NAVSHIPS 0967-282-0010 CHANGE 1

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

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
NOVEMBER 1969

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

TABLE OF CONTENTS ERRATA

1. Page vi

After paragraph K add the following:

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

2. Page vi

After figure 3-1 add the following:

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

After figure 5-10 add the following:

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

3. Page vii

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

4. Page vii

After table 5-1 add the following:

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

SECTION III, INSTALLATION AND OPERATION ERRATA

1. Page 3-1 and 3-2

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

SECTION IV, THEORY OF OPERATION ERRATA

1. Page 4-1 and 4-2

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

2. Page 4-3, paragraph 1

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

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

   Add on asterisk, indicating factory adjustment, to L4.

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

   Add an asterisk, indicating factory adjustment, to L10.

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

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

SECTION V, MAINTENANCE ERRATA

1. Page 5-2

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

2. Page 5-3, paragraph 4.B

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

3. Page 5-3, paragraph 4.C

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

4. Page 5-10, table 5-4

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

5. Page 5-10, table 5-4

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

6. Page 5-11, table 5-5

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

7. Page 5-14, figure 5-5

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

8. Page 5-14, figure 5-6

   Change "6.0 MC" to "12 MC".

9. Page 5-15, paragraph 1

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

10. Page 5-15, paragraph m

    Delete "at 500 mc".

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

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

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

    Change "5 cm" to "3 cm".

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

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

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

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

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

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

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

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

17. Page 5-17, figure 5-9

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

18. Page 5-17, figure 5-10

    Change "2.0 MC" to "1.0 MC".

19. Page 5-18, table 5-9

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

20. Page 5-18, table 5-10

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

21. Page 5-18, table 5-10

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

22. Page 5-19, table 5-11

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

23. Page 5-19, table 5-12

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

24. Page 5-20, table 5-13

Change "Connector" to "Collector".

25. Page 5-21 and 5-22

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

26. Page 5-22

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

27. Page 5-23 and 5-24

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

28. Page 5-25, figure 5-14

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

29. Page 5-26, figure 5-15

Change "950 MC" to "1 MC".

SECTION VI, PARTS AND MANUFACTURER'S LIST ERRATA

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

Add to item name "(NOT CONNECTED)".

2. Page 6-82

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

SECTION III

INSTALLATION AND OPERATION

1. Installation.

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

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

NOTE

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

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

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

(3) Lock the three front panel thumbscrews.

(4) Installation is complete.

B. IF Amplifier, IF-212-500

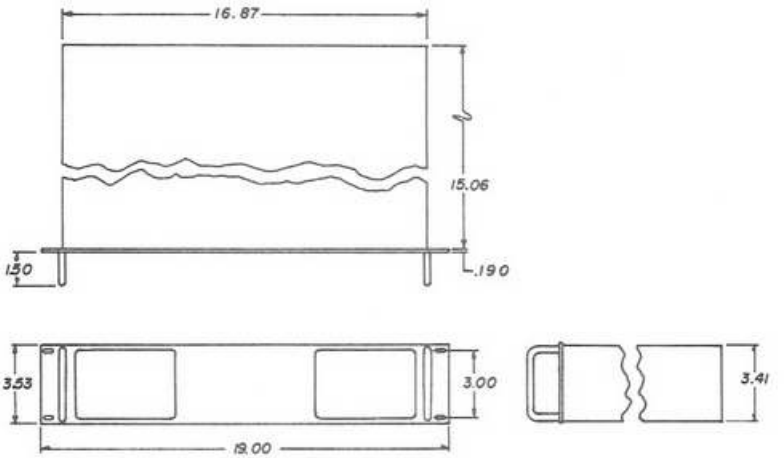
The IF amplifier module is designed to mount into main receiver chassis receptacle XA2, XA3, or XA4. Normally, main receiver chassis receptacle XA4 is a wired spare. Mount the IF amplifier in the spare receptacle when possible. When there are no spare receptacles, remove any IF amplifier from the receiver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

2. Operation.

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

3. Storage.

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



Outline Drawing

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

SECTION IV

THEORY OF OPERATION

1. General.

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

2. Functional Description.

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

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

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

(2) 60-21.4 mc Converter, CV-204-4, A2

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

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

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

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

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

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

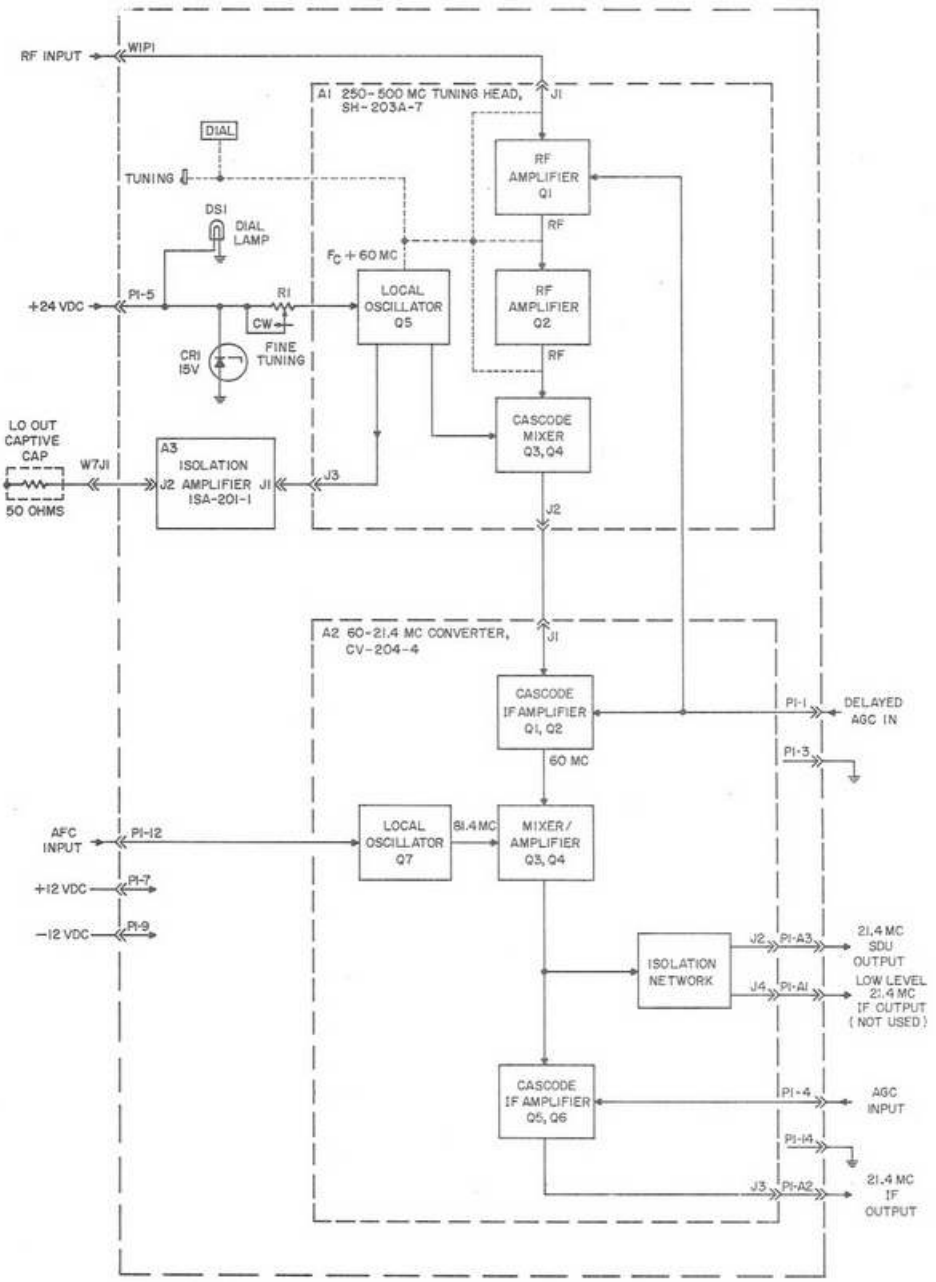


Figure 4-1. 250-500 Mc Plug-in RF Tuner, TN-519/WRR, Functional Block Diagram.

2.1 Tools.

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

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

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

C. 490 to 1000 Mc RF Tuner Alignment

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CAUTION

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

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

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

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

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

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

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

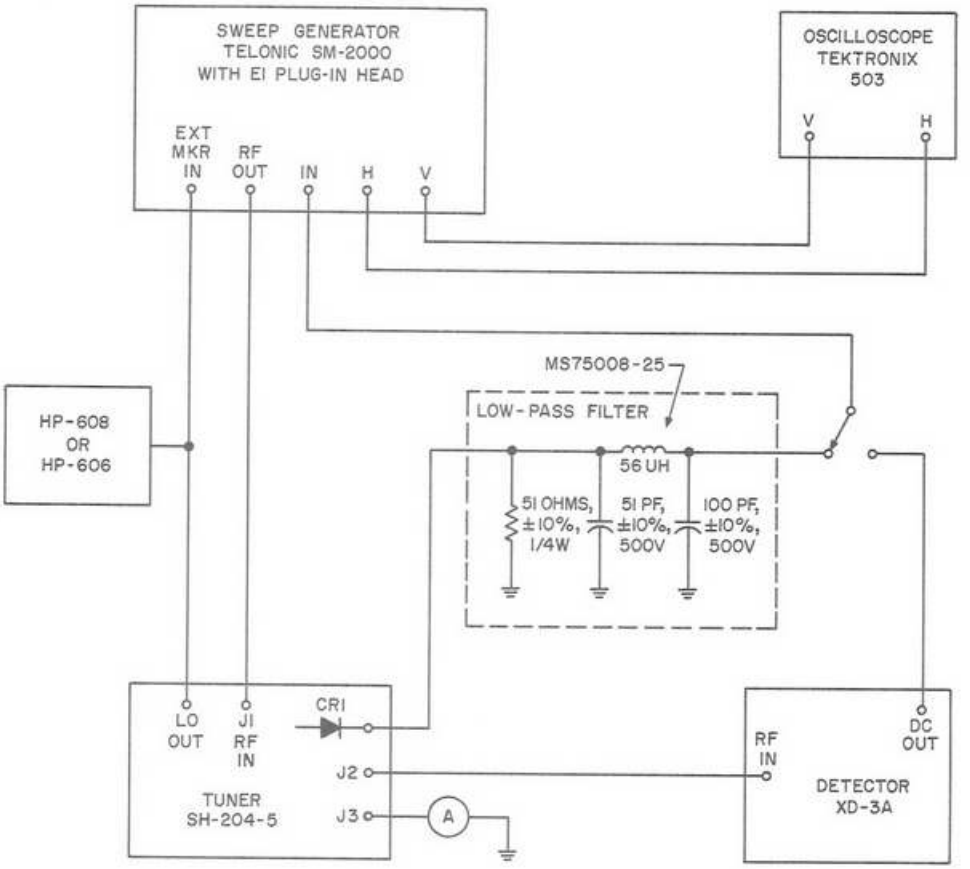


Figure 5-10.1. 490-1000 MC RF Tuning Head, SH-204-5, 60 MC IF Amplifier, Test Setup.

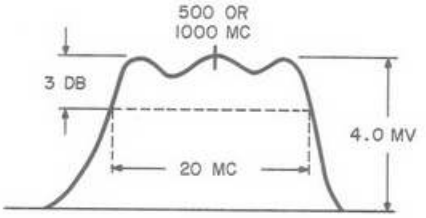


Figure 5-11. 490-1000 MC RF Tuner Response Waveform at CR1.

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

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

v. Remove test equipment and replace all covers.

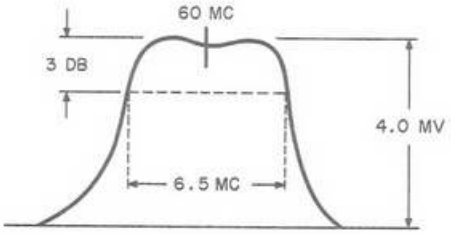


Figure 5-12. 490-1000 Mc RF Tuner, IF Response Waveform at J2.

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

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

7. IF Amplifier, IF-212-500.

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

A. Minimum Performance Standards.

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

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

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

B. Voltage and Resistance Measurements.

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

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

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

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

C. IF Amplifier, IF-212-500 Alignment

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

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

(1) AM Alignment:

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

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	MAINT KIT, EL EQ Contains special items used for maintenance	19905	SK250	1	1
	EXTENDER, PC BD 8 in. lg, 2.220 in. w; held on this board by spring clips are two H.H. Smith socket hd screw keys 341 and 343; one F01A250V1-2AS spare fuse, one CTC alignment tool 2033-1; two Elco 12 pin connectors 02-012-013-5200 are mtd on the board	19905	AB482-3	1	1
	CABLE ASSY, SP, EL One Cannon DCM25W3S receptacle and three Cannon DM53742-5006 contact termination type receptacles mounted in a Cannon DC51214-1 shell one end, one Cannon DCM25W3P plug and three Cannon DM53740-5008 contact termination type plugs mounted in a Cannon DC51214-1 shell other end, 24 in. lg	19905	AB519	1	1
	EXTENDER, PC BD 3.940 in. lg, 2.220 in. w; one F01A250V1-2AS spare fuse, one ACL A551 connector mtd on the board	19905	AB698	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CABLE ASSY, RF RG55/U coaxial cable, one Gremar 8212A receptacle one end, one MS35168-88E plug other end, 6 in. lg	19905	AC076-102	1	1
	CABLE ASSY, RF RG196/U coaxial cable, one Amphenol 31-369 receptacle one end, one Cannon D53741 plug other end, 12 in. lg	19905	AC076-154	1	1
	CABLE ASSY, RF RG196/U coaxial cable, one Amphenol 31-369 receptacle one end, one Amphenol 5116-037475 plug other end, 4.750 in. lg	19905	AC076-84	1	1
	EXTRACTOR, PC BD For use on all printed circuit boards that have two 12 pin connectors, steel rod 0.187 in. dia bent into the shape of a handle 9.75 in. lg, 1.50 in. w	19905	AC1477-1	1	1
	PRINTED WRG BD (P/OAB698) 3.940 in. lg, 2.220 in. w; mtd on board are two Littlefuse 121001 electrical clips, one Elco 02-016-013-5200 16 pin connector	19905	AC565	2	2

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	TUNING TOOL Bent into the shape of the letter "S", 2.750 in. long, 0.111 in. dia brass rod, each end made for screwdriver type adjustment	19905	A1148	1	1
	CONN, RECP, ELEC (P/OAB482-3) printed circuit card type, 12 contacts, low-loss plastic dielectric, 2 mtg holes	19905	A349	2	2
	CONN, RECP, ELEC (P/OAB698) printed circuit card type, 16 contacts, low-loss plastic dielectric 2 mtg holes	19905	A551	2	2
	SPACER (P/OAB482-3) AL alloy, 0.187 in. od, 0.117 in. id, 0.103 in. thk	19905	A691-2	4	4
	EXTRACTOR, PC BD For use on all printed circuit boards that have two 16 pin connectors, steel rod 0.187 in. dia bent into the shape of a handle 10.75 in. lg, 1.50 in. w	19905	B699	1	1

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	PRINTED WRG BD (P/OAB482-3) 8 in. lg, 2.220 in. w; two Elco 12 pin connectors 02-012-013-5200 are mtd on the board	19905	C234	1	1
	CONN, PLUG, ELEC (P/OAB519) subminiature rectangular type, 22 brass contacts	71468	DCM25W3P	1	1
	CONN, RECP, ELEC (P/OAB519) subminiature rectangular type, 22 brass contacts	71468	DCM25W3S	1	1
	SHELL, ELEC, CONN (P/OAB519) molded plastic straight type	71468	DC51214-1	2	2
	CONN, PLUG, ELEC (P/OAB519) contact termination type	71468	DM53740-5008	3	3
	CONN, PLUG, ELEC (P/OAC076-154) right angle crimp braid type	71468	DM53741	1	1
	CONN, RECP, ELEC (P/OAB519) contact termination type	71468	DM53742-5006	3	3

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

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

SYMBOL NO. PREFIX OR UNIT NOMENCLATURE	ELECTRONIC EQUIPMENT MAINTENANCE KIT, SK-250				
REF SYM NO.	ITEM NAME	FEDERAL MFR. CODE	MFR. PART NO.	QTY PER ASSY	QTY PER END ITEM
	CONN, PLUG, ELEC (P/OAC076-84) 150 ohm screw on type	74868	5116-037475	1	1
	CLIP, SPRINGTENS (P/OAB482-3) cadmium plate copper 2 mtg holes	91506	6008-14CC	1	1
	TOOL BOX, PORT Extra heavy full drawn seamless, rounded corners, returned edges. Removable tote tray. Metallic charcoal gray with red tray, 14.500 in. by 7.250 in. by 6.000 in.	78934	6115	1	1
	CONN, RECP, ELEC (P/O AC076-102) bulkhead mounted push-on type	91737	8212B	1	1

NAVSHIPS 0967-282-0010 SUPPLEMENT 1

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

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
JANUARY 1969

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

SECTION I

GENERAL DESCRIPTION

1. Introduction.

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

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

2. Electrical Characteristics.

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

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

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

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

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

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

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

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

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

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

C. IF Amplifier, IF-212-500

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

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

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

3. Mechanical Characteristics.

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

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

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

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

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

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

B. IF Amplifier, IF-212-500

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

SECTION II

SPECIFICATIONS

1. RF Tuner TN-519/WRR.

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

2. RF Tuner TN-520/WRR.

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

RF Tuner TN-520/WRR (continued)

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

3. IF Amplifier IF-212-500.

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

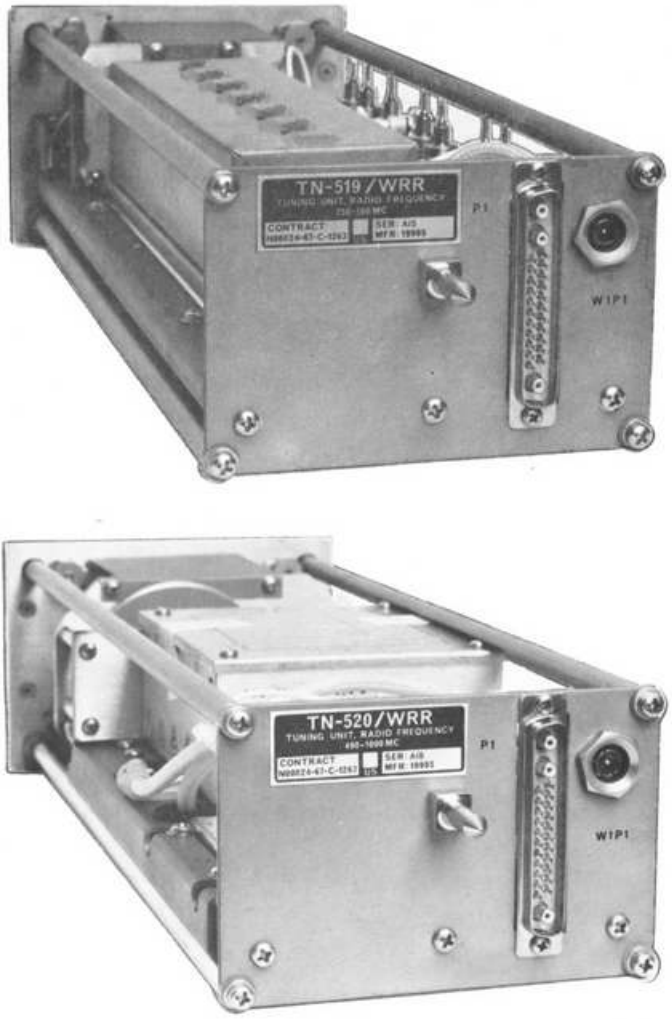


Figure 3-1. Radio Frequency Tuner TN-519/WRR and TN-520/WRR, Rear View

SECTION III

INSTALLATION AND OPERATION

1. Installation.

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

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

NOTE

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

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

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

(3) Lock the three front panel thumbscrews.

(4) Installation is complete.

B. IF Amplifier, IF-212-500

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

2. Operation.

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

SECTION IV

THEORY OF OPERATION

1. General.

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

2. Functional Description.

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

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

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

(2) 60-21.4 mc Converter, CV-204-4, A2

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

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

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

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

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

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

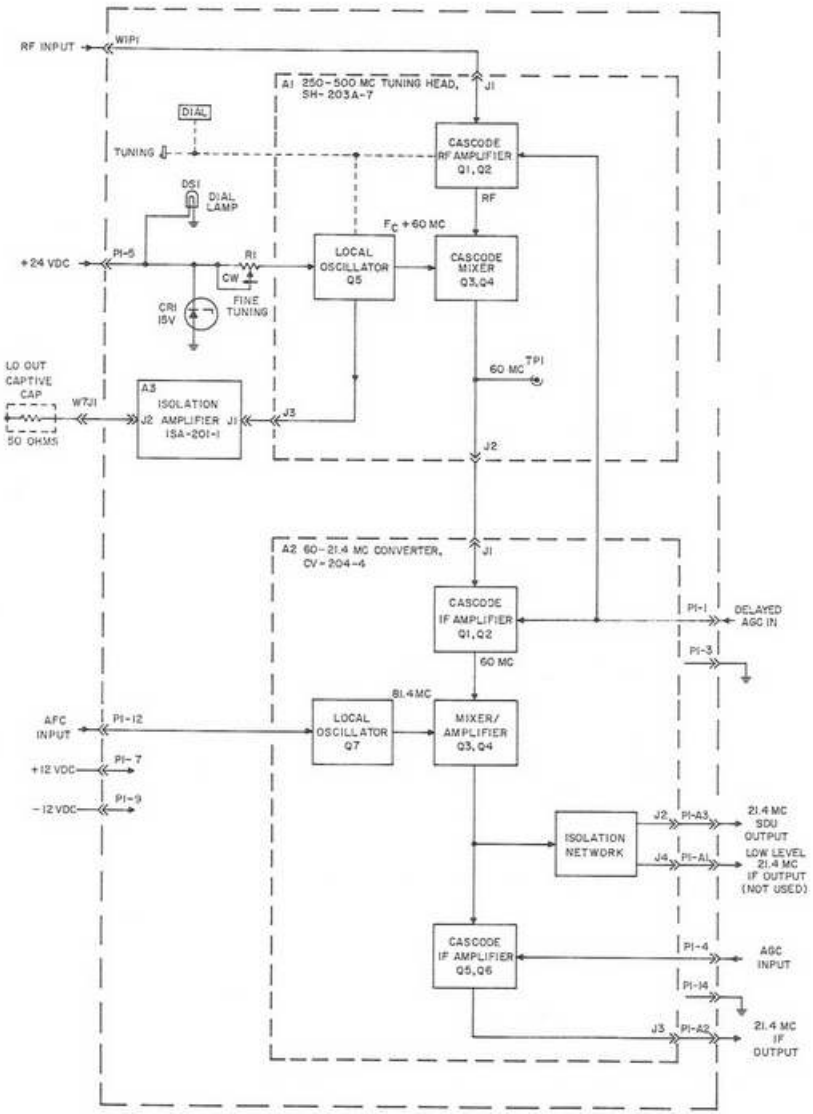


Figure 4-1. 250-500 Mc Plug-in RF Tuner, TN-519/WRR, Functional Block Diagram.

