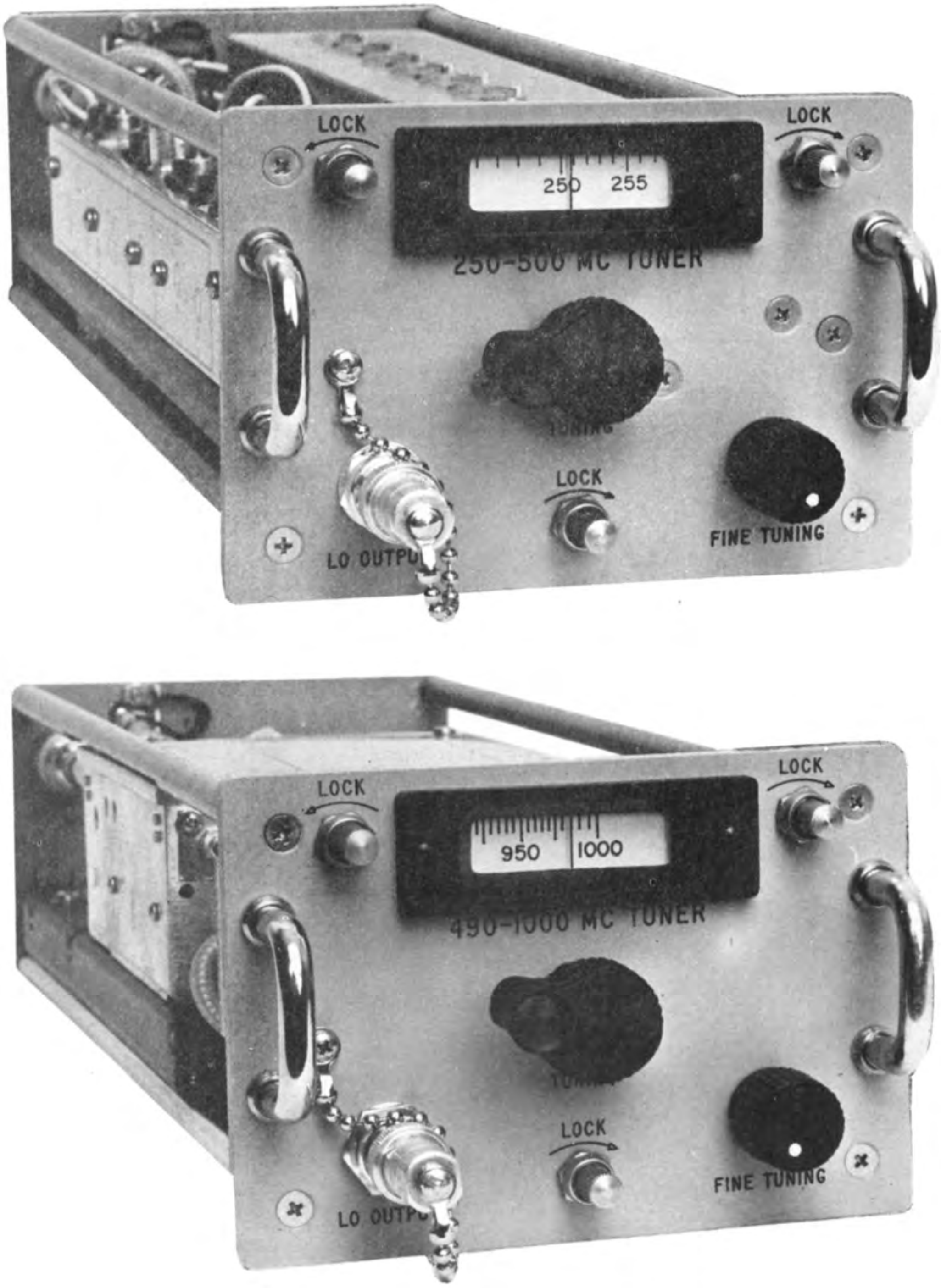


Figure 1-1. Radio Frequency Tuner TN-519/WRR
and TN-520/WRR, Front View

SECTION I

GENERAL DESCRIPTION

1. Introduction.

This supplement covers RF tuning units TN-519/WRR and TN-520/WRR and IF module IF-212-500. These plug-in modules are to be used with Countermeasures Receiver R-1524(P) /WRR. RF tuning unit TN-519/WRR is continuously tunable from 250 to 500 mc and tuning unit TN-520/WRR is continuously tunable from 490 to 1000 mc. Intermediate frequency (IF) module IF-212-500 will accept deviations up to 250 Kc on either side of the receiver 21.4 mc IF.

Installation of the modules included in this supplement do not alter the receiver operator procedures. Refer to NAVSHIPS technical manual 0967-282-0010 for all information concerning Countermeasures Receiver R-1524(P) /WRR. Use this supplement in conjunction with the above technical manual for complete installation and maintenance data when the modules listed above are used.

2. Electrical Characteristics.

A. RF Tuner TN-519/WRR, Figure 1-1

The TN-519/WRR RF Tuner is a solid state plug-in module continuously tunable from 250 to 500 mc. The module is designed to operate with Countermeasures Receiver R-1524(P)/WRR. Tuning is accomplished by rotating a front panel turn crank and a FINE TUNING control. Frequency selection is indicated by a lighted front panel calibrated-tape dial.

The tuner mounts three (3) subchassis: (1) tuning, SH-203A-7; (2) 60 to 21.4 Mc converter, CV-204-4; and (3) isolation amplifier, ISA-201-1. Tuning head, SH-203A-7 consists of a RF amplifier, local oscillator, and mixer/amplifier. Input signals from the antenna are amplified by the RF amplifier and applied to the mixer/amplifier. The local oscillator generates an output frequency which is 60 mc above the selected input RF signal. The local oscillator and RF amplifier signals are mixed, filtered and amplified by the mixer/amplifier and applied as a 60 mc signal to 60 to 21.4 mc converter module CV-204-4. The converter module consists of a 60 mc IF amplifier, a local oscillator, mixer/amplifier, output isolation network, and 21.4 mc output amplifier. Sixty (60) mc IF signals from tuning head module SH-203A-7 are amplified by the 60 mc IF amplifier and applied to the mixer/amplifier. The local oscillator generates an output frequency which is 21.4 mc above the 60 mc IF. The local oscillator and 60 mc IF signals are mixed, filtered and amplified by the mixer/amplifier and applied as a 21.4 mc signal to the isolation network and 21.4 mc IF amplifier. This isolation network applies the 21.4 mc IF to an external signal display unit. A second 21.4 mc IF output of the isolation network is used when the tuner is used with logarithmic receivers. The 21.4 mc IF amplifier applies the 21.4 mc IF to the receiver main chassis IF circuits.

Manual or automatic gain control signals from the receiver main chassis are applied to the tuner. Automatic gain control maintains a constant tuner output level relative to antenna signal level. High antenna signal levels result in a gain decrease in the tuner. Low antenna signal levels result in a gain increase in the tuner. Manual gain presets the overall tuner gain regardless of antenna signal levels.

Automatic frequency control (AFC), generated on the receiver main chassis, is applied to the local oscillator on converter module CV-204-4. This signal will cause the local oscillator frequency to change, compensating for local oscillator or transmitting station frequency drift.

B. RF Tuner TN-520/WRR, Figure 1-1

The TN-520/WRR RF Tuner is a solid state plug-in module continuously tunable from 490 to 1000 mc. The module is designed to operate with Countermeasures Receiver R-1524(P)/WRR. Tuning is accomplished by rotating a front panel turn crank and a FINE TUNING control. Frequency selection is indicated by a lighted front panel calibrated-tape dial.

The tuner mounts three (3) subchassis: (1) tuning head, SH-204-5; (2) 60 to 21.4 Mc converter, CV-205-1; and (3) isolation amplifier, ISA-202. Tuning head SH-204-5 consists of a 4-pole preselector, local oscillator, mixer and output amplifier. Input signals from the antenna are applied through the preselector to the mixer. The local oscillator generates an output frequency which is 60 mc above the selected input RF signal. The local oscillator and RF amplifier signals are mixed and filtered by the mixer and applied as a 60 mc IF signal through the output amplifier to 60 to 21.4 mc converter module CV-205-1. The converter module consists of a 60 mc IF amplifier, a local oscillator, mixer/amplifier, output isolation network, and 21.4 mc output amplifier. Sixty (60) mc IF signals from tuning head module SH-204-5 are amplified by the 60 mc IF amplifier and applied to the mixer/amplifier. The local oscillator generates an output frequency which is 21.4 mc above the 60 mc IF. The local oscillator and 60 mc IF signals are mixed, filtered and amplified by the mixer/amplifier and applied as a 21.4 mc signal to the isolation network and 21.4 mc IF amplifier. The isolation network applies the 21.4 mc IF to an external signal display unit. A second 21.4 mc IF output of the isolation network is used when the tuner is used with a logarithmic receiver. The 21.4 mc IF amplifier applies the 21.4 mc IF to the receiver main chassis IF circuits.

Manual or automatic gain control signals from the receiver main chassis are applied to the tuner. Automatic gain control maintains a constant tuner output level relative to antenna signal level. High antenna signal levels result in a gain decrease in the tuner. Low antenna signal levels result in a gain increase in the tuner. Manual gain presets the overall tuner gain regardless of antenna signal levels.

Automatic frequency control (AFC), generated on the receiver main chassis, is applied to the local oscillator on converter module CV-205-1. This signal will cause the local oscillator frequency to change, compensating for local oscillator or transmitting station frequency drift.

C. IF Amplifier, IF-212-500

The IF-212-500 IF amplifier is a solid state plug-in module. The module is designed to operate in Countermeasures Receiver R-1524(P)/WRR. The module operates at a center frequency of 21.4 mc and will accept a maximum deviation of ±250 Kc. The module consists of two (2) 21.4 mc IF amplifiers, an AM detector, two FM limiting amplifiers, and a FM discriminator.

Intermediate frequencies from the receiver tuner are coupled through the two (2) 21.4 mc IF amplifiers. The amplifiers determine the IF bandwidth and apply the 21.4 mc signal to the AM detector and FM limiting amplifiers. The AM detector applies AM video to the receiver video circuits. The FM limiting amplifiers provide a constant level 21.4 mc signal to the FM discriminator. The discriminator detects and demodulates, applying video signals to the receiver video circuits.

The module mounts in a spare IF receptacle on the receiver main chassis and is selected by the receiver front panel IF BANDWIDTH switch.

3. Mechanical Characteristics.

A. RF Tuner TN-519/WRR and TN-520/WRR

Mechanically, the construction of both tuners is identical. Aluminum is used for construction of the front, back and main deck. The front and back panels are held rigidly in place by four aluminum rods which serve as positioning guides when installing the plug-in tuner in the receiver chassis. A metal guide pin on the rear panel aligns the tuner in the receiver chassis for proper mating of connectors. Three Camloc thumbscrews secure the tuner in the receiver.

Each tuner includes three brass subchassis which are silver plated and gold flashed to prevent radio frequency leakage. Each active circuit within a subchassis is contained within a brass compartment to minimize circuit interaction. Copper foil and resilient foam pad are cemented to the tuner subchassis cover to provide an RF tight enclosure. Major component placement within the subchassis are silk screened on the bottom cover. Adjustments and test points are silk screened on the top of the subchassis. All markings on the front panel are mechanically engraved and filled with black enamel.

Two rear panel mounted connectors mate with connectors in the receiver chassis. One connector couples power supply voltages from the receiver and tuner output IF. The other connects the antenna input to the tuner.

Front panel controls include a turn crank for coarse tuning and a FINE TUNING control. The turn crank is mechanically connected to a direct reading frequency indicating tape which is recessed behind a protective window. The LO OUTPUT connector is front panel mounted and is terminated in a 50 ohm captive cap when not in use. Gaskets used around the dial window, controls and LO OUTPUT jack provide a drip proof front panel. Handles on the front panel provide a grip for installation and front panel control protection.

The tuner is 3-1/2 inches high, 4-3/4 inches wide, and 13-3/4 inches deep and weighs 5-1/2 pounds.

B. IF Amplifier, IF-212-500

The IF amplifier is a printed-circuit board and mounts all electronic components of the IF circuit. Two edge mounted 12-pin connectors couple all input and output signals of the IF amplifier. The module model number, serial number, and electronic component reference designation are etched into the board. All electronic components are mounted on one side of the board; the majority of the etched circuit connections are on the opposite side.

SECTION II

SPECIFICATIONS

1. RF Tuner TN-519/WRR.

Frequency Range	250 to 500 mc
Tuning Dial Accuracy	±1% maximum error
Input Impedance	50 ohms
Intermediate Frequency	
First IF	60 mc
Second IF	21.4 mc
Noise Figure	10 db maximum into 50 ohms
IF Rejection (First IF)	90 db minimum
Image Rejection	65 db minimum
LO Radiation	10 uv maximum
LO Output	100 mv rms minimum into 50 ohms
SDU Output	3 mc minimum at 3 db point
Single Frequency Spurious Rejection	60 db minimum
LO Incidental FM	1 Kc peak-to-peak maximum
Fine Tuning	Front panel control to vary tuning ±50 Kc
Gain Variation	6 db maximum over tuning range
Dimensions	3-1/2 inches high 4-3/4 inches wide 13-3/4 inches deep
Weight	Approximately 5 pounds
Power	+12 vdc; -12 vdc; +24 vdc
Finish	Gray enamel, MIL-E-15090 color 26329, Federal Standard 595

2. RF Tuner TN-520/WRR.

Frequency Range	490 to 1000 mc
Tuning Dial Accuracy	±1% maximum error

RF Tuner TN-520/WRR (continued)

Input Impedance	50 ohms
Intermediate Frequency	
First IF	60 mc
Second IF	21.4 mc
Noise Figure	12 db maximum into 50 ohms
IF Rejection (First IF)	90 db minimum
Image Rejection	70 db minimum
LO Radiation	50 uv maximum
LO Output	100 mv rms minimum into 50 ohms
SDU Output	3 mc minimum at 3 db point
Single Frequency Spurious Rejection	60 db minimum
LO Incidental FM	2 Kc peak-to-peak maximum
Fine Tuning	Front panel control to vary tuning ±50 Kc
Gain Variation	6 db maximum over tuning range
Dimensions	3-1/2 inches high 4-3/4 inches wide 13-3/4 inches deep
Weight	Approximately 5 pounds
Power	+12 vdc; -12 vdc; +24 vdc
Finish	Gray enamel, MIL-E-15090 color 26329, Federal Standard 595

3. IF Amplifier IF-212-500.

Input Frequency	21.4 mc
Bandwidth	500 Kc, ±10%
Outputs	AM video; FM video
Power	+12 vdc; -12 vdc

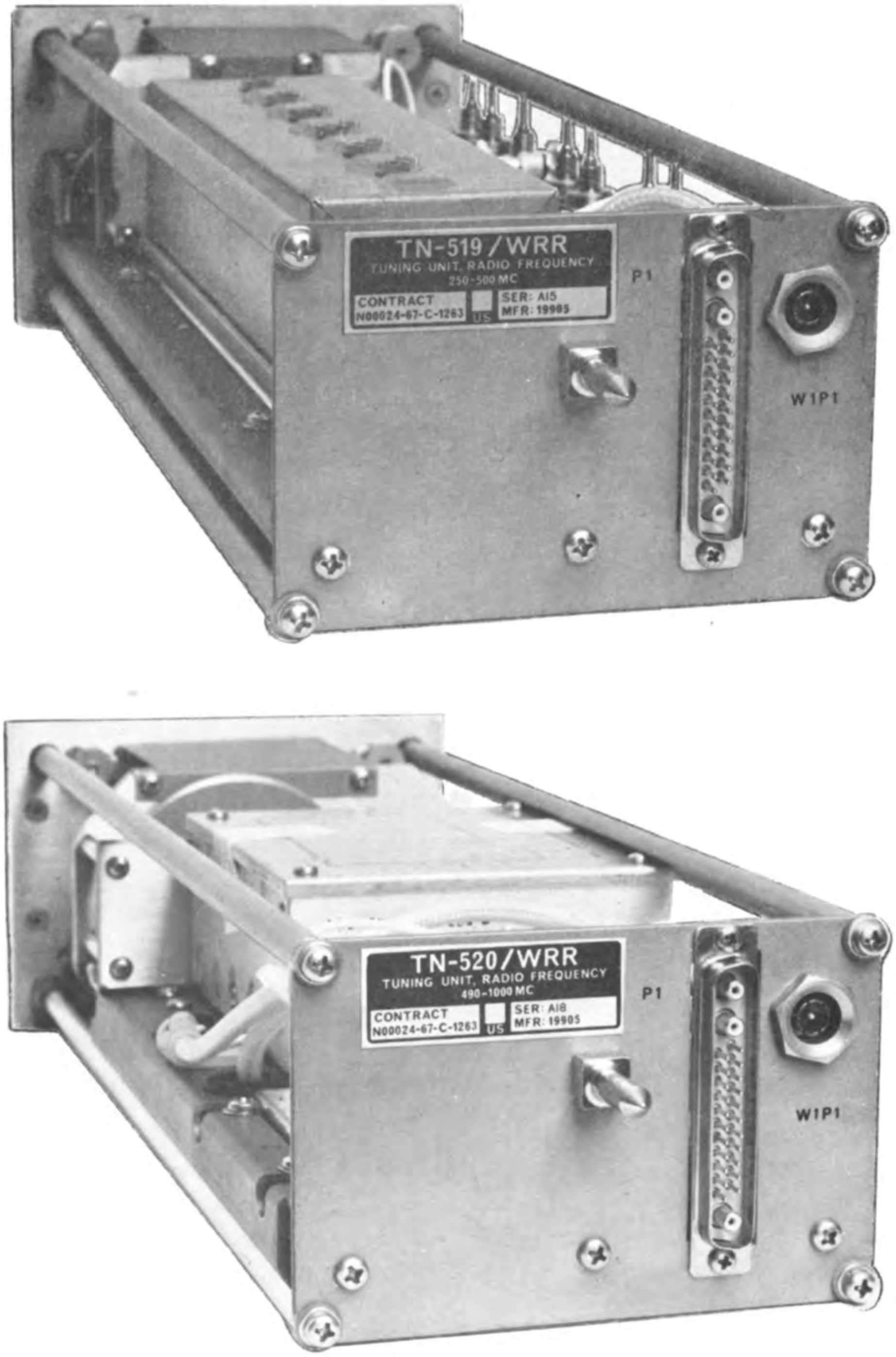


Figure 3-1. Radio Frequency Tuner TN-519/WRR
and TN-520/WRR, Rear View

SECTION III

INSTALLATION AND OPERATION

1. Installation.

A. RF Tuner TN-519/WRR and TN-520/WRR

The TN-519/WRR and TN-520/WRR RF tuners are plug-in modules. The modules are designed to fit into the main chassis of Countermeasures Receiver R-1524(P)/WRR. Perform the following procedure to install the plug-in tuner.

NOTE

When installing the tuner module, care should be taken to prevent damage to the rear panel connectors. Do not force or jam the plug-in tuner into the receiver chassis. When a reasonable amount of hand pressure does not seat the module, remove the module and inspect for obstructions and/or bent connector pins.

(1) Grasp the plug-in tuner by the front panel handles and align with receiver compartment opening.

(2) Push the tuner into the receiver compartment until the rear panel connectors are firmly seated. Seating is complete when front panels are flush.

(3) Lock the three front panel thumbscrews.

(4) Installation is complete.

B. IF Amplifier, IF-212-500

The IF amplifier module is designed to mount into main receiver chassis receptacle XA2, XA3, or XA4. Normally, main receiver chassis receptacle XA4 is a wired spare. Mount the IF amplifier in the spare receptacle when possible. When there are no spare receptacles, remove any IF amplifier from the receiver and replace with IF amplifier module IF-212-500. No special procedure is required to mount the IF amplifier module. Remove power from the receiver before installation to prevent damage to the module.

2. Operation.

All operator procedures are contained in the technical manual NAVSHIPS 0967-282-0010, Countermeasures Receiver R-1524(P)/WRR. Specifically, refer to Section III, Installation and Operation of the technical manual.

SECTION IV

THEORY OF OPERATION

1. General.

RF tuner TN-519/WRR and TN-520/WRR, and IF amplifier, IF-212-500 are designed for use in Countermeasures Receiver R-1524(P)/WRR. RF tuner TN-519/WRR is tunable from 250 to 500 mc and RF tuner TN-520/WRR is tunable from 490 to 1000 mc. IF module IF-212-500 will accept deviations up to 250 Kc on either side of a 21.4 mc center frequency. These plug-in modules expand the versatility of Countermeasures Receiver R-1524(P)/WRR. Complete schematic diagrams are located in Section VII of this supplement.

2. Functional Description.

A. RF tuner TN-519/WRR, Figure 4-1

RF Tuner TN-519/WRR consists of three (3) subchassis as follows:

(1) Tuning head, SH-203A-7, A1

(2) 60-21. 4 mc Converter, CV-204-4, A2

(3) Isolation amplifier, ISA-201-1, A3

(1) Tuning Head, SH-203A-7: RF signals from the antenna are routed through the main chassis of Countermeasures receiver R-1524(P)/WRR to jack J1 of tuning head SH-203A-7. Cascade RF amplifier Q1-Q2 amplifies and selects the radio frequency for receiver processing. Frequency selection is accomplished by a tunable inductor component of cascade amplifier Q1-Q2. A front panel TUNING crank is mechanically linked to the tunable (variable) inductor and front panel calibrated dial. Rotating the TUNING crank tunes the cascade RF amplifier to the required frequency. The selected frequency is indicated on the calibrated dial. Gain control applied to RF amplifier Q1-Q2 prevents overloading of this amplifier stage. The RF output of Q1-Q2 is coupled to cascode mixer Q3-Q4.

Local oscillator Q5 generates a signal which is 60 mc above the selected RF. The oscillator output frequency is determined by the setting of the front panel TUNING crank. The local oscillator output signal is coupled to cascode mixer Q3-Q4 and isolation amplifier module A3. Front panel FINE TUNING control R1 varies the oscillator output frequency ±50 Kc.

The RF output of cascade RF amplifier Q1-Q2 and local oscillator Q5 are mixed, amplified and filtered by cascode mixer circuit Q3-Q4. The output of cascode mixer Q3-Q4 is a 60 mc IF which is coupled to 60 to 21.4 mc converter module A2. Test point TP1 is used for monitoring during calibration of the tuning head module.

(2) 60-21.4 mc Converter, CV-204-4: The 60 mc IF from tuning head module A1 is applied to input cascode IF amplifier Q1-Q2 of converter module A2. The output of Q1-Q2 is coupled to mixer/amplifier Q3-Q4. Gain control is applied to Q1-Q2 to prevent overloading.

Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer/amplifier Q3-Q4. Automatic frequency control (AFC) from the main chassis of Countermeasures Receiver R-1524(P)/WRR will cause the output of Q7 to vary. The AFC signal compensates for local oscillator or transmitting station frequency drift by maintaining the output frequency of Q7 exactly 21.4 mc above the 60 mc IF input from the tuning head module.

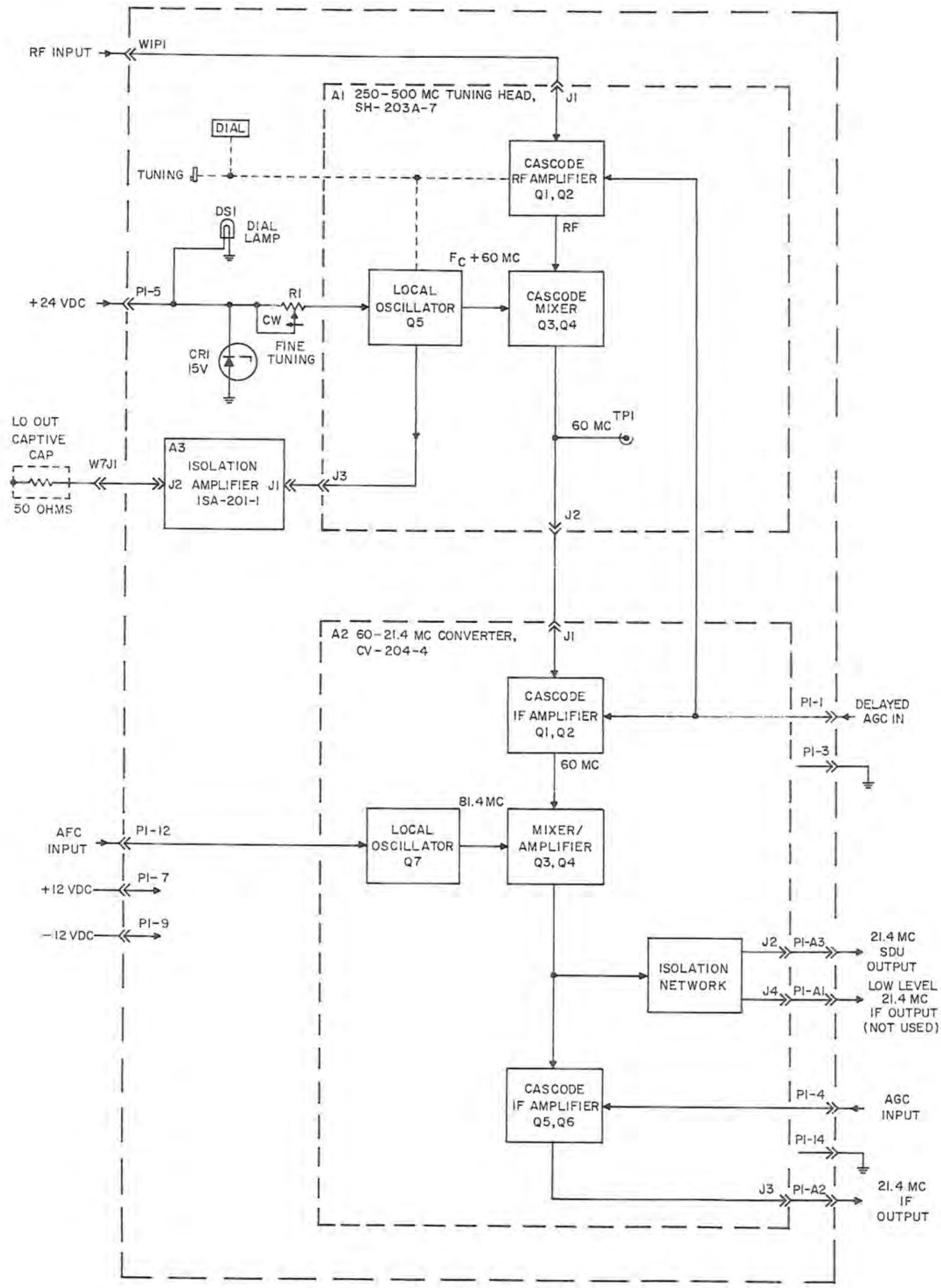


Figure 4-1. 250-500 Mc Plug-in RF Tuner, TN-519/WRR, Functional Block Diagram.

Mixer/Amplifier Q3-Q4 mixes, and filters the local oscillator and 60 mc IF signals, applying a 21.4 mc second IF signal to the isolation network and cascode amplifier Q5-Q6. The isolation network is passive and applies the 21.4 mc IF signal to an external 21.4 mc signal display unit. The second output of the isolation network is used by logarithmic receivers. This output is not used by Countermeasures Receiver R-1524(P)/WRR. Cascode IF amplifier Q5-Q6 applies the 21.4 mc second IF signal to the receiver main chassis IF circuits. Gain control (AGC or MGC) is applied to Q5-Q6 to prevent circuit overloading.

(3) Isolation Amplifier, ISA-201-1: Isolation amplifier module A3 couples the local oscillator output of tuning head module A1 to an output connector on the front panel of the RF tuner. This output is used for monitoring purposes. When not in use, this output is terminated in a removable 50-ohm captive cap.

(4) Miscellaneous Circuits: Dial lamp DS1 is on when power is applied to the RF tuner. Zener diode CR1 regulates the voltage applied to FINE TUNING control R1. The regulated voltage prevents local oscillator frequency variations due to voltage level changes. All power is applied to the RF tuner from the receiver main chassis supply.

B. RF Tuner TN-520/WRR, Figure 4-2

RF tuner TN-520/WRR consists of three (3) subchassis as follows:

(1) Tuning head, SH-204-5, A1

(2) 60-21.4 Mc Converter, CV-205-1 A2

(3) Isolation amplifier, ISA-202, A3

(1) Tuning Head, SH-204-5: RF signals from the antenna are routed through the main chassis of Countermeasures Receiver R-1524(P)/WRR to a 4-pole preselector on the tuning head module. The preselector couples the selected antenna signal to mixer CR1. The preselector consists of four 1/4-wavelength tuned coaxial lines. Coupling between each tuned coaxial line is through irises in the walls separating the lines. A ganged tuning capacitor is mechanically linked to the front panel TUNING crank. Rotating the TUNING crank operates a calibrated dial and the ganged tuning capacitor. Varying the preselector capacitance selects the required RF.

Local oscillator Q1 generates a signal which is 60 mc above the selected RF. The oscillator output frequency is determined by the setting of the front panel TUNING crank. The local oscillator output signal is coupled to mixer CR1 and isolation amplifier module A3. Front panel FINE TUNING control R1 varies the oscillator output frequency ±50 Kc.

The RF output of the preselector and local oscillator Q1 are mixed by CR1 and applied to cascode IF amplifier Q2-Q3. The mixer output is monitored at J3 during alignment of the tuning head.

Cascode IF amplifier Q2-Q3 amplifies and filters the output of mixer CR1. The output of Q2-Q3 is a 60 mc IF which is applied to converter module A2. Gain control is applied to Q2-Q3 to prevent overloading.

(2) 60-21.4 Mc Converter, CV-205-1: The 60 mc IF signal from tuning head module A1 is applied to cascode IF amplifier Q1-Q2 of the converter module. The output of Q1-Q2 is coupled to mixer/amplifier Q3-Q4. Gain control is applied to Q1-Q2 to prevent overloading. Zener diode CR4 sets the required gain control signal level at 3.9 volts. Gain control signals exceeding the 3.9 volt level are applied to Q1-Q2.

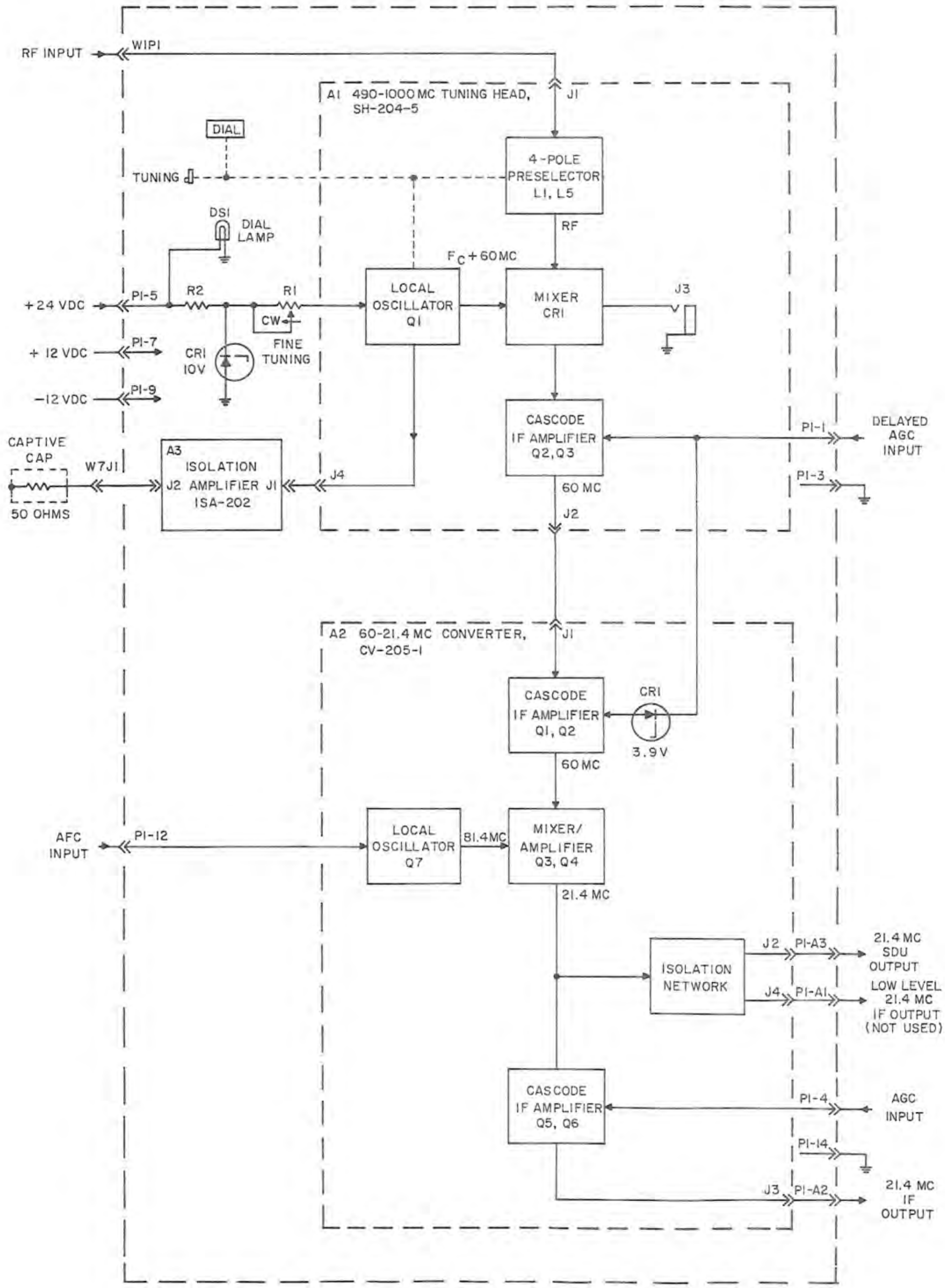


Figure 4-2. 490-1000 Mc Plug-in RF Tuner, TN-520/WRR, Functional Block Diagram.

Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer/amplifier Q3-Q4. Automatic frequency control (AFC) from the main chassis of Countermeasures Receiver R-1524(P)/WRR will cause the output of Q7 to vary.

The AFC signal compensates for local oscillator or transmitting station frequency shift by maintaining the output frequency of Q7 exactly 21.4 mc above the 60 mc IF input from the tuning head module.

Mixer/amplifier Q3-Q4 mixes and filters the local oscillator and 60 mc IF signals, applying a 21.4 mc second IF to the isolation network and cascode amplifier Q5-Q6. The isolation network is passive and applies the 21.4 mc IF signal to an external 21.4 mc signal display unit. The second output of the isolation network is used by logarithmic receivers. This output is not used by Countermeasures Receiver R-1524(P)/WRR. Cascode IF amplifier Q5-Q6 applies the 21.4 mc second IF signal to the receiver main chassis IF circuits. Gain control (AGC or MGC) is applied to Q5-Q6 to prevent circuit overloading.

(3) Isolation Amplifier, ISA-202: Isolation amplifier module A3 couples the local oscillator output of tuning head module A1 to an output connector on the front panel of the RF tuner. This output is used for monitoring purposes. When not in use, the output is terminated in a removable 50-ohm captive cap.

(4) Miscellaneous Circuits: Dial lamp DS1 is on when power is applied to the RF tuner. Zener diode CR1 regulates the voltage applied to FINE TUNING control R1. The regulated voltage prevents local oscillator frequency variations due to voltage level changes. All power is applied to the RF tuner from the receiver main chassis supply.

C. IF Amplifier, IF-212-500, Figure 4-3

The IF amplifier module demodulates the 21.4 mc IF output of the RF tuner. The module will pass deviations up to 250 Kc on either side of the 21.4 mc center frequency. The module includes two (2) cascode input IF amplifier stages connected in cascade, FM demodulating circuit, and an AM demodulating circuit. All operating voltages are supplied from the receiver main chassis power supply.

IF signals from the RF tuner are applied to IF amplifier Q1-Q2. The output of Q1-Q2 is applied to IF amplifier Q3-Q4. The IF amplifiers establish the input bandwidth of the module and provide the power required to drive the FM and AM demodulating circuits.

AM Detector CR1 is driven by IF amplifier Q3-Q4. The detector rectifies and filters the 21.4 mc IF signal. The detector output is AM video to output emitter follower Q5.

FM Limiter Q6-Q7 and Q8-Q9 provide a constant amplitude 21.4 mc IF signal to the FM demodulator circuit. The demodulator discriminates, detects and filters the 21.4 mc IF. The final output of the FM demodulator is FM video to output emitter follower Q10.

