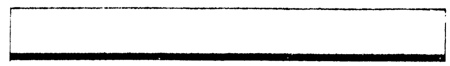
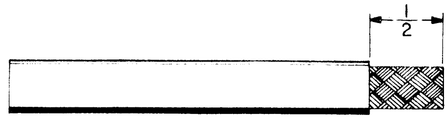
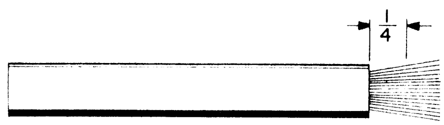


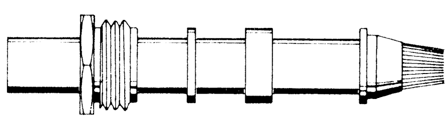
CUT END OF CABLE EVEN.



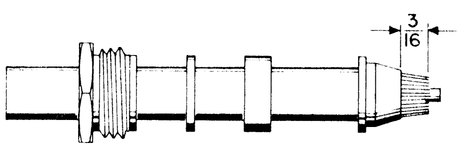
REMOVE VINYL JACKET 1/2 INCH - DON'T NICK BRAID.



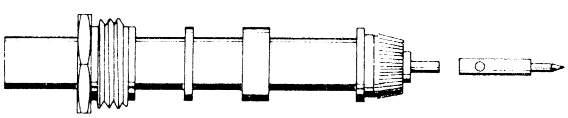
COMB OUT COPPER BRAID AS SHOWN. BARE 1/4 INCH OF CENTER CONDUCTOR. DON'T NICK CONDUCTOR.



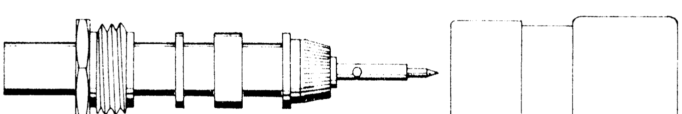
TAPER BRAID AS SHOWN. SLIDE NUT, WASHER AND GASKET ON VINYL JACKET. SLIDE CLAMP ON BRAID.



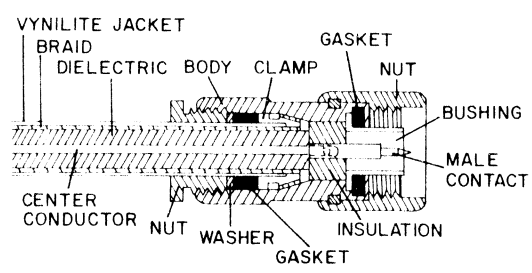
WITH CLAMP IN PLACE, TRIM BRAID AS SHOWN.



FOLD COPPER BRAID BACK ON CLAMP. TIN CENTER CONDUCTOR, USING MINIMUM AMOUNT OF HEAT.



HOLDING CONTACT WITH PLIERS, SOFT SOLDER CONTACT TO CENTER CONDUCTOR. IT IS IMPERATIVE THAT BACK END OF CONTACT BE FLUSH WITH POLYETHYLENE DIELECTRIC. DO NOT USE EXCESS SOLDER. WIPE CLEAN. - SEE THAT END OF CABLE INSULATOR IS CLEAN AND FREE OF SOLDER, ROSIN AND FOREIGN MATERIAL.



SLIDE BODY INTO PLACE CAREFULLY SO THAT CENTER CONDUCTOR ENTERS HOLE IN INSULATOR. FACE OF CABLE DIELECTRIC MUST FIT FLUSH AGAINST INSULATOR. PROPERLY TIGHTEN BODY AND NUT WITH WRENCHES.

Figure 2-4. Assembly of N-Type Coaxial Connector.

2.7.2 *Procedures*

2.7.2.1 *Equipment Setup*

Table 2-1 lists the controls that are used during the tuning and adjustment procedures. Table 2-2 is a list of recommended external test equipment required. Substitute test equipment may be used as long as the substitute test equipment is equal to or better than the recommended test equipment. A typical initial tuning and adjustment test setup is shown in figures 2-5 and 2-6. Use test setup of figure 2-5 if procedures of table 2-4, step 4.1, are to be followed. Use test setup of figure 2-6 if procedures of table 2-4, step 4.2, are to be followed.

2.7.2.2 *Use of Procedure*

Note

Before beginning any tuning and adjustment procedures, refer to table 2-3 and position all of the referenced 242F-9C functional controls as shown.

The tuning and adjustment procedures for the 242F-9C are presented in tabular format and are shown in table 2-4. The following paragraphs provide an outline for the use of table 2-4.

a. Unless otherwise noted, all procedures should be performed in the order shown beginning with procedure number 0.1.
b. Ensure that the test equipment is properly connected as shown in figure 2-5 or 2-6.
c. When any block under the 242F-9C front panel control settings column is empty, that control has been properly set in a previous procedure and does not have to be changed.
d. The PROCEDURE column lists steps to be performed.
e. The RESULT column provides the correct indications for a procedure.
f. The COMMENTS column is used for notes and/or supplemental information pertaining to a procedure.
g. To aid in troubleshooting, it is recommended that the initial MULTIMETER indications be recorded in table 5-2 in the maintenance section of this manual.
h. On the uhf band, the multimeter in the RF PWR position will indicate a higher power level than a meter on the output due to filter and coax losses. Final adjustment is made with a Thruline rf wattmeter. For these steps, on either the uhf or vhf band, the external wattmeter should be connected by a short length of low-loss cable.

Table 2-1. Tuning and Adjustment Controls.

CONTROL	LOCATION	FUNCTION
OSC FINE (L2)	Oscillator-doubler	Fine tunes the crystal oscillator.
OSC COARSE (C13)	Oscillator-doubler	Coarse tunes the crystal oscillator.
BUFFER (C20)	Oscillator-doubler	Tunes the buffer-amplifier tank circuit.
DBLR 1 (C31)	Oscillator-doubler	Tunes the first frequency doubler tank circuit.
DBLR 2 (C38)	Oscillator-doubler	Tunes the second frequency doubler tank circuit.
RF AMP 1 (C109)	Vhf exciter	Tunes the first rf amplifier tank circuit.
RF AMP 2 (C123)	Vhf exciter	Tunes the second rf amplifier tank circuit.
RF AMP 3 (C140)	Vhf exciter	Tunes the third rf amplifier tank circuit.
RF AMP 4 (C152)	Vhf exciter	Tunes the fourth amplifier tank circuit.
RF AMP 1 (C208)	Uhf exciter	Tunes the first rf amplifier tank circuit.
RF AMP 2 (C222)	Uhf exciter	Tunes the second rf amplifier tank circuit.
RF AMP 3 (C236)	Uhf exciter	Tunes the third rf amplifier tank circuit.
RF AMP 4 (C247)	Uhf exciter	Tunes the fourth rf amplifier tank circuit.
	Power amplifier cavity (inside driver tube compartment)	Tuning element in the driver plate circuit.
DRIVER (L27)	Power amplifier cavity (mounted through front of driver tube compartment)	Tuning element in the driver plate circuit.

CONTROL	LOCATION	FUNCTION
OUTPUT COUPLING (C77)	Power amplifier cavity (mounted directly in front of L37)	Provides variable capacitive coupling between the power amplifier plate and the antenna.
Vhf band switch	Top of power amplifier compartment	Provides power amplifier tuning for the low end of the vhf band.
VHF-UHF	Power amplifier cavity (located on gear train assembly plate in upper right front corner of cabinet)	Vhf-uhf band switch.
AUDIO GAIN (R303)	Modulator panel	Controls the audio input gain level.
MIKE GAIN (R306)	Modulator panel	Controls the audio input gain level.
RF DRIVE (R358)	Modulator panel	Controls the collector voltage for the transistors in the oscillator-doubler module.
AUDIO FEEDBACK (R338)	Modulator panel	Controls the audio feedback level.
AUDIO LIMITER (R344)	Modulator panel	Controls the audio limiting level.
% MOD CAL (R355)	Modulator panel	Provides a means to calibrate the percent modulation indication on the MULTIMETER.
AGC (R415)	Modulator panel	Controls the automatic gain control level.
PA BIAS (R416)	Modulator panel	Controls the bias level for the power amplifier control grid.
DR BIAS (R419)	Modulator panel	Controls the bias level for the driver control grid.

Table 2-2. Test Equipment Required.

TEST EQUIPMENT	MANUFACTURER AND MODEL
Dummy load	Bird Model 82A
Thruline rf wattmeter	Bird Model 43
Wattmeter elements	100 watts, 100-250 MHz 200-500 MHz
Audio generator (with 600-ohm output)	Hewlett-Packard Model 200AB
Ac voltmeter (with db scale)	Hewlett-Packard Model 400D
Vtvm	Hewlett-Packard Model 410B
Oscilloscope	Tektronix Model 561
Transfer oscillator	Hewlett-Packard Model 540
T-attenuator	General Radio Model GR-874A
Frequency counter (with associated tuning heads)	Hewlett-Packard Model 524B
Rf signal generator	Hewlett-Packard Model 606

Table 2-3. Initial Functional Control Settings.

CONTROL	SETTING
MIKE GAIN	Fully counterclockwise
AUDIO GAIN	Fully counterclockwise
AUDIO FEEDBACK	Fully counterclockwise
AUDIO LIMITER	Fully counterclockwise
% MOD CAL	Fully counterclockwise
RF DRIVE	Fully counterclockwise
AGC	Fully counterclockwise
PA BIAS	Fully counterclockwise
DR BIAS	Fully counterclockwise

Revised 1 July 1969

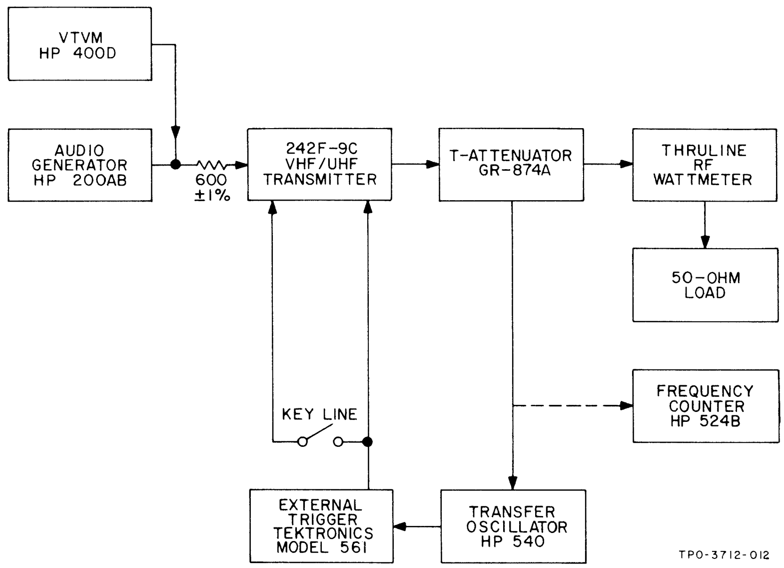


Figure 2-5. Test Equipment Setup, Initial Tuning and Adjustment, and Modulator Alignment Procedure One.

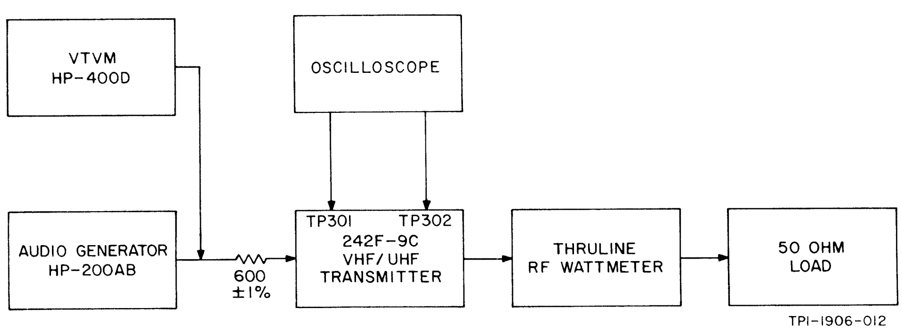


Figure 2-6. Test Equipment Setup, Initial Tuning and Adjustment, and Modulator Alignment Procedure Two.

Table 2-4. 242F-9C Tuning and Adjustment Procedures.

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
0.1 Initial setup	OFF	OFF	OFF	OFF	Read paragraph 2.7.2.2 before proceeding, and position switches as shown at left.		All results should be recorded in table 5-2 (troubleshooting) for future use.
1.0 Power supply check							
1.1					Remove rf drive source from 242F-9C (either crystal oven or external oscillator). Ensure that proper ac power cable is connected to 242F-9C and to the power source. Proceed to 1.2.		Rf drive source is removed at this time to prevent damage to rf stages (rf stages not tuned yet).
1.2	ON			BIAS PS X1		MULTIMETER indicates 66 on TUNING scale.	This check ensures that the low-voltage power supply is operating properly.
				28 VPS X1/2		MULTIMETER indicates 56 on TUNING scale.	
1.3		ON		300 VPS X5		MULTIMETER indicates 60 on TUNING scale. **Note** MULTIMETER indicates only in keydown position if SB 2 has been installed.	This check ensures that the high-voltage power supply is operating properly.
				850 VPS X10		MULTIMETER indicates 85 on TUNING scale.	
				2000 VPS X4		MULTIMETER indicates 50 on TUNING scale.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
2.0 Driver and power amplifier bias supply adjustments	ON	ON	OFF	2000 VPS X4			
					Caution POWER switch and PLATE switch must both be on for 1 minute before positioning LOCAL-REMOTE switch to LOCAL KEY. If results obtained in 2.1 and 2.2 are high, immediately remove power from 242F-9C, and refer to troubleshooting procedures in section 5 of this manual.		
2.1			LOCAL KEY		Observe POWER AMPLIFIER meter.	POWER AMPLIFIER meter indication should be less than 70.	
2.2				DR PLATE MA X1	Observe MULTIMETER.	MULTIMETER indication should be less than 40.	
2.3					Adjust DR BIAS control R419 for an indication of 50 on MULTIMETER.	MULTIMETER indicates 50.	
2.4					Adjust PA BIAS control R416 for an indication of 80 on POWER AMPLIFIER meter.	POWER AMPLIFIER meter indicates 80.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
2.5	ON	ON	OFF	DR PLATE MA X1	Observe MULTIMETER and POWER AMPLIFIER meter.	Both meters should indicate 0.	This ensures that key relay K402 is operating properly.
2.6	OFF	OFF			The 242F-9C is now ready for rf tuning and adjustments. Proceed to 3.0.		
3.0 Rf tuning and adjust-ment					Two rf tuning and adjustment procedures must be performed for each configuration (vhf or uhf) of the 242F-9C. The first of these procedures (3.1.0) is a low-level rf tuning and adjustment procedure, and is common to both configurations (vhf or uhf) of the 242F-9C. The second procedure consists of two driver-power amplifier tuning and adjustment procedures. Step 3.2.0 is for the vhf configuration, and step 3.3.0 is for the uhf configuration.		
3.1.0 Low-level rf tuning and adjustment (vhf and uhf)					Determine mode of operation (vhf or uhf) and select crystal frequency as follows: $\text{vhf} = \frac{\text{desired output frequency}}{4}$ or $\text{uhf} = \frac{\text{desired output frequency}}{8}$	Proper crystal frequency for desired mode of operation is selected.	Refer to paragraph 2.9 in the text for vhf to uhf, or uhf to vhf conversion procedures.
					Postion VHF-UHF PA BAND SW, S411, (located on power amplifer cavity gearplate) to applicable position.	VHF-UHF band switch correctly positioned.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	OFF	OFF	OFF	DR PLATE MA X1			
3.1.1					Once mode of operation and output frequency have been established, refer to table 2-5 or table 2-6 shown on facing page. Table 2-5 pertains to vhf operation, and table 2-6 pertains to uhf operation. Each table lists initial rf control settings for three frequencies within the appropriate operating range. Position all referenced controls as shown in the applicable table.	Initial rf control settings (vhf or uhf) positioned as shown in table 2-5 or table 2-6, and by interpolating for frequencies other than those shown.	Once the 242F-9C operating frequency has been established, the initial rf control settings for that particular frequency may be determined by referring to table 2-5 or table 2-6 and interpolating.
3.1.2					Install appropriate crystal in crystal oven and connect to XZ1 inside of 242F-9C front panel door, or connect external oscillator to AUXILIARY OSCILLATOR INPUT jack J12 on oscillator-doubler module.	Crystal or external oscillator properly connected to 242F-9C.	
					Note Adjustments performed in steps 3.1.3 through 3.1.13 should be made with a flat-blade screwdriver.		
3.1.3	ON		LOCAL KEY	OSC	Adjust OSC COARSE control C13 for minimum indication on MULTIMETER.	MULTIMETER indicates dip.	
3.1.4					Adjust OSC FINE control L2 for minimum indication on MULTIMETER.	MULTIMETER indicates dip.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	OFF	LOCAL KEY	OSC			
3.1.5				BUFFER	Adjust RF DRIVE control R358 for slight indication on MULTIMETER.	MULTIMETER needle just begins to move.	
3.1.6					Adjust BUFFER control C20 for maximum indication on MULTIMETER.	MULTIMETER indicates peak.	If necessary, readjust RF DRIVE control R358 so that peak indication is on scale.
3.1.7				DBLR 1	Adjust DBLR 1 control C31 for maximum indication on MULTIMETER.	MULTIMETER indicates peak	**Note** While performing steps 3.1.7 through 3.1.12, it may be necessary to readjust RF DRIVE control R358 to ensure that each MULTIMETER indication is on scale.
3.1.8				DBLR 2	Adjust DBLR 2 control C38 for maximum indication on MULTIMETER.	MULTIMETER indicates peak.	
3.1.9				RF AMP 1	Adjust RF AMP 1 control (C109 vhf, C208 uhf) for maximum indication on MULTIMETER.	MULTIMETER indicates peak.	
3.1.10				RF AMP 2	Adjust RF AMP 2 control (C123 vhf, C222 uhf) for maximum indication on MULTIMETER.	MULTIMETER indicates peak.	
3.1.11				RF AMP 3	Adjust RF AMP 3 control (C140 vhf, C236 uhf) for maximum indication on MULTIMETER.	MULTIMETER indicates peak.	
3.1.12				RF AMP 4	Adjust RF AMP 4 control (C152 vhf, C247 uhf) for maximum indication on MULTIMETER. **Warning** Do not contact the terminal of C75, extending below envelope detector module.	MULTIMETER indicates peak.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	OFF	LOCAL KEY	RF AMP 4			
3.1.13				See procedure	Repeat 3.1.7 through 3.1.12, and proceed to 3.2.0 for vhf operation or 3.3.0 for uhf operation.	Same as results obtained in 3.1.7 through 3.1.12.	
3.2.0 Vhf driver - power amplifier tuning and adjustment			OFF	DR PLATE MA X1	**Note** Perform steps 3.2.1 through 3.2.22 only after low-level rf tuning and adjustment procedures of steps 3.1.0 through 3.1.13 have been completed and if the 242F-9C is to be operated in the vhf configuration. Refer to 3.3.0 for vhf procedures.		
3.2.1					Position RF DRIVE control fully counterclockwise. Position VHF-UHF PA BAND SW, S411, to VHF.	RF DRIVE control is fully counterclockwise. S411 is in VHF position.	
3.2.2		ON	LOCAL KEY		**Caution** POWER switch and PLATE switch must both be on for 1 minute to allow equipment to warm up and stabilize before positioning LOCAL-REMOTE switch to LOCAL KEY. Slowly adjust RF DRIVE control in clockwise direction and observe MULTIMETER.	Initial 50 indication or MULTIMETER should increase slightly.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	DR PLATE MA X1			
3.2.3					Adjust RF DRIVE control to approximately 55 on MULTIMETER.	MULTIMETER indicates approxi-55.	
3.2.4				RF AMP 4	Carefully adjust DRIVER control L27 for maximum indication on POWER AMPLIFIER meter, and observe where pointer on DRIVER shaft L27 is positioned.	POWER AMPLIFIER meter indicates peak.	**Note** Peak indication should occur with DRIVER control L27 set in approximate initial position (table 2-5). If peak indication does not occur at this position, then capacitor C49 must be adjusted for a maximum reading. Capacitor C49 can be reached by removing the #10 screw in the rear cover plate. Adjust C49 with insulated alignment tool.
3.2.5					Adjust PA TUNING counter (located on power amplifier cavity gearplate) for maximum indication on Thruline rf wattmeter. **Caution** Ensure that POWER AMPLIFIER meter indication does not rise above 170 during this adjustment by adjusting RF DRIVE control R358 to reduce indication to less than 170.	Wattmeter indicates peak.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF AMP 4			
3.2.6					Adjust DRIVER control L27 for maximum indication on Thru-line rf wattmeter.	Wattmeter indicates peak.	
3.2.7				RF PWR	Adjust PA TUNE control for peak indication on MULTIMETER. **Caution** Ensure that POWER AMPLIFIER meter indication does not rise above 170 during this adjustment by adjusting RF DRIVE control R358 to reduce indication to less than 170.	MULTIMETER indicates peak.	
3.2.8					Adjust RF DRIVE for 50 watts output.	MULTIMETER indicates 50 watts.	
3.2.9					Adjust PA TUNE control and note whether maximum power and minimum plate current occur at the same setting. If so, proceed to step 3.2.14. If not, proceed to step 3.2.10.		
3.2.10					Adjust PA TUNE control in the direction that reduces plate current until MULTIMETER indicates 47 to 48 watts output.	MULTIMETER indicates 97 to 48 watts.	This results in more efficient power amplifier operation.

