

REQUIRED TEST EQUIPMENT

1. DC Voltmeter

- 1) Input resistance : More than 1 MΩ
- 2) Voltage range : 1.5 to 1000V AC/DC

NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.

2. DC Ammeter

- 1) Current range : 150 mA, 500 mA, 2A, 10A, High-precision ammeter may be used.

3. RF VTVM

- 1) Input impedance : 1 MΩ and less than 3 pF, min.
- 2) Voltage range : 10 mV to 300V
- 3) Frequency range : 10 kHz~100 MHz or greater

4. AF Voltmeter

- 1) Frequency range : 50 Hz to 10 kHz
- 2) Input resistance : 1MΩ or greater
- 3) Voltage range : 10 mV to 30 V

5. AF Generator (AG)

- 1) Frequency range : 200 Hz to 5 kHz
- 2) Output : 1mV or less ~1V, low distortion

6. AF Dummy Load

- 1) Impedance : 8Ω
- 2) Dissipation : 3W or greater

7. Oscilloscope

Requires high sensitivity, and external synchronization capability.

8. Sweep Generator

- 1) Center frequency : 5 MHz~60 MHz
- 2) Frequency deviation : Maximum±16 MHz
- 3) Output voltage : 0.1 V or greater
- 4) Sweep rate : At least 0.5sec/cm

9. Standard Signal Generator (SSG)

- 1) Frequency range : 8 to 60 MHz
- 2) Output : -20 dB/0.1μV~120 dB/1V
- 3) Output impedance : 50 Ω
- 4) AM and FM modulation can be possible.

NOTE : Generator must be frequency stable.

10. Frequency Counter

- 1) Minimum input voltage : 50 mV
- 2) Frequency range : 60 MHz or greater

11. Noise Generator

Must generate ignition noise containing harmonics beyond 60 MHz.

12. Power Meter

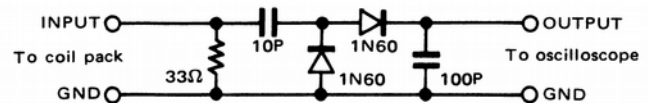
- 1) Impedance : 50Ω
- 2) Dissipation : 15 W continuous or greater
- 3) Frequency limits : 60 MHz or greater

13. Spectrum Analyzer

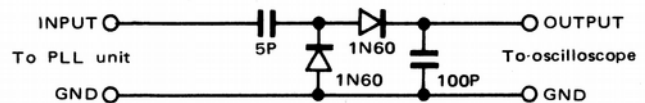
- 1) Frequency range : 100 K to 110 MHz or greater
- 2) Bandwidth : 1 kHz to 3 MHz

14. Detector

- 1) For adjustment of TX BPF



- 2) For adjustment of PLL BPF



15. Directional Coupler

16. Power supply

13.8 V DC. Min 4A

PREPARATION

Unless otherwise specified, set the controls as follows.

POWER ON	RIT SW OFF
BAND 50	NB OFF
AF MIN	F.LOCK OFF
RF MAX	F.STEP OFF
MIC MIN	VFO/MEMO VFO
CAR MIN	HOLD OFF
FUNCTION A	SEND/REC REC
RIT CEN	MEMORY 3
IF SHIFT CEN	MODE SSB
SQL MIN	ALC/RF RF

The output level of SSG is indicated as SSG's open circuit.

ADJUSTMENT

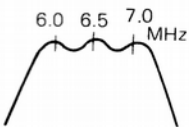
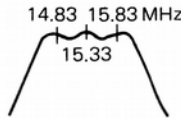
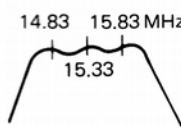
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VOLTAGE ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Parts	Method		
Voltage adjustment and confirmation	POWER : ON RF GAIN : MAX MODE : SSB STBY : REC	DC V.M	IF	9V				8.55~9.45V	Confirm
				-6V				-5.9~-6.1V	Confirm
				5V				4.75~5.25V	Confirm
				RFG	SW	VR3	3.3V	±0.1V	
				RXB				8.0~9.0V	Confirm
				RB				about 1.5V	Confirm
				TBL				about -5.9V	Confirm
				TXB				0V	Confirm
	STBY : SEND								
	STBY : REC							ON AIR IND goes off	Confirm

