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
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	F	4-6	4-7
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	H	4-7	4-8
	I	4-7	4-8
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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:

Table		Page
5-7.1	Isolation Amplifier, ISA-203 Minimum Performance Standards	5-8.1

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)

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

11. Page 5-23, table 5-19

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

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

Under the NOTES, 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

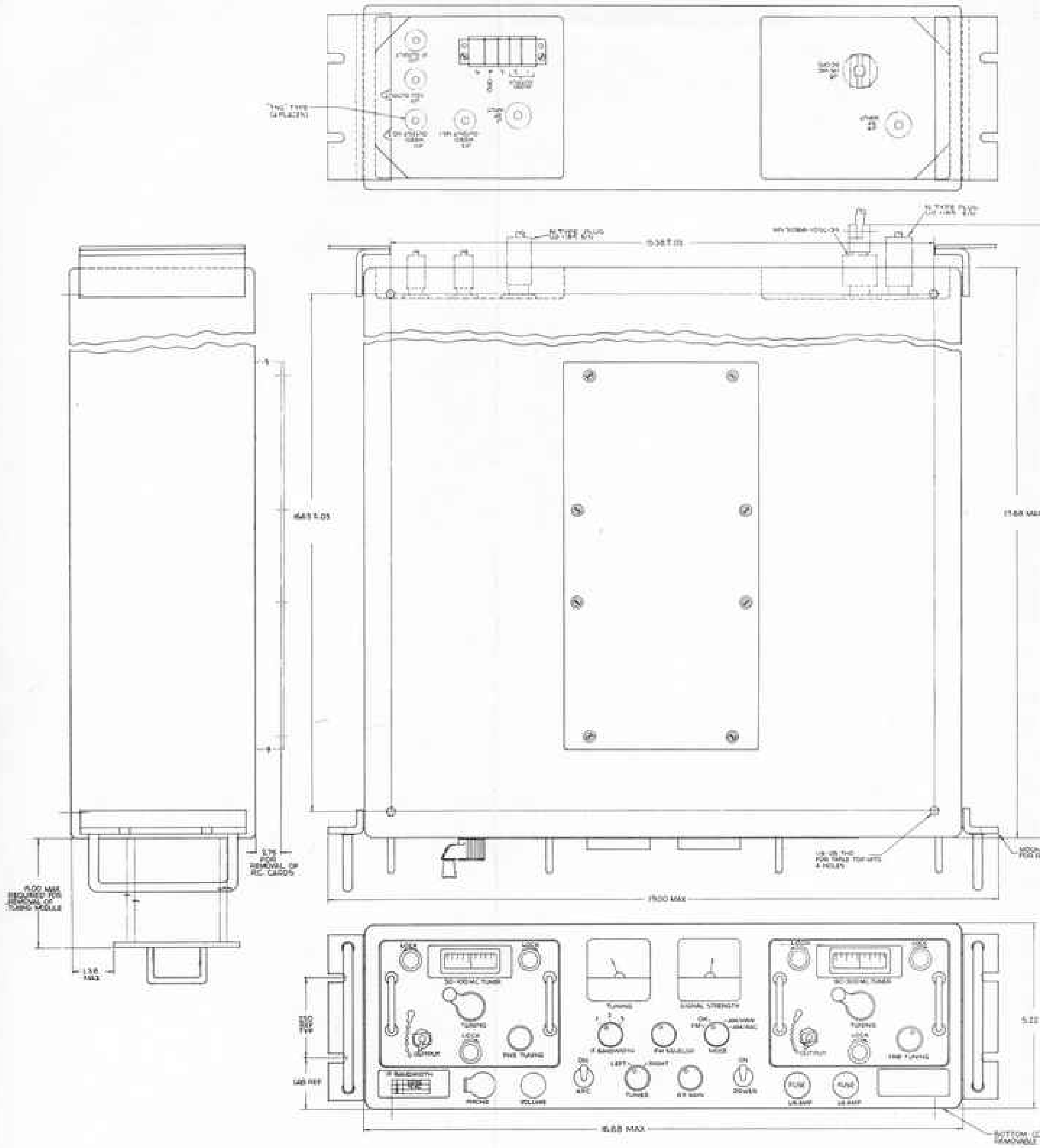
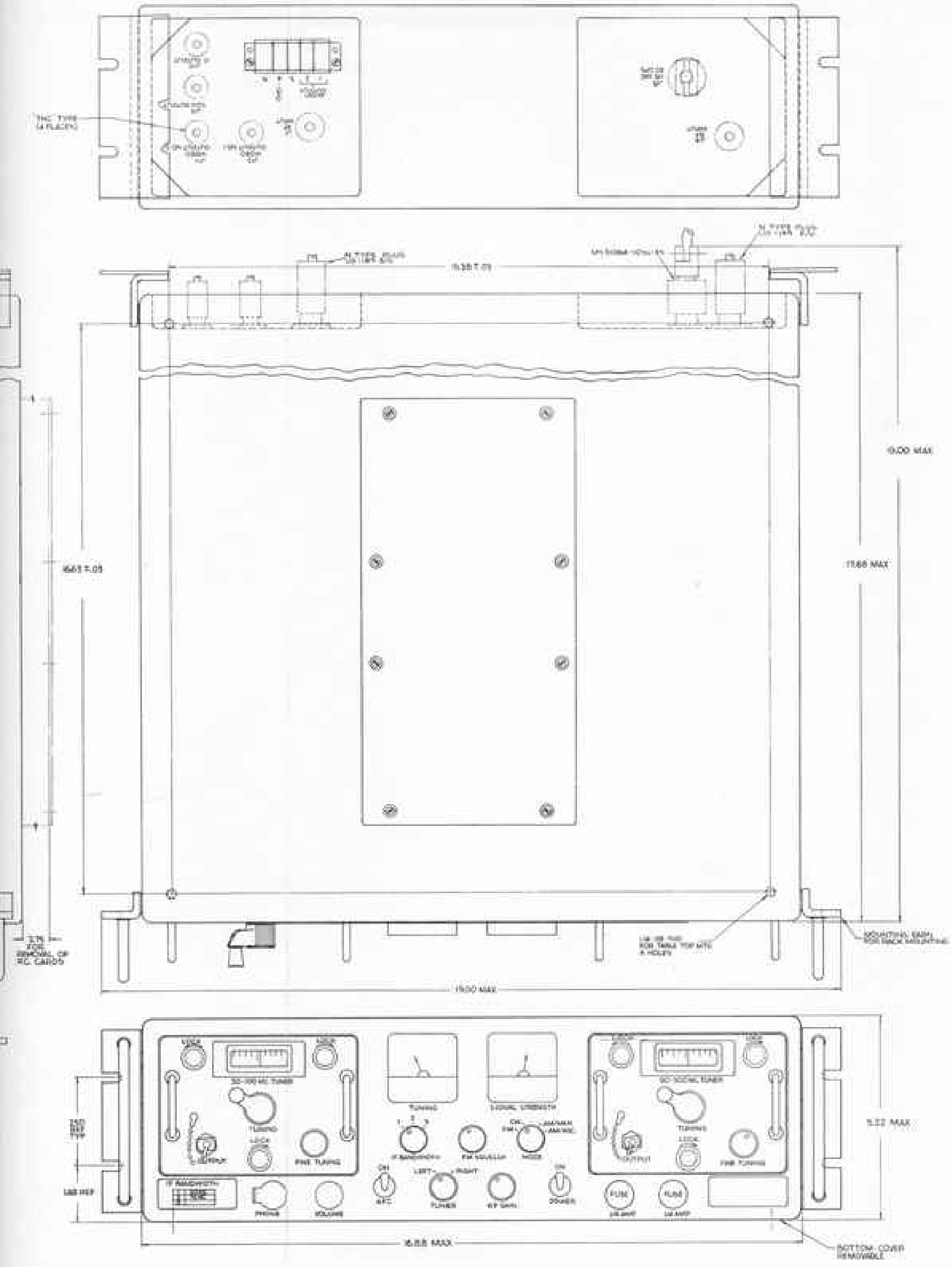


Figure 3-1. Installation Planning Diagram



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.

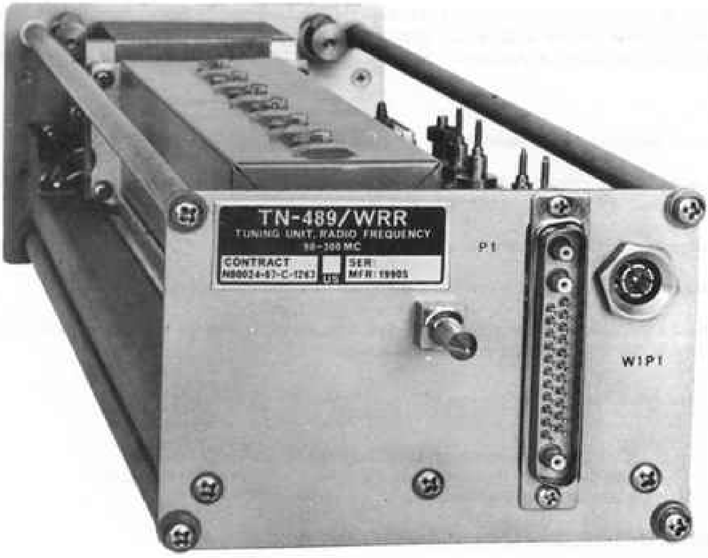


Figure 3-2. Typical Tuning Unit Showing Rear Panel Mating Connectors

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.

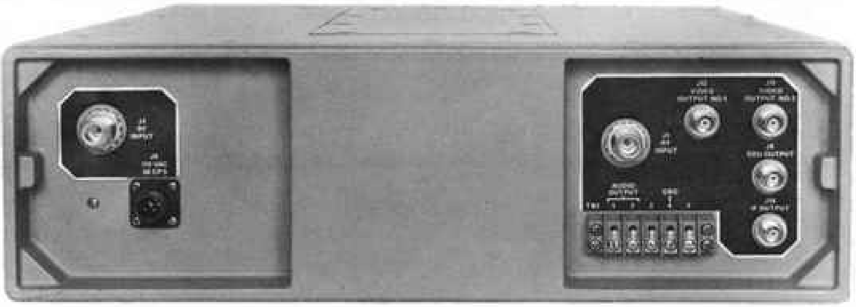


Figure 3-3. Receiver, Rear Panel View

(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.

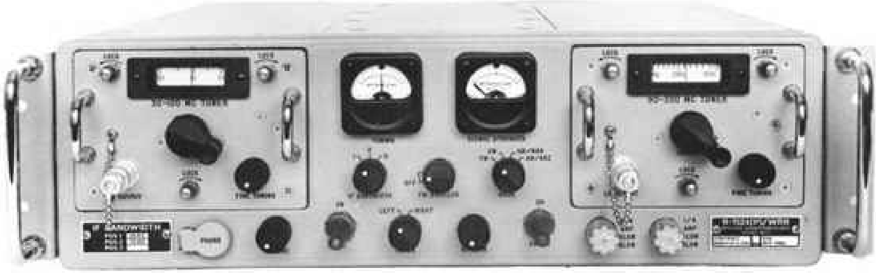


Figure 3-4. Operators Controls and Indicators

(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.

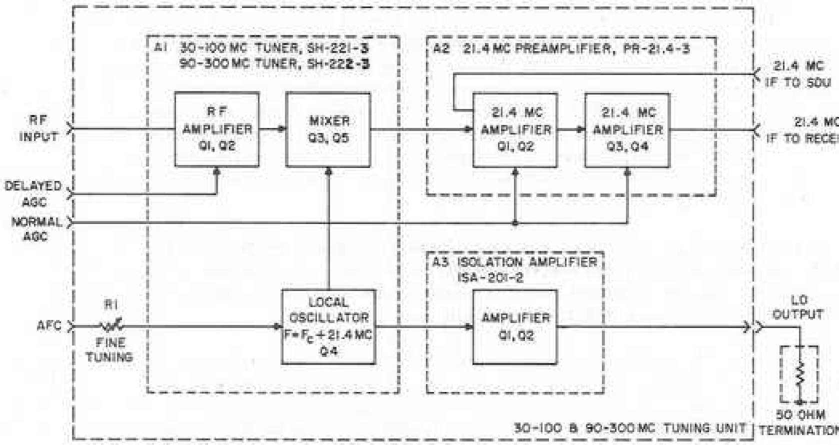


Figure 4-3. Tuning Unit Functional Block Diagram

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 Meg Ω (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 K Ω (R x 1 K)	9.1 K Ω (R x 1 K)	5.4 K (15 V)	8.9 K Ω (R x 1 K)	12.0 Meg Ω (R x 1 Meg)	9.8 V (15 V)	3.5 K Ω (R x 1 K)	3.1 K Ω (R x 1 K)
Q2	-5.6 V (15 V)	6.8 K Ω (R x 1 K)	6.8 K Ω (R x 1 K)	-5.2 V (15 V)	5.6 K Ω (R x 1 K)	5.6 K Ω (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 K Ω (R x 1 K)	80.0 Ω (R x 10)
Q4	-5.9 V (15 V)	4.1 K Ω (R x 1 K)	4.1 K Ω (R x 1 K)	-5.3 V (15 V)	5.6 K Ω (R x 1 K)	5.6 K Ω (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 K Ω (R x 1 K)	3.1 K Ω (R x 1 K)
Q6	5.3 V (15 V)	10.0 K Ω (R x 1 K)	9.1 K Ω (R x 1 K)	5.2 V (15 V)	6.3 K Ω (R x 1 K)	3.0 K Ω (R x 1 K)	11.5 V (50 V)	500 Meg Ω (R x 1 Meg)	9.6 K Ω (R x 1 K)
Q7	-1.0 V (1.5 V)	6.7 K Ω (R x 1 K)	7.2 K Ω (R x 1 K)	-0.34 V (0.5 V)	9.0 K Ω (R x 1 K)	17.0 K Ω (R x 1 K)	10.9 V (15 V)	3.5 K Ω (R x 1 K)	3.2 K Ω (R x 1 K)
Q8	-2.6 V (5 V)	4.1 K Ω (R x 1 K)	4.1 K Ω (R x 1 K)	-1.9 V (5 V)	3.4 K Ω (R x 1 K)	3.4 K Ω (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 K Ω (R x 1 K)	4.1 K Ω (R x 1 K)
Q10	-0.7 V (1.5 V)	12.0 K Ω (R x 1 K)	10.5 K Ω (R x 1 K)	0.13 V (0.5 V)	8.5 K Ω (R x 1 K)	83.0 K Ω (R x 10 K)	11.1 V (15 V)	3.2 K Ω (R x 1 K)	3.0 K Ω (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	89.0Ω (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)	89.0Ω (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 MegΩ (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 selecter 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.

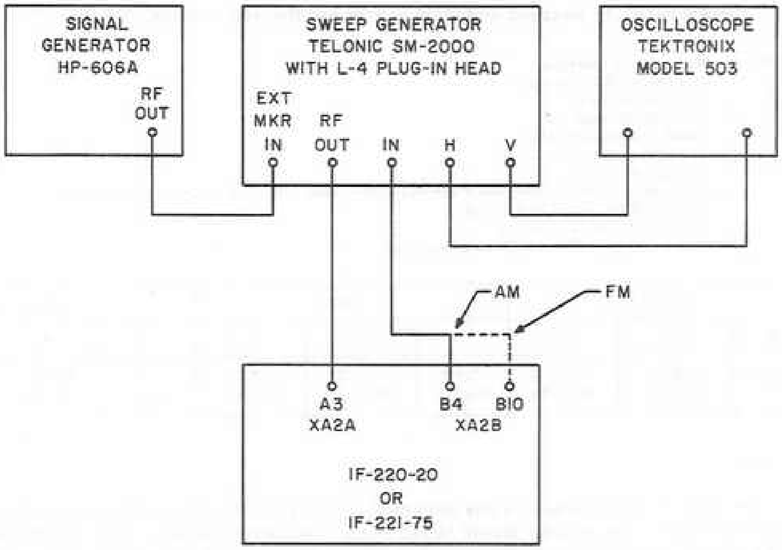


Figure 5-1. IF Amplifier Test Set-Up

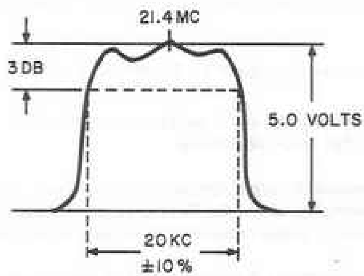


Figure 5-2. IF-220-20 AM Response

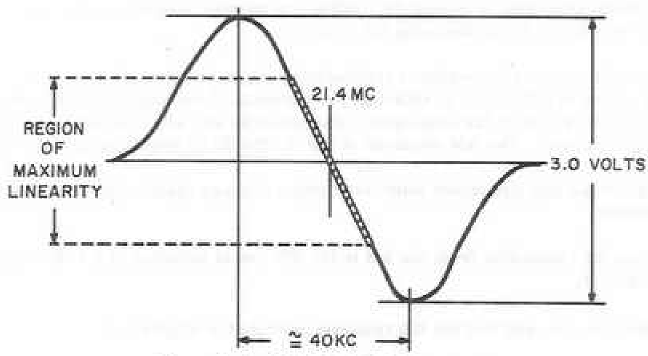


Figure 5-3. IF-220-20 FM Response

(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.

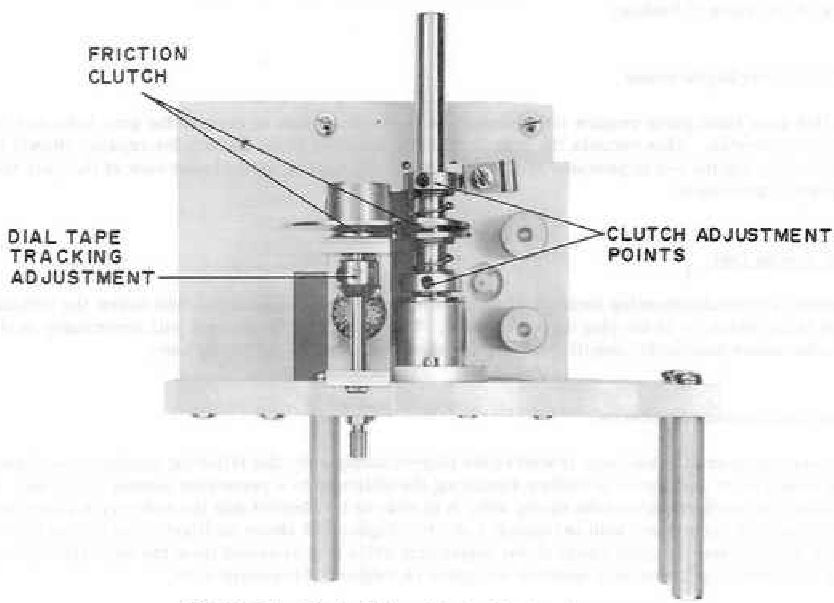


Figure 5-4. Typical Gear Train Clutch Adjustment Points.

(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.

<u>6. 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.

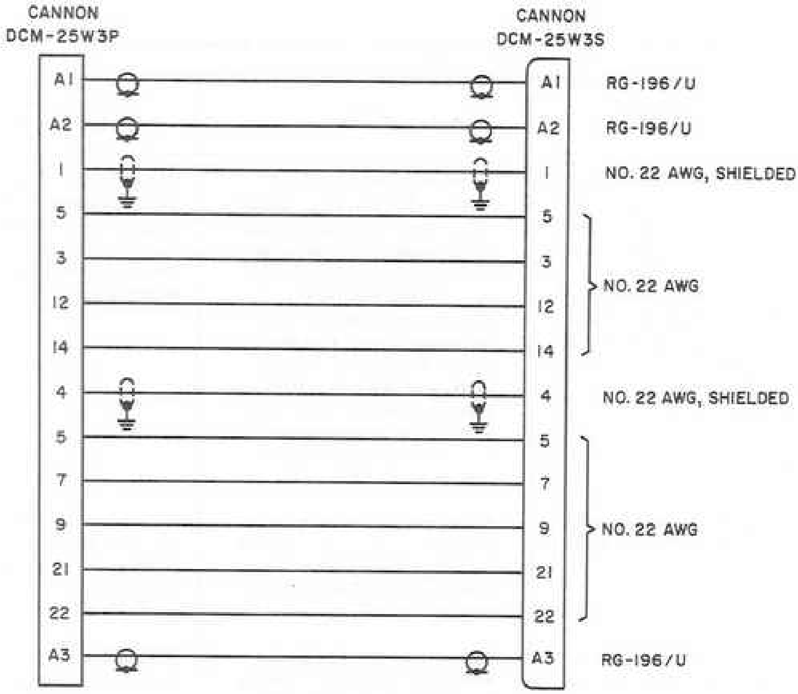


Figure 5-6. Power Extender Cable

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 50Ω 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 50Ω 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 50Ω 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	5.2 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)	-0.75 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.