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
3.2.11					Increase RF DRIVE for 100 watts output. **Caution** Do not maintain the 100-watt indication for more than 10 seconds. Proceed immediately to step 3.2.11.	MULTIMETER indicates 100 watts.	
3.2.12					Adjust AGC control R415 for 50-watt indication on Thruline rf wattmeter.	Wattmeter indicates 50 watts.	
3.2.13					Carefully adjust PA TUNE control for minimum plate current.	POWER AMPLIFIER meter indicates minimum.	
3.2.14					Check POWER AMPLIFIER meter for indication of 130 on the 116- to 123-MHz range, 140 on the 123- to 136-MHz range, or 150 on the 136- to 152-MHz range.		
3.2.15					If POWER AMPLIFIER meter indicates correctly, proceed to step 3.2.17. If POWER AMPLIFIER meter does not indicate correctly, proceed to step 3.2.16.		

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
3.2.16					If the plate current is low, adjust OUTPUT COUPLING toward a larger number than that shown in table 2-5. If the plate current is high, adjust OUTPUT COUPLING toward a smaller number than that shown in table 2-5.		
3.2.17					Set AGC control to full counter-clockwise position. Repeat steps 3.2.10 through 3.2.14.		
3.2.18					Turn AGC control R415 fully counterclockwise and adjust RF DRIVE for 100 watts output. **Caution** Do not maintain 100-watt indication for more than 10 seconds. Proceed immediately to step 3.2.19.	MULTIMETER indicates 100 watts.	
3.2.19					Set AGC control for 50-watt indication on Thruline rf wattmeter.	Wattmeter indicates 50 watts.	
3.2.20				DBLR 2	Carefully adjust RF DRIVE control for indication of 30 on TUNING scale of MULTIMETER. Secure RF DRIVE locking nut.	MULTIMETER indicates 30.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	DBLR 2			
3.2.21				RF PWR	If necessary, adjust AGC control for an indication of 50 watts on Thruline rf wattmeter.	Wattmeter indicates 50 watts.	Secure AGC control locking nut. Ensure that indication has not changed.
3.2.22					242F-9C carrier output frequency can now be checked with frequency counter.	Counter indicates desired carrier frequency.	
3.2.23		OFF	OFF		This completes the vhf rf tuning and adjustment procedures. The 242F-9C is now ready for modulator tuning and adjustment. Proceed to 4.0 (do not perform 3.3.0).		
UHF TUNING 3.3.0				DR PLATE MA X1	**Note** Perform steps 3.3.1 through 3.3.19 only after low-level rf tuning and adjustment procedures of steps 3.1.0 through 3.1.13 have been completed and if the 242F-9C is to be operated in the uhf configuration. Refer to 3.2.0 for vhf procedures.		
3.3.1					Position RF DRIVE control fully counterclockwise. Position VHF-UHF PA BAND SW, S411, to UHF.	RF DRIVE control is fully counterclockwise VHF-UHF PA BAND SW is in UHF position.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	OFF	OFF	DR PLATE MA X1			
3.3.2		ON	LOCAL KEY		**Caution** POWER switch and PLATE switch must both be on for 1 minute to allow equipment to warm up and stabilize before positioning LOCAL-REMOTE switch to LOCAL KEY. Slowly adjust RF DRIVE control in clockwise direction and observe MULTIMETER.	Initial 50 (driver plate mA) indication on MULTIMETER should increase slightly.	
3.3.3					Adjust RF DRIVE control to approximately 55 on MULTIMETER.	MULTIMETER indicates approximately 55.	
3.3.4				RF AMP 4	Carefully adjust DRIVER control L27 for maximum indication on POWER AMPLIFIER meter, and observe where pointer on DRIVER shaft L27 is positioned.	POWER AMPLIFIER meter indicates peak.	
3.3.5					Adjust PA TUNING counter (located on power amplifier cavity gearplate) for maximum indication on Thruline rf wattmeter.	Wattmeter indicates peak.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF AMP 4			
3.3.5 (Cont)					**Caution** Ensure that POWER AMPLIFIER meter indication does not rise above 170 during this adjustment by adjusting RF DRIVE control R358 to reduce indication to less than 170.		
3.3.6					Adjust DRIVER control L27 for maximum indication on Thru-line rf wattmeter.	Wattmeter indicates peak.	
3.3.7				RF PWR	Adjust PA TUNE control for peak indication on MULTIMETER. **Caution** Ensure that POWER AMPLIFIER meter indication does not rise above 170 during this adjustment by adjusting RF DRIVE control R358 to reduce indication to less than 170.	MULTIMETER indicates peak.	
3.3.8					Adjust RF DRIVE for 50 watts output.	MULTIMETER indicates 50 watts.	
3.3.9					Adjust PA TUNE control in the direction that reduces plate current until MULTIMETER indicates 47 to 48 watts output.	MULTIMETER indicates 47 to 48 watts.	This results in more efficient power amplifier operation.

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
3.3.10					Increase RF DRIVE for 100 watts output. **Caution** Do not maintain the 100-watt indication for more than 10 seconds. Proceed immediately to step 3.2.11.	MULTIMETER indicates 100 watts.	
3.3.11					Adjust AGC control R415 for 50-watt indication on Thruline rf wattmeter.	Wattmeter indicates 50 watts.	
3.3.12					Carefully adjust PA TUNE control for minimum plate current.	POWER AMPLIFIER meter indicates minimum.	
3.3.13					Check POWER AMPLIFIER meter for indication of 145 for 225- to 300-MHz range or 150 for 300- to 400-MHz range.		
3.3.14					If POWER AMPLIFIER meter indicates correctly, proceed to step 3.3.17. If POWER AMPLIFIER meter does not indicate correctly, proceed to step 3.3.15.		

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
3.3.15					If the plate current is low, adjust OUTPUT COUPLING toward a larger number than that shown in table 2-6. If the plate current is high, adjust OUTPUT COUPLING toward a smaller number than that shown in table 2-6.		
3.3.16					Set AGC control to full counterclockwise position. Repeat steps 3.3.10 through 3.3.14.		
3.3.17					Turn AGC control R415 fully counterclockwise and adjust RF DRIVE for 125 watts output or maximum, whichever is less. Secure RF DRIVE control locking nut and ensure that indication has not changed. **Caution** Do not maintain the 125-watt indication for more than 10 seconds. Proceed immediately to step 3.3.18.	MULTIMETER indicates 125 watts or maximum.	
3.3.18					Set AGC control for 50-watt indication on Thruline rf wattmeter.	Wattmeter indicates 50 watts.	
3.3.19					242F-9C carrier output frequency can now be checked with frequency counter.	Counter indicates desired carrier frequency.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
3.3.20		OFF	OFF		This completes the uhf rf tuning and adjustment procedures. The 242F-9C is now ready for modulator tuning and adjustment. Proceed to 4.0.		
4.0 Modulator tuning and adjustment		ON	LOCAL KEY		**Note** Two procedures are provided for modulator tuning and adjustment. The preferred procedure, step 4.1, makes use of a transfer oscillator and an oscilloscope. An alternate procedure, step 4.2, presents a method of tuning and adjusting the modulator by means of a vtvm. This procedure should only be used when a transfer oscillator and oscilloscope are not available.		**Note** Procedure one, step 4.1, uses a transfer oscillator for modulation adjustment. Procedure two, step 4.2, is an alternate procedure using a vtvm in place of the transfer oscillator. The steps of either procedure may be performed at this time with equal results.
4.1 Procedure one							
4.1.1 Audio feedback					Connect vtvm between TP301 and TP302 on 242F-9C modulator.		

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
4.1.1.1					Slowly adjust AUDIO GAIN control R303 clockwise until oscilloscope indicates 10-percent modulation. Observe vtvm and record indication shown on db scale.	Oscilloscope indicates 10 percent and db indication on vtvm recorded.	
4.1.1.2					Carefully adjust AUDIO FEEDBACK control R338 until vtvm indication decreases 8.0 db from indication recorded in step 4.1.1.1.	Vtvm indication drops 8.0 db.	
4.1.1.3					Secure AUDIO FEEDBACK control locking nut and recheck vtvm to ensure that db indication has not changed.		
4.1.2 Percent modulation calibration		OFF	OFF		Refer to figure 2-5 and ensure that General Radio 874A T-attenuator is properly connected between 242F-9C rf output and 50-ohm dummy load. The output of the T-attenuator should be connected to the transfer oscillator and oscilloscope as shown in figure 2-5. Apply audio input as described in COMMENTS column.	242F-9C and test equipment properly connected as shown in figure 2-5. Audio input signal properly applied.	Note If local operation is to be used, apply 0 dbm, 1000 Hz to TB401-1 and TB401-2. If remote operation is to be used, apply an audio signal that will correspond to the level expected to be obtained from the remote audio line (-15 dbm to +10 dbm).
4.1.2.1		ON	LOCAL KEY		Adjust AUDIO GAIN control R303 and observe oscilloscope for a 90-percent modulated signal.	Oscilloscope shows 90-percent modulation.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
4.1.2.2				% MOD	Adjust % MOD CAL control R355 until MULTIMETER indicates 90 on tune scale.	MULTIMETER indicates 90.	This procedure calibrates the MULTIMETER indication to the actual observed percent of modulation.
4.1.2.3					Position AUDIO GAIN control R303 fully counterclockwise.	AUDIO GAIN control fully counterclockwise.	
4.1.3 Audio limiting					Readjust AUDIO GAIN control R303 until MULTIMETER indicates 85 (or desired maximum modulation percentage). Record MULTIMETER indication.	MULTIMETER indicates 85 or desired maximum. MULTIMETER indication recorded.	Note To ensure that overmodulation will not occur, the maximum percentage of modulation should not exceed 85.
4.1.3.1					Carefully adjust AUDIO LIMITER control R344 until MULTIMETER indication recorded in 4.1.3 is reduced from 2 to 5 percent.	MULTIMETER indication reduced 2 to 5 percent from indication recorded in 4.1.3.	
4.1.3.2					Increase audio signal generator output by 10 db and verify that modulation percentage indicated on MULTIMETER does not exceed 100.	MULTIMETER indicates less than 100.	
4.1.3.3					Secure locking nuts on all adjustable controls. This completes the tuning and adjustment procedures. Do not proceed to step 4.2.		

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	% MOD			
4.2 Procedure two					**Note** Do not perform procedure two if procedure one was performed.		
4.2.1 Audio feedback							
4.2.1.1					Apply 1000 Hz, 0 dbm to modulator input for local operation, or an audio level equal to that obtained from the remote audio line (-15 dbm to +10 dbm) if remote operation is to be used. **Note** The voltage measured at the signal generator will always be twice that required at the input terminals. Input voltages shall be measured at the generator only. The following are signal generator voltages corresponding to input power: 1.55 vrms = 0 dbm 4.90 vrms = +10 dbm 0.275 vrms = -15 dbm		
4.2.1.2					Connect HP-410B VTVM between TP301 (positive) and TP302 (negative). Position meter function selector to 1-volt dc full scale.	Vtvm indicates approximately 1 volt dc.	

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	% MOD			
4.2.1.3					Set HP-400D VTVM to 1-volt scale and connect to TP301 and TP302.		
4.2.1.4					Slowly adjust AUDIO GAIN control clockwise to satisfy the following equation: Ac voltage = (0.1) dc voltage measured in step 4.2.1.2.		
4.2.1.5				OFF	Adjust AUDIO FEEDBACK control until ac vtvm decreases 8 db.		
4.2.1.6					Secure AUDIO FEEDBACK control locking nut and ensure that vtvm indication has not changed.		
4.2.2 Percent modulation calibration							
4.2.2.1				RF POWER	Adjust AUDIO GAIN control fully counterclockwise.		
4.2.2.2					Remove ac vtvm and connect oscilloscope to TP301 and TP302. Adjust oscilloscope for sweep rate of approximately 5 milliseconds.		

Table 2-4. 242F-9C Tuning and Adjustment Procedures (Cont).

PROCEDURE NUMBER AND NAME	242F-9C FRONT PANEL CONTROL SETTINGS				PROCEDURE	RESULT	COMMENTS
	POWER SWITCH	PLATE SWITCH	LOCAL-REMOTE SWITCH	MULTIMETER SWITCH			
	ON	ON	LOCAL KEY	RF PWR			
4.2.2.3					Adjust AUDIO GAIN control clockwise until waveform just begins to clip. The waveform should not be noticeably distorted.	The carrier is now 90 percent modulated.	A distortion-free sine wave indicates that the transmitter is adjusted correctly.
4.2.2.4				% MOD	Adjust % MOD CAL control R355 until MULTIMETER indicates 90 on tune scale.	MULTIMETER indicates 90.	This procedure calibrates the MULTIMETER indication to the actual observed percent of modulation.
4.2.2.5					Position AUDIO GAIN control R303 fully counterclockwise.	AUDIO GAIN control fully counterclockwise.	
4.2.3 Audio					Readjust AUDIO GAIN control R303 until MULTIMETER indicates 85 (or desired maximum modulation percentage). Record MULTIMETER indication.	MULTIMETER indicates 85 or desired maximum MULTIMETER indication recorded.	Note To ensure that overmodulation will not occur, the maximum percentage of modulation should not exceed 85.
4.2.3.1					Carefully adjust AUDIO LIMITER control R344 until MULTIMETER indication recorded in 4.2.3 is reduced 2 to 5 percent.	MULTIMETER indication reduced 2 to 5 percent from indication recorded in 4.2.3.	
4.2.3.2					Increase audio signal generator output by 10 db and verify that modulation percentage indicated on MULTIMETER does not exceed 100.	MULTIMETER indicates less than 100.	
4.2.3.3					Secure locking nuts on all adjustable controls. This completes the tuning and adjustment procedures.		

Table 2-5. Recommended Initial RF Control Settings for VHF Operation.

CONTROL	SETTING					
	116 MHz		136 MHz		152 MHz	
OSC COARSE (C13)	2		6		8	
BUFFER (C20)	2		6		8	
DBLR 1 (C31)	2		6		8	
DBLR 2 (C38)	2		6		8	
RF AMP 1 (C109)	2		6		8	
RF AMP 2 (C123)	2		6		8	
RF AMP 3 (C140)	2		6		8	
RF AMP 4 (C152)	2		6		8	
Vhf bandswitch (See note 1.)	Maximum counterclockwise			Maximum counterclockwise		
	116 MHz	127 MHz	136 MHz	136 MHz	144 MHz	152 MHz
DRIVER (L27)	1	5	7	3	5.5	9
OUTPUT COUPLING (C77)	9	9	7	8	7	6.5
PA TUNING (counter)	0069	0560	0885	0613	0913	1238
	Caution Do not exceed maximum plate current ratings.					
PA plate current, maximum (50 watts indicated on MULTIMETER)	140	150	150	150	150	165
OSC FINE (L2)	1/8 in. of threaded shaft exposed					
VHF-UHF bandswitch	VHF	VHF	VHF	VHF	VHF	VHF
Driver trimmer (C49)	(See note 2.)			(See note 3.)		