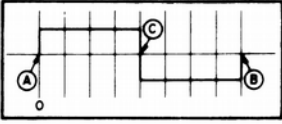
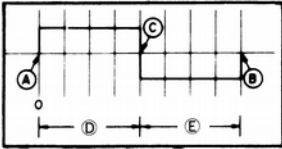
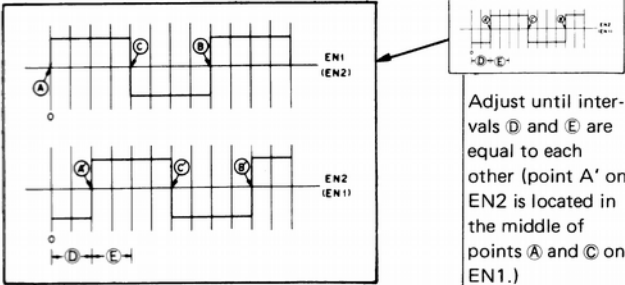
PLL ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks		
		Test equipment	Unit	Terminal	Unit	Parts	Method				
1. Adjustment of standard oscillation	1) RIT : OFF RIT VR : CENTER	f. counter	Control	D48 cathode	Control	TC1	8,000,000 Hz	±3 Hz			
	2) RIT : ON					TC3		±50 Hz	RIT IND lights		
	3) RIT : Turn full CW, then full CCW.							±1 kHz or more	Confirm		
	4) RIT : OFF								RIT IND goes off		
	5) MODE : CW ANT : DUMMY LOAD STBY : SEND						VR3	8,000,800 Hz	±50 Hz		
	6) STBY : REC										
	7) MODE : FM					D39 cathode	Control	TC2	8,731,500 Hz	±50 Hz	
	8) MODE : AM									±200 Hz	Confirm
2. VCO-1	1) MODE : SSB Display : 51.000.0	DC V.M	Control	TP1	Control	L26	7.0V	±0.1V			
	2) Display : 50.999.9								2.4±0.5V	Confirm	
3. VCO-2	1) MODE : SSB Display : 51.000.0	DC V.M	Control	TP4	Control	L13	2.3V	±0.1V			
	2) Display : 50.999.9								6.0±1.0V	Confirm	
	3) Display : 51.000.0 ↓ 51.009.9	f. counter		TP2				6.000 MHz ↓ 2 kHz Steps. 4.002 MHz	This item is confirmed also after adjustment of item 2, VCO-1.		
4. VCO-3-1	1) BAND : 21 Display : 21.999.9	DC V.M	PLL	TP1	PLL	L3	6.5V	±0.1V			
	2) BAND : 24 Display : 24.999.9								6.0 +0.5V -1.0V	Confirm	
	3) Display : 24.000.0								2.8±0.5V		

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Parts	Method		
	4) BAND : 21 Display : 21.000.0							2.5±0.5V	
5. VCO-3-2	1) BAND : 28 Display : 29.999.8	RF V.M	PLL	TP1		L6	1.9V	±0.1V	
	2) Display : 28.000.0							5.0±0.5V	Confirm
6. VCO-3-3	1) BAND : 50 Display : 53.999.9	RF V.M	PLL	TP1		L8	7.7V	±0.1V	
	2) Display : 50.000.0							3.0±0.5V	Confirm
7. VCO output check	1) BAND : 21~50 Display : □□.500.0	RF V.M	PLL	TP2				0.63V +3 dB -2 dB	Confirm
8. BPF-1	1) MODE : SSB or CW Ground TP4 of control unit. Connect sweep GEN. RF output to control unit TP5.	Sweep generator Oscillo- scope Detector	Control	Jumper wire on right of C6	Control	L16~18	Adjust as shown at right.		
9. BPF-2	1) MODE : SSB or CW BAND : 21 or 24	RF V.M	Control	D27 cathode	Control	L1,2	MAX.		
	2) Remove control unit connector ①. Connect sweep GEN. RF output to jumper wire at right of C69 on control unit.	Sweep generator Oscillo- scope Detector		Connector ①		L4~6	Adjust as shown at right.		
10. BPF-3	1) MODE : SSB or CW BAND : 28 or 50	RF V.M	Control	D28 cathode	Control	L3	MAX.		
	2) Remove control unit connector ①. Connect sweep GEN. RF output to jumper wire at right of C69 on control unit.	Sweep generator Oscillo- scope Detector		Connector ①		L7~9	Adjust as shown at right.		
11. BPF-4		RF V.M	Control	IC11 5 PIN	Control	L30,31	MAX.		
12. BPF-5	1) RIT : OFF	RF V.M	Control	D48 cathode	Control	L34,35	MAX.		
13. MIX Balance		Spectrum analyzer	Control	Jumper wire at right of C69	Control	VR1	Adjust for minimum adjacent spurious response.		