3. Functional Circuit Analysis.

A. RF Tuner TN-519/WRR, Figure 7-1

RF Tuner TN-519/WRR includes three (3) submodules as follows:

(1) Tuning head, SH-203A-7, A1

(2) 60-21.4 Mc Converter, CV-204-4, A2

(3) Isolation amplifier, ISA-201-1, A3

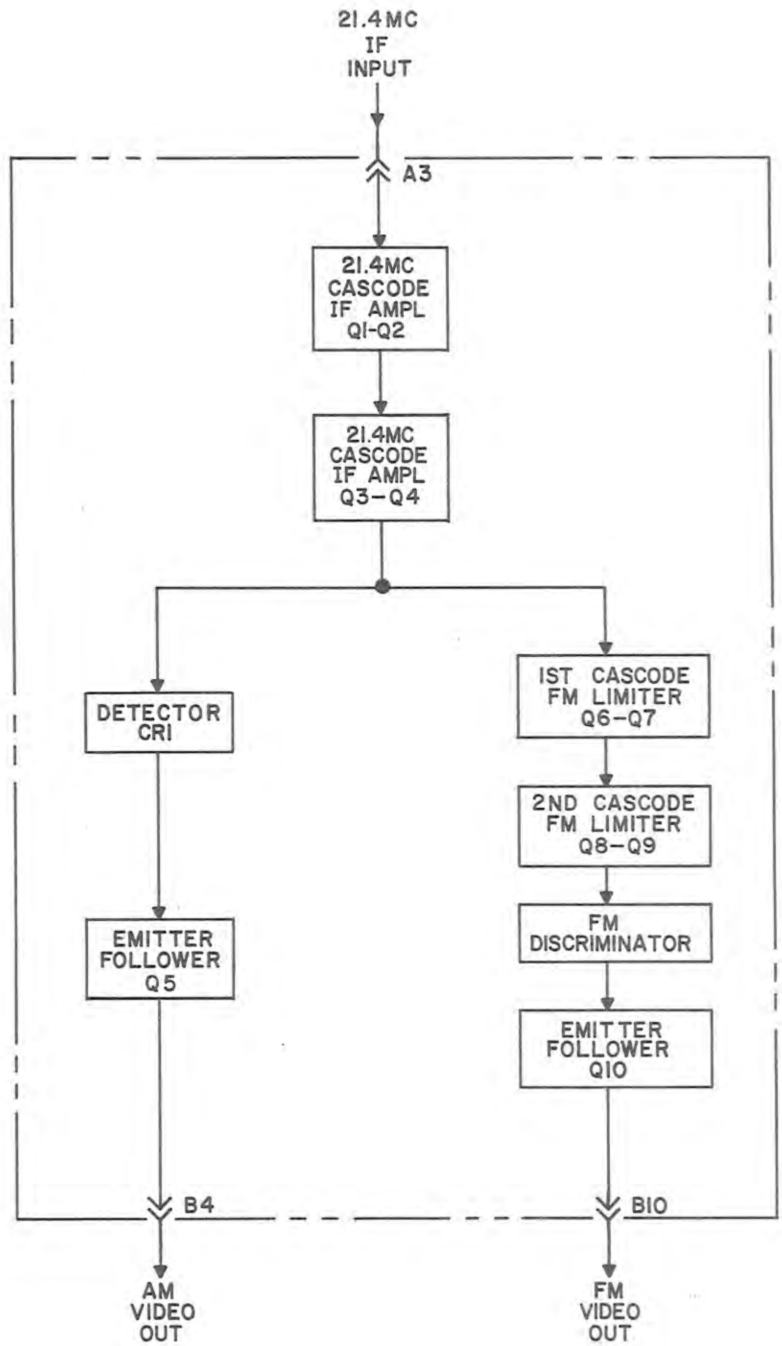


Figure 4-3. IF Amplifier, IF-212-500, Functional Block Diagram.

All power is applied from the receiver main chassis. Dial lamp DS1 is on when power is applied to the tuner. A gear train operated by the front panel TUNING crank, operates front panel mounted calibrated dial tape and an inductuner mounted in tuning head module A1.

B. Tuning Head, SH-203A7, Figure 7-2A and 7-2B

(1) Input Network: Signals from the antenna are coupled to the input network of the tuning head through connector J1. A static discharge path to ground for the input coaxial line is through R1. Impedance step-up to 50 ohms is by capacitive divider C1 and C2. The first inductuner section L1A and L2 form the primary of the double-tuned input network. The secondary is formed by L1B and L3. Impedance matching to the base of RF amplifier Q1 is by capacitive divider C4 and C8. Inductuner sections are mechanically ganged to other tuning sections in the interstage networks and to the collector circuit of the local oscillator, Q5. L2* and L3* provide adjustment of the double-tuned input network at the high end of the tuning range. Capacitors C5 and C6 adjust the low end of the tuning range. Inductor L4 and capacitor C7 form a series tuned circuit which forms a wave trap to reduce the RF image response of the tuner. After bandpass filtering by the double-tuned input network, the received signal is applied to RF amplifier stage Q1.

(2) RF Amplifier: Two (2) RF amplifier stages, Q1 and Q2, precede the mixer. The RF signal is applied to the base of Q1. Q1 is a gain controlled amplifier connected in a common emitter configuration. The base of Q1 is coupled through R2, R9, C13, and C14 to the delayed gain control source of the receiver. Q1 conducts through tuned circuit L5, L1C and C15. The collector of Q1 is tapped down on L5 to reduce RF image response. A small degenerative feedback to the base of Q1 through C9 and C10 reduces local oscillator back radiation into the RF circuits. This feedback is very small compared to RF signal amplification; therefore, has little affect on selected RF signals. The collector circuit of Q1 is double-tuned by resonant circuits L1C, L5, L1D, L6, and C15 through C17. Capacitors C15 and C16 are used to align the tuned circuit. RF amplifier Q2 is driven by Q1. Q2 operates identical to Q1. The output of Q2 is single-tuned and applied through C27 to the mixer circuit. Capacitor C21 is used to align the tuned circuit. Series tuned circuit C25 and L7 forms a wave trap which reduces the RF image response of the circuit.

(3) Local Oscillator: Local oscillator energy is generated by Q5. The circuit is a Colpitts oscillator operating 60 mc above the selected RF. Base bias conditions are established by resistive divider R14 and R15. The emitter stabilizing resistor is R16. Circuit tuning is by section L1F of the inductuner. Feedback for oscillation is through C38. The oscillator frequency range is from 310 to 560 mc. The oscillator output frequency is adjusted by C30. L10 across L1F is preset for the operating frequency range. An output used for monitoring is coupled through C39 and resistive attenuator R17, R18 and R19 to the front panel LO output jack through isolation amplifier module A3. Fine tuning of the local oscillator is provided by a variable dc voltage which is applied to the collector circuit of Q5. The local oscillator output to the mixer is through C29.

(4) Mixer: The mixer is connected in a cascode configuration. The signal from the RF amplifier is coupled through C27 to the base of common emitter stage Q3. Series tuned circuit C28 and L9 forms a wave trap which reduces the RF image response of the tuner. The local oscillator signal is applied to the base of Q3 through C29. Base and emitter bias conditions for Q3 are determined by R20, R23, and R24. The output of Q3 is coupled to the emitter of Q4 through oscillation damping network L14 and C37. After mixing, the 60 mc IF signal is selected by the double-tuned collector circuit of Q4. L12 and L13 are adjusted for resonance during alignment of the tuner. Test point TP1 is connected to the collector of Q4 through C50. A low impedance detector connected to the test point permits a check of the tuner RF response. From the tuned output of Q4, the 60 mc IF is coupled through resistive impedance network R26, R27, and R28 to the 60 to 21.4 mc down converter module A2.

*Note: Indicates factory adjustment.

C. 60-21.4 Mc Converter, CV-204-4, Figure 7-3A and 7-3B

(1) 60 Mc IF Amplifier: The 60 mc IF input from the tuning head module is applied through resistive impedance network R1, R2, and R3 and capacitor C1 to the base of Q1. The resistive network provides a 50-ohm input impedance. Cascode IF amplifier Q1-Q2 receives gain control signals at the base of Q1 through R4. The gain control (AGC or MGC) signals are generated on the receiver main chassis. The output of Q2 is double-tuned to the input of mixer Q3. Resistor R7 and capacitor C3 prevents Q1 and Q2 from oscillating. Inductors L1 and L2 are adjusted during alignment for a 3 db bandwidth of 3 mc.

(2) Local Oscillator: Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer Q3 through C10. Inductor L7 adjusts the oscillator output frequency. Automatic frequency control (AFC) is applied through R28 to the collector of Q7. The AFC signal is generated on the receiver main chassis. AFC varies the oscillator output frequency to compensate for frequency drift; thus, maintaining on station tuning.

(3) Mixer: Mixer Q3 amplifies both the 81.4 mc local oscillator output and 60 mc IF amplifier output. The mixed signals at the drain output of field effect transistor Q3 is coupled through L13 and R36 to the base of amplifier Q4. L13 and R36 prevent Q4 from overloading Q3 through impedance matching.

(4) Mixer Output Amplifier: Amplifier Q4 is double-tuned to the input of the 21.4 mc cascode IF amplifier, Q5-Q6. Amplifier Q4 also drives a signal display unit (SDU) output and a low level output. The double-tuned output of Q4 is centered at 21.4 mc. Alignment is accomplished with L3 and L4. The SDU output at J2 is coupled through R17 and R18 for impedance matching. The low level output at J4 is not used by Countermeasures Receiver R-1524(P)/WRR.

(5) 21.4 Mc IF Amplifier: Cascode 21.4 mc IF amplifier Q5-Q6 drives the receiver IF circuits through a double-tuned output. The double-tuned circuit is centered at 21.4 mc by adjusting L5 and L6. Diode clippers CR2 and CR3 prevent high level signals from passing into the receiver IF circuits. Capacitor C19 and resistor R21 prevent Q5 and Q6 from oscillating. Gain control (AGC or MGC) is applied to the base of Q5 through R19 and R38. Zener diode CR4 prevents the junction of R19 and R38 from going more positive than 6.2 volts.

D. Isolation Amplifier, ISA-201-1, Figure 7-4A and 7-4B

The tuning head module Al,local oscillator output signal is applied to isolation amplifier module A3. The isolation amplifier module consists of a single cascode amplifier, Q1-Q2. The isolation amplifier output is connected to the RF tuner front panel LO OUTPUT jack. The amplifier provides isolation and impedance matching.

E. RF Tuner TN-520/WRR, Figure 7-5

RF tuner TN-520/WRR includes three (3) submodules as follows:

(1) Tuning head, SH-204-5, A1

(2) 60-21.4 Mc Converter, CV-205-1, A2

(3) Isolation amplifier, ISA-202, A3

All power is applied from the receiver main chassis. Dial lamp DS1 is on when power is applied to the tuner. A gear train, operated by the front panel TUNING crank, operates a front panel calibrated dial tape and a ganged tuning capacitor mounted in tuning head module A1.

F. Tuning Head, SH-204-5, Figure 7-6A and 7-6B

(1) RF Preselector: The RF preselector consists of four (4) high Q, 1/4-wavelength, tuned coaxial lines, L2 through L5. Coupling between cavities is achieved through iris type apertures in the cavity walls. Preselector tuning is accomplished by varying the ganged loading capacitors, C1A through C1D. Inductor L1 matches the preselector to a 50-ohm input impedance. The output of the preselector is matched to crystal mixer CR1 through L6. The four-pole preselector insures high spurious signal rejection and low local oscillator radiation. Capacitors C2 through C5 align the preselector.

(2) Local Oscillator: Local oscillator Q1 is tuned by a 1/2-wavelength transmission line and variable capacitor C1E. The oscillator operates 60 mc above the RF input. Capacitor C6 adjusts the high frequency end of the oscillator output, 1060 mc. Capacitor C9 adjusts the low frequency end of the oscillator output, 550 mc.

(3) Mixer: The RF and local oscillator signals are coupled to crystal mixer CR1 through L6. Capacitors C12 and C22, and coils L14 and L10 impedance match the crystal output to the base of Q2. Coil L9 and capacitor C24 impedance match the test output at jack J3.

(4) 60 Mc IF Amplifier: Cascode 60 mc IF amplifier Q2-Q3 is gain controlled and applies a 60 mc IF to the 60-21.4 mc converter module A2. Gain control (AGC or MGC) is coupled through R5 to the base of Q2. The gain control signal is generated on the receiver main chassis. The output of Q3 is double-tuned by L12 and L13. Coils L12 and L13 are aligned for 4 mc bandwidth at 60 mc. Capacitor C26 and resistor R11 prevent Q1 and Q2 from oscillating.

G. 60 to 21.4 Mc Converter, CV-205-1, Figure 7-7A and 7-7B

(1) 60 Mc IF Amplifier: The 60 mc IF input from the tuning head module, A1, is applied through resistive impedance network R1, R2, and R3 and capacitor C1 to the base of Q1. The resistive network provides a 50-ohm input impedance. Cascode IF amplifier Q1-Q2 receives gain control signals at the base of Q1 through R4 and zener diode CR1. The gain control signals (AGC or MGC) are generated on the receiver main chassis. Zener diode CR1 will pass signals 3.9 volts or above to Q1. The output is double-tuned to the input of mixer Q3. Resistor R7 and capacitor C3 prevents Q1 and Q3 from oscillating. Coils L1 and L2 are adjusted during alignment for a 3 db bandwidth of 3 mc.

(2) Local Oscillator: Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer Q3 through C10. Inductor L7 adjusts the oscillator output frequency. Automatic frequency control (AFC) is applied through R28 to the collector of Q7. The AFC signal is generated on the receiver main chassis. AFC varies the oscillator output frequency to compensate for frequency drift; thus, maintaining on station tuning.

(3) Mixer: Mixer Q3 amplifies both the 81.4 mc local oscillator output and 60 mc IF amplifier output. The mixed signals at the drain output of field effect transistor Q3 is coupled through R29 and L11 to the base of Q4. L11 and R29 prevent Q4 from overloading Q3 through impedance matching.

(4) Mixer Output Amplifier: Amplifier Q4 is double-tuned to the input of the 21.4 mc cascode IF amplifier, Q5-Q6. Amplifier Q4 also drives a signal display unit (SDU) output and a low level output. The double-tuned output of Q4 is centered at 21.4 mc. Alignment is accomplished with L3 and L4. The SDU output at J2 is coupled through R17 and R18 for impedance matching. The low level output at J4 is not used by Countermeasures Receiver R-1524(P)/WRR.

(5) 21.4 Mc IF amplifier: Cascode 21.4 mc IF amplifier Q5-Q6 drives the receiver IF circuits through a double-tuned output. The double tuned circuit is centered at 21.4 mc by adjusting L5 and L6. Diode clippers CR2 and CR3 prevent high level signals from passing into the receiver IF circuits. Capacitor C19 and resistor R21 prevent Q5 and Q6 from oscillating. Gain control (AGC or MGC) is applied to the base of Q5 through R19.

H. Isolation Amplifier, ISA-202, Figure 7-8A and 7-8B

Isolation amplifier module A3 consists of a single transistor, Q1, and associated input and output impedance matching components. The tuned output of Q1 is coupled to the RF tuner front panel LO OUTPUT jack.

I. I F Amplifier, IF-212-500, Figure 7-9A and 7-9B

(1) Input IF Amplifier: A 21.4 mc IF signal is applied through a 50-ohm impedance matching network to the input of cascode IF amplifier Q1-Q2. The output of Q2 is double-tuned to the input of cascode IF amplifier Q3-Q4. The tuned circuits consist of C4, C6, and L1; and C9, C10, and L2. The output of Q4 is double-tuned to the input of AM detector CR1 and first FM limiter Q6-Q7. The tuned circuits consist of C15, C16, and L3; and C18, C19 and L4.

(2) AM Demodulator: Diode CR1 applies detected AM signals to the base of emitter follower Q5. Radio frequency choke L5 removes all the 21.4 mc IF from the detected AM signal before application to the receiver audio circuits.

(3) FM Limiter: Capacitors C18 and C19 form a voltage divider, and the voltage drop across C19 is applied to first FM limiter Q6-Q7. The output of cascode limiter Q6-Q7 is single-tuned to the input of cascode limiter Q8-Q9. The second limiter output is single-tuned to the input of the FM discriminator. The tuned circuits include C26, C27, L6, and R35; and C31, C32, L8 and R41. The resistors de-tune the respective tuned circuit for wideband operation.

(4) FM Demodulator: The FM discriminator circuit supplies varying video signals to the base of emitter follower Q10. Radio frequency choke L12 removes all the 21.4 mc IF signal from the video before application to the receiver video circuits. Tuned circuits L10-C38 and L11-C39 form the input "S" curve of the discriminator. Diodes CR2 and CR3 detect the output of their respective tuned circuit. RC networks C40-R36 and C41-R47 form the diode load circuits for CR2 and CR3, respectively. When the input frequency is above the 21.4 mc IF, the FM demodulator output is positive going. When below the 21.4 mc IF, the demodulator output is negative going. Emitter follower Q10 drives the receiver video circuits.

4. Functional Operation of Mechanical Assemblies.

A. General

Mechanical functions are limited to the tuning unit gear train subassemblies. Each gear train serves to mechanically adjust its associated tuner to the desired frequency.

B. Gear Train Subassemblies

The 250 to 500 and 490 to 1000 mc gear trains are identical each consisting of a gear train and a tape deck assembly. All bearings are prelubricated and factory sealed eliminating the need for lubrication and servicing. The gear train incorporates a friction clutch design to minimize maintenance and adjustments for tuner dial accuracy. Specifically, the clutch will slip preventing damage to components and preventing the tuning tape from unwinding on the tape spools. The tuning control crank is secured to the input drive shaft with set screws. This shaft is fed through the front panel and supported by a combination bearing and support housing. Two adjustable shaft collars serve to compress springs located on each side of two shaft mounted friction clutch plates. A clutch disc is centered between the two clutch plates to provide the friction drive to the tuner and tape deck. Torque from the tuning control crank is transferred to the output shaft via this clutch. The clutch disc is located on the output drive shaft and supplies torque directly to the tape deck by a shaft mounted Bevel gear and to the tuners through a pinion gear. The pinion gear extends from the rear of the gear train housing to mesh with the tuner mounted anti-backlash gear. Tape deck drive is taken from a Bevel gear to provide tape tracking to the tuned frequency. The tape feed system is a series of guide spools and spring loaded sprocket spools to maintain tape tension and smooth feed from end to end.

SECTION V

MAINTENANCE

1. General.

Section V of the manual provides instructions which, when carefully followed, will result in minimizing operational failures. In addition, should an operational failure occur, information is provided in an organized manner which will assist in effecting speedy and efficient repair. The maintenance instructions have been separated into those tasks which are suitable for performance by the equipment operator and those tasks which are more appropriately assigned to a technician. Operator preventive maintenance operations should be performed on a bi-monthly or monthly basis, while the minimum performance standards should be checked by a technician on a semiannual or annual basis. How often maintenance operations are performed will depend largely on the extent of equipment usage and on the required confidence level.

2. Test Equipment.

The electronic test equipment listed in Table 5-1, is required to perform the minimum standard tests and to effect efficient troubleshooting and repair.

Table 5-1. Required Test Equipment Characteristics

EQUIPMENT	MODEL	MFR	REQUIRED CHARACTERISTICS
Sweep Generator	SM-2000	Telonic	Sweep Rate: 0.01 to 1000 cps RF Attenuation: 0 to 60 db in 1 db steps Mkr System: Birdy-by-pass, Ext. marker in, plug-in crystal markers, rectified markers Output Impedance: 50 ohms Scope Horizontal Output: 15 volts p-to-p
Plug-In Head	E1	Telonic	Frequency Range: 460 to 1840 mc Sweep Width: 0.1 to 10% of C. F.
Plug-In Head	SH-1	Telonic	Frequency Range: 0.5 to 460 mc Sweep Width: 200 kc to 200 mc
Signal Generator	606A	Hewlett-Packard	Frequency Range: 50 kc to 65 mc in six bands RF Output: 0.1uv to 3 volts Modulation: AM, 0 to 100%, 400 and 1000 cps; external 0 to 100%, dc to 20 kc Output Impedance: 50 ohms

Table 5-1. Required Test Equipment Characteristics. (Cont)

EQUIPMENT	MODEL	MFR	REQUIRED CHARACTERISTICS
Signal Generator	608D	Hewlett-Packard	Frequency Range: 10 to 420 mc in five bands
			RF Output: -125 dbm to +4 dbm
			Modulation: AM, 0 to 100%, 400 and 1000 cps
			Output Impedance: 50 ohms
Signal Generator	612A	Hewlett-Packard	Frequency Range: 450 to 1230 mc
			RF Output: 0.1uv to 0.5 volts into 50 ohms
			Modulation: AM, 0 to 90%, 400 to 1000 cps; external 0 to 85%, dc to 1 mc
			Output Impedance: 50 ohms
Oscilloscope	503	Tektronix	Frequency Range: dc to 450 kc
			Vertical Sensitivity: 1 mv/cm to 20 volt/cm
			Sweep Range: 1 microsecond/cm to 5 sec/cm
			Input Impedance: 1 meg ohm shunted by 47 pf
VTVM	WV-98C	RCA	Range: 0 to 1500 volts, ac and dc, 0 to 1000 meg ohms
			Input Resistance: 11 meg ohms dc
			Frequency Range: 30 cps to 3 mc
			Accuracy: ±3%
50-ohm Detector	XD-3A	Telonic	

3. Operator Preventive Maintenance.

The equipment operator may assist in maintaining the equipment by performing certain monthly checks, table 5-2, and noting the results. Undesirable trends in the operational checks and measurements should be reported to the appropriate maintenance personnel in order that timely corrective measures may be initiated.

Table 5-2. Monthly Operational Maintenance Checks.

Sequence Number	Item	Procedure
1	Exterior Surfaces	Clean front and rear panels. Check all knobs and controls for tightness and signs of improper indexing.

Table 5-2. Monthly Operational Maintenance Checks. (Cont)

Sequence Number	Item	Procedure
2	Cables and Connectors	Check cables and connectors for proper fit, clearance, and wear.
3	Controls, Dials and Switches	In performing operational checks, observe the mechanical action of each control and switch. They should operate easily and free of binding.

4. Tuning Unit Mechanical Adjustments.

A. General

The tuning units are mechanically rugged and should require little, if any, mechanical adjustment. Periodically, mounting and set screws should be checked for tightness to avoid deterioration of performance, especially when the receiver is operated in an environment which results in the application of vibrations or shocks. Other than the periodic checks, mechanical maintenance is limited to friction clutch adjustment, frequency tape adjustments, and gear train parts replacement.

B. Friction Clutch Adjustment

The friction clutch adjustment should be performed when the tuning control crank turns excessively hard, or when clutch slippage is evident while tuning.

(1) Refer to Figure 5-1 and locate the clutch adjustment points on the gear train.

(2) Loosen the two set screws in both retaining collars.

(3) Move the collars closer to the clutch plates (increased spring compression) for increasing torque and reducing clutch slippage. Reduce spring compression by moving the two retaining collars away from the clutch plates for easier tuning. The distance from the retaining collar to the clutch plate on each end of the shaft should be the same.

(4) Tighten the set screws in each retaining collar.

(5) Rotate the tuning crank over the tuning range and note performance. Repeat steps 1 through 4, when required.

C. Dial Tape Adjustment

In the event, the tuning tape appears to have a large error, or when the gear train has been replaced, the tuning dial tape will require adjustment. This may be achieved by using the following procedures.

(1) Rotate the turn crank clockwise until the motion of the tuning tape is restrained by the inductuner stops at or near the last mark on the tape.

(2) Loosen the two allen head set screws securing the large gear to the inductuner shaft. Care should be exercised to assure that the large gear on the inductuner shaft does not disengage from the small drive gear on the gear train or the tension in the antibacklash springs may be released.

(3) While preventing movement of the inductuner from its stop with a screwdriver or other tool, rotate the front panel tuning crank until the highest mark on the tuning tape lines up with the hairline.

CAUTION: When rotating the tuning crank, do not wind the dial tape more than one inch beyond last tape marking.

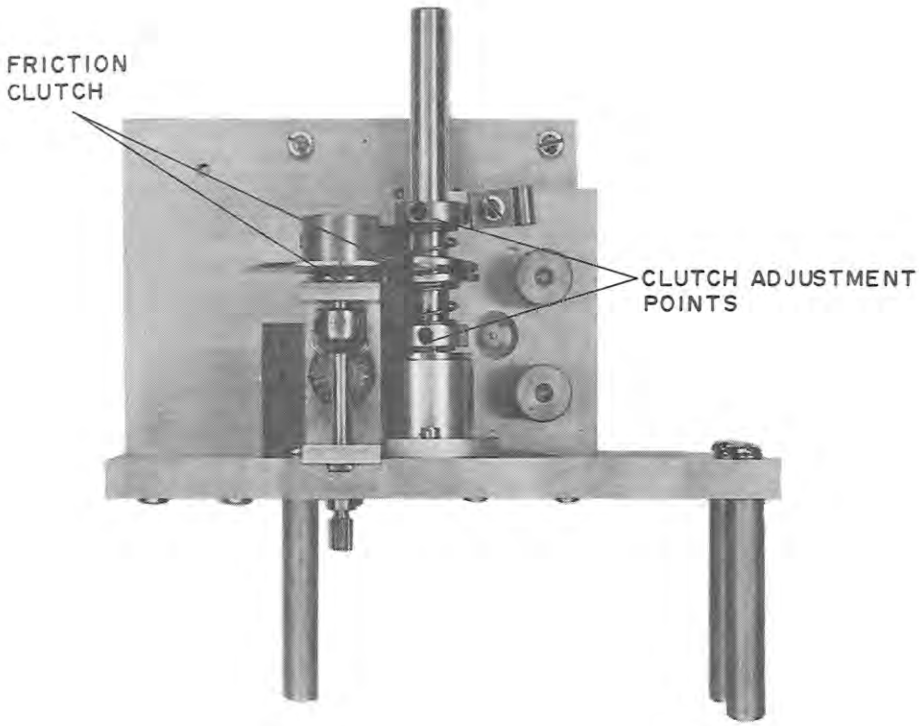


Figure 5-1. Gear Train Clutch Adjustment Points.

(4) Tighten the allen head set screws on the large gear.

(5) Rotate the tuning crank over the entire tuning range and note that the tuning action is smooth and free of binding

D. Gear Train Parts Replacement

When gear train parts require replacement, the manufacturer suggests replacement of the gear train assembly, and return to the factory for repair. Should this not be feasible, refer to Figure 5-2 and 5-3 for an exploded view of the gear train to facilitate parts replacement.

5. 250 to 500 Mc RF Tuner, TN-519/WRR

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in the isolation of faults to the RF tuner module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the TN-519/WRR RF tuner.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts will assist in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, be assured that the receiver power supplies are functioning normally in accordance with paragraph 4.A. (4) of NAVSHIPS instruction manual 0967-282-0010. Figure 5-4 illustrates the power extender cable which is required to operate the tuning unit outside the receiver housing. The performance standards for the various modules of the tuner are given in Tables 5-3 through 5-5.

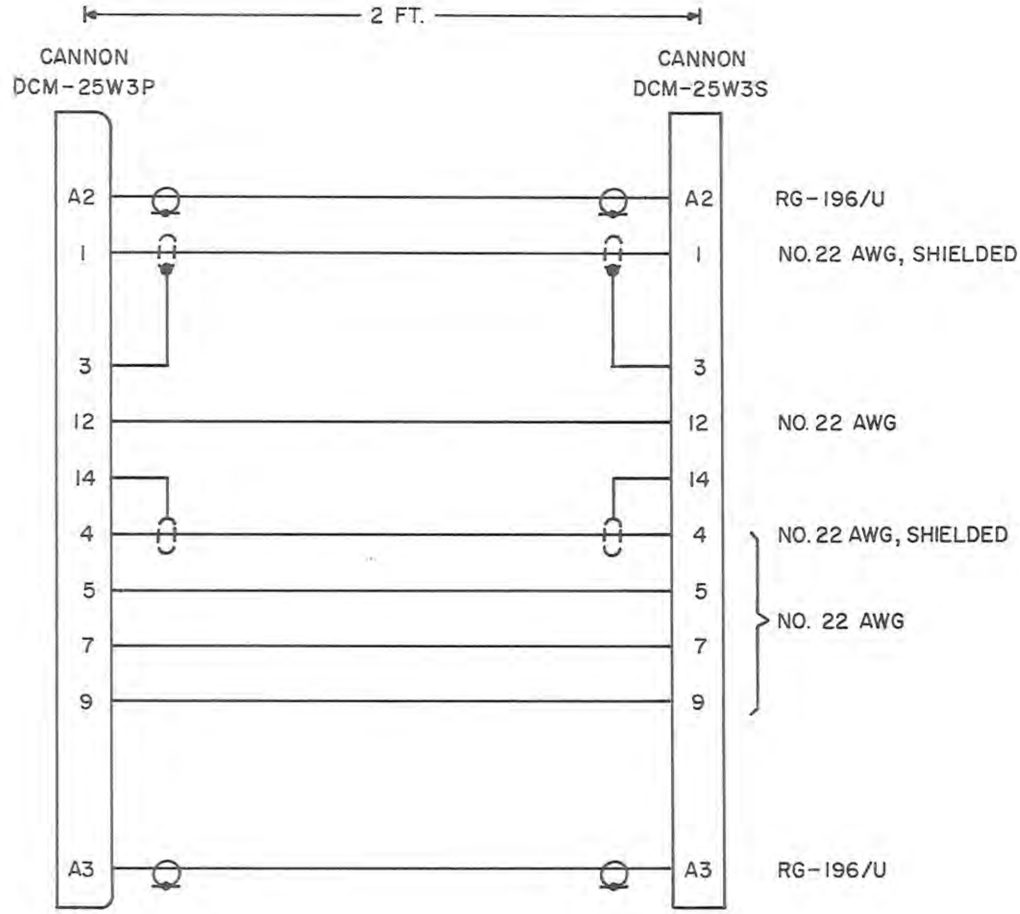


Figure 5-4. Power Extender Cable.

When performing the minimum standards tests, remove the tuning unit from the Countermeasures Receiver and reconnect with the power extender cable. Place the following Countermeasures Receiver front panel switches to the positions shown before proceeding:

SWITCH	POSITION
POWER	ON
TUNER	RIGHT or LEFT (as required)
RF GAIN	Maximum clockwise
AFC	OFF
IF SELECTOR	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	Midrange

Tuning Tape	250 Mc
VOLUME	Midrange

Table 5-3. Tuning Head, SH-203A-7 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1, antenna input, of the SH-203A-7 tuning head. Connect a 50 ohm detector to J2 of the tuning head module. Place the tuner in operation at 350 mcs. Adjust the signal generator output frequency to 350 mcs. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the oscilloscope. The oscilloscope signal should be a 400 cps sine wave. Record the setting of the signal generator attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the setting of the signal generator attenuator.	The difference between the two recorded signal generator attenuator settings is the gain of the SH-203A-7 tuning head. The gain should be 31 db minimum.

Table 5-4. 60 to 21.4 Mc Converter, CV-204-4 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the CV-204-4 converter module. Connect a 50 ohm detector to J3 of the converter module. Connect the detector output to the vertical input of a Tektronix 503 oscilloscope. Calibrate the signal generator output to 60 mc. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the CV-204-4 converter module. The gain should be about 35 db minimum.

Table 5-5. Isolation Amplifier ISA-201-1 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the ISA-201-1 module. Connect a 50 ohm detector to the LO OUTPUT jack at the tuning unit front panel. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator output frequency to 350 mcs. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the ISA-201-1 amplifier module. The gain should be 44.0 db minimum.

B. Voltage and Resistance Measurements (Tables 5-6 through 5-8)

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the faulty components. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C was used in performing all measurements. The front panel control and switch positions for Countermeasures Receiver R-1524(P)/WRR are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and the other for meters using a positive ground lead. The RCA meter, referenced above, has a negative ground lead when measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

Table 5-6. 250-500 Mc Tuning Head, SH-203A-7 Voltage and Resistance Chart.

NOTES:
1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counterclockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (1)	R (+)	V	R (-)	R (+)
Q1	-3.98 V (5.0 V)	3.9 K (R x 100)	2.75 K (R x 100)	-3.15 V (5.0 V	4.4 K (R x 100)	34 K (R x 1 K)	6.8 V (15 V)	3.6 K (R x 100)	2.81 K (R x 100)
Q2	-0.935 V (1.5 V)	5.2 K (R x 1K)	1.9 K (R x 100)	-0.175 V (0.5 V)	2.5 K (R x 100)	4.0 K (R x 100)	7.0 V (15 V)	3.7 K (R x 100)	2.1 K (R x 100)
Q3	-5.8 V (15 V)	3.7 K (R x 100)	1.62 K (R x 100)	-5.15 V (15 V)	10.1K (R x 1 K)	14.8 K (R x 1 K)	-0.65 V (1.5 V)	100 meg (R x 1 meg)	17.8 (R x 1)
Q4	-0.65 V (1.5 V)	100 meg (R x 1 meg)	17.9 (R x 1)	0 V	0	0	9.2 V (15 V)	2.8 K (R x 100)	39.0 (R x 1)
Q5	-5.3 V (15 V)	2.7 K (R x 100)	1.65 K (R x 100)	-5.62 V (15 V)	2.61 K (R x 100)	5.0 K (R x 100)	4.25 V (5.0 V)	3.75 K (R x 100)	2.62 K (R x 100)

Table 5-7. 60 to 21.4 Mc Converter, CV-204-4 Voltage and Resistance Chart.

NOTES:
1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.4 V (1.5 V)	3.6 K (R x 1 K)	1.4 K (R x 100)	-0.68 V 1.5 V)	5.8 K (R x 1 K)	4.5 K (R x 1 K)	7.4 V (15 V)	4.2 K (R x 1 K)	1.6 K (R x 100)
Q2	-0.68 V (1.5 V)	7.0 K (R x 1 K)	100 (R x 10)	0	0	0	9.9 V (15 V)	4.2 K (R x 1 K)	85 (R x 10)
Q4	6.8 V (15 V)	2.2 K (R x 100)	1.4 K (R x 100)	7.5 V (15 V)	4.4 K (R x 1 K)	3.3 K (R x 1 K)	8.8 V (15 V)	4.3 K (R x 1 K)	1.9 K (R x 100)
Q5	-2.4 V (5 V)	3.7 K (R x 1 K)	1.7 K (R x 100)	-1.6 V (5 V)	10 K (R x 1 K)	18 K (R x 1 K)	8.0 V (15 V)	4.2 K (R x 1 K)	1.8 K (R x 100)
Q6	0.68 V (1.5 V)	4.5 V (R x 1 K)	100 (R x 10)	0	0	0	8.6 V (15 V)	4.2 K (R x 1 K)	850 (R x 10)
Q7	-6.5 V (15 V)	1.9 K (R x 100)	1.49 K (R x 100)	-7.4 V (15 V)	1.71 K (R x 100)	2.0 K (R x 100)	4.05 V (5 V)	11.9 K (R x 1 K)	2.0 K (R x 100)
	SOURCE			GATE			DRAIN		
*Q3	1.37 V (1.5 V)	4.5 K (R x 1 K)	4.0 K (R x 1 K)	0	11 K (R x 1 K)	14 K (R x 1 K)	7.5 V (15 V)	4.4 K (R x 1 K)	4.0 K (R x 1 K)

*Field effect transistor, bottom view

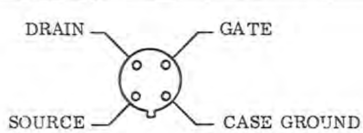


Table 5-8. Isolation Amplifier, ISA-201-1 Voltage and Resistance Chart.

NOTES:
1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (1)	R (+)	V	R (-)	R (+)
Q1	-7.6 V (15 V)	3.4 K (R x 1 K)	1.3 K (R x 100)	-6.8 V (15 V)	5.4 K (R x 1K)	4.3 K (R x 1 K)	-0 8 V (1.5 V)	Inf.	900 (R x 100)
Q2	-0.8 V (1.5 V)	Inf.	900 (R x 100)	0	0	0	11.4 V (15 V)	3.8 K (R x 1 K)	900 (R x 100)

C. 250 to 500 Mc RF Tuner Alignment

Alignment of the 250 to 500 mc RF tuner is divided into tuning head and 60 to 21.4 mc converter alignment. Countermeasures Receiver R-1524(P)/WRR and the tuner should be placed on a workbench adjacent to the test equipment being used for alignment to facilitate the use of short cables and test leads. The power extender cable illustrated in Figure 5-4 should be connected between the rear of the tuning unit and the right hand connector J5 on the main chassis of the receiver. Place the following receiver front panel switches and controls to the positions indicated below before performing alignment.

SWITCH	POSITION
POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	250 mc
VOLUME	Midrange

(1) 250 to 500 Mc Tuning Head, SH-203A-7, Alignment

a. Connect Countermeasures Receiver R-1524(P)/WRR to 115 vac, 60 cps power source.

b. Connect test equipment as shown in Figure 5-5.

c. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust horizontal sensitivity as required for full scale deflection. Connect the detector to TP1 as illustrated in Figure 5-5.

d. Adjust the sweep generator output frequency to 500 mc. Adjust the output level of the sweep generator as required to achieve an oscilloscope deflection of about 4.0 cm.