NOTES:

1. Control for C63 is located behind S404 on the PA tube cover.
2. Set L27 at 1 on the lagging scale and adjust C49 at 116 MHz, and use that setting of C49 for 116 to 136 MHz. Either a crystal or a Hewlett-Packard Model 606 RF Signal Generator (50 to 100 mv) may be used for rf input. Input frequency must be 29.0 MHz.
3. Set L27 at 1 on the lagging scale and adjust C49 at 136 MHz, and use that setting of C49 for 136 to 152 MHz. Either a crystal or a Hewlett-Packard Model 606 RF Signal Generator (50 to 100 mv) may be used for rf input. Input frequency must be 34.0 MHz.

Table 2-6. Recommended Initial RF Control Settings for UHF Operation.

CONTROL	SETTING		
	225 MHz	300 MHz	400 MHz
OSC COARSE (C13)	2	6	10
BUFFER (C20)	2	6	10
DBLR 1 (C31)	2	6	10
DBLR 2 (C38)	2	6	10
RF AMP 1 (C208)	2	6	10
RF AMP 2 (C222)	2	6	10
RF AMP 3 (C236)	2	6	10
RF AMP 4 (C247)	2	6	10
DRIVER (L27)	4	9	15
OUTPUT COUPLING (C77)	5	3	2
PA TUNING counter	840	1175	1500
OSC FINE (L2)	1/8 in. of threaded shaft exposed		
VHF-UHF bandswitch	UHF	UHF	UHF
Vhf bandswitch (C63) (See note 1.)	Maximum counter-clockwise		Maximum counter-clockwise

NOTES:

1. The control for C63 is located behind S404 on the PA tube cover.

2.8 NARROW AUDIO BAND TO WIDE AUDIO BAND CONVERSION

The 242F-9C is supplied wired for narrow audio band (300 to 3000 Hz). However, the 242F-9C has the capability of wide audio band operation (100 to 20,000 Hz). If the customer wishes to use the wider band to handle data transmission inputs, the following wiring modification must be made to the 242F-9C modulator circuit:

a. Refer to figure 2-7 for simplified wiring diagram of circuitry to be modified.
b. Remove jumpers between 1-3 and 4-6.
c. Place jumpers between 1-2 and 4-5.

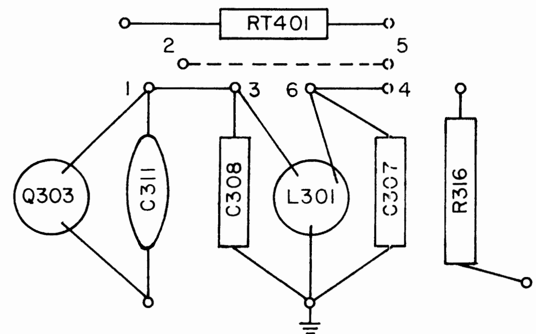


Figure 2-7. Narrow Audio Band to Wide Audio Band Conversion, Wiring Diagram.

2.9 RF BAND CONVERSION

The 242F-9C, as shipped from the factory, can be either a vhf or uhf transmitter, depending on customer requirements. However, either configuration can be converted to the other configuration (vhf to uhf, or uhf to vhf) at the customer's site by performing the procedures in paragraphs 2.9.1 or 2.9.2 as applicable.

2.9.1 VHF to UHF Conversion

a. Remove all power from 242F-9C.
b. Place VHF-UHF PA BAND SW S411 in UHF position.
c. Remove covers from driver tube and envelope detector compartments.
d. Refer to figures 2-8 and 2-9 while making following modifications:
   1. Remove screw securing inductor L38 to power amplifier grid ring.
   2. Loosen screw securing L38 to capacitor C64.
   3. Rotate L38 until it is clear of all components and compartment wall. Tighten screw.
   4. Remove screw securing lug on C49 to plate of driver tube V1.
   5. Position lug at least one-half of an inch from V1.
   6. Place jumper between resistors R26 and R27.

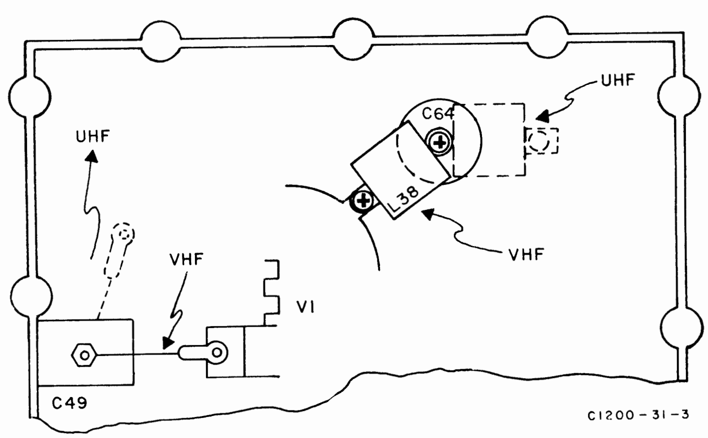


Figure 2-8. VHF Transmitter, Mounting of Inductor L38.

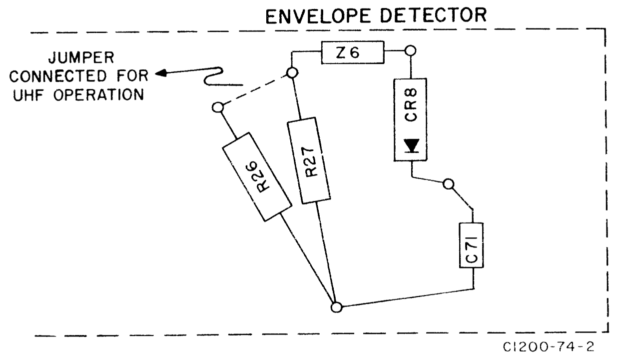


Figure 2-9. UHF Transmitter, Mounting of Resistors R26 and R27.

e. Replace covers on the driver tube and envelope detector compartments.
f. Install appropriate crystal, keeping in mind that 242F-9C output frequency for uhf is eight times that of crystal frequency.
g. Remove vhf exciter module, and replace it with uhf exciter module.
h. Replace vhf filter with appropriate uhf filter.
i. Perform tuning and adjustment procedures prescribed for uhf configuration (procedure 3.3.0 of table 2-4).

2.9.2 UHF to VHF Conversion

a. Remove all power from 242F-9C.
b. Place VHF-UHF PA BAND SW S411 in VHF position.
c. Remove covers from driver tube and envelope detector compartments.
d. Refer to figures 2-8 and 2-9 while making following modifications:
   1. Loosen screw securing inductor L38 to capacitor C64.
   2. Using a screw, secure opposite end of L38 to power amplifier grid ring.
   3. Using screw on plate of driver tube V1, secure lug on capacitor C64 to plate of V1.
   4. Remove jumper between resistors R26 and R27.
e. Replace covers on the driver tube and envelope detector compartments.
f. Install appropriate crystal, keeping in mind that 242F-9C output for vhf is four times that of crystal frequency.
g. Remove uhf exciter module, and replace it with vhf exciter module.
h. Remove uhf filter, and replace it with vhf filter.
i. Perform tuning and adjustment procedures prescribed for vhf configuration (procedures 3.2.0 of table 2-4).

section 3
operation

3.1 GENERAL

The 242F-9C VHF/UHF Transmitter is a 50-watt, crystal-controlled transmitter designed for ground-to-air communication. The 242F-9C is rated for continuous duty and may be operated under local or remote conditions.

During either local or remote operation, the POWER and PLATE switches must be turned on at the equipment. The keying of the 242F-9C may then be controlled with either a push-to-talk microphone, the key selector switch, or a keying switch at the remote position.

3.2 OPERATING CONTROLS AND INDICATORS

A list of the 242F-9C operating controls and indicators and their functions is shown in table 3-1.

Figure 3-1 shows the location of the front panel controls and indicators. The remaining controls are located on the internal circuit panel.

3.3 OPERATING PROCEDURES

The following procedures should be used for the operation of the 242F-9C.

Caution

Before operating the 242F-9C, ensure that all connections are secure and that the initial tuning and adjustment procedures prescribed in paragraph 2.7 of this manual have been performed.

Table 3-1. Operating Controls and Indicators and Their Functions.

CONTROLS/ INDICATORS	FUNCTION
POWER switch	Controls the power to the filaments, crystal oven, and low-voltage power supply circuits.
PLATE switch	Controls the power to the high-voltage power supply.
LOCAL-REMOTE key selector switch	Selects the keying mode for local or remote operation.
POWER indicator	Indicates when primary ac power is applied to the low-voltage power supply.
PLATE indicator	Indicates when primary ac power is applied to the high-voltage power supply.
AUDIO GAIN control	Controls the audio input level.
MIKE GAIN control	Controls the microphone input level.

3.3.1 Local Operation

a. Position key selector switch to OFF.
b. Position POWER switch to ON.
c. Position PLATE switch to ON.

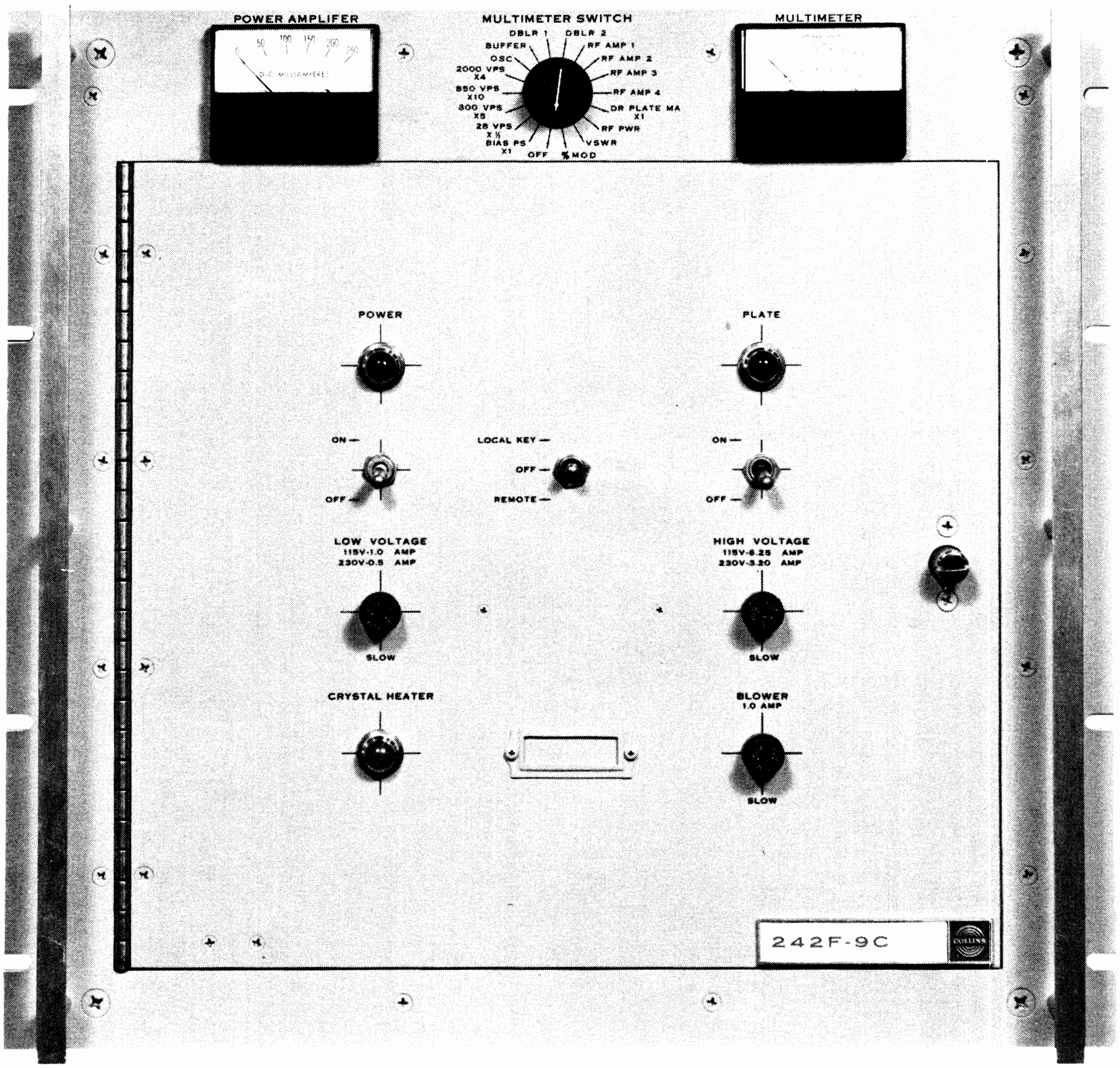


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Figure 3-1. 242F-9C VHF/UHF Transmitter, Location of Operating Controls and Indicators.

Note

If the transmitter has been modified per service bulletin no. 1, a momentary 3/4 scale current indication will appear on the PA CURRENT meter when the PLATE switch is turned on. This is a normal indication and is due to the charging current of the power supply capacitors.

After the power supply capacitors have charged, a residual current of approximately 5 ma will be indicated on the PA CURRENT meter due to current through the bleeder resistance in the 2000-volt power supply.

d. After approximately 60 seconds of warmup time, the 242F-9C may be keyed by one of the following methods:
   1. With a push-to-talk microphone (Collins part number 020-0200-000) connected to J301. The push-to-talk microphone connector must be wired in accordance with figure 3-2.
   2. With LOCAL-REMOTE key selector switch positioned to LOCAL KEY.
e. Position MULTIMETER SWITCH to % MOD. While talking into the microphone, adjust MIKE GAIN control for peaks of approximately 10 on MULTIMETER. This is approximately 80 percent modulation.

3.3.2 Remote Operation

3.3.2.1 Remote Keying Using the Internal 48-VDC Power Supply and a Remote Push-to-Talk Microphone (Refer to figure 4-23(A).)

a. Connect the remote microphone (Collins part number 020-0200-000) as indicated in figure 3-2.
b. Connect a jumper between TB402-1 and TB402-2.
c. Connect a jumper between TB402-3 and TB402-4.
d. Position LOCAL-REMOTE key selector switch to REMOTE.
e. Position POWER switch to ON.
f. Position PLATE switch to ON.
g. After approximately 60 seconds of warmup time, the 242F-9C may be keyed by depressing the microphone push-to-talk switch.
h. Position MULTIMETER SWITCH to % MOD. While talking into the microphone, adjust MIKE GAIN control for peaks of approximately 10 on MULTIMETER. This is equal to approximately 80 percent modulation.

3.3.2.2 Remote Keying Using an External 48-VDC Power Supply and a Remote Push-to-Talk Microphone (Refer to figure 4-23(B).)

a. Ensure that jumper between TB402-1 and TB402-2 is removed.

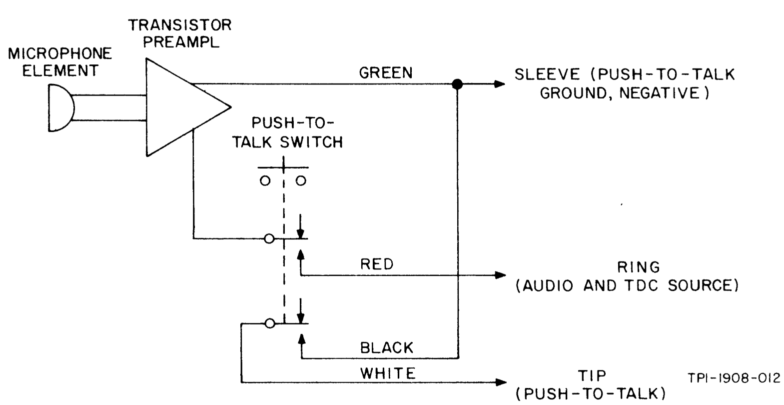

Figure 3-2. Microphone Plug Connections.

b. Ensure that jumper between TB402-3 and TB402-4 is removed.
c. Install jumper between TB402-2 and TB402-3.
d. Install a jumper between TB401-8 and TB402-3.
e. Connect the remote microphone (Collins part number 020-0200-000) as indicated in figure 3-2.
f. Position POWER switch to ON.
g. Position PLATE switch to ON.
h. After approximately 60 seconds of warmup time, the 242F-9C may be keyed with the 48-volt external power supply by depressing the microphone push-to-talk switch.
i. Position MULTIMETER SWITCH to % MOD. While talking into the microphone, adjust MIKE GAIN control for peaks of approximately 10 on MULTIMETER. This is approximately 80-percent modulation.

section 4

principles of operation

4.1 GENERAL

The 242F-9C VHF/UHF Transmitter is a continuous duty, amplitude-modulated unit designed for ground-to-air communications in either the 116- to 152- or 225- to 400-MHz frequency bands. The 242F-9C is capable of producing a carrier power output of 50 watts on any frequency within these bands.

4.2 GENERAL PRINCIPLES OF OPERATION (Refer to figure 4-1.)

The oscillator circuit produces an output ranging between 28 and 50 MHz. This output is multiplied (4 times for vhf, 8 times for uhf) and then amplified by solid-state amplifiers before being applied to a driver tube stage. The final multiplier output is at the same frequency as the 242F-9C output carrier frequency. The vhf configuration of the 242F-9C contains 2 doublers and 4 rf amplifiers, the rf amplifiers being contained in a separate exciter module. The uhf configuration of the 242F-9C contains 3 doublers and 3 rf amplifiers, the third doubler and the 3 rf amplifiers also being contained in a separate exciter module. The rf signal for both the vhf and uhf transmitters is modulated by the audio signal applied to the rf amplifier stages. In addition, an automatic gain control voltage is applied to the rf amplifier stages. The driver stage operates as a class A grounded grid amplifier. This tube supplies the power necessary to develop an adequate voltage swing across the reactively swamped power amplifier tube grid. A coupling network provides the proper impedance match between the driver plate and the power amplifier grid.

The power amplifier stage operates as a class AB_1 linear amplifier to reduce intermodulation products. This tube is a grounded-cathode amplifier with reactive grid swamping and without neutralization, a combination which provides optimum intermodulation performance.