ADJUSTMENT

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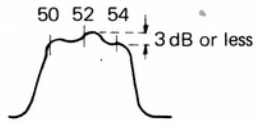
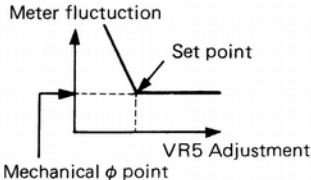
Item	Condition	Measurement			Adjustment			Specification	Remarks		
		Test equipment	Unit	Terminal	Unit	Parts	Method				
14. Encoder adjustment	1) Remove the VFO knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Connector ⑳ EN1 terminal	Encoder	VR1			Point ③ may be located anywhere. When a motor is not available, manually turn the VFO to check the duty ratio.		
	2) EN1 duty ratio adjustment : Turn a motor CW and CCW						After adjusting with the VFO control turned CW, check that intervals ④ and ⑤ are also identical when the VFO control is turned CCW.				
	3) EN2 duty ratio adjustment : Turn a motor in the both direction.			Connector ⑳ EN2 terminal						VR2	Adjust until intervals ④ and ⑤ are equal to each other with point ③ placed at the center.
	4) EN1-EN2 phase difference alignment : Same as above.			Connector ⑳ EN1 and EN2 terminals						Phase adjustment screw	

RX ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks		
		Test equipment	Unit	Terminal	Unit	Parts	Method				
1. CAR level and frequency	1) MODE : SSB IF SHIFT : CEN.	RF V.M	IF	CAR	IF	L1	0.26V Adjust CCW from peak turn slug OUT.				
		f. counter				TC1	8,831,500 Hz	± 50 Hz		Confirm	
							8,831,500 Hz				
							Stopped				
	2) MODE : CW										
	3) MODE : AM										
	4) MODE : FM										
	5) MODE : SSB STBY : SEND							VR2		8,831,500 Hz	± 10 Hz
	6) MODE : CW STBY : SEND						VR1	8,830,700 Hz			
7) MODE : AM STBY : SEND					8,831,500 Hz	Confirm					
8) MODE : FM STBY : SEND					Stopped						
9) MODE : CW STBY : REC IF SHIFT : Turn full CW, and CCW.				Center frequency is standard	± 900 Hz or more						

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Item	Condition	Measurement			Adjustment			Specification	Remarks	
		Test equipment	Unit	Terminal	Unit	Parts	Method			
2. 50 MHz BPF	1) BAND : 50 ANT SW : 21~50 Remove connector ⑤ (VCO input). Connect RF output of sweep GEN. to ANT terminal.	Sweep generator Oscilloscope Detector	RF	TP1	RF	L3,4 L6 T12				
3. IF	1) BAND : 52 VFO : 52.100.0 MODE : SSB 2) MODE : FM	SSG		EXT.SP	RF	VR1 T2~6	MAX.	Must be $1V/8\Omega$ or more at maximum AF gain with SSG output of -6dB.		
					IF	L6~8				
4. HF ANT Coil	1) BAND : 21 VFO : 21.225.0	SSG AF VM AF DUMMY LOAD Oscilloscope		EXT.SP	RF	L9	MAX.			
	2) BAND : 24 VFO : 24.920.0				L10					
	3) BAND : 28 VFO : 28.800.0				L11					
5. RX carrier balance	1) IF SHIFT VR : CEN. RF GAIN : Turn full CCW. BAND : 52	RF V.M	IF	TP	IF	VR3 TC3	MIN. Adjust by repeating alternately. Sufficient when RF V.M reads minimum in the 0.03V range.	(0.01V or less)		
6. S Meter	1) BAND : 52 VFO : 52.100.0 RF GAIN : Turn full CW. IF SHIFT : CEN. MODE : CW	SSG S-Meter			IF	VR5	Shut off SSG output. Adjust to mechanical ϕ point.			
	2) SSG output 6 dB				L7	S-1 adjust CCW from peak. (turn slug OUT).				6 dB \pm 4 dB
	3) SSG output 20 dB				VR4	S-9				20 dB \pm 6 dB
	4) MODE : FM SSG output : 30 dB				FM IF	VR2				Full scale
7. SQ	1) SQ : 12 O'clock MODE : CW	SP.		EXT.SP	IF	VR11	Adjust VR slowly and stop at threshold.			
8. IF trap.	1) BAND : 21 SSG output : 8.830 MHz 80dB	SSG AF V.M AF DUMMY LOAD Oscilloscope		EXT.SP	RF	L29	MIN.	70 dB or more		
9. Noise Blanker	1) BAND : 52 NB : ON SSG output : 52.1 MHz	SSG DC V.M	RF	TP2	RF	T7,8	MIN. (First adjust SSG output to 60 dB, then using the minimum input as possible.)			

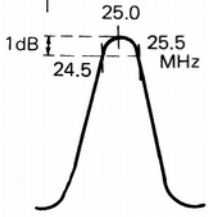
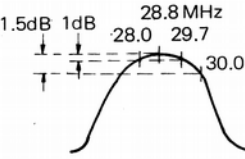
ADJUSTMENT

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Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Parts	Method		
	2) Connect noise generator output to ANT terminal.	Noise generator			RF	T5	Adjust in core removal direction to effective position at low input level.	Must be effective at large and small outputs.	