Mixer/Amplifier Q3-Q4 mixes, and filters the local oscillator and 60 mc IF signals, applying a 21.4 mc second IF signal to the isolation network and cascode amplifier Q5-Q6. The isolation network is passive and applies the 21.4 mc IF signal to an external 21.4 mc signal display unit. The second output of the isolation network is used by logarithmic receivers. This output is not used by Countermeasures Receiver R-1524(P)/WRR. Cascode IF amplifier Q5-Q6 applies the 21.4 mc second IF signal to the receiver main chassis IF circuits. Gain control (AGC or MGC) is applied to Q5-Q6 to prevent circuit overloading.

(3) Isolation Amplifier, ISA-201-1: Isolation amplifier module A3 couples the local oscillator output of tuning head module A1 to an output connector on the front panel of the RF tuner. This output is used for monitoring purposes. When not in use, this output is terminated in a removable 50-ohm captive cap.

(4) Miscellaneous Circuits: Dial lamp DS1 is on when power is applied to the RF tuner. Zener diode CR1 regulates the voltage applied to FINE TUNING control R1. The regulated voltage prevents local oscillator frequency variations due to voltage level changes. All power is applied to the RF tuner from the receiver main chassis supply.

B. RF Tuner TN-520/WRR, Figure 4-2

RF tuner TN-520/WRR consists of three (3) subchassis as follows:

(1) Tuning head, SH-204-5, A1

(2) 60-21.4 Mc Converter, CV-205-1 A2

(3) Isolation amplifier, ISA-202, A3

(1) Tuning Head, SH-204-5: RF signals from the antenna are routed through the main chassis of Countermeasures Receiver R-1524(P)/WRR to a 4-pole preselector on the tuning head module. The preselector couples the selected antenna signal to mixer CR1. The preselector consists of four 1/4-wavelength tuned coaxial lines. Coupling between each tuned coaxial line is through irises in the walls separating the lines. A ganged tuning capacitor is mechanically linked to the front panel TUNING crank. Rotating the TUNING crank operates a calibrated dial and the ganged tuning capacitor. Varying the preselector capacitance selects the required RF.

Local oscillator Q1 generates a signal which is 60 mc above the selected RF. The oscillator output frequency is determined by the setting of the front panel TUNING crank. The local oscillator output signal is coupled to mixer CR1 and isolation amplifier module A3. Front panel FINE TUNING control R1 varies the oscillator output frequency ±50 Kc.

The RF output of the preselector and local oscillator Q1 are mixed by CR1 and applied to cascode IF amplifier Q2-Q3. The mixer output is monitored at J3 during alignment of the tuning head.

Cascode IF amplifier Q2-Q3 amplifies and filters the output of mixer CR1. The output of Q2-Q3 is a 60 mc IF which is applied to converter module A2. Gain control is applied to Q2-Q3 to prevent overloading.

(2) 60-21.4 Mc Converter, CV-205-1: The 60 mc IF signal from tuning head module A1 is applied to cascode IF amplifier Q1-Q2 of the converter module. The output of Q1-Q2 is coupled to mixer/amplifier Q3-Q4. Gain control is applied to Q1-Q2 to prevent overloading. Zener diode CR4 sets the required gain control signal level at 3.9 volts. Gain control signals exceeding the 3.9 volt level are applied to Q1-Q2.

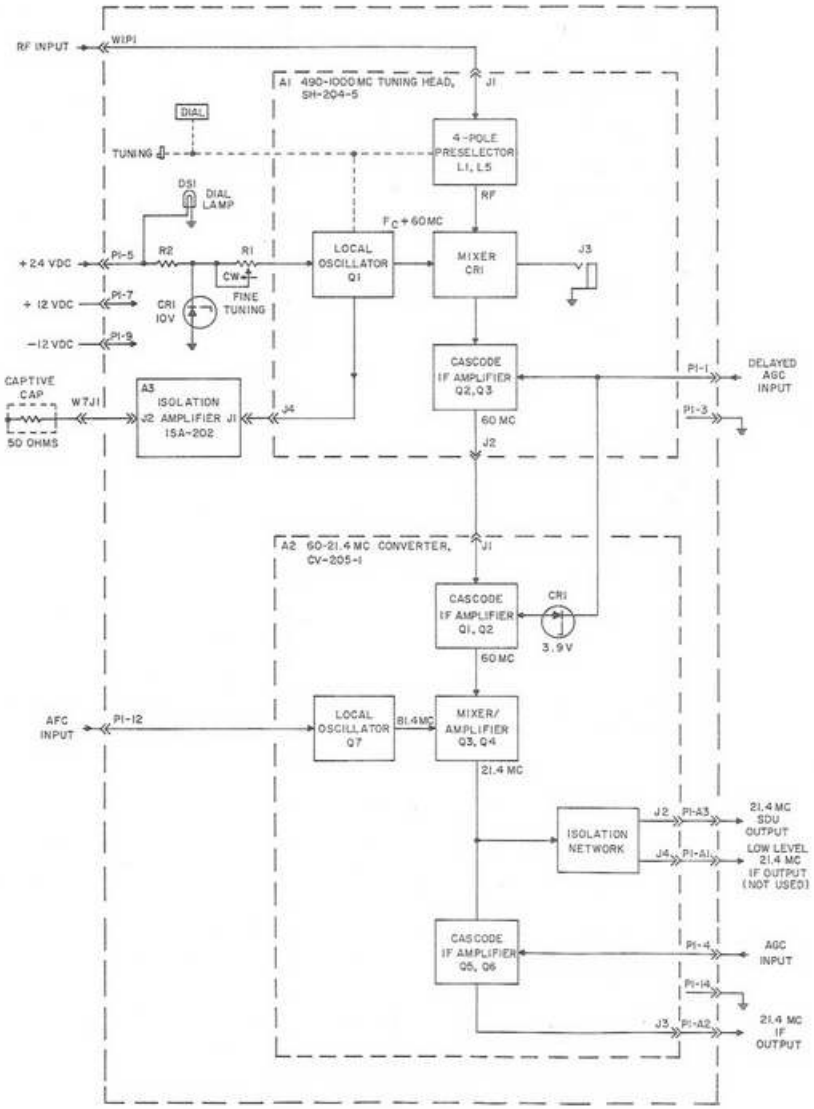


Figure 4-2. 490-1000 Mc Plug-in RF Tuner, TN-520/WRR, Functional Block Diagram.

Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer/amplifier Q3-Q4. Automatic frequency control (AFC) from the main chassis of Countermeasures Receiver R-1524(P)/WRR will cause the output of Q7 to vary.

The AFC signal compensates for local oscillator or transmitting station frequency shift by maintaining the output frequency of Q7 exactly 21.4 mc above the 60 mc IF input from the tuning head module.

Mixer/amplifier Q3-Q4 mixes and filters the local oscillator and 60 mc IF signals, applying a 21.4 mc second IF to the isolation network and cascode amplifier Q5-Q6. The isolation network is passive and applies the 21.4 mc IF signal to an external 21.4 mc signal display unit. The second output of the isolation network is used by logarithmic receivers. This output is not used by Countermeasures Receiver R-1524(P)/WRR. Cascode IF amplifier Q5-Q6 applies the 21.4 mc second IF signal to the receiver main chassis IF circuits. Gain control (AGC or MGC) is applied to Q5-Q6 to prevent circuit overloading.

(3) Isolation Amplifier, ISA-202: Isolation amplifier module A3 couples the local oscillator output of tuning head module A1 to an output connector on the front panel of the RF tuner. This output is used for monitoring purposes. When not in use, the output is terminated in a removable 50-ohm captive cap.

(4) Miscellaneous Circuits: Dial lamp DS1 is on when power is applied to the RF tuner. Zener diode CR1 regulates the voltage applied to FINE TUNING control R1. The regulated voltage prevents local oscillator frequency variations due to voltage level changes. All power is applied to the RF tuner from the receiver main chassis supply.

C. IF Amplifier, IF-212-500, Figure 4-3

The IF amplifier module demodulates the 21.4 mc IF output of the RF tuner. The module will pass deviations up to 250 Kc on either side of the 21.4 mc center frequency. The module includes two (2) cascode input IF amplifier stages connected in cascade, FM demodulating circuit, and an AM demodulating circuit. All operating voltages are supplied from the receiver main chassis power supply.

IF signals from the RF tuner are applied to IF amplifier Q1-Q2. The output of Q1-Q2 is applied to IF amplifier Q3-Q4. The IF amplifiers establish the input bandwidth of the module and provide the power required to drive the FM and AM demodulating circuits.

AM Detector CR1 is driven by IF amplifier Q3-Q4. The detector rectifies and filters the 21.4 mc IF signal. The detector output is AM video to output emitter follower Q5.

FM Limiter Q6-Q7 and Q8-Q9 provide a constant amplitude 21.4 mc IF signal to the FM demodulator circuit. The demodulator discriminates, detects and filters the 21.4 mc IF. The final output of the FM demodulator is FM video to output emitter follower Q10.

3. Functional Circuit Analysis.

A. RF Tuner TN-519/WRR, Figure 7-1

RF Tuner TN-519/WRR includes three (3) submodules as follows:

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

(2) 60-21.4 Mc Converter, CV-204-4, A2

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

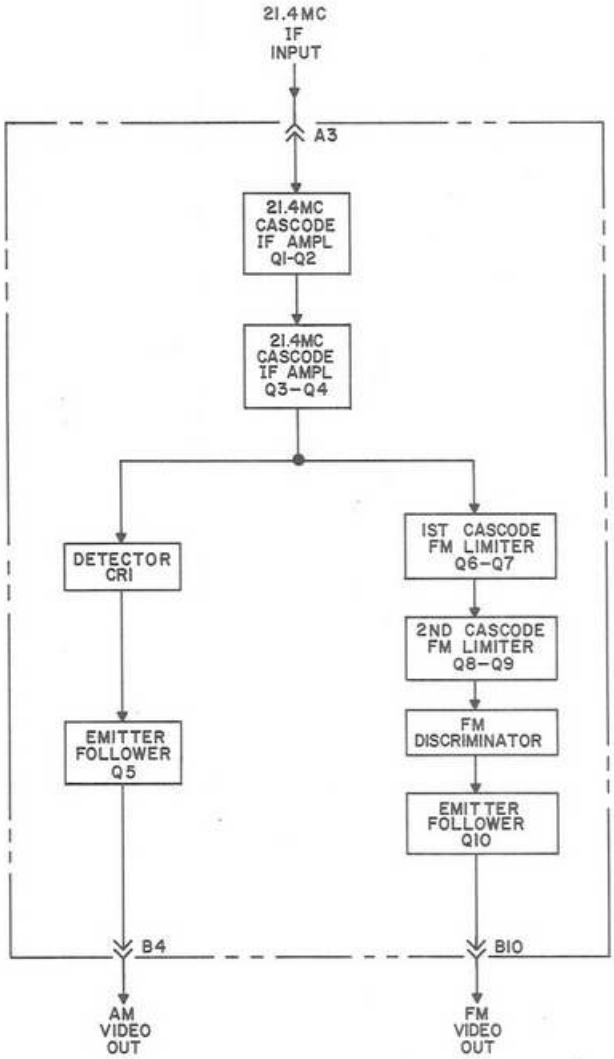


Figure 4-3. IF Amplifier, IF-212-500, Functional Block Diagram.

All power is applied from the receiver main chassis. Dial lamp DS1 is on when power is applied to the tuner. A gear train operated by the front panel TUNING crank, operates front panel mounted calibrated dial tape and an inductuner mounted in tuning head module A1.

B. Tuning Head, SH-203A7, Figure 7-2A and 7-2B

(1) Input Network: Signals from the antenna are coupled to the input network of the tuning head through connector J1. A static discharge path to ground for the input coaxial line is through R1. Impedance step-up to 50 ohms is by capacitive divider C1 and C2. The first inductuner section L1A and L2 form the primary of the double-tuned input network. The secondary is formed by L1B and L3. Impedance matching to the base of RF amplifier Q1 is by capacitive divider C4 and C8. Inductuner sections are mechanically ganged to other tuning sections in the interstage networks and to the collector circuit of the local oscillator, Q5. L2* and L3* provide adjustment of the double-tuned input network at the high end of the tuning range. Capacitors C5 and C6 adjust the low end of the tuning range. Inductor L4 and capacitor C7 form a series tuned circuit which forms a wave trap to reduce the RF image response of the tuner. After bandpass filtering by the double-tuned input network, the received signal is applied to RF amplifier stage Q1.

(2) RF Amplifier: Two (2) RF amplifier stages, Q1 and Q2, precede the mixer. The RF signal is applied to the base of Q1. Q1 is a gain controlled amplifier connected in a common emitter configuration. The base of Q1 is coupled through R2, R9, C13, and C14 to the delayed gain control source of the receiver. Q1 conducts through tuned circuit L5, L1C and C15. The collector of Q1 is tapped down on L5 to reduce RF image response. A small degenerative feedback to the base of Q1 through C9 and C10 reduces local oscillator back radiation into the RF circuits. This feedback is very small compared to RF signal amplification; therefore, has little affect on selected RF signals. The collector circuit of Q1 is double-tuned by resonant circuits L1C, L5, L1D, L6, and C15 through C17. Capacitors C15 and C16 are used to align the tuned circuit. RF amplifier Q2 is driven by Q1. Q2 operates identical to Q1. The output of Q2 is single-tuned and applied through C27 to the mixer circuit. Capacitor C21 is used to align the tuned circuit. Series tuned circuit C25 and L7 forms a wave trap which reduces the RF image response of the circuit.

(3) Local Oscillator: Local oscillator energy is generated by Q5. The circuit is a Colpitts oscillator operating 60 mc above the selected RF. Base bias conditions are established by resistive divider R14 and R15. The emitter stabilizing resistor is R16. Circuit tuning is by section L1F of the inductuner. Feedback for oscillation is through C38. The oscillator frequency range is from 310 to 560 mc. The oscillator output frequency is adjusted by C30. L10 across L1F is preset for the operating frequency range. An output used for monitoring is coupled through C39 and resistive attenuator R17, R18 and R19 to the front panel LO output jack through isolation amplifier module A3. Fine tuning of the local oscillator is provided by a variable dc voltage which is applied to the collector circuit of Q5. The local oscillator output to the mixer is through C29.

(4) Mixer: The mixer is connected in a cascode configuration. The signal from the RF amplifier is coupled through C27 to the base of common emitter stage Q3. Series tuned circuit C28 and L9 forms a wave trap which reduces the RF image response of the tuner. The local oscillator signal is applied to the base of Q3 through C29. Base and emitter bias conditions for Q3 are determined by R20, R23, and R24. The output of Q3 is coupled to the emitter of Q4 through oscillation damping network L14 and C37. After mixing, the 60 mc IF signal is selected by the double-tuned collector circuit of Q4. L12 and L13 are adjusted for resonance during alignment of the tuner. Test point TP1 is connected to the collector of Q4 through C50. A low impedance detector connected to the test point permits a check of the tuner RF response. From the tuned output of Q4, the 60 mc IF is coupled through resistive impedance network R26, R27, and R28 to the 60 to 21.4 mc down converter module A2.

*Note: Indicates factory adjustment.

C. 60-21.4 Mc Converter, CV-204-4, Figure 7-3A and 7-3B

(1) 60 Mc IF Amplifier: The 60 mc IF input from the tuning head module is applied through resistive impedance network R1, R2, and R3 and capacitor C1 to the base of Q1. The resistive network provides a 50-ohm input impedance. Cascode IF amplifier Q1-Q2 receives gain control signals at the base of Q1 through R4. The gain control (AGC or MGC) signals are generated on the receiver main chassis. The output of Q2 is double-tuned to the input of mixer Q3. Resistor R7 and capacitor C3 prevents Q1 and Q2 from oscillating. Inductors L1 and L2 are adjusted during alignment for a 3 db bandwidth of 3 mc.

(2) Local Oscillator: Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer Q3 through C10. Inductor L7 adjusts the oscillator output frequency. Automatic frequency control (AFC) is applied through R28 to the collector of Q7. The AFC signal is generated on the receiver main chassis. AFC varies the oscillator output frequency to compensate for frequency drift; thus, maintaining on station tuning.

(3) Mixer: Mixer Q3 amplifies both the 81.4 mc local oscillator output and 60 mc IF amplifier output. The mixed signals at the drain output of field effect transistor Q3 is coupled through L13 and R36 to the base of amplifier Q4. L13 and R36 prevent Q4 from overloading Q3 through impedance matching.

(4) Mixer Output Amplifier: Amplifier Q4 is double-tuned to the input of the 21.4 mc cascode IF amplifier, Q5-Q6. Amplifier Q4 also drives a signal display unit (SDU) output and a low level output. The double-tuned output of Q4 is centered at 21.4 mc. Alignment is accomplished with L3 and L4. The SDU output at J2 is coupled through R17 and R18 for impedance matching. The low level output at J4 is not used by Countermeasures Receiver R-1524(P)/WRR.

(5) 21.4 Mc IF Amplifier: Cascode 21.4 mc IF amplifier Q5-Q6 drives the receiver IF circuits through a double-tuned output. The double-tuned circuit is centered at 21.4 mc by adjusting L5 and L6. Diode clippers CR2 and CR3 prevent high level signals from passing into the receiver IF circuits. Capacitor C19 and resistor R21 prevent Q5 and Q6 from oscillating. Gain control (AGC or MGC) is applied to the base of Q5 through R19 and R38. Zener diode CR4 prevents the junction of R19 and R38 from going more positive than 6.2 volts.

D. Isolation Amplifier, ISA-201-1, Figure 7-4A and 7-4B

The tuning head module A1,local oscillator output signal is applied to isolation amplifier module A3. The isolation amplifier module consists of a single cascode amplifier, Q1-Q2. The isolation amplifier output is connected to the RF tuner front panel LO OUTPUT jack. The amplifier provides isolation and impedance matching.

E. RF Tuner TN-520/WRR, Figure 7-5

RF tuner TN-520/WRR includes three (3) submodules as follows:

(1) Tuning head, SH-204-5, A1

(2) 60-21.4 Mc Converter, CV-205-1, A2

(3) Isolation amplifier, ISA-202, A3

All power is applied from the receiver main chassis. Dial lamp DS1 is on when power is applied to the tuner. A gear train, operated by the front panel TUNING crank, operates a front panel calibrated dial tape and a ganged tuning capacitor mounted in tuning head module A1.

F. Tuning Head, SH-204-5, Figure 7-6A and 7-6B

(1) RF Preselector: The RF preselector consists of four (4) high Q, 1/4-wavelength, tuned coaxial lines, L2 through L5. Coupling between cavities is achieved through iris type apertures in the cavity walls. Preselector tuning is accomplished by varying the ganged loading capacitors, C1A through C1D. Inductor L1 matches the preselector to a 50-ohm input impedance. The output of the preselector is matched to crystal mixer CR1 through L6. The four-pole preselector insures high spurious signal rejection and low local oscillator radiation. Capacitors C2 through C5 align the preselector.

(2) Local Oscillator: Local oscillator Q1 is tuned by a 1/2-wavelength transmission line and variable capacitor C1E. The oscillator operates 60 mc above the RF input. Capacitor C6 adjusts the high frequency end of the oscillator output, 1060 mc. Capacitor C9 adjusts the low frequency end of the oscillator output, 550 mc.

(3) Mixer: The RF and local oscillator signals are coupled to crystal mixer CR1 through L6. Capacitors C12 and C22, and coils L14 and L10 impedance match the crystal output to the base of Q2. Coil L9 and capacitor C24 impedance match the test output at jack J3.

(4) 60 Mc IF Amplifier: Cascode 60 mc IF amplifier Q2-Q3 is gain controlled and applies a 60 mc IF to the 60-21.4 mc converter module A2. Gain control (AGC or MGC) is coupled through R5 to the base of Q2. The gain control signal is generated on the receiver main chassis. The output of Q3 is double-tuned by L12 and L13. Coils L12 and L13 are aligned for 4 mc bandwidth at 60 mc. Capacitor C26 and resistor R11 prevent Q1 and Q2 from oscillating.

G. 60 to 21.4 Mc Converter, CV-205-1, Figure 7-7A and 7-7B

(1) 60 Mc IF Amplifier: The 60 mc IF input from the tuning head module, A1, is applied through resistive impedance network R1, R2, and R3 and capacitor C1 to the base of Q1. The resistive network provides a 50-ohm input impedance. Cascode IF amplifier Q1-Q2 receives gain control signals at the base of Q1 through R4 and zener diode CR1. The gain control signals (AGC or MGC) are generated on the receiver main chassis. Zener diode CR1 will pass signals 3.9 volts or above to Q1. The output is double-tuned to the input of mixer Q3. Resistor R7 and capacitor C3 prevents Q1 and Q3 from oscillating. Coils L1 and L2 are adjusted during alignment for a 3 db bandwidth of 3 mc.

(2) Local Oscillator: Local oscillator Q7 generates a 81.4 mc signal which is applied to mixer Q3 through C10. Inductor L7 adjusts the oscillator output frequency. Automatic frequency control (AFC) is applied through R28 to the collector of Q7. The AFC signal is generated on the receiver main chassis. AFC varies the oscillator output frequency to compensate for frequency drift; thus, maintaining on station tuning.

(3) Mixer: Mixer Q3 amplifies both the 81.4 mc local oscillator output and 60 mc IF amplifier output. The mixed signals at the drain output of field effect transistor Q3 is coupled through R29 and L11 to the base of Q4. L11 and R29 prevent Q4 from overloading Q3 through impedance matching.

(4) Mixer Output Amplifier: Amplifier Q4 is double-tuned to the input of the 21.4 mc cascode IF amplifier, Q5-Q6. Amplifier Q4 also drives a signal display unit (SDU) output and a low level output. The double-tuned output of Q4 is centered at 21.4 mc. Alignment is accomplished with L3 and L4. The SDU output at J2 is coupled through R17 and R18 for impedance matching. The low level output at J4 is not used by Countermeasures Receiver R-1524(P)/WRR.

(5) 21.4 Mc IF amplifier: Cascode 21.4 mc IF amplifier Q5-Q6 drives the receiver IF circuits through a double-tuned output. The double tuned circuit is centered at 21.4 mc by adjusting L5 and L6. Diode clippers CR2 and CR3 prevent high level signals from passing into the receiver IF circuits. Capacitor C19 and resistor R21 prevent Q5 and Q6 from oscillating. Gain control (AGC or MGC) is applied to the base of Q5 through R19.

H. Isolation Amplifier, ISA-202, Figure 7-8A and 7-8B

Isolation amplifier module A3 consists of a single transistor, Q1, and associated input and output impedance matching components. The tuned output of Q1 is coupled to the RF tuner front panel LO OUTPUT jack.

I. I F Amplifier, IF-212-500, Figure 7-9A and 7-9B

(1) Input IF Amplifier: A 21.4 mc IF signal is applied through a 50-ohm impedance matching network to the input of cascode IF amplifier Q1-Q2. The output of Q2 is double-tuned to the input of cascode IF amplifier Q3-Q4. The tuned circuits consist of C4, C6, and L1; and C9, C10, and L2. The output of Q4 is double-tuned to the input of AM detector CR1 and first FM limiter Q6-Q7. The tuned circuits consist of C15, C16, and L3; and C18, C19 and L4.