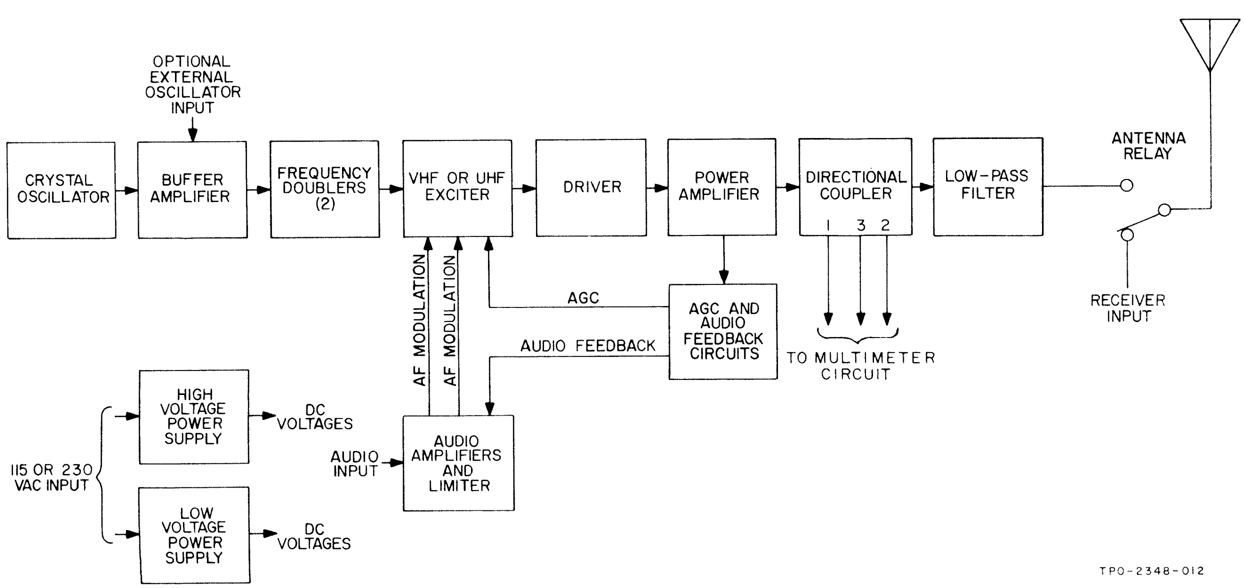

Figure 4-1. 242F-9C VHF/UHF Transmitter, Block Diagram.

The power amplifier output network is a 2-band transmission line cavity using a movable slider to determine its resonant frequency. A set of multiturn gear-driven lead screws move the slider up and down the length of the cavity. Frequency logging is provided by a rotary counter mounted on the gearplate.

A shaft-driven capacitor mounted near the tube plate provides a variable capacitance to compensate for any impedance mismatch up to a 3:1 vswr over the frequency range.

The power amplifier output is applied to a directional coupler before connection to a low-pass filter. The directional coupler provides vswr and power output information to the front panel multimeter. One filter is available for the vhf band and 2 are available for the uhf band (225 to 300 MHz and 300 to 400 MHz). Each of the filters provides harmonic suppression of 80 db or more.

A sample of the power amplifier output is applied to a detector circuit, which produces an automatic gain control voltage for the rf amplifiers in the exciter modules and an audio feedback voltage for the modulator circuit. The modulator contains a manual level control, audio amplifiers, and an audio limiter circuit. Adequate audio is available to fully modulate the rf amplifiers with an input level of -15 dbm. The transmitter can be used for voice or data transmission by removing or replacing a jumper wire across a filter network. Narrow audio band response is between 300 and 3000 Hz, and wide audio band response is between 100 and 20,000 Hz. The audio limiter circuit prevents overmodulation and equalizes the inputs from various microphones and operators.

The 242F-9C power supply circuits provide the required high- and low-voltages. The high-voltage circuit provides a +2000-volt dc power amplifier plate supply, a +850-volt dc driver plate supply, and a +300-volt dc driver and power amplifier screen supply. The low-voltage circuit provides power amplifier and driver bias supplies, a +28-volt dc transistor supply, and a +48-volt dc control circuit supply. All of the power supplies use solid-state rectifiers. The bias supplies, the 28-volt dc supply, and the 300-volt dc supply are all regulated. Either 115 or 230 volt, 50 to 60 Hz, single-phase power input may be used. Fuses provide ample overload and short circuit protection. Safety interlock switches are used with the protective covers to provide protection for maintenance personnel.

A front panel switch controls the primary power input. A key relay controls the voltages to the blower, crystal oscillator, driver, and power amplifier screens.

Cooling air is required only during the transmit condition. A thermal cutoff switch is provided to protect the driver and power amplifier tubes in case of blower failure.

4.3 DETAILED THEORY OF OPERATION

The theory presented in the following paragraphs applies to both vhf and uhf configurations of the 242F-9C unless otherwise stated.

4.3.1 Crystal Oscillator and Frequency Doublers

4.3.1.1 Crystal Oscillator (Refer to figure 4-2.)

The fundamental signal frequency for the 242F-9C is generated by an impedance-inverting, transistorized, Pierce crystal oscillator. The oscillator provides an output frequency which ranges between 29.0 to 38.0 MHz for the vhf range, or between 28.125 to 50.0 MHz for the uhf range. The choice of the 242F-9C output frequency, and the use of the formula $\text{vhf} = \frac{\text{vhf output frequency}}{4}$ or $\text{uhf} = \frac{\text{uhf output frequency}}{8}$ will determine the exact oscillator output frequency.

The frequency stability of the oscillator is essentially equal to that of the crystal. Frequency stability is achieved by using a crystal oven to maintain a constant crystal temperature. The oscillator functions as follows.

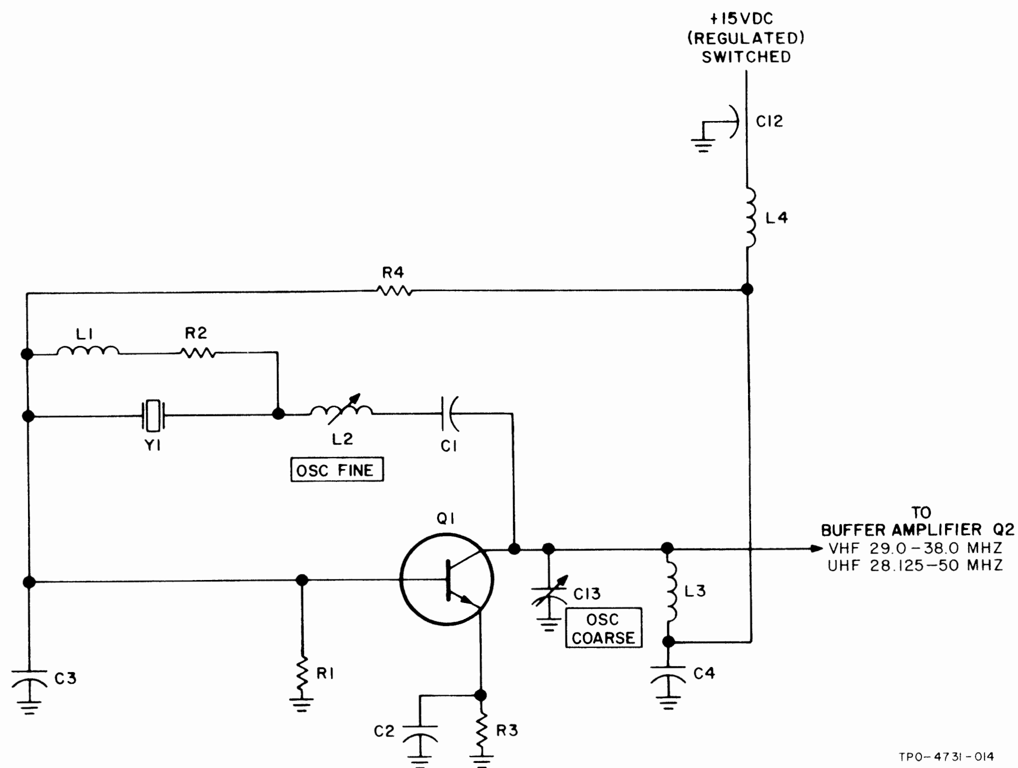

Figure 4-2. Crystal Oscillator, Simplified Schematic Diagram.

Regulated +15 volts dc is only applied to the oscillator when the 242F-9C is keyed. Figure 4-2 shows the oscillator as a common-emitter configuration with regenerative feedback applied from the collector to base of Q1. Capacitor C3, crystal Y1, and inductor L2 are series-connected, while L3 and C13 are in parallel. The combination of C3, Y1, and L2 is in parallel with the combination of L3 and C13. A resistive load results at the collector of Q1 when the combination of C3, Y1, and L2 is parallel resonant with the resultant capacitive reactance of L3 and C13. This resistive load is approximately equal to the square of the resultant reactance of L3-C13 divided by the resistance of crystal Y1. The reactance of Y1-L2 at resonance is inductive and is approximately equal to the reactance of L2. Assuming the resistance of Y1 is negligible, then the current in Y1 will lag the collector voltage of Q1 by 90 degrees. The base voltage of Q1 will also lag the current in Y1 by 90 degrees. Therefore, base voltage of Q1 is 180 degrees out of phase with the collector voltage. This 180-degree phase shift is a characteristic of the common-emitter configuration. When Q1 has a resistive load (caused by C3, Y1, and L2 being parallel resonant with the capacitive reactance of L3 and C13), the phasing is again inverted so that the total phase shift around the closed loop is 360 degrees. Regeneration takes place, and, because the gain is greater than 1, oscillation will occur.

The oscillator is tuned by first adjusting OSC COARSE, C13, and observing MULTIMETER (paragraph 4.3.9.2) in the OSC position for a dip. OSC FINE, L2, is then adjusted until the sharpest dip occurs. When the oscillator is tuned by OSC FINE, L2, the current in Y1 will remain essentially constant, and the voltage which appears across Y1 will be proportional to the crystal impedance. As the frequency approaches series resonance (by adjusting OSC FINE, L2) of Y1, the impedance of Y1 passes through a minimum value. At this time, the voltage across Y1 will also be a minimum value. At frequencies above and below the series-resonant frequency of Y1 the crystal impedance increases and reduces the amount

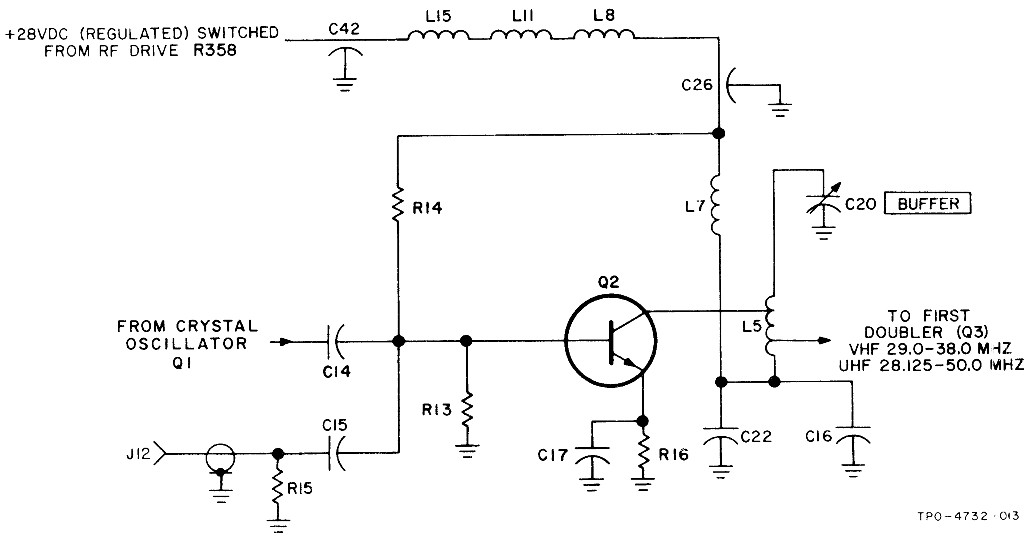

Figure 4-3. Buffer Amplifier, Simplified Schematic Diagram.

of regenerative feedback. This in turn prevents oscillations from occurring at frequencies other than the series-resonant frequency. Therefore, the oscillator can be tuned to the series mode of Y1 by observing the MULTIMETER (in OSC position) for the sharpest dip (voltage across Y1) while adjusting OSC FINE, L2.

To prevent stray capacitance associated with Y1 from interfering with the tuning process, a compensation network consisting of L1 and R2 is placed in parallel with Y1. Resistors R4 and R1 provide a base biasing voltage divider for Q1. Capacitors C12 and C4 and inductor L4 provide rf filtering for the regulated +15 volts dc. A meter detector circuit is also connected across crystal Y1, and is discussed in paragraph 4.3.9.2.g.

The output of the crystal oscillator is taken from the collector circuit of Q1, and applied to buffer amplifier Q2.

4.3.1.2 Buffer Amplifier (Refer to figure 4-3.)

The buffer amplifier stage provides isolation between the crystal oscillator and the remaining stages of the rf circuitry. This isolation ensures that the oscillator frequency will not be "pulled" due to the effects of the following doubler and rf stages. The buffer amplifier stage also drives the first doubler by amplifying the rf output from the crystal oscillator.

The buffer stage consists of a common-emitter configuration amplifier, associated biasing components, output tank circuit, and rf filtering network. The stage gain is controlled by the base bias on Q2, which is determined by RF DRIVE control R358.

The output signal from Q2 is developed across the collector tank circuit consisting of L5 and C20. BUFFER capacitor C20 is used in conjunction with the BUFFER position of the MULTIMETER to tune the buffer amplifier output to the appropriate crystal frequency. Inductor L5 is tapped to provide impedance matching between the buffer amplifier and the first doubler.

The buffer amplifier also has provisions for accepting an input from an external oscillator. An external oscillator can be used by first disabling the internal crystal oscillator. This is accomplished by removing the crystal oven from its socket. The external oscillator is then connected to the buffer amplifier input through the external oscillator connector J12. In either case, the buffer amplifier functions as described.

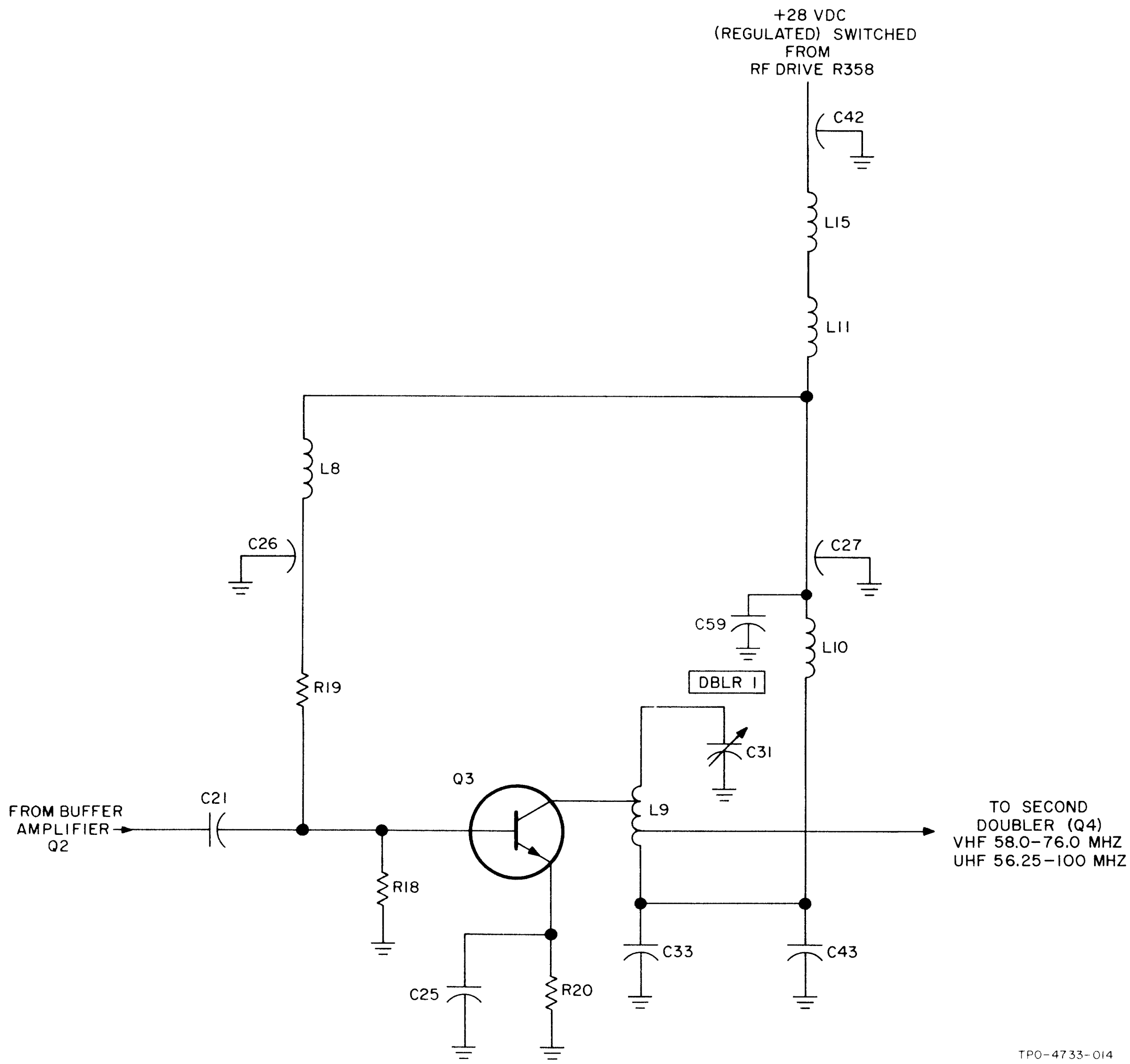

Figure 4-4. First Doubler, Simplified Schematic Diagram.

4.3.1.3 First Doubler (Refer to figure 4-4.)

First doubler Q3 is a common-emitter amplifier which drives an output tank circuit tuned to twice the crystal frequency. The first doubler is common to both configurations of the 242F-9C. When the 242F-9C is used in the vhf configuration, the first doubler provides an output frequency of 58.0 to 76.0 MHz. In the uhf configuration, the output frequency is from 56.25 to 100.0 MHz.

The RF DRIVE control R358 also determines the gain of the first doubler. The output signal from Q3 is developed across the collector tank circuit consisting of L9 and C31. The value of C31 (DBLR 1) is adjusted so that the output frequency of the tank circuit is twice the crystal oscillator rf output frequency. The DBLR 1 position of the MULTIMETER is used when adjusting C31. Interstage impedance matching between the output of the first doubler and the second doubler input is provided by the tap on L9.