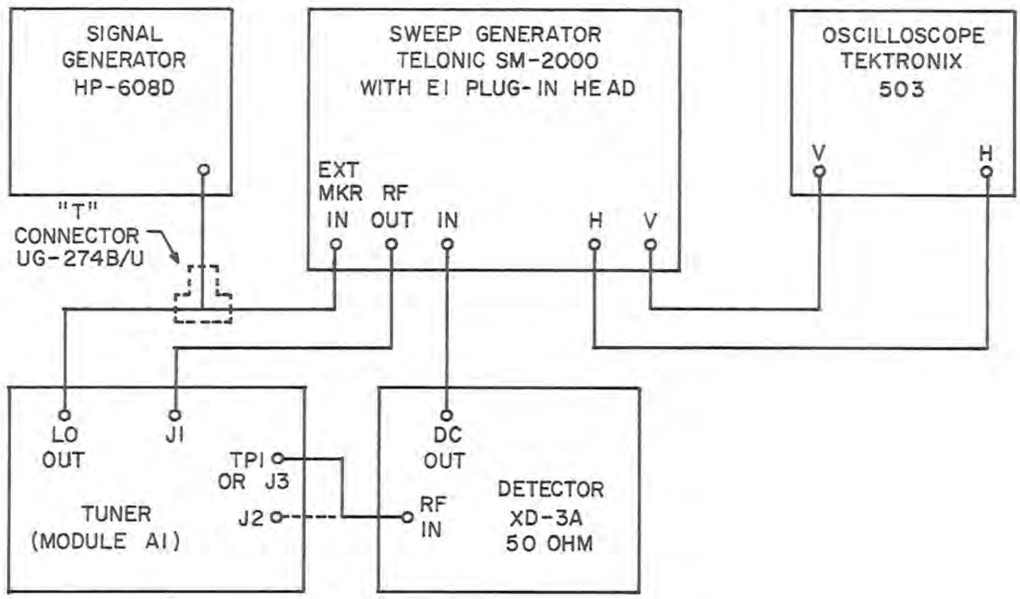


Figure 5-5. 250-500 Mc RF Tuner Test Set-Up.

e. Calibrate the signal generator frequency at 60 mc and adjust the output amplitude to achieve a marker "birdy" on the response waveform. Adjust the external marker input control on the sweep generator until the marker "birdy" of the required amplitude is achieved at 500 mc.

f. Turn the internal 10 mc markers of the sweep generator on. Adjust the sweep generator marker amplitude control as required to achieve the marker display.

g. With the tuning unit set at 500 mc, the LO output and signal generator markers should be superimposed.

h. Adjust C30 on the tuner until the LO output and signal generator markers are superimposed.

i. The RF response displayed on the oscilloscope should have the characteristics illustrated in Figure 5-6.

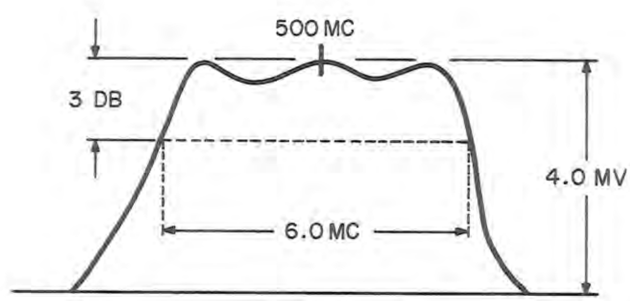


Figure 5-6. 250-500 Mc RF Tuner Response Waveform at TP1.

j. Adjust C5, C6, C15, C16 and C26 for maximum symmetrical response centered around the 500 mc marker.

k. Rotate the tuning crank over the tuning range, adjusting the sweep generator output frequency as required to maintain the response on the oscilloscope. Adjust the signal generator output level as required to maintain an oscilloscope deflection of about 4.0 cm.

l. The marker should remain centered on the response waveform over the tuning range and the response waveform shape should remain essentially as illustrated in Figure 5-5. Slight readjustment of the capacitors in step j. may be necessary to obtain a suitable response over the tuning range.

m. Disconnect the detector from TP1 and connect to J2 on the tuning head module. The sweep generator output level should be readjusted as required to achieve a 4.0 cm deflection on the oscilloscope at 500 mc.

n. The IF response at the tuning head module IF output J2 should be as illustrated in Figure 5-7.

o. Adjust L10 and L11 for maximum symmetrical response centered around the 60 mc marker. The response at 3 db point will be approximately 4 mc.

p. Alignment complete; remove test equipment.

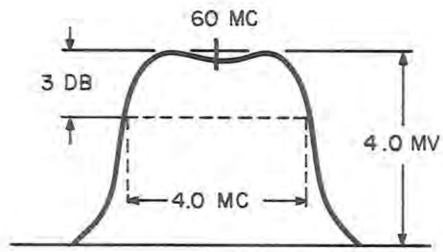


Figure 5-7. 250-500 Mc RF Tuner IF Response Waveform at J2.

(2) 60 to 21.4 Mc Converter, CV-204-4, Alignment

a. Connect Countermeasures Receiver to a 115 vac, 60 cps power source.

b. Connect test equipment as shown in Figure 5-8.

c. Calibrate the 606D signal generator at 60 mc and the 608D at 21.4 mc.

d. Set the sweep generator in operation at 60 mc with a sweep range of ±4 mc.

e. Adjust the oscilloscope vertical gain for 2 mv/cm.

f. Adjust the sweep generator output level for a vertical deflection of 5 cm on the oscilloscope.

g. Adjust the oscilloscope horizontal gain to display the response waveform.

h. Adjust the 606D signal generator output level for a small marker on the response waveform.

i. Adjust the 608D signal generator output level for a small marker on the response waveform.

j. Adjust L7 on the converter module until both markers are superimposed. Increase the oscilloscope horizontal gain; readjust L7 until both markers are perfectly superimposed.

k. Complete the following test set-up changes:

1. Disconnect 608D signal generator from test set-up.

2. Connect the XD-3A detector to J2, SDU OUT.

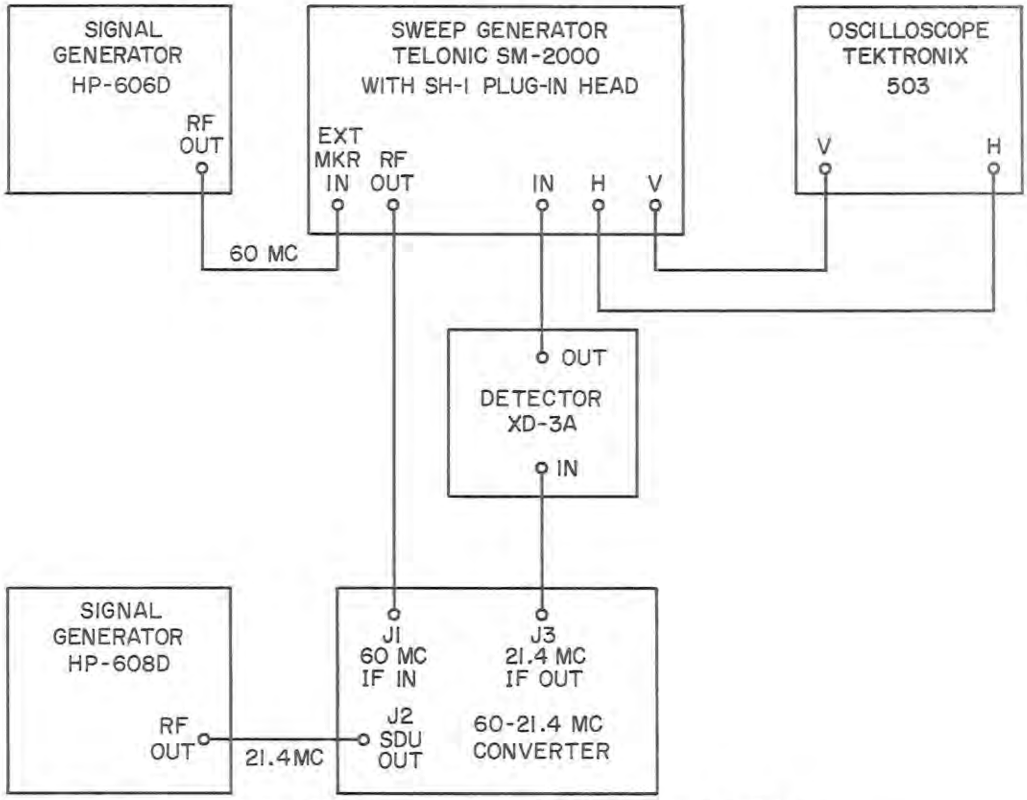


Figure 5-8. 60-21.4 Mc Converter Module Alignment, Test Set-up.

l. Reduce oscilloscope horizontal gain until the complete response waveform is displayed.

m. Adjust the 606D signal generator output level until a small marker is present on the response waveform.

n. Adjust L1, L2, L3 and L4 for maximum response centered around the marker. Refer to Figure 5-9.

o. Connect the XD-3A detector to J3 on the converter module.

p. Adjust L5 and L6 for maximum response centered around the marker. Refer to Figure 5-10.

(3) ISA-201-1 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about 4.0 db over the tuning range of the local oscillator and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-5 of the minimum performance standards. When the unit does not meet the minimum standards, the difficulty is likely to be a defective component and not alignment.

6. 490 to 1000 Mc RF Tuner, TN-520/WRR.

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in the isolation of faults to the RF tuner module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the TN-520/WRR RF tuner.

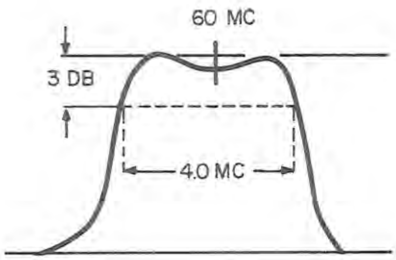


Figure 5-9. 60-21.4 Mc Converter Response Waveform at J2 Output.

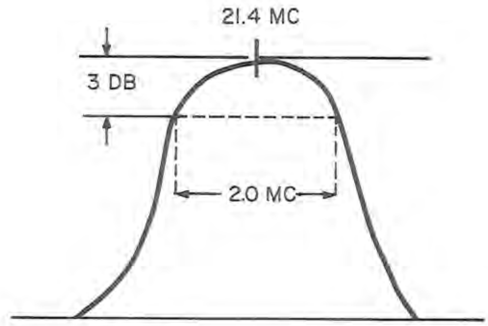


Figure 5-10. 60-21.4 Mc Converter Response Waveform at J3 Output.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts will assist in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, assure that the receiver power supplies are functioning normally in accordance with paragraph 4.A.(4) of NAVSHIPS instruction manual 0967-282-0010. Figure 5-4 illustrates the power extender cable which is required to operate the tuning unit outside the receiver housing. The performance standards for the various modules of the tuner are given in Tables 5-9 through 5-11. When performing the minimum standards tests, remove the tuning unit from the Countermeasures receiver and reconnect with the power extender cable. Place the following Countermeasures receiver front panel switches to the positions shown before proceeding:

SWITCH	POSITION
POWER	ON
TUNER	RIGHT of LEFT (as required)
RF GAIN	Maximum clockwise
AFC	OFF
IF SELECTOR	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	Midrange
Tuning Tape	490 mc
VOLUME	Midrange

Table 5-9. Tuning Head, SH-204-5 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 612A signal generator to J1, antenna input, of the SH-204-5 tuning head module. Connect a 50 ohm detector to J2 of the tuning head module. Place the tuner in operation at 750 mcs. Adjust the signal generator output frequency to 750 mcs. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the oscilloscope. The oscilloscope signal should be a 400 cps sine wave. Record the setting of the signal generator attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the setting of the signal generator attenuator.	The difference between the two recorded signal generator attenuator settings is the gain of the SH-204-5 tuning head. The gain should be 24 db minimum.

Table 5-10. 60 to 21.4 Mc Converter, CV-205-1 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the CV-205-1 converter module. Connect a 50 ohm detector to J3 of the converter module. Connect the detector output to the vertical input of a Tektronix 503 oscilloscope. Calibrate the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the CV-205-1 converter module. The gain should be 45 db minimum.

Table 5-11. Isolation Amplifier, ISA-202 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 612D signal generator to J1 on the ISA-202 module. Connect a 50 ohm detector to the LO OUTPUT jack at the tuning unit front panel. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator output frequency to 750 mcs. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the ISA-202 amplifier module. The gain should be 4.0 db or more.

B. Voltage and Resistance Measurements (Tables 5-12 through 5-14)

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the fault. The following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. The front panel control and swtich positions for Countermeasures Receiver R-1524(P)/WRR are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and one set for meters using a positive ground lead. The RCA meter, referenced above, has a negative ground lead when measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

Table 5-12. 490-100 Mc Tuning Head, SH-204-5, Voltage and Resistance Chart.

NOTES:
1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counterclockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	3.9 V (5 V)	580 (R x 100)	560 (R x 100)	4.1 V (5V)	1.5 K (R x 100)	3.3 K (R x 1 K)	8.9 V (15 V)	1.09 K (R x 100)	299 (R x 10)
Q2	-1.0 V (1.5 V)	3.5 K (R x 1 K)	1.41 K (R x 100)	-0.23 V (.5 V)	2.35 K (R x 100)	4.0 K (R x 1 K)	7.1 V (15 V)	2.71 K (R x 100)	1.62 K (R x 100)
Q3	0.7 V (1.5 V)	4.1 K (R x 1 K)	15.5 (R x 1)	0	0	0	6.0 V (15V)	3.3 K (R x 100)	12.9 (R x 1)

'Table 5-13. 60 to 21.4 Mc Converter, CV-205-1 Voltage and Resistance Chart

NOTES:
1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			CONNECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	1.6 V (5V)	3.3 K (R x 1 K)	1.4 K (R x 100)	-0.8 V (1.5 V)	4.1 K (R x 1 K)	3.9 K (R x 1 K)	7.4 V (15 V)	3.6 K (R x 1 K)	1.6 K (R x 100)
Q2	-0.64 V (1.5 V)	7.3 K (R x 1 K)	750 (R x 100)	0	0	0	11.4 V (15 V)	3.6 K (R x 1 K)	85 (R x 10)
Q4	7.6 V (15 V)	2.2 K (R x 1 K)	1.4 K (R x 100)	8.3 V (15 V)	4.3 K (R x 1 K)	4.2 K (R x 1 K)	10.2 V (15 V)	3.5 K (R x 1 K)	1.8 K (R x 100)
Q5	-3.0 V (5 V)	3.9 K (R x 1 K)	2.0 K (R x 100)	-2.3 V (5 V)	9.4 K (R x 1 K)	28 K (R x 1 K)	9.7 V (15 V)	3.6 K (R x 1 K)	1.8 K (R x 100)
Q6	-0.68 V (1.5 V)	7.2 K (R x 1 K)	100 (R x 10)	0	0	0	11.4 V (15 V)	3.5 K (R x 1 K)	85 (R x 10)
Q7	-6.4 V (15 V)	2.3 K (R x 100)	1.4 K (R x 100)	7.6 V (15 V)	2.1 K (R x 100)	1.9 K (R x 100)	4.0 V (5 V)	4.1 K (R x 1 K)	1.7 K (R x 100)
	SOURCE			GATE			DRAIN		
*Q3	1.34 V (5 V)	4.3 K (R x 1 K)	4.2 K (R x 1 K)	0	11 K (R x 1 K)	22 K (R x 1 K)	8.3 V (15 V)	4.3 K (R x 1 K)	4.0 K (R x 1 K)

*Field effect transistor, bottom view

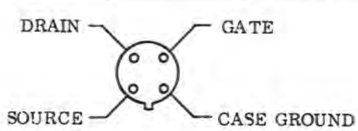


Table 5-14. Isolation Amplifier, ISA-202 Voltage and Resistance Chart.

NOTES:
1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (1)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-7.2 V	2.4 K	1.4 K	-6.5 V	5.3 K	5.4 K	0	0	0

C. 490 to 1000 Mc RF Tuner Alignment

Alignment of the 490 to 1000 mc RF tuner is divided into tuning head and 60 to 21.4 mc converter alignment. Countermeasures Receiver R-1524(P)/WRR and the tuner should be placed on a workbench adjacent to the test equipment being used for alignment to facilitate the use of short cables and test leads. The power extender cable illustrated in Figure 5-4 should be connected between the RF tuner and the right hand connector J5 on the receiver main chassis. Place the following front panel switches and controls to the positions indicated below before performing alignment.

SWITCH	POSITION
POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	As indicated in procedure
VOLUME	Midrange

(1) RF Tuning Head, SH-204-5 Alignment

a. Connect Countermeasures Receiver to a 115 vac, 60 cps power source.

b. Connect test equipment as illustrated in Figure 5-5.

c. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust horizontal sensitivity as required for full scale deflection. Connect the detector to test point J3 as illustrated in Figure 5-5.

d. Adjust the sweep generator output frequency to 500 mc. Adjust the output level of the sweep generator as required to achieve an oscilloscope deflection about 4.0 cm.

e. Calibrate the signal generator frequency at 60 mc and adjust the output amplitude to achieve a marker "birdy" on the response waveform. Adjust the external marker input control on the sweep generator until the marker "birdy" of the required amplitude is achieved at 500 mc.

f. Turn the internal 10 mc markers of the sweep generator on. Adjust the sweep generator marker amplitude control as required to achieve the marker display.

g. With the tuning unit set at 500 mc, the LO output and signal generator markers should be superimposed.

h. Adjust C9 on the tuner until the LO and signal generator output markers are superimposed.

i. Repeat steps d. through g. substituting 1000 mc for 500 mc.

j. Adjust C6 on the tuner until the LO and signal generator output markers are superimposed.

k. Adjust C2, C3, C4 and C5 for maximum response centered around 1000 mc.

l. The RF response displayed on the oscilloscope should have the characteristics illustrated in Figure 5-11.

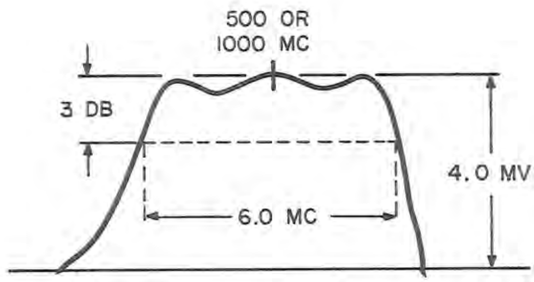


Figure 5-11. 490-1000 Mc RF Tuner Response Waveform at J3.

m. Rotate the tuning crank over the tuning range, adjusting the sweep generator output frequency as required to maintain the response on the oscilloscope. Adjust the signal generator output level as required to maintain a deflection of 4.0 cm on the oscilloscope.

n. The marker should remain centered on the response waveform over the tuning range and the response waveform shape should remain essentially as illustrated in Figure 5-11. Slight re-adjustment of the capacitors in step k. may be necessary to obtain a suitable response over the tuning range.

o. Disconnect the detector from J3 and connect to J2 on the tuner. The sweep generator output level should be readjusted as required to achieve a 4.0 cm deflection on the oscilloscope at 1000 mc.

p. The IF response at the tuner IF output J2 should be as illustrated in Figure 5-12.

q. Adjust L12 and L13 for maximum symmetrical response centered around the 60 mc marker.

r. Alignment complete, remove test equipment.

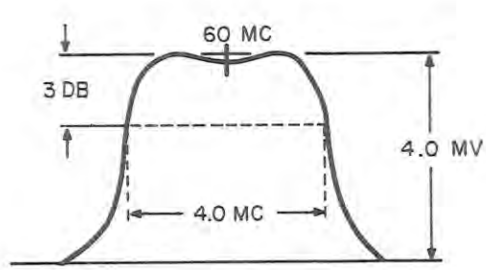


Figure 5-12. 490-1000 Mc RF Tuner IF Response Waveform at J2.

(2) 60 to 21.4 Mc Converter, CV-205-1 Alignment: The alignment of the CV-205-1 converter is identical to the alignment of the CV-204-4 converter. Refer to Section V, paragraph 5, C, (2) of this supplement for the converter alignment procedure.

(3) ISA-202 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about 4.0 db over the range of frequencies from 490 to 1000 mc and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-11 of the minimum performance standards. If the unit exhibits more loss than is indicated, the difficulty is likely to be a defective component and not the alignment.

7. IF Amplifier, IF-212-500.

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in isolation of faults to the IF amplifier module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the IF-212-500 IF amplifier.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the receiver main chassis, the following minimum performance standards chart will assist in further fault isolation.

Table 5-15. 500 Kc IF Amplifier Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Remove RF tuner from left hand receiver tuner receptacle. Connect a 606A signal generator to J2A2 on the receiver main chassis. Calibrate the signal generator output at 21.4 mc with 50% modulation at 1000 cps. Connect the vertical input of a Tektronix 503 oscilloscope to pin B4 of the IF module.	Set the Countermeasures Receiver IF BANDWIDTH switch to select the LEFT position. Set the oscilloscope to display a 1000 cps signal. Adjust the signal generator output level as required to achieve a display on the oscilloscope.	The oscilloscope display should be a clean 1000 cps signal. The overall signal gain should be 56 ± 3 db.
2	Same as step 1 except do not use modulation.	Vary the output frequency of the signal generator around 21.4 mc.	The Countermeasures Receiver tuning meter should track the varying output of the signal generator. At 21.4 mc the tuning meter should indicate 0.

B. Voltage and Resistance Measurements

After a fault has been localized to a particular circuit or module, voltage and resistance measurements on the suspected components should reveal the faulty components. Accordingly, the following tabulations of the transistor voltages and resistances are presented. An RCA Vacuum Tube Multimeter, Type WV-98C, was used in performing all measurements. The front panel control and switch positions for Countermeasures Receiver R-1524(P)/WRR are with each tabulation for ease of reference. Note that two sets of resistance readings are given, one set for meters using a negative ground lead and the other for measuring resistance. With each entry in the tabulation of either voltage or resistance, the meter range used is included within parentheses.

Table 5-16. 500 Kc IF Amplifier, IF-212-500 Voltage and Resistance Chart.

NOTES: 1. IF BANDWIDTH switch set to position of IF module under test.
2. POWER switch set to ON.
3. Disconnect power cord from Countermeasures Receiver R-1524(P)WRR during resistance measurements.

REF DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-5.4 V (15 V)	4.3 K (R x 1 K)	4.3 K (R x 1 K)	-4.6 V (15 V	5.7 K (R x 1 K)	5.7 K (R x 1 K)	-0.65 (1.5 V)	100 M (R x 1 M)	6.1 K (R x 1 K)
Q2	-0.65 (1.5 V)	100 M (R x 1M)	6.1 K (R x 1 K)	0	0	0	9.6 (15 V)	4.3 K (R x 1 K)	3.9 K (R x 1 K)
Q3	-5.4 V (15 V	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-4.7 (15 V)	5.7 K (R x 1 K)	5.7 K (R x 1 K)	-0.66 V (1.5 V)	200 M (R x 1 M)	94 (R x 10)
Q4	-0.66 V (1.5 V)	200 M (R x 1 M)	94 (R x 10)	0	0	0	11.0 V (15 V)	3.2 K (R x 1 K)	3.2 K (R x 1 K)
Q5	-0.72 V (1.5 V)	6.8 K (R x 1 K)	6.8 K (R x 1 K)	-0.9 (0.5 V)	8.1 K (R x 1 K)	360 (R x 100)	11.5 V (15 V)	3.3 K (R x 1 K)	3.3 K (R x 1 K)
Q6	-2.65 V (5 V)	4.1 K (R x 1 K)	4.1 K (R x 1 K)	-2.0 (5 V)	4.1 K (R x 1 K)	4.1 K (R x 1 K)	-0.68 (1.5 V)	500 M (R x 1 M)	6.2 K (R x 1 K)
Q7	0.68 V (1.5 V)	500 M (R x 1 M)	6.2 K (R x 1 K)	0	0	0	4.6 (15 V)	5.5 K (R x 1 K)	4.2 K (R x 1 K)
Q8	-2.9 V (15 V)	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-2.4 (5 V)	4.0 K (R x 1 K)	4.0 K (R x 1 K)	-0.66 (1.5 V)	200 M (R x 1 M)	6.1 K (R x 1 K)
Q9	-0.66 (1.5 V)	200 M (R x 1 M)	6.1 K (R x 1 K)	0	0	0	8.0 V (15 V)	4.1 K (R x 1 K)	3.9 K (R x 1 K)
Q10	-1.44 V (5 V)	5.3 K (R x 1 K)	5.3 K (R x 1 K)	-0.16 V (0.5 V)	7.5 K (R x 1 K)	51.0 K (R x 10 K)	11.9 (15 V)	3.1 K (R x 1 K)	850 (R x 100)

C. IF Amplifier, IF-212-500 Alignment

Remove left hand RF tuner from Countermeasures Receiver R-1524(P)/WRR and set following switches to position indicated before proceeding.

<u>SWITCH</u>	<u>POSITION</u>
IF BANDWIDTH	To select IF module under test
POWER	ON
TUNER	LEFT

(1) AM Alignment:

a. Connect the test setup as shown in Figure 5-13.

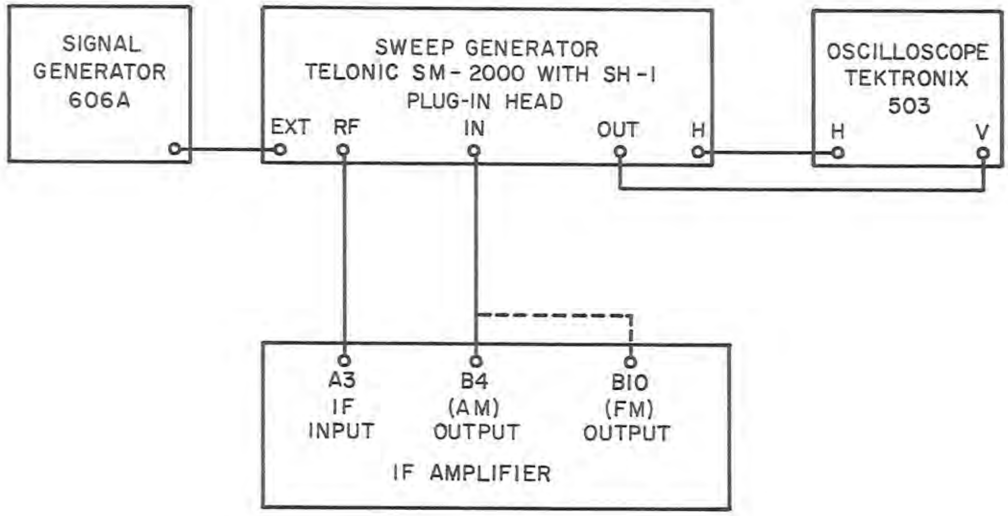


Figure 5-13. IF Amplifier Alignment Test Setup.

b. Set and calibrate the 606A signal generator for 21.4 mc.

c. Set oscilloscope for full scale horizontal sensitivity and 0.5 volt/cm vertical sensitivity.

d. Adjust sweep generator frequency to 21.4 mc and the output to display a 4 cm oscilloscope response. Adjust marker gain control to display a 21.4 mc center frequency marker on the response.

e. Adjust L1, L2, L3, and L4 for optimum symmetrical response centered around the 21.4 mc marker, Figure 5-14.

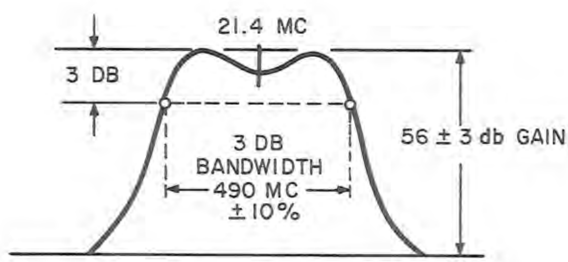


Figure 5-14. IF Amplifier, IF-212-500 AM Response Waveform.

(2) FM Alignment

a. Maintain test equipment setup and control settings used for AM alignment.

b. Connect terminal B10 of IF module to sweep generator; refer to Figure 5-13.

c. Adjust L10 and L11 to center the discriminator response curve around the 21.4 mc marker.

d. Adjust L6 and L8 for maximum linearity of the "S" curve response for the bandwidth indicated in Figure 5-15.

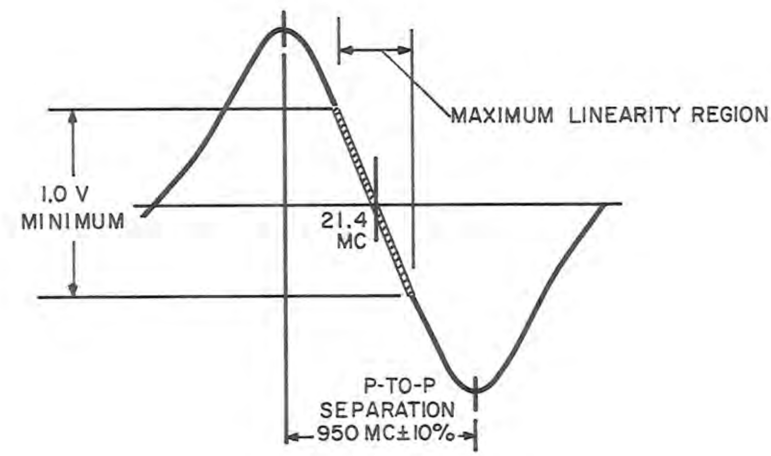


Figure 5-15. IF Amplifier, IF-212-500 FM Discriminator Response Waveform.

SECTION VI

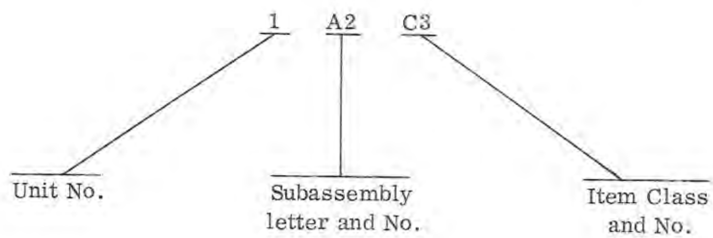
PARTS AND MANUFACTURER'S LIST

1. Introduction.

This section contains the parts list for the tuning units and IF amplifier. The parts list includes a complete tabulation of the component parts which are maintenance significant. Paragraph 3 lists the name to code cross reference for each part manufacturer. The parts list was compiled using the unit numbering method.

A. Unit Numbering Method

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify units, subassemblies (and modules) and parts. Use of the unit numbering method provides a cross reference in the numbering system between the parts lists and the schematic diagrams. An example of the unit numbering method follows:



Read as: Third (3) capacitor (C) of second (2) subassembly (A) of unit 1

B. Reference Designation Prefix

Partial reference designations have been used on the equipment and on the schematic diagrams 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 included on the schematic diagram following the notation "REF DESIG PREFIX".

2. Parts List.

The parts list presented on the following pages lists the repair parts for the receiver and the tuning units.

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4 TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUN. UNIT, RF	19905	TN-519/WRR	1	1
CR1	SEMICONDDEV, DIO Zener, 15 volts, 8.5 ohms max impedance, 16 ma max current, 2 axial wire lead terminals	81349	1N965B	1	1
DS1	LAMP, INCANDES Single contact midget flanged base, TI 3/4 bulb, 28v, 0.04 amp	96906	MS25237-327	1	1
P1	CONN, PLUG, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCM25W3PNMB	1	1
R1	RESISTOR, VAR 250 ohms, ±10%, 2w	81349	RV4NAYSD251A	1	1
R2	RES., FIXED, COMP 820 ohms, ±5%, 1/4w	81349	RC07GF821J	1	5
R3	RES., FIXED, COMP 220 ohms, ±5%, 1/4w	81349	RC07GF221J	1	2
XDS1	LAMPHOLDER Chassis mounting subminiature type for TI 3/4 incandescent lamp	72619	8-1930XP24	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4 — TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Z1	DUMMY LOAD, ELEC 51 ohms, ±5%, 1/2w	95712	534-2	1	1
MP1	WINDOW, DIAL Plastic sheet, acrylic base, transparent, 1.68 in. lg, 0.06 in. thk, 0.50 in. h o/a dim. with engraved hair line	19905	A205	1	1
MP2	GEARSHAFT, SPUR Anodized aluminum gear, 115 teeth, 1.625 in. dia.	19905	A206-2	1	1
MP3	KNOB Crank type, plastic, black, 0.252 in. dia shaft, 0.58 in. thk, 0.89 in. dia o/a dim	19905	A281	1	1
MP4	DIAL, SCALE White background, black markings, 0.004 in. thk, 0.629 in. w, 32.12 in. lg o/a dim	19905	D038	1	1
MP5	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E2B	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4 — TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP6	SEAL SHAFT Gray silicone rubber boot, brass nut, 3/8-32thd size, 1/4 in. shaft size, 7/32 in. depth, 1/2 in. across flats o/a dim.	97539	N9030-1-4	2	2
MP7	SEAL SHAFT		SAME AS 4MP6	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4 — TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W1	CABLE ASSY, SP, EL RG55/U coaxial cable, one end terminated with a 8205B plug, the other end with a MS35168-88F plug, 4.500 in. lg.	19905	AC076-72-1	1	1
W1P1	CONN, PLUG, ELEC Bulkhead mounted push-on type, silver plated, beryllium copper contacts, teflon insulation	91737	8205B	1	1
W1P2	CONN, PLUG, ELEC BNC type, weatherproof, quick-disconnect	96906	MS35168-88F	1	1
W2	CABLE ASSY, SP, EL RG196/U coaxial cable, each end terminated with a 5116-037475 plug, 4.500 in. lg	19905	AC076-73-1	1	1
W2P1	CONN, PLUG, ELEC 50 ohm screw-on type, teflon insulated, gold plated male contacts	74868	5116-037475	2	8
W2P2	CONN, PLUG, ELEC		SAME AS 4W2P1	REF	REF
W3	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug, 9.500 in. lg	19905	AC801-7-1	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4 TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W3P1	CONN, PLUG, ELEC		SAME AS 4W2P1	1	REF
W3P2	CONN, PLUG, ELEC Right angle solder type, gold over silver plated brass contact, nylon insulator	71468	DM53741-5000	1	3
W4	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug, 6.250 in. lg	19905	AC801-1-1	1	1
W4P1	CONN, PLUG, ELEC		SAME AS 4W2P1	1	REF
W4P2	CONN, PLUG, ELEC		SAME AS 4W3P2	1	REF
W5	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug, 10.250 in.lg	19905	AC801-8-1	1	1
W5P1	CONN, PLUG, ELEC		SAME AS 4W2P1	1	REF
W5P2	CONN, PLUG, ELEC		SAME AS 4W3P2	1	REF
W6	CABLE ASSY, SP, EL RG196/U coaxial cable, each end terminated with a 5116-037475 plug, 2.500 in. lg	19905	AC076-90-1	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4   TUNING UNIT, RADIO FREQUENCY TN-519/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W6P1	CONN, PLUG, ELEC		SAME AS 4W2P1	2	REF
W6P2	CONN, PLUG, ELEC		SAME AS 4W2P1	REF	REF
W7	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a 31-369 receptacle, 3.500 in. lg	19905	AC076-104-1	1	1
W7J1	CONN, RECP, ELEC Quick crimp bulkhead type, teflon insulated, gold plated captive contacts	74868	31-369	1	1
W7P1	CONN, PLUG, ELEC		SAME AS 4W2P1	1	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNER, RF	19905	SH203A-7	1	1
C1	CAP., FXD, CER DL 6.0 pf, ±.25 pf, NPO ± 60 ppm	81349	CC20CH060C	1	2
C2	CAP., FXD, CER DL 1.5 pf, ± .25 pf, NPO ± 250 ppm	81349	CC20CK1R5C	4	4
C3	CAP., FXD, MICADL 0.20 pf, ±10%, 500 vdcw	95121	MC0.20	1	1
C4	CAP., FXD, CER DL		SAME AS 4A1C2	REF	REF
C5	CAP., VAR, GL DL 0.8-8.5 pf, 750 vdcw	81349	PC40J8R5	6	6
C6	CAP., VAR, GL DL		SAME AS 4A1C5	REF	REF
C7	CAP., FXD, MICADL 0.7 pf, ± 10%, 500 vdcw	95121	MC0.75	4	4
C8	CAP., FXD, CER DL 4.7 pf, ±.25 pf, NPO ± 60 ppm	81349	CC20CH4R7C	3	3
C9	CAP., FXD, CER DL 1.0 pf, ± .25 pf, NPO ± 250 ppm	81349	CC20CK010C	3	3