(2) AM Demodulator: Diode CR1 applies detected AM signals to the base of emitter follower Q5. Radio frequency choke L5 removes all the 21.4 mc IF from the detected AM signal before application to the receiver audio circuits.

(3) FM Limiter: Capacitors C18 and C19 form a voltage divider, and the voltage drop across C19 is applied to first FM limiter Q6-Q7. The output of cascode limiter Q6-Q7 is single-tuned to the input of cascode limiter Q8-Q9. The second limiter output is single-tuned to the input of the FM discriminator. The tuned circuits include C26, C27, L6, and R35; and C31, C32, L8 and R41. The resistors de-tune the respective tuned circuit for wideband operation.

(4) FM Demodulator: The FM discriminator circuit supplies varying video signals to the base of emitter follower Q10. Radio frequency choke L12 removes all the 21.4 mc IF signal from the video before application to the receiver video circuits. Tuned circuits L10-C38 and L11-C39 form the input "S" curve of the discriminator. Diodes CR2 and CR3 detect the output of their respective tuned circuit. RC networks C40-R36 and C41-R47 form the diode load circuits for CR2 and CR3, respectively. When the input frequency is above the 21.4 mc IF, the FM demodulator output is positive going. When below the 21.4 mc IF, the demodulator output is negative going. Emitter follower Q10 drives the receiver video circuits.

4. Functional Operation of Mechanical Assemblies.

A. General

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

B. Gear Train Subassemblies

The 250 to 500 and 490 to 1000 mc gear trains are identical each consisting of a gear train and a tape deck assembly. All bearings are prelubricated and factory sealed eliminating the need for lubrication and servicing. The gear train incorporates a friction clutch design to minimize maintenance and adjustments for tuner dial accuracy. Specifically, the clutch will slip preventing damage to components and preventing the tuning tape from unwinding on the tape spools. The tuning control crank is secured to the input drive

shaft with set screws. This shaft is fed through the front panel and supported by a combination bearing and support housing. Two adjustable shaft collars serve to compress springs located on each side of two shaft mounted friction clutch plates. A clutch disc is centered between the two clutch plates to provide the friction drive to the tuner and tape deck. Torque from the tuning control crank is transferred to the output shaft via this clutch. The clutch disc is located on the output drive shaft and supplies torque directly to the tape deck by a shaft mounted Bevel gear and to the tuners through a pinion gear. The pinion gear extends from the rear of the gear train housing to mesh with the tuner mounted anti-backlash gear. Tape deck drive is taken from a Bevel gear to provide tape tracking to the tuned frequency. The tape feed system is a series of guide spools and spring loaded sprocket spools to maintain tape tension and smooth feed from end to end.

SECTION V

MAINTENANCE

1. General.

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

2. Test Equipment.

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

Table 5-1. Required Test Equipment Characteristics

EQUIPMENT	MODEL	MFR	REQUIRED CHARACTERISTICS
Sweep Generator	SM-2000	Telonic	Sweep Rate: 0.01 to 1000 cps RF Attenuation: 0 to 60 db in 1 db steps Mkr System: Birdy-by-pass, Ext. marker in, plug-in crystal markers, rectified markers Output Impedance: 50 ohms Scope Horizontal Output: 15 volts p-to-p
Plug-In Head	E1	Telonic	Frequency Range: 460 to 1840 mc Sweep Width: 0.1 to 10% of C. F.
Plug-In Head	SH-1	Telonic	Frequency Range: 0.5 to 460 mc Sweep Width: 200 kc to 200 mc
Signal Generator	606A	Hewlett-Packard	Frequency Range: 50 kc to 65 mc in six bands RF Output: 0.1uv to 3 volts Modulation: AM, 0 to 100%, 400 and 1000 cps; external 0 to 100%, dc to 20 kc Output Impedance: 50 ohms

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

EQUIPMENT	MODEL	MFR	REQUIRED CHARACTERISTICS
Signal Generator	608D	Hewlett-Packard	Frequency Range: 10 to 420 mc in five bands RF Output: -125 dbm to +4 dbm Modulation: AM, 0 to 100%, 400 and 1000 cps Output Impedance: 50 ohms
Signal Generator	612A	Hewlett-Packard	Frequency Range: 450 to 1230 mc RF Output: 0.1uv to 0.5 volts into 50 ohms Modulation: AM, 0 to 90%, 400 to 1000 cps; external 0 to 85%, dc to 1 mc Output Impedance: 50 ohms
Oscilloscope	503	Tektronix	Frequency Range: dc to 450 kc Vertical Sensitivity: 1 mv/cm to 20 volt/cm Sweep Range: 1 microsecond/cm to 5 sec/cm Input Impedance: 1 meg ohm shunted by 47 pf
VTVM	WV-98C	RCA	Range: 0 to 1500 volts, ac and dc, 0 to 1000 meg ohms Input Resistance: 11 meg ohms dc Frequency Range: 30 cps to 3 mc Accuracy: ±3%
50-ohm Detector	XD-3A	Telonic	

3. Operator Preventive Maintenance.

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

Table 5-2. Monthly Operational Maintenance Checks.

Sequence Number	Item	Procedure
1	Exterior Surfaces	Clean front and rear panels. Check all knobs and controls for tightness and signs of improper indexing.

Table 5-2. Monthly Operational Maintenance Checks. (Cont)

Sequence Number	Item	Procedure
2	Cables and Connectors	Check cables and connectors for proper fit, clearance, and wear.
3	Controls, Dials and Switches	In performing operational checks, observe the mechanical action of each control and switch. They should operate easily and free of binding.

4. Tuning Unit Mechanical Adjustments.

A. General

The tuning units are mechanically rugged and should require little, if any, mechanical adjustment. Periodically, mounting and set screws should be checked for tightness to avoid deterioration of performance, especially when the receiver is operated in an environment which results in the application of vibrations or shocks. Other than the periodic checks, mechanical maintenance is limited to friction clutch adjustment, frequency tape adjustments, and gear train parts replacement.

B. Friction Clutch Adjustment

The friction clutch adjustment should be performed when the tuning control crank turns excessively hard, or when clutch slippage is evident while tuning.

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

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

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

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

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

C. Dial Tape Adjustment

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

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

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

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

CAUTION: When rotating the tuning crank, do not wind the dial tape more than one inch beyond last tape marking.

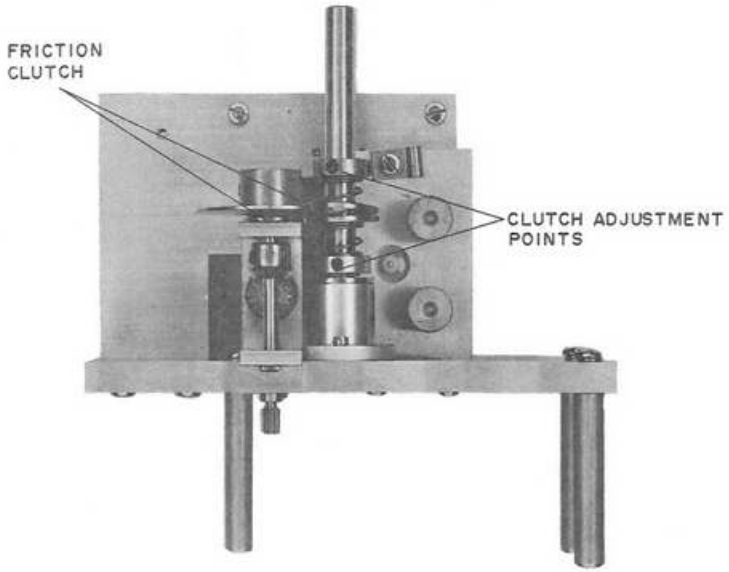


Figure 5-1. Gear Train Clutch Adjustment Points.

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

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

D. Gear Train Parts Replacement

When gear train parts require replacement, the manufacturer suggests replacement of the gear train assembly, and return to the factory for repair. Should this not be feasible, refer to Figure 5-2 and 5-3 for an exploded view of the gear train to facilitate parts replacement.

5. 250 to 500 Mc RF Tuner, TN-519/WRR

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in the isolation of faults to the RF tuner module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the TN-519/WRR RF tuner.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts will assist in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, be assured that the receiver power supplies are functioning normally in accordance with paragraph 4.A. (4) of NAVSHIPS instruction manual 0967-282-0010. Figure 5-4 illustrates the power extender cable which is required to operate the tuning unit outside the receiver housing. The performance standards for the various modules of the tuner are given in Tables 5-3 through 5-5.

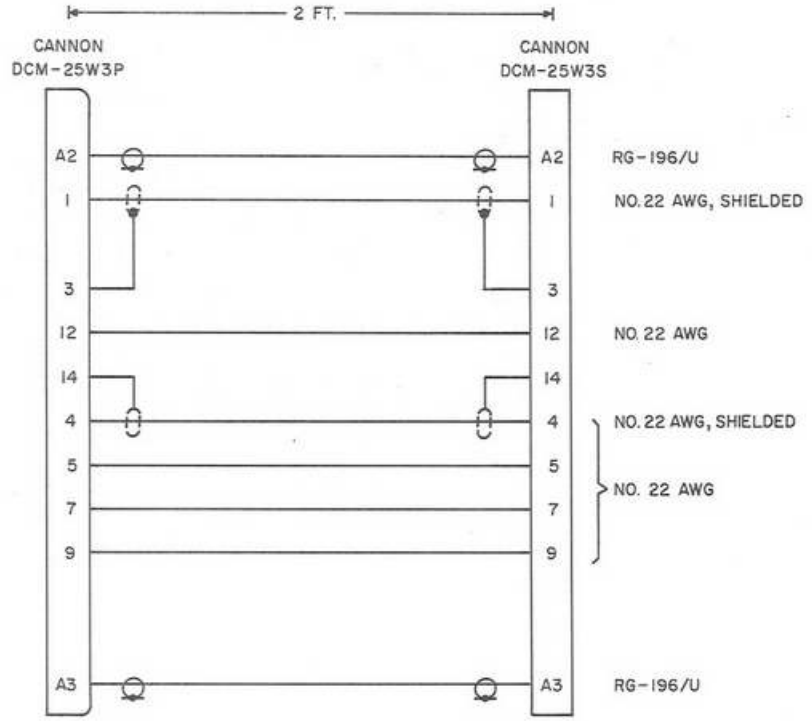


Figure 5-4. Power Extender Cable.

When performing the minimum standards tests, remove the tuning unit from the Countermeasures Receiver and reconnect with the power extender cable. Place the following Countermeasures Receiver front panel switches to the positions shown before proceeding:

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

Tuning Tape	250 Mc
VOLUME	Midrange

Table 5-3. Tuning Head, SH-203A-7 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1, antenna input, of the SH-203A-7 tuning head. Connect a 50 ohm detector to J2 of the tuning head module. Place the tuner in operation at 350 mcs. Adjust the signal generator output frequency to 350 mcs. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the oscilloscope. The oscilloscope signal should be a 400 cps sine wave. Record the setting of the signal generator attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the setting of the signal generator attenuator.	The difference between the two recorded signal generator attenuator settings is the gain of the SH-203A-7 tuning head. The gain should be 31 db minimum.

Table 5-4. 60 to 21.4 Mc Converter, CV-204-4 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the CV-204-4 converter module. Connect a 50 ohm detector to J3 of the converter module. Connect the detector output to the vertical input of a Tektronix 503 oscilloscope. Calibrate the signal generator output to 60 mc. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the CV-204-4 converter module. The gain should be about 35 db minimum.

Table 5-5. Isolation Amplifier ISA-201-1 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the ISA-201-1 module. Connect a 50 ohm detector to the LO OUTPUT jack at the tuning unit front panel. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator output frequency to 350 mcs. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the ISA-201-1 amplifier module. The gain should be 44.0 db minimum.

B. Voltage and Resistance Measurements (Tables 5-6 through 5-8)

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

Table 5-6. 250-500 Mc Tuning Head, SH-203A-7 Voltage and Resistance Chart.

NOTES: 1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counterclockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (1)	R (+)	V	R (-)	R (+)
Q1	-3.98 V (5.0 V)	3.9 K (R x 100)	2.75 K (R x 100)	-3.15 V (5.0 V	4.4 K (R x 100)	34 K (R x 1 K)	6.8 V (15 V)	3.6 K (R x 100)	2.81 K (R x 100)
Q2	-0.935 V (1.5 V)	5.2 K (R x 1K)	1.9 K (R x 100)	-0.175 V (0.5 V)	2.5 K (R x 100)	4.0 K (R x 100)	7.0 V (15 V)	3.7 K (R x 100)	2.1 K (R x 100)
Q3	-5.8 V (15 V)	3.7 K (R x 100)	1.62 K (R x 100)	-5.15 V (15 V)	10.1K (R x 1 K)	14.8 K (R x 1 K)	-0.65 V (1.5 V)	100 meg (R x 1 meg)	17.8 (R x 1)
Q4	-0.65 V (1.5 V)	100 meg (R x 1 meg)	17.9 (R x 1)	0 V	0	0	9.2 V (15 V)	2.8 K (R x 100)	39.0 (R x 1)
Q5	-5.3 V (15 V)	2.7 K (R x 100)	1.65 K (R x 100)	-5.62 V (15 V)	2.61 K (R x 100)	5.0 K (R x 100)	4.25 V (5.0 V)	3.75 K (R x 100)	2.62 K (R x 100)

Table 5-7. 60 to 21.4 Mc Converter, CV-204-4 Voltage and Resistance Chart.

NOTES: 1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Counter-measures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-1.4 V (1.5 V)	3.6 K (R x 1 K)	1.4 K (R x 100)	-0.68 V 1.5 V)	5.8 K (R x 1 K)	4.5 K (R x 1 K)	7.4 V (15 V)	4.2 K (R x 1 K)	1.6 K (R x 100)
Q2	-0.68 V (1.5 V)	7.0 K (R x 1 K)	100 (R x 10)	0	0	0	9.9 V (15 V)	4.2 K (R x 1 K)	85 (R x 10)
Q4	6.8 V (15 V)	2.2 K (R x 100)	1.4 K (R x 100)	7.5 V (15 V)	4.4 K (R x 1 K)	3.3 K (R x 1 K)	8.8 V (15 V)	4.3 K (R x 1 K)	1.9 K (R x 100)
Q5	-2.4 V (5 V)	3.7 K (R x 1 K)	1.7 K (R x 100)	-1.6 V (5 V)	10 K (R x 1 K)	18 K (R x 1 K)	8.0 V (15 V)	4.2 K (R x 1 K)	1.8 K (R x 100)
Q6	0.68 V (1.5 V)	4.5 V (R x 1 K)	100 (R x 10)	0	0	0	8.6 V (15 V)	4.2 K (R x 1 K)	850 (R x 10)
Q7	-6.5 V (15 V)	1.9 K (R x 100)	1.49 K (R x 100)	-7.4 V (15 V)	1.71 K (R x 100)	2.0 K (R x 100)	4.05 V (5 V)	11.9 K (R x 1 K)	2.0 K (R x 100)
	SOURCE			GATE			DRAIN		
*Q3	1.37 V (1.5 V)	4.5 K (R x 1 K)	4.0 K (R x 1 K)	0	11 K (R x 1 K)	14 K (R x 1 K)	7.5 V (15 V)	4.4 K (R x 1 K)	4.0 K (R x 1 K)

*Field effect transistor, bottom view

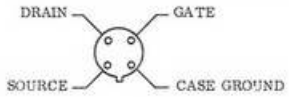


Table 5-8. Isolation Amplifier, ISA-201-1 Voltage and Resistance Chart.

NOTES: 1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (1)	R (+)	V	R (-)	R (+)
Q1	-7.6 V (15 V)	3.4 K (R x 1 K)	1.3 K (R x 100)	-6.8 V (15 V)	5.4 K (R x 1K)	4.3 K (R x 1 K)	-0 8 V (1.5 V)	Inf.	900 (R x 100)
Q2	-0.8 V (1.5 V)	Inf.	900 (R x 100)	0	0	0	11.4 V (15 V)	3.8 K (R x 1 K)	900 (R x 100)

C. 250 to 500 Mc RF Tuner Alignment

Alignment of the 250 to 500 mc RF tuner is divided into tuning head and 60 to 21.4 mc converter alignment. Countermeasures Receiver R-1524(P)/WRR and the tuner should be placed on a workbench adjacent to the test equipment being used for alignment to facilitate the use of short cables and test leads. The power extender cable illustrated in Figure 5-4 should be connected between the rear of the tuning unit and the right hand connector J5 on the main chassis of the receiver. Place the following receiver front panel switches and controls to the positions indicated below before performing alignment.

SWITCH	POSITION
POWER	ON
TUNER	RIGHT
RF GAIN	Maximum CW
AFC	OFF
IF BANDWIDTH	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	CW
Tuning Tape	250 mc
VOLUME	Midrange

(1) 250 to 500 Mc Tuning Head, SH-203A-7, Alignment

a. Connect Countermeasures Receiver R-1524(P)/WRR to 115 vac, 60 cps power source.

b. Connect test equipment as shown in Figure 5-5.

c. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust horizontal sensitivity as required for full scale deflection. Connect the detector to TP1 as illustrated in Figure 5-5.

d. Adjust the sweep generator output frequency to 500 mc. Adjust the output level of the sweep generator as required to achieve an oscilloscope deflection of about 4.0 cm.

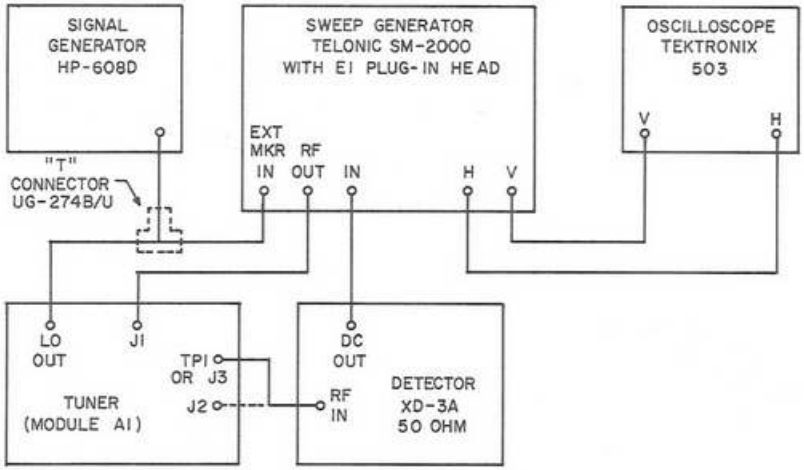


Figure 5-5. 250-500 Mc RF Tuner Test Set-Up.

e. Calibrate the signal generator frequency at 60 mc and adjust the output amplitude to achieve a marker "birdy" on the response waveform. Adjust the external marker input control on the sweep generator until the marker "birdy" of the required amplitude is achieved at 500 mc.

f. Turn the internal 10 mc markers of the sweep generator on. Adjust the sweep generator marker amplitude control as required to achieve the marker display.

g. With the tuning unit set at 500 mc, the LO output and signal generator markers should be superimposed.

h. Adjust C30 on the tuner until the LO output and signal generator markers are superimposed.

i. The RF response displayed on the oscilloscope should have the characteristics illustrated in Figure 5-6.

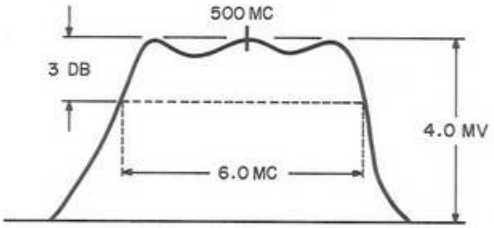


Figure 5-6. 250-500 Mc RF Tuner Response Waveform at TP1.

j. Adjust C5, C6, C15, C16 and C26 for maximum symmetrical response centered around the 500 mc marker.

k. Rotate the tuning crank over the tuning range, adjusting the sweep generator output frequency as required to maintain the response on the oscilloscope. Adjust the signal generator output level as required to maintain an oscilloscope deflection of about 4.0 cm.

l. The marker should remain centered on the response waveform over the tuning range and the response waveform shape should remain essentially as illustrated in Figure 5-5. Slight readjustment of the capacitors in step j. may be necessary to obtain a suitable response over the tuning range.

m. Disconnect the detector from TP1 and connect to J2 on the tuning head module. The sweep generator output level should be readjusted as required to achieve a 4.0 cm deflection on the oscilloscope at 500 mc.

n. The IF response at the tuning head module IF output J2 should be as illustrated in Figure 5-7.

o. Adjust L10 and L11 for maximum symmetrical response centered around the 60 mc marker. The response at 3 db point will be approximately 4 mc.

p. Alignment complete; remove test equipment.

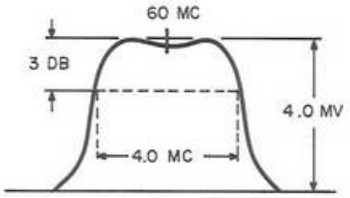


Figure 5-7. 250-500 Mc RF Tuner IF Response Waveform at J2.

(2) 60 to 21.4 Mc Converter, CV-204-4, Alignment

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

b. Connect test equipment as shown in Figure 5-8.

c. Calibrate the 606D signal generator at 60 mc and the 608D at 21.4 mc.

d. Set the sweep generator in operation at 60 mc with a sweep range of ±4 mc.

e. Adjust the oscilloscope vertical gain for 2 mv/cm.

f. Adjust the sweep generator output level for a vertical deflection of 5 cm on the oscilloscope.

g. Adjust the oscilloscope horizontal gain to display the response waveform.

h. Adjust the 606D signal generator output level for a small marker on the response waveform.

i. Adjust the 608D signal generator output level for a small marker on the response waveform.

j. Adjust L7 on the converter module until both markers are superimposed. Increase the oscilloscope horizontal gain; readjust L7 until both markers are perfectly superimposed.

k. Complete the following test set-up changes:

1. Disconnect 608D signal generator from test set-up.

2. Connect the XD-3A detector to J2, SDU OUT.

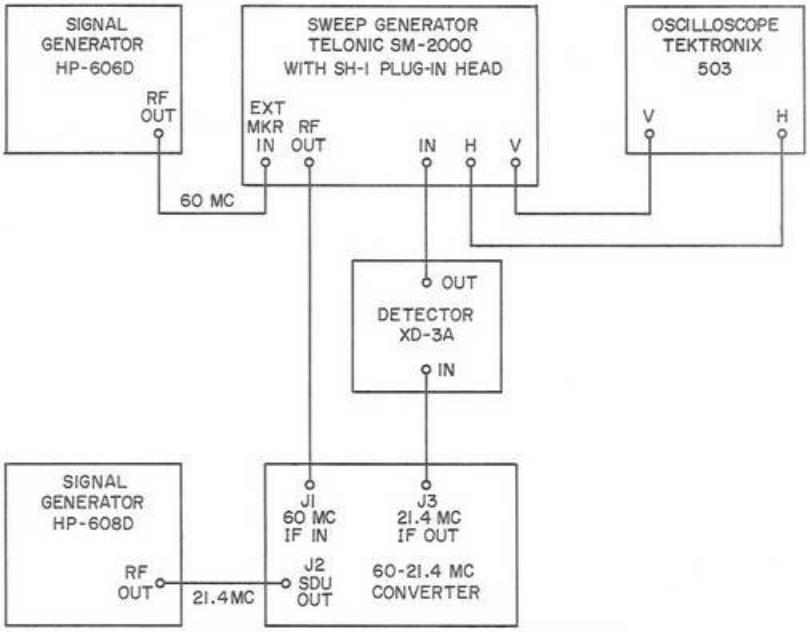


Figure 5-8. 60-21.4 Mc Converter Module Alignment, Test Set-up.

l. Reduce oscilloscope horizontal gain until the complete response waveform is displayed.

m. Adjust the 606D signal generator output level until a small marker is present on the response waveform.

n. Adjust L1, L2, L3 and L4 for maximum response centered around the marker. Refer to Figure 5-9.

o. Connect the XD-3A detector to J3 on the converter module.

p. Adjust L5 and L6 for maximum response centered around the marker. Refer to Figure 5-10.