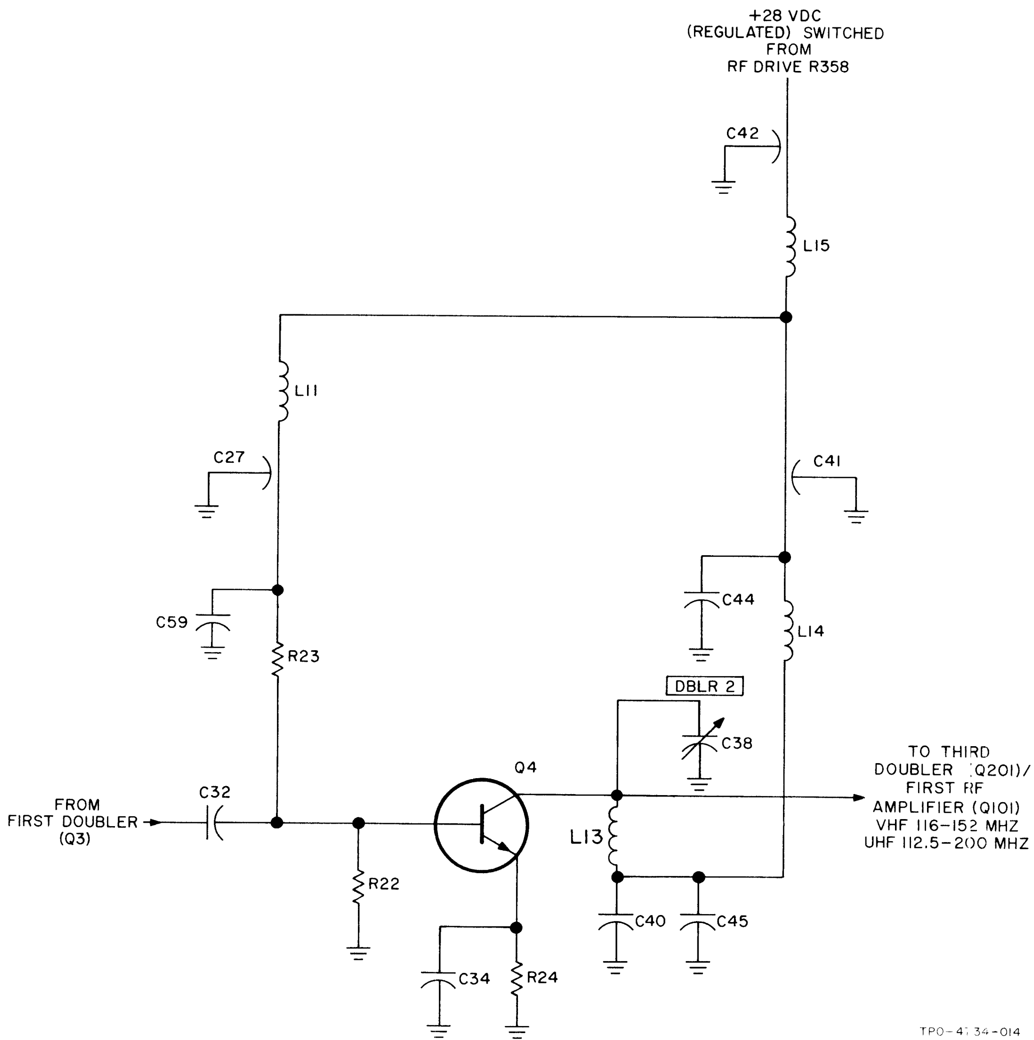

Figure 4-5. Second Doubler, Simplified Schematic Diagram.

4.3.1.4 Second Doubler (Refer to figure 4-5.)

Second doubler Q4 amplifies the output of the first doubler and applies this output to a tank circuit which is tuned to four times the crystal oscillator rf output frequency. The second doubler is also common to both configurations of the 242F-9C. With the 242F-9C in the vhf configuration, the second doubler provides an output frequency of 116.0 to 152.0 MHz. In the uhf configuration, the output frequency is from 112.5 to 200 MHz.

The second doubler stage consists of common-emitter amplifier Q4. The gain of Q4 is determined by the setting of the RF DRIVE control R358. The output signal from Q4 is developed across the collector rank circuit consisting of L13 and C38. The value of C38 (DBLR 2) is adjusted so that the output frequency of the tank circuit is four times the crystal oscillator rf output frequency. The DBLR 2 position of the MULTIMETER is used when adjusting C38. Interstage impedance matching between the output of the second doubler and the vhf or uhf exciter module input is provided by the tap on L13.

4.3.2 Exciter Module

Two exciter modules are available with the 242F-9C. The circuitry in these two modules is the main difference between the vhf and uhf configurations of the 242F-9C. In the vhf configuration, the exciter module with Collins part number 528-0604-004 is used. The uhf configuration of the 242F-9C uses the exciter module with Collins part number 528-0603-004. Both exciter modules have identical connectors on a pendant cable which mate with chassis connector J403 (located inside of the front door and centered on the chassis).

The vhf exciter module contains four rf amplifier stages. The rf amplifiers increase the signal level from the second doubler to the value necessary for controlling the driver stage. Low- and high-level modulation signals and agc (automatic gain control) voltage are applied to the vhf exciter module. Detailed theory for the vhf exciter module is discussed in paragraph 4.3.2.1.

The uhf exciter module contains a combination rf amplifier/third doubler stage and three rf amplifier stages. The uhf exciter module also contains a 2-stage modulation amplifier. Modulation signals and agc voltage are applied to the uhf exciter module. Detailed theory for the uhf exciter module is discussed in paragraph 4.3.2.2.

4.3.2.1 VHF Exciter Module

4.3.2.1.1 First RF Amplifier (Refer to figure 4-6.)

The rf signal in the vhf range of 116.0 to 152.0 MHz is applied from the second doubler to the first rf amplifier, Q101. The first rf amplifier is connected in the common-emitter configuration for the highest power gain. Base bias for Q101 is applied from the +28-volt dc regulated power supply. Resistor R101 provides a shunt feed for the base bias voltage. This voltage is such that Q101 will operate in

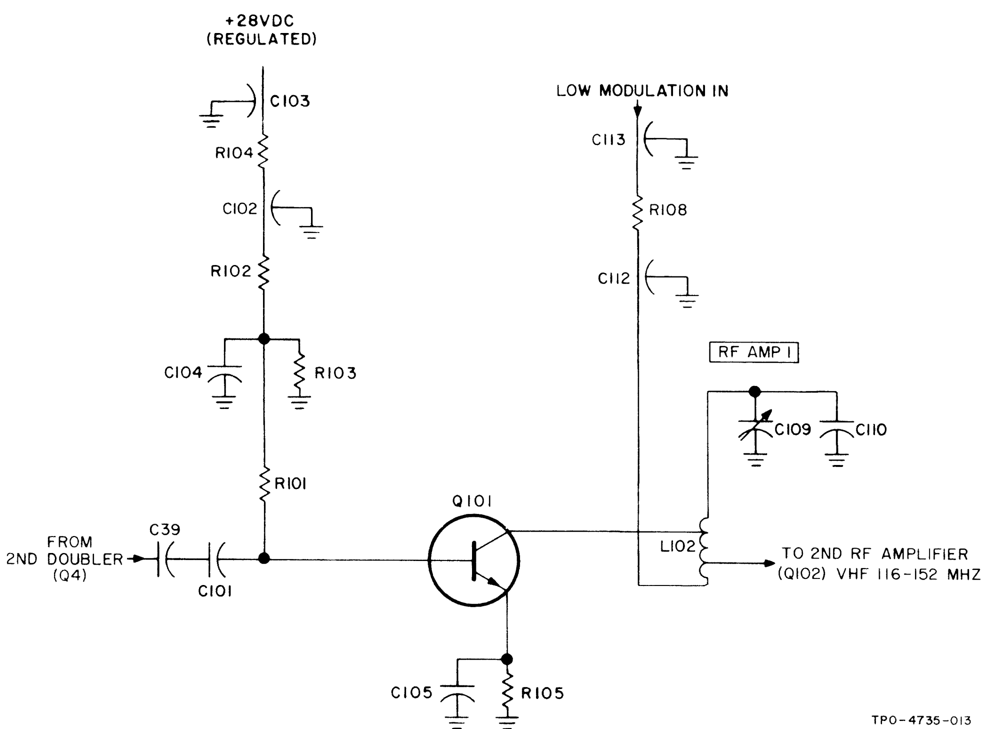

Figure 4-6. VHF First RF Amplifier, Simplified Schematic Diagram.

the linear portion of its characteristic curve. The result is that Q101 will provide high gain over the frequency range of 116.0 to 152.0 MHz.

The output signal from Q101 is developed across the collector tank circuit. Capacitors C109 and C110 provide a capacitance range which ensures that the tank circuit can be tuned over the vhf range of 116.0 to 152.0 MHz. Capacitor C109 (RF AMP 1) is adjusted to the vhf carrier frequency by selecting the RF AMP 1 position on the MULTIMETER and observing the meter for a maximum indication.

To ensure that the 242F-9C provides a 90-percent modulation capability, two separate modulation signals are applied to the vhf exciter module. One of these modulation signals provides collector modulation for the first rf amplifier. (Modulator theory is discussed in paragraph 4.3.8.)

Interstage impedance matching between the output of the first rf amplifier and the second rf amplifier input is provided by the tap on L102.

4.3.2.1.2 ***Second RF Amplifier*** (Refer to figure 4-7.)

The second rf amplifier, Q102, is connected in the common-emitter configuration for a higher power gain. Base bias for Q102 is obtained from the regulated +28-volt dc power supply. Thermistor RT101 provides stabilization of the base-emitter voltage over the operating temperature range. Controlled regulation of the base bias voltage on Q102 is required due to the presence of modulation signals. This ensures that Q102 will operate in the linear portion of its characteristic curve throughout this temperature range.

The output signal from Q102 is developed across the collector tank circuit. Capacitors C122 and C123 provide a capacitance range which ensures that the tank circuit of Q102 can be tuned over the vhf range of 116.0 to 152.0 MHz. Capacitor C123 (RF AMP 2) is adjusted to the vhf carrier frequency by selecting the RF AMP 2 position on the MULTIMETER, and observing the meter for a maximum indication.

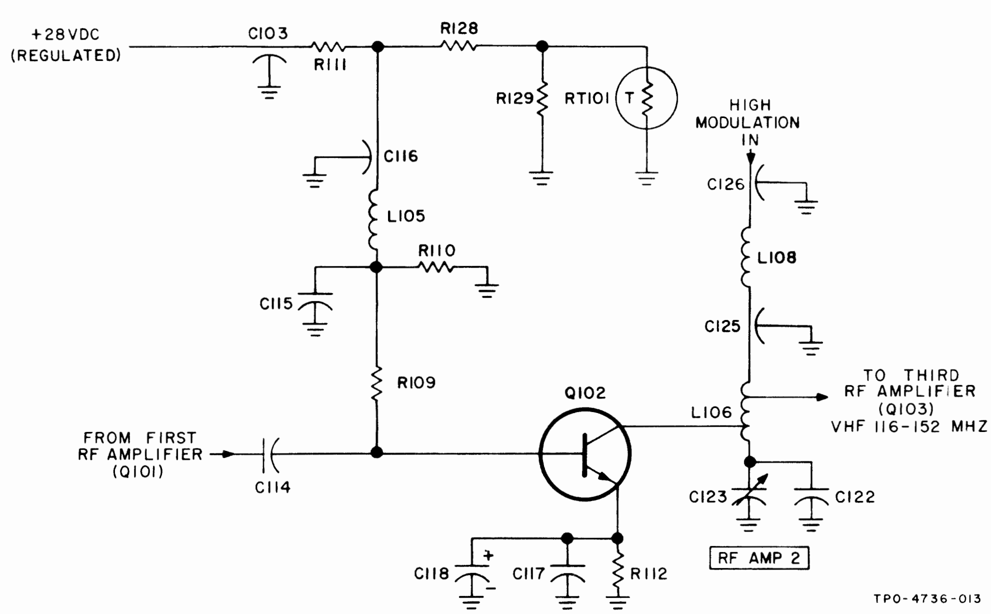

Figure 4-7. VHF Second RF Amplifier, Simplified Schematic Diagram.

The second of two modulation signals provides collector modulation for the second rf amplifier. Interstage impedance matching between the output of the second rf amplifier and the third rf amplifier input is provided by the tap on L106.

4.3.2.1.3 ***Third RF Amplifier*** (Refer to figure 4-8.)

The modulated rf output from the second rf amplifier is applied through C128 and C129 to the third rf amplifier, Q103. Capacitor C128 has a dual purpose. First, C128 provides interstage coupling and dc isolation between the second and third rf amplifiers. Second, C128 combines with C129 and voltage-variable capacitor CR103 to form a variable T-attenuation network. The third rf amplifier is connected in the common-emitter configuration for a high-power gain. The third rf amplifier stage is the only rf stage in the vhf exciter module that is controlled by agc voltage. All dc biasing voltage for Q103 and the dc control voltage for the variable T-attenuation network are supplied by the agc circuit (paragraph 4.3.7.1).

The amount of dc agc voltage applied to the third rf amplifier is inversely proportional to the rf power output of the 242F-9C. This dc agc voltage is applied to the third rf amplifier

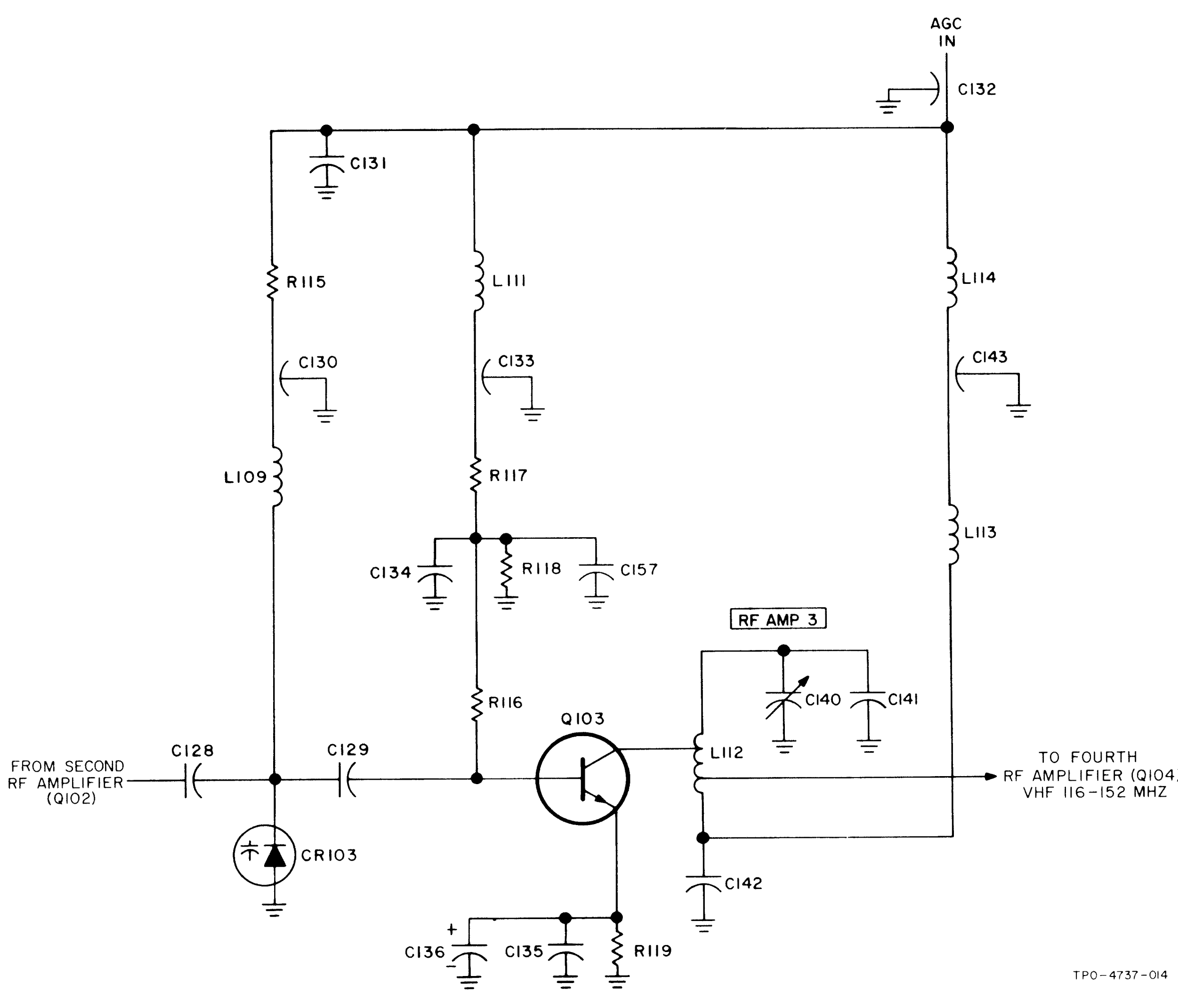

Figure 4-8. VHF Third RF Amplifier, Simplified Schematic Diagram.

in two places. Consider the variable T-attenuation network. The agc voltage provides the reverse bias dc control for CR103. The capacitance of voltage-variable capacitor CR103 varies inversely with the agc voltage. The variable T-attenuation network is designed to regulate the modulated rf signal being applied to Q103. The amount of regulation is controlled by the agc voltage which is proportional to the 242F-9C rf power output.

The variable T-attenuation network presents an impedance to the rf signal from the second rf amplifier. This impedance will remain fixed unless the 242F-9C rf power output tends to change. The dc agc voltage also controls the biasing of the third rf amplifier, Q103. As shown in figure 4-8, the base and collector voltage applied to Q103 is the same voltage used to control the variable T-attenuation network. As this voltage increases, the overall gain of Q103 increases, and as the voltage decreases, the gain of Q103 will decrease.

The output signal from Q103 is developed across the collector tank circuit. Capacitors C140 and C141 provide a capacitance range which ensures that the tank circuit of Q103 can be tuned over the vhf range of 116.0 to 152.0 MHz. Capacitor C140 (RF AMP 3) is adjusted to the vhf carrier frequency by selecting the RF AMP 3 position on the MULTI-METER and observing the meter for a maximum indication.

Interstage impedance matching between the output of the third rf amplifier and the fourth rf amplifier input is provided by the tap on L112.

4.3.2.1.4 **Fourth RF Amplifier** (Refer to figure 4-9.)

The fourth rf amplifier is connected in the common-emitter configuration for a high-power gain. The dc biasing voltages for Q104 are obtained from the +28-volt dc regulated power supply.