TX ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Parts	Method		
1. Base idle current	1) Remove DRV connector from RF unit. STBY : SEND	DC A.M	Final	A	Final	VR1	If adjustment to 300 mA is not possible, 200 mA or more at position where reduced about 10 mA from about 10 mA from VR MAX.	300 mA. (200~300 mA)	Remove jumper between (A) and (B)
	2) Reconnect DRV connector STBY : REC			B		VR2	Resolder (A) to (B)	100 mA	NOTE : First turn power supply off.
2. 50 MHz TX. BPF	1) BAND : 50 Store the following frequencies in memory ① 50.000.0 ② 52.000.0 ③ 53.999.9 VFO/MEMO : MEMO CAR VR : Full CW. Remove connector (5) and attach sweep GEN. STBY : SEND	Sweep generator Oscilloscope Detector Power meter Directional coupler		ANT (Directional coupler)	RF	TC1~3 T10	First, connect connector (5) and obtain peak at 52M. * There is a 52M marker output at MEMORY 2.		
					Final	TC1			
	2) STBY : REC VFO/MEMO : VFO Reinstall connector (5)				RF	L37,38 TC1~3	Adjust as shown at right. When adjusting TC1,2,3 tune so that curve is raised to 52M.		1) Adjust at minimum inputs as possible. 2) Use MEMORY as marker.
3. 21 MHz BPF. (Common with RX)	1) BAND : 21 Store the following frequencies in memory ① 21.000.0 ② 21.225.0 ③ 21.450.0 VFO/MEMO : MEMO CAR VR : Full CW Remove connector (5) and attach sweep GEN. STBY : SEND	Sweep generator Oscilloscope Detector Power meter Directional coupler		ANT (Directional coupler)	RF	L17~19	Adjust as shown at right.		
								1) Adjust using the minimum input possible. 2) Use MEMORY as marker.	

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Parts	Method		
	2) STBY : REC VFO/MEMO : VFO Reinstall connector ⑤								
4. 24.5 MHz BPF (Common with RX)	1) BAND : 24 Store the following frequencies in memory. ① 24.500.0 ② 25.000.0 ③ 25.500.0 VFO/MEMO : MEMO CAR VR : Full CW Remove connector ⑤ and attach sweep GEN. Remove connector to disable transmission. STBY : SEND	Sweep generator Oscilloscope Detector Power meter Directional coupler		ANT (Directional coupler)	RF	L20~22	Adjust as shown at right.		1) Adjust using the minimum input possible. 2) Use MEMORY as marker.
	2) STBY : REC VFO/MEMO : VFO Reinstall connector ⑤. Insert connector enable transmission								
5. 28 MHz BPF (Common with RX)	1) BAND : 28 Store the following frequencies in memory ① 28.000.0 ② 28.800.0 ③ 29.700.0 ④ 30.000.0 VFO/MEMO : MEMO CAR VR : Full CW Remove connector ⑤ and attach sweep GEN. STBY : SEND	Sweep generator Oscilloscope Detector Power meter Directional coupler		ANT (Directional coupler)	RF	L23~25	Adjust as shown at right.		1) Adjust using the minimum input possible 2) Use MEMORY as marker.
	2) STBY : REC VFO/MEMO : VFO Reinstall connector ⑤								
6. SWR After this adjustment perform 7. Adjustment of power and 9. Adjustment of protection	1) BAND : 53 VFO : 53.999.9 Filter unit VR1 : Full CW MODE : CW CAR VR : Full CW STBY : SEND	Power meter		ANT (21~50)	Filter	TC1	Power to maximum.		
	2) STBY : REC								

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Item	Condition	Measurement			Adjustment			Specification	Remarks	
		Test equipment	Unit	Terminal	Unit	Parts	Method			
7. Power	1) BAND : 28 VFO : 28.800.0 MODE : CW CAR VR : Full CW Filter unit VR1 : mechanical center STBY : SEND 2) STBY : REC	Power meter		ANT (21~50)	Filter	VR2	11W			
8. Spurious	1) BAND : 21.50,53 MODE : CW STBY : SEND 2) STBY : REC	Spectrum analyzer or Directional coupler		ANT (21~50)	RF	VR3	① f 50.000.0 (58.83M)	-60 dB or less	Power down is 2 dB or less. Repeat ① and ② and then	
						VR2	② f 53.999.9 (45.17M)			
						VR4	③ f 21.999.9 (26.49M)	-40 dB or less		
9. Protection	1) BAND : 50 MODE : CW ANT : OPEN STBY : SEND	DC A.M			Filter	VR1	4.0A	Less than 4.5A		
	2) STBY : REC									
	3) BAND : Check each BAND STBY : SEND									If any BAND exceeds 4A, readjust to 4A. (confirm 24.999.9)
	4) STBY : REC									
10. Carrier balance and carrier point	1) BAND : 50 MODE : SSB MIC GAIN : Full CCW STBY : SEND	Power meter Directional coupler		ANT (21~50)	IF	VR6 TC2	Repeat alternately and adjust to minimum.	-40 dB or less from CW full power.		
	2) MIC connector : AG (AG : 5 mV 1.5 kHz) Adjust MIC GAIN for approx 1/2 of full RF output (NO ALC) Change AG frequency between 300 Hz and 2.7 kHz.					TC1				Adjust so that the 300 Hz and 2.7 kHz outputs are the same.
	3) STBY : REC									
11. TX.IF	1) MODE : CW CAR : Full CW STBY : SEND	RF V.M	IF	IF Connector ① 2 Pin (TIF)	IF	L9,10	MAX.		When peak point is not clear, reduce CAR level.	
	2) STBY : REC									
12. FM-IF	1) BAND : 50 or 28 MODE : FM STBY : SEND	RF V.M	FM,IF	D2 cathode	FM,IF	T1	MAX.			
	2) STBY : REC									