(3) ISA-201-1 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about 4.0 db over the tuning range of the local oscillator and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-5 of the minimum performance standards. When the unit does not meet the minimum standards, the difficulty is likely to be a defective component and not alignment.

6. 490 to 1000 Mc RF Tuner, TN-520/WRR.

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in the isolation of faults to the RF tuner module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the TN-520/WRR RF tuner.

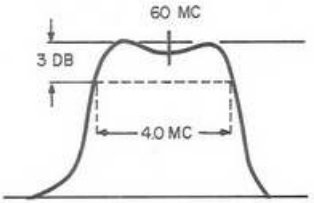


Figure 5-9. 60-21.4 Mc Converter Response Waveform at J2 Output.

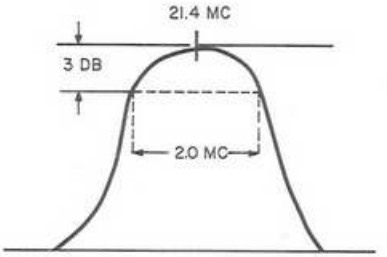


Figure 5-10. 60-21.4 Mc Converter Response Waveform at J3 Output.

A. Minimum Performance Standards

When faulty receiver operation has been traced to the plug-in tuning unit, the following minimum performance standards charts will assist in further localizing the difficulty to a particular module or circuit. Before attempting to evaluate the performance of the tuning unit, assure that the receiver power supplies are functioning normally in accordance with paragraph 4.A.(4) of NAVSHIPS instruction manual 0967-282-0010. Figure 5-4 illustrates the power extender cable which is required to operate the tuning unit outside the receiver housing. The performance standards for the various modules of the tuner are given in Tables 5-9 through 5-11. When performing the minimum standards tests, remove the tuning unit from the Countermeasures receiver and reconnect with the power extender cable. Place the following Countermeasures receiver front panel switches to the positions shown before proceeding:

SWITCH	POSITION
POWER	ON
TUNER	RIGHT of LEFT (as required)
RF GAIN	Maximum clockwise
AFC	OFF
IF SELECTOR	Position 2
FM SQUELCH	OFF
MODE	AM/MAN
FINE TUNING	Midrange
Tuning Tape	490 mc
VOLUME	Midrange

Table 5-9. Tuning Head, SH-204-5 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 612A signal generator to J1, antenna input, of the SH-204-5 tuning head module. Connect a 50 ohm detector to J2 of the tuning head module. Place the tuner in operation at 750 mcs. Adjust the signal generator output frequency to 750 mcs. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator modulation to 400 cps at 50% AM.	Set the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust the output level of the signal generator as required to achieve a 4.0 cm deflection on the oscilloscope. The oscilloscope signal should be a 400 cps sine wave. Record the setting of the signal generator attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the setting of the signal generator attenuator.	The difference between the two recorded signal generator attenuator settings is the gain of the SH-204-5 tuning head. The gain should be 24 db minimum.

Table 5-10. 60 to 21.4 Mc Converter, CV-205-1 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 608D signal generator to J1 on the CV-205-1 converter module. Connect a 50 ohm detector to J3 of the converter module. Connect the detector output to the vertical input of a Tektronix 503 oscilloscope. Calibrate the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the CV-205-1 converter module. The gain should be 45 db minimum.

Table 5-11. Isolation Amplifier, ISA-202 Minimum Performance Standards.

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1.	Connect a 612D signal generator to J1 on the ISA-202 module. Connect a 50 ohm detector to the LO OUTPUT jack at the tuning unit front panel. Connect the 50 ohm detector output to the vertical input of a Tektronix 503 oscilloscope. Set the signal generator output frequency to 750 mcs. Set the signal generator modulation to 400 cps at 50% AM.	Set the oscilloscope vertical sensitivity to 1.0 mv/cm. Adjust the signal generator output level to achieve a 4.0 cm deflection on the oscilloscope. The signal should be a 400 cps sine wave. Record the setting of the signal generator output attenuator. Connect the output of the signal generator directly to the input of the 50 ohm detector. Adjust the signal generator output level until a 4.0 cm deflection is again achieved on the oscilloscope. Record the signal generator output attenuator setting.	The difference between the two recorded signal generator settings is the gain of the ISA-202 amplifier module. The gain should be 4.0 db or more.

B. Voltage and Resistance Measurements (Tables 5-12 through 5-14)

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

Table 5-12. 490-100 Mc Tuning Head, SH-204-5, Voltage and Resistance Chart.

NOTES: 1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES	EMITTER			BASE			COLLECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	3.9 V (5 V)	580 (R x 100)	560 (R x 100)	4.1 V (5V)	1.5 K (R x 100)	3.3 K (R x 1 K)	8.9 V (15 V)	1.09 K (R x 100)	299 (R x 10)
Q2	-1.0 V (1.5 V)	3.5 K (R x 1 K)	1.41 K (R x 100)	-0.23 V (.5 V)	2.35 K (R x 100)	4.0 K (R x 1 K)	7.1 V (15 V)	2.71 K (R x 100)	1.62 K (R x 100)
Q3	0.7 V (1.5 V)	4.1 K (R x 1 K)	15.5 (R x 1)	0	0	0	6.0 V (15V)	3.3 K (R x 100)	12.9 (R x 1)

Table 5-13. 60 to 21.4 Mc Converter, CV-205-1 Voltage and Resistance Chart

NOTES: 1. TN-520/WRR RF tuner connected to right hand tuner receptacle with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-520/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			CONNECTOR		
	V	R (-)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	1.6 V (5V)	3.3 K (R x 1 K)	1.4 K (R x 100)	-0.8 V (1.5 V)	4.1 K (R x 1 K)	3.9 K (R x 1 K)	7.4 V (15 V)	3.6 K (R x 1 K)	1.6 K (R x 100)
Q2	-0.64 V (1.5 V)	7.3 K (R x 1 K)	750 (R x 100)	0	0	0	11.4 V (15 V)	3.6 K (R x 1 K)	85 (R x 10)
Q4	7.6 V (15 V)	2.2 K (R x 1 K)	1.4 K (R x 100)	8.3 V (15 V)	4.3 K (R x 1 K)	4.2 K (R x 1 K)	10.2 V (15 V)	3.5 K (R x 1 K)	1.8 K (R x 100)
Q5	-3.0 V (5 V)	3.9 K (R x 1 K)	2.0 K (R x 100)	-2.3 V (5 V)	9.4 K (R x 1 K)	28 K (R x 1 K)	9.7 V (15 V)	3.6 K (R x 1 K)	1.8 K (R x 100)
Q6	-0.68 V (1.5 V)	7.2 K (R x 1 K)	100 (R x 10)	0	0	0	11.4 V (15 V)	3.5 K (R x 1 K)	85 (R x 10)
Q7	-6.4 V (15 V)	2.3 K (R x 100)	1.4 K (R x 100)	7.6 V (15 V)	2.1 K (R x 100)	1.9 K (R x 100)	4.0 V (5 V)	4.1 K (R x 1 K)	1.7 K (R x 100)
	SOURCE			GATE			DRAIN		
*Q3	1.34 V (5 V)	4.3 K (R x 1 K)	4.2 K (R x 1 K)	0	11 K (R x 1 K)	22 K (R x 1 K)	8.3 V (15 V)	4.3 K (R x 1 K)	4.0 K (R x 1 K)

*Field effect transistor, bottom view

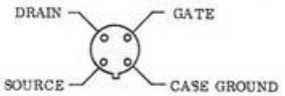


Table 5-14. Isolation Amplifier, ISA-202 Voltage and Resistance Chart.

NOTES: 1. TN-519/WRR RF tuner connected to right hand tuner receptacle of Countermeasures Receiver R-1524(P)/WRR with extender cable (Figure 5-4).
2. TUNER control set to RIGHT position.
3. IF BANDWIDTH set to position 2.
4. AFC set to off (down).
5. RF GAIN maximum clockwise.
6. MODE switch set to AM/MAN.
7. VOLUME control maximum counter-clockwise.
8. FM SQUELCH set to OFF.
9. POWER switch set to ON.
10. TN-519/WRR tuner FINE TUNING control maximum clockwise.
11. Disconnect power cord from Countermeasures Receiver R-1524(P)/WRR during resistance measurements.

REF. DES.	EMITTER			BASE			COLLECTOR		
	V	R (1)	R (+)	V	R (-)	R (+)	V	R (-)	R (+)
Q1	-7.2 V	2.4 K	1.4 K	-6.5 V	5.3 K	5.4 K	0	0	0

C. 490 to 1000 Mc RF Tuner Alignment

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

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

(1) RF Tuning Head, SH-204-5 Alignment

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

b. Connect test equipment as illustrated in Figure 5-5.

c. Adjust the vertical sensitivity of the oscilloscope to 1.0 mv/cm. Adjust horizontal sensitivity as required for full scale deflection. Connect the detector to test point J3 as illustrated in Figure 5-5.

d. Adjust the sweep generator output frequency to 500 mc. Adjust the output level of the sweep generator as required to achieve an oscilloscope deflection about 4.0 cm.

e. Calibrate the signal generator frequency at 60 mc and adjust the output amplitude to achieve a marker "birdy" on the response waveform. Adjust the external marker input control on the sweep generator until the marker "birdy" of the required amplitude is achieved at 500 mc.

f. Turn the internal 10 mc markers of the sweep generator on. Adjust the sweep generator marker amplitude control as required to achieve the marker display.

g. With the tuning unit set at 500 mc, the LO output and signal generator markers should be superimposed.

h. Adjust C9 on the tuner until the LO and signal generator output markers are superimposed.

i. Repeat steps d. through g. substituting 1000 mc for 500 mc.

j. Adjust C6 on the tuner until the LO and signal generator output markers are superimposed.

k. Adjust C2, C3, C4 and C5 for maximum response centered around 1000 mc.

l. The RF response displayed on the oscilloscope should have the characteristics illustrated in Figure 5-11.

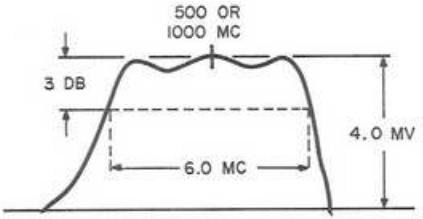


Figure 5-11. 490-1000 Mc RF Tuner Response Waveform at J3.

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

n. The marker should remain centered on the response waveform over the tuning range and the response waveform shape should remain essentially as illustrated in Figure 5-11. Slight readjustment of the capacitors in step k. may be necessary to obtain a suitable response over the tuning range.

o. Disconnect the detector from J3 and connect to J2 on the tuner. The sweep generator output level should be readjusted as required to achieve a 4.0 cm deflection on the oscilloscope at 1000 mc.

p. The IF response at the tuner IF output J2 should be as illustrated in Figure 5-12.

q. Adjust L12 and L13 for maximum symmetrical response centered around the 60 mc marker.

r. Alignment complete, remove test equipment.

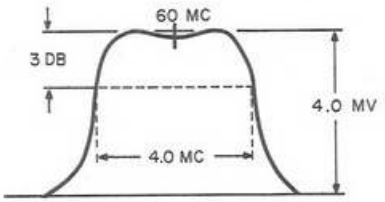


Figure 5-12. 490-1000 Mc RF Tuner IF Response Waveform at J2.

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

(3) ISA-202 Isolation Amplifier: The amplifier used to provide isolation between the local oscillator and the LO OUTPUT jack on the front panel of the tuning unit is broadly tuned and will not require alignment in the field. The module provides a loss of about 4.0 db over the range of frequencies from 490 to 1000 mc and effectively isolates the oscillator from variations in load impedance. Perform the tests outlined in Table 5-11 of the minimum performance standards. If the unit exhibits more loss than is indicated, the difficulty is likely to be a defective component and not the alignment.

7. IF Amplifier, IF-212-500.

The maintenance and troubleshooting sections of the Countermeasures Receiver R-1524(P)/WRR instruction manual, NAVSHIPS 0967-282-0010 will assist the technician in isolation of faults to the IF amplifier module. This supplement to the NAVSHIPS instruction manual will accordingly deal with minimum performance standards, alignment, and repair of the IF-212-500 IF amplifier.

A. Minimum Performance Standards

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

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

Step	Test Equipment Operation	Procedure	Minimum Acceptable Performance
1	Remove RF tuner from left hand receiver tuner receptacle. Connect a 606A signal generator to J2A2 on the receiver main chassis. Calibrate the signal generator output at 21.4 mc with 50% modulation at 1000 cps. Connect the vertical input of a Tektronix 503 oscilloscope to pin B4 of the IF module.	Set the Countermeasures Receiver IF BANDWIDTH switch to select the LEFT position. Set the oscilloscope to display a 1000 cps signal. Adjust the signal generator output level as required to achieve a display on the oscilloscope.	The oscilloscope display should be a clean 1000 cps signal. The overall signal gain should be 56 ± 3 db.
2	Same as step 1 except do not use modulation.	Vary the output frequency of the signal generator around 21.4 mc.	The Countermeasures Receiver tuning meter should track the varying output of the signal generator. At 21.4 mc the tuning meter should indicate 0.

B. Voltage and Resistance Measurements

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

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

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

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

C. IF Amplifier, IF-212-500 Alignment

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

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

(1) AM Alignment:

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

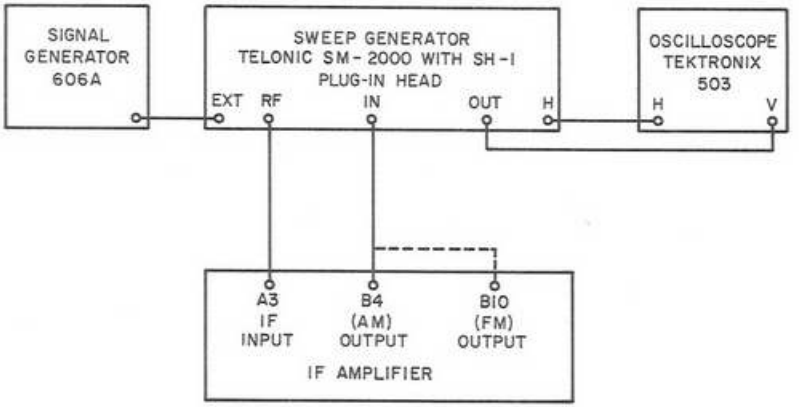


Figure 5-13. IF Amplifier Alignment Test Setup.

b. Set and calibrate the 606A signal generator for 21.4 mc.

c. Set oscilloscope for full scale horizontal sensitivity and 0.5 volt/cm vertical sensitivity.

d. Adjust sweep generator frequency to 21.4 mc and the output to display a 4 cm oscilloscope response. Adjust marker gain control to display a 21.4 mc center frequency marker on the response.

e. Adjust L1, L2, L3, and L4 for optimum symmetrical response centered around the 21.4 mc marker, Figure 5-14.

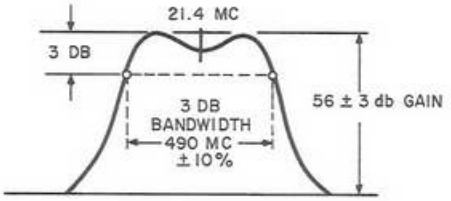


Figure 5-14. IF Amplifier, IF-212-500 AM Response Waveform.

(2) FM Alignment

a. Maintain test equipment setup and control settings used for AM alignment.

b. Connect terminal B10 of IF module to sweep generator; refer to Figure 5-13.

c. Adjust L10 and L11 to center the discriminator response curve around the 21.4 mc marker.

d. Adjust L6 and L8 for maximum linearity of the "S" curve response for the bandwidth indicated in Figure 5-15.

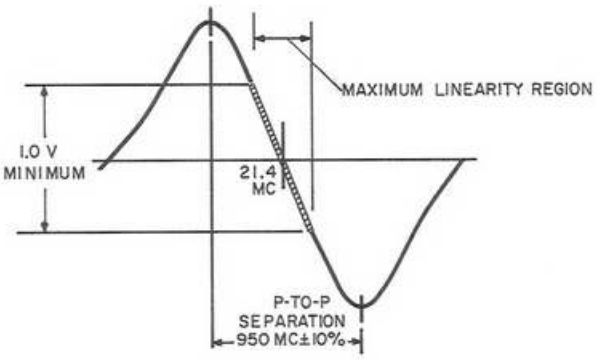
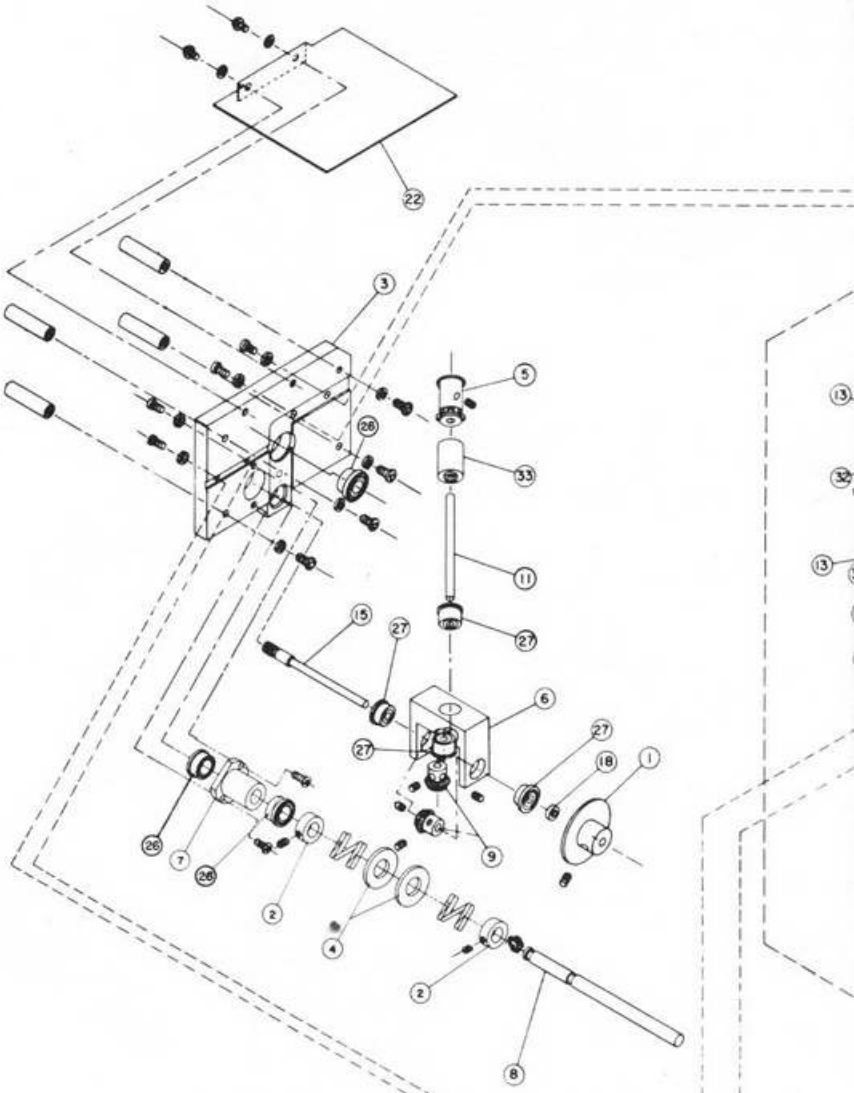