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C10	CAP., FXD, MICADL 25 pf,± 10%, 500 vdcw	81349	CB11RD250K	2	2
C11	CAP., FXD, CER DL 470 pf, ±20%, 500 vdc	01121	FW5N4712	2	2
C12	CAP., FXD, CER DL 470 pf, ± 20%, 500 vdc	01121	FA5C4712	12	12
C13	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C14	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C15	CAP., VAR, GL DL		SAME AS 4A1C5	REF	REF
C16	CAP., VAR, GL DL		SAME AS 4A1C5	REF	REF
C17	CAP., FXD, MICADL 0.36 pf, ± 10%, 500 vdcw	95121	MC0.36	1	1
C18	CAP., FXD, CER DL		SAME AS 4A1C2	REF	REF
C19	CAP., FXD, CER DL		SAME AS 4A1C8	REF	REF
C20	CAP., FXD CER DL		SAME AS 4A1C9	REF	REF
C21	CAP., FXD, CER DL		SAME AS 4A1C11	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C22	CAP., FXD, MICADL		SAME AS 4A1C10	REF	REF
C23	CAP. FXD, CER DL		SAME AS 4A1C12	REF	REF
C24	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C25	CAP., FXD, MICADL		SAME AS 4A1C7	REF	REF
C26	CAP., VAR, GL DL		SAME AS 4A1C5	REF	REF
C27	CAP., FXD, CER DL		SAME AS 4A1C2	REF	REF
C28	CAP., FXD, MICADL		SAME AS 4A1C7	REF	REF
C29	CAP., FXD, CER DL 0.5 pf, ± .25 pf, NPO ± 250 ppm	81349	CC20CK0R5C	2	2
C30	CAP., VAR, GL DL		SAME AS 4A1C5	REF	REF
C31	CAP., FXD, CER DL 5.0 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CH050C	1	1
C32	CAP., FXD, CER DL		SAME AS 4A1C8	REF	REF
C33	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C34	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 — TUNER, RF — SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C35	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C36	CAP., FXD, CER DL 1000 pf, ± 20%, 1000 vdc	81349	CK60AW102M	3	14
C37	CAP., FXD, CER DL 3.3 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CJ3R3C	1	1
C38	CAP., FXD, CER DL		SAME AS 4A1C29	REF	REF
C39	CAP., FXD, CER DL		SAME AS 4A1C9	REF	REF
C40	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C41	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C42	CAP., FXD, CER DL 8.2 pf, ± .25 pf, NPO ± 60 ppm	81349	CC20CH8R2C	1	3
C43	CAP., FXD, MICADL		SAME AS 4A1C7	REF	REF
C44	CAP.,FXD, MICADL 10 pf, ±5%, 500 vdcw	81349	CM05C100J03	1	3
C45	CAP., FXD, MICADL 27 pf, ±5%, 500 vdcw	81349	CM05E270J03	1	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C46	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C47	CAP., FXD, CER DL 470 pf, ±20%, 500 vdc	01121	SS5A4712	1	1
C48	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C49	CAP., FXD, CER DL		SAME AS 4A1C12	REF	REF
C50	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
J1	CONN, RECP, ELEC BNC type, quick-disconnect	96906	MS35179-1094A	1	1
J2	CONN, RECP, ELEC 50 ohms, screw on type, teflon insulation, gold plated female contacts	74868	5116-058350	2	4
J3	CONN, RECP, ELEC		SAME AS 4A1J2	REF	REF
L1	TUNING UNIT, RF Sealed unit	19905	A123-2	1	1
L2	COIL, RF One piece of no.18 awg wire 1.75 in. lg.	19905	B045-5	5	5
L3	COIL, RF		SAME AS 4A1L2	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L4	COIL, RF 4 turns no.18 awg wire closewound	19905	B516-1	3	3
L5	COIL, RF		SAME AS 4A1L2	REF	REF
L6	COIL, RF		SAME AS 4A1L2	REF	REF
L7	COIL, RF		SAME AS 4A1L4	REF	REF
L8	COIL, RF		SAME AS 4A1L2	REF	REF
L9	COIL, RF		SAME AS 4A1L4	REF	REF
L10	COIL, RF Ind 18 uh, 10 turns no. 24 awg wire closewound on a mineral molded form	19905	AB518	1	1
L11	COIL, RF One piece of no.18 awg wire 1 in. lg.	19905	B045-1	1	1
L12	COIL, RF Max ind. 8.9 uh, min ind 0.5 uh, 11 turns no. 26 wire closewound on a ceramic form	19905	AB517	2	2
L13	COIL, RF		SAME AS 4A1L12	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 — TUNER, RF — SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L14	COIL, RF 2 1/2 turns no. 24 awg wire closewound	19905	B516-2	1	1
Q1	TRANSISTOR Small signal NPN silicon type, 3 radial wire lead terminals	20754	2N2857	3	3
Q2	TRANSISTOR		SAME AS 4A1Q1	REF	REF
Q3	TRANSISTOR		SAME AS 4A1Q1	REF	REF
Q4	TRANSISTOR NPN, triode, 4 radial wire lead terminals	07263	2N3337	1	3
Q5	TRANSISTOR Amplifier oscillator, 3 radial wire lead terminals	20754	K2614	1	1
R1	RES., FIXED, COMP 100 K ohms, ±5%, 1/4w	81349	RC07GF104J	1	1
R2	RES., FIXED, COMP 3.9K ohms, ±5%, 1/4w	81349	RC07GF392J	3	3
R3	RES., FIXED, COMP 2.7K ohms, ±5%, 1/4w	81349	RC07GF272J	2	4

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R4	RES., FIXED, COMP 2.2K ohms,±5%, 1/4	81349	RC07GF222J	3	4
R5	RES., FIXED, COMP		SAME AS 4A1R4	REF	REF
R6	RES., FIXED, COMP 1.8K ohms,±5%, 1/4w	81349	RC07GF182J	2	4
R7	RES., FIXED, COMP		SAME as 4A1R2	REF	REF
R8	RES., FIXED, COMP		SAME AS 4A1R2	REF	REF
R9	RES., FIXED, COMP 27K ohms, ±5%, 1/4w	81349	RC07GF273J	1	1
R10	RES., FIXED, COMP 1.2 K ohms, ±5%, 1/4w	81349	RC07GF122J	1	1
R11	RES., FIXED, COMP		SAME AS 4A1R6	REF	REF
R12	RES., FIXED, COMP		SAME AS 4R2	1	REF
R13	RES., FIXED, COMP		SAME AS 4A1R3	REF	REF
R14	RES., FIXED, COMP 12 K ohms, ±5%, 1/4w	81349	RC07GF123J	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R15	RES., FIXED, COMP 8.2 K ohms, ±5%, 1/4w	81349	RC07GF822J	1	4
R16	RES., FIXED, COMP 1.5 K ohms, ±5%, 1/4w	81349	RC07GF152J	1	2
R17	RES., FIXED, COMP 150 ohms, ±5%, 1/4w	81349	RC07GF151J	4	7
R18	RES., FIXED, COMP		SAME AS 4A1R17	REF	REF
R19	RES., FIXED, COMP 33 ohms, ±5%, 1/4w	81349	RC07GF330J	2	3
R20	RES., FIXED, COMP 100 ohms, ±5%, 1/4w	81349	RC07GF101J	2	4
R21	RES., FIXED, COMP		SAME AS 4A1R20	REF	REF
R22	RES., FIXED, COMP		SAME AS 4A1R4	REF	REF
R23	RES., FIXED, COMP 39 K ohms, ±5%, 1/4w	81349	RC07GF393J	1	1
R24	RES., FIXED, COMP 22 K ohms, ±5%, 1/4w	81349	RC07GF223J	1	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A1 TUNER, RF SH203A-7

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R25	RES., FIXED, COMP 1 K ohm, ±5%, 1/4w	81349	RC07GF102J	1	7
R26	RES., FIXED, COMP		SAME AS 4A1R19	REF	REF
R27	RES., FIXED, COMP		SAME AS 4A1R17	REF	REF
R28	RES., FIXED, COMP		SAME AS 4A1R17	REF	REF
TP1	JACK, TIP Teflon insulation, 0.218 in. dia, copper terminal 0.045 in. dia, 0.375 in. lg o/a dim	98291	SKT12	1	1
MP1	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk	17069	88001	3	12
MP2	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2		CONVERTER CV204-4			
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CONVERTER	19905	CV204-4	1	1
C1	CAP., FXD, CER DL		SAME AS 4A1C36	9	REF
C2	CAP., FXD, CER DL 1000 pf, GMV	01121	SS5A102W	2	4
C3	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C4	NOT USED				
C5	CAP., FXD, MICADL 22 pf,±5%, 500 vdcw	81349	CM05E220J03	2	2
C6	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C7	CAP., FXD, MICADL 1.2 pf, ±10%, 500 vdcw	95121	MC1.2	2	2
C8	CAP., FXD, MICADL		SAME AS 4A1C45	1	REF
C9	CAP., FXD, MICADL 1.0 pf, ±10%, 500 vdcw	95121	MC1.0	1	1
C10	CAP., FXD, CER DL 6 pf, ±.25 pf, NPO ±60 ppm	81349	CC20CH060C	1	1
C11	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2 CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C12	CAP., FXD, MICADL 15 pf, ±5%, 500 vdcw	81349	CM05C150J03	3	3
C13	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C14	CAP., FXD, CER DL		SAME AS 4A1C42	2	REF
C15	CAP., FXD, MICADL		SAME AS 4A2C12	REF	REF
C16	CAP., FXD, MICADL 120 pf,±5%, 500 vdcw	81349	CM05F121J03	1	1
C17	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C18	CAP., FXD, CER DL		SAME AS 4A2C2	REF	REF
C19	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C20	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C21	CAP., FXD, MICADL		SAME AS 4A2C12	REF	REF
C22	CAP., FXD, MICADL		SAME AS 4A2C7	REF	REF
C23	CAP., FXD, MICADL		SAME AS 4A2C5	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2 — CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C24	CAP., FXD, MICADL 200 pf, ±5%, 500 vdcw	81349	CM05F201J03	1	1
C25	CAP., FXD, MICADL 12 pf, ±5%, 500 vdcw	81349	CM05C120J03	2	2
C26	CAP., FXD, MICADL		SAME AS 4A1C44	2	REF
C27	CAP., FXD, MICADL		SAME AS 4A2C25	REF	REF
C28	CAP., FXD, CER DL 1000 pf, GMV	01121	FA5C102W	10	12
C29	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C30	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C31	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C32	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C33	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C34	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C35	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2

CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C36	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C37	NOT USED				
C38	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
C39	CAP., FXD, MICADL		SAME AS 4A1C44	REF	REF
C40	CAP., FXD, CER DL		SAME AS 4A1C42	REF	REF
C41	CAP., FXD, MICADL 18 pf, ±5%, 500 vdcw	81349	CM05C180J03	1	1
C42	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
CR1	NOT USED				
CR2	SEMICONDDEV, DIO Silicon, 50 PIV, 2 axial wire lead terminals	81349	1N3064	2	2
CR3	SEMICONDDEV, DIO		SAME AS 4A2CR2	REF	REF
CR4	SEMICONDDEV, DIO Zener, 7.2 volts, 20 ohms max impedance, 7 ma max current, 2 axial wire lead terminals	81349	1N753A	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A2 CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
J1	CONN, RECP, ELEC 50 ohms, screw on printed circuit type, teflon insulation, gold plated female contacts	74868	5116-054900	4	4
J2	CONN, RECP, ELEC		SAME AS 4A2J1	REF	REF
J3	CONN, RECP, ELEC		SAME AS 4A2J1	REF	REF
J4	CONN, RECP, ELEC		SAME AS 4A2J1	REF	REF
L1	COIL, RF Max ind. 0.30uh, min ind 0.18 uh, 4 turns no. 27 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-0-1	2	2
L2	COIL, RF		SAME AS 4A2L1	REF	REF
L3	COIL, RF Max ind 3.5 uh, min ind 1.7 uh, 18 turns no. 34 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-3-1	4	4
L4	COIL, RF		SAME AS 4A2L3	REF	REF
L5	COIL, RF		SAME AS 4A2L3	REF	REF
L6	COIL, RF		SAME AS 4A2L3	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2 — CONVERTER CV 204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L7	COIL, RF Max ind 0.55 uh, min ind 0.28 uh, 6 turns no. 27 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-11-1	1	1
L8	NOT USED				
L9	COIL, RF Ind. 3.3 uh,±10%, Q min 30, min self-resonant freq 70 mc, max DC resistance 0.140 ohms	81349	LT4K040	3	3
L10	NOT USED				
L11	COIL, RF		SAME AS 4A2L9	REF	REF
L12	NOT USED				
L13	COIL, RF		SAME AS 4A2L9	REF	REF
Q1	TRANSISTOR		SAME AS 4A1Q4	2	REF
Q2	TRANSISTOR NPN, silicon, 4 radial wire lead terminals	19905	A395	3	3
Q3	TRANSISTOR Planar field-effect, silicon, 4 radial wire lead terminals	01295	2N3823	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A2

CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q4	TRANSISTOR NPN, silicon, 3 radial wire lead terminals	81349	2N918	1	3
Q5	TRANSISTOR		SAME AS 4A1Q4	REF	REF
Q6	TRANSISTOR		SAME AS 4A2Q2	REF	REF
Q7	TRANSISTOR		SAME AS 4A2Q2	REF	REF
R1	RES., FIXED, COMP		SAME AS 4A1R17	3	REF
R2	RES., FIXED, COMP		SAME AS 4A1R19	1	REF
R3	RES., FIXED, COMP		SAME AS 4A1R17	REF	REF
R4	RES., FIXED, COMP		SAME AS 4A1R15	3	REF
R5	RES., FIXED, COMP		SAME AS 4A1R3	2	REF
R6	RES., FIXED, COMP		SAME AS 4A1R25	6	REF
R7	RES., FIXED, COMP		SAME AS 4A1R6	2	REF
R8	RES., FIXED, COMP 5.6 K ohms,±5%, 1/4w	81349	RC07GF562J	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A2

CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R9	RES., FIXED, COMP 15 K ohms,±5%, 1/4w	81349	RC07GF153J	1	1
R10	RES., FIXED, COMP		SAME AS 4A1R25	REF	REF
R11	RES., FIXED, COMP		SAME AS 4A1R24	1	REF
R12	RES., FIXED, COMP 3.3 K ohms, ±5%, 1/4w	81349	RC07GF332J	4	5
R13	RES., FIXED, COMP		SAME AS 4A1R15	REF	REF
R14	RES., FIXED, COMP		SAME AS 4A1R25	REF	REF
R15	NOT USED				
R16	NOT USED				
R17	RES., FIXED, COMP		SAME AS 4A1R20	2	REF
R18	RES., FIXED, COMP		SAME AS 4A1R17	REF	REF
R19	RES., FIXED, COMP		SAME AS 4A1R15	REF	REF
R20	RES., FIXED, COMP		SAME AS 4A1R3	REF	REF
R21	RES., FIXED, COMP		SAME AS 4A1R20	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2	CONVERTER CV204-4				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R22	RES., FIXED, COMP		SAME AS 4A1R25	REF	REF
R23	RES., FIXED, COMP		SAME AS 4A1R25	REF	REF
R24	RES., FIXED, COMP		SAME AS 4A2R12	REF	REF
R25	RES., FIXED, COMP		SAME AS 4A2R12	REF	REF
R26	RES., FIXED, COMP		SAME AS 4R2	1	REF
R27	RES., FIXED, COMP		SAME AS 4A2R12	REF	REF
R28	RES., FIXED, COMP		SAME AS 4A1R16	1	REF
R29	NOT USED				
R30	RES., FIXED, COMP 4.7 K ohms, ±5%, 1/4w	81349	RC07GF472J	1	1
R31	NOT USED				
R32	NOT USED				
R33	NOT USED				
R34	RES., FIXED, COMP 10 ohms, ±5%, 1/4w	81349	RC07GF100J	1	2

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A2 CONVERTER CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R35	RESISTOR, VAR 1 K ohm, ±10%, 1/2 w	81349	RV6LAYSA102A	1	1
R36	RES., FIXED, COMP		SAME AS 4A1R25	REF	REF
R37	RES., FIXED, COMP		SAME AS 4A1R4	1	REF
R38	RES., FIXED, COMP		SAME AS 4A1R6	REF	REF
MP1	RETAINER, TSTR Copper, 0.380 in. dia, 0.370 in.lg, 8 contacts 0.300 in. lg for retaining transistor	98978	TXB2P032-037B	6	6
MP2	RETAINER, TSTR		SAME AS 4A2MP1	REF	REF
MP3	RETAINER, TSTR		SAME AS 4A2MP1	REF	REF
MP4	RETAINER, TSTR		SAME AS 4A2MP1	REF	REF
MP5	RETAINER, TSTR		SAME AS 4A2MP1	REF	REF
MP6	RETAINER, TSTR		SAME AS 4A2MP1	REF	REF
MP7	INSULATOR, DISK		SAME AS 4A1MP1	7	REF
MP8	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A2 CONVERTOR CV204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP9	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF
MP10	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF
MP11	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF
MP12	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF
MP13	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A3 — AMPLIFIER, ISOLATION ISA201-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPL, ISOLATION	19905	ISA201-2	1	1
C1	CAP., FXD, CER DL		SAME AS 4A1C36	2	REF
C2	CAP., FXD, CER DL		SAME AS 4A2C2	2	REF
C3	CAP., FXD, CER DL		SAME AS 4A2C2	REF	REF
C4	CAP., FXD, CER DL		SAME AS 4A1C36	REF	REF
C5	CAP., FXD, CER DL		SAME AS 4A2C28	2	REF
C6	CAP., FXD, CER DL		SAME AS 4A2C28	REF	REF
J1	CONN, RECP, ELEC		SAME AS 4A1J2	2	REF
J2	CONN, RECP, ELEC		SAME AS 4A1J2	REF	REF
L1	COIL, RF Max ind .09 uh, min ind .03 uh, 3 turns no. 18 awg wire closewound on a ceramic form	19905	AB764	1	1
Q1	TRANSISTOR		SAME AS 4A2Q4	2	REF
Q2	TRANSISTOR		SAME AS 4A2Q4	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A3 — AMPLIFIER, ISOLATION ISA201-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RES., FIXED, COMP		SAME AS 4A2R12	1	REF
R2	RES., FIXED, COMP 10 K ohms, ±5%, 1/4w	81349	RC07GF103J	1	1
R3	RES., FIXED, COMP		SAME AS 4R2	2	REF
R4	RES., FIXED, COMP		SAME AS 4R2	REF	REF
R5	RES., FIXED, COMP		SAME AS 4R3	1	REF
R6	RES., FIXED, COMP		SAME AS 4A2R34	1	REF
MP1	INSULATOR, DISK		SAME AS 4A1MP1	2	REF
MP2	INSULATOR, DISK		SAME AS 4A1MP1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	GEAR TRAIN ASSY Mechanical linkage for tuner and tape drive assembly	19905	GT203-4	1	1
MP1	BUSHING, ASSY Aluminum, 0.125 in. thk, 1.250 in. w, 1.780 in. h, with two retainers, 0.440 in. dia pressed fitted on plate o/a dim	19905	AB1107-4	1	1
MP2	SPROCKET ASSY Modified sprocket with a tape retainer press fitted	19905	AB522-2	1	1
MP3	DISK, CLUTCH Brass hub, 0.500 in. dia with two holes 4-40 unc-2B mated with a disk 1.235 in. dia o/a dim.	19905	AB525-2	1	1
MP4	COLLAR, SHAFT Brass, 0.14 in. thk, 0.500 in. od, 0.250 in. id, 2 holes drilled 4-40 unc-2B o/a dim.	19905	A018	2	2
MP5	COLLAR, SHAFT		SAME AS 4A4MP4	REF	REF
MP6	WASHER, BEVEL CRES sheet type 302, 0.090 in. thk, 0.620 in. od, 0.254 in. id o/a dim.	19905	A063	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A4 — GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP7	WASHER, BEVEL		SAME AS 4A4MP6	REF	REF
MP8	HOUSING, GEAR Aluminum alloy plate, "C" shaped, two legs 0.666 in. lg with one 0.3750 in. dia hole each leg, 0.500 in. w, 1.112 in lg o/a dim.	19905	A078-2	1	1
MP9	GEAR ASSY, SPUR Hub type gear spur with a straight headless pin attached, 2.030 in. lg o/a dim	19905	A079-1	1	1
MP10	HOUSING, BEARING Aluminum alloy, 0.620 in. lg, 0.060 in. thk shoulder with two mtg holes 0.104 in. dia one centrally located hole 0.500 in dia o/a dim.	19905	A080-2	1	1
MP11	GEAR, BEVEL Brass, modified 0.312 in. dia with two holes 4-40 unc-2B o/a dim.	19905	A082	2	2
MP12	GEAR, BEVEL		SAME AS 4A4MP11	REF	REF
MP13	PIN, STR, HDLS CRES type 303, 0.124 in. dia, 1.810 in. lg, both ends chamfer .01X45° o/a dim.	19905	A093-2	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP14	REEL, TAPE Teflon, 0.500 in. dia ends, 0.030 in. lg 0.300 in. dia center, 0.128 in. dia centrally located hole, 0.22 in. w o/a dim.	19905	A095	2	2
MP15	REEL, TAPE		SAME AS 4A4MP14	REF	REF
MP16	REEL, POST Brass, 0.124 in. dia, 0.280 in. lg, flange one end 0.187 in. dia o/a dim.	19905	A097	2	2
MP17	REEL, POST		SAME AS 4A4MP16	REF	REF
MP18	WASHER, FLAT Brass, 0.500 in. thk, 0.250 in. od, 0.125 in. id, o/a dim.	19905	A220	1	1
MP19	GUIDE, ROLLER Aluminum alloy, 0.310 in. dia, 0.690 in. lg center hole 0.140 in. dia o/a dim.	19905	A222-2	3	3
MP20	GUIDE, ROLLER		SAME AS 4A4MP19	REF	REF
MP21	GUIDE, ROLLER		SAME AS 4A4MP19	REF	REF
MP22	PIN, GROOVE, HD Brass, 0.124 in. dia, 0.720 in. lg, flange one end 0.180 in. dia, tapped 2-56 unc-2B on flanged end o/a dim.	19905	A223	3	3

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP23	PIN, GROOVE, HD		SAME AS 4A4MP22	REF	REF
MP24	PIN, GROOVE, HD		SAME AS 4A4MP22	REF	REF
MP25	BRACKET, LAMP Aluminum alloy, one leg 0.250 in. lg with two mtg holes 0.093 in. dia, other leg 0.437 in. dia, 0.620 in. w o/a dim.	19905	A236-2	1	1
MP26	SPACER Aluminum alloy, 0.560 in. thk, 0.444 in. od. 0.125 in. id o/a dim.	19905	A291-8	1	1
MP27	PIN, GROOVE, HDLS Steel, 0.124 in. dia, two grooves located 0.040 in. and 0.872 in. from one end, 1.410 in. lg o/a dim.	19905	A429	2	2
MP28	PIN, GROOVE, HDLS		SAME AS 4A4MP27	REF	REF
MP29	COVER, TAPE DECK Aluminum, 0.020 in. thk, 2.250 in. lg, 2.120 in. w o/a dim.	19905	A621-2	1	1
MP30	SHAFT, STRAIGHT Glass epoxy rod, 0.249 in. dia, both ends chamfer .01X45^{O}, 3.16 in. lg o/a dim.	19905	A624-3	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP31	BUSHING, SLEEVE Teflon, 0.105 in. thk, 0.250 in. od, 0.127 in. id, chamfer .015X45° o/a dim.	19905	A689	10	10
MP32	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP33	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP34	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP35	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP36	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP37	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP38	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP39	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP40	BUSHING, SLEEVE		SAME AS 4A4MP31	REF	REF
MP41	PLATE, GUIDE ROLLER Aluminum, 0.125 in. thk, 2.630 in. lg, 2.280 in. w o/a dim.	19905	B098-2	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP42	SPOOL, DRIVE Aluminum, 0.680 in. dia ends, 0.910 in. lg, 0.510 in. dia center, 0.190 in. dia hole entire length o/a dim.	19905	B523-2	2	2
MP43	SPOOL, DRIVE		SAME AS 4A4MP42	REF	REF
MP44	PLATE, GEAR Aluminum, 0.250 in. thk, 2.970 in. lg, 2.000 in. w o/a dim.	19905	C113-3	1	1
MP45	TERMFEEDTHRUINS Teflon insulation, 0.178 in. dia, brass terminals 0.040 in. dia, 0.515 in. lg o/a dim.	98291	FTSM1	1	1
MP46	SPG, SPIRAL, TOR CRES, 0.002 in. thk, 0.125 in. w, 40.00 in. lg, hole one end 0.062 in. dia o/a dim.	80545	N7443	2	2
MP47	SPG, SPIRAL, TOR		SAME AS 4A4MP46	REF	REF
MP48	BRG, BALLANNULAR CRES, 0.187 in. w, 0.500 in. od, 0.250 in. id, 8 balls, radial play .0001-.0005 o/a dim.	83086	SFR1883MM	3	3
MP49	BRG, BALLANNULAR		SAME AS 4A4MP48	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 4A4 GEAR TRAIN ASSY GT203-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP50	BRG, BALLANNULAR		SAME AS 4A4MP48	REF	REF
MP51	BRG, BALLANNULAR CRES, 0.156 in. w, 0.375 in. od, 0.125 in. id, 7 balls, radial play .0001-.0005 o/a dim.	83086	SFR23MM	4	4
MP52	BRG, BALLANNULAR		SAME AS 4A4MP51	REF	REF
MP53	BRG, BALLANNULAR		SAME AS 4A4MP51	REF	REF
MP54	BRG, BALLANNULAR		SAME AS 4A4MP51	REF	REF
MP55	STRAP, RETAINING Brass, 0.020 in. thk, 0.250 in. w, 0.440 in. lg, one mtg hole 0.120 in. dia o/a dim.	79963	116H.125	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5

TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUN. UNIT, RF	19905	TN-520/WRR	1	1
CR1	SEMICONDDEV, DIO Zener, 10 volts, 17 ohms max impedance, 20 ma max current, 2 axial wire lead terminals	81349	1N758A	1	1
DS1	LAMP, INCANDES Single contact midget flanged base, TI 3/4 bulb, 28v, 0.04 amp	96906	MS25237-327	1	1
P1	CONN, PLUG, ELEC Panel mount, glass filled diallyl phthalate insulator, non-magnetic base, gold plated contacts	71468	DCM25W3PNMB	1	1
R1	RESISTOR, VAR 250 ohms, ±10%, 2w	81349	RV4NAYSD251A	1	1
R2	RES., FIXED, COMP 1 K ohms, ±5%, 1/2w	81349	RC20GF102J	1	1
R3	RES., FIXED, COMP 270 ohms, ±5%, 1/4w	81349	RC07GF271J	1	1
XDS1	LAMPHOLDER Chassis mounting subminiature type for TI 3/4 incandescent lamp	72619	8-1930XP24	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5 TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Z1	DUMMY LOAD, ELEC 51 ohms, ±5%, 1/2w	95712	534-2	1	1
MP1	WINDOW, DIAL Plastic sheet, acrylic base, transparent, 1.68 in.lg, 0.06 in. thk, 0.50 in. h o/a dim. with engraved hair line	19905	A205	1	1
MP2	GEARSHAFT, SPUR Anodized aluminum gear, 185 teeth, 2.597 in. dia	19905	A206-5	1	1
MP3	KNOB Crank type, plastic, black, 0.252 in. dia shaft, 0.58 in. thk, 0.89 in. dia o/a dim.	19905	A281	1	1
MP4	DIAL, SCALE White background, black markings, 0.004 in. thk, 0.629 in. w, 31.448 in.lg. o/a dim.	19905	D327	1	1
MP5	KNOB Skirted round with dot, plastic, black, 0.250 in. dia shaft, 0.782 in. thk, 0.700 in. dia o/a dim	96906	MS91528-1E2B	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5 TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP6	SEAL SHAFT Gray silicone rubber boot, brass nut, 3/8-32thd size, 1/4 in. shaft size, 7/32 in. depth, 1/2 in. across flats o/a dim	97539	N9030-1-4	2	2
MP7	SEAL SHAFT		SAME AS 5MP6	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5 — TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W1	CABLE ASSY, SP, EL RG55/U coaxial cable, one end terminated with a 8205B plug, the other end with a MS35168-88F plug, 18 in. lg	19905	AC076-105-1	1	1
W1P1	CONN, PLUG, ELEC Bulkhead mounted push-on type, silver plated, beryllium copper contacts, teflon insulation	91737	8205B	1	1
W1P2	CONN, PLUG, ELEC BNC type, weatherproof, quick-disconnect	96906	MS35168-88F	1	4
W2	CABLE ASSY, SP, EL RG196/U coaxial cable, each end terminated with a 5116-037475 plug, 14.500 in. lg	19905	AC076-24-1	1	1
W2P1	CONN, PLUG, ELEC 50 ohm screw-on type, teflon insulated, gold plated male contacts	74868	5116-037475	2	5
W2P2	CONN, PLUG, ELEC		SAME AS 5W2P1	REF	REF
W3	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug, 8.500 in. lg	19905	AC801-3-1	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5 — TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W3P1	CONN, PLUG, ELEC		SAME AS 5W2P1	1	REF
W3P2	CONN, PLUG, ELEC Right angle solder type, gold over silver plated brass contact, nylon insulator	71468	DM53741-5000	1	3
W4	CABLE ASSY, SP, EL RG196/U coaxial cable, one end terminated with a 5116-037475 plug, the other end with a DM53741-5000 plug, 6.750 in. lg	19905	AC801-9-1	1	2
W4P1	CONN, PLUG, ELEC		SAME AS 5W2P1	1	REF
W4P2	CONN, PLUG, ELEC		SAME AS 5W3P2	1	REF
W5	CABLE ASSY, SP, EL		SAME AS 5W4	1	REF
W5P1	CONN, PLUG, ELEC		SAME AS 5W2P1	1	REF
W5P2	CONN, PLUG, ELEC		SAME AS 5W3P2	1	REF
W6	CABLE ASSY, SP, EL RG55/U coaxial cable, each end terminated with a MS35168-88F plug, 6.500 in. lg	19905	AC076-7-1	1	1
W6P1	CONN, PLUG, ELEC		SAME AS 5W1P2	2	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5

TUNING UNIT, RADIO FREQUENCY TN-520/WRR

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
W6P2	CONN, PLUG, ELEC		SAME AS 5W1P2	REF	REF
W7	CABLE ASSY, SP EL RG55/U coaxial cable, one end terminated with a UG909/U receptacle, the other end with a MS35168-88F plug, 6.250 in. lg	19905	AC076-106-1	1	1
W7J1	CONN, RECP, ELEC Quick connect and disconnect bulkhead type, weatherproof, 50 ohm impedance	81349	UG909/U	1	1
W7P1	CONN, PLUG, ELEC		SAME AS 5W1P2	1	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNER, RF	19905	SH204-5	1	1
C1	CAP., VAR, AIR DL Carbon steel rod with copper blades, 10 blades spaced along a 0.250 in. dia rod 3.660 in. lg	19905	AC390	1	1
C2	CAP., VAR, AIR DL Copper sheet 0.03 in. thk, 0.16 in. w, 0.56 in. lg, 90° bend one end 0.16 in. lg.	19905	SA180	4	4
C3	CAP., VAR, AIR DL		SAME AS 5A1C2	REF	REF
C4	CAP., VAR, AIR DL		SAME AS 5A1C2	REF	REF
C5	CAP., VAR, AIR DL		SAME AS 5A1C2	REF	REF
C6	CAP., VAR, AIR DL Brass, silver plate, 0.380 in. dia, 0.375 in. lg	19905	A195	1	1
C7	CAP., FXD, CER DL 470 pf, ±20%, 500 vdc	01121	FA5C4712	1	1
C8	CAP., FXD, CER DL 470 pf, ±20%, 500 vdc	01121	SS5A4712	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C9	CAP., VAR, AIR DL Carbon steel rod threaded 6-32NC2B with a ceramic dielectric base internally threaded 6-32 NC 2B, 0.220 in. dia, 0.500 in. lg	19905	SA196	1	1
C10	CAP., FXD, PL DL Brass sheet 0.032 in. thk, 0.440 in. w, 0.500 in. lg, 90^{0} bend one end 0.180 in. lg, soldered to the brass sheet is a piece of glass filled teflon with copper on each side 0.500 in. square	19905	AB531-1	1	1
C11	CAP., FXD, MICADL 15 pf, ±10%, 500 vdcw	81349	CB11RD150K	1	1
C12	CAP., FXD, CER DL 1000 pf, ±20%, 1000vdc	81349	CK60AW102M	5	14
C13	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C14	CAP., FXD, CER DL 1000 pf, GMV	01121	SS5A102W	1	8
C15	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C16	CAP., FXD, MICADL 22 uf, ±5%, 500vdcw	81349	CM05E220J03	1	3

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C17	CAP., FXD, MICADL 3.3 pf, ±10%, 500 vdcw	95121	MC3.3	1	1
C18	CAP., FXD, MICADL 33 pf, ±5%, 500vdcw	81349	CM05E330J03	1	1
C19	CAP., FXD, MICADL 120 pf, ±5%, 500vdcw	81349	CM05F121J03	1	2
C20	CAP., FXD, CER DL 1000 pf, GMV	01121	FA5C102W	3	14
C21	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C22	CAP., FXD, MICADL 56 pf, ±5%, 500vdcw	81349	CM05E560J03	1	1
C23	NOT USED				
C24	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C25	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C26	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
CR1	SEMICONDDEV, DIO Silicon, 3 volts reverse working, 10-25 ma average forward current	81349	1N82A	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
J1	CONN, RECP, ELEC Angle type, teflon insulation, female contacts	81349	UG535/U	1	1
J2	CONN, RECP, ELEC 50 ohms, screw on type, teflon insulation, gold plated female contacts	74868	5116-058350	1	5
J3	JACK, TIP Nickel plated brass, phenolic insulated two conductor closed circuit type, 0.312 in. dia, 0.516 in. lg	82389	TR2A	1	1
J4	CONN, RECP, ELEC Panel type, rexolite insulation, female contacts	81349	UG185/U	1	1
L1	COIL, RF One piece of no. 16 awg wire 2.50 in. lg, .066 uh	19905	B045-3	1	2
L2	COIL, RF Steel 0.032 in. thk, formed in the shape of a U, 0.500 in. w, 2.500 in. lg	19905	A164	4	4
L3	COIL, RF		SAME AS 5A1L2	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L4	COIL, RF		SAME AS 5A1L2	REF	REF
L5	COIL, RF		SAME AS 5A1L2	REF	REF
L6	COIL, RF One piece of no. 20 awg wire 2 in. lg, .058 uh	19905	B045-4	1	1
L7	COIL, RF Steel 0.032 in. thk, one straight piece of metal with a second piece soldered on the end formed in the shape of a U, 0.220 in. w, 2.170 in. lg	19905	A165	1	1
L8	COIL, RF 34 turns no. 34 awg wire closewound on a composition resistor, .6 uh	19905	AB539-1	1	1
L9	COIL, RF 5 turns no. 26 awg wire closewound, .14 uh	19905	B516-3	1	1
L10	COIL, RF Max ind 0.16 uh, min ind 0.13 uh, 4 turns no. 30 awg wire closewound on a molded powered iron core	19905	AB532-1	1	1
L11	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L12	COIL, RF Max ind 0.360 uh, min ind 0.260 uh, 8 turns no. 30 awg wire closewound on a molded powered iron core	19905	AB537	2	2
L13	COIL, RF		SAME AS 5A1L12	REF	REF
L14	COIL, RF 3 turns no. 26 awg wire closewound, .11 uh	19905	B516-4	2	2
L15	COIL, RF One piece of copper wire, uninsulated tin plated, 0.620 in. lg, .023 uh	19905	A262	1	1
L16	COIL, RF		SAME AS 5A1L14	REF	REF
Q1	TRANSISTOR NPN, silicon type, 3 radial wire lead terminals	20754	K2501	1	1
Q2	TRANSISTOR Small signal NPN, silicon type, 3 radial wire lead terminals	20754	2N2857	1	2
Q3	TRANSISTOR NPN, silicon type, 4 radial wire lead terminals	19905	A395	1	4

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF SH204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RES., FIXED, COMP 6.8 K ohms, ±5%, 1/4w	81349	RC07GF682J	2	2
R2	RES., FIXED, COMP 4.7 K ohms, ±5%, 1/4w	81349	RC07GF472J	1	3
R3	RES., FIXED, COMP		SAME AS 5A1R1	REF	REF
R4	RES., FIXED, COMP 560 ohms,±5%, 1/4w	81349	RC07GF561J	1	1
R5	RES., FIXED, COMP 2.2 K ohms, ±5%, 1/4w	81349	RC07GF222J	2	4
R6	RES., FIXED, COMP 2.7 K ohms, ±5%, 1/4w	81349	RC07GF272J	1	3
R7	RES., FIXED, COMP		SAME AS 5A1R5	REF	REF
R8	RES., FIXED, COMP 1.5 K ohms, ±5%, 1/4w	81349	RC07GF152J	1	2
R9	RES., FIXED, COMP 100 ohms, ±5%, 1/4w	81349	RC07GF101J	2	4
R10	RES., FIXED, COMP 1 K ohms, ±5%, 1/4w	81349	RC07GF102J	1	9