Item	Condition	Measurement			Adjustment			Specification	Remarks						
		Test equipment	Unit	Terminal	Unit	Parts	Method								
13. Deviation	1) BAND : 50 or 28 MODE : FM AG : 20 mV 1 kHz MIC connector Pins ① and ② STBY : SEND	Linear detector Power meter Directional coupler AG		ANT (Directional coupler)	FM,IF	VR1	5 kHz								
	2) AG : 2 mV													3.5 kHz or less	Confirm
	3) STBY : REC														
14. FM.CAR	1) BAND : 50 or 28 MODE : FM STBY : SEND	f.counter	FM,IF	D2 cathode	FM,IF	TC1	8.831.500 Hz	±100 Hz							
15. Side tone	1) MODE : CW AF GAIN : 12 O'clock KEY jack : KEY STBY : SEND	Power meter Oscilloscope AF V.M AF DUMMY LOAD		EXT.SP	IF	VR8	KEY DOWN	0.63V/8Ω	Must be no distortions at 800 Hz level.						
	2) STBY : REC					VR10	KEY DOWN	Confirm to change time to return to RX. Then set to center.							
	3) Remove KEY														
16. ALC,RF meter	1) MODE : SSB MIC GAIN : Full CCW Meter : ALC BAND : 21 STBY : SEND	Power meter Oscilloscope AF V.M AF DUMMY LOAD			IF	VR13	Adjust to mechanical φ point.	<p>Meter reading</p> <p>Set point</p> <p>VR3 Adjustment</p> <p>Mechanical φ point</p>							
	2) MIC GAIN : Set S scale at S-1. MIC : AG (5 mV, 1.5 kHz)					VR7	1) Raise AG output 3 dB from 5 mV. 2) Adjust to ALC zone maximum.								
	3) Meter SW : RF					VR9	Adjust to S-8.								
	4) STBY : REC														

ADJUSTMENT

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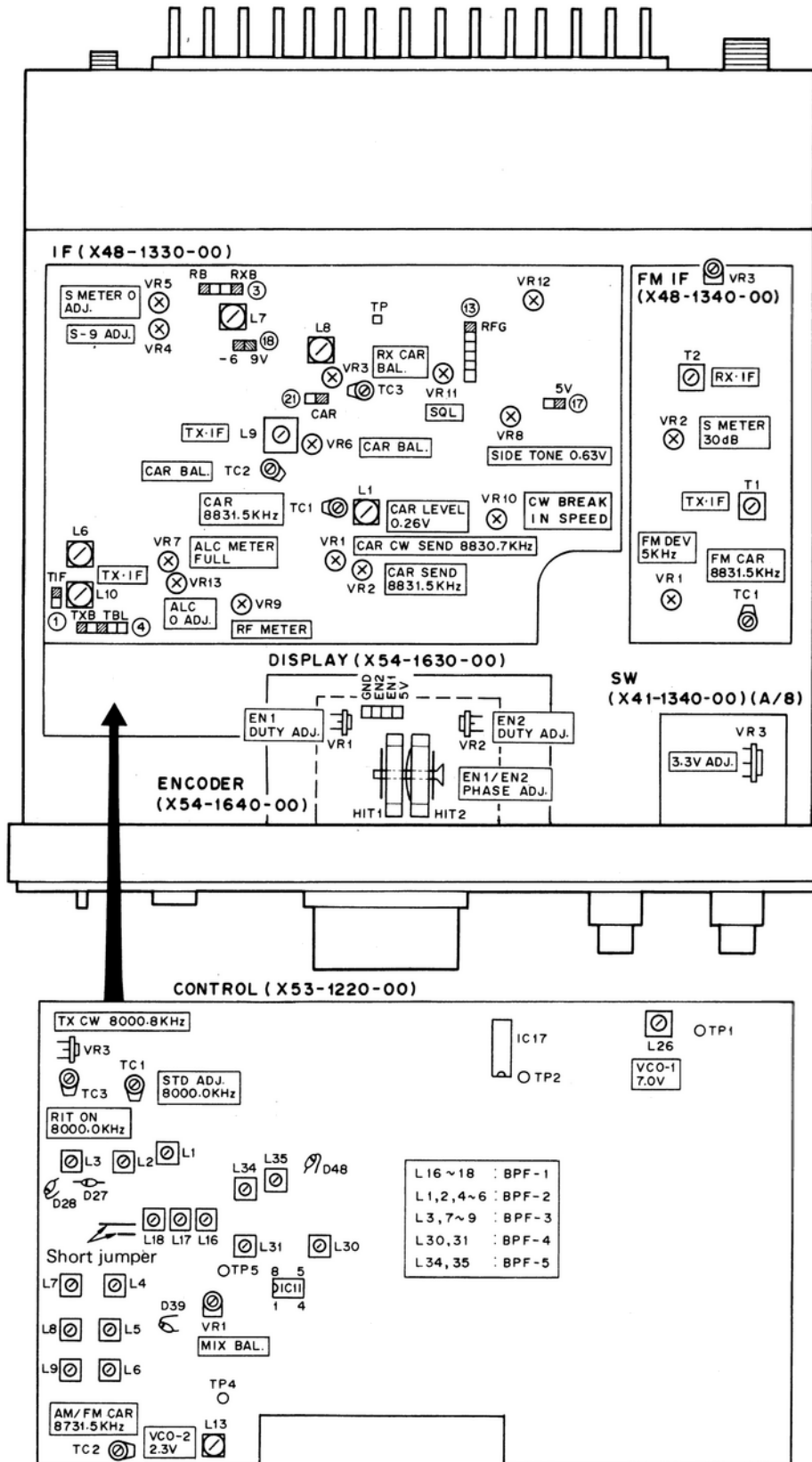
Micro-processor operational check