Figure 5-15. IF Amplifier, IF-212-500 FM Discriminator Response Waveform.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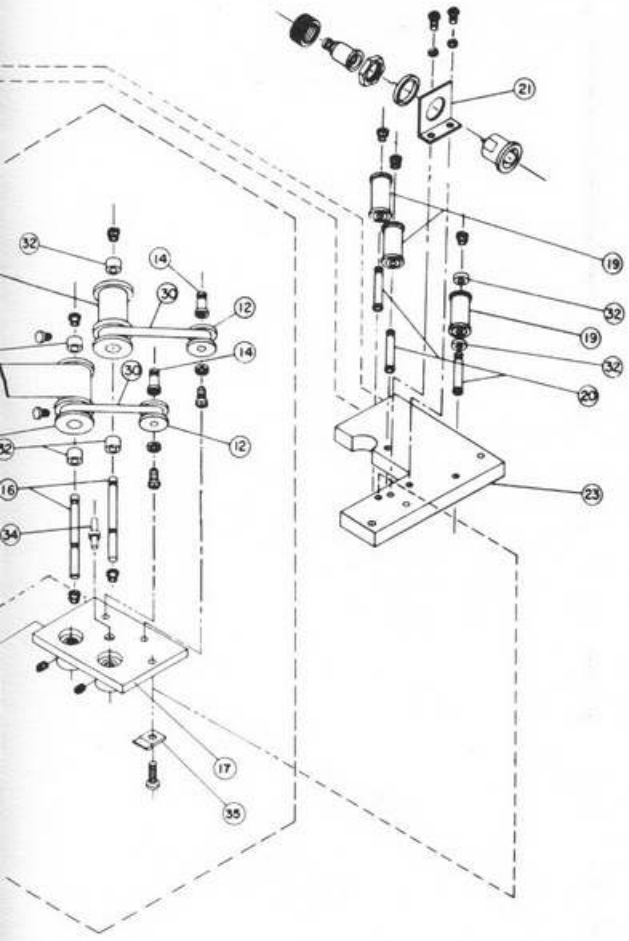
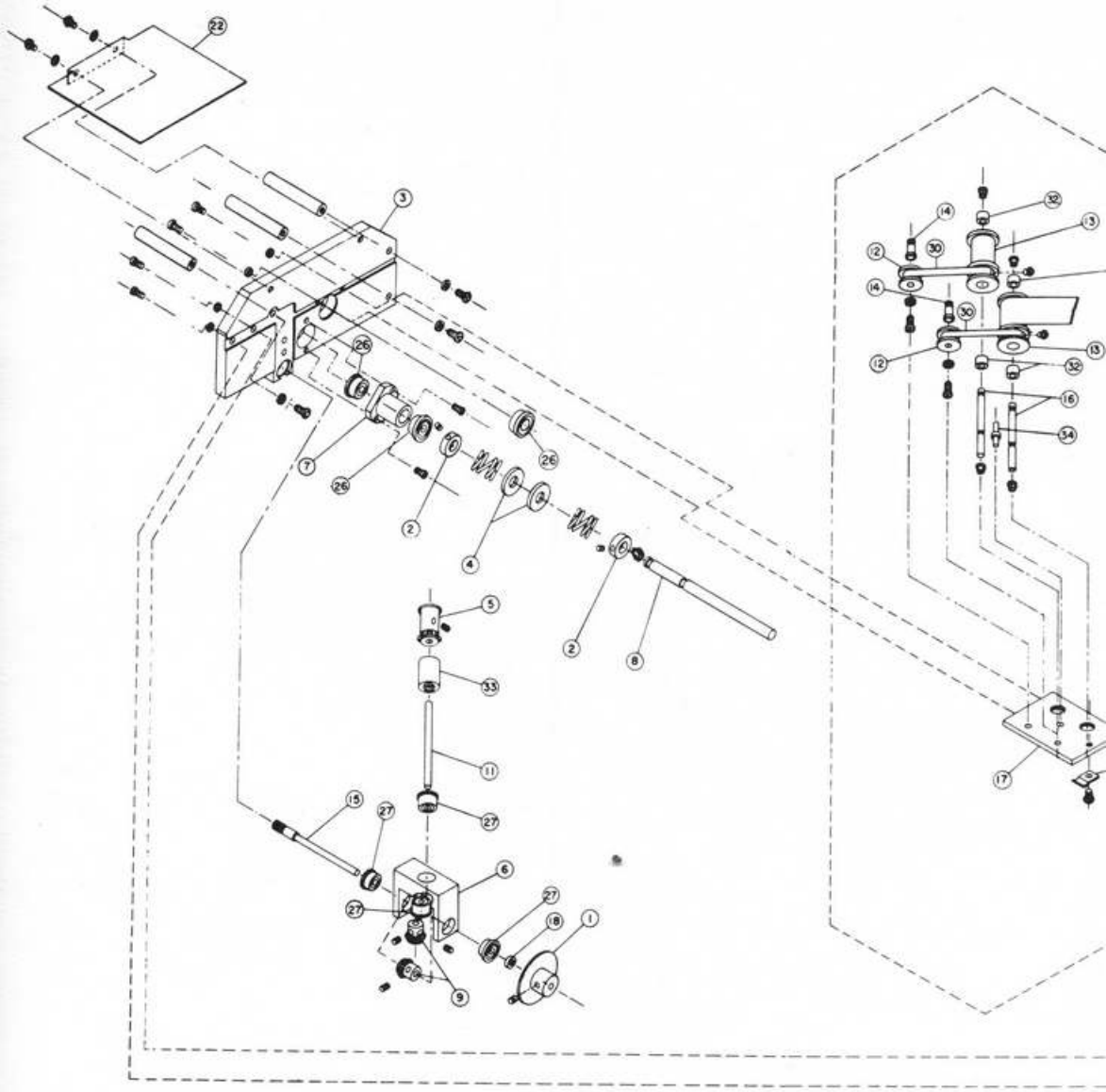


ITEM NO.	PART NO.	ITEM NAME	FEDERAL MFR CODE	QTY
33	1240112-1	STRAP, RETAINING	79963	1
34	1258511	TERMINAL, FEEDTHRU, INS	88591	1
35	A290-8	SPACER	19005	1
36	A600	BUSHING, SLEEVE	19005	10
37				
38	527443	SPRING, SPIRAL, TORSION	86545	2
39				
40				
41	MR72-5M	BEARING, BALL ANNULAR	83086	4
42	MR104-5MD	BEARING, BALL ANNULAR	83086	3
43				
44				
45	B1086-7	PLATE, GUIDE ROLLER	19005	1
46	A521-2	COVER, TAPE DECK	19005	1
47	A726-7	JACKET, LAMP	19005	1
48	A722	PIN, GROOVED, HD	19005	3
49	A727-7	GUIDE, ROLLER	19005	3
50	A720	WASHER, FLAT	19005	1
51	A81102-4	HOUSING, ASSEMBLY	19005	1
52	A479	PIN, GROOVED, HEADLESS	19005	2
53	A1039-1	GEAR ASSEMBLY, SPUR	19005	1
54	A697	POST, REEL	19005	2
55	B1251-2	SPOOL, DRIVE	19005	2
56	A693	REEL, TAPE	19005	2
57	A903-7	PIN, STRAIGHT, HEADLESS	19005	1
58				
59	A642	GEAR, BEVEL	19005	2
60	A821-3	SHAFT, STRAIGHT	19005	1
61	A646-9	HOUSING, BEARING	19005	1
62	A678-2	HOUSING, GEAR	19005	1
63	A81122-2	SPROCKET ASSEMBLY	19005	1
64	A663	WASHER, BEVEL	19005	2
65	C113-3	PLATE, GEAR	19005	1
66	A614	COLLAR, SHAFT	19005	2
67	A81172-2	RING, CLUTCH	19005	1

Figure 5-2. TN-519/WRR, RF Tuning Unit
Gear Train Assembly, GT-203-4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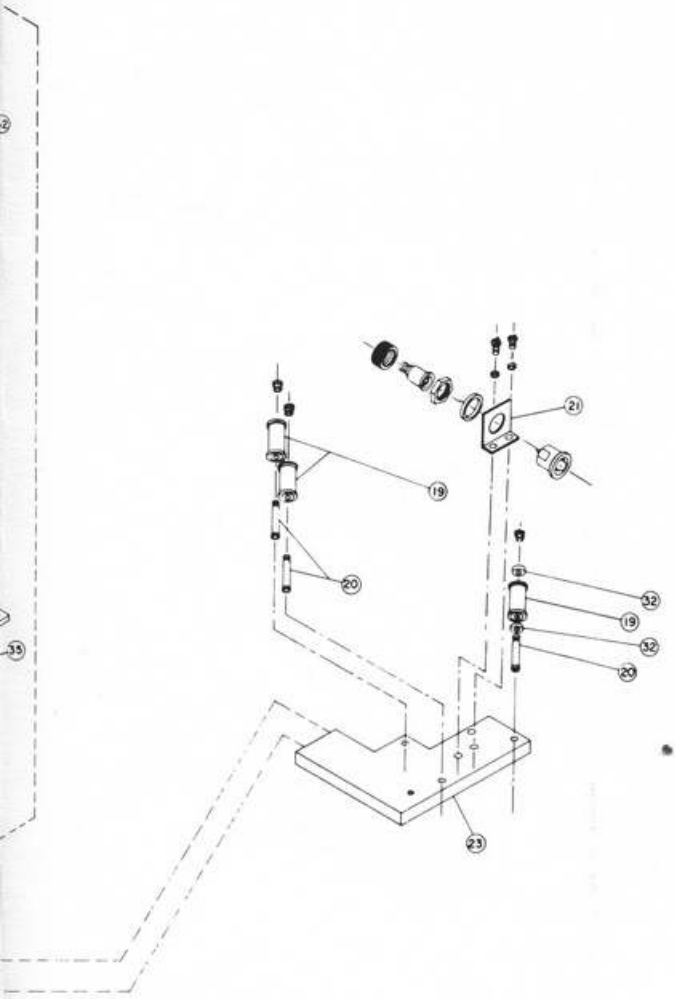
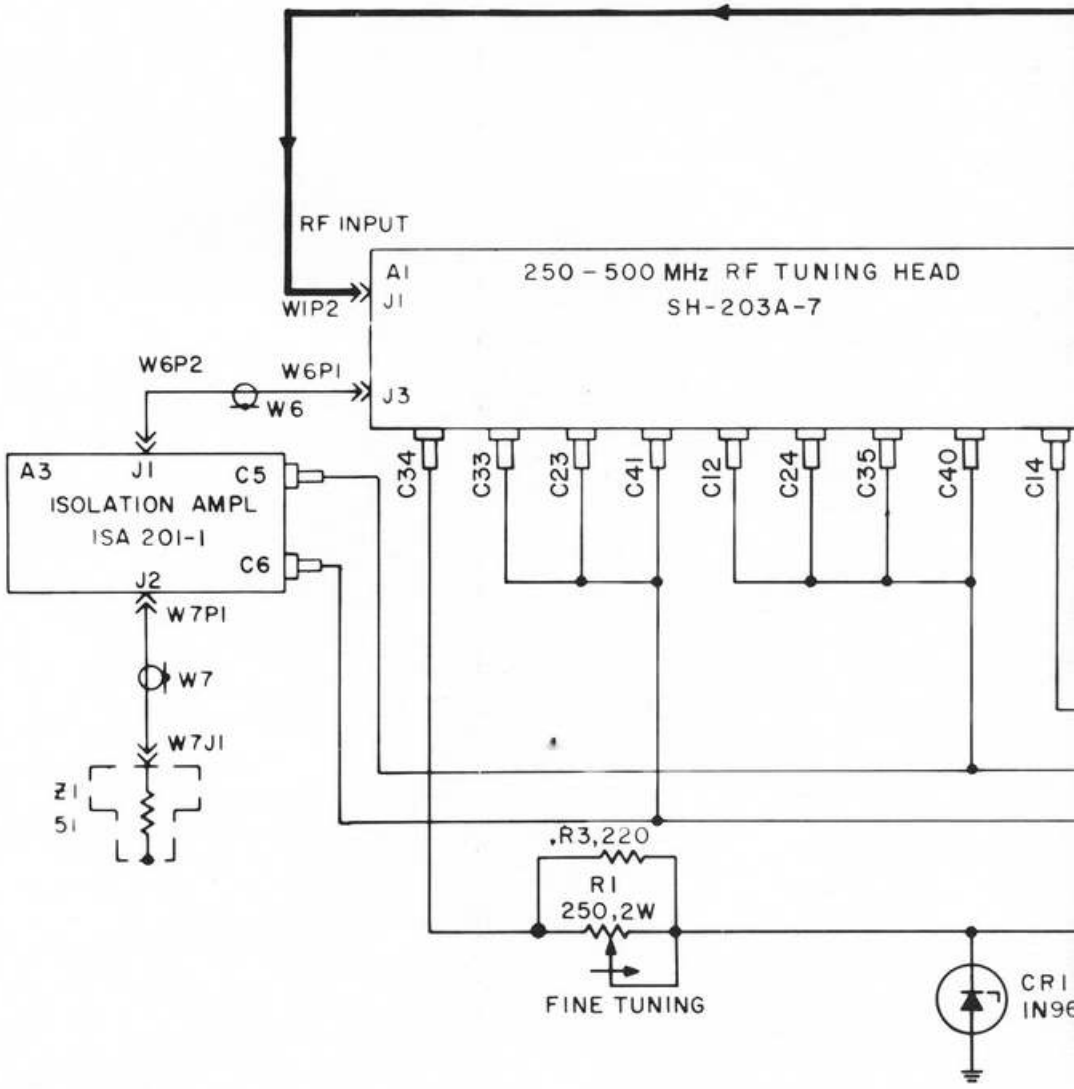


ITEM NO.	PART NO.	ITEM NAME	FEDERAL MFR CODE	QTY
35	116H125	STRAP, RETAINING	79963	1
34	FTSM1	TERMINAL, FEEDTHRU, INS	98291	1
33	A291-7	SPACER	19903	1
32	A689	BUSHING, SLEEVE	19903	10
31				
30	N7443	SPRING, SPIRAL, TORSION	80543	2
29				
28				
27	SFR23MM	BEARING, BALLANNULAR	83086	4
26	SFR188MM	BEARING, BALLANNULAR	83086	3
25				
24				
23	B099-4	PLATE, GUIDE ROLLER	19903	1
22	A620-2	COVER, TAPE DECK	19903	1
21	A230-2	BRACKET, LAMP	19903	1
20	A223	PIN, GROOVED, HD	19903	3
19	A222-2	GUIDE, ROLLER	19903	3
18	A220	WASHER, FLAT	19903	1
17	AB1109-2	BUSHING, ASSEMBLY	19903	1
16	A429	PIN, GROOVED, HEADLESS	19903	2
15	A979-1	GEAR ASSEMBLY, SPUR	19903	1
14	A097	POST, REEL	19903	2
13	B523-2	SPOOL, DRIVE	19903	2
12	A095	REEL, TAPE	19903	2
11	A093-2	PIN, STRAIGHT, HEADLESS	19903	1
10				
9	A082	GEAR, BEVEL	19903	2
8	A624-2	SHAFT, STRAIGHT	19903	1
7	A080-2	HOUSING, BEARING	19903	1
6	A078-2	HOUSING, GEAR	19903	1
5	AB522-2	SPROCKET ASSEMBLY	19903	1
4	A063	WASHER, BEVEL	19903	2
3	C114-2	PLATE, GEAR	19903	1
2	A018	COLLAR, SHAFT	19903	2
1	AB525-2	DISK, CLUTCH	19903	1

Figure 5-3. TN-520/WRR RF Tuning Unit
Gear Train Assembly, GT-204-4


RF INPUT
A1
J1
W1P2
250 - 500 MHz RF TUNING HEAD
SH-203A-7
W6P2
W6P1
W6
J3
A3
J1
C5
ISOLATION AMPL
ISA 201-1
C6
J2
W7P1
W7
W7J1
Z1
51
C34
C33
C23
C41
C12
C24
C35
C40
C14
.R3,220
R1
250,2W
FINE TUNING
CR1
IN96

NOTES:

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

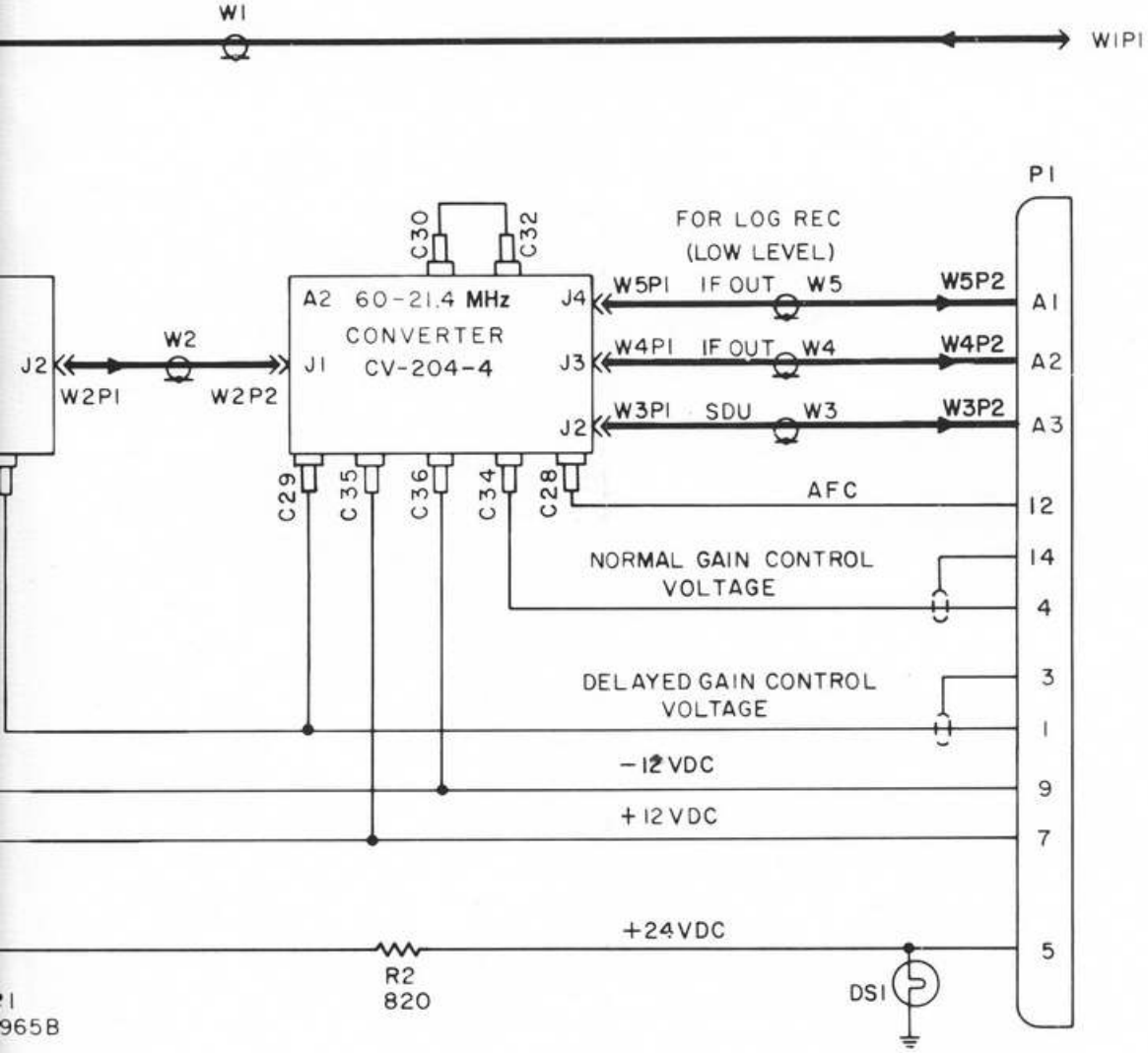


Figure 7-1. 250-500 Mc RF Tuner, TN-519/WRR, Schematic Diagram

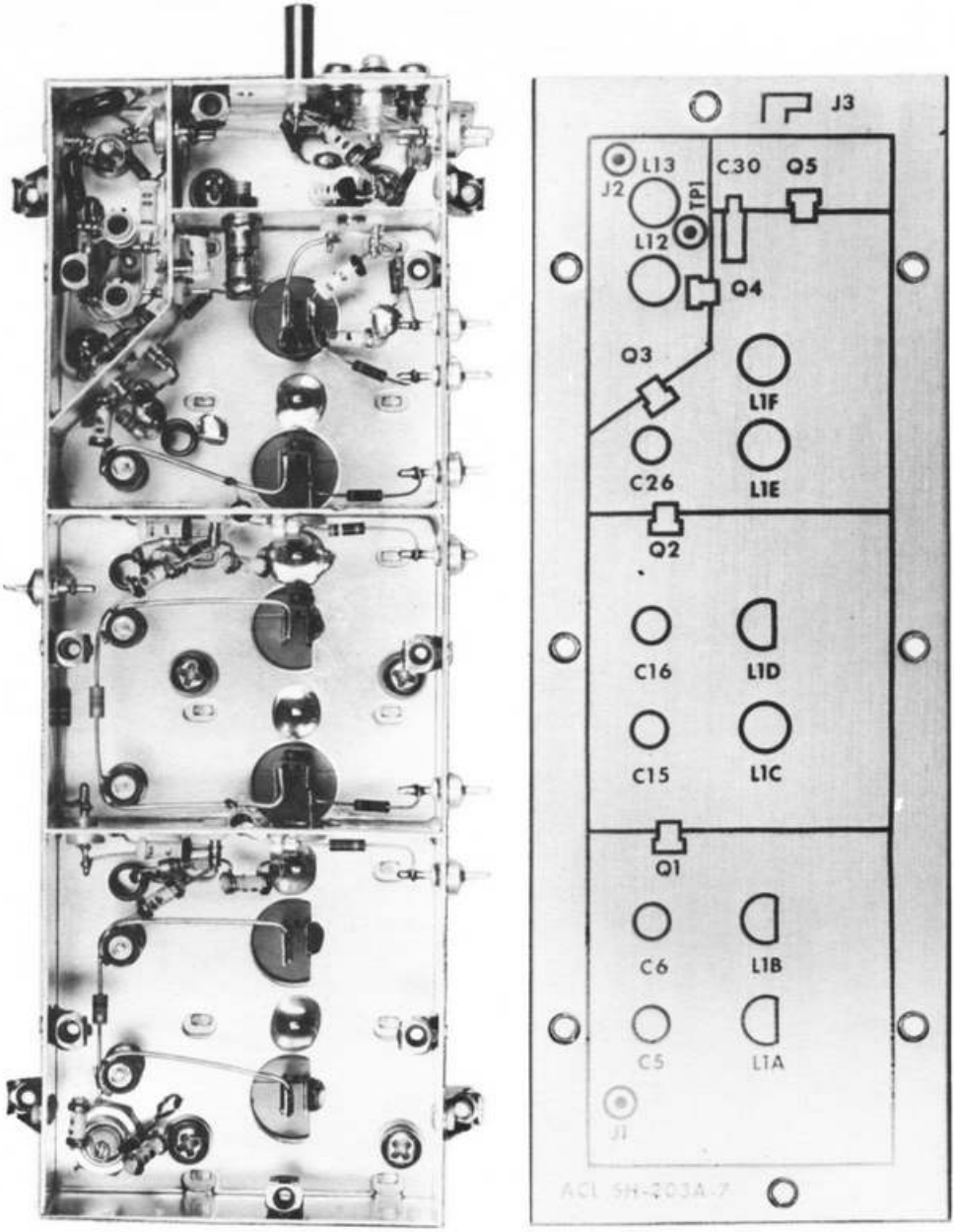
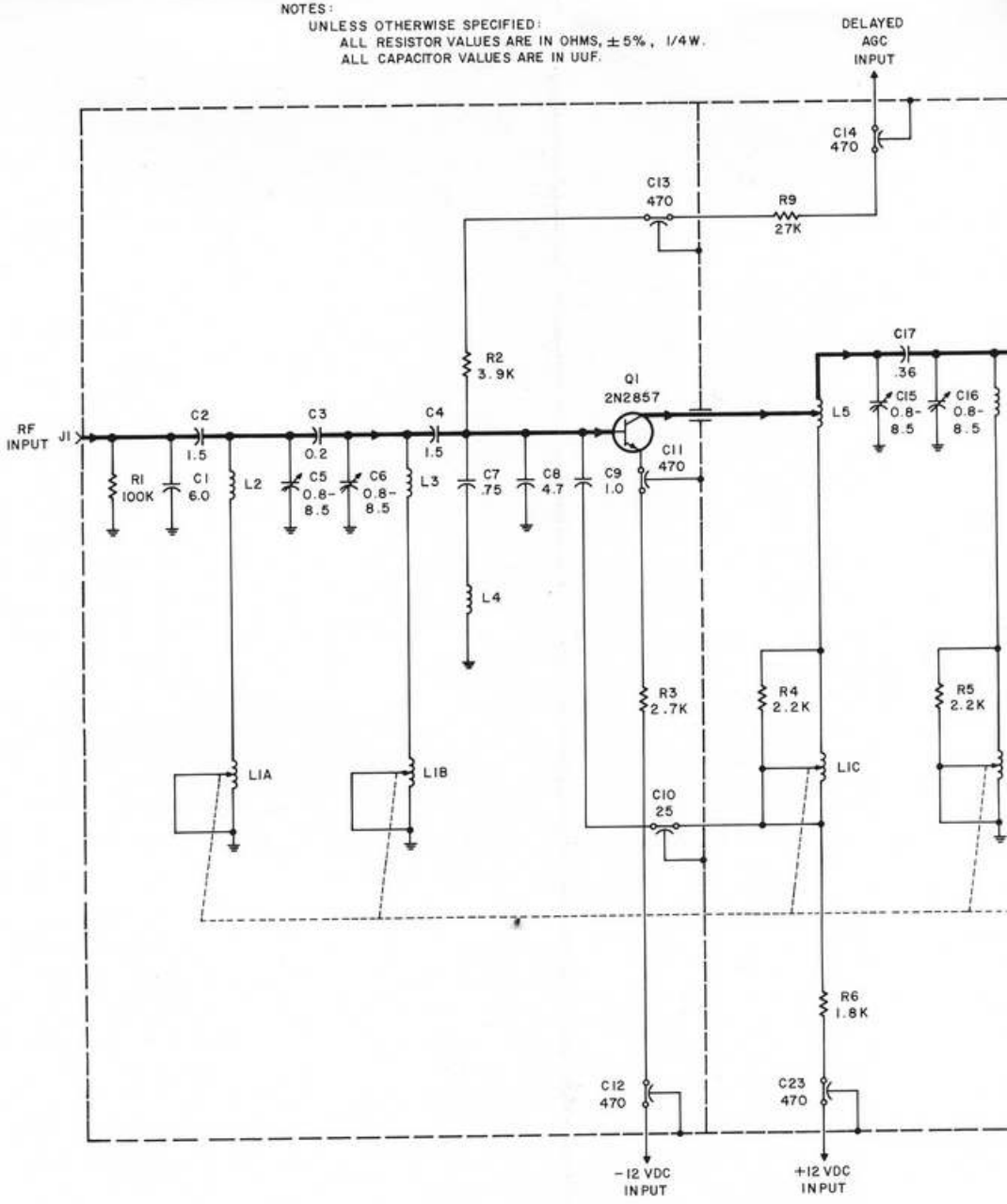
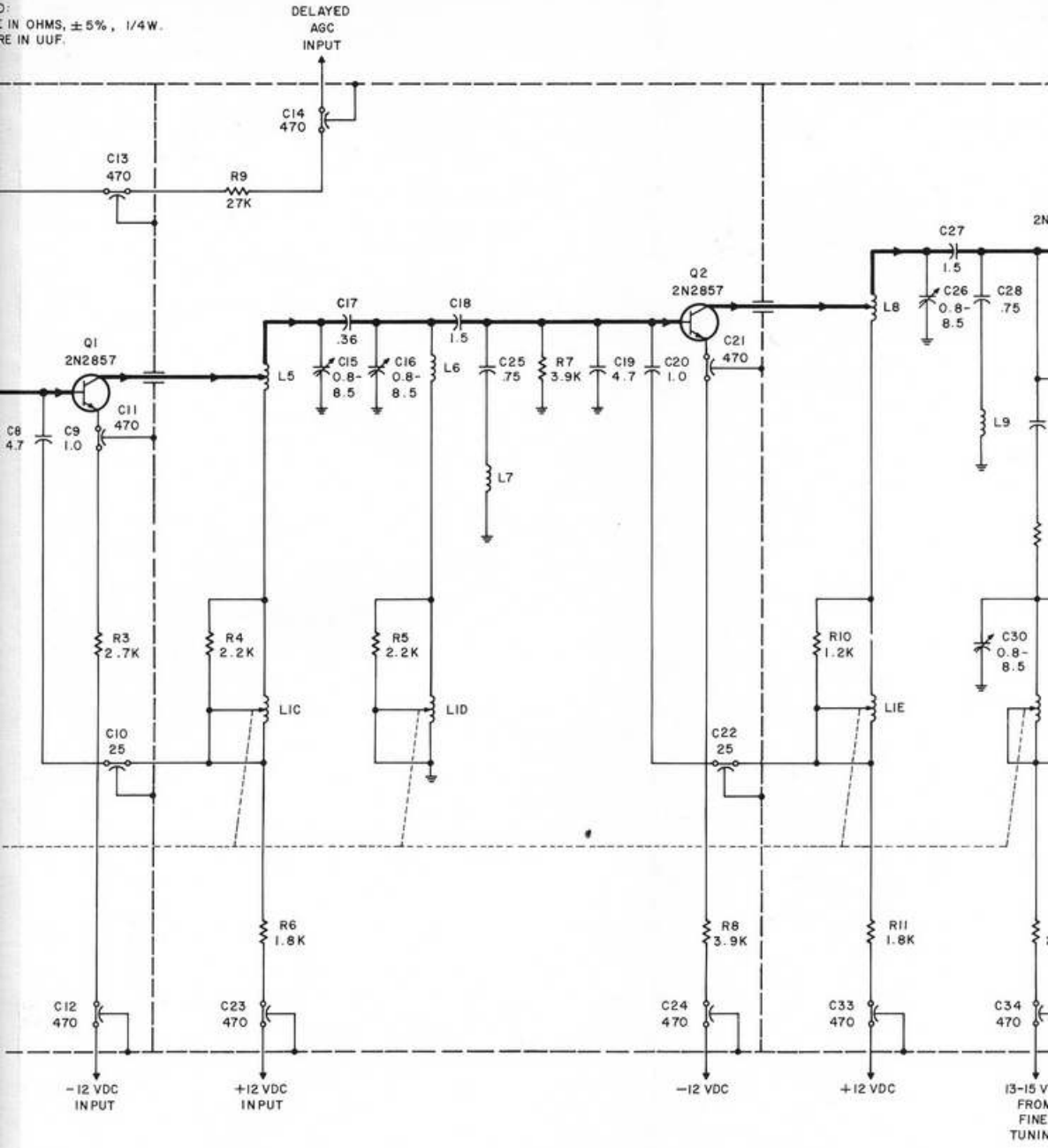


