COMMUNICATIONS RECEIVER
FRG-7

GENERAL DESCRIPTION

The model FRG-7 is an all solid state synthesized communication receiver designed to cover the entire high frequency spectrum, 500 kHz to 29.9 MHz.

FRG-7 is a triple conversion super heterodyne receiver utilizing synthesized heterodyne oscillator known as the "Wadley Loop System" which offers unparalleled stable performance.

The calibrated dial mechanism provides 10 kHz frequency readout throughout the receiver coverage.

Good selectivity is provided for SSB, AM and CW with the utilization of a ceramic filter in the 455 kHz IF circuits.

The FRG-7 includes three step front end attenuator, amplified AGC and low-normal-high tone select switch for extreme flexibility that even the most demanding amateur, CBer, or broadcast listener desires. In addition, the large cabinet and hi-fl speaker will provide you with high quality audio output.

The FRG-7 includes a self-contained three way power supply for 100/110/117/200/220/234 volts AC 50/60 Hz, an internal battery or external 12 volt DC. If the AC power source fails, the unit switches automatically to an internal battery which uses eight UM-l dry cells.

To save battery consumption, the dial lamps can be switched off

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SPECIFICATIONS

Frequency Range:
0.5 MHz 29.9 MHz

Type of Emission:
AM, SSB (USB or LSB), CW

Sensitivity:
SSB/CW: Better than 0.7 MV at S/N 10 dB
AM : Better than 2 MV at S/N 10 dB

Selectivity:
±3 kHz at -6 dB, ±7 kHz at -50 dB

Stability:
Less than ±500 Hz at any 30 minutes after warm up

Antenna Impedance:
High impedance for 0.5 MHz ~1.6 MHz 50 ohm unbalanced for 1.6 MHz ~ 29.9 MHz

Speaker Impedance:
4 ohms

Audio Output:
2 watts

Power Requirement:
100/110/117/200/220/234 volts AC 50/60 Hz, 12 volts DC external or internal dry cell UM-1x8

Power Consumption:
AC 14VA

Size:
340(W), 153(H), 285 (D)mm

Weight:
Approx. 7 kg without batteries

SEMICONDUCTORS COMPLEMENTS

IC:			
AN-214	1	SN76514	1
FET:			
3SK-40	3	2SK19	6
Transistor:			
2SC372	8	2SC784	4
2SD313	1		
Diode:			
1N6OAM	9	1S1555	2
VO6B	3		
Zener Diode:			
WZ-1 10	1	BZO9I	1

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INSTALLATION

Carefully remove the FRG-7 receiver from the carton and examine it for any physical damage.

Should any be apparent immediately notify the carrier stating the damage in detail. Save the carton and packing materials for future use.

Location:
In general, the location of the FRG-7 is not critical, however, it is recommended that excessively warm location be avoided.

POWER REQUIREMENT

The FRG-7 is supplied with a multi-voltage power transformer (export model only) and can be operated in many areas of the world where supply voltage may differ from your local supply voltage. Therefore before connecting the AC cord to the power outlet, be sure that the voltage marked on the rear of the receiver agrees with the local AC supply voltage.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE RECEIVER.

The FRG-7 will operate satisfactorily from any 1 2 volt, negative ground battery source by connecting the DC power cord (plug is supplied) to the rear panel receptacle. When making connections to the battery, be certain that the inner conductor is connected to the positive (+) and the outer conductor is connected to the negative (-) terminals of the battery. Reversed connection could permanently damage the receiver circuit

The FRG-7 will also operate from eight dry cells in the built-in dry cell pack. (Cells are not supplied) If the AC supply fails, the dry cell supply is automatically connected to the circuit.

The following Table I shows the power supply combination of FRG-7.

Power Source	1	2	3	4	5	6	7
AC Supply	O	-	-	O	O	O	-
External DC	-	O	-	X	-	X	O
Internal DC	-	-	O	-	X	X	X

O Power source in use

X Power source connected but not in use

- Power source not connected

Table 1

ANTENNA AND GROUND

The antenna is the most important part of the communication receiver installation. The FRG-7 is designed for use with a long wire antenna for 0.5 ~ 1.6 MHz and with a resonant antenna at the operating frequency having an impedance of 50 to 75 ohms for higher frequency than 1.6 MHz. This requirement is easily met by using a center fed dipole antenna resonated to the receiving frequency and fed with coaxial cable.

The FRG-7 should be connected to a good ground. The ground lead should be connected to the terminal marked E located on the rear panel of the receiver.