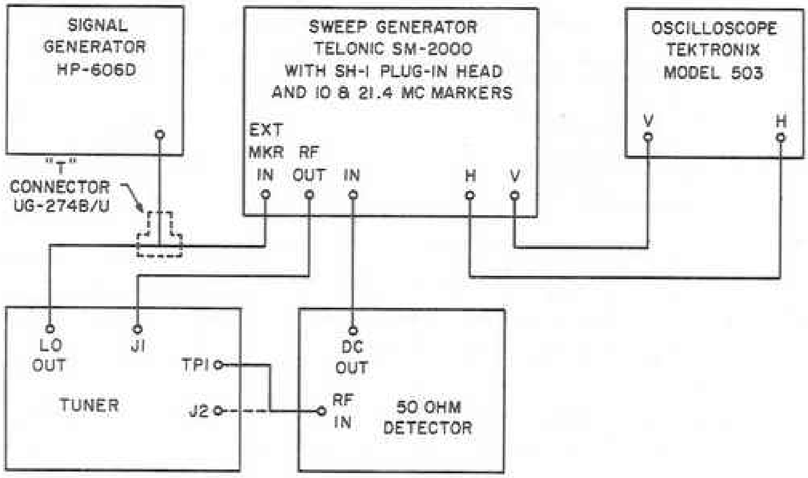


Figure 5-7. Tuner Alignment Test Set-Up

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.

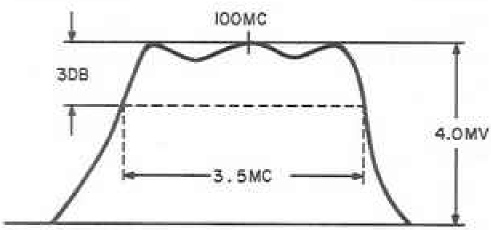


Figure 5-8. RF Response of 30 to 100 mc Tuner

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.

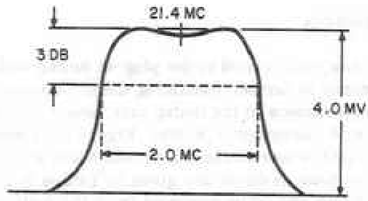


Figure 5-9. IF Response of 30 to 100 mc Tuner

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.

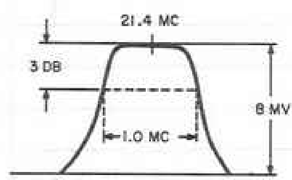


Figure 5-10. 21.4 mc Preamplifier Response

(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

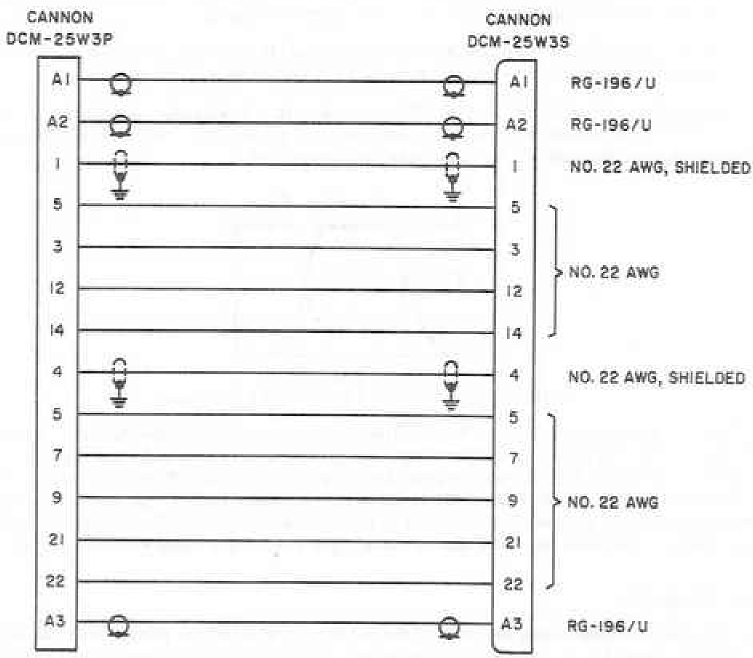


Figure 5-11. Power Extender Cable

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.

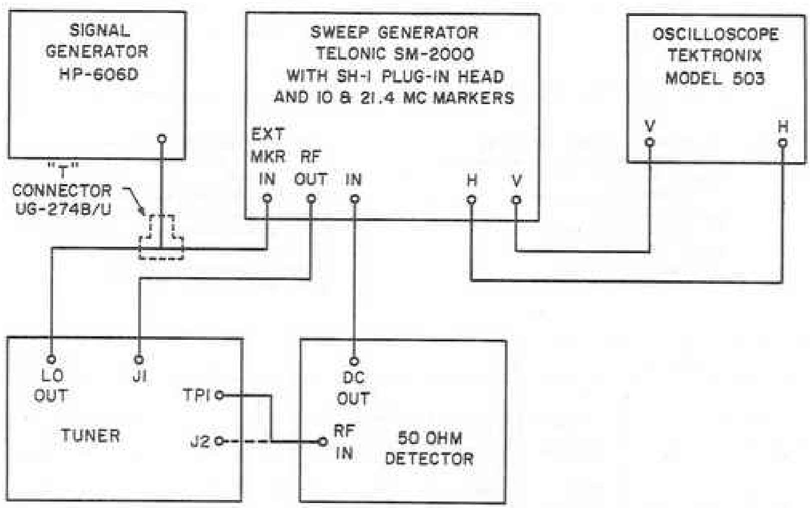


Figure 5-12. Tuner Alignment Test Set-Up

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.

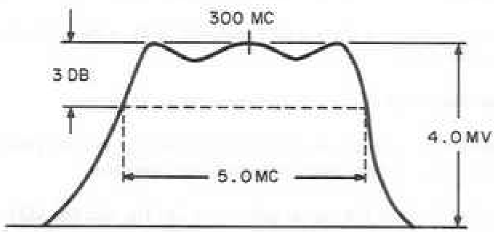


Figure 5-13. RF Response of 90 to 300 mc Tuner

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.

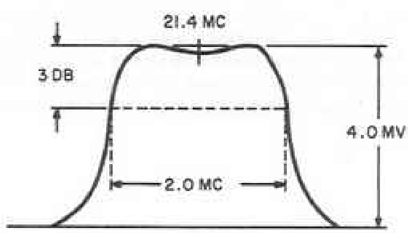


Figure 5-14. IF Response of 90 to 300 mc Tuner

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.

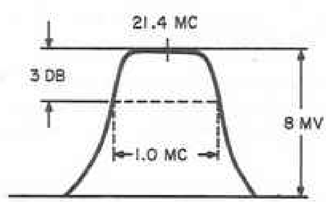


Figure 5-15. 21.4 mc Preamplifier Response

(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

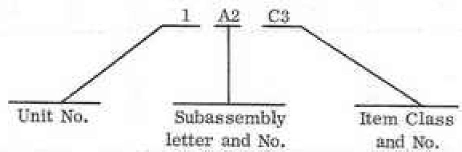
PARTS AND MANUFACTURER'S LIST

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.

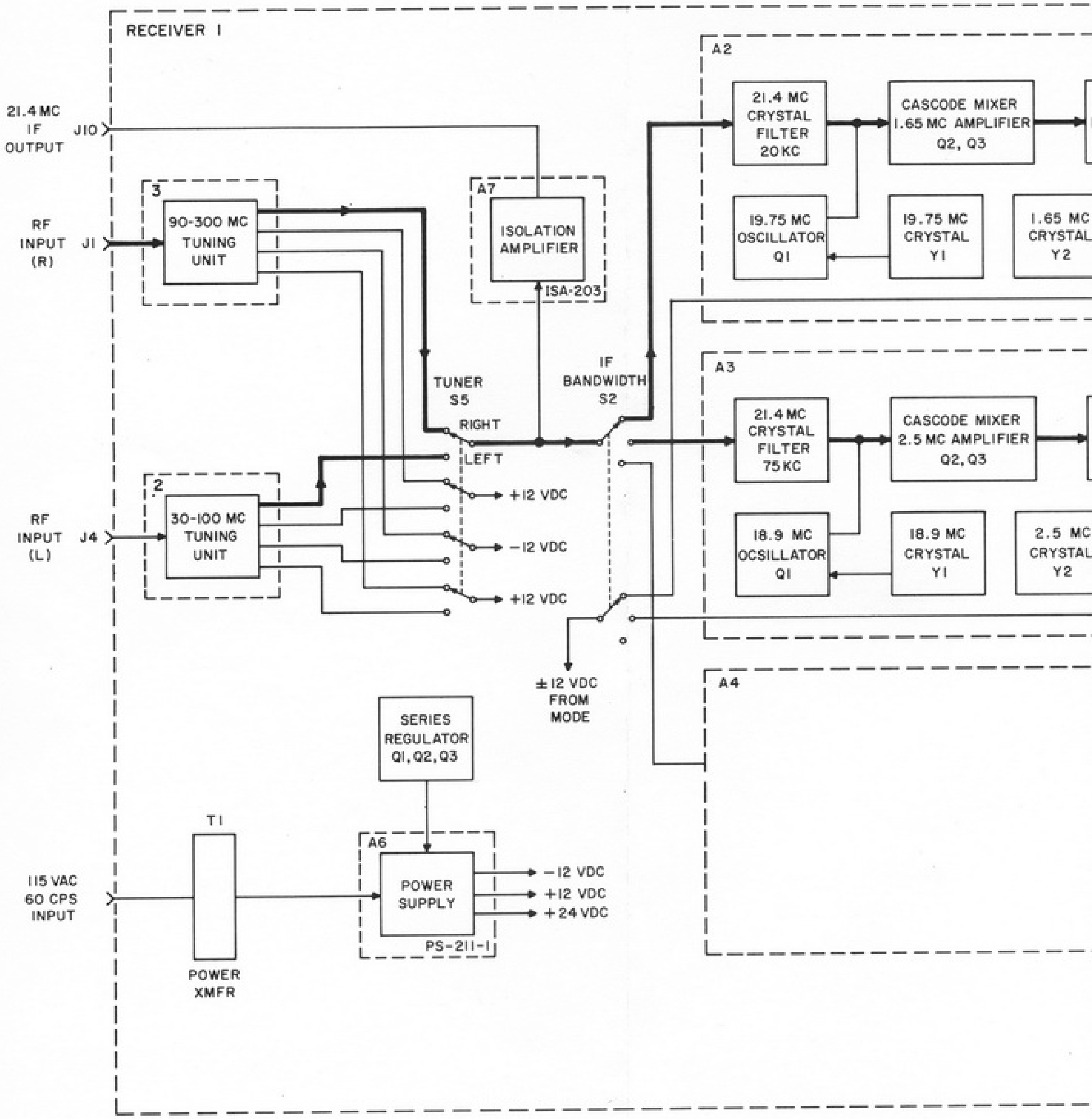
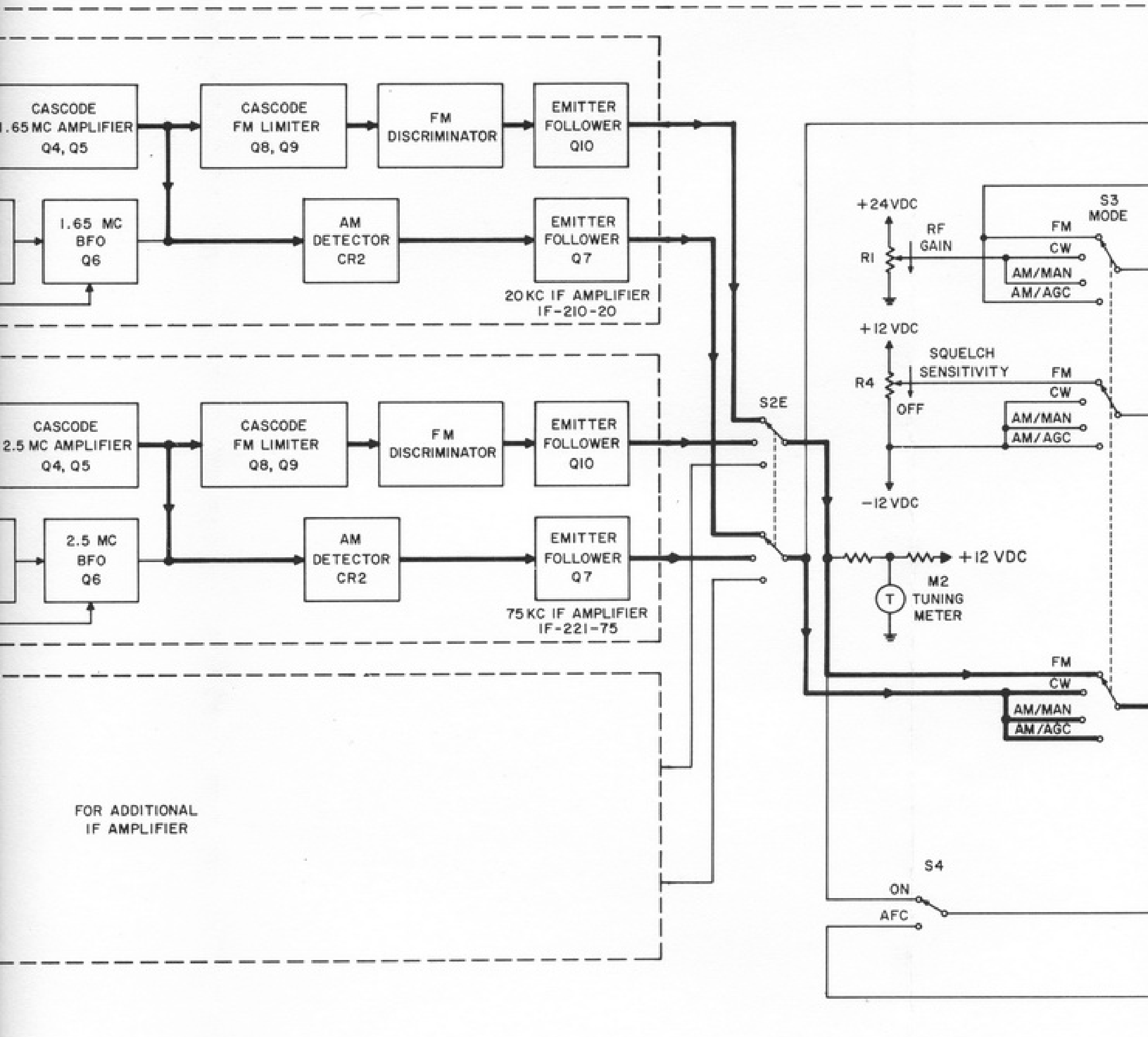
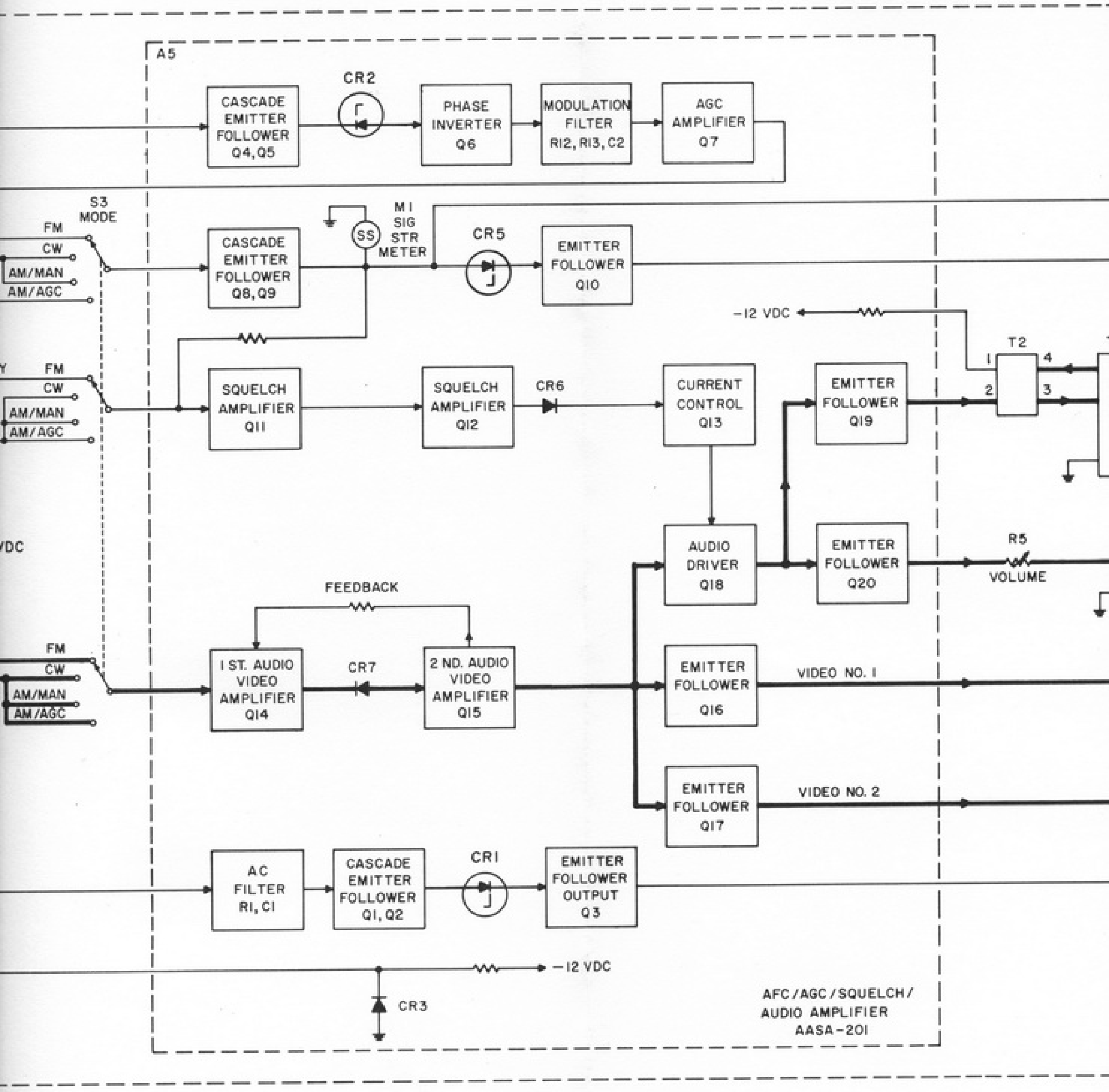
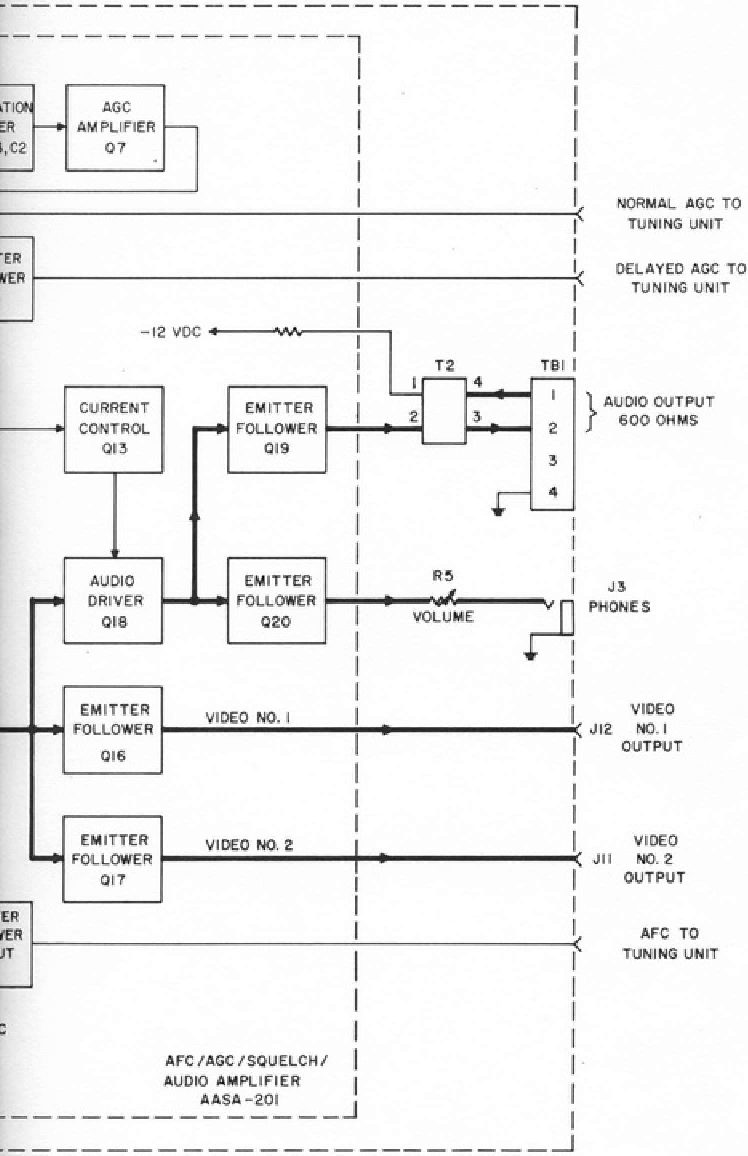
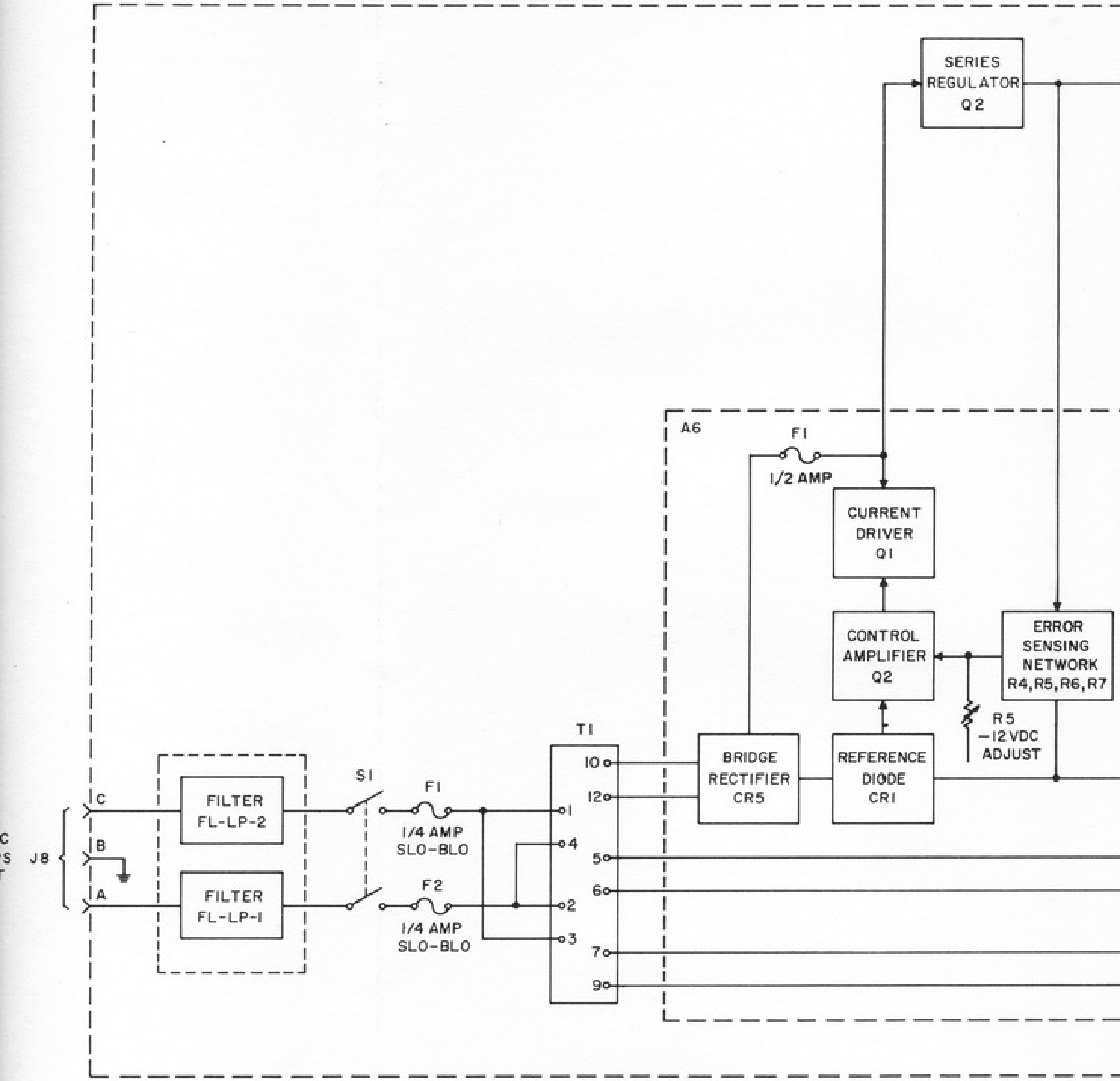