The output signal from Q104 is developed across the tuned collector tank circuit. Capacitors C152 and C153 provide a capacitance range which ensures that the tank circuit of Q104 can be tuned over the vhf range

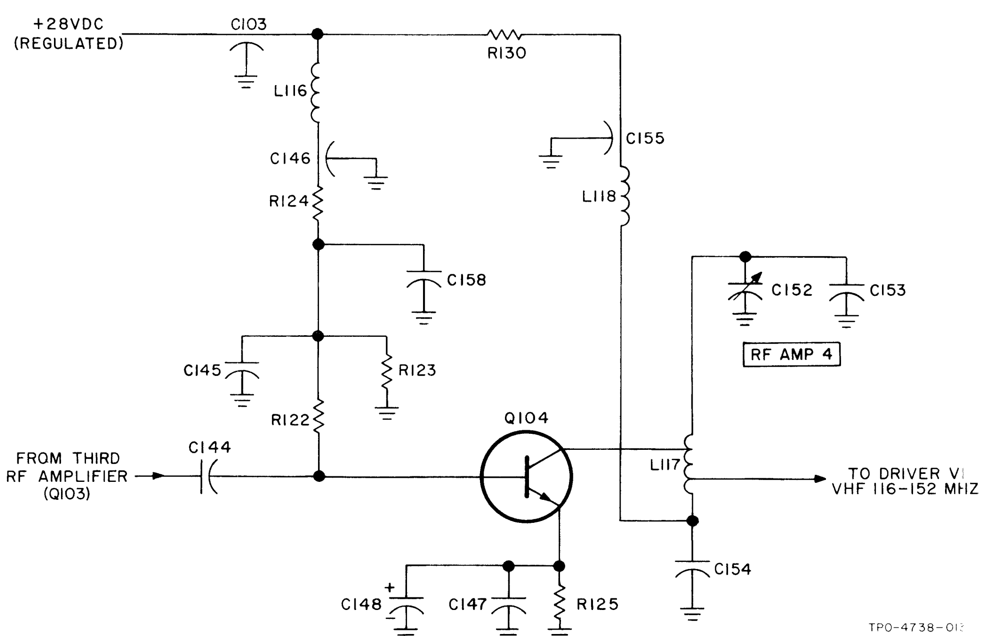

Figure 4-9. VHF Fourth RF Amplifier, Simplified Schematic Diagram.

of 116 to 152 MHz. Capacitor C152 (RF AMP 4) is adjusted to the vhf carrier frequency by selecting the RF AMP 4 position on the MULTIMETER and observing the meter for a maximum indication.

Interstage impedance matching between the output of the fourth rf amplifier and the driver stage (paragraph 4.3.3) input is provided by the tap on L117.

4.3.2.2 UHF Exciter Module

The uhf exciter module is used when the 242F-9C is operated in the uhf configuration.

4.3.2.2.1 First RF Amplifier/Third Doubler (Refer to figure 4-10.)

First rf amplifier/third doubler Q201 amplifies the 112.5- to 200-MHz output of the second doubler and applies this output to a tank circuit that is tuned to eight times the crystal oscillator rf output frequency. The first rf amplifier/third doubler provides an output in the uhf range of 225 to 400 MHz. The first rf amplifier/third doubler is the first of three stages in the uhf exciter module that have their overall gain controlled by agc voltage.

The first rf amplifier/third doubler, Q201, is connected in the common-emitter configuration for a high-power gain factor. The overall stage gain is controlled by dc agc voltage (paragraph 4.3.7.1). The amount of agc voltage is inversely proportional to the 242F-9C rf power output. As the agc voltage decreases (due to an increase in 242F-9C rf power output), the collector-emitter junction voltage of Q201 also decreases. This reduces the gain of Q201. If the agc voltage increases (due to

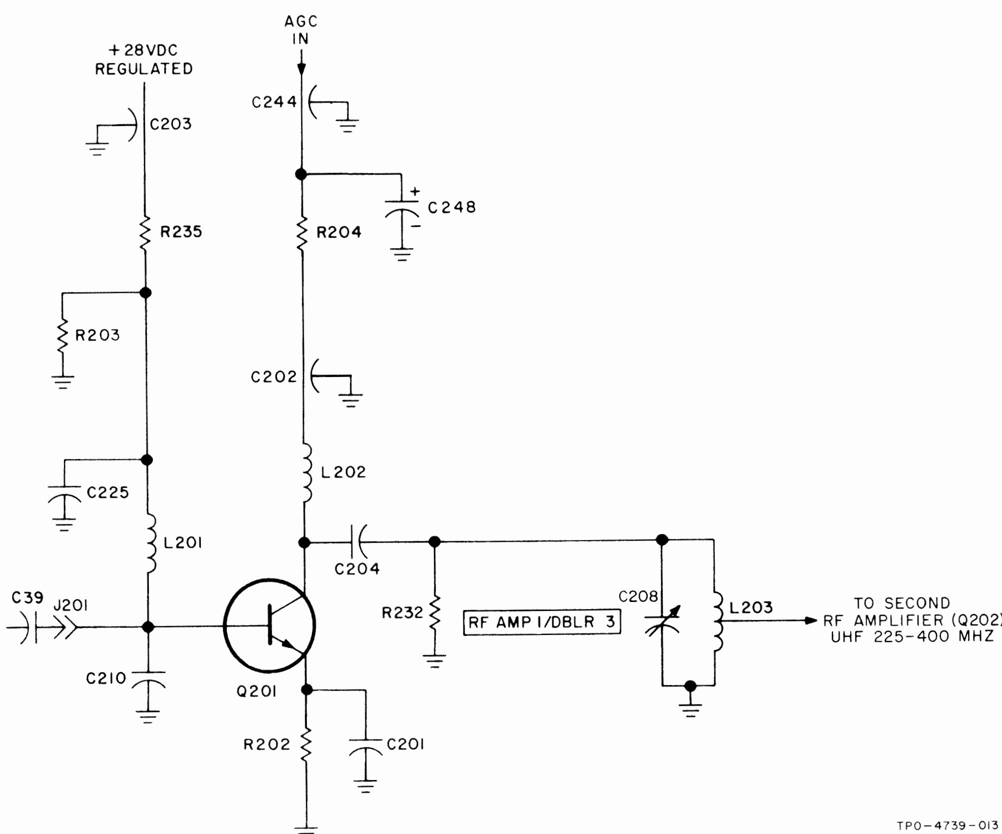

Figure 4-10. UHF First RF Amplifier/Third Doubler, Simplified Schematic Diagram.

a decrease in 242F-9C rf power output), the collector-emitter junction voltage of Q201 increases. This results in an increase of gain through Q201. The agc action ensures that the rf power output of the 242F-9C remains constant.

The output signal from Q201 is developed across the collector tank circuit.

The output of Q201 is also sampled by the multimeter circuit. Capacitor C208 (RF AMP 1/DBLR 3) is adjusted so that the tank circuit is tuned to eight times the crystal oscillator frequency. This is accomplished by selecting the RF AMP 1/DBLR 3 position on the MULTIMETER SWITCH and observing the meter for a maximum indication.

Interstage impedance matching between the output of the first rf amplifier/third doubler and the second rf amplifier input is provided by the tap on L203.

4.3.2.2.2 ***Second RF Amplifier*** (Refer to figure 4-11.)

Capacitor C209 provides interstage coupling and dc isolation between the first rf amplifier/third doubler and the second rf amplifier, Q202. All dc biasing voltage for Q202 is supplied by the 2-stage modulation amplifier in the uhf exciter module. This 2-stage amplifier is discussed in paragraph 4.3.2.2.5. The second rf amplifier is also amplitude modulated by the 2-stage amplifier. The output of this 2-stage amplifier is a dc voltage with the audio signal from the modulator (paragraph 4.3.8) superimposed on the dc voltage.

During periods of no modulation, the base bias level of Q202 is established by the dc output of the 2-stage modulation amplifier. Thermistor RT201 provides base bias stabilization over the operating temperature range of the 242F-9C. Both the base and collector are modulated in the second rf amplifier. This is

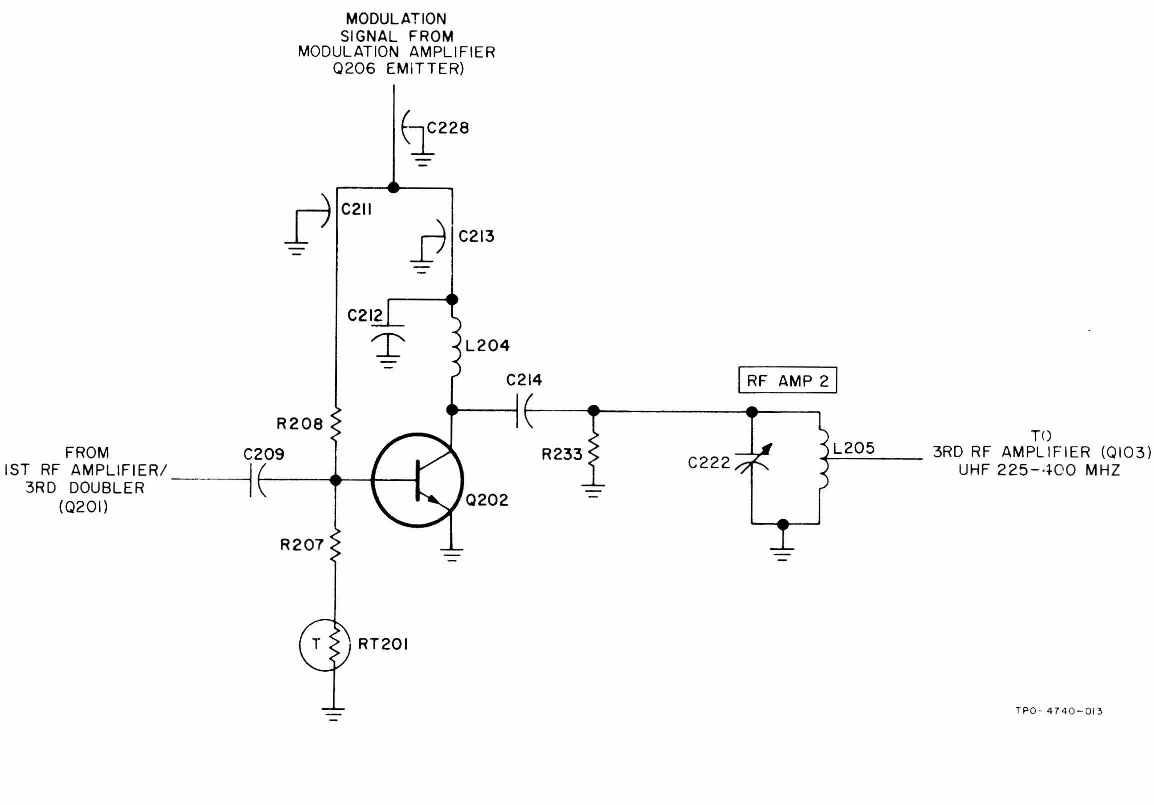

Figure 4-11. UHF Second RF Amplifier, Simplified Schematic Diagram.

done to ensure that a 100-percent modulation capability is obtainable. The modulation signal applied to the base of Q202 provides greater driving power while the modulation signal at the collector provides a higher output voltage. Simultaneously increasing both the base and collector voltages (due to the modulation signal) ensures that Q202 will operate in the linear portion of its characteristic curve. In this way, a high gain factor and a low percentage of modulation distortion are provided.

The output signal from Q202 is developed across the collector tank circuit. The output of Q202 is also sampled by the multimeter circuit. The value of C222 (RF AMP 2) is adjusted so that the tank circuit is tuned to the uhf carrier frequency by selecting the RF AMP 2 position on the MULTIMETER SWITCH and observing the meter for a maximum indication.

Interstage impedance matching between the output of the second rf amplifier and the third rf amplifier input is provided by the tap on L205.

4.3.2.2.3 ***Third RF Amplifier*** (Refer to figure 4-12.)

The modulated rf output from the second rf amplifier is applied through C224 to the third rf amplifier, Q203. The third rf amplifier is connected in the common-emitter configuration for a high-power gain. The third rf amplifier is the second stage in the uhf exciter module to have agc voltage applied. The dc agc voltage is used to control the rf gain. The third rf amplifier stage is also modulated by the 2-stage modulation amplifier. All dc biasing, bias stabilization, and amplitude modulating of Q203 are identical to that discussed for the second rf amplifier, Q202 (paragraph 4.3.2.2.2).

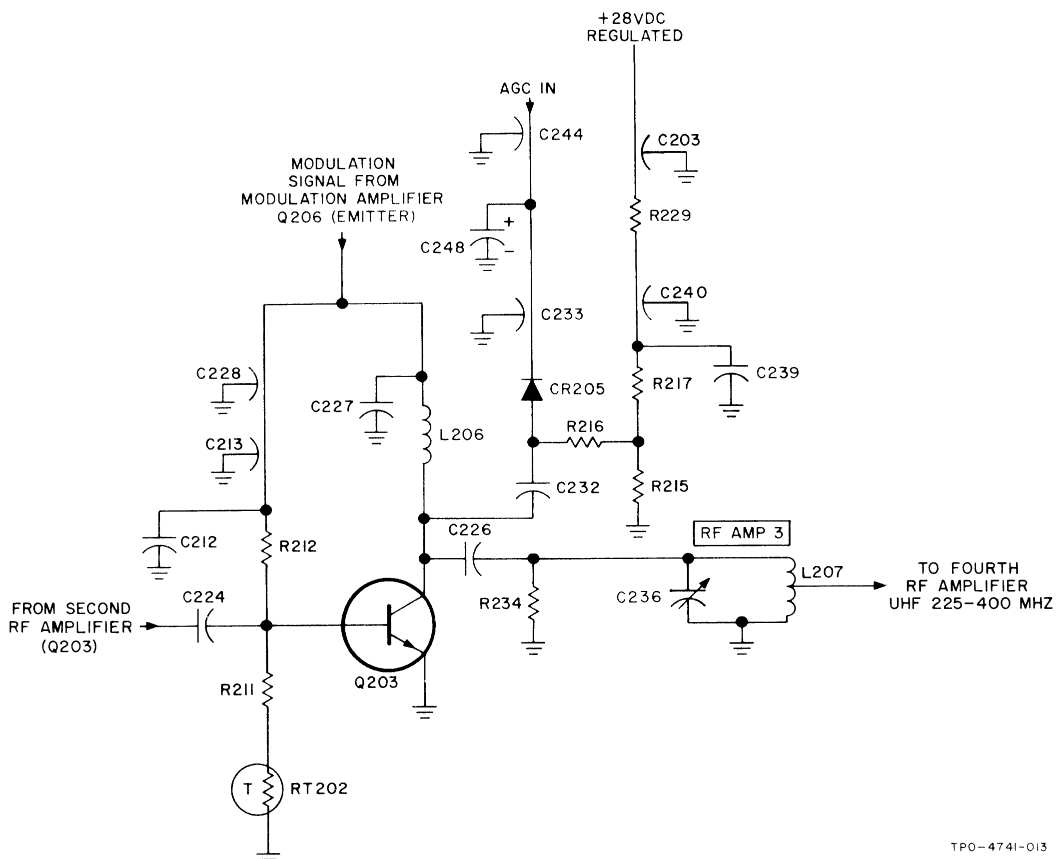

Figure 4-12. UHF Third RF Amplifier, Simplified Schematic Diagram.

As shown in figure 4-12, agc voltage is applied to an rf attenuator circuit. This circuit provides rf gain control by loading the collector of Q203 as a function of the 242F-9C rf power output. The dc agc voltage is applied to the cathode of CR205. This dc agc voltage varies inversely as the 242F-9C rf power output changes. The anode of CR205 has a fixed amount of positive dc voltage applied through voltage dividers R215, R216, and R217. The agc voltage on the cathode of CR205 controls the biasing and, therefore, the dynamic resistance of CR205.

The biasing of CR205 by the agc voltage is continuous and provides the control required to ensure that the 242F-9C rf power output remains constant. The output signal from Q203 is developed across the collector tank circuit. Capacitor C226 provides dc isolation and rf coupling between the collector of Q203 and the tank circuit. The output of Q203 is also sampled by the multimeter circuit. The value of C236 (RF AMP 3) is adjusted to the uhf carrier frequency by selecting the RF AMP 3 position on the MULTIMETER SWITCH and observing the meter for a maximum indication.

Interstage impedance matching between the output of the third rf amplifier and the fourth rf amplifier input is provided by the tap on L207.

4.3.2.2.4 Fourth RF Amplifier (Refer to figure 4-13.)

The modulated rf output from the third rf amplifier is applied through C237 to the fourth rf amplifier, Q204. The fourth rf amplifier is connected in the common-emitter configuration for a high-power gain. The fourth rf amplifier is the third and last stage in the uhf exciter module to have agc voltage applied. The rf attenuator circuit for the fourth rf amplifier functions the same as the rf attenuator circuit for the third rf amplifier. (Refer to paragraph 4.3.2.2.3 for the circuit discussion.)

The fourth rf amplifier is base modulated by the 2-stage modulation amplifier. Modulating the base-emitter circuit of the last rf stage in the uhf exciter module is done to ensure that the modulation envelope will provide the 242F-9C with a 100-percent modulation capability. Thermistor RT203 provides temperature stabilization for the fourth rf amplifier, Q204.

The output signal from Q204 is developed across the collector tank circuit. The output of Q204 is also sampled by the multimeter circuit. The value of C247 (RF AMP 4) is adjusted to the uhf carrier frequency by selecting the RF AMP 4 position on the MULTIMETER SWITCH and observing the meter for a maximum indication.

Interstage impedance matching between the output of the fourth rf amplifier and the driver stage (paragraph 4.3.3) input is provided by the tap on L209.

4.3.2.2.5 Modulation Amplifier (Refer to figure 4-14.)

The audio power required to modulate the rf stages in the uhf exciter module is greater than the audio power needed for the rf stages in the vhf exciter module. For this reason, a 2-stage modulation amplifier, Q205 and Q206, is included in the uhf exciter module. The low-level modulation signal from modulator Q305 is applied to 2-stage amplifier Q205 and Q206. The amplified output, taken from Q206, is then applied to the second, third, and fourth rf amplifiers in the uhf exciter module.