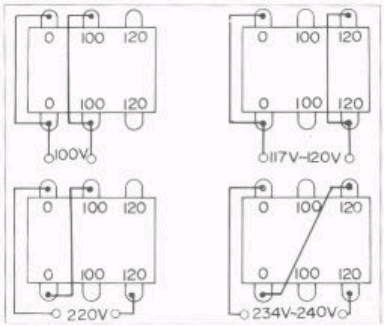
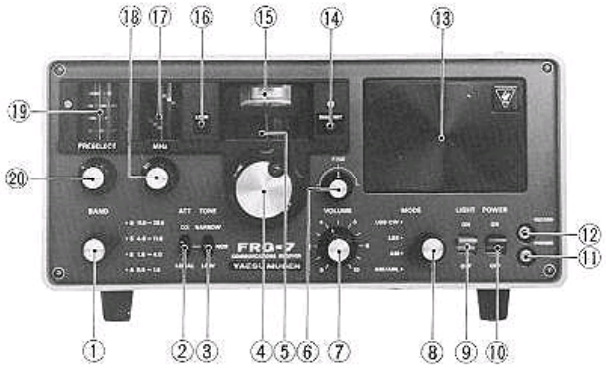


Fig. 1 Transformer Primary Wiring

CONTROLS AND SWITCHES

The FRG-7 has been designed for ease of operation. All controls have been properly adjusted at the factory. Several panel controls and switches are unusual in operation, and an improper setting may result in poor reception. The function of various controls and switches is described in the following paragraph.

Be certain that you thoroughly understand the individual function of each before operating the receiver.



FRONT PANEL

(1) BAND
The BAND switch is a four position switch. The switch selects the desired frequency range.

(2) ATI (NOR. DX, LOCAL)
The ATT (attenuator) switch attenuates the incom-ing signal to prevent over-loading of the front end when an extremely strong signal is present. At the switch NOR (normal) position, the attenuator is removed from the input circuit.

(3) TONE (NOR, NARROW, LOW)
The TONE switch changes audio response of the receiver. The audio amplifier passes at the NOR position, 250 Hz through 3000 Hz, at NARROW 400 Hz through 2500 Hz band at LOW 250 Hz through 1500Hz.

(4) (5) TUNING DIAL
The main TUNING knob determines the frequency in combination with the BAND switch and MHz setting.

(6) FINE TUNING
The FINE TUNING control is used for precise tuning of the received signal. The main tuning dial is calibrated to the frequency with the fine control at centre.

(7) VOLUME
The VOLUME controls the audio output level from the speaker.

(8) MODE
The MODE switch determines the appropriate detector in use. In the USBCW position. the USB (Upper Side Band) and code signal is heard. In the LSB position, the LSB (Lower Side Band) signal is heard. In the AM position, the ampLitude modulat-ed signal is heard and the Noise Limiter is put into the circuit in the AM/ANL position.

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CONTROLS AND SWITCHES (continued)

(9) LIGHT
This switch is used to turn off the lamp so as to save the current drain when the FRG-7 is operated from internal dry cells.

(10) POWER
This switch turns off the supply voltage for 1)0th AC anti DC operation.

(11) PHONES
Phone jack is provided for private listening and the speaker is disconnected when the plug is in-serted in this jack.

(12) RECORD
This jack is for recording purpose and the output level is set to approximately 50 mV regardless of setting of the VOLUME control.

(13) SPEAKER
Internal Speaker.

(14) DIAL SET
Main tuning dial calibrator.

(15) S-METER
The S-meter indicates the relative signal strength of the received signal. It is calibrated in S-unit from S-1 to S-9 and in dB over S-9.

(16) LOCK
The LOCK lamp lights up when the synthesized heterodyne oscillator is unlocked.

(17) (18) MHz
This MI-lz control synthesizes heterodyne oscillator to the harmonics of 1 MHz crystal oscillator. The scale is calibrated in MHz with the frequency show-ing the correct setting of the heterodyne signal.

(19) (20) PRESELECT
The PRESELECTOR control tunes the receiver front end. The scale is calibrated with the fre- ~ quency showing the correct setting for various bands.

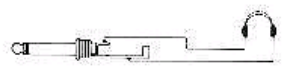
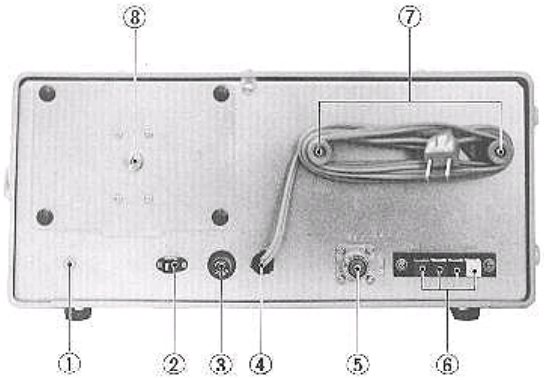


Fig. 2 Headphone Connection



Rear Panel Connection

(1) EXTSP
This jack is for connection of a 4 ohm external speaker when desired. With the plug in the S jack, the internal speaker is disconnected.

(2) EXT DC
Receptacle for external 12 volts DC supply.

(3) FUSE
Fuse for AC operation. Use 0.15 amp rating fuse.

(4) AC cord
Cord for AC operation.

(5) SW2
Coaxial connector for short wave listening.

(6) SW.BC,E,MUTE
SW is long wire antenna terminal for the short wave listening.
BC is long wire antenna terminal for the broadcast band listening.
E is ground connection.
MUTE is used to disable the receiver while trans-mitting. Connect this terminal to ground for receiver muting.

(7) (8)
AC cord holder and the internal battery pack. Use eight UM-1 dry cells.