Figure 4-1. Receiver Functional Block Diagram

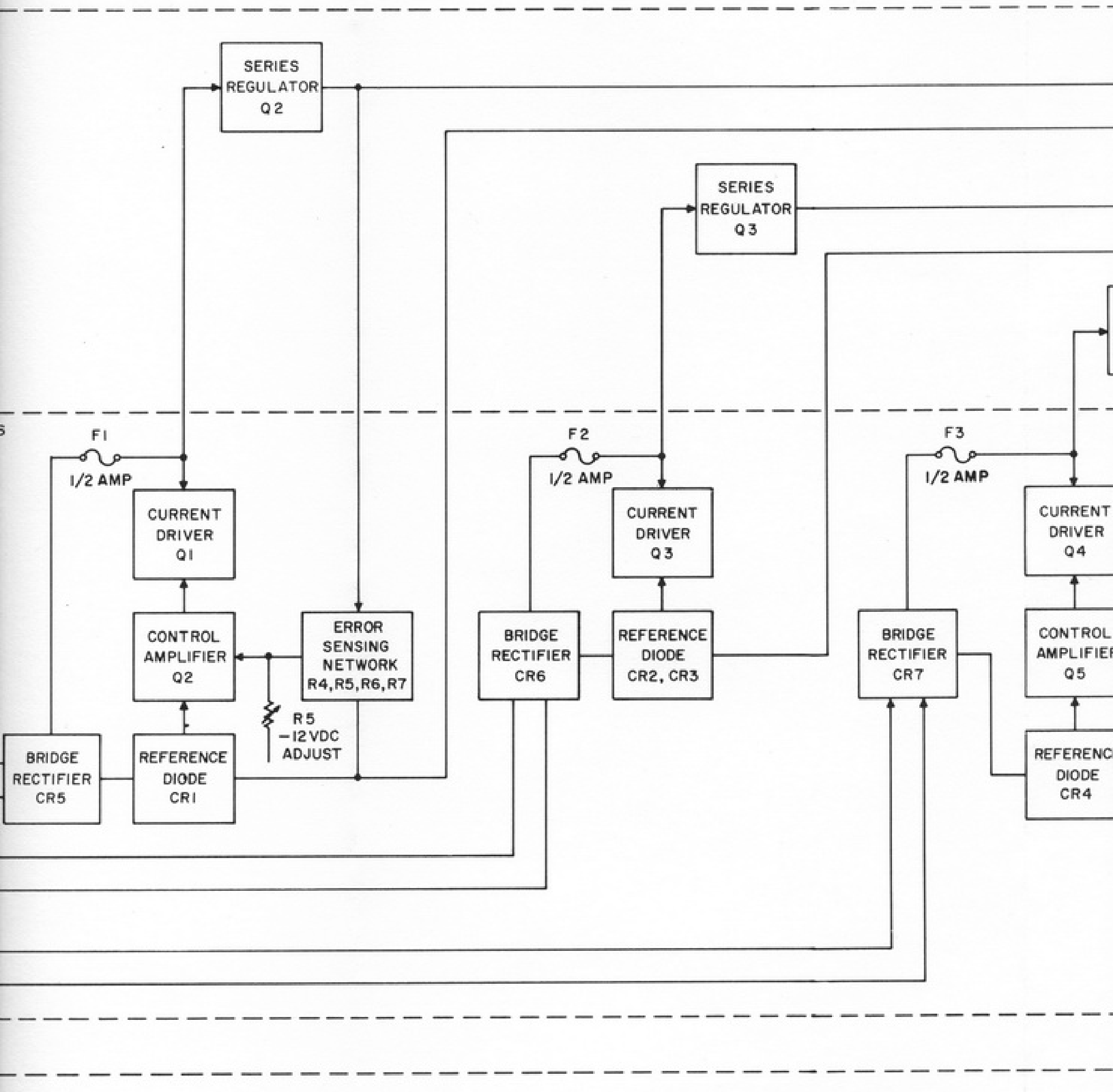

CASCODE
1.65 MC AMPLIFIER
Q4, Q5
CASCODE
FM LIMITER
Q8, Q9
FM
DISCRIMINATOR
EMITTER
FOLLOWER
Q10
1.65 MC
BFO
Q6
AM
DETECTOR
CR2
EMITTER
FOLLOWER
Q7
20 KC IF AMPLIFIER
IF-210-20
CASCODE
2.5 MC AMPLIFIER
Q4, Q5
CASCODE
FM LIMITER
Q8, Q9
FM
DISCRIMINATOR
EMITTER
FOLLOWER
Q10
2.5 MC
BFO
Q6
AM
DETECTOR
CR2
EMITTER
FOLLOWER
Q7
75 KC IF AMPLIFIER
IF-221-75
FOR ADDITIONAL
IF AMPLIFIER
S2E
+24 VDC
RF
GAIN
R1
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
SQUELCH AMPLIFIER Q11
SQUELCH AMPLIFIER Q12
CR6
CURRENT CONTROL Q13
EMITTER FOLLOWER Q19
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
3, C2
AGC
AMPLIFIER
Q7
NORMAL AGC TO
TUNING UNIT
TER
WER
DELAYED AGC TO
TUNING UNIT
-12 VDC
T2
TB1
1
2
3
4
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
NO. 2
OUTPUT
TER
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
2
3
5
6
7
9
S1
F1
1/4 AMP SLO-BLO
F2
1/4 AMP SLO-BLO
FILTER FL-LP-2
FILTER FL-LP-1
J8
C
B
A


SERIES
REGULATOR
Q2
SERIES
REGULATOR
Q3
F1
1/2 AMP
CURRENT
DRIVER
Q1
CONTROL
AMPLIFIER
Q2
ERROR
SENSING
NETWORK
R4, R5, R6, R7
R5
-12VDC
ADJUST
BRIDGE
RECTIFIER
CR5
REFERENCE
DIODE
CR1
F2
1/2 AMP
BRIDGE
RECTIFIER
CR6
CURRENT
DRIVER
Q3
REFERENCE
DIODE
CR2, CR3
F3
1/2 AMP
BRIDGE
RECTIFIER
CR7
CURRENT
DRIVER
Q4
CONTROL
AMPLIFIER
Q5
REFERENC
DIODE
CR4

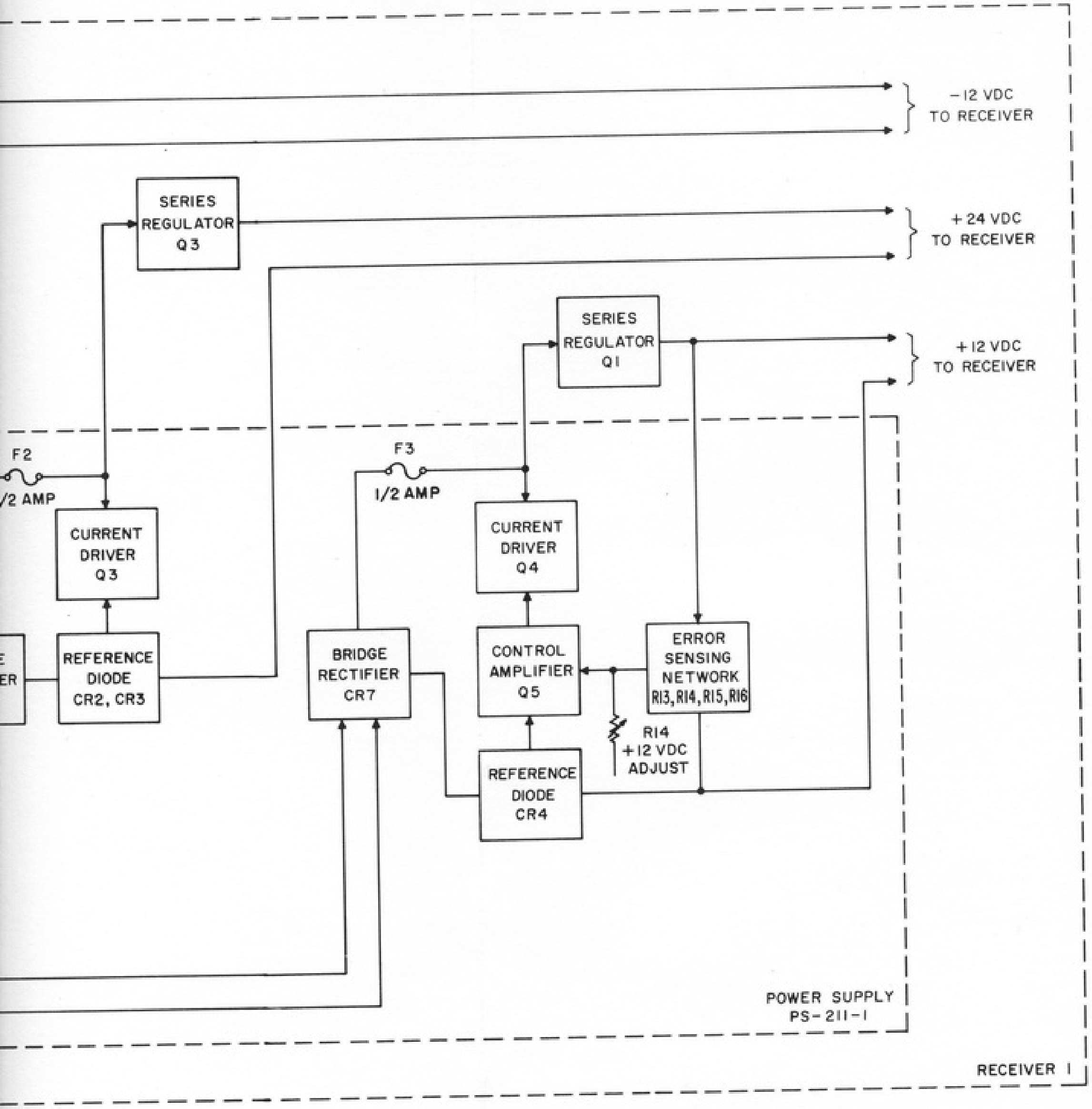
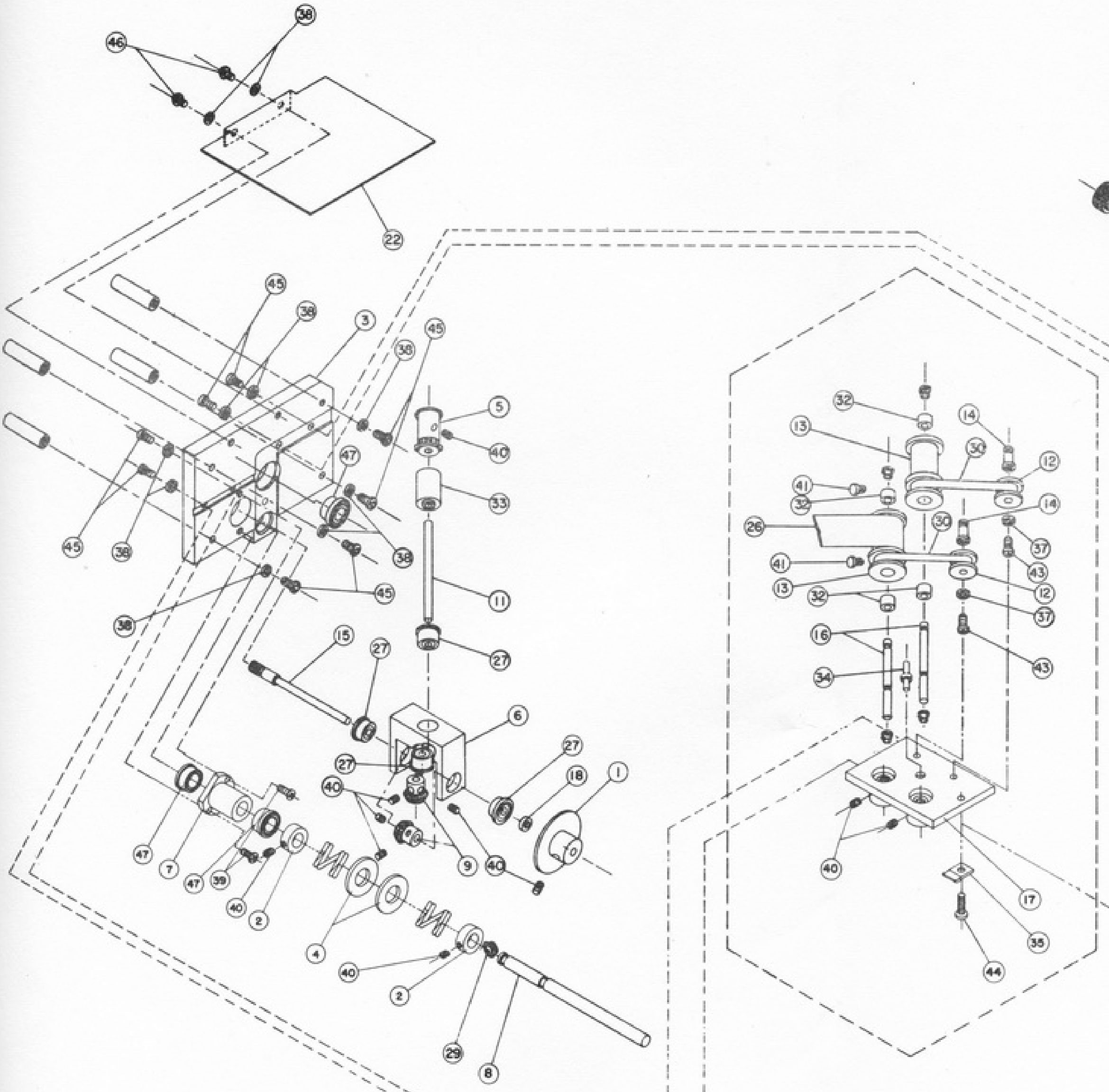
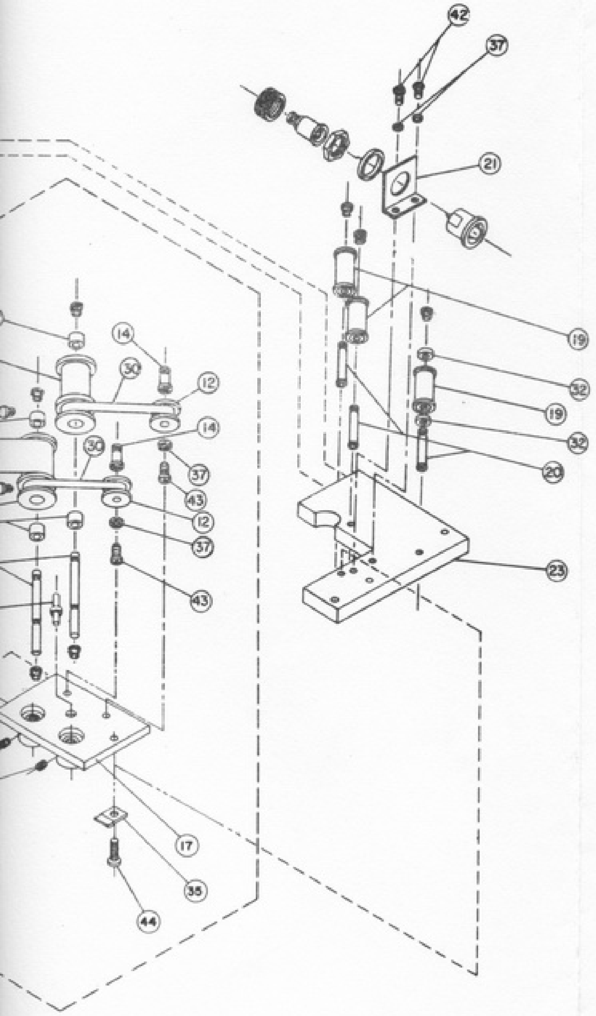


Figure 4-2. Power Supply, Functional Block Diagram


46
38
22
45
38
3
38
45
5
40
47
33
45
38
38
45
38
11
15
27
27
6
27
27
18
1
40
9
40
47
7
47
39
40
2
4
40
2
29
8
32
13
14
30
12
41
32
26
14
30
37
41
43
13
12
32
37
16
43
34
40
17
35
44



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	19903	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