Transistor Q205 is connected in the common-base configuration to provide impedance matching and voltage gain for the low-level modulation signal. Base biasing for Q205 is provided by regulated +28 volts dc. The +28 volts dc is applied to base bias voltage divider R226 and R227. The output of this voltage divider is such that under quiescent conditions, Q205 is being operated in the linear

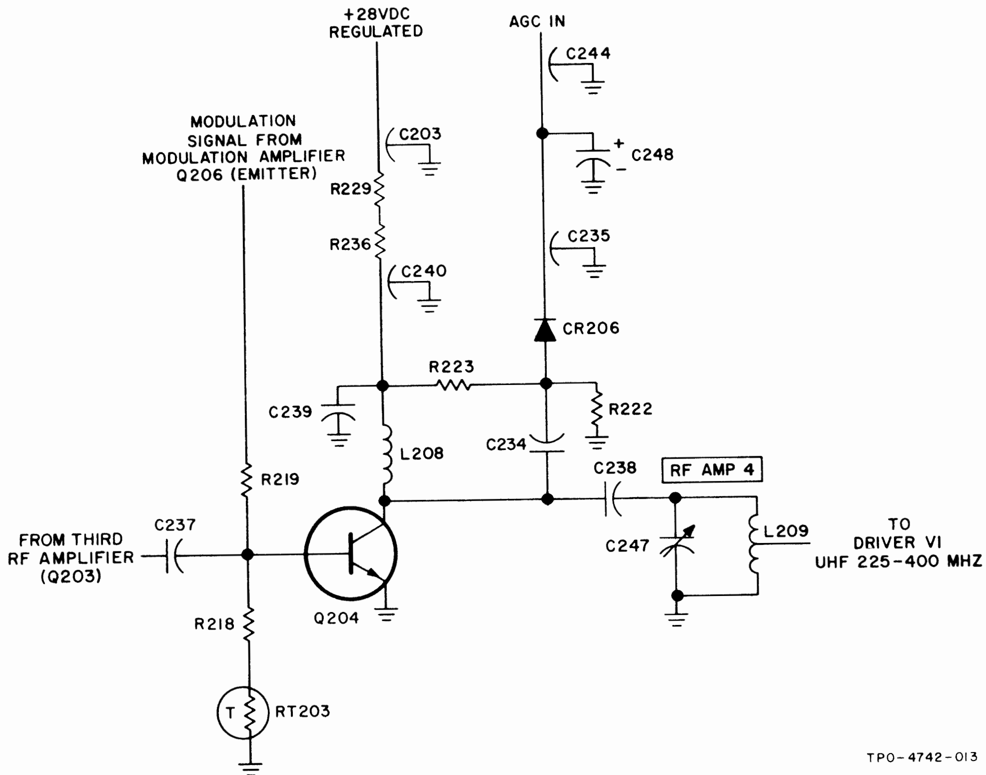

Figure 4-13. UHF Fourth RF Amplifier, Simplified Schematic Diagram.

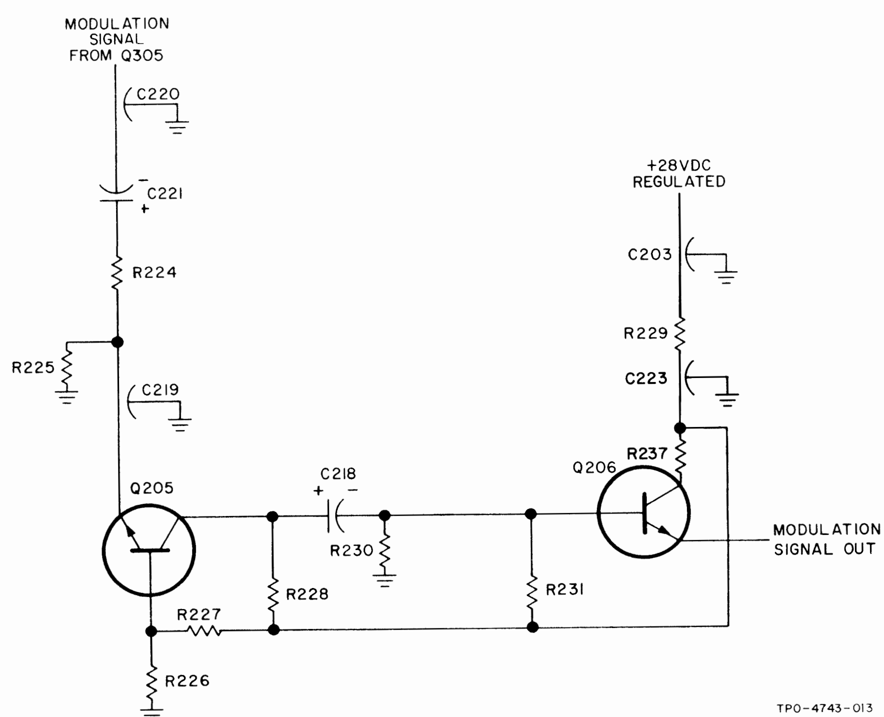

Figure 4-14. UHF Modulation Amplifier, Simplified Schematic Diagram.

portion of its characteristic curve. Transistor Q206 provides the output of the 2-stage modulation amplifier. This stage is connected in the common-collector configuration. This configuration provides a high current gain while only having a voltage gain of 1. However, the voltage gain has already been provided by Q205. The additional modulating signal power gain required by the uhf exciter module rf stages is then the product of the voltage gain from Q205 and the current gain from Q206. This power output is taken from the emitter of Q206 and distributed to the second, third, and fourth rf amplifier stages. Under quiescence, the output taken from the emitter of Q206 is approximately +6.5 volts dc. When the modulating signal is applied to Q205, the output from Q206 consists of a dc level with the audio signal superimposed on it.

4.3.3 ***Driver Stage*** (Refer to figure 4-15.)

The modulated rf signal from the fourth rf amplifier in either the vhf or the uhf exciter module is applied to the cathode of driver V1. The driver is connected in the grounded grid configuration and operates as a class A linear amplifier. The control grid bias for V1 ranges in value from -7 to -24 volts dc, and is taken from the arm of the DRIVER BIAS potentiometer, R149 (refer to the low-voltage power supply, paragraph 4.3.10). The control grid bias is extensively rf filtered. Resistor R38 provides hum cancellation and is placed between the 6.3-volt ac filament voltage and the control grid bias voltage of V1. A small value of the 60-Hz filament voltage is placed on the control grid dc bias voltage which provides cancellation of any hum voltage that may appear on the cathode. The high-voltage power supply (paragraph 4.3.10) provides the operating voltages for the screen grid and plate of V1. Extensive rf filtering is provided for both the screen grid and plate voltages. The regulated +300-volt dc screen voltage is applied to the screen grid only when the 242F-9C is keyed. The output signal from the plate of V1 is developed across the plate tank circuit. The tank circuit appears as a tapped L-configuration when the 242F-9C is operated as a vhf transmitter and as a pi-network configuration when the 242F-9C is operated as a uhf transmitter. When the 242F-9C is operated in the vhf mode, capacitor C49 is a trimmer that is adjusted to provide a peak output indication with L27 in the optimum inductance position for the frequency being used. The tapped tank circuit consists of L27 and L38. Inductor L27 (DRIVER) is adjusted for circuit resonance at the frequency of operation. Resonance is indicated by a maximum power output indication on an external wattmeter. In the uhf mode of operation, the output capacitance of driver V1, along with L27 and capacitors C88 through C91, forms the interstage pi-network tank. Inductor L27 (DRIVER) is adjusted until the pi-network tank resonates at the carrier frequency. Resonance is indicated by the same means used in the vhf mode. Interstage coupling and dc isolation between driver V1 and power amplifier V2 are provided by C58.

4.3.4 ***Power Amplifier*** (Refer to figure 4-16.)

The rf signal from the driver plate circuit is applied to the control grid of power amplifier V2. The power amplifier is connected in the grounded cathode configuration and operates as a class AB_1 linear amplifier. A high voltage gain and a high power gain are achieved with this configuration. The control grid bias applied to the grid of V2 is variable and is supplied from the low-voltage power supply. Extensive rf filtering is provided for the 5.87-volt ac filament voltage. The +300-volt dc screen voltage is applied from the high-voltage power supply and is rf filtered by the same components used for the driver tube screen voltage. The output signal from the plate of V2 is developed across the power amplifier cavity. Capacitor C63 is adjusted to ensure that the power amplifier cavity will tune over the low end of the vhf range.

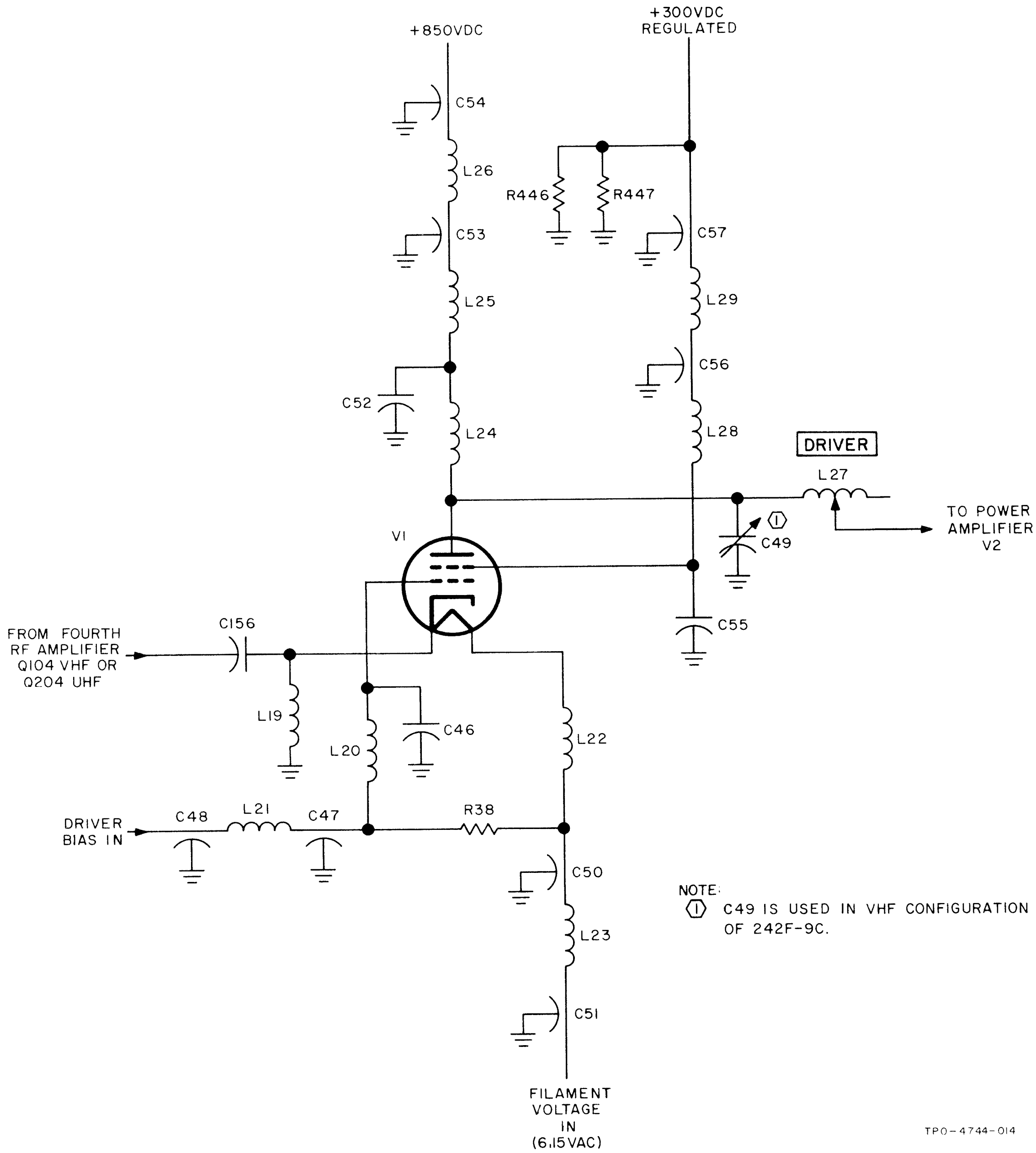

Figure 4-15. Driver Stage, Simplified Schematic Diagram.

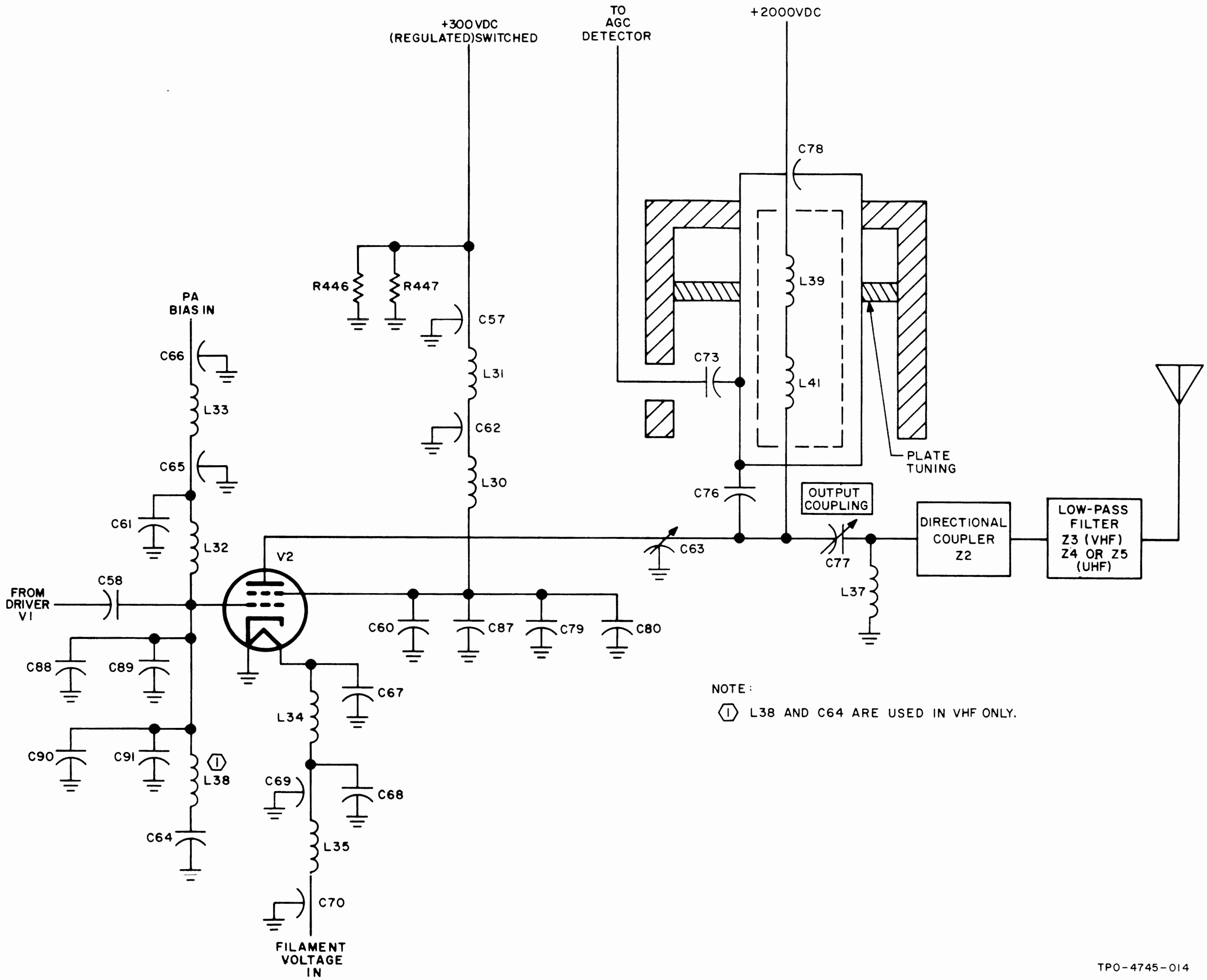

Figure 4-16. Power Amplifier and Cavity, Simplified Schematic Diagram.

4.3.5 Power Amplifier Cavity (Refer to figure 4-16.)

The power amplifier cavity consists of an adjustable foreshortened coaxial quarter-wavelength line. The center conductor of the coaxial line is the adjustable portion. A VHF/UHF band switch positions the center conductor to correspond with the desired mode of frequency operation. With the band switch positioned to VHF, the center conductor of the coaxial line is moved away from the plate end of the line, exposing a small portion of the inner conductor. In this position, the coaxial line consists of a fixed length inner line and a variable length outer line. The PA TUNE control is used to vary the length of the outer line. With the band switch positioned to UHF, the center conductor of the coaxial line makes contact with plate blocking capacitor C76 at the plate end of the cavity. In this position, the coaxial line consists of only the variable length outer line. Tuning the cavity to the resonant vhf or uhf operating frequency is accomplished by adjusting the PA TUNE control.

The power amplifier cavity and its associated components also provide a high to low impedance match between the power amplifier output and the load. OUTPUT COUPLING control C77 provides output to load coupling. The output is applied through power indicator coupler Z2, a low-pass filter network, and then to the antenna.

4.3.6 Output Circuitry (Refer to figure 7-1.)

Power indicator coupler Z2 is a 3-element directional coupler inserted between the power amplifier cavity output and the low-pass filter input. Power indicator coupler Z2 provides three sensor functions over the operating frequency range of the 242F-9C. These functions are forward rf power sensor, reflected rf power sensor, and modulation sensor. Outputs 1 and 3 of Z2 (refer to figure 7-1) are applied directly to the multimeter circuit. Output 1 provides the multimeter circuit input for the RF POWER position of the MULTIMETER SWITCH, and output 3 provides the input for the VSWR position. Output 2 provides a demodulated audio signal output which is applied to a test point on the modulation panel. The demodulated audio signal is also applied to a modulation percentage calibration circuit only when the MULTIMETER SWITCH is in the % MOD position. The modulation percentage calibration circuit, in turn, provides a dc output to the multimeter circuit. This output is proportional to the amount of audio on the rf carrier at the power amplifier cavity output. In the % MOD position, the meter then indicates the percentage of modulation at the output of the 242F-9C.

Harmonic suppression is provided by the low-pass filter connected between power indicator coupler Z2 and the antenna relay. Three filters are available, each of which is designed for a specific frequency range. Low-pass filter Z3 is used when the 242F-9C is operated in the vhf configuration (116 to 152 MHz). In the uhf configuration, two low-pass filters are available. Low-pass filter Z4 covers the uhf range of 225 to 300 MHz, and Z5 covers the uhf range of 300 to 400 MHz. The desired output frequency of the 242F-9C determines which one of the three low-pass filters should be used.