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A1 TUNER, RF 3H204-5

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R11	RES., FIXED, COMP		SAME AS 5A1R9	REF	REF
R12	RES., FIXED, COMP 22ohms, ±5%, 1/4w	81349	RC07GF220J	1	1
MP1	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk	17069	88001	2	10
MP2	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CONVERTER	19905	CV205-1	1	1
C1	CAP., FXD, CER DL		SAME AS 5A1C12	8	REF
C2	CAP., FXD, CER DL		SAME AS 5A1C14	6	REF
C3	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C4	CAP., FXD, CER DL		SAME AS 5A1C14	REF	REF
C5	CAP., FXD, MICADL		SAME AS 5A1C16	2	REF
C6	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C7	CAP., FXD, MICADL 1.2 pf, ±10%, 500 vdcw	95121	MC1.2	1	1
C8	CAP., FXD, MICADL 27 pf, ±5%, 500 vdcw	81349	CM05E270J03	1	1
C9	CAP., FXD, MICADL 1.0 pf, ±10%, 500vdcw	95121	MC1.0	1	1
C10	CAP., FXD, CER DL 6 pf,±.25 pf, NPO ±60 ppm	81349	CC20CH060C	1	1
C11	CAP., FXD, CER DL		SAME AS 5A1C14	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C12	CAP., FXD, CER DL 4.7 pf,±.25 pf, NPO ± 60 ppm	81349	CC20CH4R7C	1	1
C13	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C14	CAP., FXD, CER DL 8.2 pf, ±.25 pf, NPO ± 60 ppm	81349	CC20CH8R2C	2	2
C15	CAP., FXD, MICADL 15 pf, ±5%, 500vdcw	81349	CM05C150J03	2	2
C16	CAP., FXD, MICADL 100 pf, ±5%, 500 vdcw	81349	CM05F101J03	1	1
C17	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C18	CAP., FXD, CER DL		SAME AS 5A1C14	REF	REF
C19	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C20	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
C21	CAP., FXD, MICADL		SAME AS 5A2C15	REF	REF
C22	CAP., FXD, MICADL 1.5 pf, ±10%, 500vdcw	95121	MC1.5	1	2

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C23	CAP.,FXD, MICADL		SAME AS 5A1C16	REF	REF
C24	CAP., FXD, MICADL		SAME AS 5A1C19	1	REF
C25	CAP., FXD, MICADL 12 pf, ±5%, 500vdcw	81349	CM05C120J03	2	2
C26	CAP., FXD, MICADL 10 pf, ±5%, 500vdcw	81349	CM05C100J03	2	2
C27	CAP., FXD, MICADL		SAME AS 5A2C25	REF	REF
C28	CAP., FXD, CER DL		SAME AS 5A1C20	9	REF
C29	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C30	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C31	NOT USED				
C32	CAP., FXD, CER DL		SAME AS 5A2C14	REF	REF
C33	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C34	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C35	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C36	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C37	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C38	CAP., FXD, CER DL		SAME AS 5A1C20	REF	REF
C39	CAP., FXD, CER DL		SAME AS 5A1C14	REF	REF
C40	CAP., FXD, CER DL		SAME AS 5A1C14	REF	REF
C41	CAP., FXD, MICADL		SAME AS 5A2C26	REF	REF
C42	CAP., FXD, MICADL 18 pf, ±5%, 500vdcw	81349	CM05C180J03	1	1
C43	CAP., FXD, CER DL		SAME AS 5A1C12	REF	REF
CR1	SEMICONDDEV, DIO Zener, 3.9 volts, 23 ohms max impedance, 20 ma max current, 2 axial wire lead terminals	81349	1N748A	1	1
CR2	SEMICONDDEV, DIO Silicon, 50PIV, 2 axial wire lead terminals	81349	1N3064	2	2
CR3	SEMICONDDEV, DIO		SAME AS 5A2CR2	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
J1	CONN, RECP, ELEC		SAME AS 5A1J2	4	REF
J2	CONN, RECP, ELEC		SAME AS 5A1J2	REF	REF
J3	CONN, RECP, ELEC		SAME AS 5A1J2	REF	REF
J4	CONN, RECP, ELEC		SAME AS 5A1J2	REF	REF
L1	COIL, RF Max ind 0.30 uh, min ind 0.18 uh, 4 turns no. 27 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-0-1	2	2
L2	COIL, RF		SAME AS 5A2L1	REF	REF
L3	COIL, RF Max ind 3.5 uh, min ind 1.7 uh, 18 turns no. 34 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-3-1	4	4
L4	COIL, RF		SAME AS 5A2L3	REF	REF
L5	COIL, RF		SAME AS 5A2L3	REF	REF
L6	COIL, RF		SAME AS 5A2L3	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L7	COIL, RF Max ind 0.55 uh, min ind 0.28 uh, 6 turns no.27 awg wire closewound on CTC coil form 2455-3-1	19905	AC184-11-1	1	1
L8	NOT USED				
L9	COIL, RF Ind 2.2 uh, ±10%, Q min 30, min self-resonant freq 140 mc, max DC resistance 0.970 ohms	96906	MS75008-32	2	2
L10	COIL, RF		SAME AS 5A2L9	REF	REF
L11	COIL, RF Ind 3.3 uh, ±10%, Q min 30, min self-resonant freq 70 mc, max DC resistance 0.140 ohms	96906	MS75008-34	1	1
Q1	TRANSISTOR NPN, triode, 4 radial wire lead terminals	07263	2N3337	2	2
Q2	TRANSISTOR		SAME AS 5A1Q3	3	REF
Q3	TRANSISTOR Planar field-effect, silicon, 4 radial wire lead terminals	01295	2N3823	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
Q4	TRANSISTOR NPN, silicon, 3 radial wire lead terminals	81349	2N918	1	1
Q5	TRANSISTOR		SAME AS 5A2Q1	REF	REF
Q6	TRANSISTOR		SAME AS 5A1Q3	REF	REF
Q7	TRANSISTOR		SAME AS 5A1Q3	REF	REF
R1	RES., FIXED, COMP 330 ohms, ±5%, 1/4w	81349	RC07GF331J	2	2
R2	RES., FIXED, COMP 18 ohms, ±5%, 1/4w	81349	RC07GF180J	1	2
R3	RES., FIXED, COMP		SAME AS 5A2R1	REF	REF
R4	RES., FIXED, COMP		SAME AS 5A1R5	2	REF
R5	RES., FIXED, COMP		SAME AS 5A1R6	2	REF
R6	RES., FIXED, COMP		SAME AS 5A1R10	7	REF
R7	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R8	RES., FIXED, COMP	81349	RC07GF562J	2	2
R9	NOT USED				

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R10	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R11	RES., FIXED, COMP 22 K ohms, ±5%, 1/4w	81349	RC07GF223J	1	1
R12	RES., FIXED, COMP 3.3 K ohms, ±5%, 1/4w	81349	RC07GF332J	3	3
R13	RESISTOR, VAR 1 K ohm, ±10%, 1/2w	81349	RV6LAYSA102A	1	1
R14	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R15	RES., FIXED, COMP 10 ohms, ±5%, 1/4w	81349	RC07GF100J	1	1
R16	NOT USED				
R17	RES., FIXED, COMP		SAME AS 5A1R9	2	REF
R18	RES., FIXED, COMP 150 ohms, ±5%, 1/4w	81349	RC07GF151J	1	3
R19	RES., FIXED, COMP 12 K ohms, ±5%, 1/4w	81349	RC07GF123J	1	1
R20	RES., FIXED, COMP		SAME AS 5A1R6	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R21	RES., FIXED, COMP		SAME AS 5A1R9	REF	REF
R22	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R23	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R24	RES., FIXED, COMP		SAME AS 5A2R8	REF	REF
R25	RES., FIXED, COMP		SAME AS 5A2R12	REF	REF
R26	RES., FIXED, COMP 820 ohms, ±5%, 1/4w	81349	RC07GF821J	1	1
R27	RES., FIXED, COMP 10 K ohms, ±5%, 1/4w	81349	RC07GF103J	1	3
R28	RES., FIXED, COMP		SAME AS 5A1R8	1	REF
R29	RES., FIXED, COMP		SAME AS 5A1R10	REF	REF
R30	RES., FIXED, COMP		SAME AS 5A2R12	REF	REF
R31	RES., FIXED, COMP		SAME AS 5A1R2	2	REF
R32	RES., FIXED, COMP		SAME AS 5A1R5	REF	REF
R33	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A2 CONVERTER CV205-1

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R34	RES., FIXED, COMP		SAME AS 5A1R2	REF	REF
MP1	INSULATOR, DISK		SAME AS 5A1MP1	7	REF
MP2	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF
MP4	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF
MP5	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF
MP6	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF
MP7	INSULATOR, DISK		SAME AS 5A1MP1	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A3 AMPLIFIER, ISOLATION ISA202

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPL, ISOLATION	19905	ISA202	1	1
C1	CAP., FXD, CER DL 1.0 pf, ±.25 pf, NPO ±250 ppm	81349	CC20CK010C	1	1
C2	CAP., FXD, CER DL		SAME AS 5A1C12	1	REF
C3	CAP., FXD, CER DL		SAME AS 5A1C14	1	REF
C4	CAP., FXD, CER DL		SAME AS 5A1C20	1	REF
C5	CAP., FXD, MICADL		SAME AS 5A2C22	1	REF
J1	CONN, RECP, ELEC BNC, bulkhead mounted, silver plated, beryllium copper contacts, teflon insulation	81349	UG1094A/U	2	2
J2	CONN, RECP, ELEC		SAME AS 5A3J1	REF	REF
L1	COIL, RF One piece of no. 16 awg wire 1.25 in. lg, .029 uh	19905	B045-12	1	1
L2	COIL, RF		SAME AS 5A1L1	1	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A3 AMPLIFIER, ISOLATION ISA202

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L3	COIL, RF 6 turns no. 24 awg wire closewound, .093 uh	19905	A107-43-1	1	1
Q1	TRANSISTOR		SAME AS 5A1Q2	1	REF
R1	RES., FIXED, COMP		SAME AS 5A2R18	2	REF
R2	RES., FIXED, COMP		SAME AS 5A2R2	1	REF
R3	RES., FIXED, COMP		SAME AS 5A2R18	REF	REF
R4	RES., FIXED, COMP		SAME AS 5A2R27	2	REF
R5	RES., FIXED, COMP		SAME AS 5A2R27	REF	REF
R6	RES., FIXED, COMP		SAME AS 5A1R10	1	REF
R7	RES., FIXED, COMP 1.8 K ohms, ±5%, 1/4w	81349	RC07GF182J	1	1
MP1	INSULATOR, DISK		SAME AS 5A1MP1	1	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	GEAR TRAIN ASSY Mechanical linkage for tuner and tape drive assembly	19905	GT204-4	1	1
MP1	BUSHING, ASSY Aluminum, 0.125 in. thk, 1.250 in. w, 1.780 in. h, with two retainers, 0.440 in. dia pressed fitted on plate o/a dim	19905	AB1108-2	1	1
MP2	SPROCKET ASSY Modified sprocket with a tape retainer press fitted	19905	AB522-2	1	1
MP3	DISK, CLUTCH Brass hub, 0.500 in. dia with two holes 4-40 unc-2B mated with a disk 1.235 in. dia o/a dim.	19905	AB525-2	1	1
MP4	COLLAR, SHAFT Brass, 0.14 in. thk, 0.500 in. od, 0.250 in. id, 2 holes drilled 4-40 unc-2B o/a dim.	19905	A018	2	2
MP5	COLLAR, SHAFT		SAME AS 5A4MP4	REF	REF
MP6	WASHER, BEVEL CRES sheet type 302, 0.090 in. thk, 0.620 in. od, 0.254 in. id o/a dim.	19905	A063	2	2

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP7	WASHER, BEVEL		SAME AS 5A4MP6	REF	REF
MP8	HOUSING, GEAR Aluminum alloy plate, "C" shaped, two legs 0.666 in. lg with one 0.3750 in. dia hole each leg, 0.500 in. w, 1.112 in. lg o/a dim.	19905	A078-2	1	1
MP9	GEAR ASSY, SPUR Hub type gear spur with a straight headless pin attached, 2.030 in. lg o/a dim	19905	A079-1	1	1
MP10	HOUSING, BEARING Aluminum alloy, 0.620 in. lg, 0.060 in. thk shoulder with two mtg holes 0.104 in. dia one centrally located hole 0.500 in. dia o/a dim.	19905	A080-2	1	1
MP11	GEAR, BEVEL Brass, modified 0.312 in. dia with two holes 4-40 unc-2B o/a dim.	19905	A082	2	2
MP12	GEAR, BEVEL		SAME AS 5A4MP11	REF	REF
MP13	PIN, STR, HDLS CRES type 303, 0.124 in. dia, 1.810 in. lg, both ends chamfer .01X45° o/a dim.	19905	A093-2	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP14	REEL, TAPE Teflon, 0.500 in. dia ends, 0.030 in. lg 0.300 in. dia center, 0.128 in. dia centrally located hole, 0.22 in. w o/a dim.	19905	A095	2	2
MP15	REEL, TAPE		SAME AS 5A4MP14	REF	REF
MP16	REEL, POST Brass, 0.124 in. dia, 0.280 in. lg, flange one end 0.187 in. dia o/a dim.	19905	A097	2	2
MP17	REEL, POST		SAME AS 5A4MP16	REF	REF
MP18	WASHER, FLAT Brass, 0.500 in. thk, 0.250 in. od, 0.125 in. id, o/a dim.	19905	A220	1	1
MP19	GUIDE, ROLLER Aluminum alloy, 0.310 in. dia, 0.690 in. lg center hole 0.140 in. dia o/a dim.	19905	A222-2	3	3
MP20	GUIDE, ROLLER		SAME AS 5A4MP19	REF	REF
MP21	GUIDE, ROLLER		SAME AS 5A4MP19	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP22	PIN, GROOVE, HD Brass, 0.124 in. dia, 0.720 in. lg, flange one end 0.180 in. dia, tapped 2-56 unc-2B on flanged end o/a dim.	19905	A223	3	3
MP23	PIN, GROOVE, HD		SAME AS 5A4MP22	REF	REF
MP24	PIN, GROOVE, HD		SAME AS 5A4MP22	REF	REF
MP25	BRACKET, LAMP Aluminum alloy, one leg 0.250 in. lg with two mtg holes 0.093 in. dia, other leg 0.437 in. dia, 0.620 in. w o/a dim.	19905	A236-2	1	1
MP26	SPACER Aluminum alloy, 0.548 in. thk, 0.444 in. od, 0.125 in. id o/a dim.	19905	A291-7	1	1
MP27	PIN, GROOVE, HDLS Steel, 0.124 in. dia, two grooves located 0.040 in. and 0.872 in. from one end, 1.410 in. lg o/a dim.	19905	A429	2	2
MP28	PIN, GROOVE, HDLS		SAME AS 5A4MP27	REF	REF
MP29	COVER, TAPE DECK Aluminum, 0.020 in. thk, 2.800 in. lg, 2.620 in. w o/a dim.	19905	A620-2	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP30	SHAFT, STRAIGHT Glass epoxy rod, 0.249 in. dia, both ends chamfer .01X45^{O} , 3.45 in. lg o/a dim.	19905	A624-2	1	1
MP31	BUSHING, SLEEVE Teflon, 0.105 in. thk, 0.250 in. od, 0.127 in. id, chamfer .015X45^{O} o/a dim.	19905	A689	10	10
MP32	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP33	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP34	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP35	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP36	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP37	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP38	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP39	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF
MP40	BUSHING, SLEEVE		SAME AS 5A4MP31	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP41	PLATE, GUIDE ROLLER Aluminum, 0.250 in. thk, 2.890 in. lg, 2.530 in. w	19905	B099-4	1	1
MP42	SPOOL, DRIVE Aluminum, 0.680 in. dia ends, 0.910 in. lg, 0.510 in. dia center, 0.190 in. dia hole entire length o/a dim.	19905	B523-2	2	2
MP43	SPOOL, DRIVE		SAME AS 5A4MP42	REF	REF
MP44	PLATE, GEAR Aluminum, 0.250 in. thk, 4.280 in. lg, 2.000 in. w o/a dim.	19905	C114-2	1	1
MP45	TERMFEEDTHRUINS Teflon insulation, 0.178 in. dia, brass terminals 0.040 in. dia, 0.515 in. lg o/a dim.	98291	FTSM1	1	1
MP46	SPG, SPIRAL, TOR CRES, 0.002 in. thk, 0.125 in. w, 40.00 in. lg, hole one end 0.062 in. dia o/a dim.	80545	N7443	2	2
MP47	SPG, SPIRAL, TOR		SAME AS 5A4MP46	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 5A4 GEAR TRAIN ASSY GT204-4

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP48	BRG, BALLANNULAR CRES, 0.187 in. w, 0.500 in. od, 0.250 in. id, 8 balls, radial play .0001-.0005 o/a dim.	83086	SFR1883MM	3	3
MP49	BRG, BALLANNULAR		SAME AS 5A4MP48	REF	REF
MP50	BRG, BALLANNULAR		SAME AS 5A4MP48	REF	REF
MP51	BRG, BALLANNULAR CRES, 0.156 in. w, 0.375 in. od, 0.125 in. id, 7 balls, radial play .0001-.0005 o/a dim.	83086	SFR23MM	4	4
MP52	BRG, BALLANNULAR		SAME AS 5A4MP51	REF	REF
MP53	BRG, BALLANNULAR		SAME AS 5A4MP51	REF	REF
MP54	BRG, BALLANNULAR		SAME AS 5A4MP51	REF	REF
MP55	STRAP, RETAINING Brass, 0.020 in. thk, 0.250 in. w, 0.440 in. lg, one mtg hole 0.120 in. dia o/a dim.	79963	116H.125	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	AMPLIFIER, IF	19905	IF212-500	1	1
C1	CAP., FXD, CER DL 1000 pf, ±20%, 1000 vdcw	81349	CK60AW102M	2	2
C2	CAP., FXD, CER DL 0.01 uf, +80% -20%, 50vdcw	56289	19C214	24	24
C3	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C4	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C5	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C6	CAP., FXD, MICADL 15 pf,±5%, 500 vdcw	84171	DM10-150J	6	6
C7	CAP., FXD, MICADL 0.22 pf, ±10%, 500 vdcw	95121	MC0.22	1	1
C8	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C9	CAP., FXD, MICADL		SAME AS 1A4C6	REF	REF
C10	CAP., FXD, MICADL 150 pf, ±5%, 500 vdcw	84171	DM10-151J	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C11	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C12	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C13	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C14	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C15	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C16	CAP., FXD, MICADL		SAME AS 1A4C6	REF	REF
C17	CAP., FXD, MICADL 0.75 pf, ±10%, 500 vdcw	95121	MC0.75	1	1
C18	CAP., FXD, MICADL		SAME AS 1A4C6	REF	REF
C19	CAP., FXD, MICADL 220 pf, ±5%, 500 vdcw	84171	DM10-221J	1	1
C20	CAP., FXD, MICADL 33 pf, ±5%, 500 vdcw	84171	DM10-330J	1	1
C21	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C22	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C23	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C24	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C25	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C26	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C27	CAP., FXD, MICADL 4.7 pf, ±10%, 500 vdcw	95121	MC4.7	1	1
C28	CAP., FXD, CER DL 8.2 pf, ±.25 pf, NPO ±60 ppm	81349	CC20CH8R2C	1	1
C29	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C30	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C31	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C32	CAP., FXD, MICADL 12 pf, ±5%, 500 vdcw	84171	DM10-120J	1	1
C33	CAP., FXD, CER DL		SAME AS 1A4C1	REF	REF
C34	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
C35	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C36	CAP., FXD, MICADL 1.5 pf, ±10%, 500 vdcw	95121	MC1.5	2	2
C37	CAP., FXD, MICADL		SAME AS 1A4C36	REF	REF
C38	CAP., FXD, MICADL		SAME AS 1A4C6	REF	REF
C39	CAP., FXD, MICADL		SAME AS 1A4C6	REF	REF
C40	CAP., FXD, MICADL 82 pf, ±5%, 500 vdcw	84171	DM10-820J	2	2
C41	CAP., FXD, MICADL		SAME AS 1A4C40	REF	REF
C42	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C43	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
C44	CAP., FXD, CER DL		SAME AS 1A4C2	REF	REF
CR1	SEMICONDDEV, DIO Germanium, 100 PIV, 2 axial wire lead terminals	81349	JAN1N933	3	3
CR2	SEMICONDDEV, DIO		SAME AS 1A4CR1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
CR3	SEMICONDDEV, DIO		SAME AS 1A4CR1	REF	REF
L1	COIL, RF Max ind 4 uh, min ind 1.7 uh, Q max 85, min 50, 19 turns no. 34 awg wire closewound on nylon bobbin	19905	AC257-3-1	8	8
L2	COIL, RF		SAME AS 1A4L1	REF	REF
L3	COIL, RF		SAME AS 1A4L1	REF	REF
L4	COIL, RF		SAME AS 1A4L1	REF	REF
L5	COIL, RF Ind 5.6 uh, ±10%, Q min 30, min self-resonant freq 50 mc, max DC resistance 0.280 ohms	96906	MS75008-37	1	1
L6	COIL, RF		SAME AS 1A4L1	REF	REF
L7	COIL, RF Ind 12 uh, ±10%, Q min 50, min self-resonant freq 36 mc, max DC resistance 1.05 ohms	96906	MS75008-41	3	3
L8	COIL, RF		SAME AS 1A4L1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
L9	COIL, RF		SAME AS 1A4L7	REF	REF
L10	COIL, RF		SAME AS 1A4L1	REF	REF
L11	COIL, RF		SAME AS 1A4L1	REF	REF
L12	COIL, RF		SAME AS 1A4L7	REF	REF
Q1	TRANSISTOR NPN, silicon, 4 radial wire lead terminals	19905	A395	10	10
Q2	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q3	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q4	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q5	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q6	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q7	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q8	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q9	TRANSISTOR		SAME AS 1A4Q1	REF	REF
Q10	TRANSISTOR		SAME AS 1A4Q1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R1	RES., FIXED, COMP 100 ohms, ±5%, 1/4w	81349	RC07GF101J	16	16
R2	RES., FIXED, COMP 68 ohms, ±5%, 1/4w	81349	RC07GF680J	1	1
R3	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R4	RES., FIXED, COMP 10 K ohms, ±5%, 1/4w	81349	RC07GF103J	6	6
R5	RES., FIXED, COMP		SAME AS 1A4R4	REF	REF
R6	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R7	RES., FIXED, COMP 47 ohms, ±5%, 1/4w	81349	RC07GF470J	1	1
R8	RES., FIXED, COMP 2.2 K ohms, ±5%, 1/4w	81349	RC07GF222J	3	3
R9	RES., FIXED, COMP 1 K ohms, ±5%, 1/4w	81349	RC07GF102J	1	1
R10	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R11	NOT USED				

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R12	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R13	RES., FIXED, COMP 150 ohms, ±5%, 1/4w	81349	RC07GF151J	1	1
R14	RES., FIXED, COMP		SAME AS 1A4R4	REF	REF
R15	RES., FIXED, COMP		SAME AS 1A4R4	REF	REF
R16	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R17	RES., FIXED, COMP 22 ohms, ±5%, 1/4w	81349	RC07GF220J	1	1
R18	RES., FIXED, COMP 1.5 K ohms, ±5%, 1/4w	81349	RC07GF152J	1	1
R19	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R20	RES., FIXED, COMP 270 ohms, ±5%, 1/4w	81349	RC07GF271J	1	1
R21	NOT USED				
R22	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R23	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R24	RES., FIXED, COMP 33 K ohms, ±5%, 1/4w	81349	RC07GF333J	1	1
R25	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R26	RES., FIXED, COMP		SAME AS 1A4R4	REF	REF
R27	RES., FIXED, COMP 220 ohms, ±5%, 1/4w	81349	RC07GF221J	1	1
R28	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R29	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R30	RES., FIXED, COMP 4.7 K ohms, ±5%, 1/4w	81349	RC07GF472J	3	3
R31	RES., FIXED, COMP 22 K ohms, ±5%, 1/4w	81349	RC07GF223J	3	3
R32	RES., FIXED, COMP		SAME AS 1A4R8	REF	REF
R33	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R34	RES., FIXED, COMP 1.8 K ohms, ±5%, 1/4w	81349	RC07GF182J	1	1

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R35	RES., FIXED, COMP		SAME AS 1A4R4	REF	REF
R36	RES., FIXED, COMP 560 ohms, ±5%, 1/4w	81349	RC07GF561J	1	1
R37	RES., FIXED, COMP		SAME AS 1A4R30	REF	REF
R38	RES., FIXED, COMP		SAME AS 1A4R31	REF	REF
R39	RES., FIXED, COMP		SAME AS 1A4R8	REF	REF
R40	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R41	RES., FIXED, COMP		SAME AS 1A4R31	REF	REF
R42	RES., FIXED, COMP 680 ohms, ±5%, 1/4w	81349	RC07GF681J	1	1
R43	RES., FIXED, COMP 470 ohms, ±5%, 1/4w	81349	RC07GF471J	1	1
R44	NOT USED				
R45	NOT USED				
R46	RES., FIXED, COMP 47 K ohms, ±5%, 1/4w	81349	RC07GF473J	2	2

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
R47	RES., FIXED, COMP		SAME AS 1A4R46	REF	REF
R48	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
R49	RES., FIXED, COMP .33 Meg ohms, ±5%, 1/4w	81349	RC07GF334J	1	1
R50	RES., FIXED, COMP		SAME AS 1A4R30	REF	REF
R51	RES., FIXED, COMP		SAME AS 1A4R1	REF	REF
MP1	INSULATOR, DISK Nylon, 0.230 in. dia, 0.080 in. thk	17069	88001	10	10
MP2	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP3	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP4	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP5	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP6	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP7	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP8	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF

SYMBOL NO. PREFIX OR
UNIT NOMENCLATURE 1A4 AMPLIFIER, IF IF212-500

REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
MP9	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF
MP10	INSULATOR, DISK		SAME AS 1A4MP1	REF	REF

3. Manufacturers List.

Manufacturer	Code Number
Aiken Industries Inc. Astro Communication Lab. Div. 801 Gaither Road Gaithersburg, Maryland 20760	19905
Allen-Bradley Co. 1201 South 2nd Street Milwaukee, Wisconsin 53204	01121
Amphenal Corp. Amphenal R F Division 33 East Franklin Street Danbury, Connecticut 06810	74868
Amtek Inc. Hunter Spring Div. 1 Spring Avenue Harfield, Pennsylvania 19440	80545
A P M-Hex Seal Corp. 41 Honeck Street P.O. Box 707 Englewood, New Jersey 06731	97539
Arco Electronics Inc. Community Dr. Great Neck, New York 11022	84171
Circuit Structures Lab. 3200 N. San Fernando Blvd. Burbank, California 91504	17069
Dage Electric Co. Inc. Hurricane Road Franklin, Indiana 46131	95712
Dialight Corporation 60 Stewart Avenue Brooklyn, New York 11200	72619

3. Manufacturers List (Cont.)

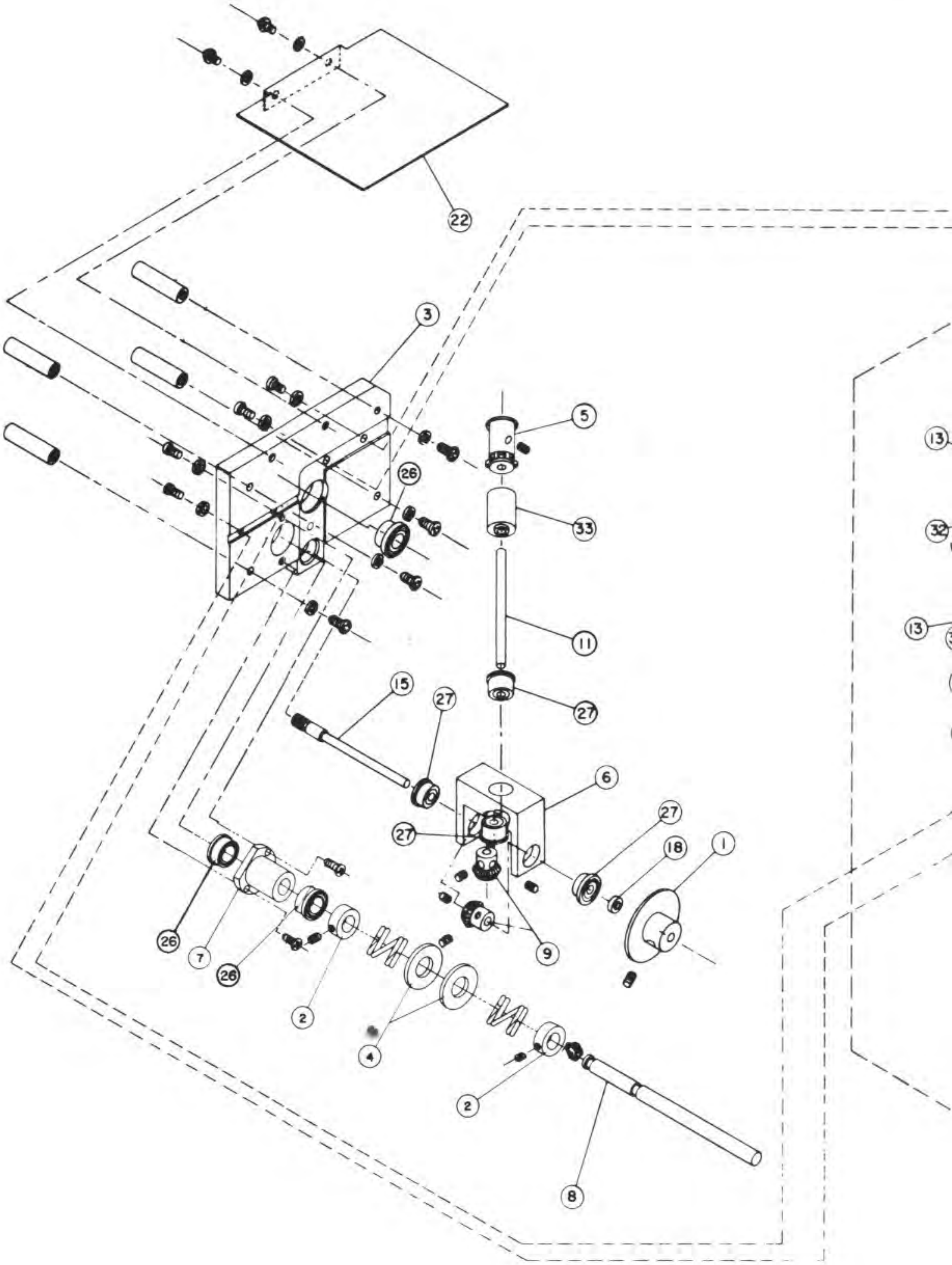
Manufacturer	Code Number
Fairchild Camera & Instrument Corp Semiconductor Division 313 Frontage Road Mountain View, California 94040	07263
Greman Mfg. Co. Inc. 7 North Avenue Wakefield, Massachusetts 01880	91737
International Electronic Research Corp. 135 West Magnolia Avenue Burbank, California 91502	98978
ITT Cannon Electric Inc. 3208 Humbolt Street Los Angeles, California 90031	71468
KMC Semiconductor Corp. Parker Road Long Valley, New Jersey 07853	20754
Military Specification	81349
Military Standards	96906
New Hampshire Ball Bearing Inc. Peterborough, New Hampshire 03458	83086
Quality Components Inc. P.O. Box 113 St. Marys, Pennsylvania 15857	95121
Sealectro Corp. 225 Hoyt Mamaroneck, New York 10544	98291
Sprague Electric Co. North Adams, Massachusetts 01247	56289
Switchcraft Inc. 5527 N. Elston Avenue Chicago, Illinois 60630	82389

3. Manufacturers List (Cont.)

Manufacturer	Code Num c
Texas Instruments, Inc. Semiconductor-Components Division Dallas, Texas 75231	01295
Zierick Mfg. Corp. 83 Rockdale Avenue New Rochelle, New York 10802	79963

SECTION VII

ILLUSTRATIONS AND SCHEMATICS



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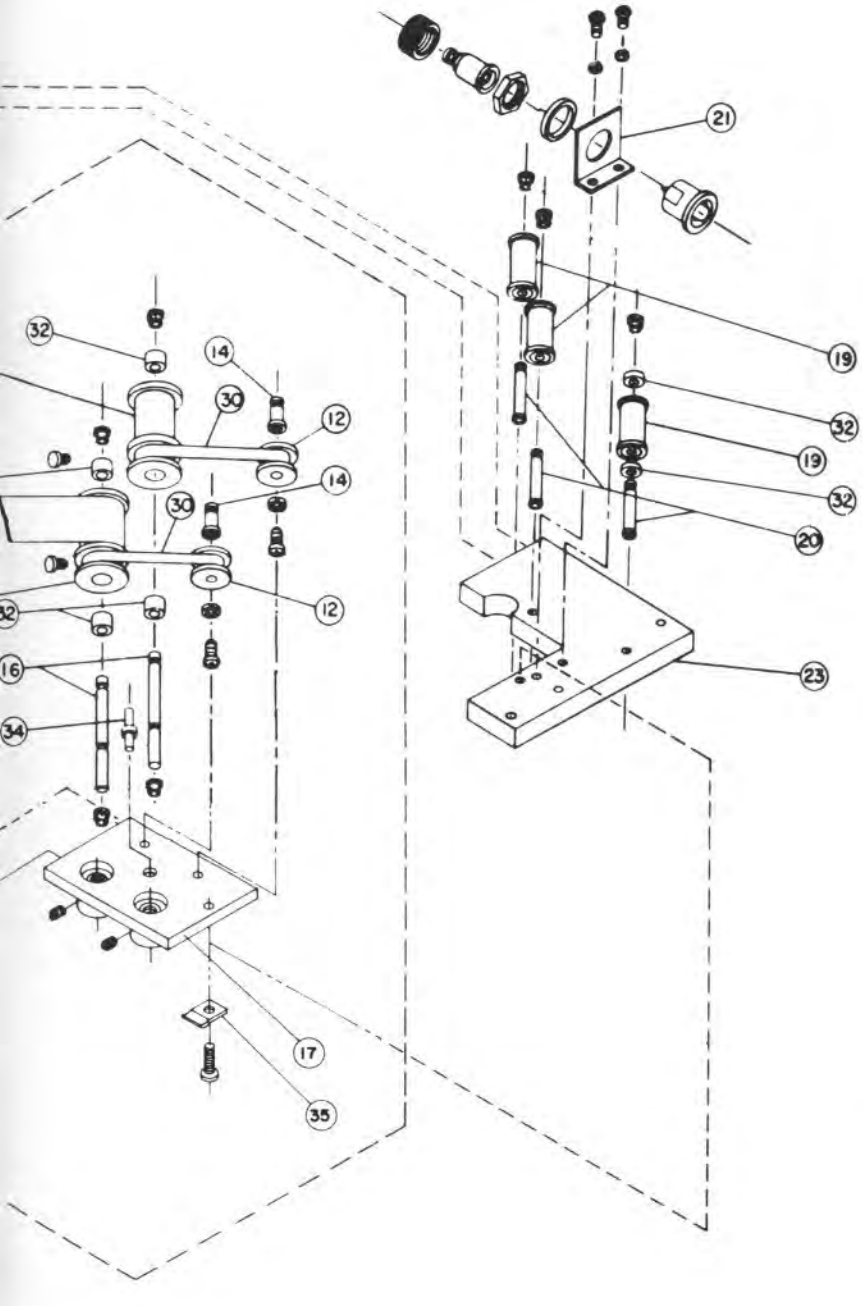
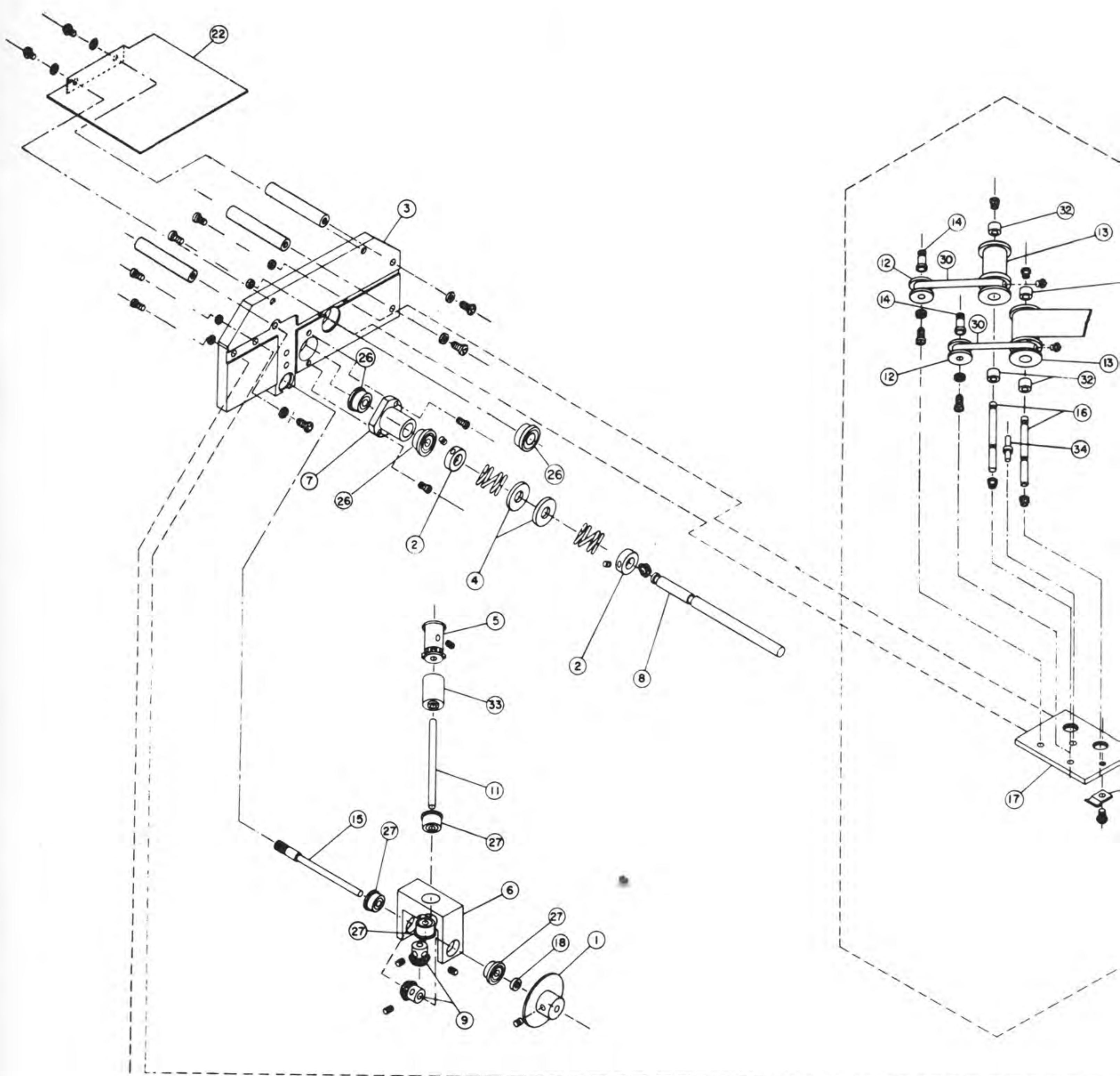