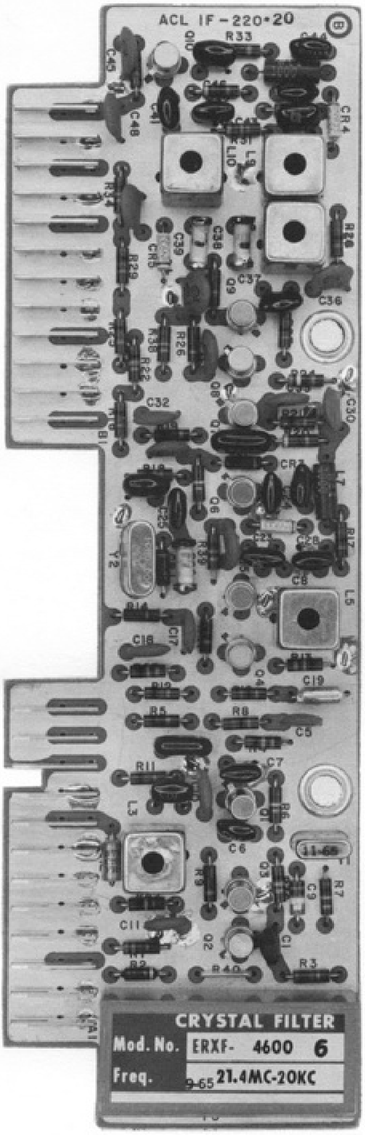
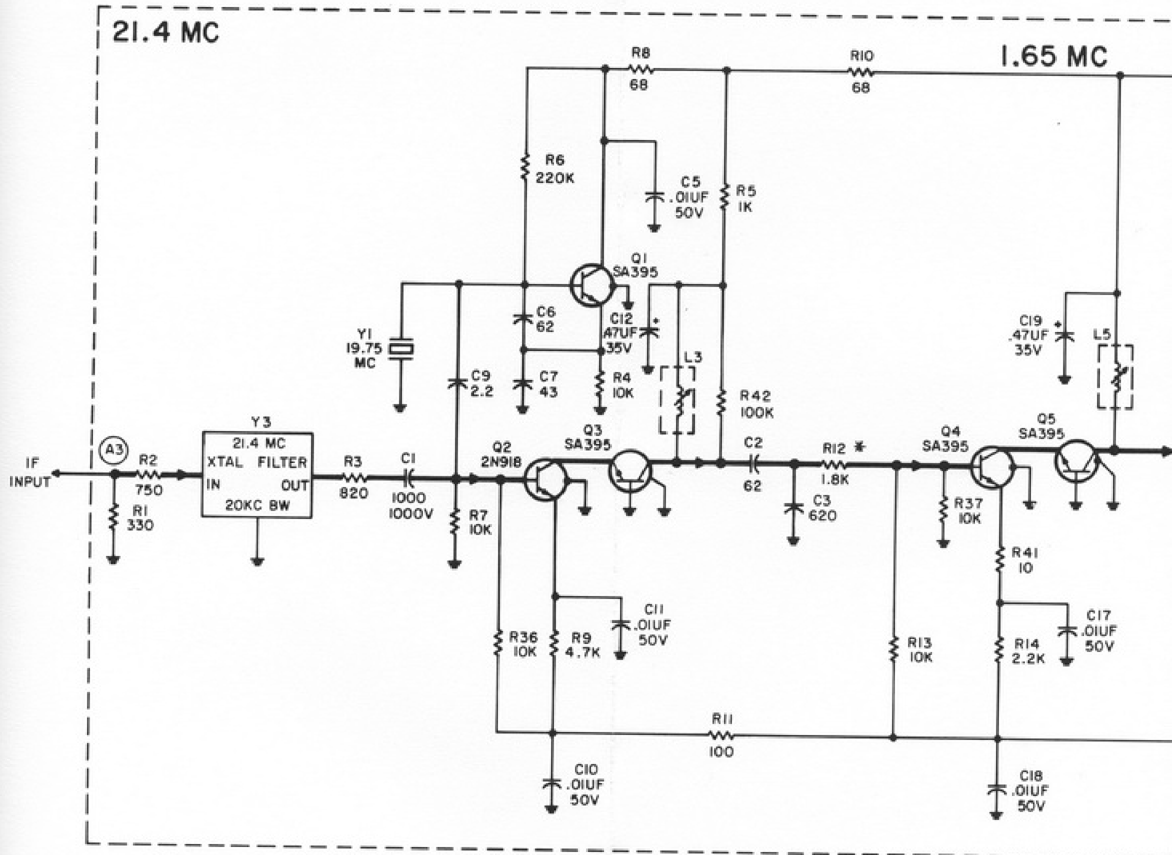
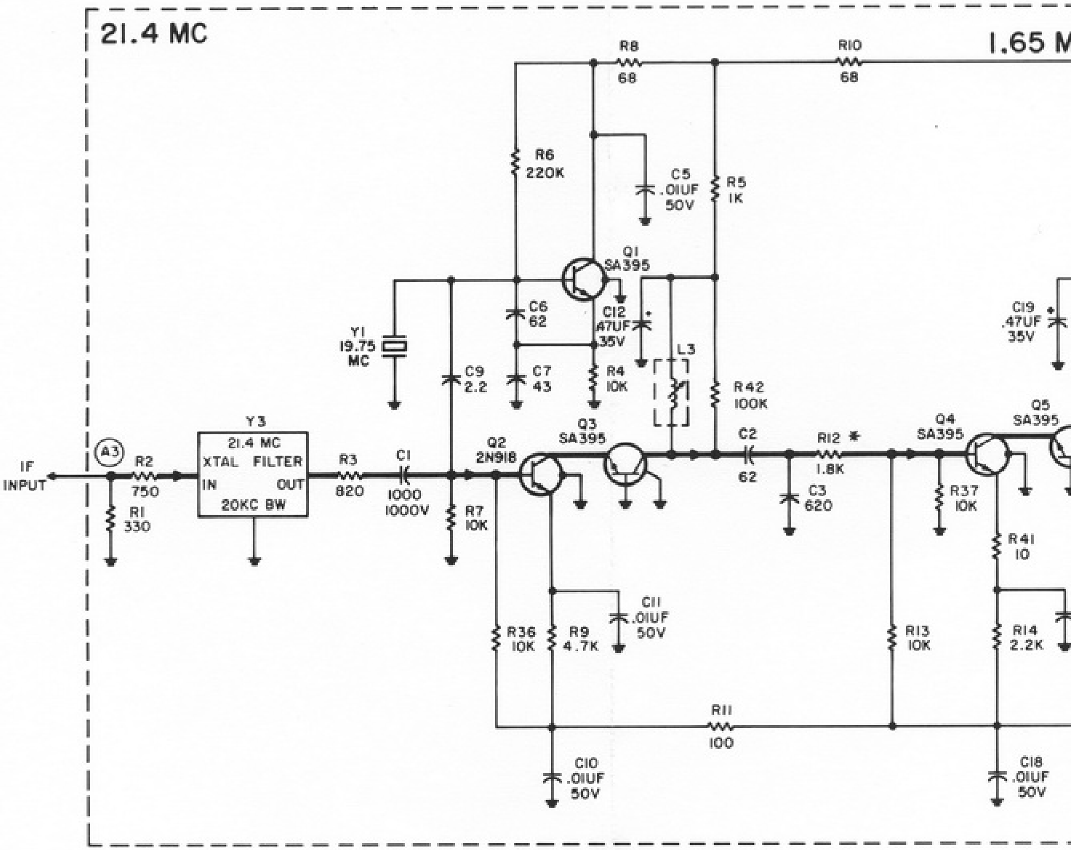


Figure 7-1A. IF-220-20 IF Amplifier



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

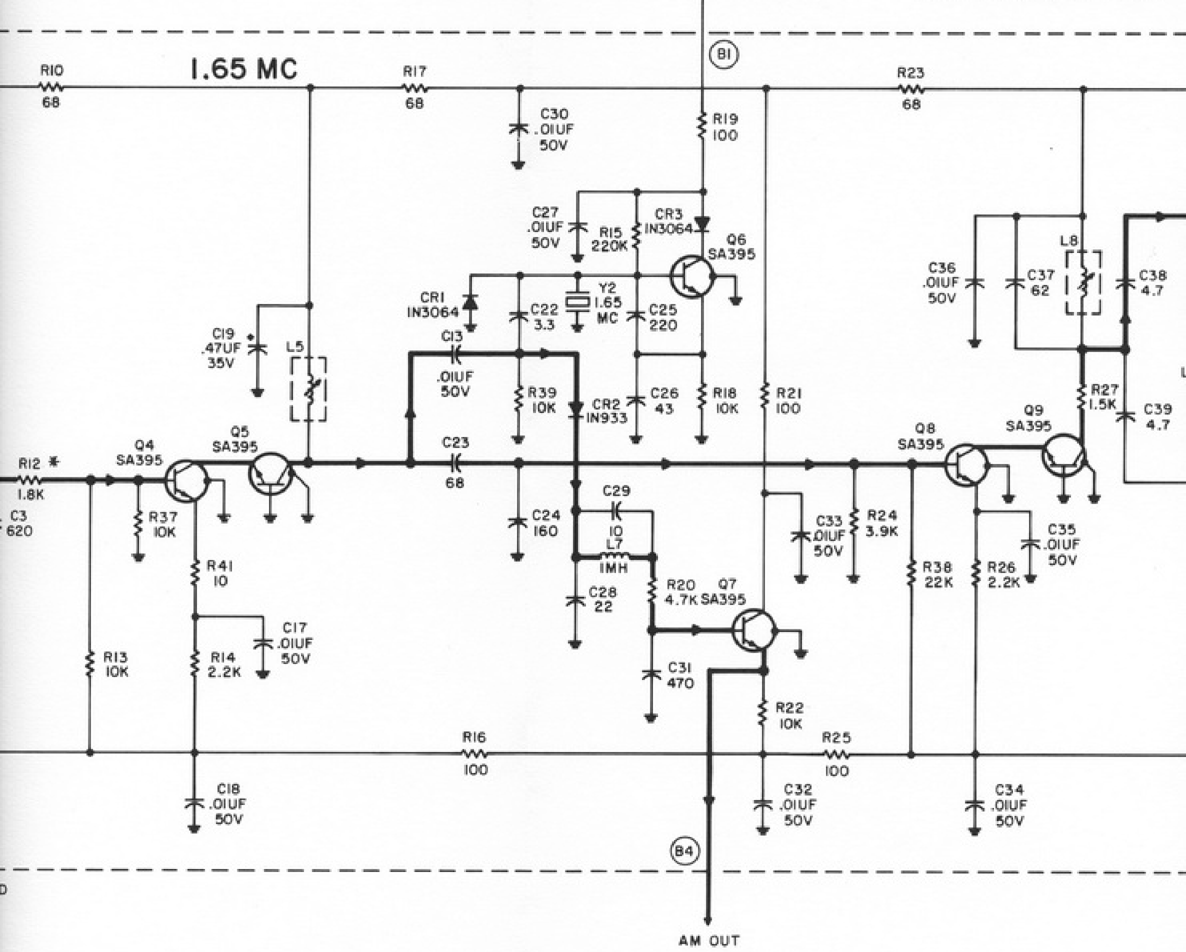
* NOMINAL



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.

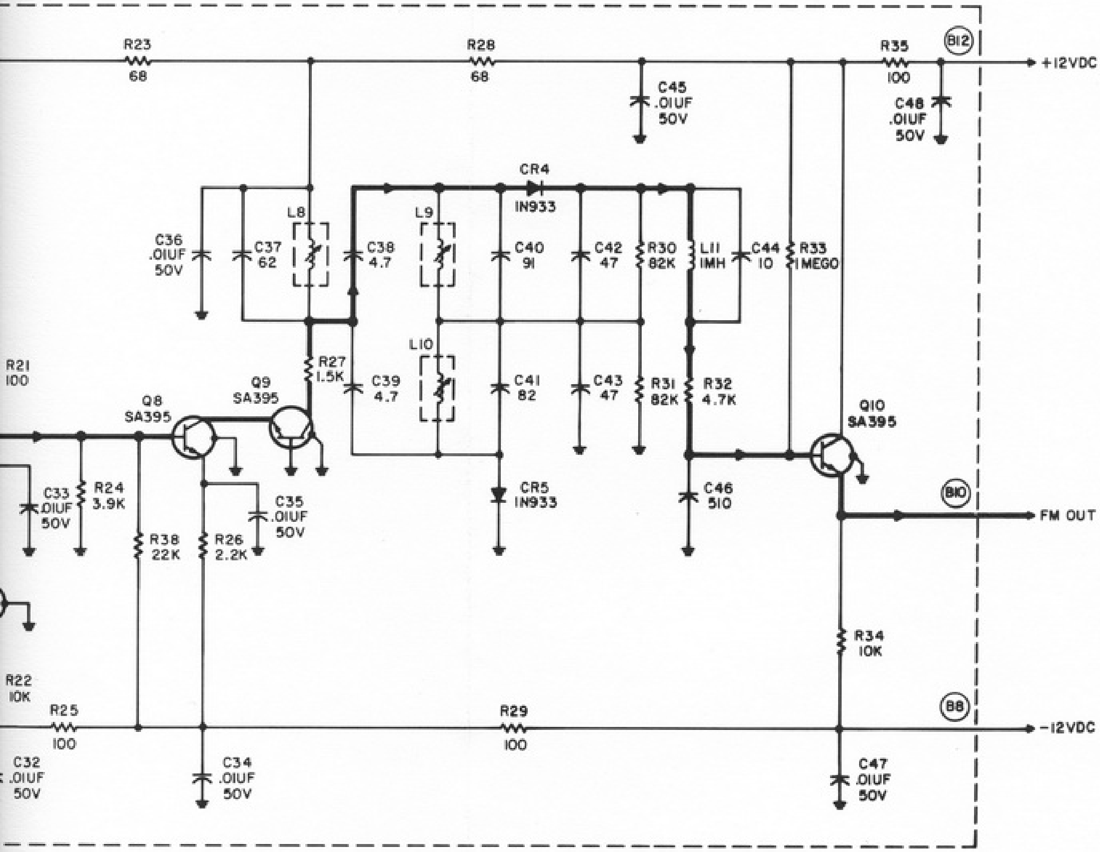


Figure 7-1B. IF-220-20, IF Amplifier, Schematic Diagram

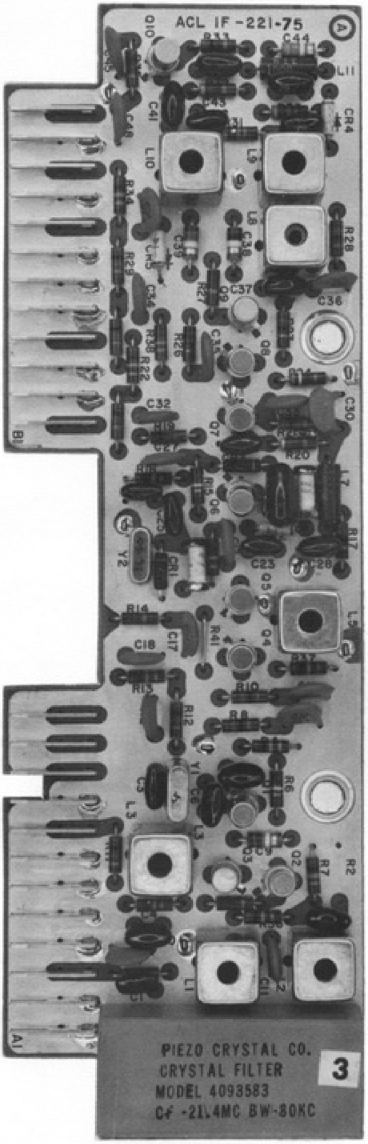
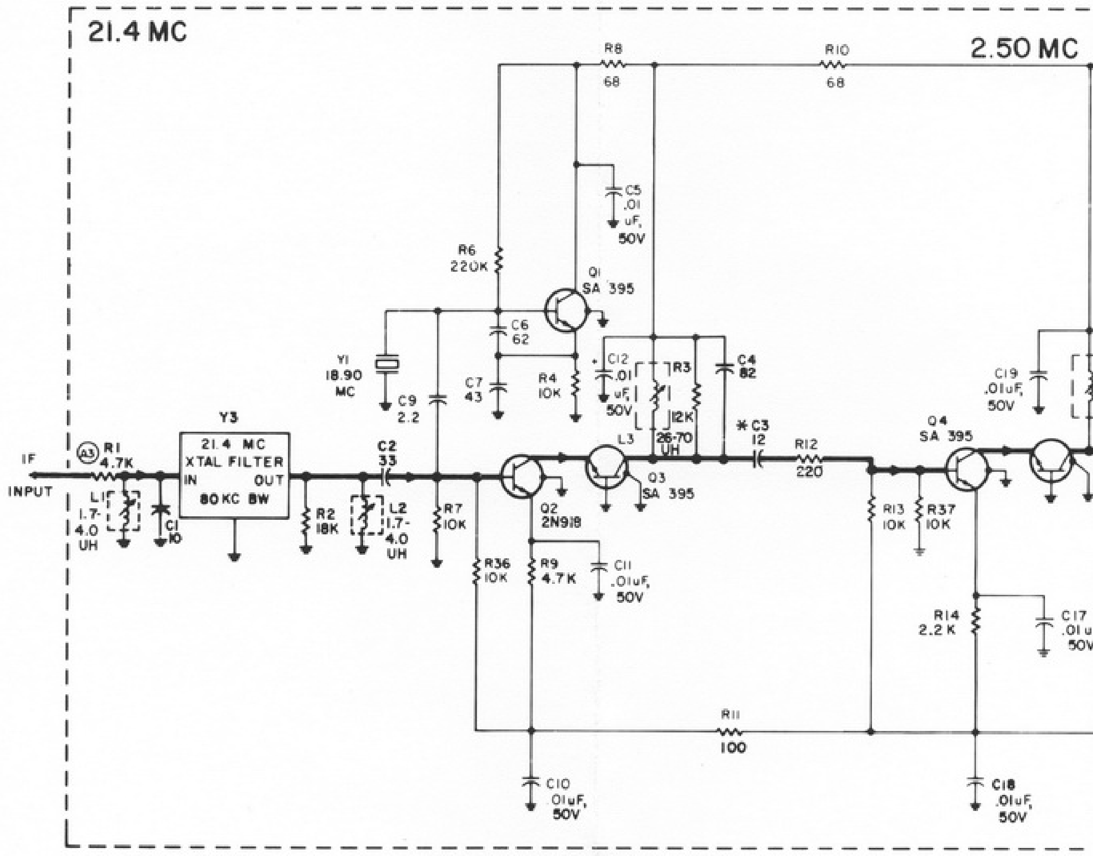