4.3.7 Feedback Circuits

A sample of the modulated rf output signal is obtained at the power amplifier cavity and is capacitor coupled to the input of an envelope detector. The envelope detector provides two outputs: one to drive the agc circuit and one to provide audio feedback to the modulator. These circuits are discussed in the following paragraphs.

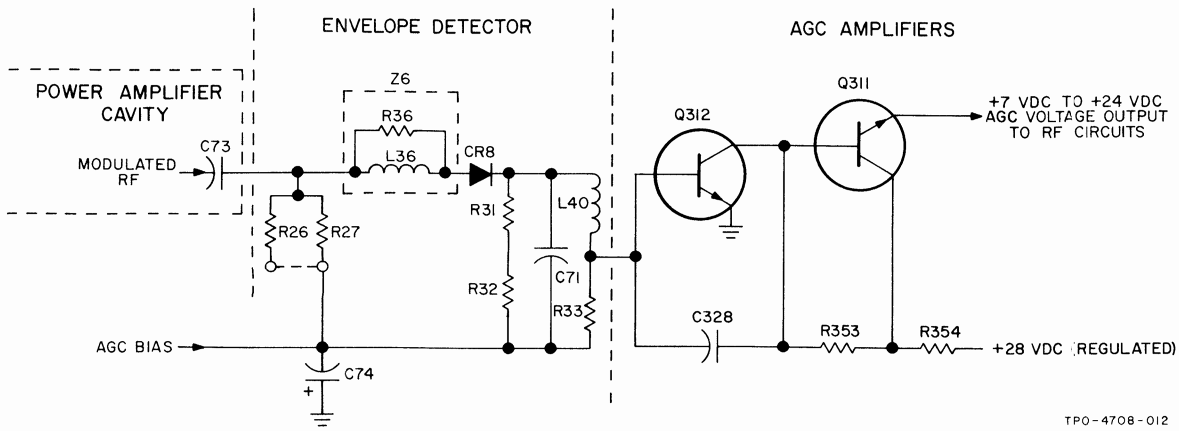

Figure 4-17 AGC Circuit, Simplified Schematic Diagram.

4.3.7.1 AGC Circuit (Refer to figure 4-17.)

The agc circuit ensures that a constant rf level is provided at the 242F-9C output. A sample of rf signal from the power amplifier cavity is applied to the anode of CR8 in the envelope detector. Resistor R27 (vhf) or resistors R26 and R27 (uhf) form a voltage divider for the rf signal. Positive agc bias voltage is applied to the cathode of CR8 from the arm of the AGC potentiometer, R415. If the rf signal is not being applied to the envelope detector, then the agc bias voltage will keep CR8 in the reverse biased condition. When an rf signal is applied to the envelope detector, its level must be large enough to overcome the reverse bias voltage at the cathode of CR8. The required level of the rf signal needed to overcome the reverse bias condition of CR8 is determined by the adjustment of the AGC potentiometer, R415. When CR8 conducts (reverse bias is overcome by the rf level), the resultant output will be rectified rf voltage. This voltage is filtered by C71 and L40. The resultant dc voltage is applied to agc detector amplifiers Q312 and Q311.

A 2-stage amplifier is formed by transistor Q312 being connected in the common-emitter configuration, and by Q311 being connected in the common-collector configuration. The output of Q312 is applied directly to the base of Q311. Biasing of Q312 and Q311 is provided by +28 volts dc (regulated) applied through R353 and R354 and the dc signal applied to the base of Q312. The output of the agc circuit is taken from the emitter of Q311 and ranges in value from +7 to +28 volts dc. The output of the agc circuit is inversely proportional to the rf output of the 242F-9C.

4.3.7.2 Envelope Feedback Amplifier (Refer to figure 4-18.)

The envelope feedback circuit ensures that the modulation distortion is held to a minimum. The modulated rf carrier is applied to the envelope detector as discussed in paragraph 4.3.7.1. The envelope detector output to the envelope feedback circuit is an ac voltage that consists of the detected audio from the modulated rf carrier. The output from CR8 is applied to a voltage divider consisting of R31 and R32. The input to envelope feedback amplifier Q310 is taken from the junction of the two resistors. At this junction point the signal consists of the positive half of the modulated rf carrier. The rf is removed by a filter consisting of C318 and R337. The resulting signal applied to the base of Q310 is the audio modulation signal.

Transistor Q310 is a conventional common-emitter amplifier. The input signal is applied

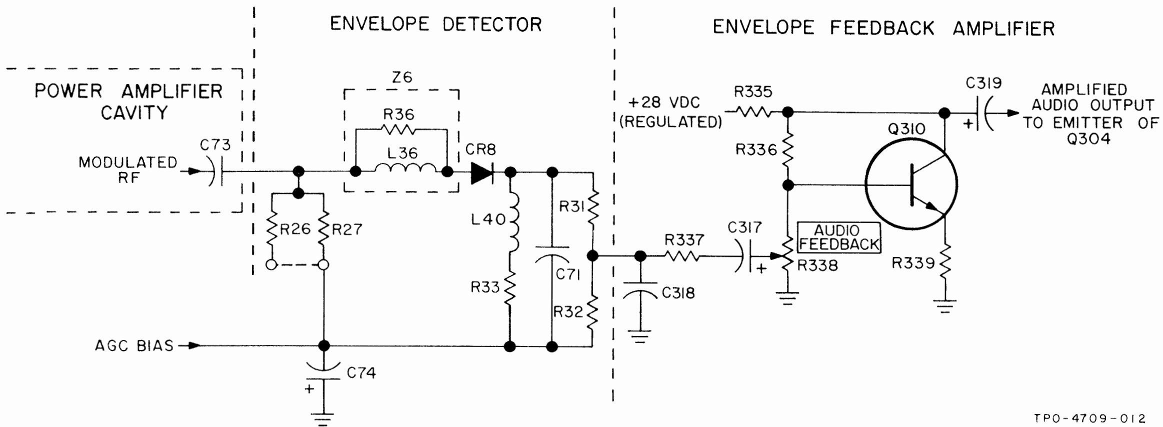

Figure 4-18. Envelope Feedback Amplifier, Simplified Schematic Diagram.

to the base of Q310 through AUDIO FEEDBACK potentiometer R338. Potentiometer R338 adjusts the amount of ac drive applied to Q310. The output of Q310 is applied to the emitter of modulation driver Q304 (figure 7-1). Transistor Q304 is also connected in the common-emitter configuration. The signal applied to the emitter of Q304 (from the collector of Q310) is in phase with the signal at the base of Q304. Because the signals at the base and emitter of Q304 are in phase, a reduction of forward bias occurs. The overall gain of Q304 is then decreased. This results in the modulation signal applied to the 242F-9C rf amplifier stages being correspondingly reduced, minimizing any distortion introduced in the rf stages.

4.3.8 Modulator (Refer to figure 7-1.)

Audio signals are applied to the modulator as discussed in the operation section of this manual, paragraphs 3.3.1 and 3.3.2. These audio signals are applied to the primary winding of input transformer T301. The primary winding consists of two windings and provides impedance matching between the external audio source and the secondary winding. When the primary windings are series connected (as shown in figure 7-1), the transformer input impedance is 600 ohms. When the windings are parallel connected, the input impedance is 150 ohms. Audio signals are developed across the secondary of T301 and applied to audio amplifier Q301. AUDIO GAIN control R303 provides adjustment of the audio level applied to the modulator.

The first two stages of the modulator consist of amplifiers Q301 and Q302. These amplifiers are connected in the common-emitter configuration. Audio amplifier Q301 has limiting applied to the base and collector circuits. The limiter is controlled by a 3-stage audio limiter amplifier (figure 7-1). A portion of the audio signal from the collector of audio amplifier Q302 is applied to the base of limiter amplifier Q309. The amplified output from Q309 is applied to the base of Q308 through AUDIO LIMITER control R344. AUDIO LIMITER control R344 adjusts the level of the audio signal applied to the limiter. The audio signal is further amplified by Q308, and applied to emitter follower Q307. Transistor Q307 provides impedance matching between audio limiter amplifier Q308 and the input of the limiter. The audio signal at the collector of Q302 is also applied to the remaining stages of the modulator. However, the limiter and its effect on audio amplifier Q301 will be discussed first.

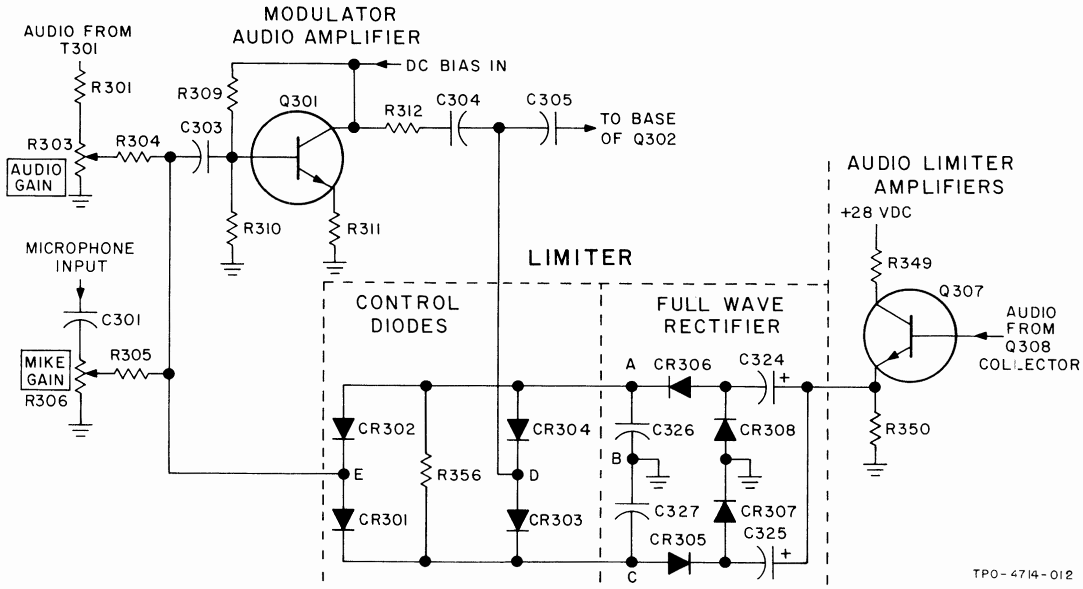

Figure 4-19. Audio Limiter, Simplified Schematic Diagram.

Refer to figure 4-19. A closed loop is formed from audio amplifiers Q301 and Q302, through audio limiter amplifiers Q309, Q308, and Q307, through the limiter, and back to Q301. Figure 4-19 shows audio amplifier Q301, emitter follower Q307 (in the audio limiter amplifier), and the limiter. The signal from Q307 is used to control the limiter. This signal is applied to a full wave rectifier and voltage doubler consisting of CR305, CR306, CR307, CR308, C326, and C327. Rectification of the positive half of the audio signal is provided by CR306 and CR308, and the resulting pulsating dc voltage at the cathode of CR306 is filtered by C326. The negative half of the audio signal is rectified and filtered in the same manner by CR305, CR307, and C327. This dc voltage is used to bias the control diodes of the limiter. Figure 4-19 shows two pair of series-connected control diodes, CR301, CR302, CR303, and CR304. Due to the polarity of the dc voltage across points A and C, diodes CR301, CR302, CR303, and CR304 are forward biased. The amount of forward bias applied to these diodes is proportional to the audio signal at the emitter of Q307. The dc bias voltage changes in value according to the audio signal level. The amount of dc forward bias determines the impedance of the diodes. This impedance is used to provide the limiting action. When the forward bias is high (due to a large audio signal level), the impedance of the diodes is low. Conversely, a low value of forward bias (due to a small audio signal level) increases the impedance of the diodes. Diodes CR303 and CR304, in conjunction with R312, form a voltage divider for the audio signal at the collector of Q301. Limiting occurs when the audio signal increases past a predetermined value (set by AUDIO GAIN and AUDIO LIMITER controls). Assume that the audio signal has increased beyond this point. The dc voltage across points A and C would be large, hence the forward bias applied to CR303 and CR304 would be large. The impedance of CR303 and CR304 would be low, so the audio at point D would be attenuated. This results in less audio being applied to the second audio amplifier, Q302. The output of transistor Q302 would then start to decrease. This decrease would also be applied through audio limiter amplifiers Q309, Q308, and Q307, and to the limiter. The dc forward bias applied to CR303 and CR304 would decrease, and the audio at point D would see an increasing impedance to ac ground. This process would continue until such time as the audio signal level at the collector of Q301 reaches the point below the threshold of the limiter. Point E and diodes CR301 and CR302 provide the same function for the base of Q301 as diodes CR303 and CR304 do for the collector circuit. In the base circuit, resistor R304 and the impedance of diodes CR301 and CR302 form the voltage divider. By limiting both the input and output of the first audio amplifier Q301, overmodulation and audio distortion is held to a minimum.

Refer to figure 7-1 for the remaining paragraphs. The limited audio signal is taken from the collector of Q302 and applied to a low-pass filter network. The low-pass filter greatly attenuates audio frequencies above 3000 Hz. The 242F-9C is supplied with the low-pass filter connected in the modulator circuit. However, wide-band modulation capabilities in the frequency range of 100 to 20,000 Hz are provided by disconnecting the low-pass filter and using the filter bypass jumper. The dotted lines of figure 7-1 show the wide-band connection. The audio signal is then applied through emitter follower Q303. Transistor Q303 provides impedance matching of the amplified audio signal to the modulator driver, Q304. Modulator driver Q304 is connected in the common-emitter configuration. The output from Q304 is taken at the collector and is applied as two separate modulation levels to modulators Q305 and Q306. Transistor Q305 provides a low-level modulation output while Q306 provides a high-level output.

When the 242F-9C is operated in the vhf configuration, both the high- and low-level modulation signals are used. However, when in the uhf configuration, only the low-level modulation signal is used.

4.3.9 Metering Circuits

The 242F-9C provides a built-in multimeter circuit that permits continuous monitoring of rf levels and dc voltages. The multimeter circuit is included in the 242F-9C to aid operating and maintenance personnel. All dc bias voltages required by the 242F-9C (vhf or uhf configuration) may be adjusted to their proper levels by using the multimeter and the potentiometers associated with each bias voltage. The output of each rf stage may be tuned by using the multimeter and the variable capacitors associated with each rf stage. The multimeter also provides an indication of percent of modulation, vswr, and rf power output.

The 242F-9C also provides a power amplifier meter, M402. This meter is inserted in the return leg of the +2000-volt dc power supply to indicate the plate current of power amplifier tube V2.

4.3.9.1 Multimeter Circuit

The multimeter circuit consists of MULTIMETER M401, MULTIMETER SWITCH S409, rectifiers, resistors, voltage dividers, and rf filter components. The multimeter circuit enables operating and maintenance personnel to monitor and adjust numerous transmitter functions. These functions include the tuning of the transistorized rf stages; adjusting the driver, power amplifier, and agc bias levels; adjusting the percent of modulation; and adjusting the power output level.

4.3.9.2 Multimeter Switch Positions and Functions (Refer to figure 4-20.)

The following paragraphs describe the purpose of each MULTIMETER SWITCH position. The adjustment controls associated with each switch position are also mentioned. The switch positions are discussed in order beginning with the MULTIMETER SWITCH in the OFF position. Paragraphs k, l, m, and n pertain only to the vhf configuration of the 242F-9C while paragraphs o, p, q, and r pertain only to the uhf configuration.

a. OFF

The positive and negative terminals of M401 are grounded.

b. BIAS PS X1

The bias output of the low-voltage power supply is applied to the negative terminal of M401 through R417. The resultant indication should be 66 and is read directly from the meter. This check ensures that the proper bias voltage is being applied to the various voltage dividers for the power amplifier bias, driver bias, and agc bias.

c. 28 VPS X1/2

The output of the regulated +28-volt dc power supply is applied to the positive terminal of M401 through resistor R431. The resultant meter indication must be divided by 2.

d. 300 VPS X5

The regulated +300-volt dc portion of the high-voltage power supply output is applied to the positive terminal of M401 by voltage divider R429 and R430. The resultant meter indication must be multiplied by 5.

e. 850 VPS X10

The +850-volt dc portion of the high voltage power supply output is applied to the positive terminal of M401 by voltage divider R424 and R425.

The resultant meter indication must be multiplied by 10.

f. 2000 VPS X40

The +2000-volt dc portion of the high-voltage power supply output is applied to the positive terminal of M401 through resistor R432 and by voltage divider R433, R444, R445, and R423. The resultant meter indication must be multiplied by 40.

g. OSC

In this position, the output of a Darlington dc amplifier circuit in the crystal oscillator stage is applied to the positive terminal of M401. By using the tuning elements in the crystal oscillator circuit and M401, the crystal oscillator may be tuned precisely to resonance. Refer to paragraph 4.3.1.1 for a discussion pertaining to the tuning elements. When the crystal oscillator is not tuned to resonance, a voltage drop will appear across the crystal. This voltage is applied to a detector circuit consisting of oscillator meter detectors CR1 and CR2 and detector balance resistor R5. The detected signal is filtered and applied to the dc amplifier circuit. The output of amplifiers Q5 and Q6 is developed across emitter resistors R11 and R12. The junction of these two resistors provides the output signal that is applied to the positive terminal of M401. the turning elements are adjusted until the meter indication is minimum (dip).

h. BUFFER

A sample of the collector output signal from Q2 is detected by rectifier CR3 before being applied through R433 to the positive terminal of M401. Capacitor C18 provides rf coupling, and resistor R17 is the detector load. The buffer stage is tuned to the appropriate crystal frequency by adjusting BUFFER tuning capacitor C20 and oserving M401 for a maximum indication.

i. DBLR 1

A sample of the collector output signal from Q3 is detected by rectifier CR4 before being applied through R434 to the positive terminal of M401. Capacitor C28 provides rf coupling, and resistor R21 is the detector load. The first doubler stage is tuned to twice the crystal frequency by adjusting DBLR 1 tuning capacitor C31 and observing M401 for a maximum indication.

j. DBLR 2

A sample of the collector output signal from Q4 is detected by rectifier CR5 before being applied through R435 to the positive terminal of M401. Capacitor C35 provides rf coupling, and resistor R25 is the detector load. The second doubler stage is tuned to four times the crystal frequency and adjusting DBLR 2 tuning capacitor C38 and observing M401 for a maximum indication.

Note

The following paragraphs (k, l, m, and n) pertain to the 242F-9C in the vhf configuration. All detectors, detector loads, and coupling capacitors are contained in the vhf exciter module.