ITEM NO.	PART NO.	ITEM NAME	FEDERAL MFR CODE	QTY
35	116H125	STRAP, RETAINING	79963	1
34	FTSM1	TERMINAL, FEEDTHRU, INS	98291	1
33	A291-8	SPACER	19905	1
32	A689	BUSHING, SLEEVE	19905	10
31				
30	N7443	SPRING, SPIRAL, TORSION	80545	2
29				
28				
27	SFR23MM	BEARING, BALLANNULAR	83086	4
26	SFR1883MM	BEARING, BALLANNULAR	83086	3
25				
24				
23	B098-2	PLATE, GUIDE ROLLER	19905	1
22	A621-2	COVER, TAPE DECK	19905	1
21	A236-2	BRACKET, LAMP	19905	1
20	A223	PIN, GROOVED, HD	19905	3
19	A222-2	GUIDE, ROLLER	19905	3
18	A220	WASHER, FLAT	19905	1
17	AB1107-4	BUSHING, ASSEMBLY	19905	1
16	A429	PIN, GROOVED, HEADLESS	19905	2
15	A079-1	GEAR ASSEMBLY, SPUR	19905	1
14	A097	POST, REEL	19905	2
13	B523-2	SPOOL, DRIVE	19905	2
12	A095	REEL, TAPE	19905	2
11	A093-2	PIN, STRAIGHT HEADLESS	19905	1
10				
9	A082	GEAR, BEVEL	19905	2
8	A624-3	SHAFT, STRAIGHT	19905	1
7	A080-2	HOUSING, BEARING	19905	1
6	A078-2	HOUSING, GEAR	19905	1
5	AB522-2	SPROCKET ASSEMBLY	19905	1
4	A063	WASHER, BEVEL	19905	2
3	C113-3	PLATE, GEAR	19905	1
2	A018	COLLAR, SHAFT	19905	2
1	AB525-2	DISK, CLUTCH	19905	1

Figure 5-2. TN-519/WRR, RF Tuning Unit
Gear Train Assembly, GT-203-4



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34
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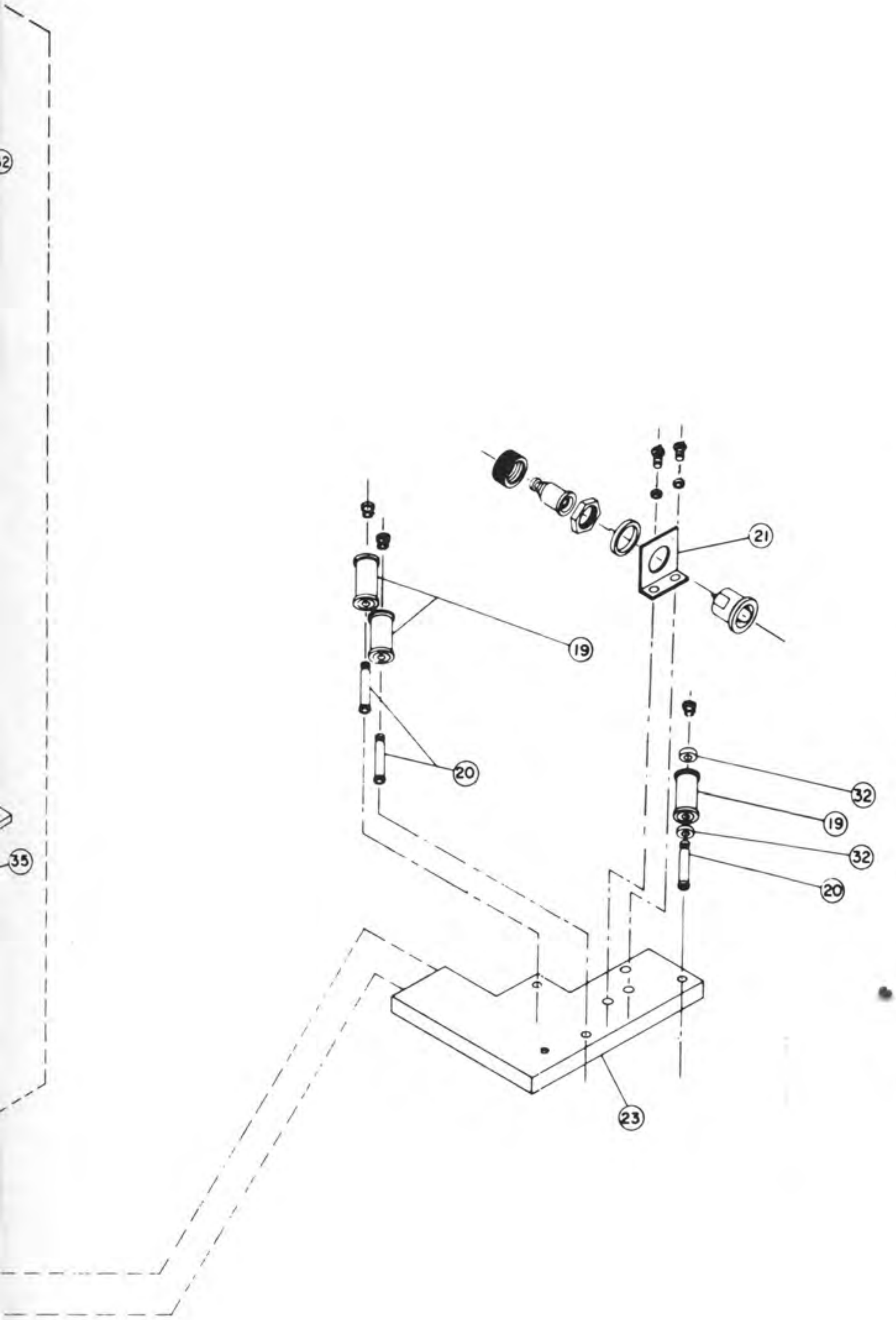
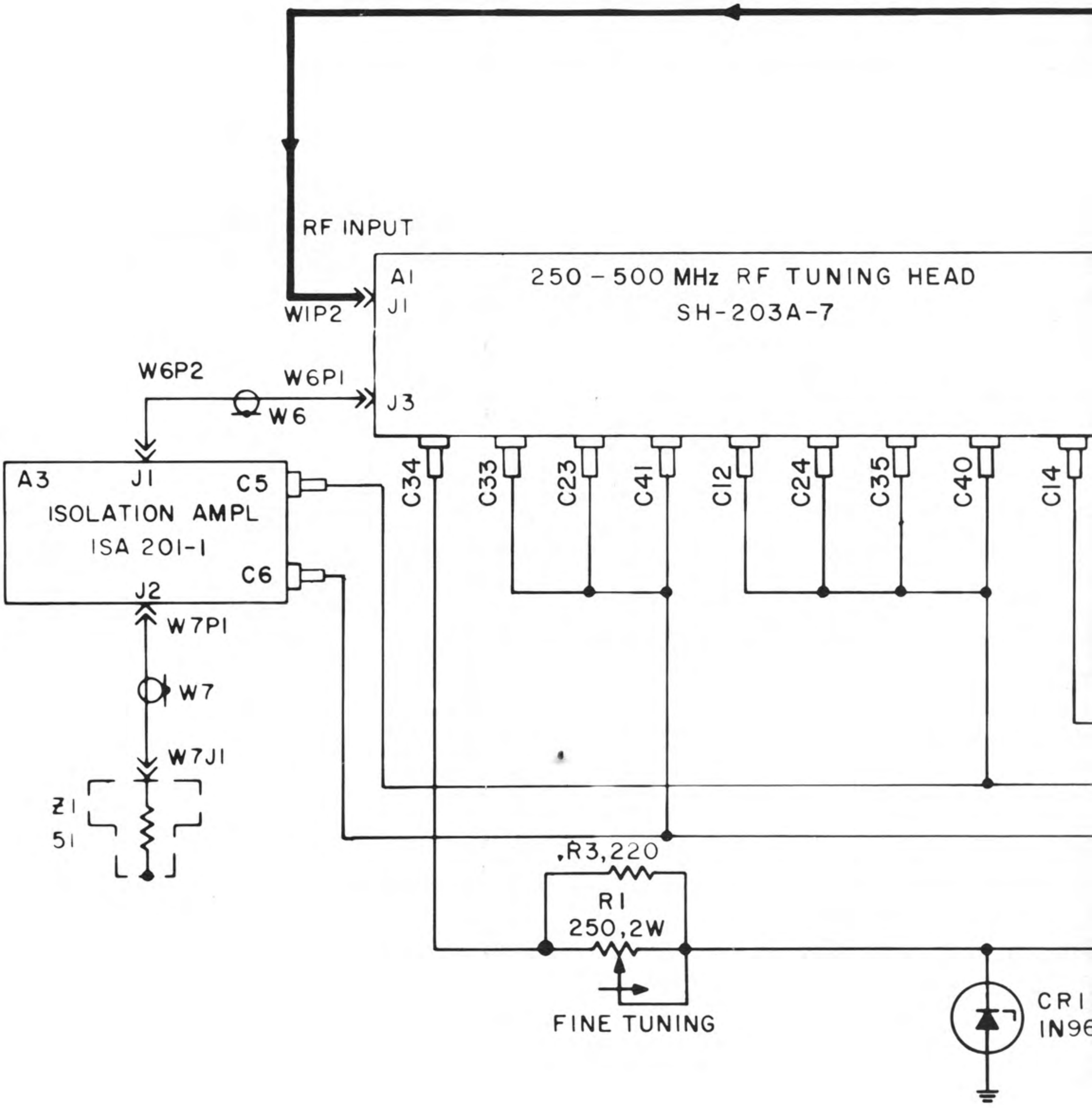


35	116H125	STRAP, RETAINING	79963	1
34	FTSM1	TERMINAL, FEEDTHRU, INS	98291	1
33	A291-7	SPACER	19905	1
32	A689	BUSHING, SLEEVE	19905	10
31				
30	N7443	SPRING, SPIRAL, TORSION	80545	2
29				
28				
27	SFR23MM	BEARING, BALLANNULAR	83086	4
26	SFR1883MM	BEARING, BALLANNULAR	83086	3
25				
24				
23	B099-4	PLATE, GUIDE ROLLER	19905	1
22	A620-2	COVER, TAPE DECK	19905	1
21	A236-2	BRACKET, LAMP	19905	1
20	A223	PIN, GROOVED, HD	19905	3
19	A222-2	GUIDE, ROLLER	19905	3
18	A220	WASHER, FLAT	19905	1
17	AB1108-2	BUSHING, ASSEMBLY	19905	1
16	A429	PIN, GROOVED, HEADLESS	19905	2
15	A079-1	GEAR ASSEMBLY, SPUR	19905	1
14	A097	POST, REEL	19905	2
13	B523-2	SPOOL, DRIVE	19905	2
12	A095	REEL, TAPE	19905	2
11	A093-2	PIN, STRAIGHT, HEADLESS	19905	1
10				
9	A082	GEAR, BEVEL	19905	2
8	A624-2	SHAFT, STRAIGHT	19905	1
7	A080-2	HOUSING, BEARING	19905	1
6	A078-2	HOUSING, GEAR	19905	1
5	AB522-2	SPROCKET ASSEMBLY	19905	1
4	A063	WASHER, BEVEL	19905	2
3	C114-2	PLATE, GEAR	19905	1
2	A018	COLLAR, SHAFT	19905	2
1	AB525-2	DISK, CLUTCH	19905	1
ITEM NO.	PART NO.	ITEM NAME	FEDERAL MFR CODE	QTY

Figure 5-3. TN-520/WRR RF Tuning Unit
Gear Train Assembly, GT-204-4



RF INPUT
A1
J1
250 – 500 MHz RF TUNING HEAD
SH-203A-7
W1P2
W6P2
W6P1
J3
W6
A3
J1
C5
ISOLATION AMPL
ISA 201-1
C6
J2
W7P1
W7
W7J1
Z1
51
C34
C33
C23
C41
C12
C24
C35
C40
C14
R3,220
R1
250,2W
FINE TUNING
CR1
IN96

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4W.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN:
   FOR COMPLETE DESIGNATIONS PREFIX WITH A1.

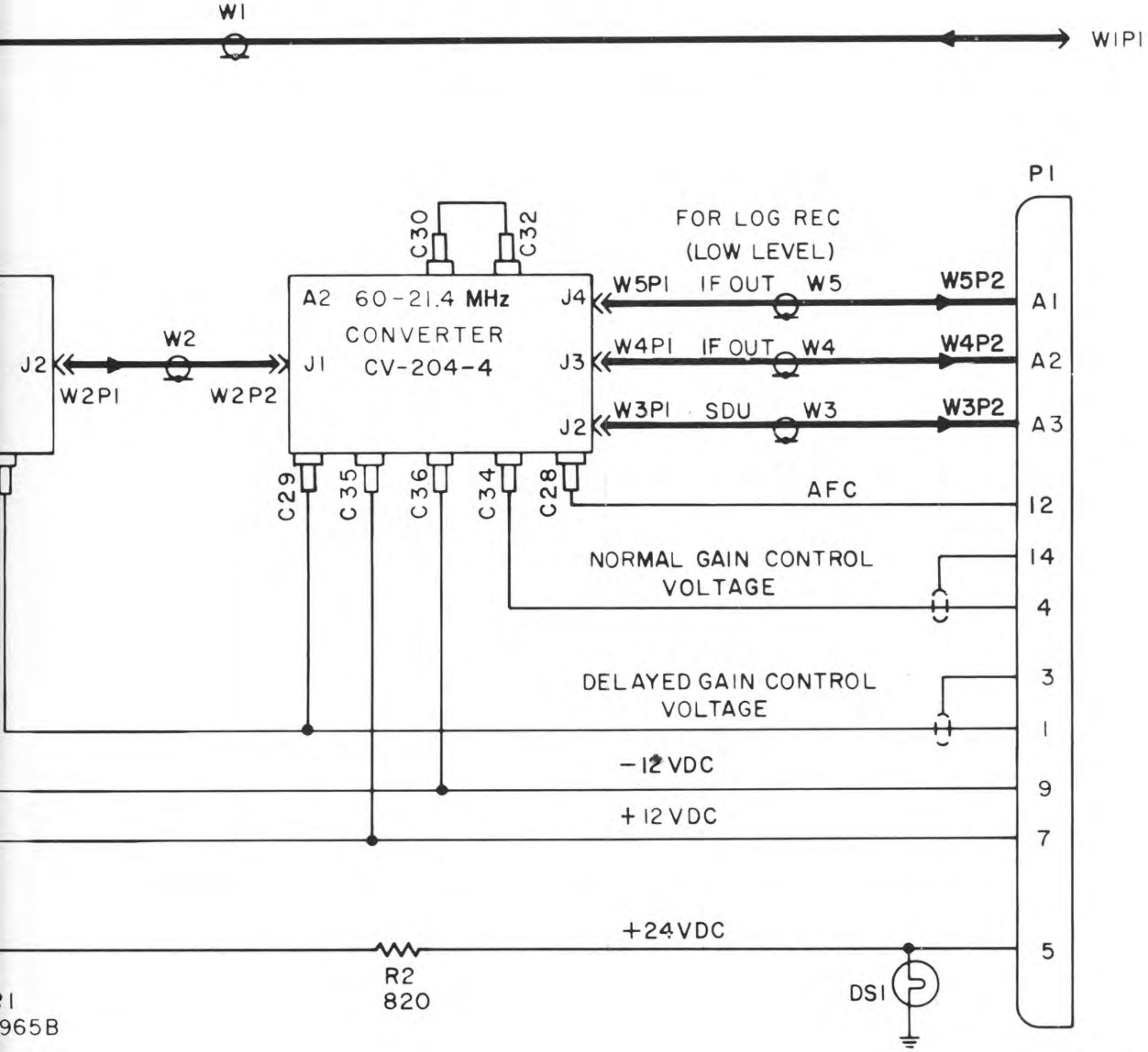


Figure 7-1. 250-500 Mc RF Tuner, TN-519/WRR, Schematic Diagram

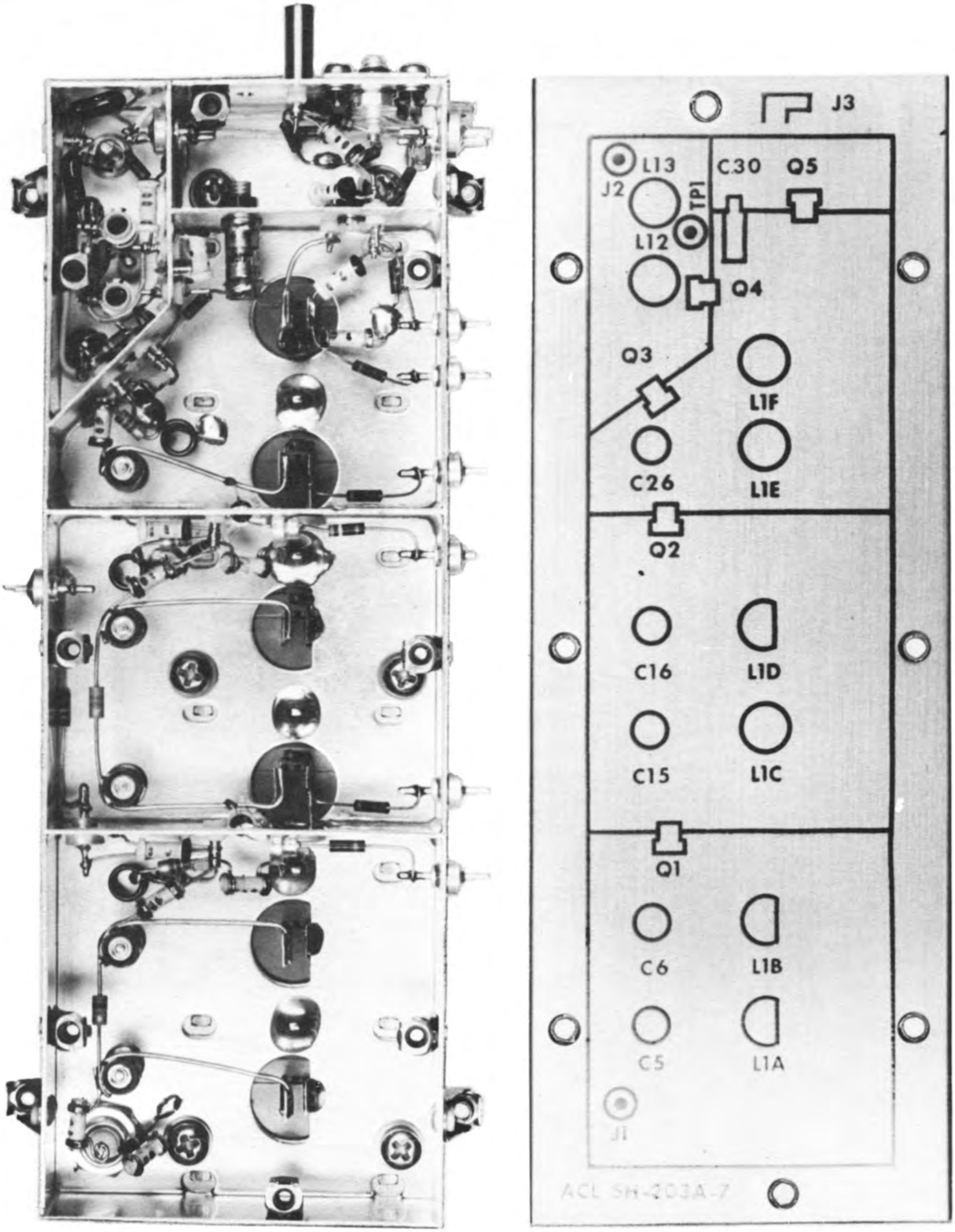
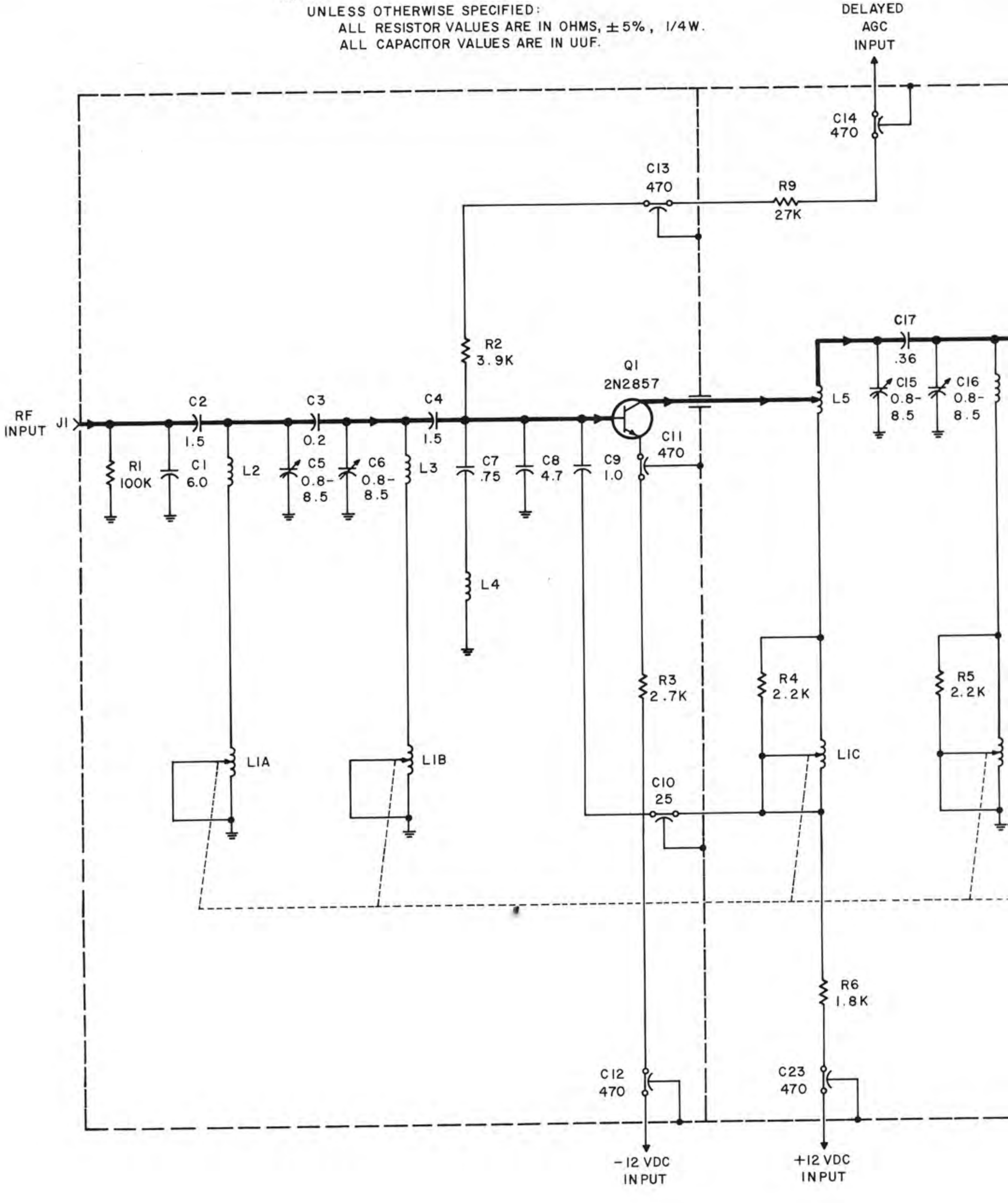


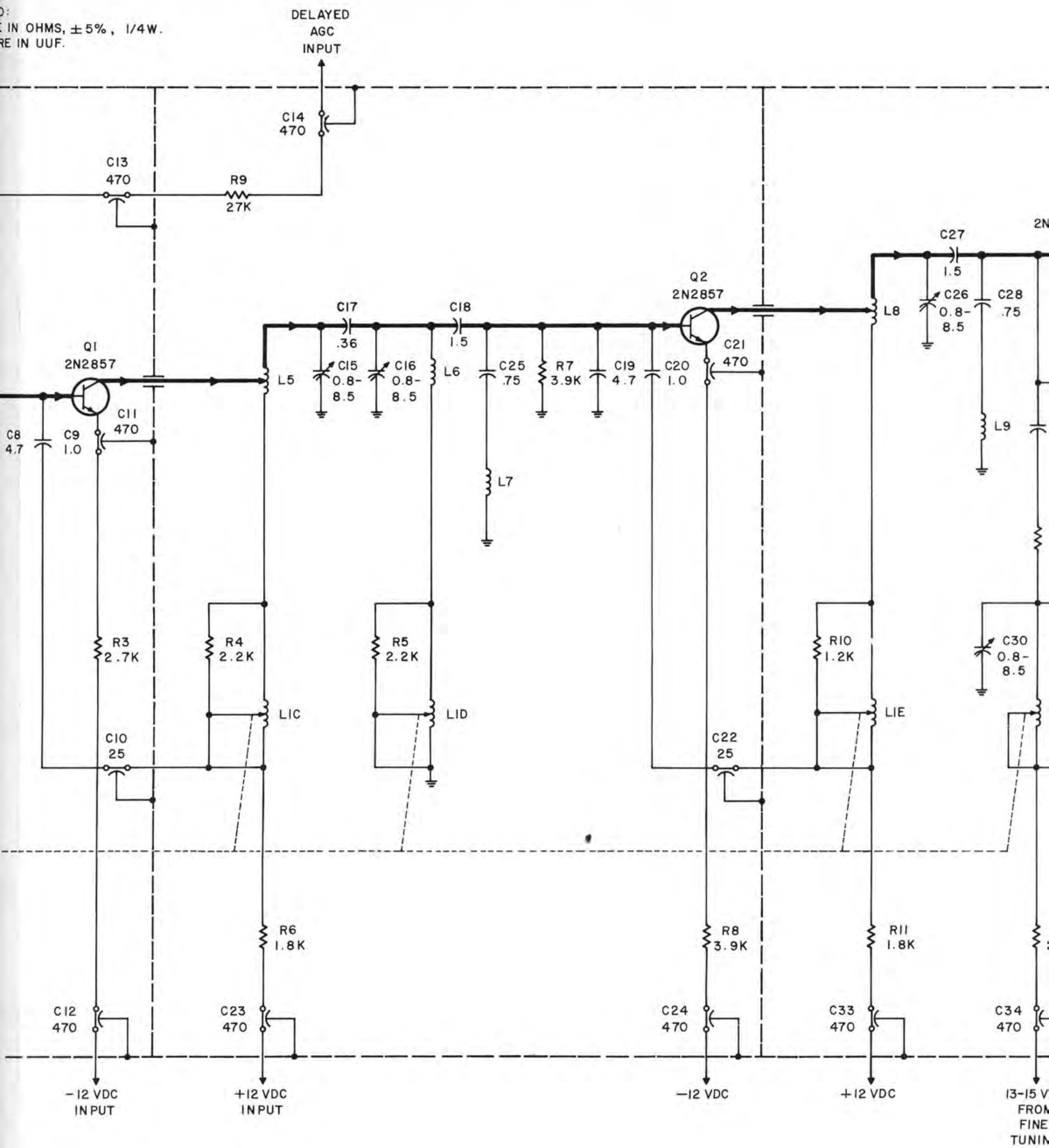
Figure 7-2A. Tuning Head, SH-203A-7

NOTES:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4W.
ALL CAPACITOR VALUES ARE IN UUF.



250-500 MHz RF TUNING UNIT, SH-

D:
E IN OHMS, ±5%, 1/4W.
RE IN UUF.



-500 MHz RF TUNING UNIT, SH-203A-7

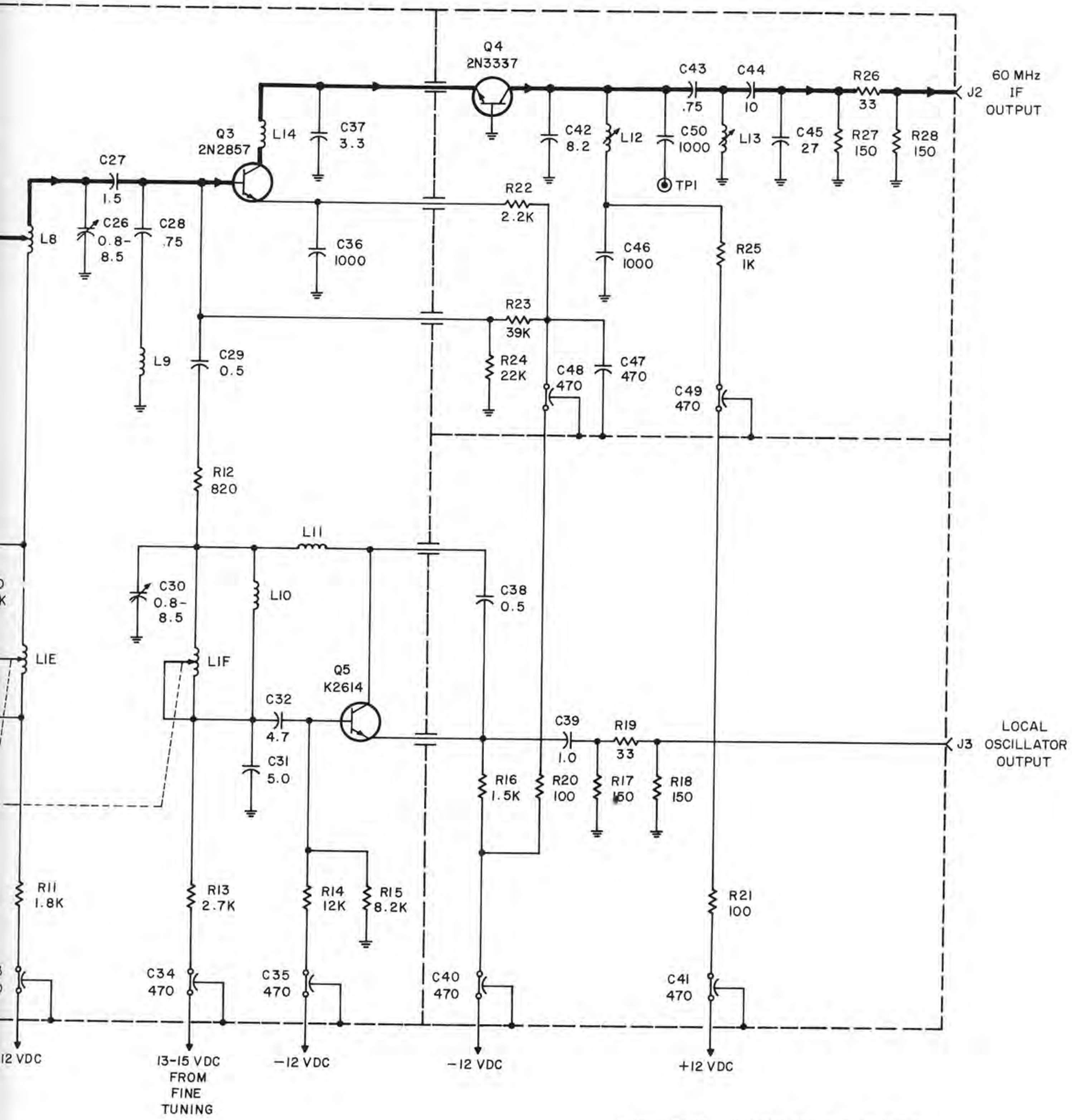


Figure 7-2B. 250-500 Mc Tuning Head, SH-203A-7, Schematic Diagram

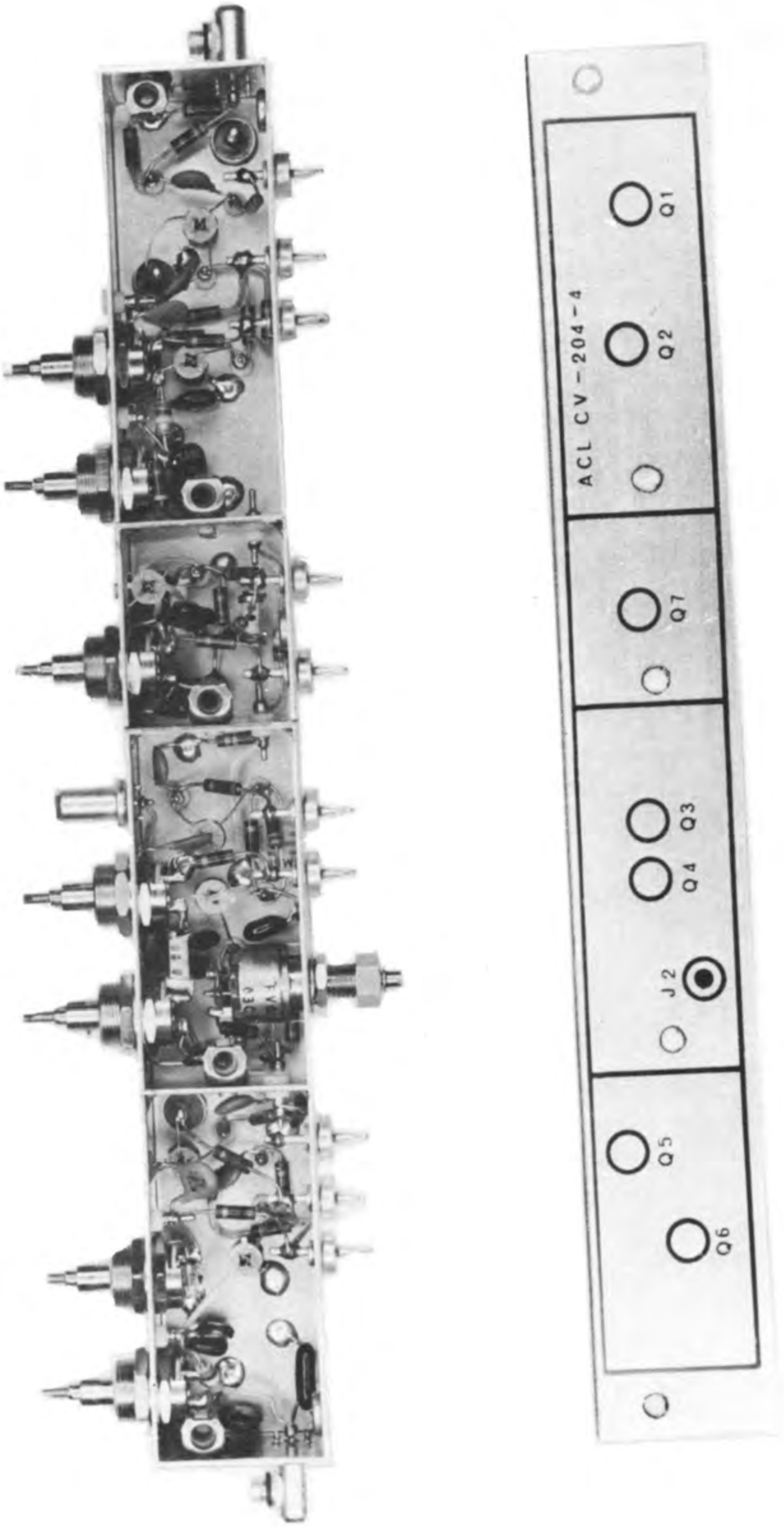
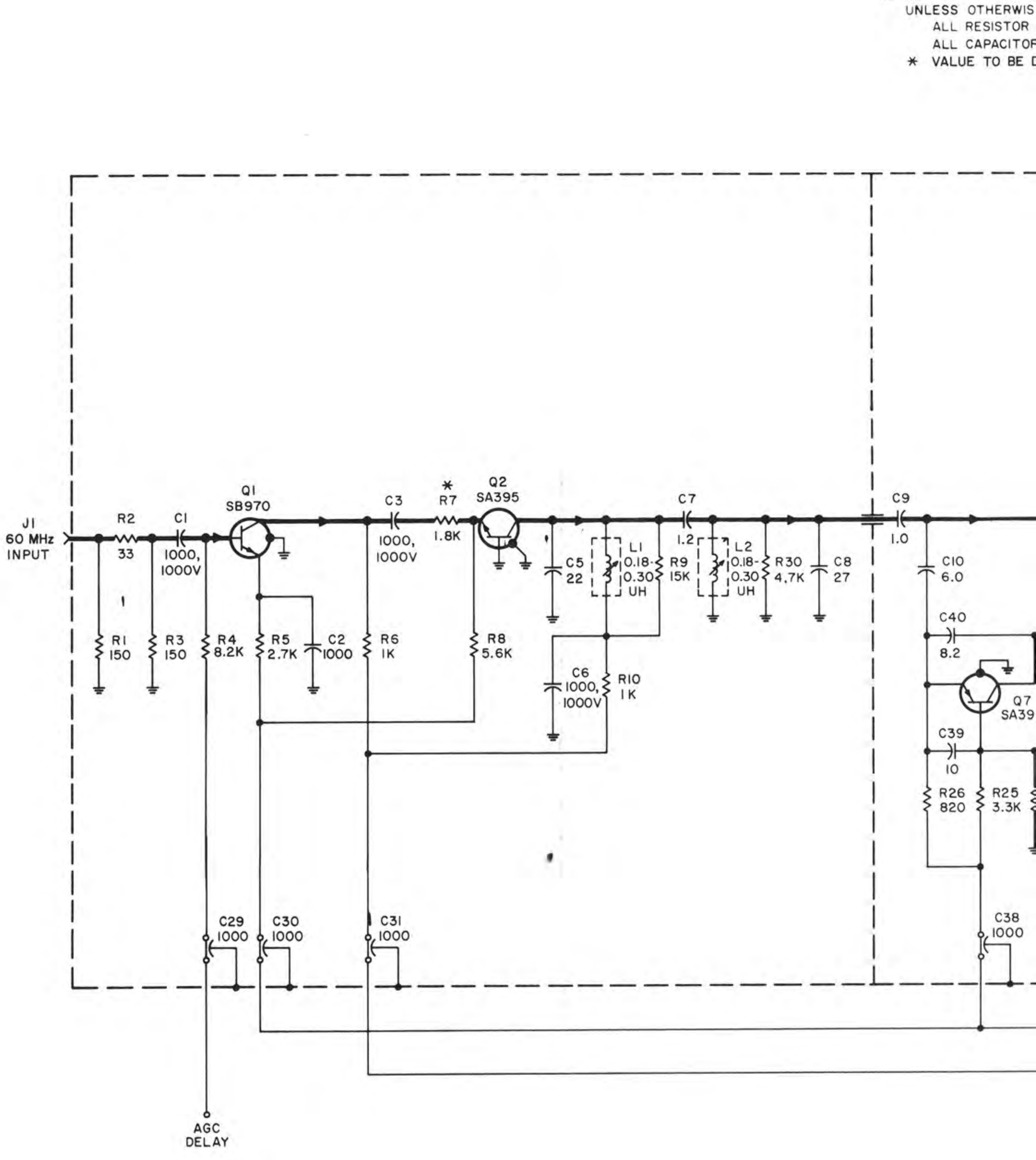