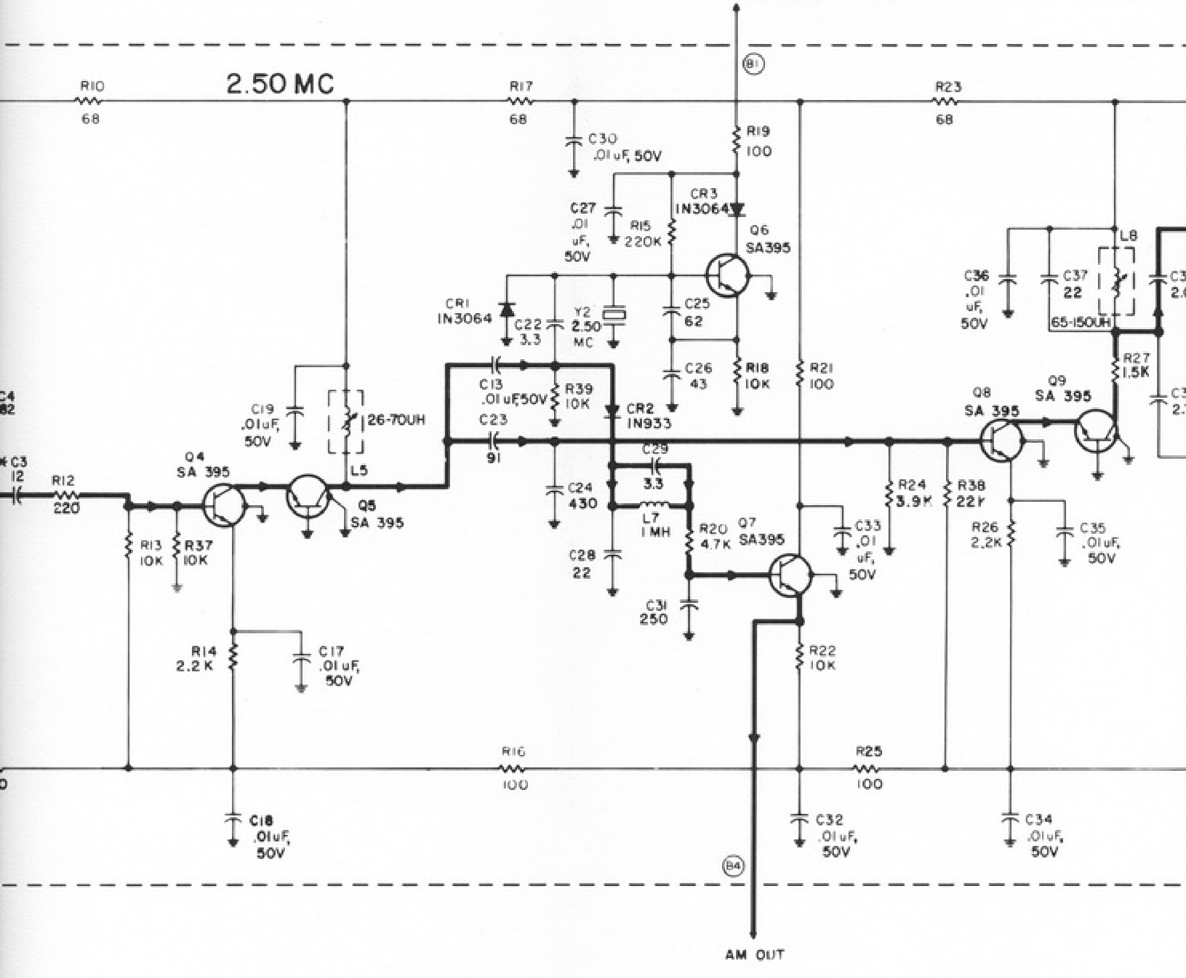
Figure 7-2A. IF-221-75 IF Amplifier



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



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

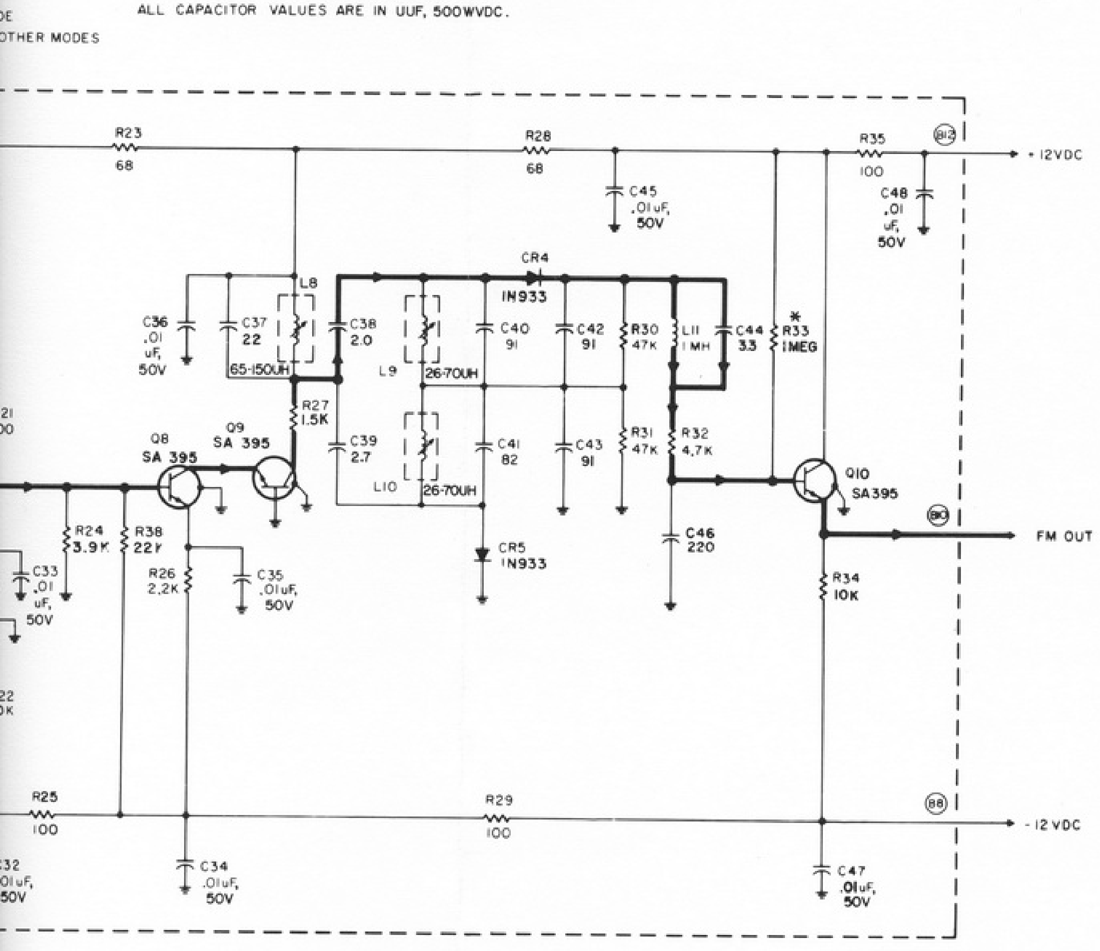


Figure 7-2B. IF-221-75, IF Amplifier, Schematic Diagram

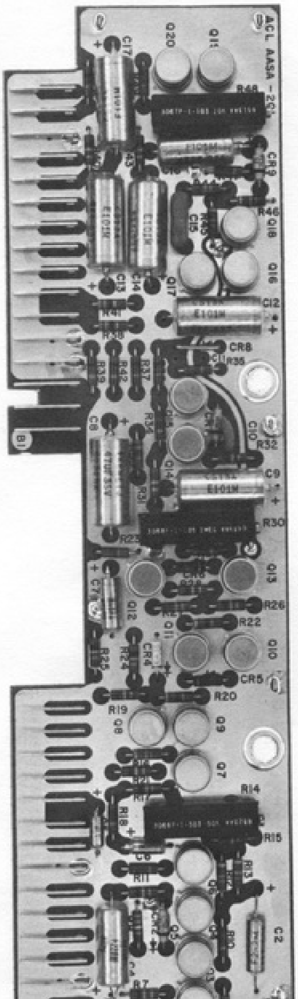
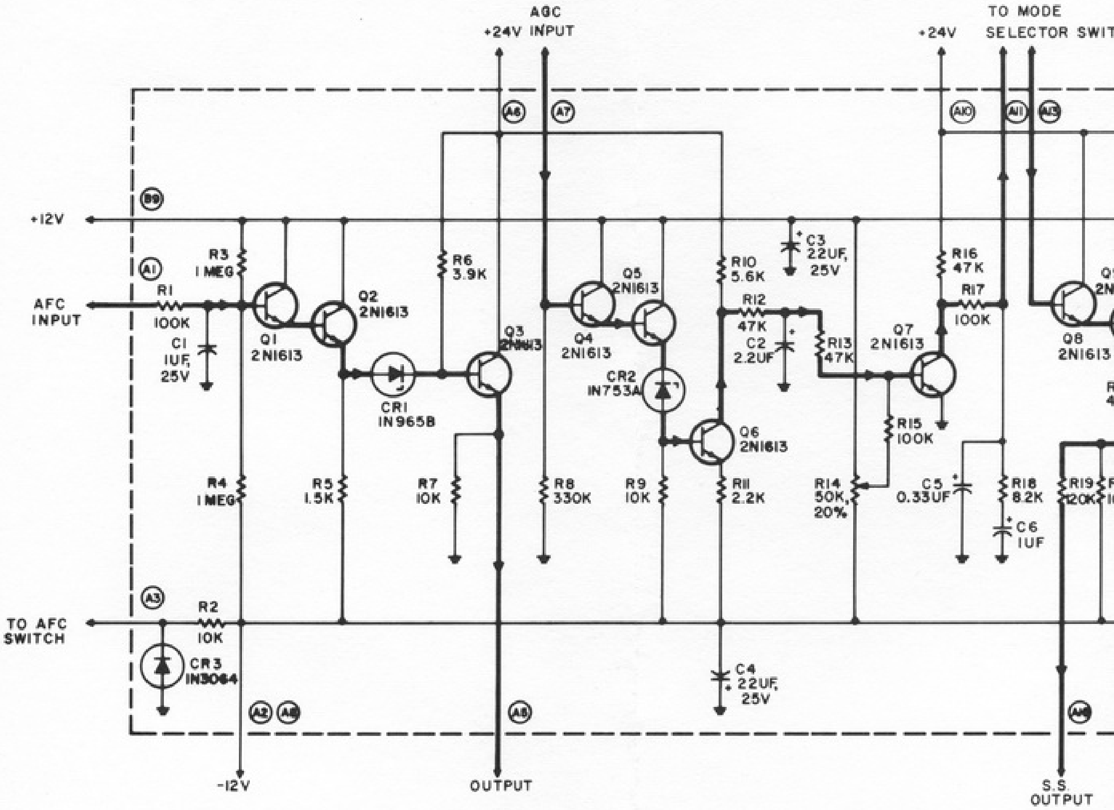
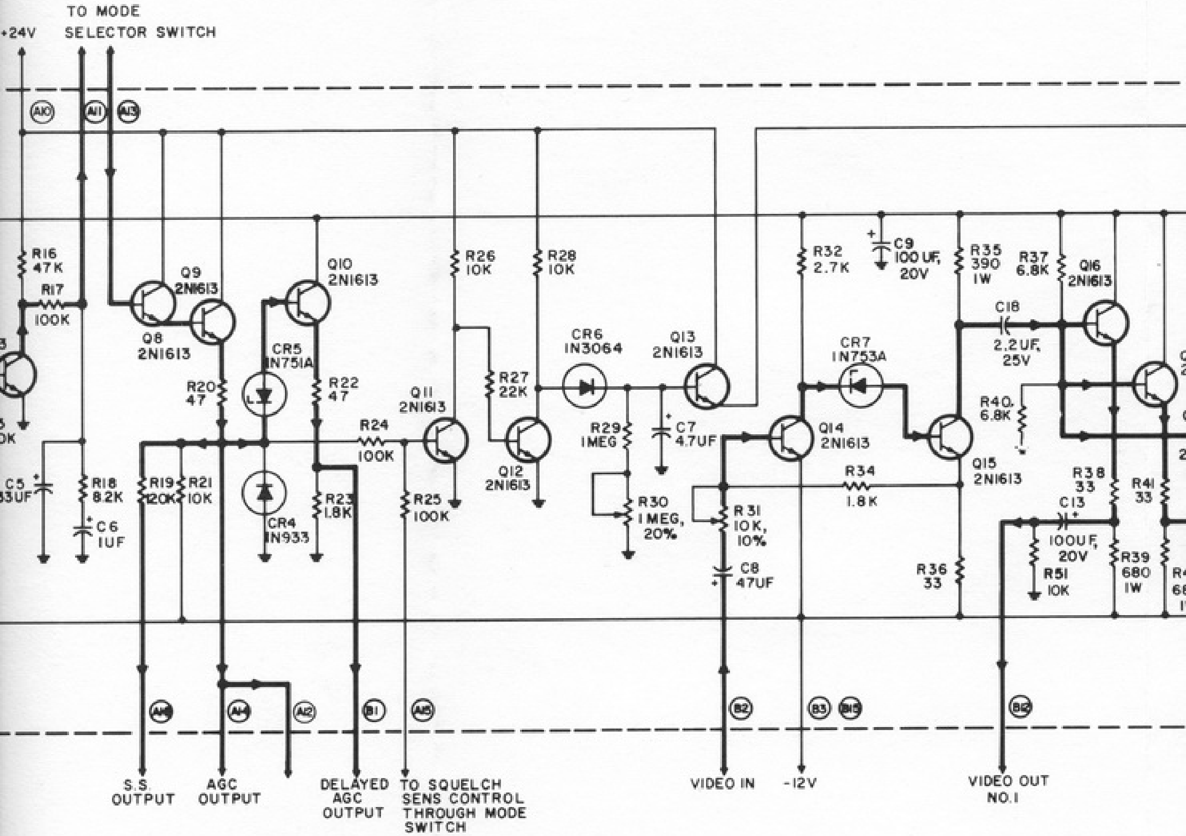


Figure 7-3A. AASA-201 AFC/AGC/Squelch/
Audio Amplifier



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.



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

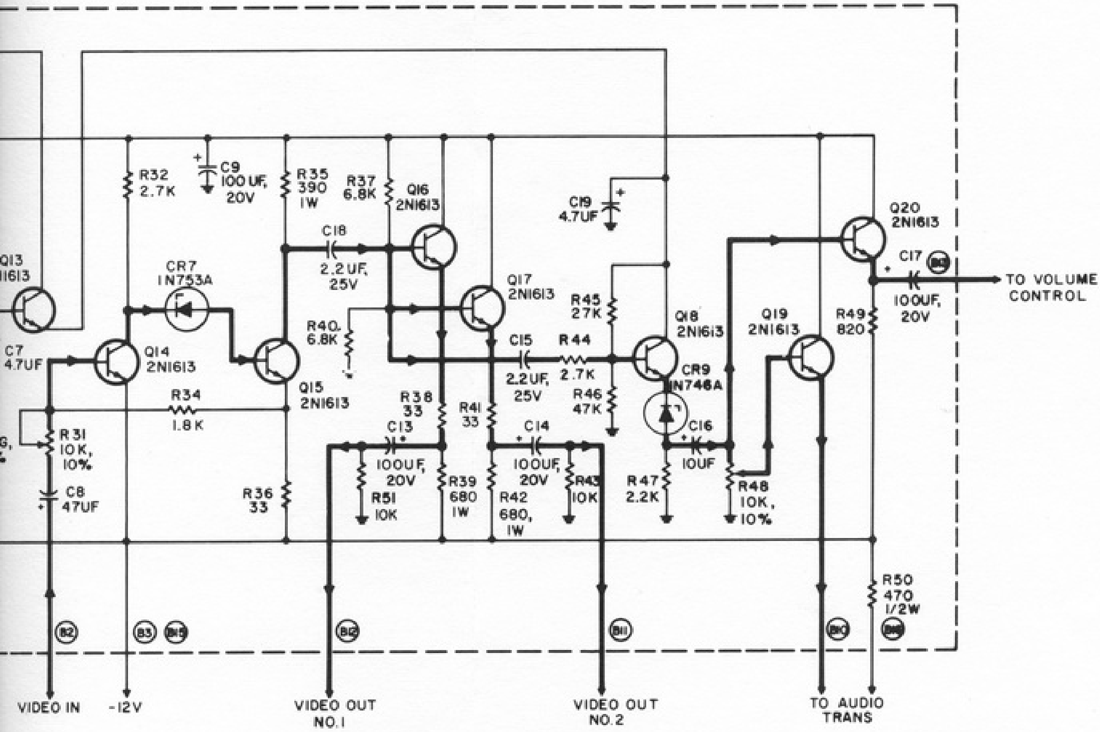


Figure 7-3B. AASA-201, AFC/AGC/Squelch/ Audio Amplifier, Schematic Diagram

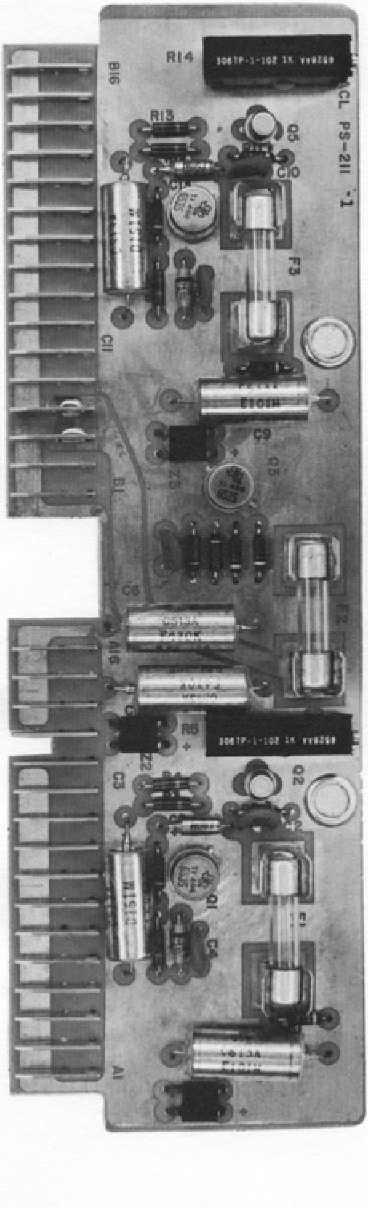
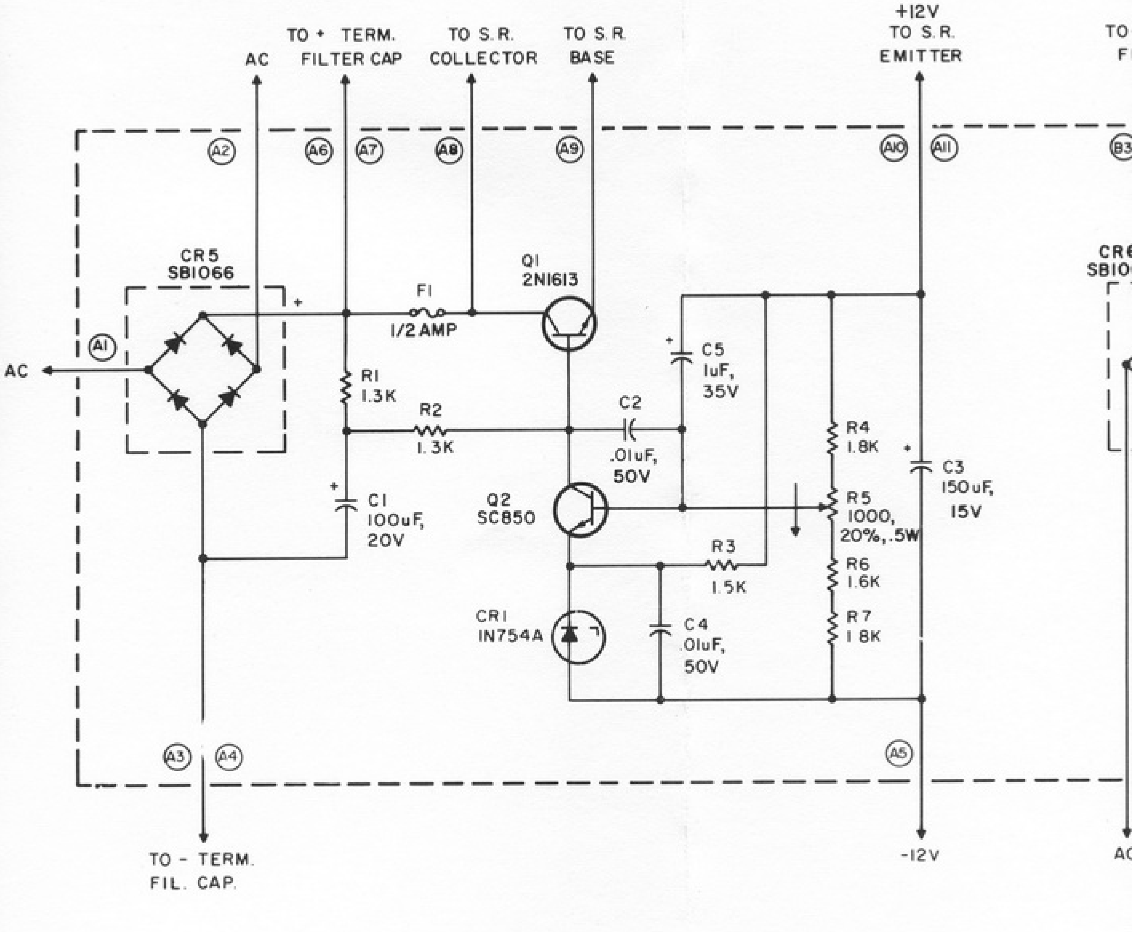
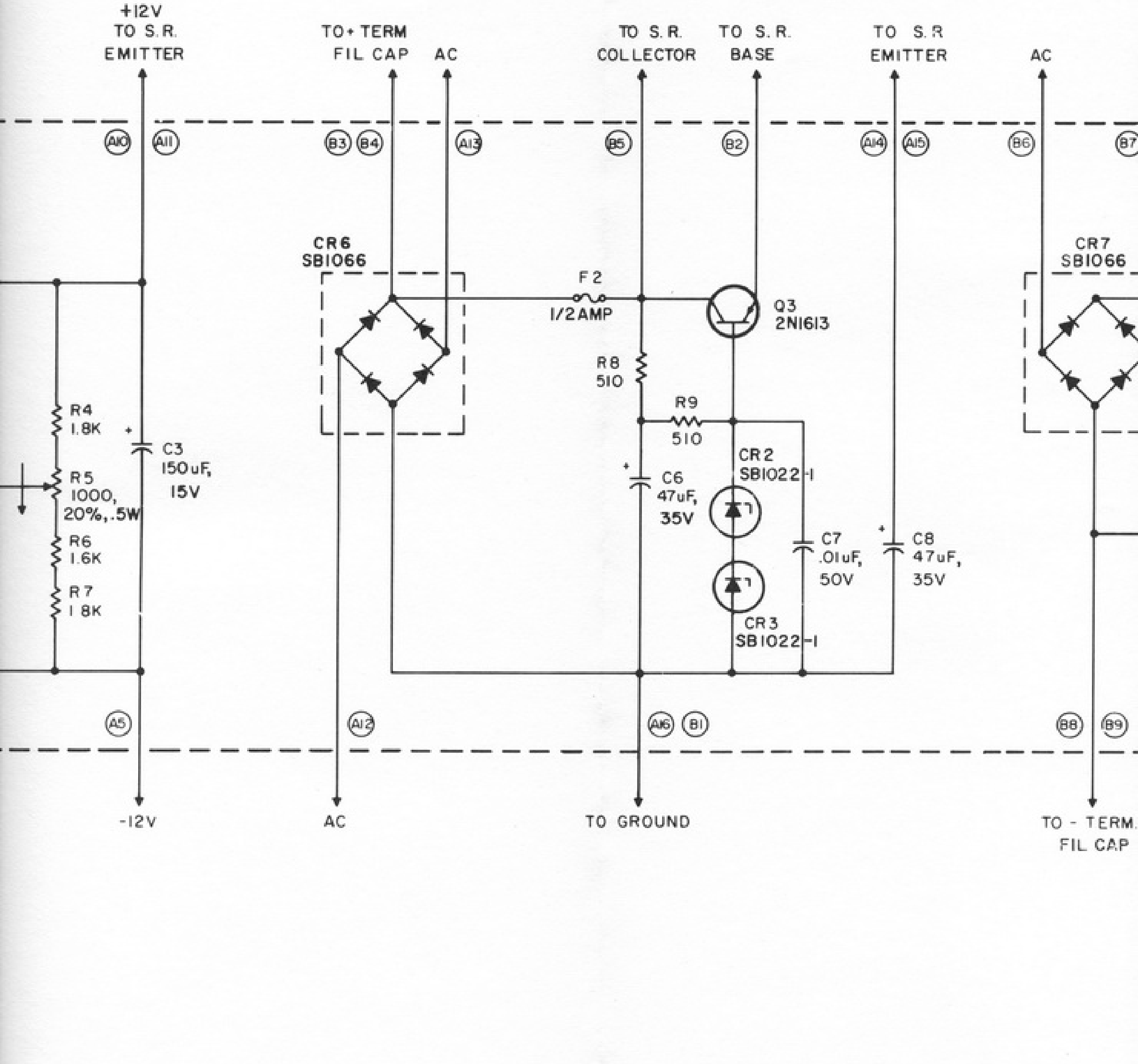


Figure 7-4A. PS-211-1 Power Supply



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

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



5%.