Item	Conditions	Specification	Item	Conditions	Specification
1. BAND	1) Power source connector: connect plug (13.8V) POWER SW : ON	With POWER SW ON, a tone is heard and meter lamps and display tube lights. (50.000.0)		4) BAND : 29 MEMORY : 4 M : ON	The tone sounds.
	BAND : Push UP button once.	51.000.0 is displayed and tone is heard.		5) BAND : 50 MEMORY : 5 M : ON	The tone sounds.
	Push UP button continuously	24.000.0→28.000.0→29.000.0→50.000.0 21.000.0←53.000.0←52.000.0←51.000.0 Continuous display and simultaneous tones.	5. MEMORY Call	1) BAND : 51 VFO/MEMO : MEMO MEMORY : 5	5 50. 4 29. 3 28. 2 24. 1 21.
	BAND : Push DOWN button once.	Display frequency decreases by 1 and simultaneously tone sounds.		2) VFO/MEMO : VFO	51.
	Push DOWN button continuously	Continuous display in reverse of UP and simultaneous tones heard.		6. SCAN and HOLD F.LOCK	1) MEMORY : SCAN STBY seen at SEND and REC.
2. FUNCTION	1) ANT : 21-28, 50 Two connections POWER meter FUNCTION : A, B, B-R, A-R MODE : SSB	STBY : REC→SEND→REC A : $\rightarrow \rightarrow \rightarrow$ B : $\rightarrow \rightarrow \rightarrow$ B-R : $\rightarrow \rightarrow \rightarrow$ A-R : $\rightarrow \rightarrow \rightarrow$	2) HOLD : ON	SCAN stopped.	
3. F.STEP		Frequency changes at one VFO turn, frequency increases CW, decreases CCW.	3) MEMORY : 1 HOLD : OFF F.LOCK : ON	VFO-BAND operation stopped. IND lamp lights, simultaneously.	
	1) F.STEP : OFF MODE : SSB-CW-AM	10 kHz change by one turn of VFO knob.	4) VFO/MEMO : MEMO Switch to 1, 2, 3, 4, 5	Switch to normal	
	2) F.STEP : ON	100 kHz change. IND lamp is lit simultaneously.	5) VFO/MEMO : VFO F.LOCK : OFF	IND lamp extinguished.	
	3) MODE : FM 4) F.STEP : OFF	100 kHz change. About 500 kHz change, IND lamp extinguished.	6) MODE : FM MIC : insert (MIC accessory) Push UP once.	10 kHz display increases by one.	
4. MEMORY read-in	1) BAND : 21 MEMORY : 1 M : ON	The tone sounds.	Push UP continuously.	Continuous increases in 10 kHz steps.	
	2) BAND : 24 MEMORY : 2 M : ON	The tone sounds.	Push DOWN once.	10 kHz display decreases by one	
	3) BAND : 28 MEMORY : 3 M : ON	The tone sounds.	Push DOWN continuously.	Continuous decreases in 10 kHz step.	