Figure 7-2A. Tuning Head, SH-203A-7

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



250-500 MHz RF TUNING UNIT, SH-



-500 MHz RF TUNING UNIT, SH-203A-7

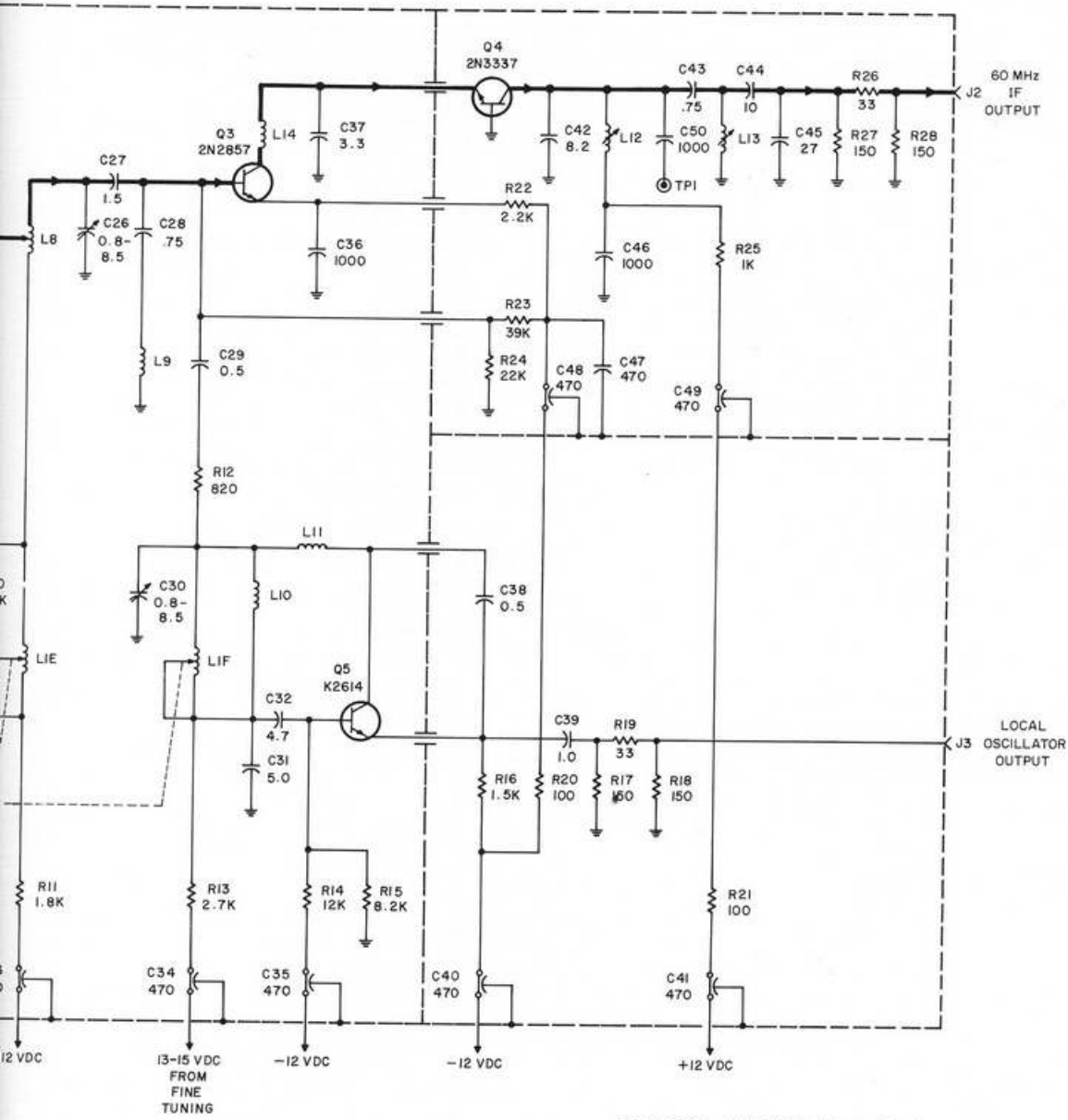


Figure 7-2B. 250-500 Mc Tuning Head, SH-203A-7, Schematic Diagram

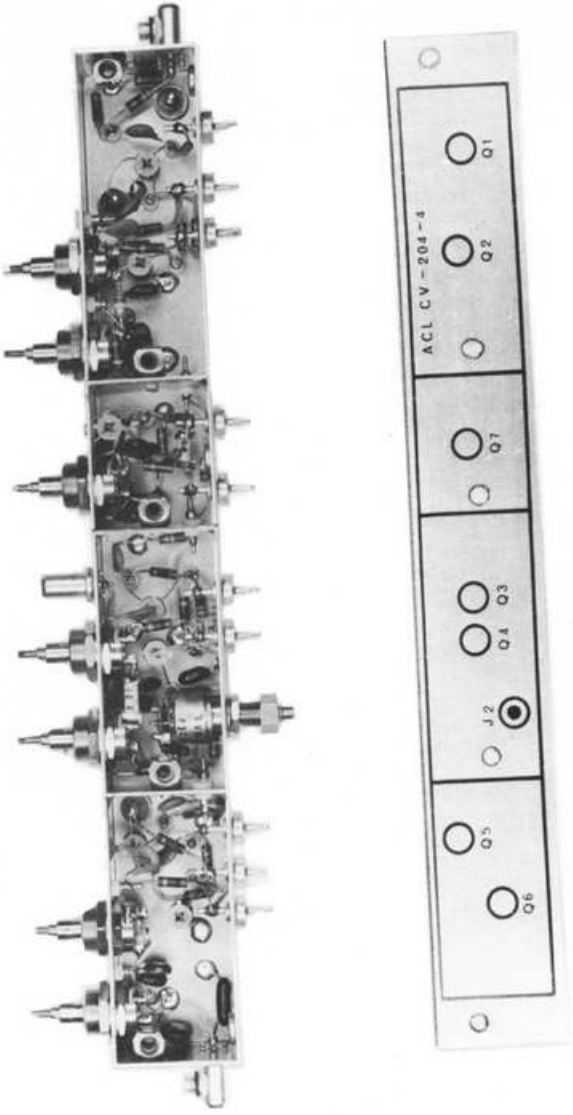
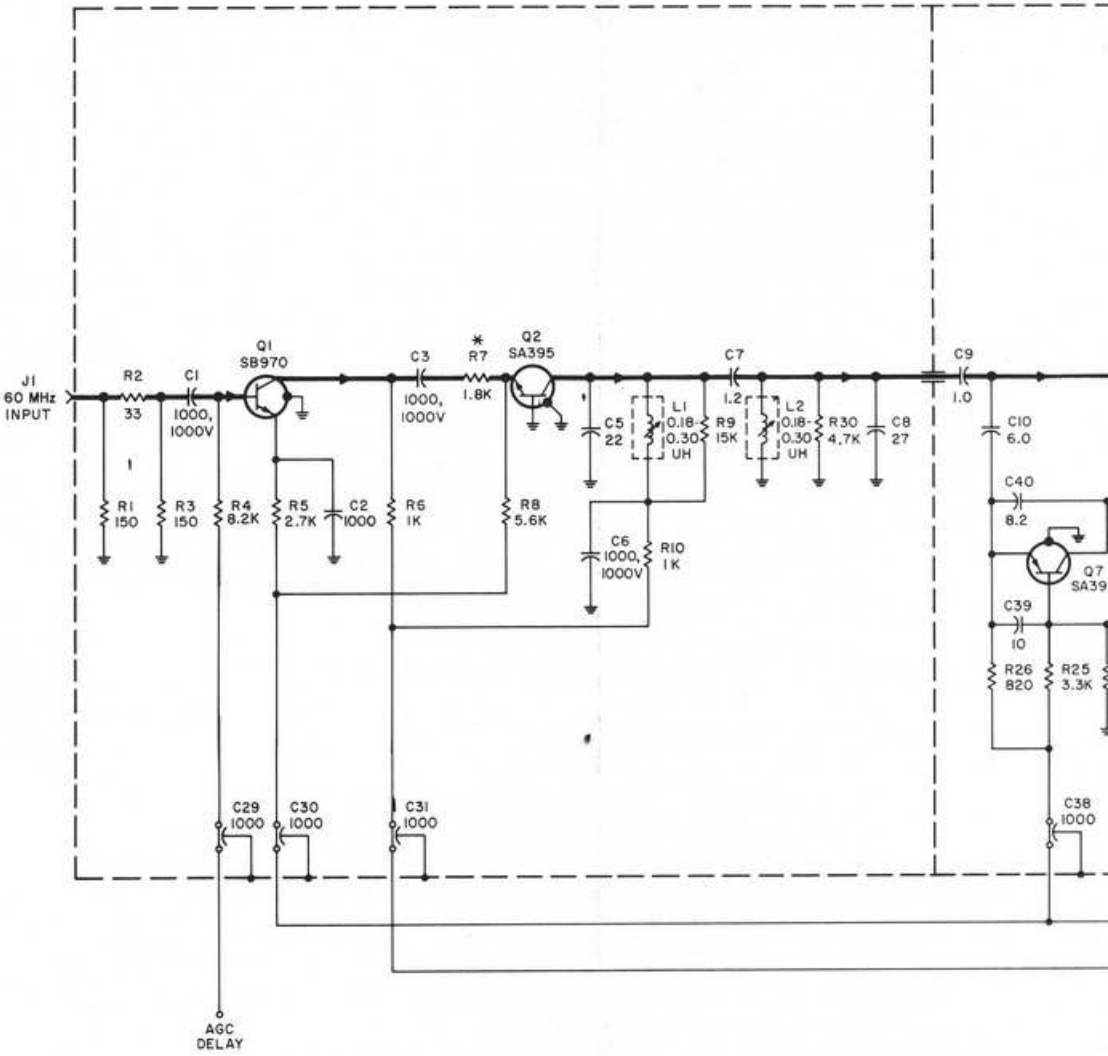
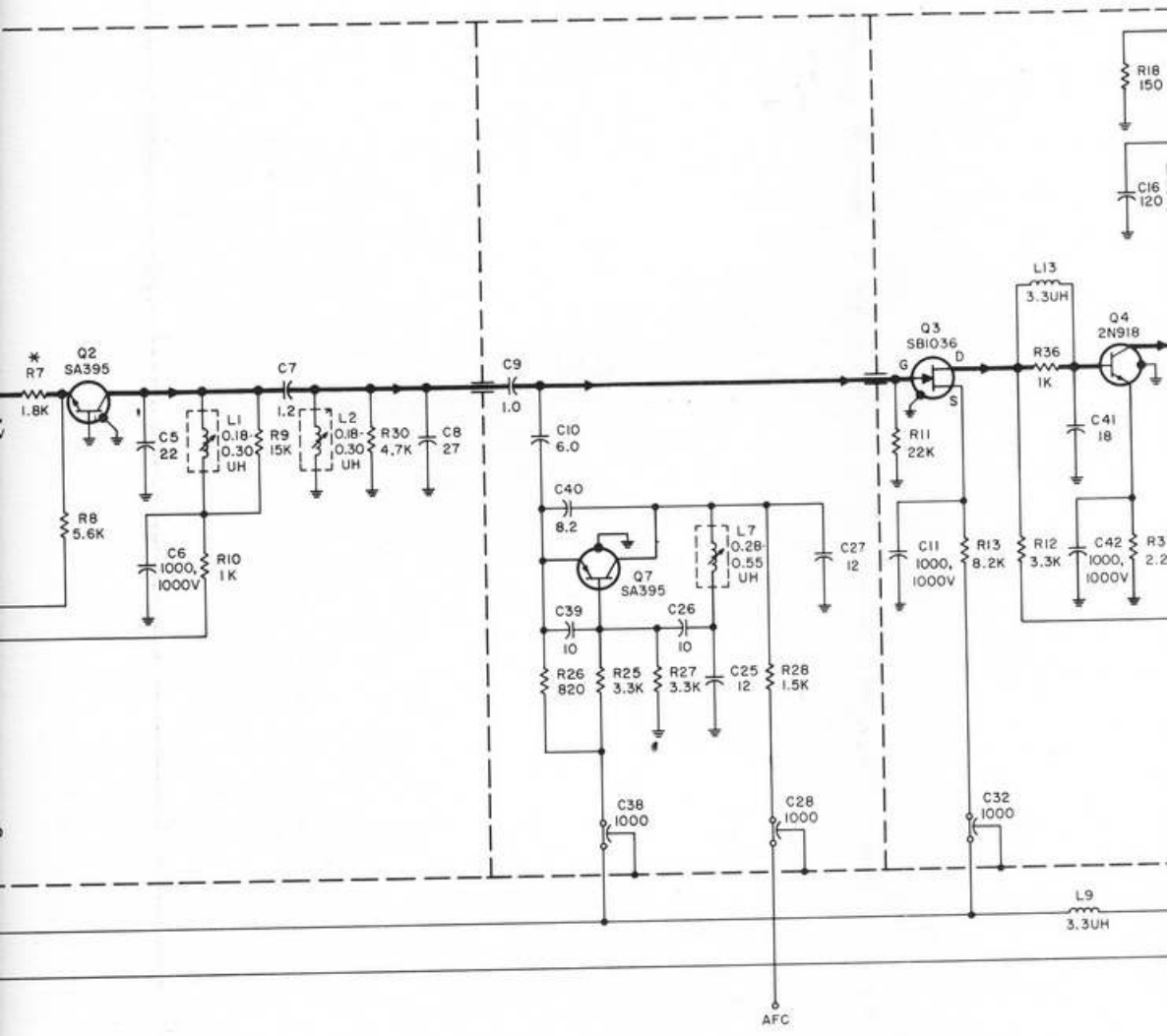


Figure 7-3A. 60-21.4 Mc Converter, CV-204-4

NOTES:
UNLESS OTHERWIS
ALL RESISTOR
ALL CAPACITOR
* VALUE TO BE D



NOTES:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
ALL CAPACITOR VALUES ARE IN UUF, 500WVDC.
* VALUE TO BE DETERMINED BY TEST: NOMINAL VALUE SHOWN.



60-21.4 MHz CONVERTER CV-204-4

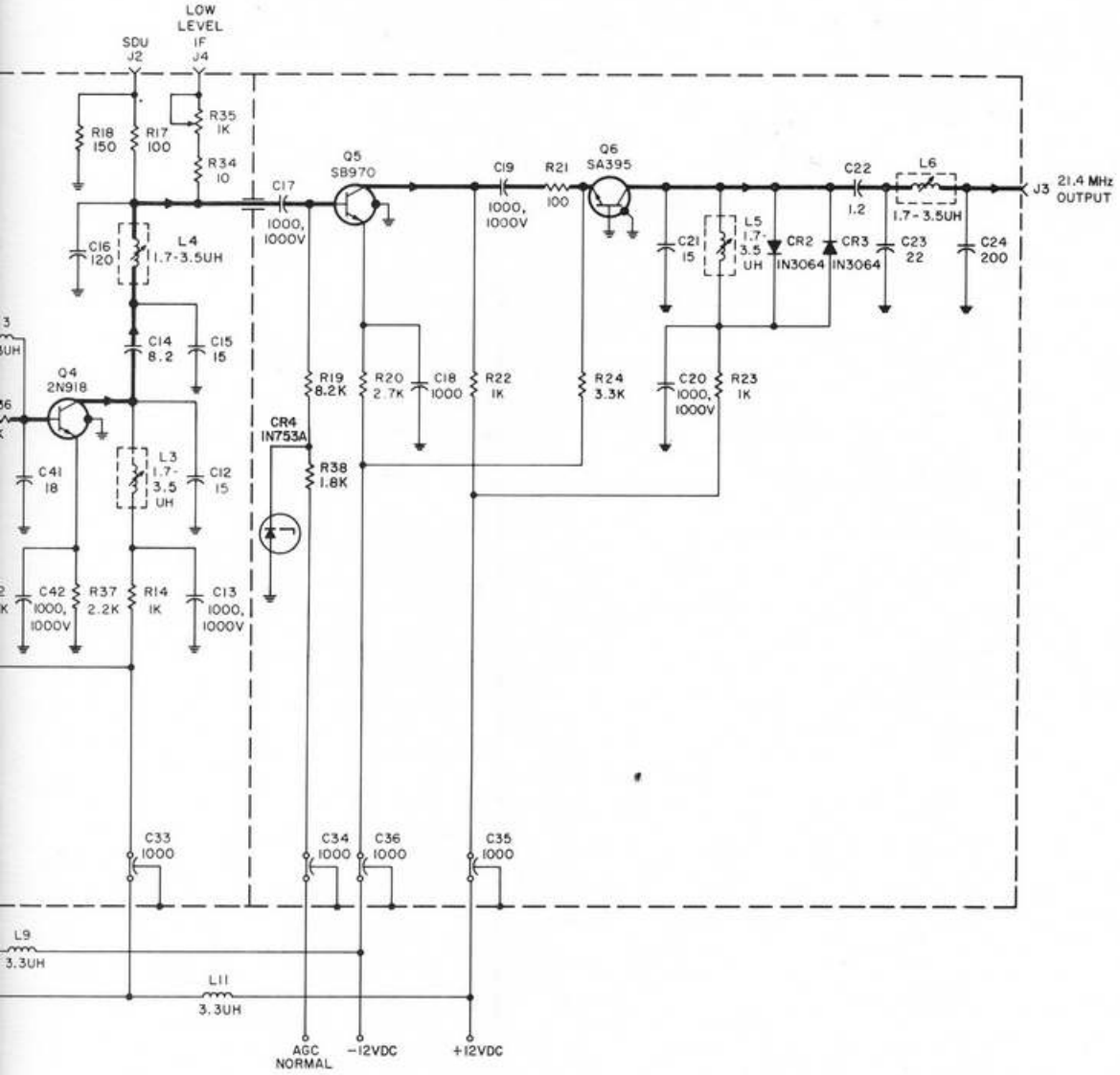


Figure 7-3B. 60-21.4 Mc Converter, CV-204-4, Schematic Diagram

204-4

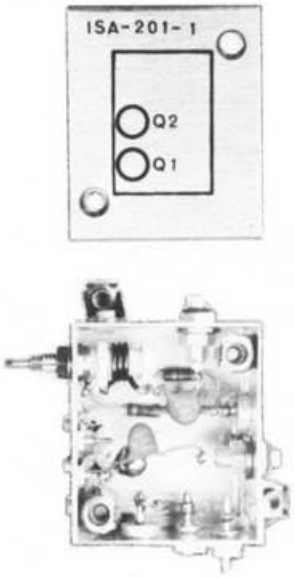
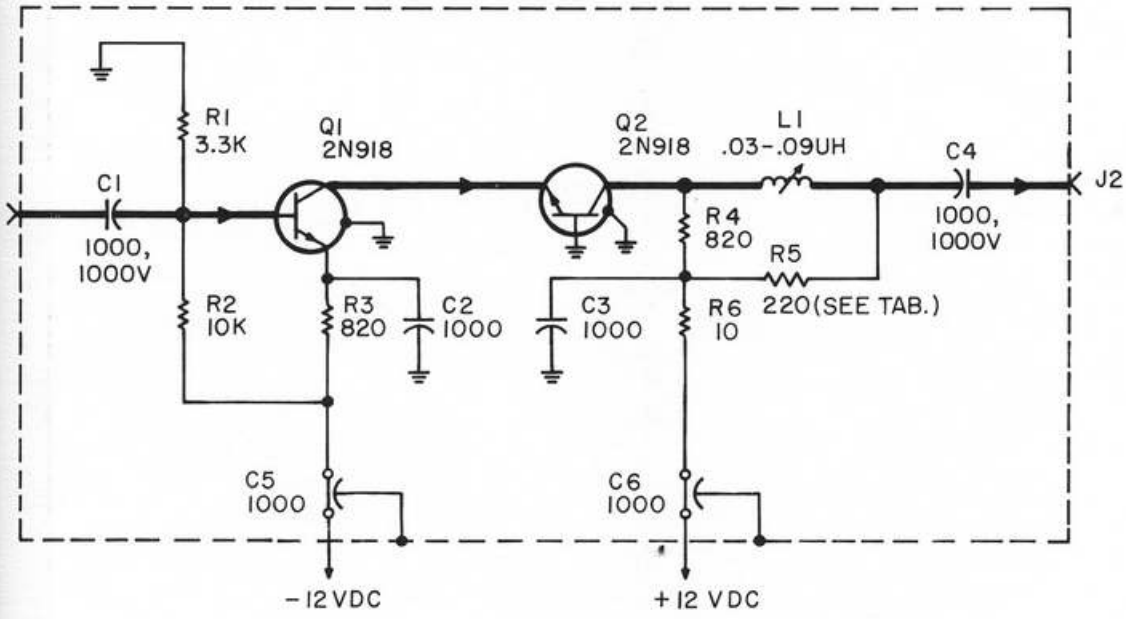