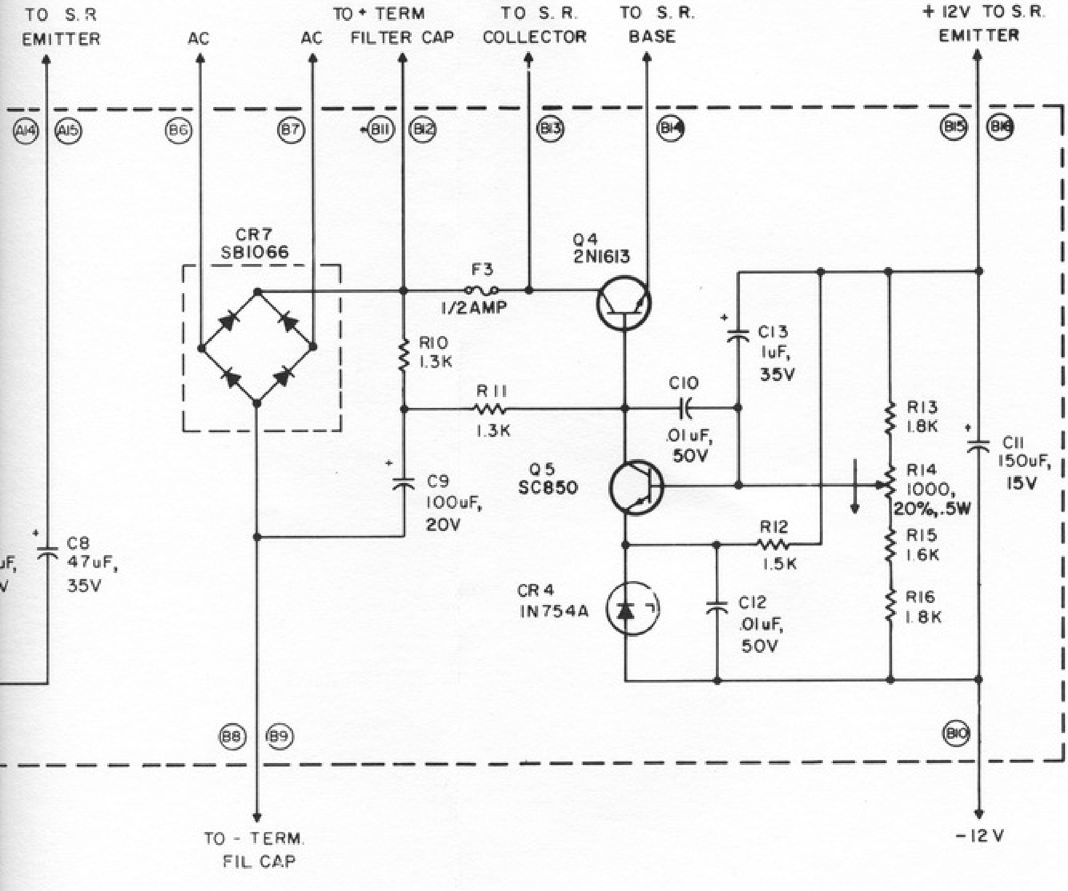


Figure 7-4B. PS-211-1, Power Supply, Schematic Diagram

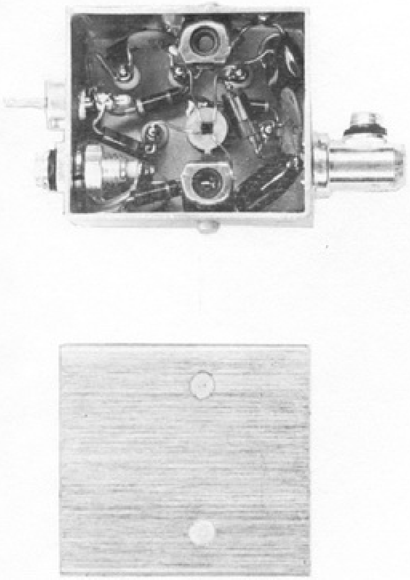


Figure 7-5A. ISA-203 Isolation Amplifier

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

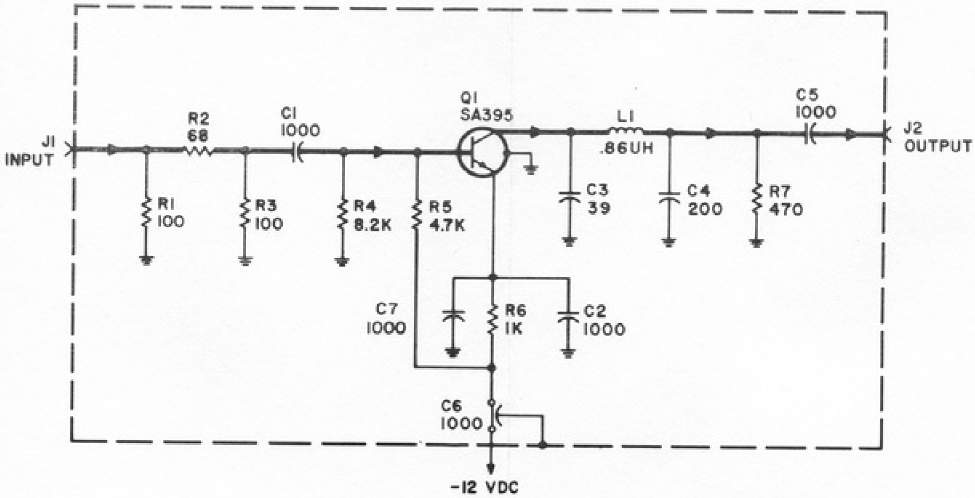
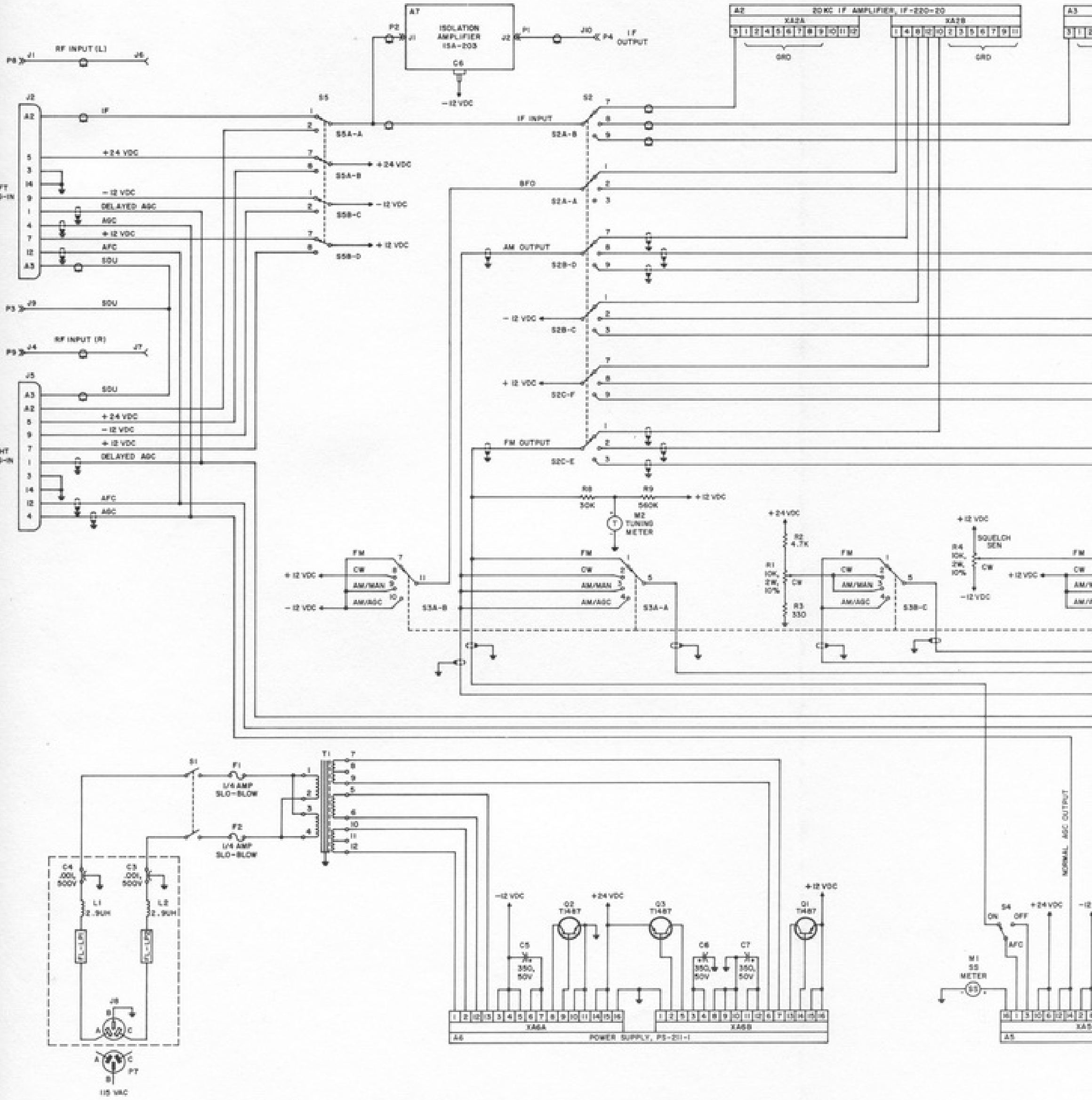
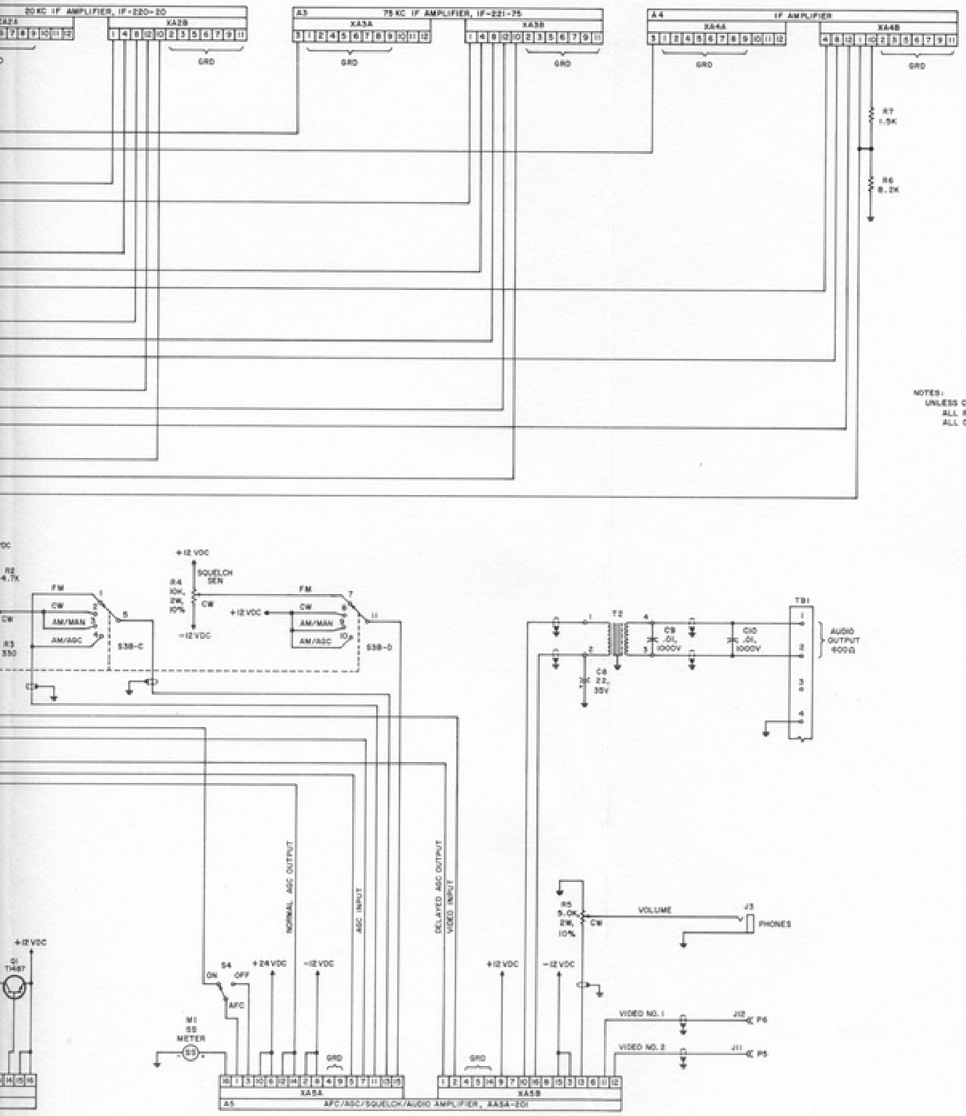


Figure 7-5B. ISA-203, Isolation Amplifier, Schematic Diagram



A7
ISOLATION AMPLIFIER 15A-203
IF OUTPUT
RF INPUT (L)
RF INPUT (R)
A2
20KC IF AMPLIFIER, IF-220-20
XA2A
XA2B
GRD
LEFT PLUG-IN
RIGHT PLUG-IN
+24 VDC
-12 VDC
+12 VDC
DELAYED AGC
AGC
AFC
SDU
IF INPUT
BFO
AM OUTPUT
FM OUTPUT
S5A-A
S5A-B
S5B-C
S5B-D
S2A-B
S2A-A
S2B-D
S2B-C
S2C-F
S2C-E
M2 TUNING METER
R8 30K
R9 560K
FM
CW
AM/MAN
AM/AGC
S3A-B
S3A-A
S3B-C
R1 10K, 2W, 10%
R2 4.7K
R3 330
R4 10K, 2W, 10%
SQUELCH SEN
1/4 AMP SLO-BLOW
C4 .001, 500V
C3 .001, 500V
L1 2.9UH
L2 2.9UH
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, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UF.

Figure 7-6. Receiver, Interconnection Wiring Diagram

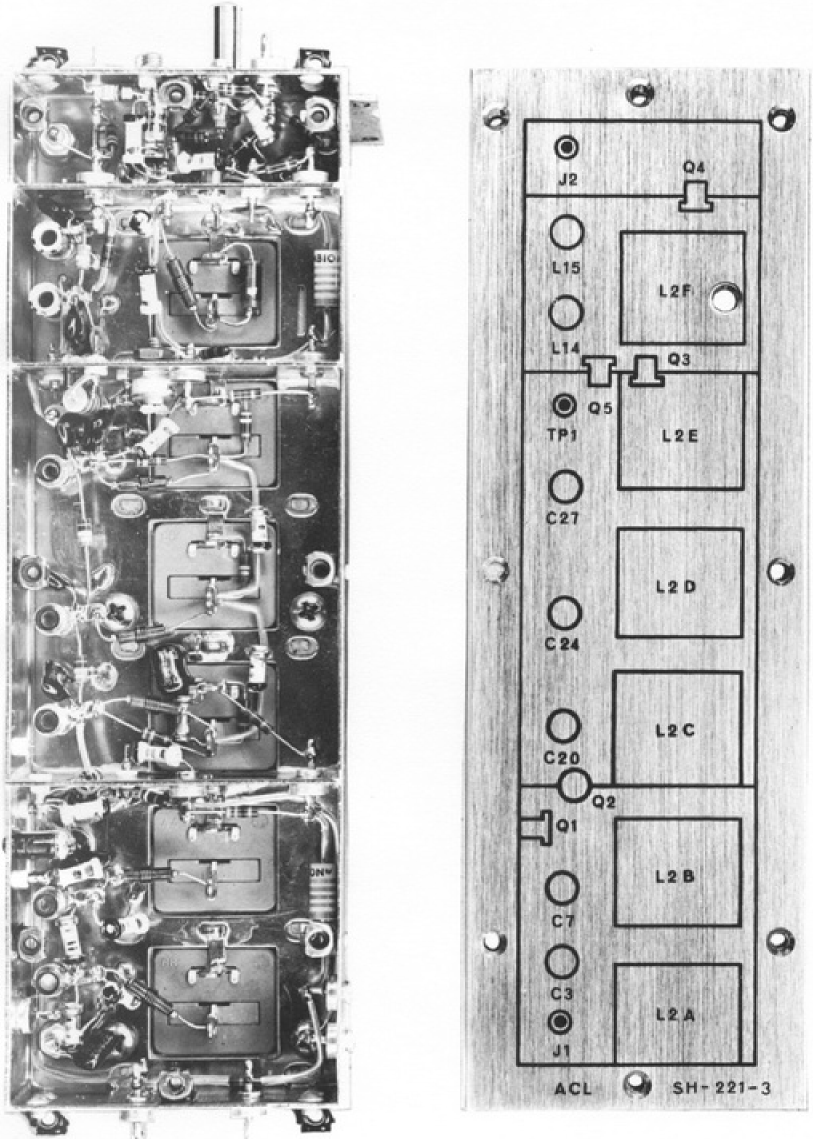
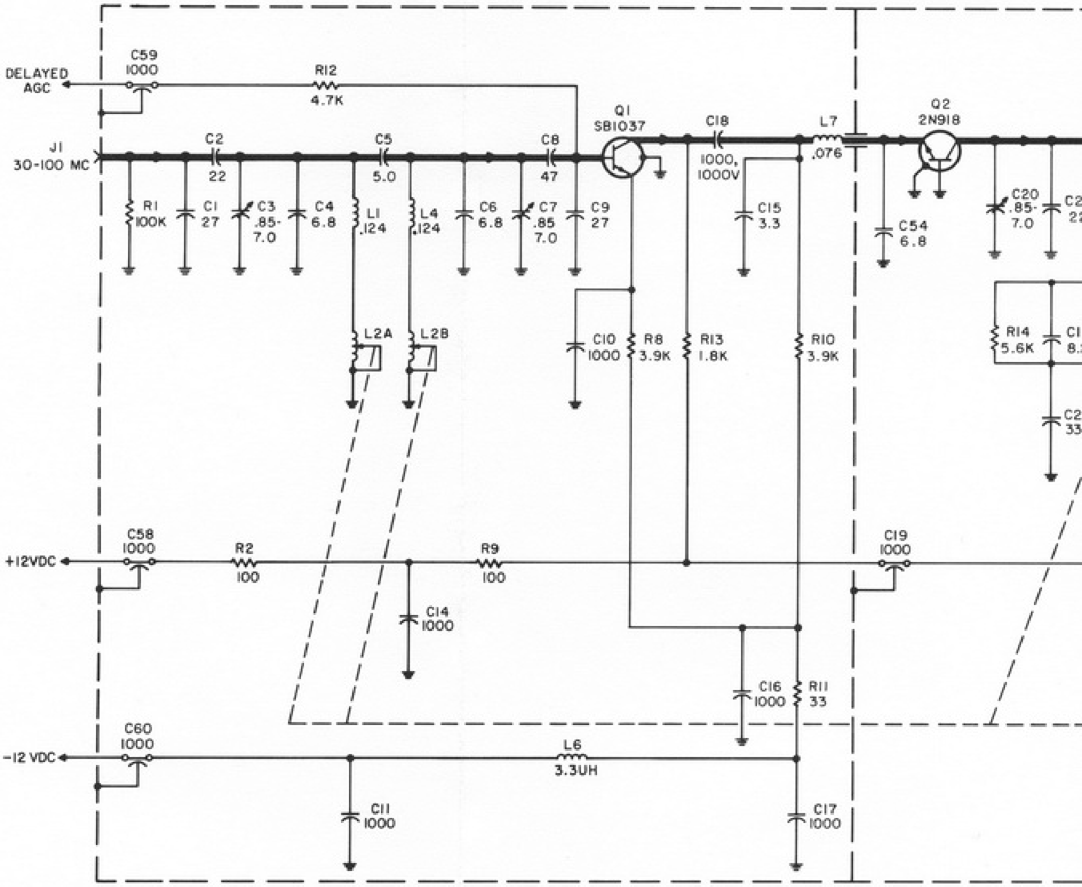
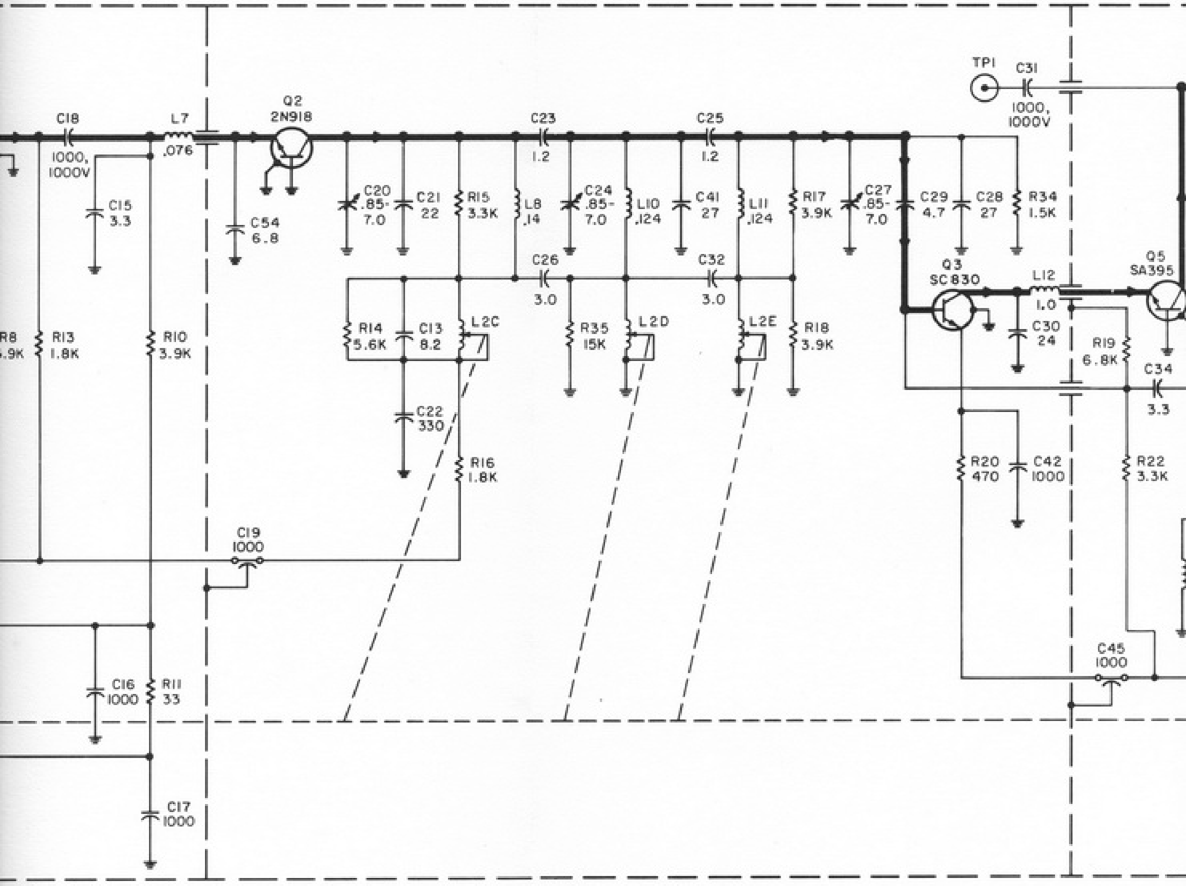