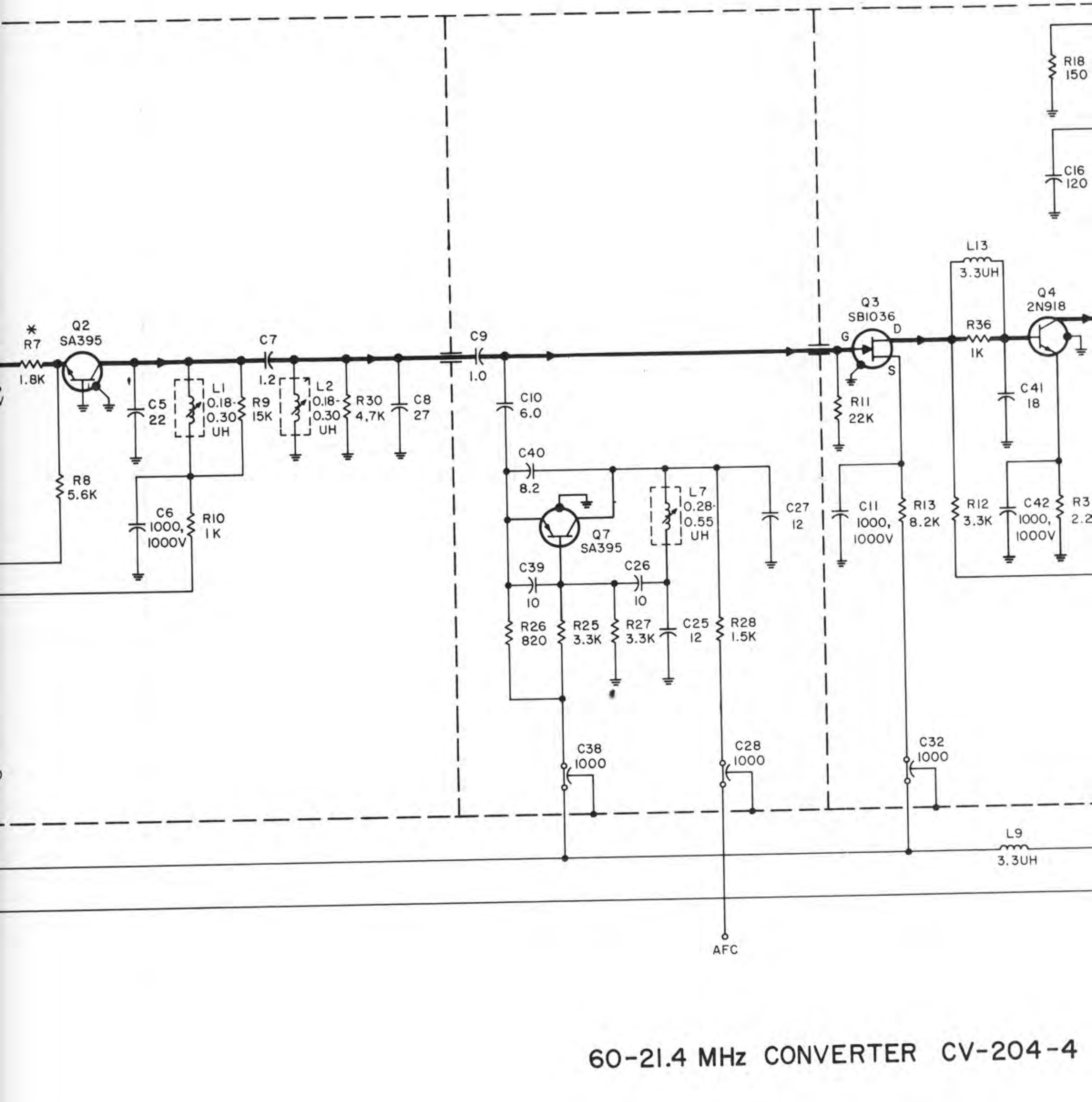
Figure 7-3A. 60-21.4 Mc Converter, CV-204-4

NOTES:
UNLESS OTHERWIS
ALL RESISTOR
ALL CAPACITOR
* VALUE TO BE D

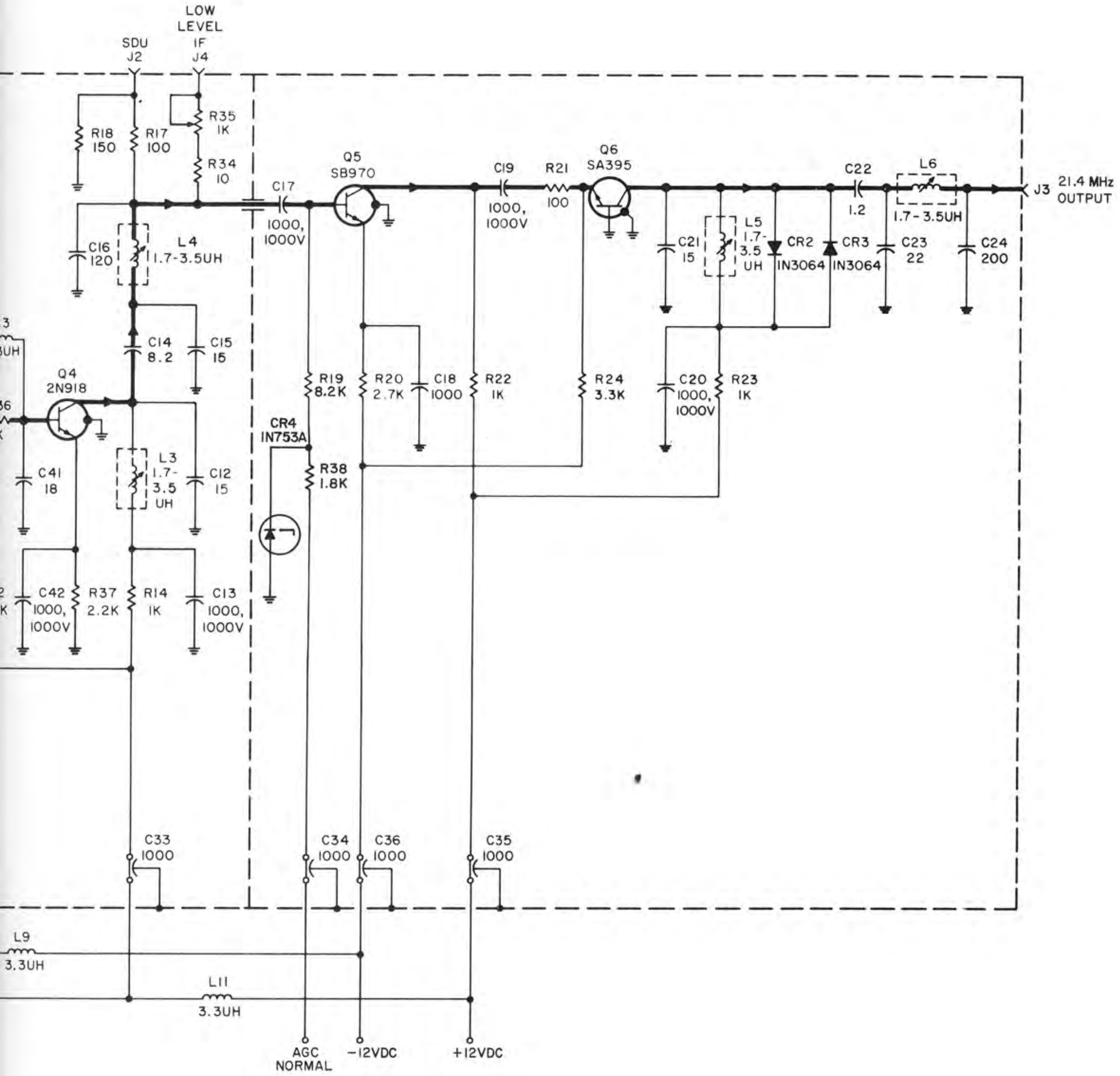


60

NOTES:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
ALL CAPACITOR VALUES ARE IN UUF, 500WVDC.
* VALUE TO BE DETERMINED BY TEST: NOMINAL VALUE SHOWN.



60-21.4 MHz CONVERTER CV-204-4



204-4

Figure 7-3B. 60-21.4 Mc Converter, CV-204-4, Schematic Diagram

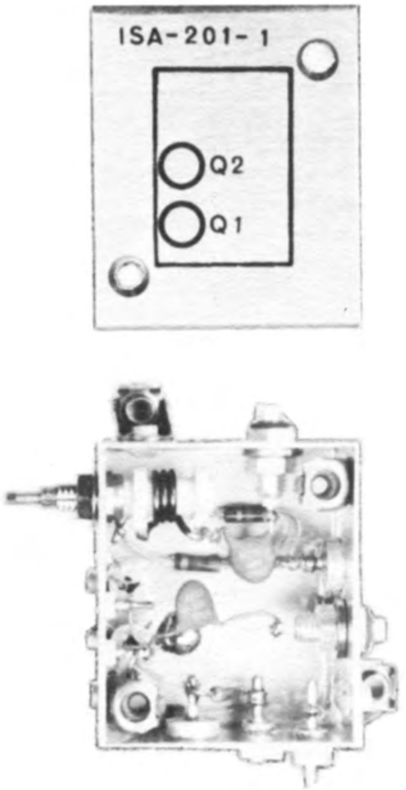
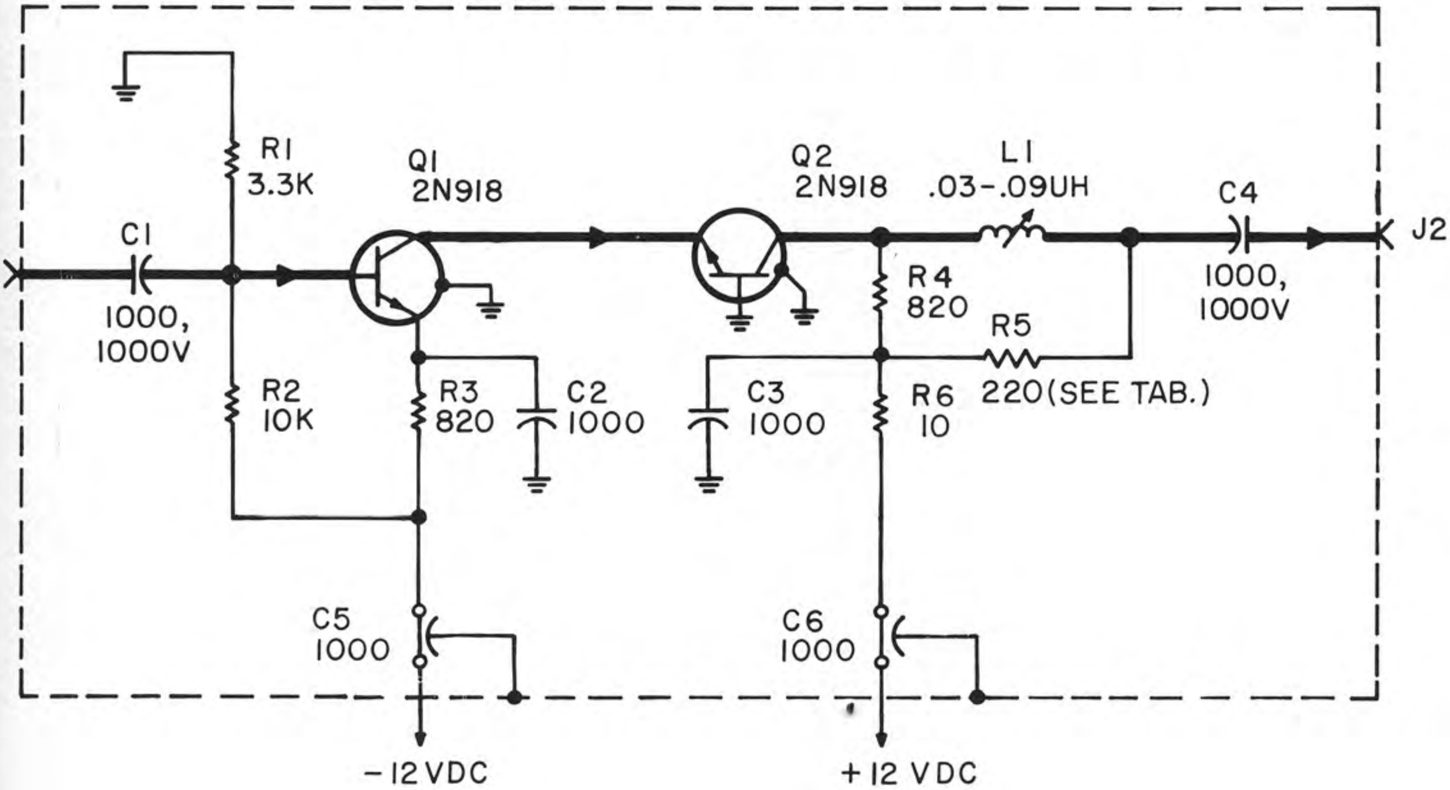


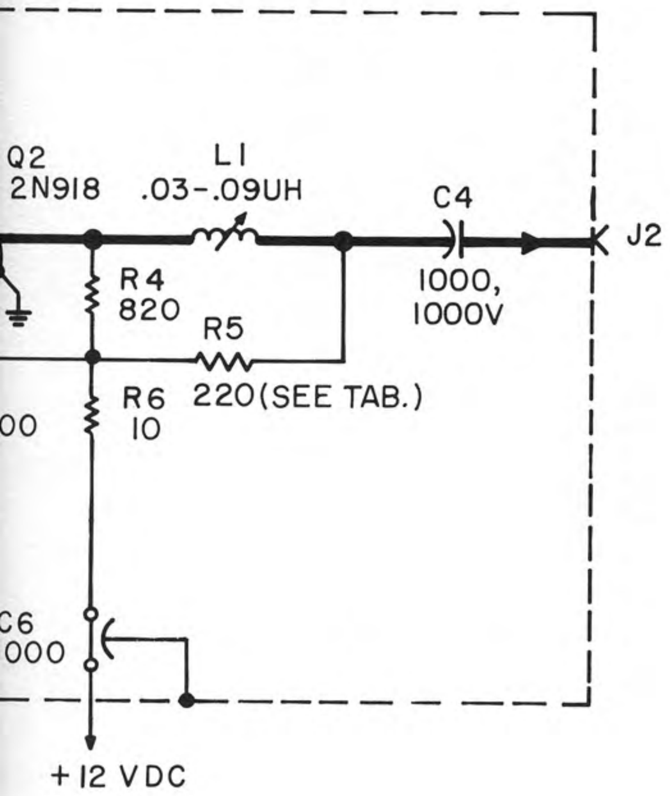
Figure 7-4A. Isolation Amplifier, ISA-201-1

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5 %.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.



ISOLATION AMPLIFIER, ISA-201 & ISA-201-1

FIED:
RE IN OHMS, 1/4 W, 5 %.
ARE IN UUF, 500 WVDC.



ASS'Y	R5 VALUE
ISA-201-1	220 Ω
ISA-201	NOT USED

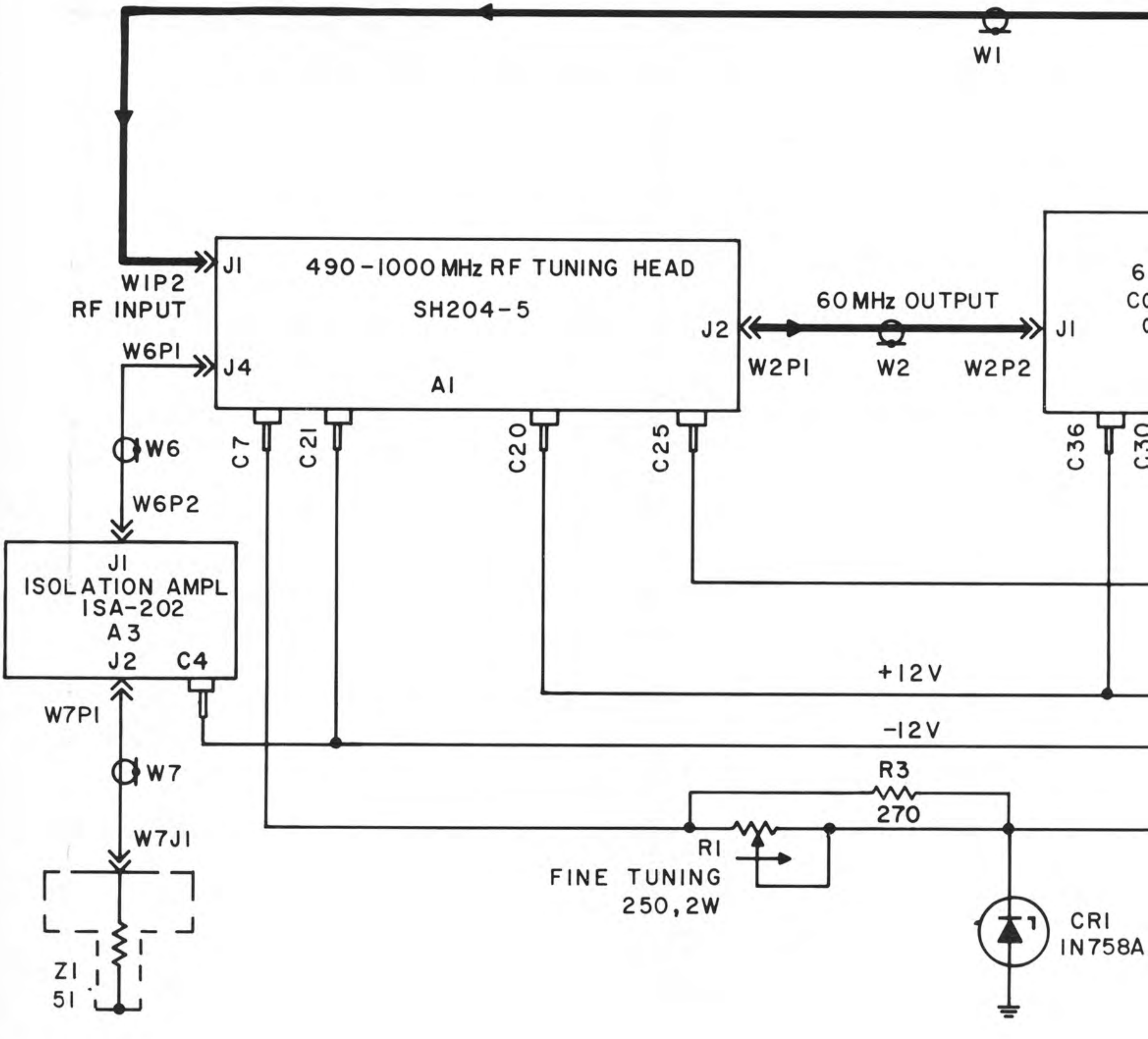
, ISA-201 & ISA-201-1

Figure 7-4B. Isolation Amplifier, ISA-201-1, Schematic Diagram

NOTES:

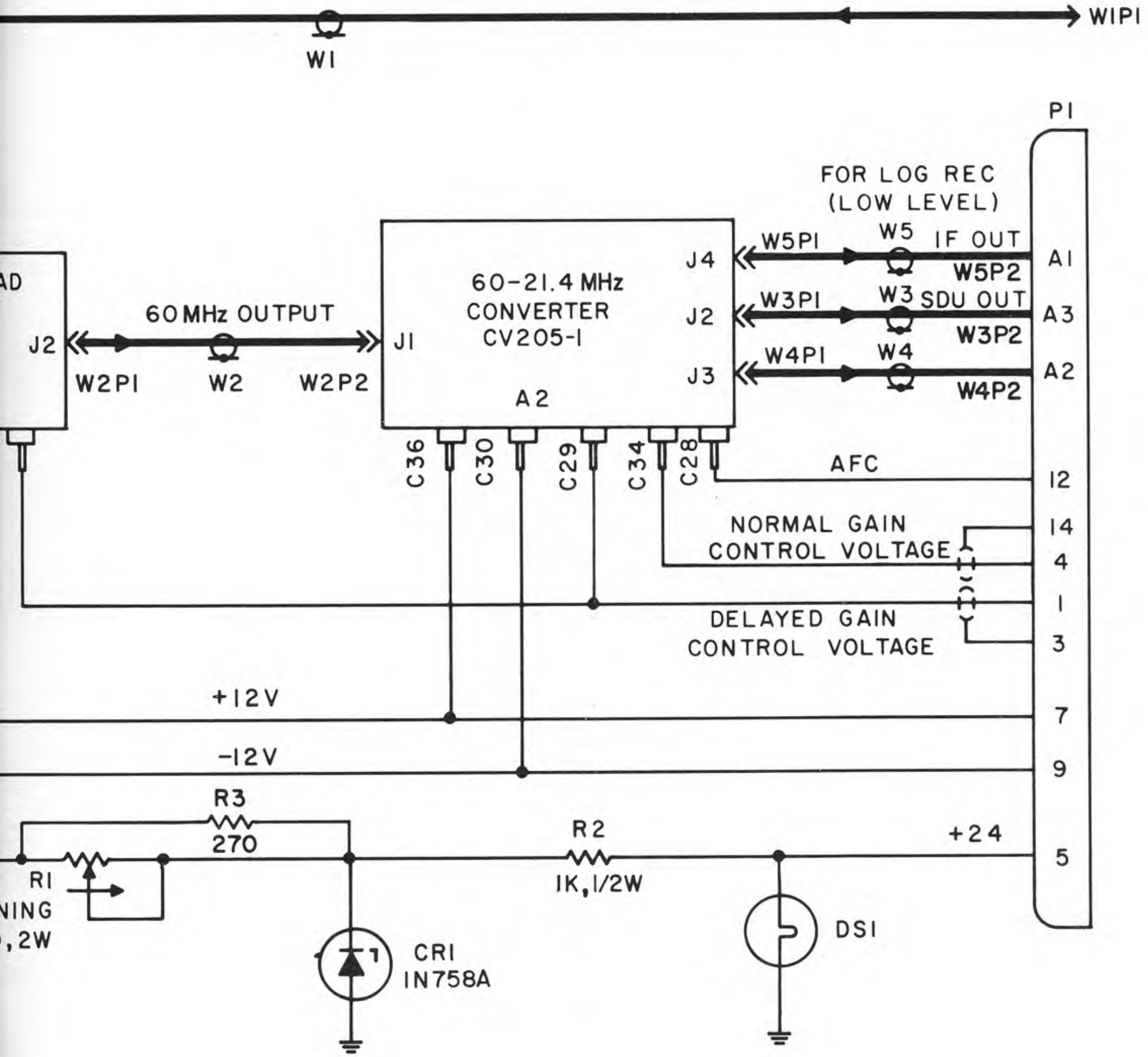
UNLESS OTHERWISE SPI

1. ALL RESISTOR VALUE



490-1000 MHz RF PLUG-IN UNIT

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4W.



MHz RF PLUG-IN UNIT SH-214-P-1

Figure 7-5. 490-1000 Mc RF Tuner, TN-520/WRR, Schematic Diagram

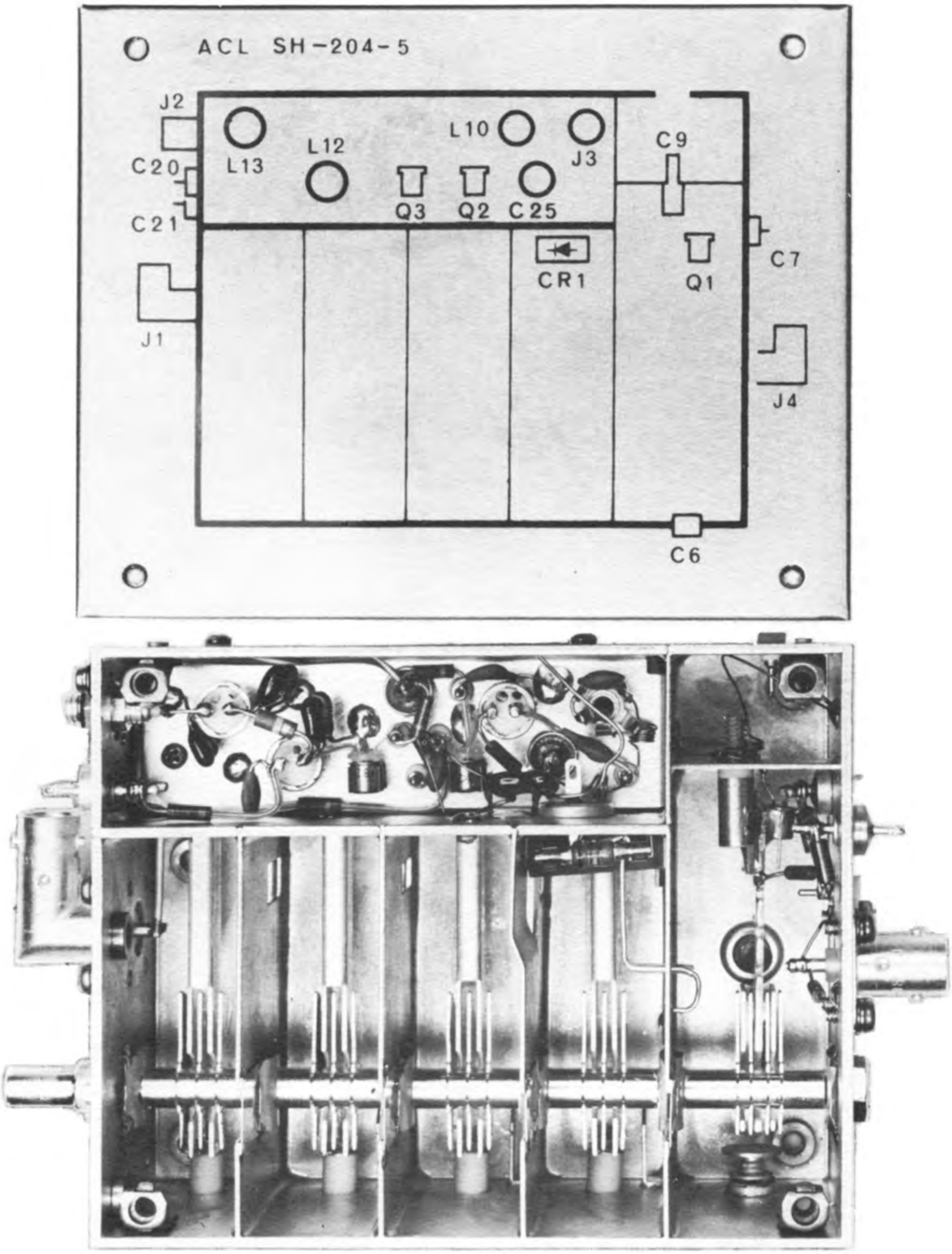
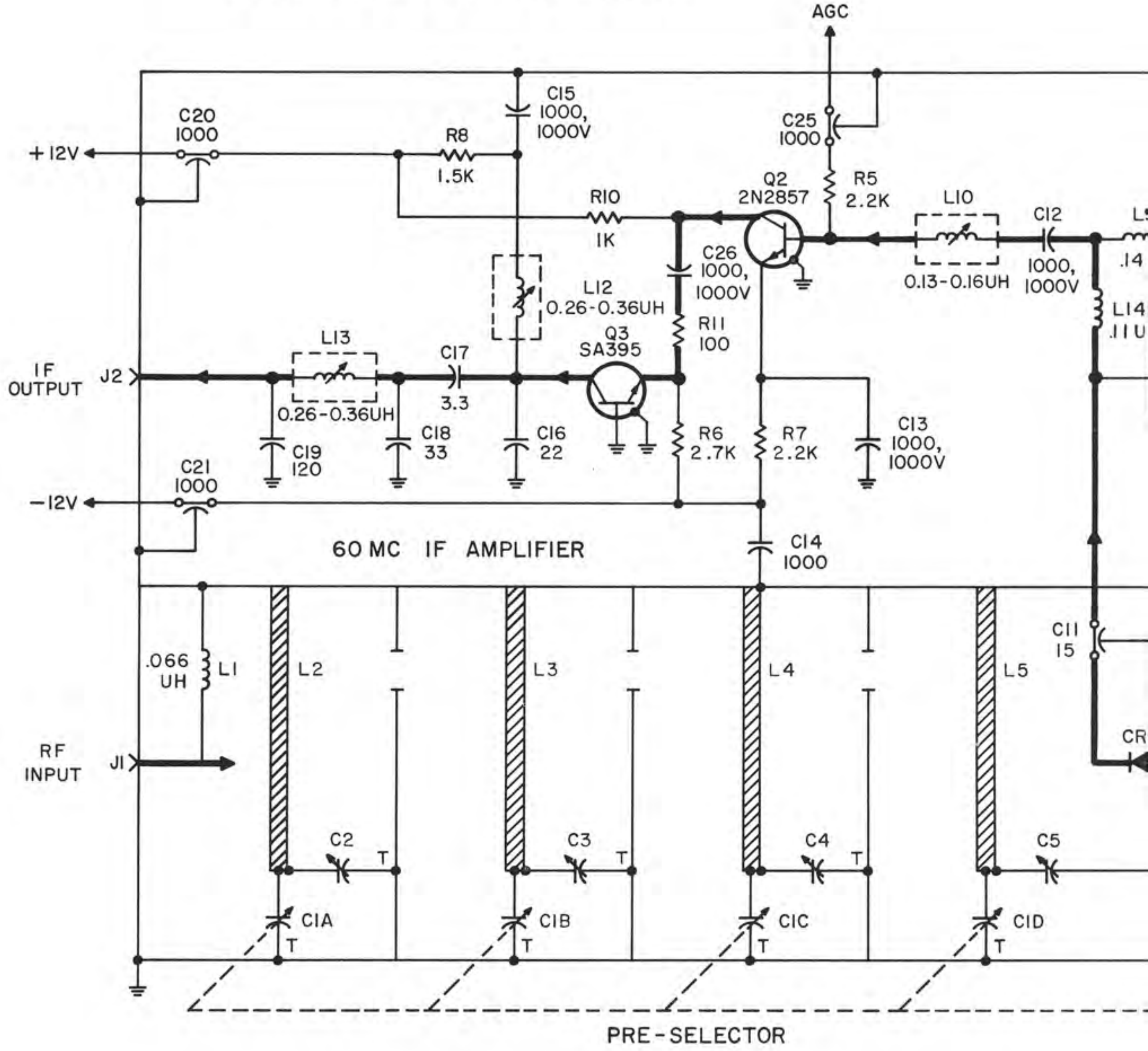


Figure 7-6A. Tuning Head, SH-204-5

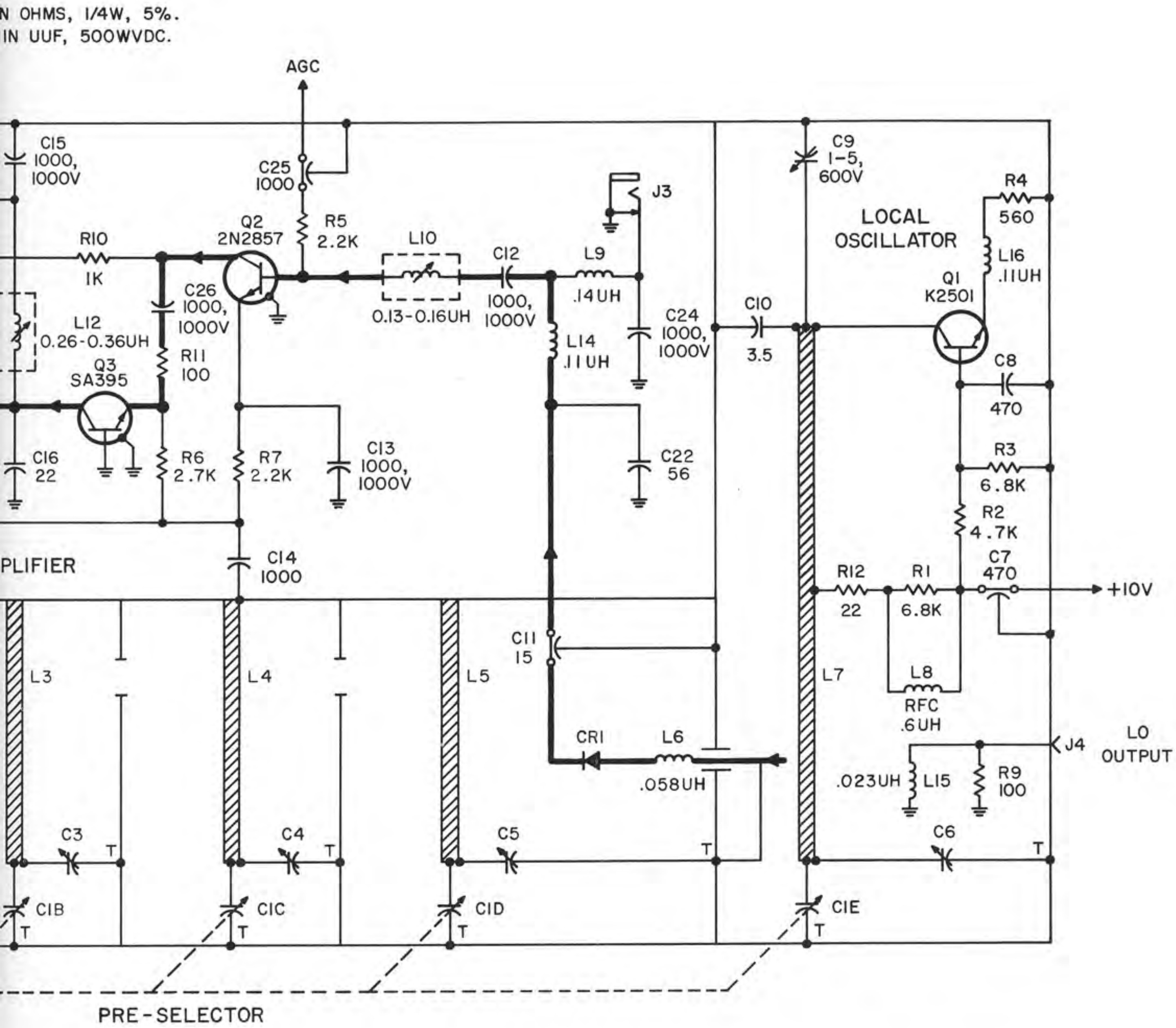
NOTES:

UNLESS OTHERWISE SPECIFIED:

ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500WVDC.