Figure 7-4A. Isolation Amplifier, ISA-201-1

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

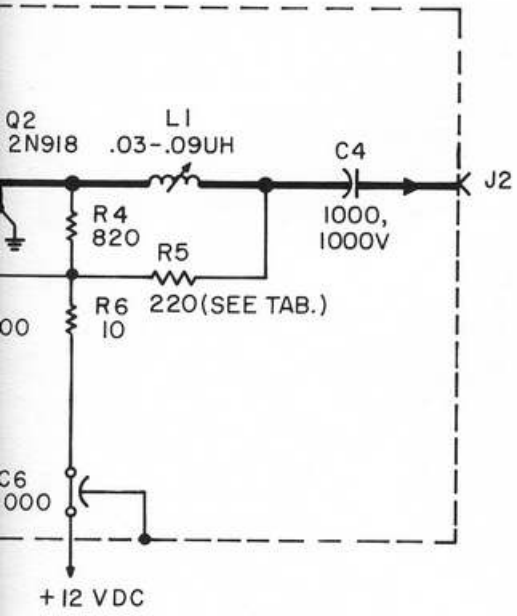


ISOLATION AMPLIFIER, ISA-201 & ISA-201-1

FIED:

RE IN OHMS, 1/4 W, 5 %.

ARE IN UUF, 500 WVDC.



ASS'Y	R5 VALUE
ISA-201-1	220 Ω
ISA-201	NOT USED

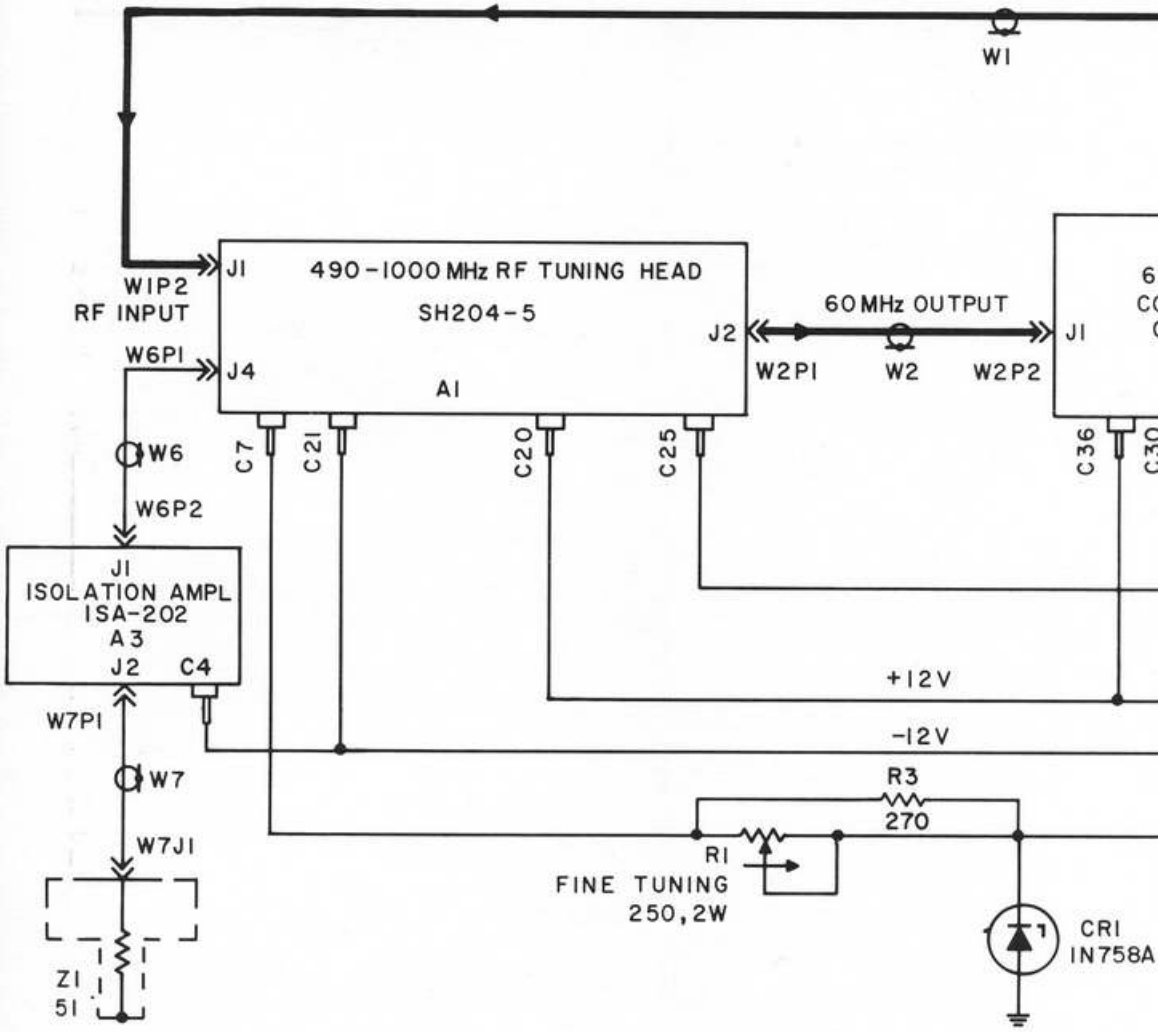
, ISA-201 & ISA-201-1

Figure 7-4B. Isolation Amplifier, ISA-201-1, Schematic Diagram

NOTES:

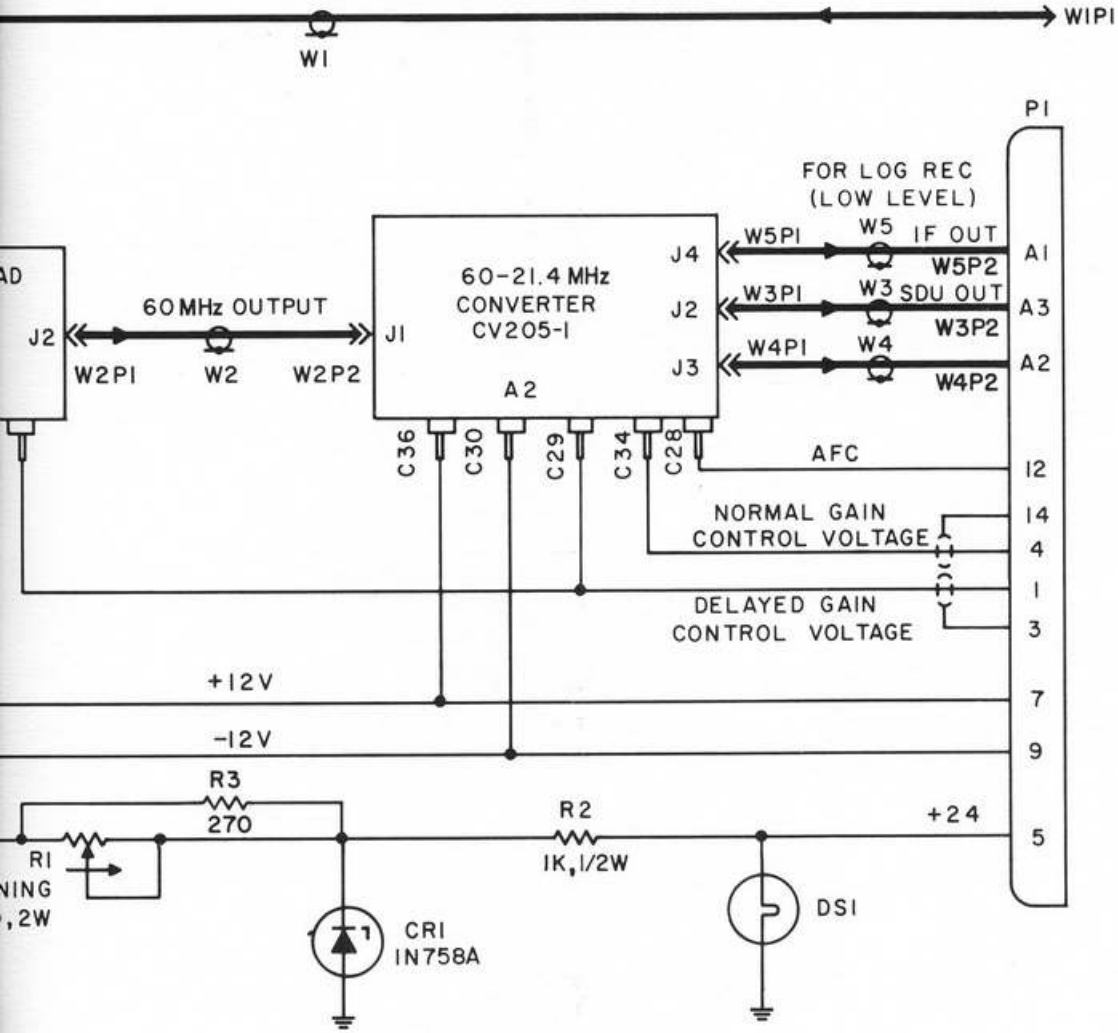
UNLESS OTHERWISE SP

1. ALL RESISTOR VALUE



490-1000 MHz RF PLUG-IN UNIT

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



MHz RF PLUG-IN UNIT SH-214-P-1

Figure 7-5. 490-1000 Mc RF Tuner, TN-520/WRR, Schematic Diagram

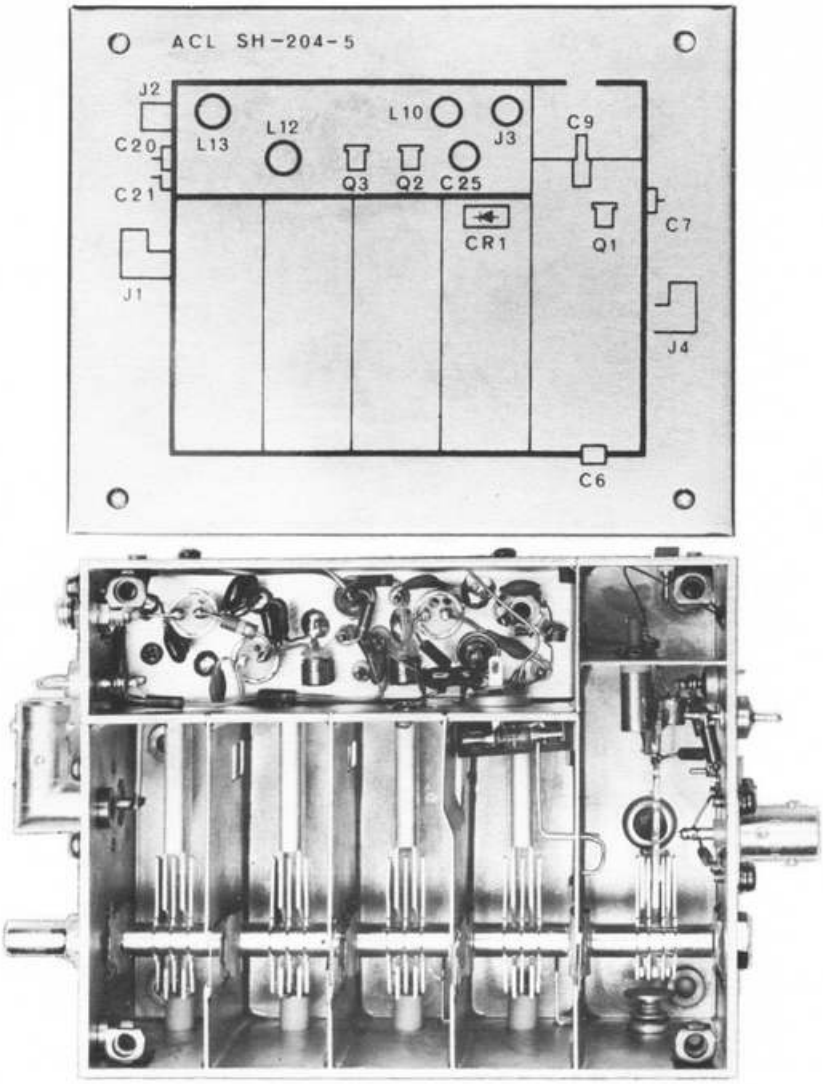
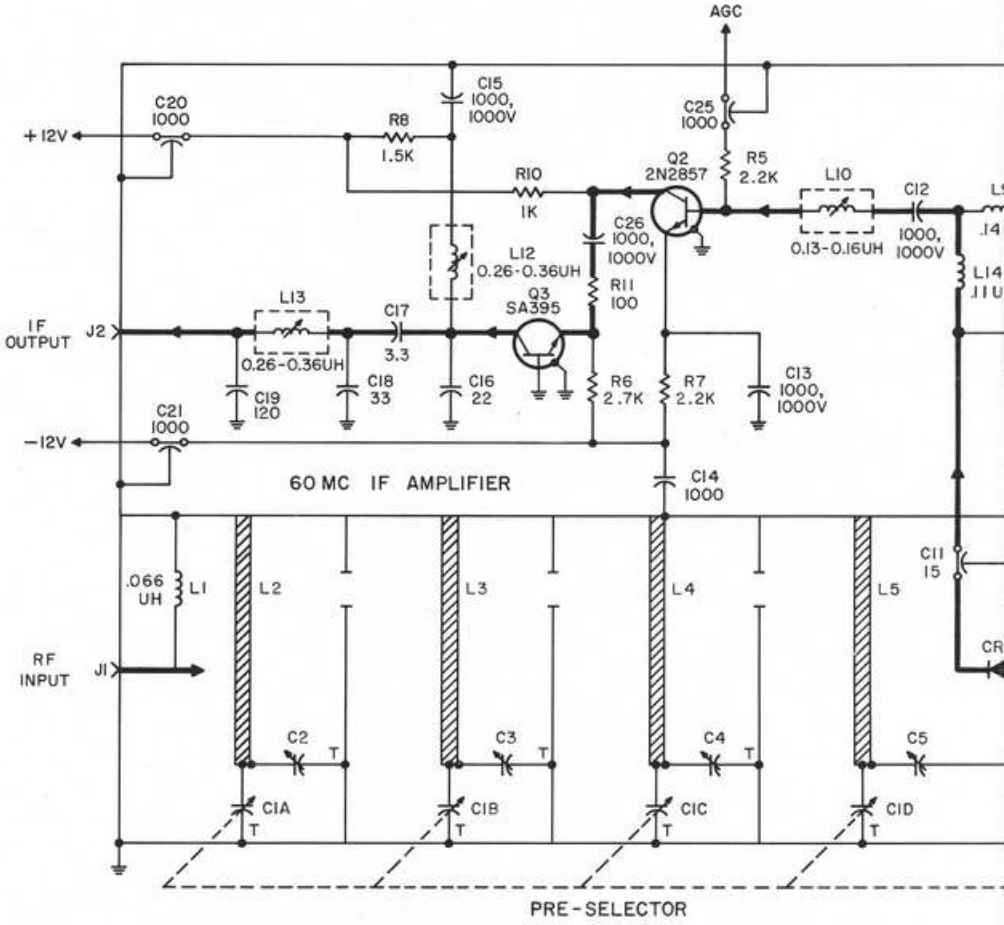


Figure 7-6A. Tuning Head, SH-204-5

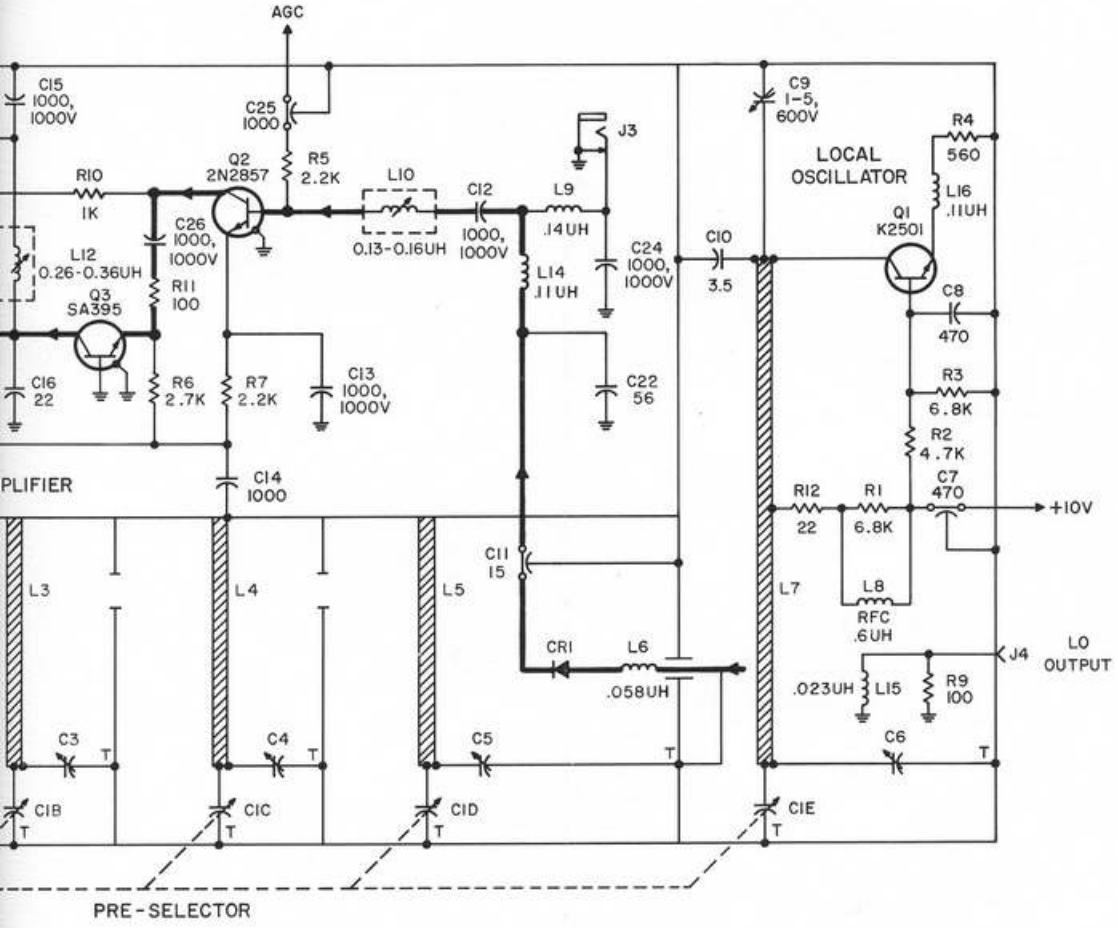
NOTES:
UNLESS OTHERWISE SPECIFIED:

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



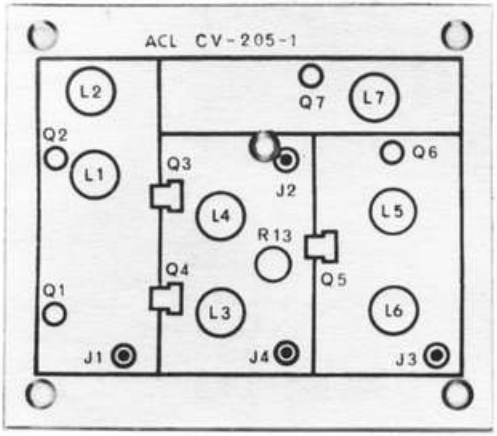
TUNER RADIO FREQUENCY, SH-2

N OHMS, 1/4W, 5%.
IN UUF, 500WVDC.