Figure 7-7A. SH-221-3 30 to 100 MC Tuner

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



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



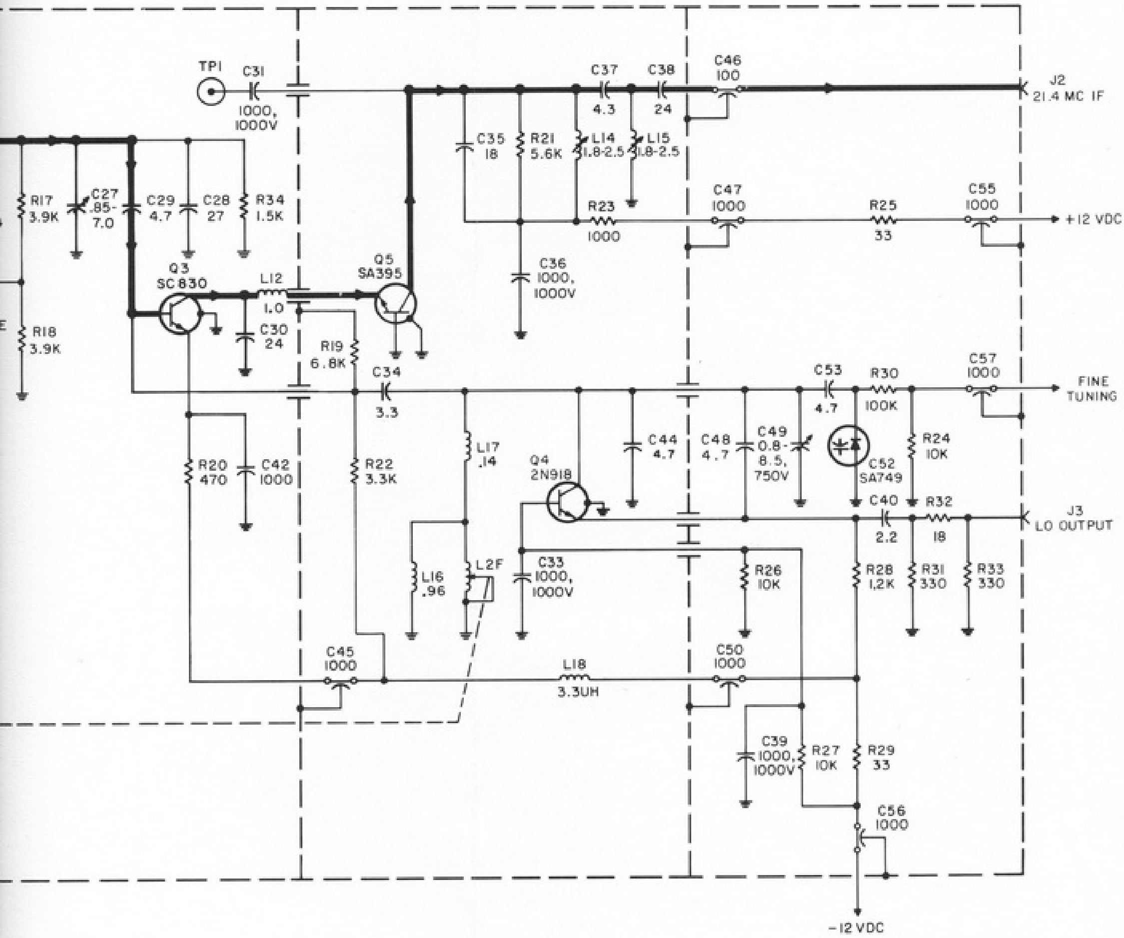


Figure 7-7B. SH-221-3, 30 to 100MC Tuner, Schematic Diagram

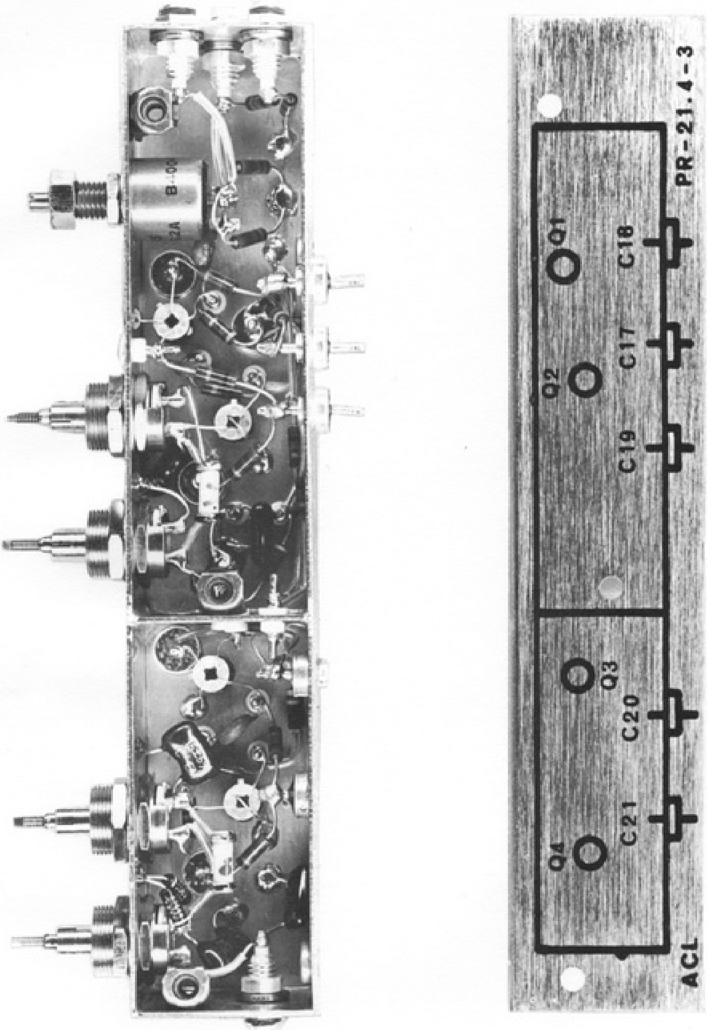
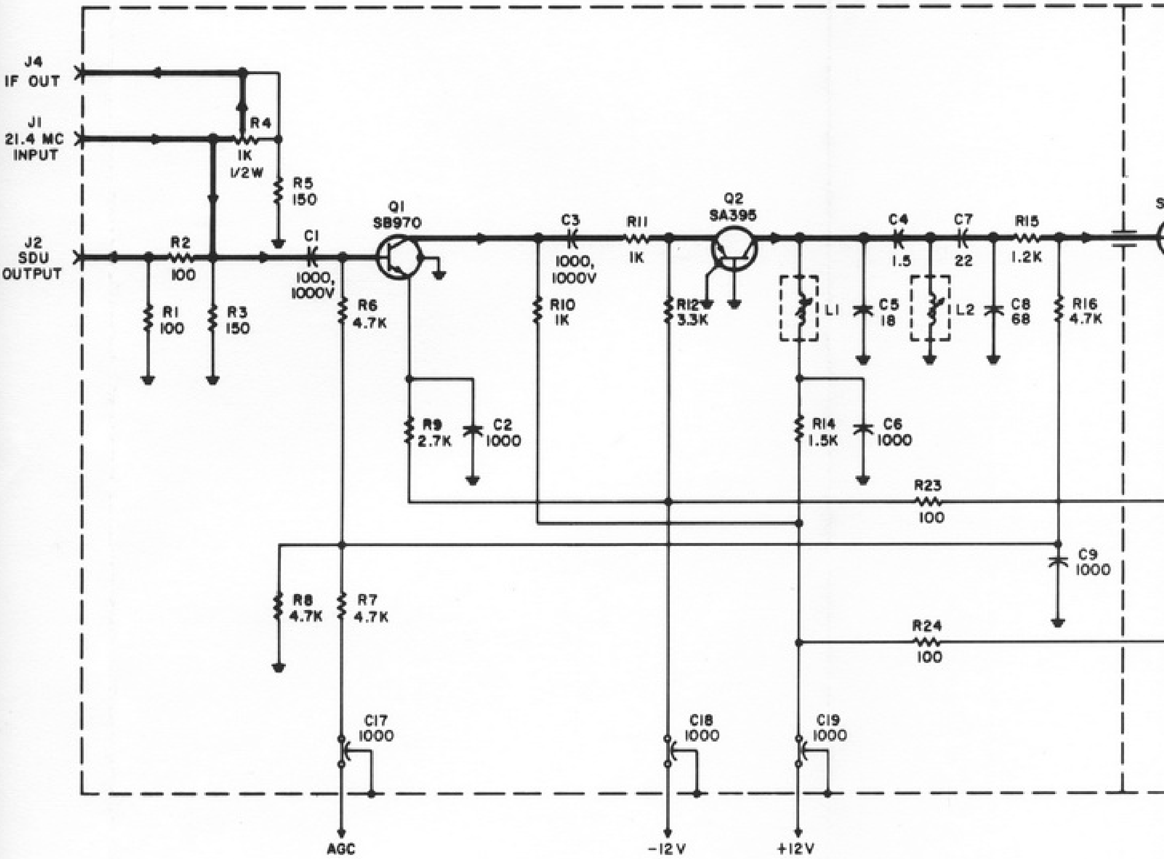


Figure 7-8A. PR-21.4-3 Preamplifier

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
C3
1000,
1000V
R11
1K
R10
1K
Q2
SA395
R12
3.3K
L1
C4
1.5
C5
18
C7
22
L2
C8
68
R15
1.2K
R16
4.7K
R14
1.5K
C6
1000
R23
100
C9
1000
R8
4.7K
R7
4.7K
R24
100
C17
1000
C18
1000
C19
1000
AGC
-12V
+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.

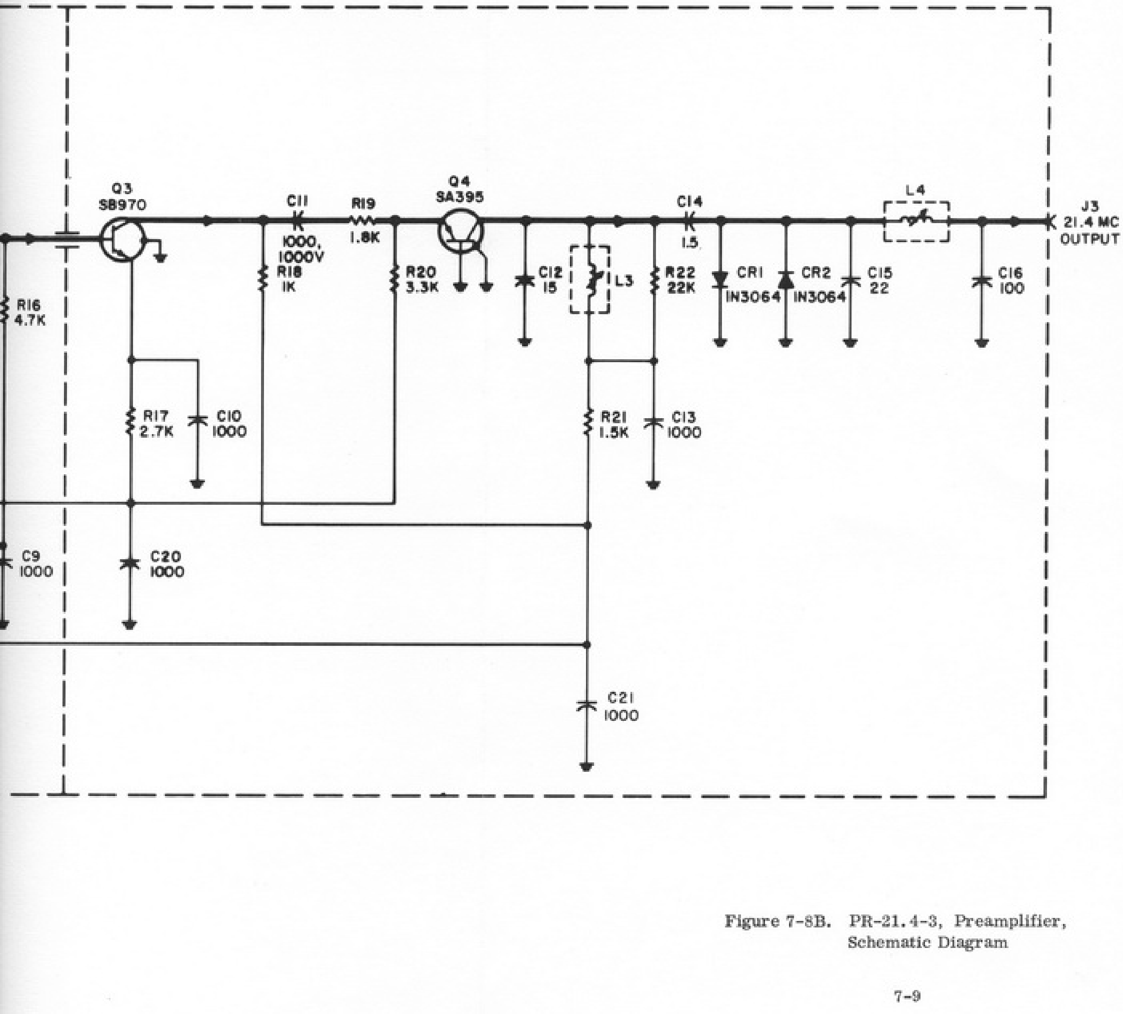


Figure 7-8B. PR-21.4-3, Preamplifier, Schematic Diagram

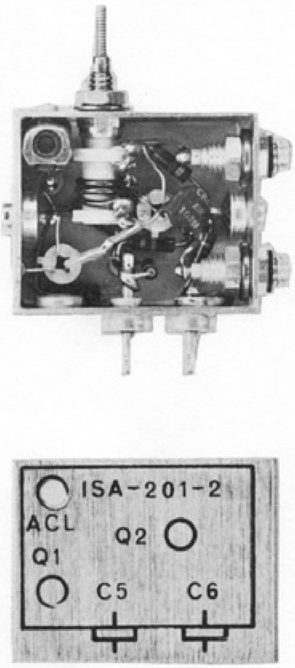


Figure 7-9A. ISA-201-2 Isolation Amplifier

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

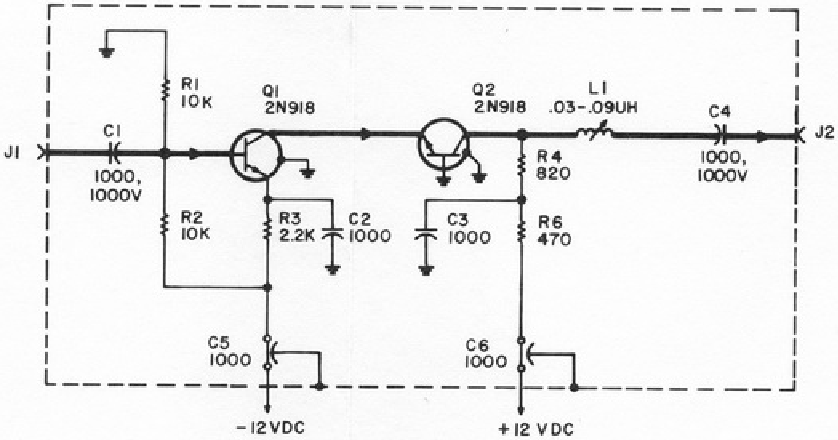
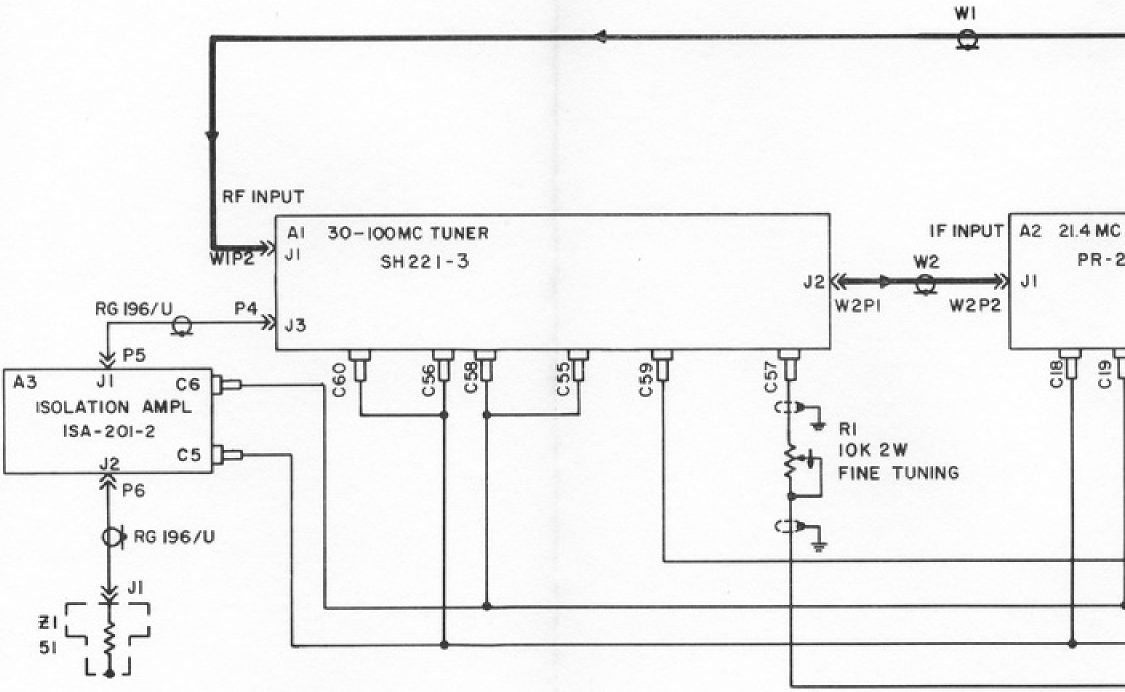


Figure 7-9B. ISA-201-2 Isolation Amplifier, Schematic Diagram

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.