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ADJUSTMENT

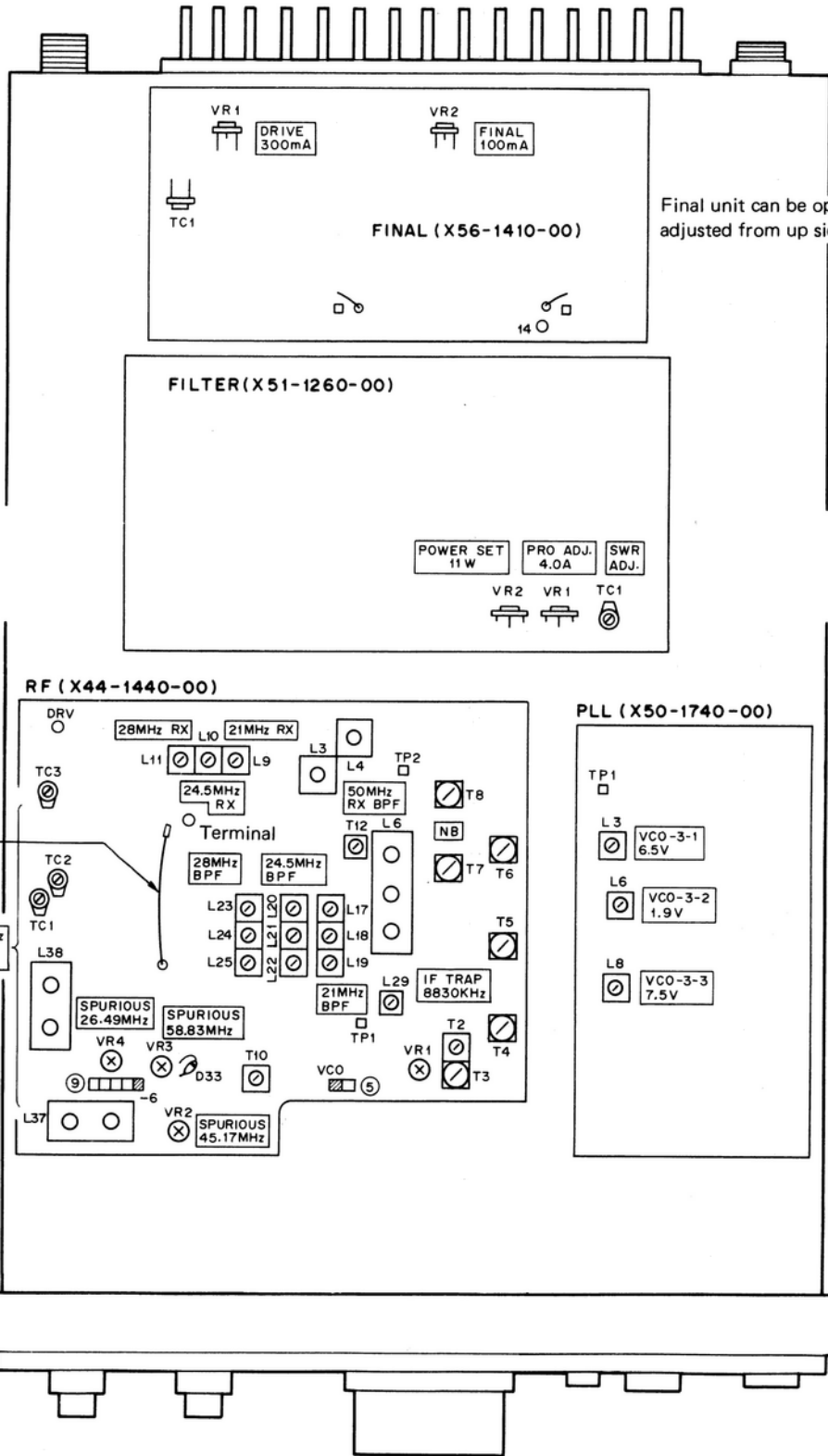
TOP VIEW



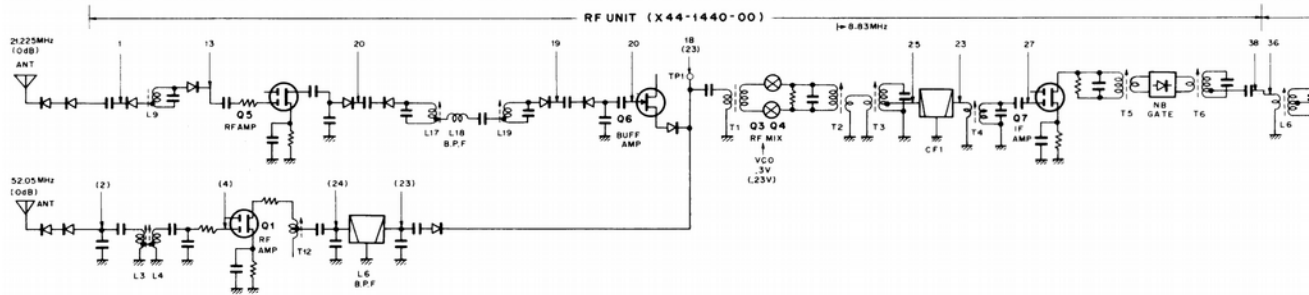
BOTTOM VIEW

ADJUSTMENT

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RECEIVER SECTION (21, 50MHz BAND SSB)