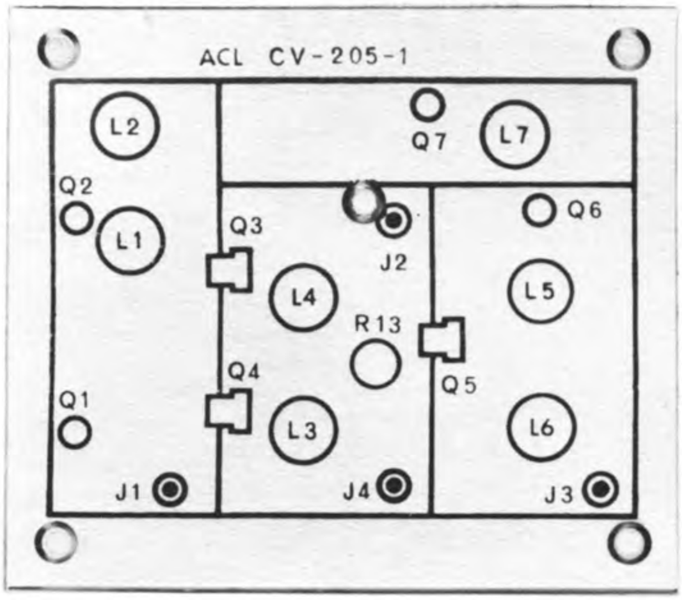


TUNER RADIO FREQUENCY, SH-2



TUNER RADIO FREQUENCY, SH-204-5

Figure 7-6B. 490-1000 Mc Tuning Head, SH-204-5, Schematic Diagram



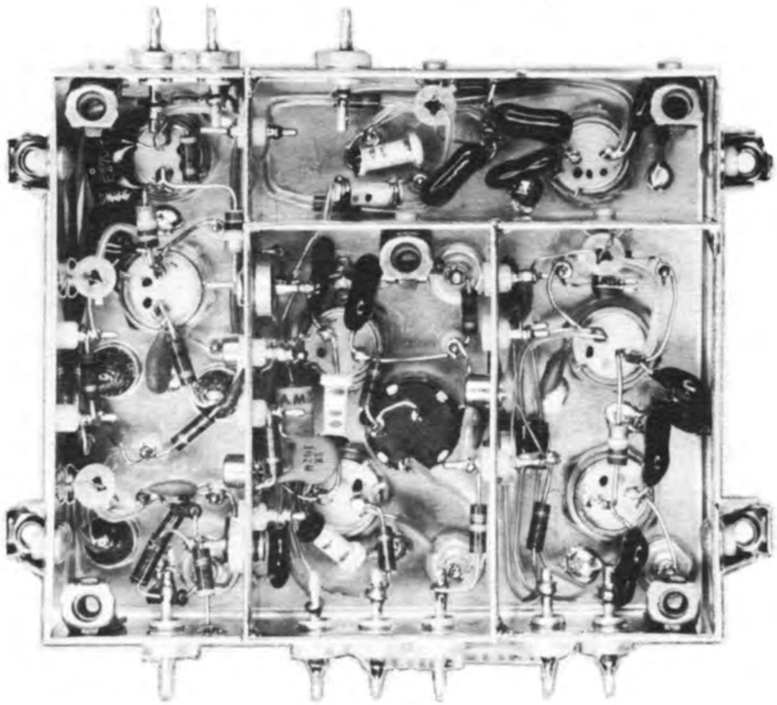
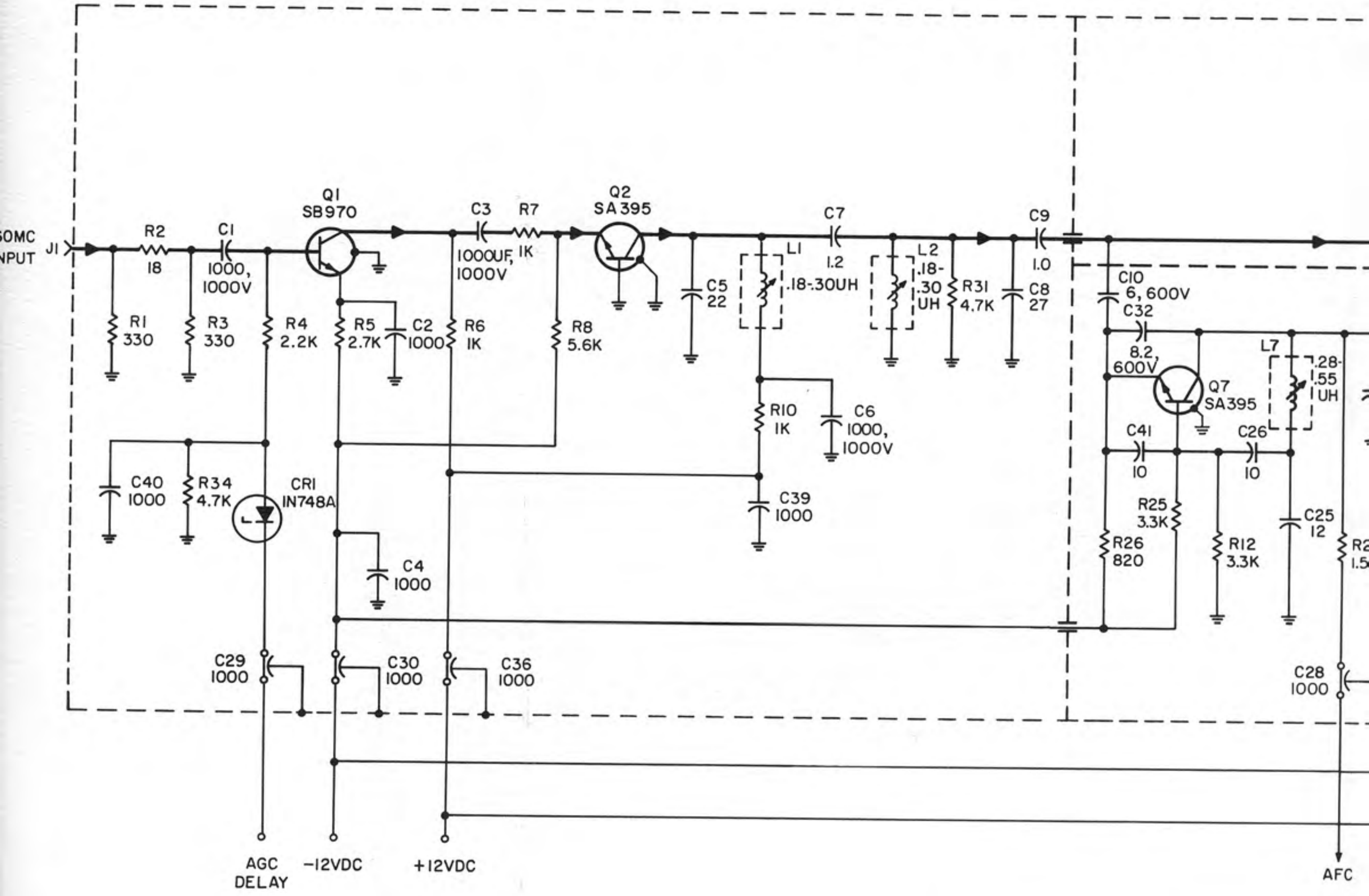


Figure 7-7A. 60-21.4 Mc Converter, CV-205-1



OMC
NPUT
JI
R2
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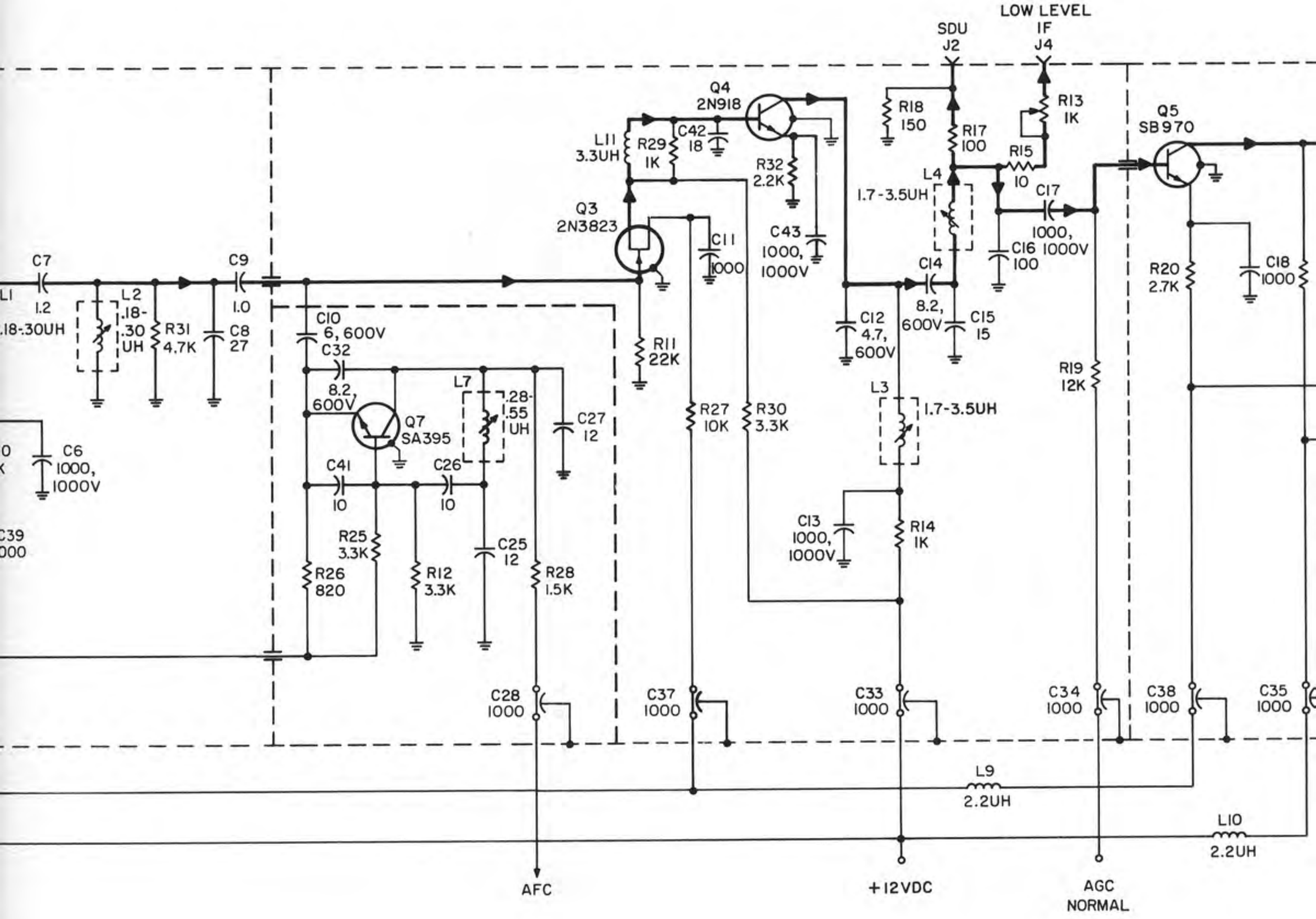
CI
1000,
1000V
QI
SB970
C3
R7
IK
1000UF,
1000V
Q2
SA395
C7
1.2
C9
1.0
RI
330
R3
330
R4
2.2K
R5
2.7K
C2
1000
R6
IK
R8
5.6K
C5
22
LI
.18-.30UH
L2
.18-
.30
UH
R31
4.7K
C8
27
CIO
6, 600V
C32
8.2,
600V
Q7
SA395
L7
.28-
.55
UH
RIO
IK
C6
1000,
1000V
C40
1000
R34
4.7K
CRI
IN748A
C39
1000
C41
10
C26
10
R25
3.3K
C25
12
R26
820
RI2
3.3K
C4
1000
C29
1000
C30
1000
C36
1000
C28
1000
AGC
DELAY
-I2VDC
+I2VDC
AFC

60-21.4 MC CO

UNLESS OTHERWISE SPECIFIED:

ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.

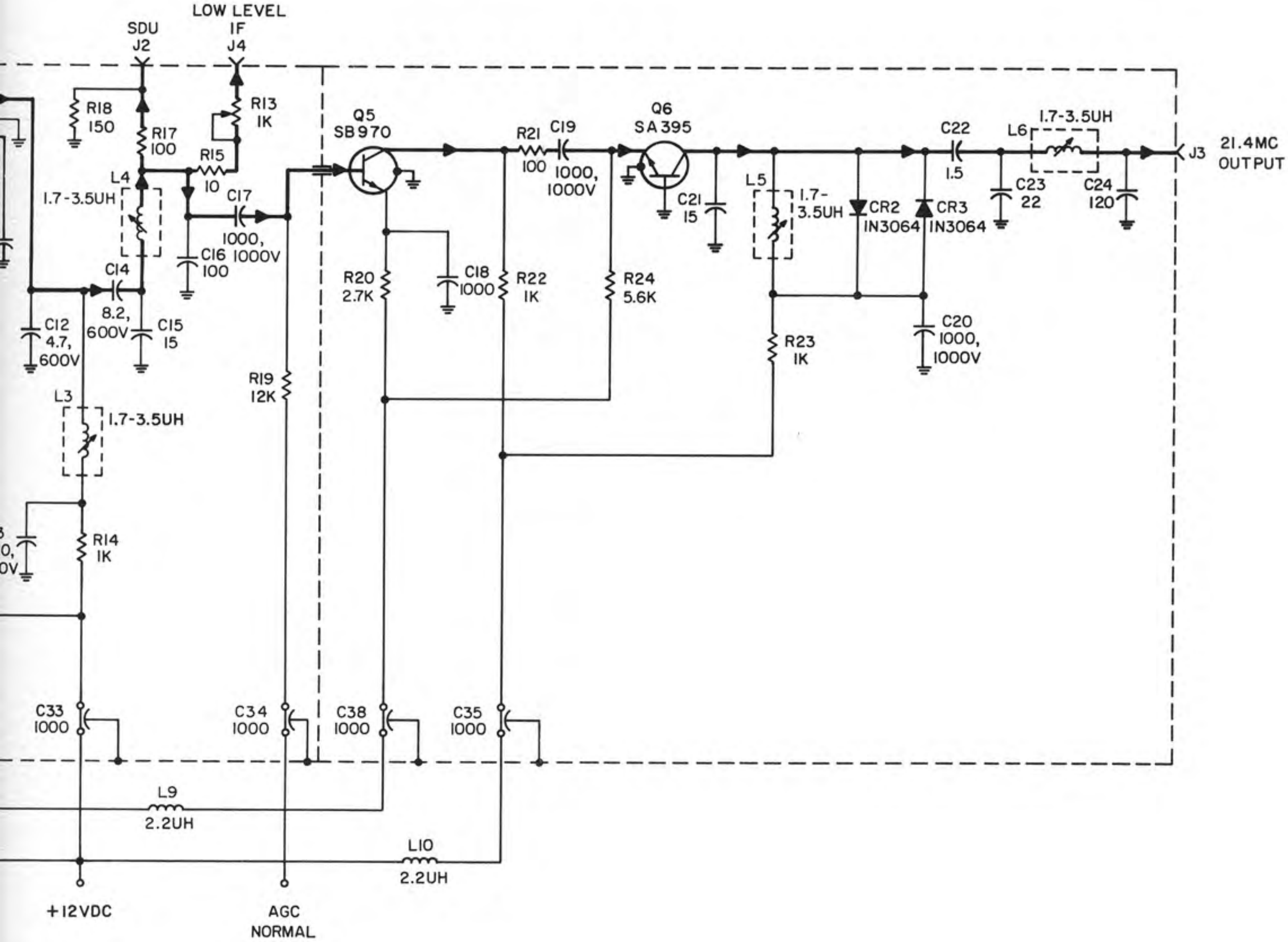


60-21.4 MC CONVERTER CV-205-1

UNLESS OTHERWISE SPECIFIED:

ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.

ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.



5-1

Figure 7-7B. 60-21.4 Mc Converter, CV-205-1, Schematic Diagram

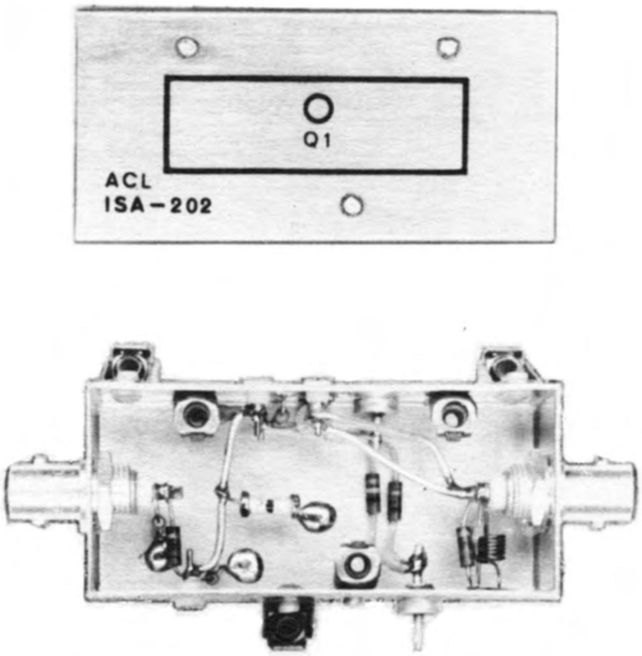
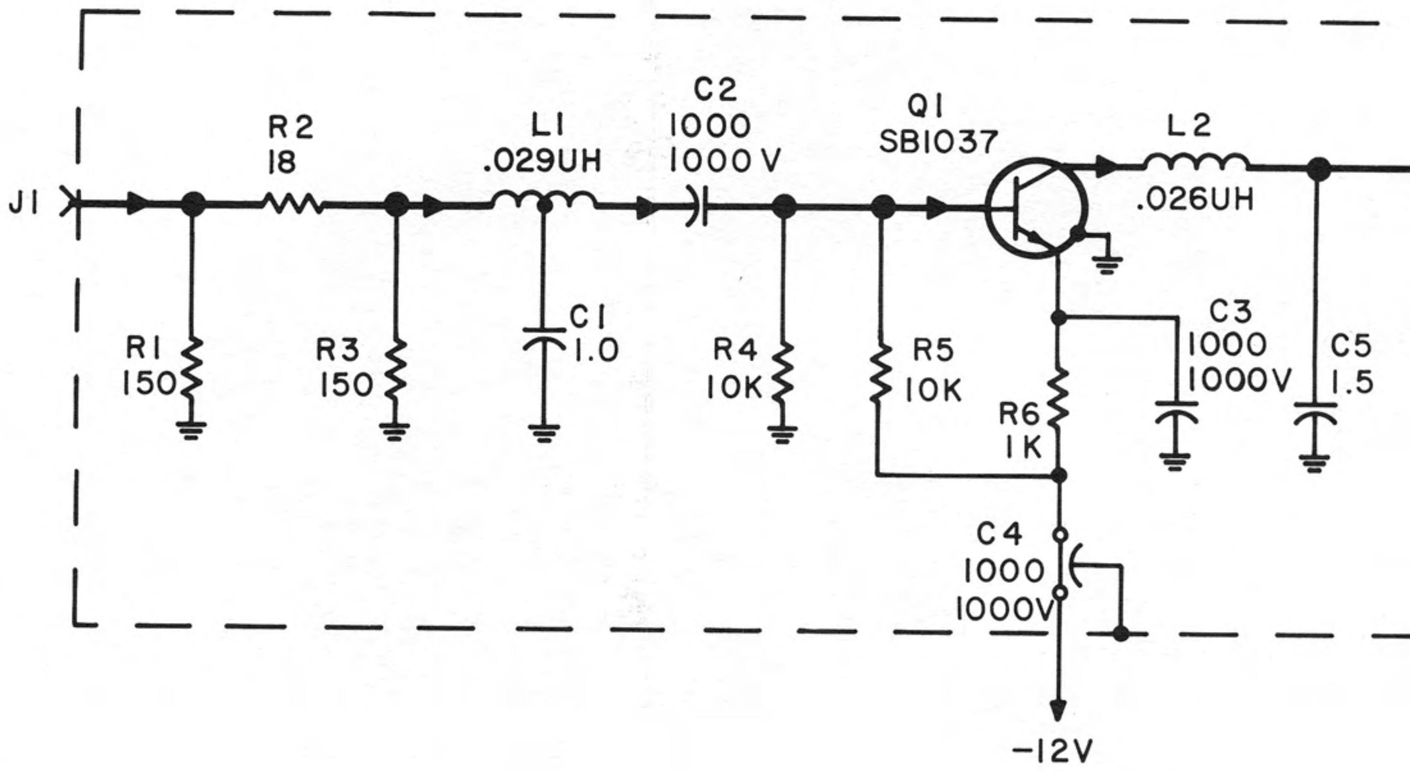
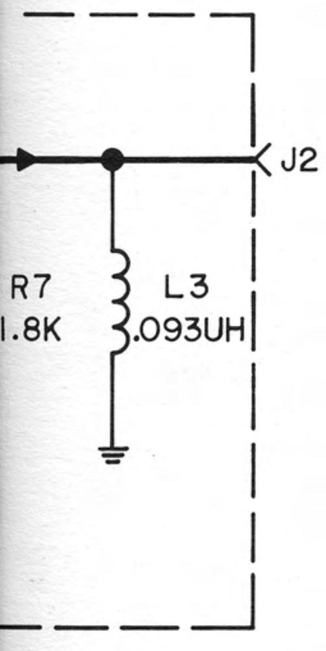


Figure 7-8A. Isolation Amplifier, ISA-202


J1
R2
18
L1
.029UH
C2
1000
1000 V
Q1
SB1037
L2
.026UH
R1
150
R3
150
C1
1.0
R4
10K
R5
10K
R6
1K
C3
1000
1000V
C5
1.5
C4
1000
1000V
-12V



NOTE:

UNLESS OTHERWISE SPECIFIED

ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%

ALL CAPACITOR VALUES ARE IN UUF, 500 V

Figure 7-8B. Isolation Amplifier, ISA-202, Schematic Diagram

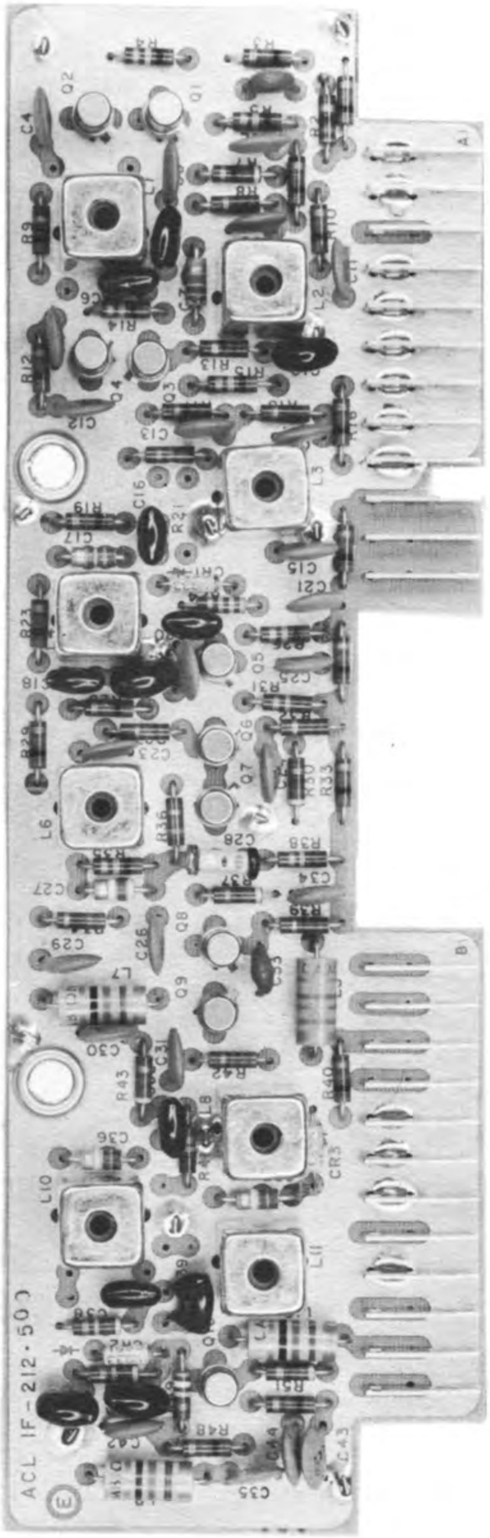
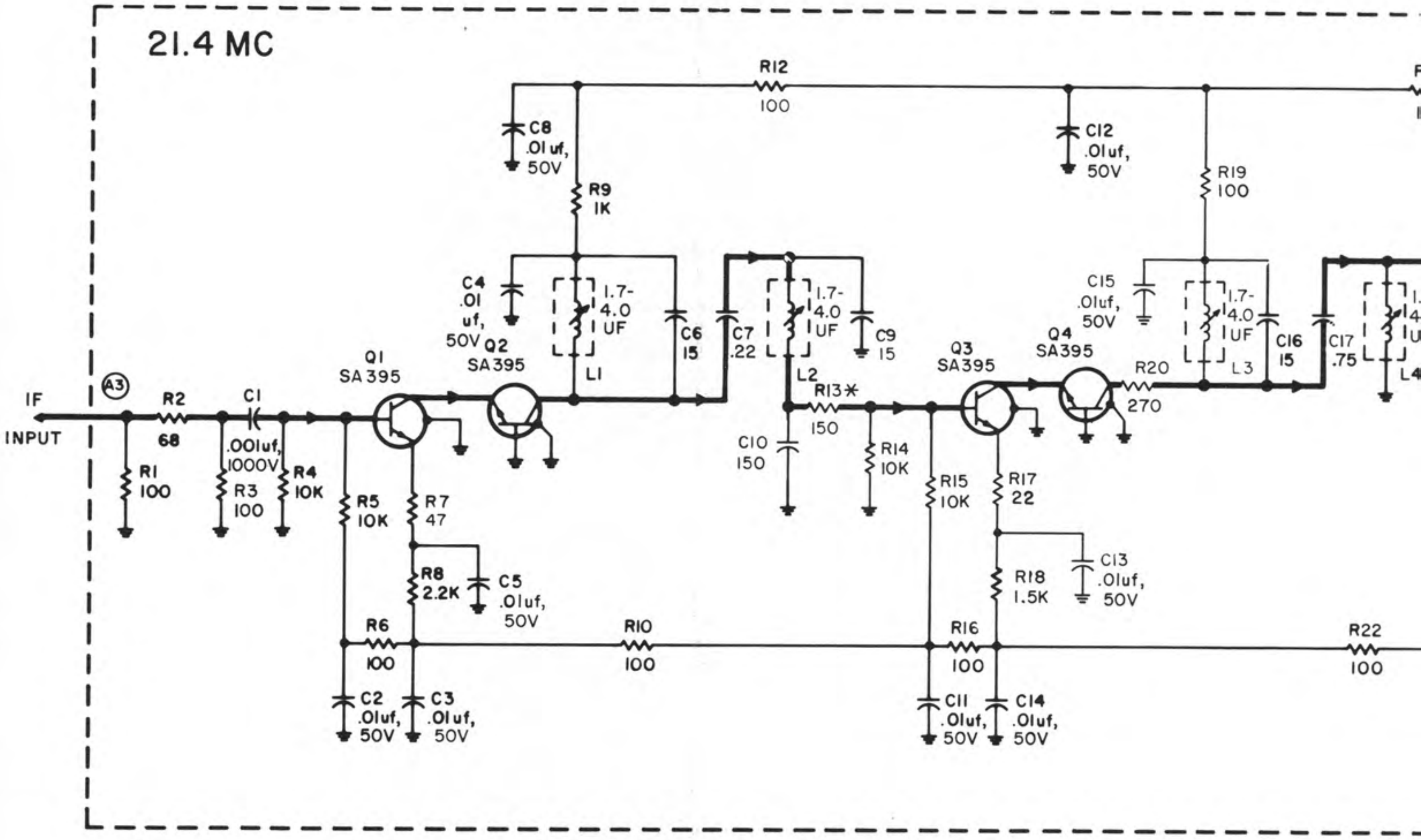


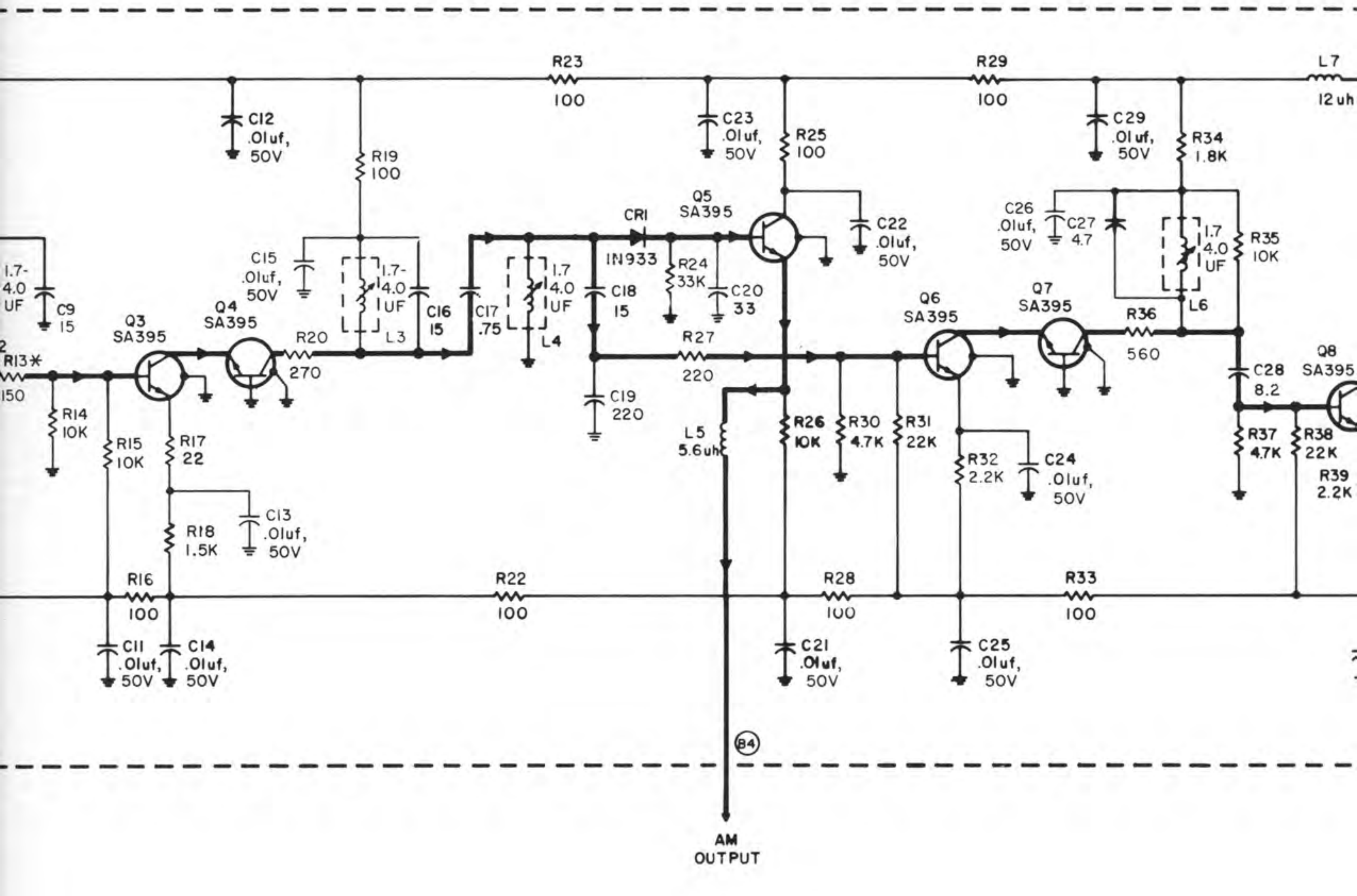
Figure 7-9A. IF Amplifier, IF-212-500



PINS A1, A2, A4, A5, A6, A7, A8, A9 AND B5, B6, B7, B9 AND B11 ARE GROUNDED.
* NOMINAL

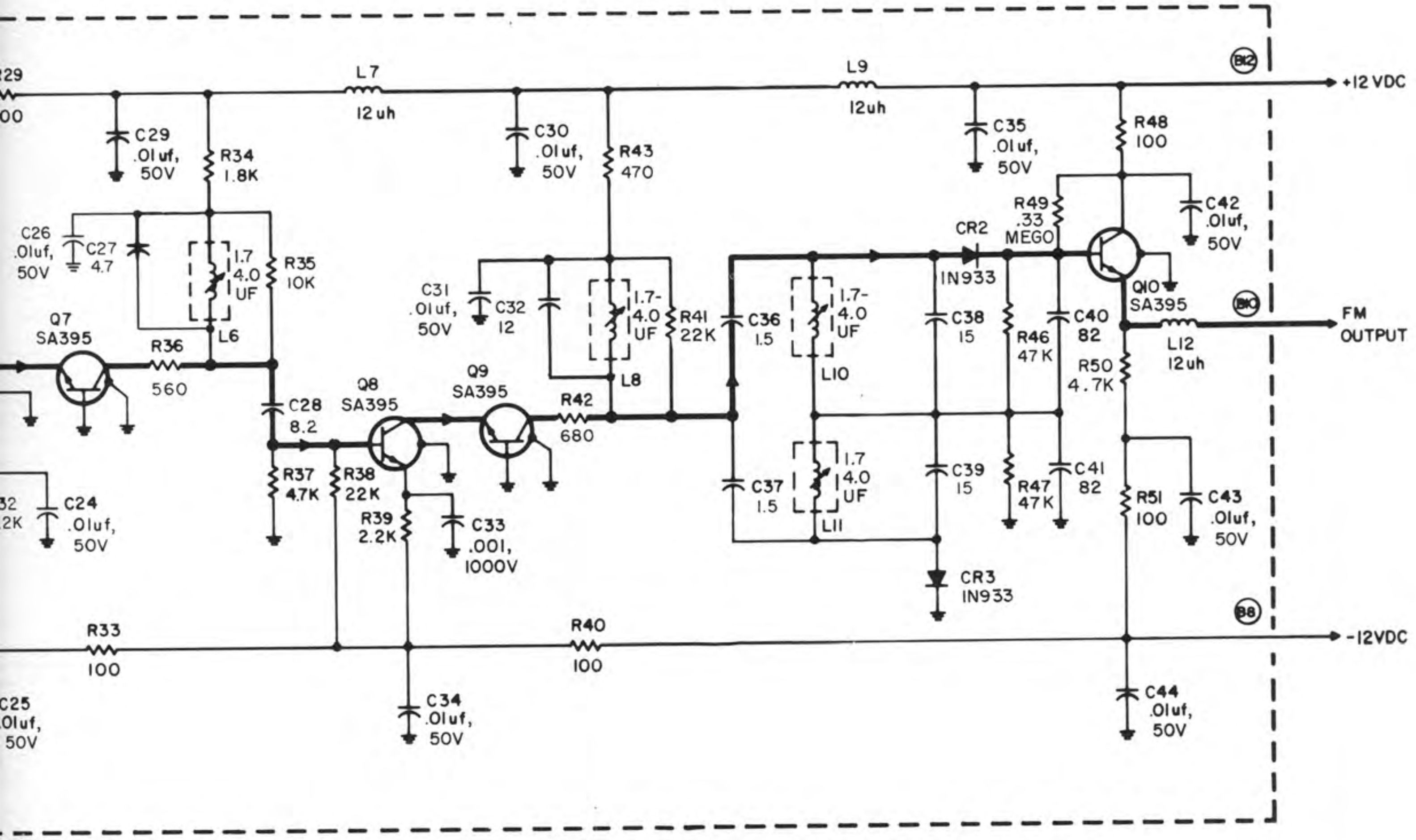
500KC BA

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
ALL CAPACITOR VALUES ARE IN UUF, 500 WVDC.



500KC BANDWIDTH IF AMPLIFIER IF-212-500

: SPECIFIED:
ALUES ARE IN OHMS, 1/4 W, 5%.
VALUES ARE IN UUF, 500 WVDC.



IF-212-500

Figure 7-9B. IF Amplifier, IF-212-500, Schematic Diagram