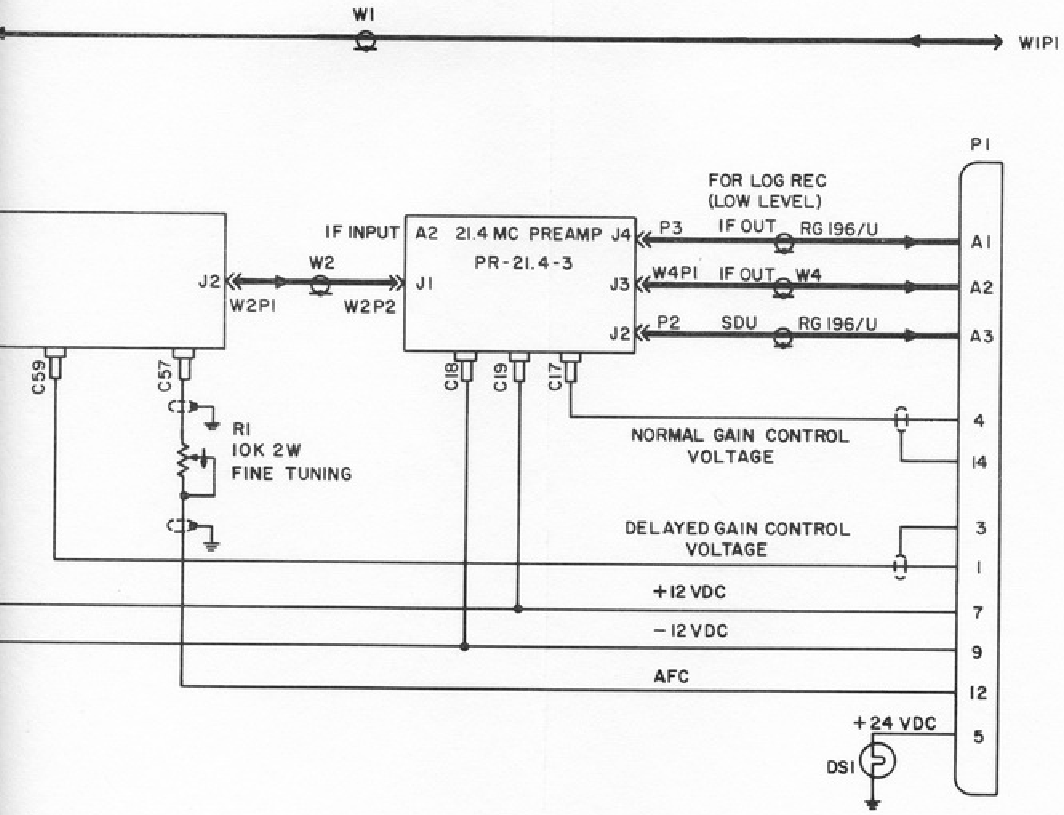


Figure 7-10. 30 to 100 MC, Tuning Unit, Interconnecting Wiring Diagram

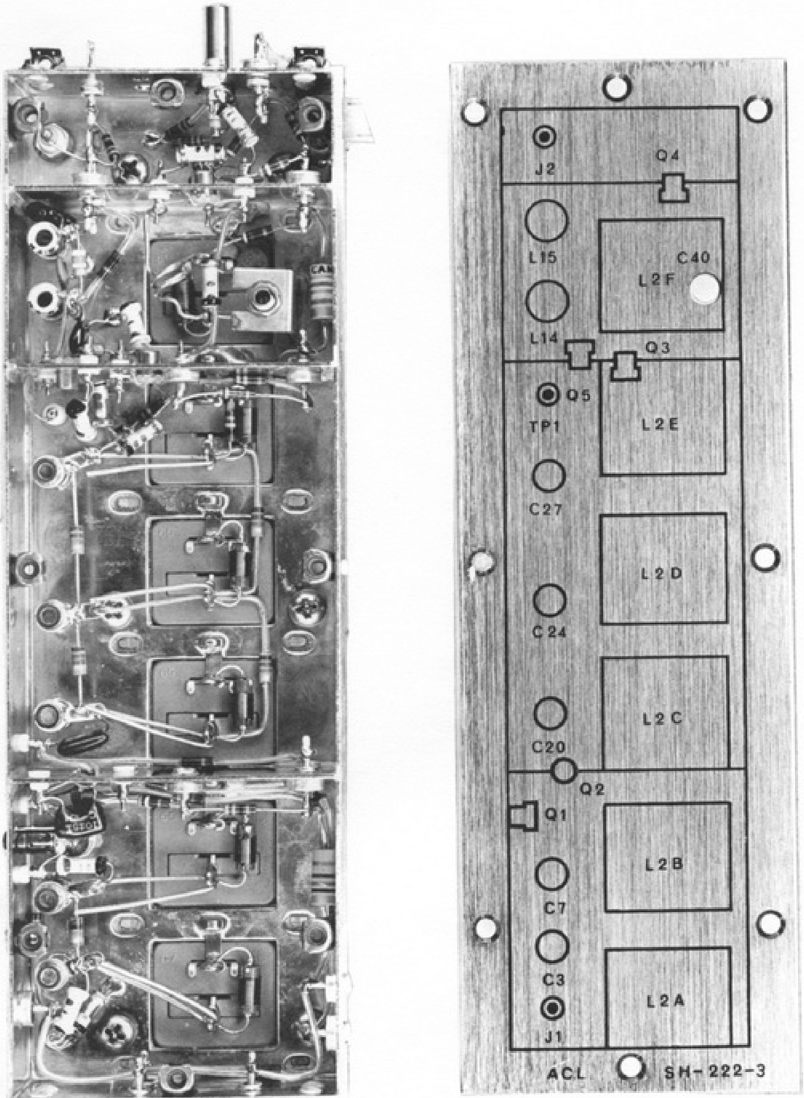
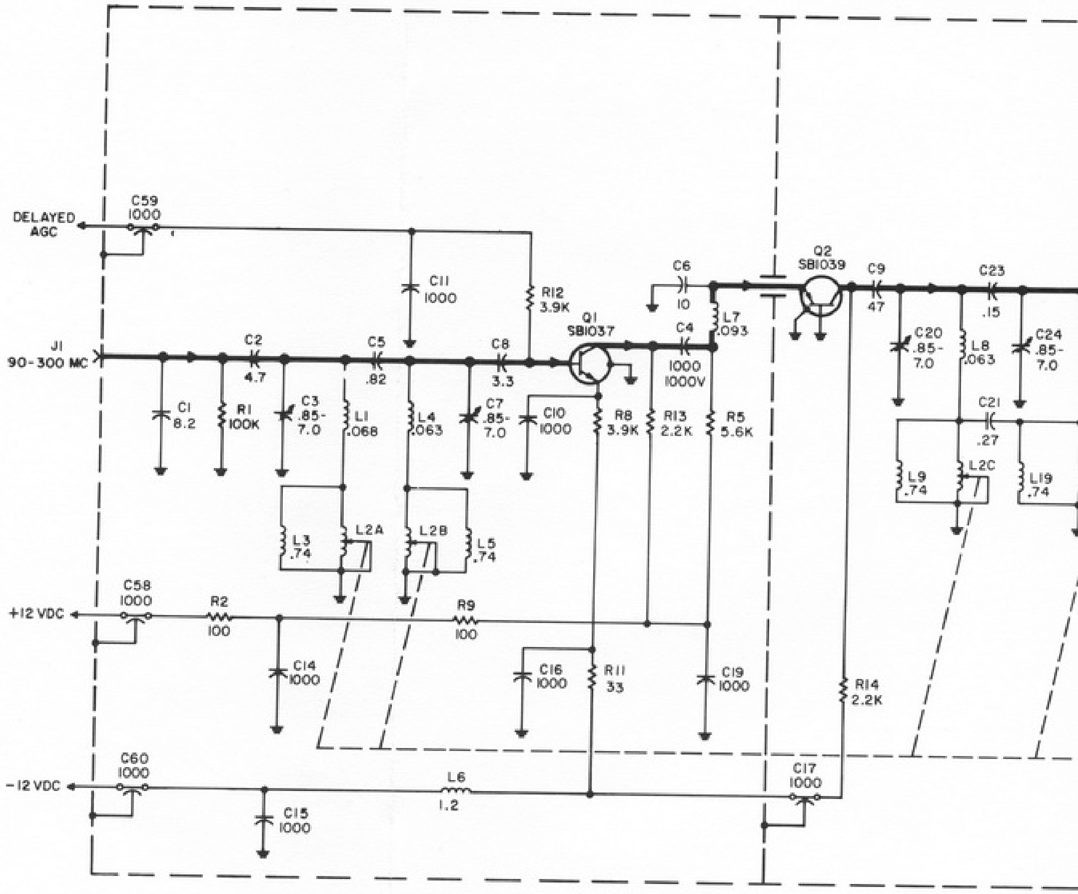
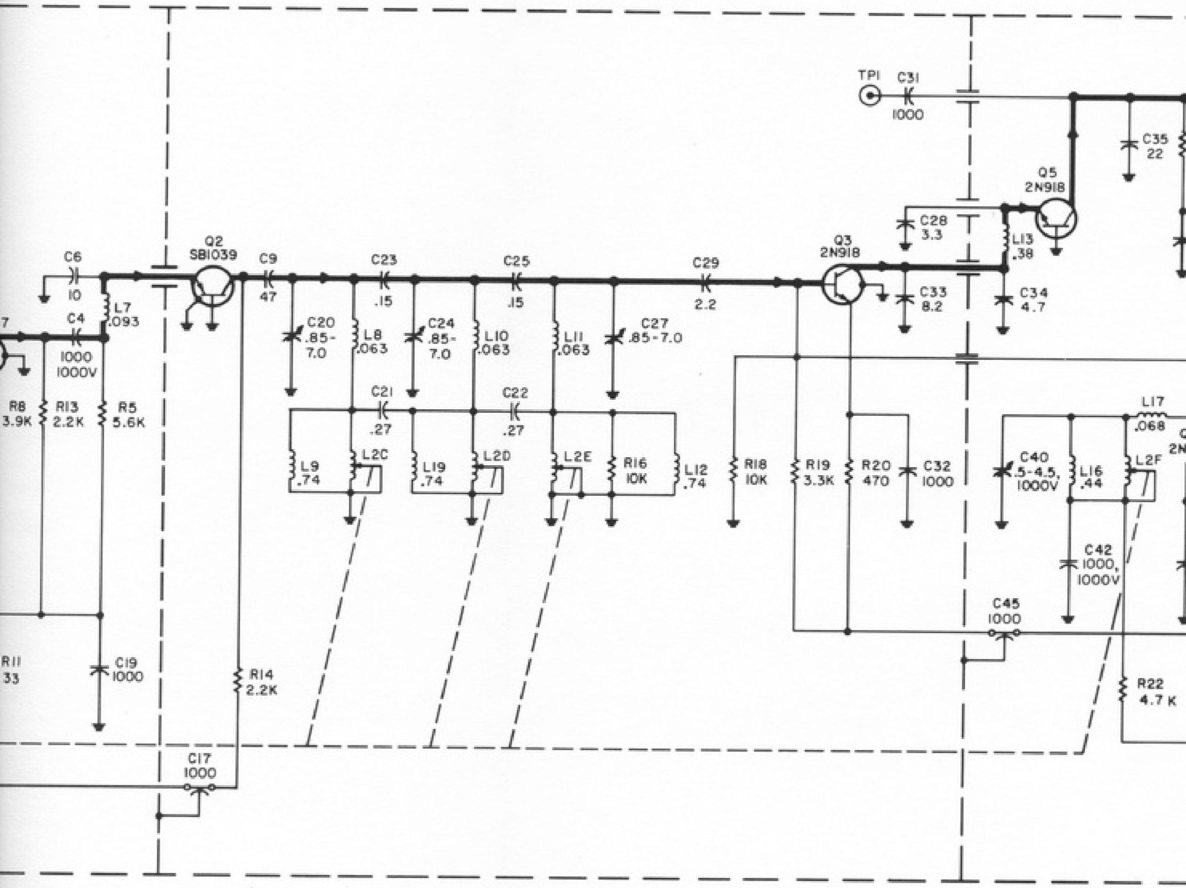


Figure 7-11A. SH-222-3 90 to 300 MC Tuner

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



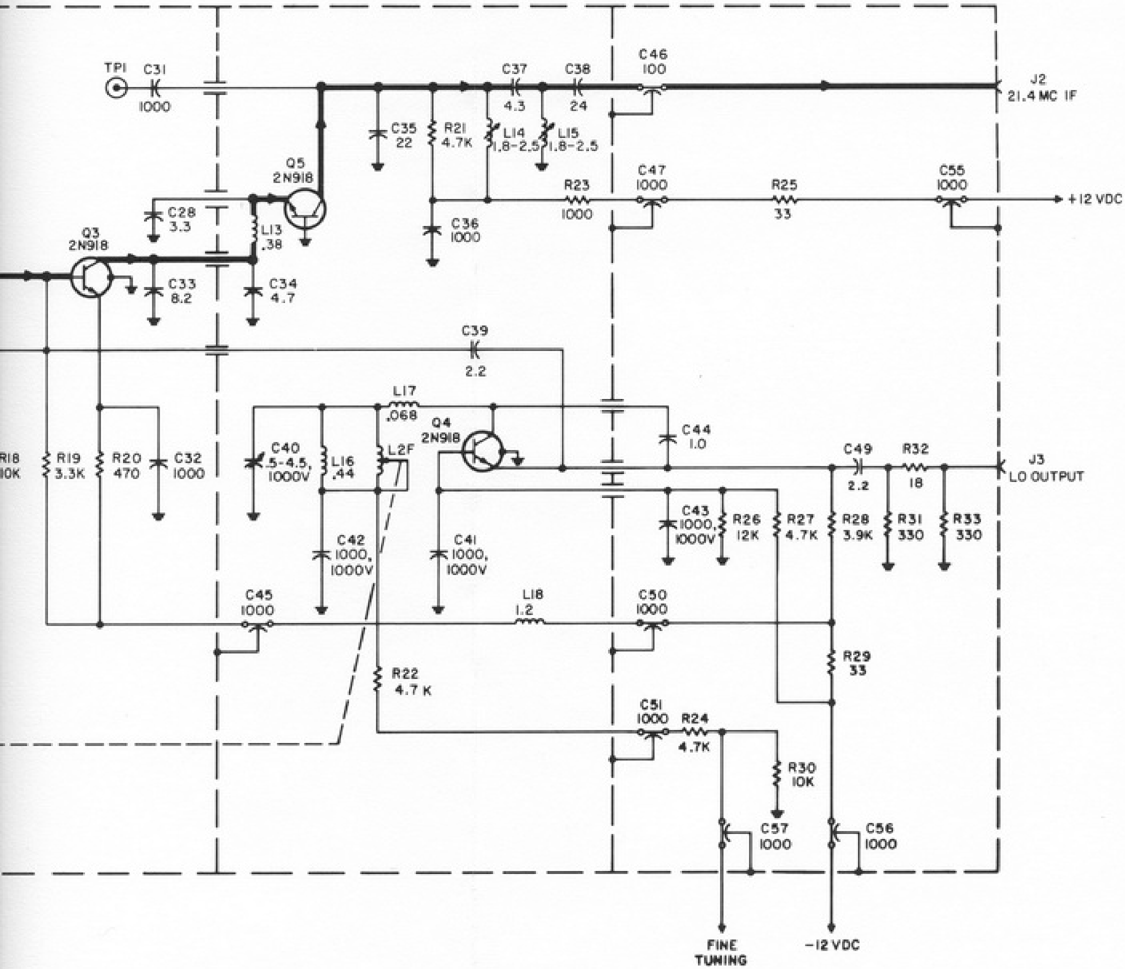
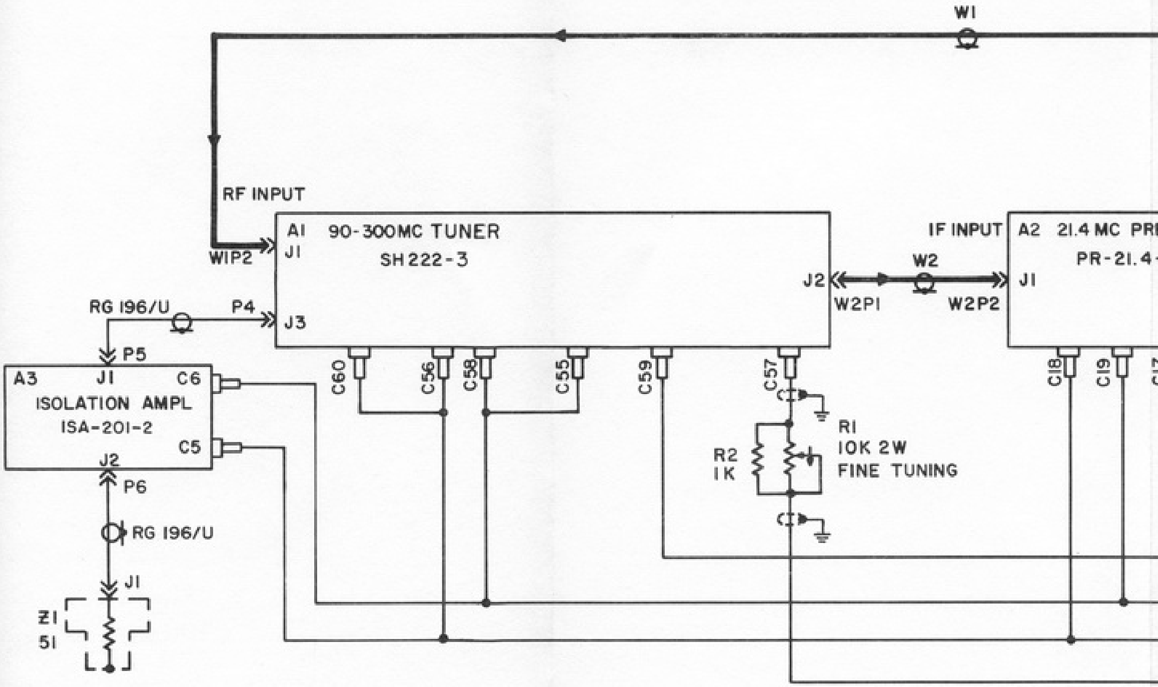


Figure 7-11B. SH-222-3, 90 to 300 MC Tuner, Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OH
2. PARTIAL REFERENCE DESIGNATION
   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.

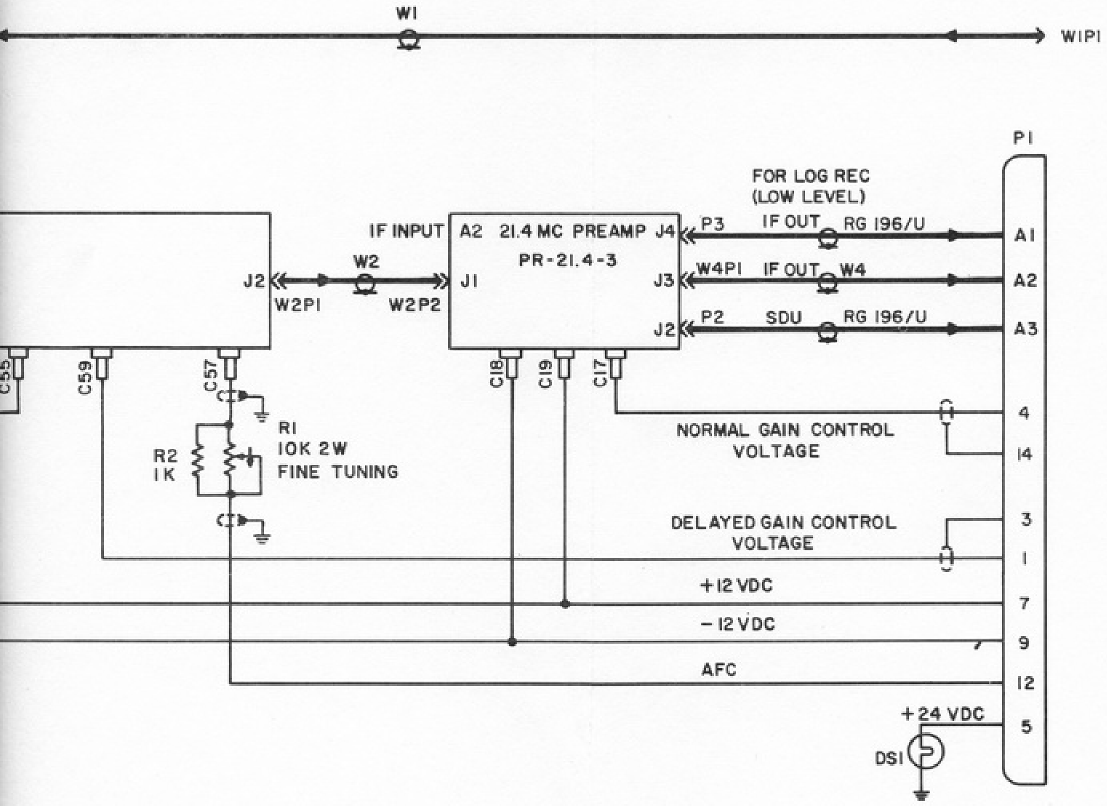


Figure 7-12. 90 to 300 MC, Tuning Unit, Interconnecting Wiring Diagram