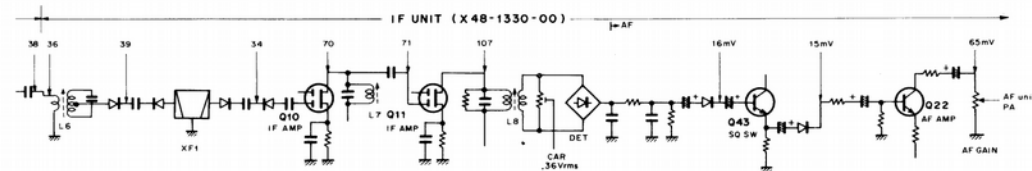


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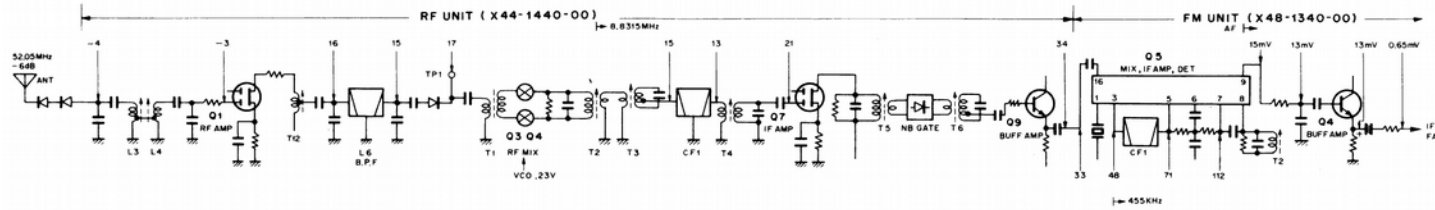
LEVEL DIAGRAM

Note 1 : SSG signal at 21.225 MHz (52.05 MHz) and 0 dB is fed into the ANT terminal and, after audio output is set at 0.63V/8Ω by the AF GAIN VR, the SSG signal input levels (dBμ) at each stage required to achieve the same audio output at constant AF GAIN VR are displayed.

Note 2 : The SSG output is connected via a 0.01μF, 50WV (or Greater) capacitor.



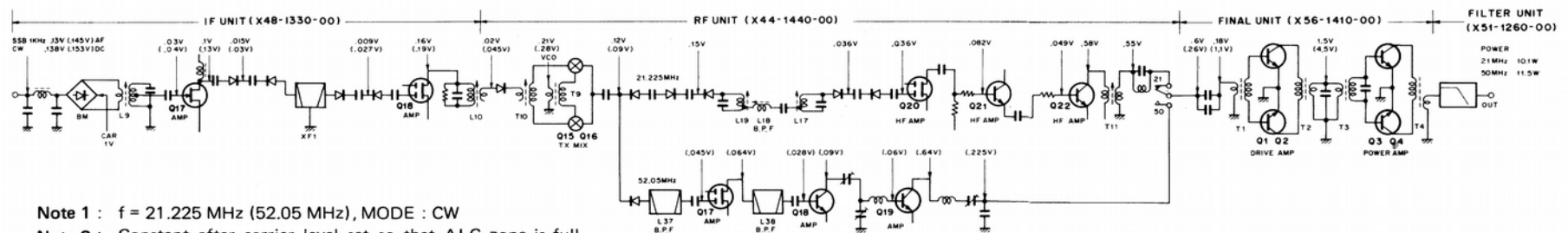
RECEIVER SECTION (50MHz BAND FM)



Note 1 : SSG unmodulated signal at 52.05 MHz and -6 dB is fed to the ANT terminal, and the SSG signal input levels (dBμ) required to achieve 20 dB noise quieting in the FM mode.

Note 2 : The SSG output is connected via a 0.01μF, 50WV (or Greater) capacitor.

TRANSMITTER SECTION (21, 50MHz BAND CW)



Note 1 : f = 21.225 MHz (52.05 MHz), MODE : CW

Note 2 : Constant after carrier level set so that ALC zone is full scale.

Note 3 : Measurement is made by a P type variable volume, a probe with a input capacity of 3pF or less is used and the ground point is near the extreme measuring point.

TS-660 BLOCK DIAGRAM