TUNER RADIO FREQUENCY, SH-204-5

Figure 7-6B. 490-1000 Mc Tuning Head, SH-204-5, Schematic Diagram



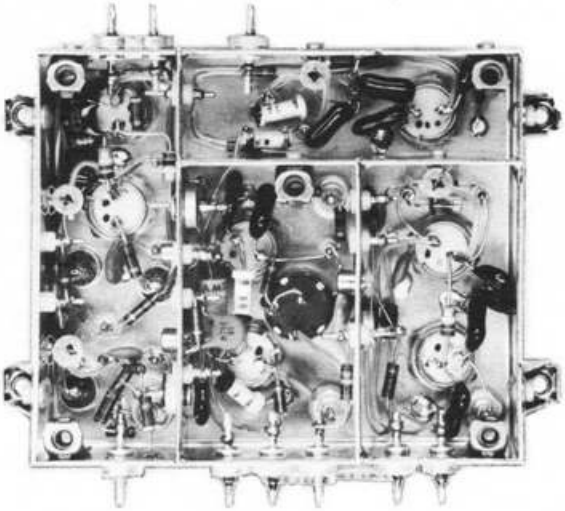
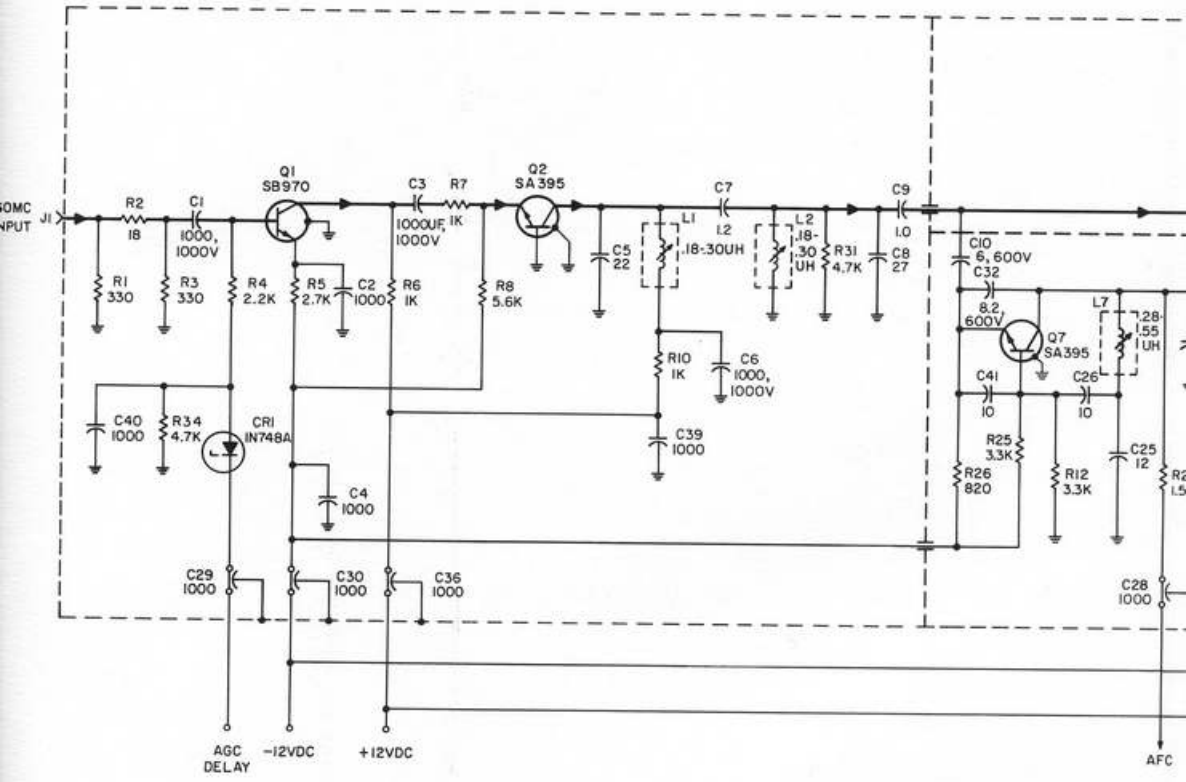
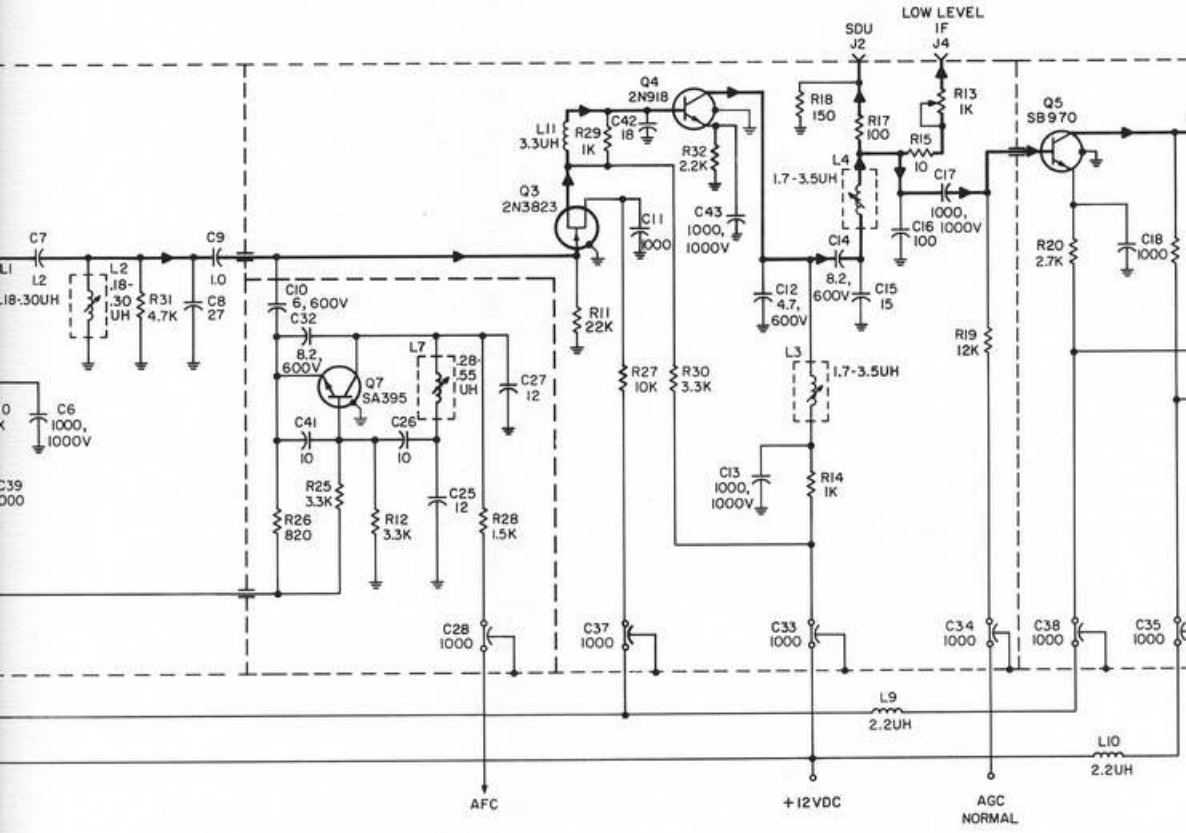


Figure 7-7A. 60-21.4 Mc Converter, CV-205-1


60MC INPUT
J1
R2 18
C1 1000, 1000V
Q1 SB970
C3 1000UF, 1000V
R7 1K
Q2 SA395
C7
C9 1.0
L1
L2 18-30UH
L2 18-30 UH
R31 4.7K
C8 27
C5 22
C10 6, 600V
C32 8.2, 600V
Q7 SA395
L7 28-55 UH
R1 330
R3 330
R4 2.2K
R5 2.7K
C2 1000
R6 1K
R8 5.6K
R10 1K
C6 1000, 1000V
C39 1000
C41 10
C26 10
R25 3.3K
R26 820
R12 3.3K
C25 12
C40 1000
R34 4.7K
CR1 IN748A
C4 1000
C29 1000
C30 1000
C36 1000
C28 1000
AGC DELAY
-12VDC
+12VDC
AFC

60-21.4 MC CO

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



60-21.4 MC CONVERTER CV-205-1

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

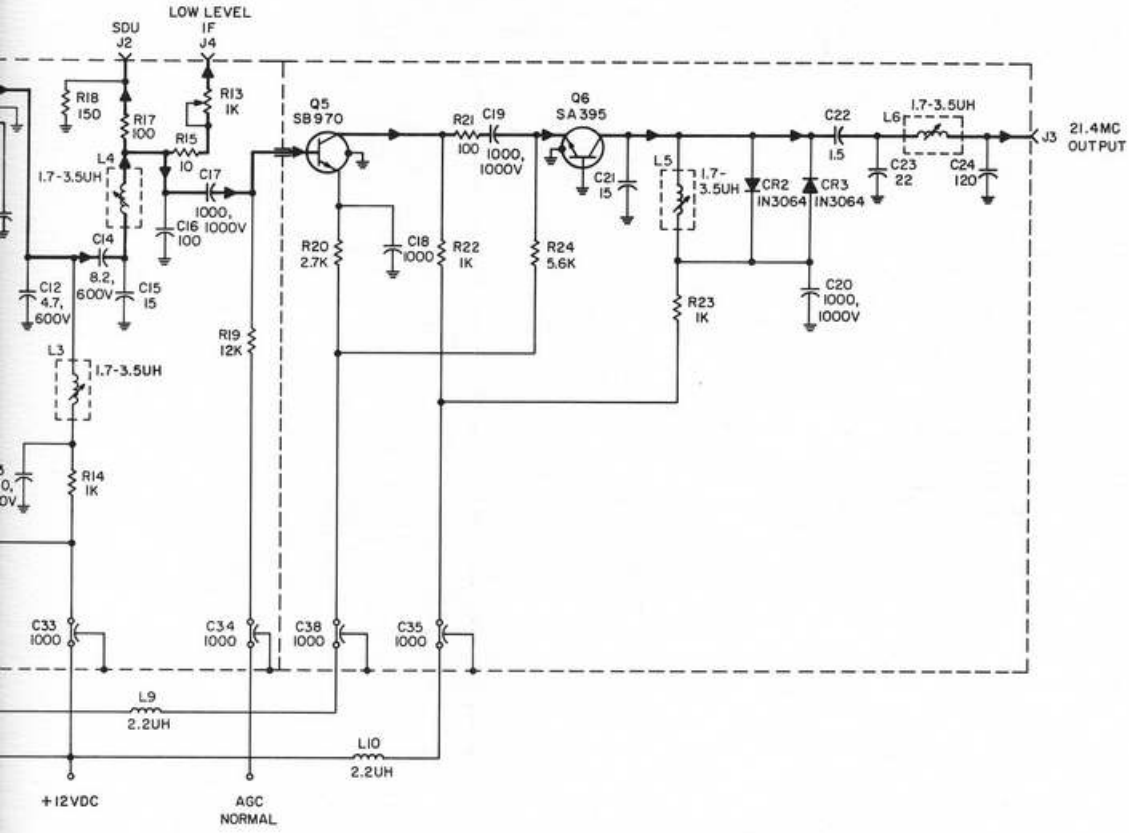


Figure 7-7B. 60-21.4 Mc Converter, CV-205-1, Schematic Diagram

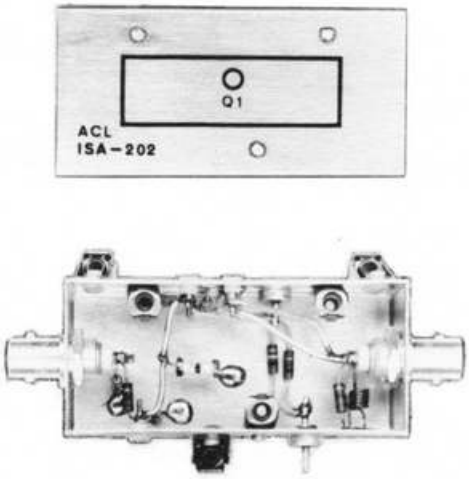
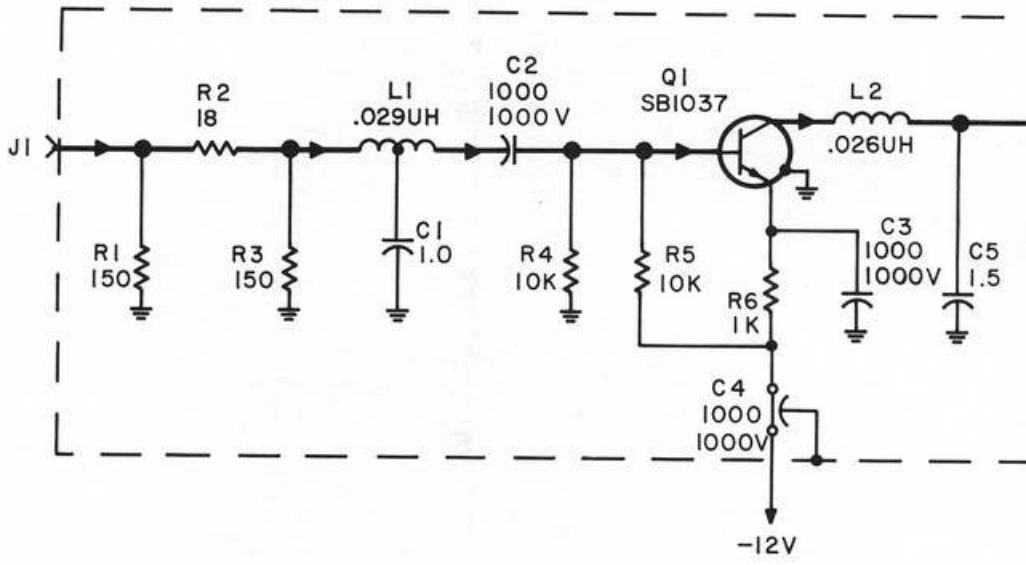
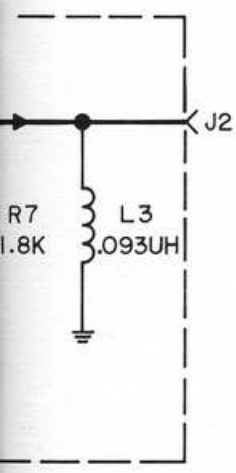


Figure 7-8A. Isolation Amplifier, ISA-202


J1
R1
150
R2
18
R3
150
L1
.029UH
C1
1.0
C2
1000
1000 V
R4
10K
Q1
SB1037
R5
10K
R6
1K
C4
1000
1000V
L2
.026UH
C3
1000
1000V
C5
1.5
-12V



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

Figure 7-8B. Isolation Amplifier, ISA-202, Schematic Diagram

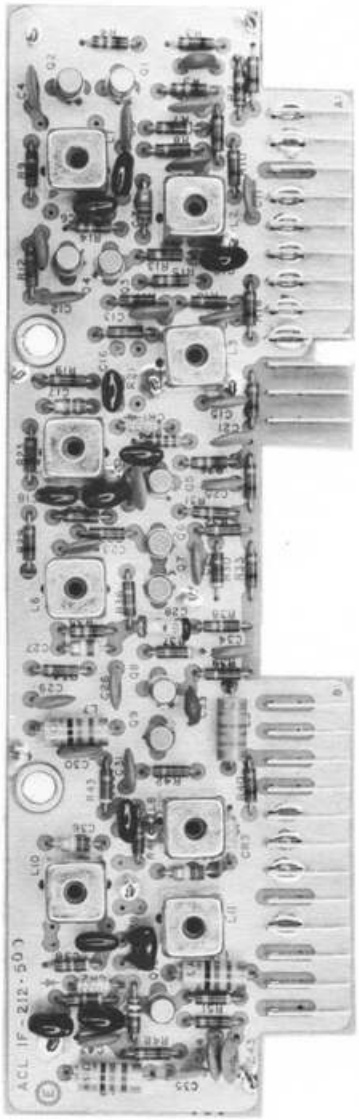
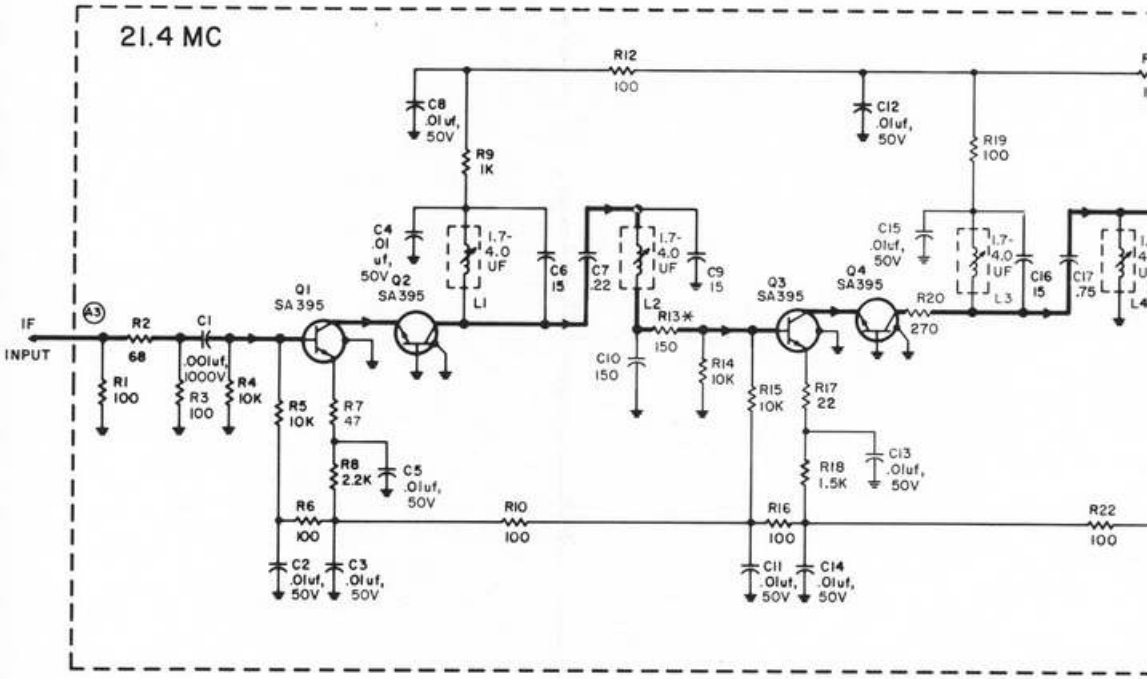


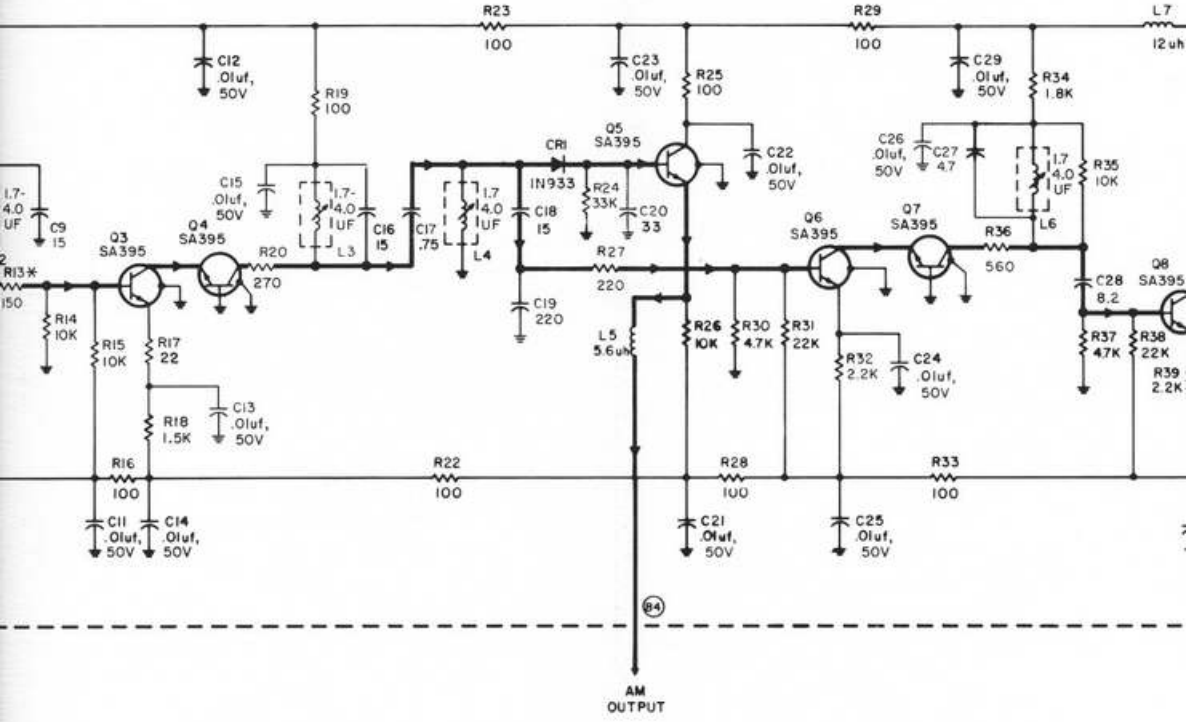
Figure 7-9A. IF Amplifier, IF-212-500



PINS A1, A2, A4, A5, A6, A7, A8, A9 AND B5, B6, B7, B9 AND B11 ARE GROUNDED.
* NOMINAL

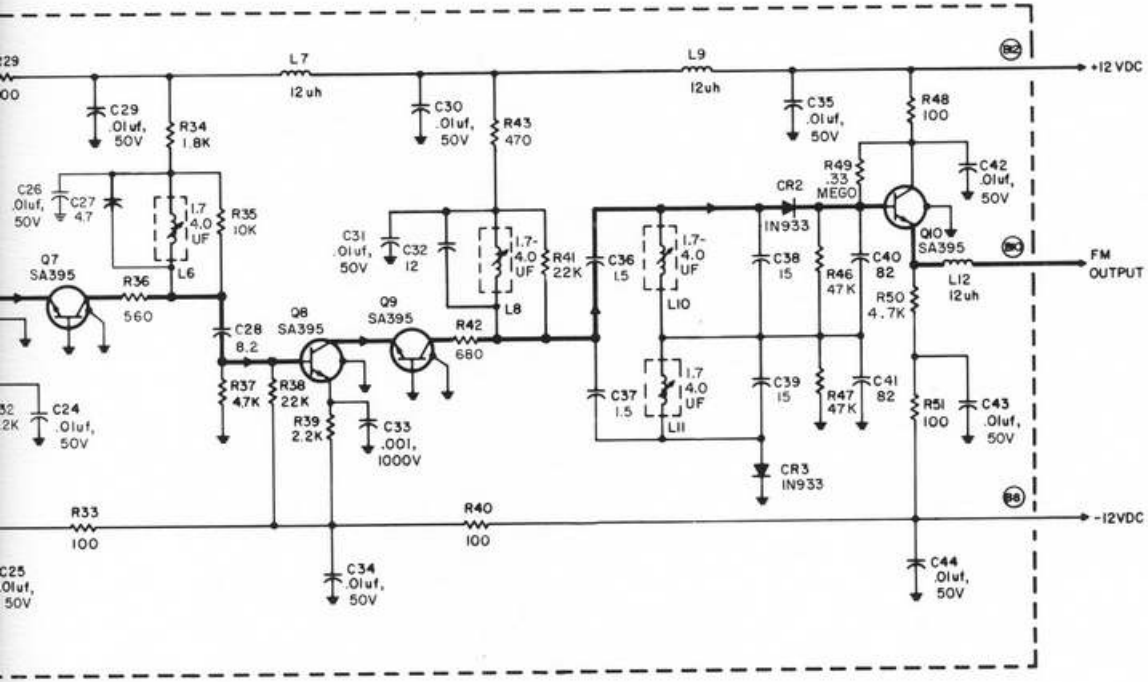
500KC BA

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



500KC BANDWIDTH IF AMPLIFIER IF-212-500

: SPECIFIED:
ALUES ARE IN OHMS, 1/4 W, 5%.
VALUES ARE IN UUF, 500 WVDC.



IF-212-500

Figure 7-9B. IF Amplifier, IF-212-500, Schematic Diagram