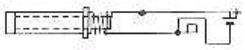


Fig.3 External Power Plug Connection

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OPERATION

FREQUENCY SELECTION

The receiving frequency is selected by the combina tion of the MHz dial and main tuning dial settings. The MHz dial selects the band at every 1 MHz and the main tuning dial selects the frequency at 10 kHz increment from 0 to 990 kHz in the band. The combination of these controls is shown in Table 2.

AMATEUR BAND RECEPTION

SSB Voice Signal:

Most amateurs use LSB on frequencies lower than 10 MHz and USB on frequencies higher than 10 MHz.

Set the controls and switches as follows;

POWER	OFF
BAND	Desired frequency segment
ATT	NOR
TONE	NOR
VOLUME	Desired listening level

	Frequency	PRESELECT	MHz	Main Dial	BAND	MODE
Amateur	kHz 1,910	2.0 1.8	1	910	81.6~4.0	USB・CW
	3,525	3.6 3.3 30mb	3	525	81.6~4.0	LSB
	7,050	7 41mb	7	050	04.0~11.0	LSB
	14,175	15 13 19mb	14	175	011.0~28.9	USB・CW
	21,225	23 20 13mb	21	225	011.0~28.9	USB・CW
	28,850	30 26 11mb	28	850	011.0~28.9	USB・CW
Medium Wave	550	0.6	0	550	A0.5~1.6	AM or AM/ANL
	980	1.0 0.9	0	980	A0.5~1.6	AM or AM/ANL
	1,170	1.2 1.0	1	170	A0.5~1.6	AM or AM/ANL
WWV,JJY	2,500	2.6 2.3 120mb	2	500	81.6~4.0	AM or AM/ANL
	5,000	5 4 60mb	5	0	04.0~11.0	AM or AM/ANL
	10,000	11 10 9 31mb	10	0	04.0~11.0	AM or AM/ANL
	15,000	17 15 19mb	15	0	011.0~29.9	AM or AM/ANL
Short Wave	3,925	4.0 3.6 75mb	3	925	81.6~4.0	AM or AM/ANL
	5,980	6 49mb	5	980	04.0~11.0	AM or AM/ANL
	9,715	10 9 31mb	9	715	04.0~11.0	AM or AM/ANL
	11,705	12 11 25mb	11	705	011.0~29.9	AM or AM/ANL
	15,120	17 15 19mb	15	120	011.0~29.9	AM or AM/ANL
	17,690	20 17 16mb	17	690	011.0~29.9	AM or AM/ANL
	21,550	23 20 13mb	21	550	011.0~29.9	AM or AM/ANL

Table 2

MODE	LSB for 160. 80 and 40 meter bands USB for 20, 15 and 10 meter bands
DIAL SET	Center
PRESELECT	Desired frequency. Refer to Table 2.
MHZ	""
MAIN DIAL	""

Turn the LOWER switch on. Precisely adjust the MHz dial until the LOCK lamp turns off. Tune the main tuning dial for the desired signal until the signal is clearly heard. Use the FINE TUNING control for precise tuning. When the received signal is garbled, try the opposite sideband. When an extremely strong signal is distorted, peak the PRESELECTOR for a maximum S-meter reading.

Set the ATT switch to LOCAL position to avoid front end over loading. Set the VOLUME for desired listening level.

The amateur SSB signals cut high and low audio response, so that it may be helpful to reduce the interference by setting the TONE switch at NARROW or LOW position.

CW (Morse Code Signal):

The code signal can be heard with the MODE switch at USB/CW position and by tuning the main tuning dial for a desired listening tone.

BROADCAST RECEPTION

The broadcast signal is transmitted on AM mode. If impulse type noise is experienced, set the MODE switch to AM/ ANL position to reduce the noise interference.

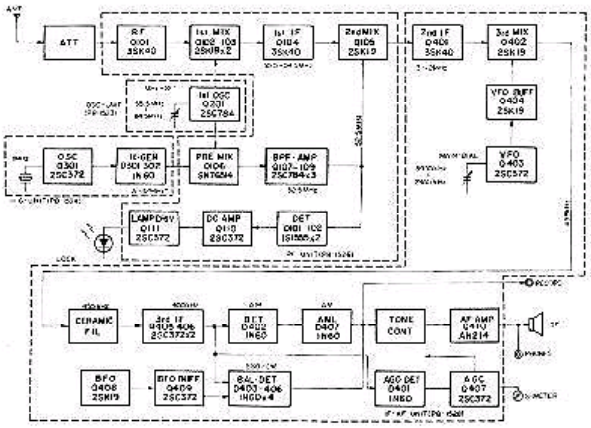

Fig.4 BLOCK DIAGRAM

CIRCUIT DESCRIPTION

The block diagram will provide you with a better understandingof this receiver. In general, the FRG-7 is a tripple conversion super heterodyne receiver utilizing synthesized local oscillator for both the first and second mixers for drift free VFO operation.

The signalfrom the antenna is fed throughthe attenuatorto the gate of the FET RF amplifier Q_{101}, **3SK40**. The amplifiedsignal is fed through a low pass filter (cut off frequency35 MHz) to the first balanced mixer consisting of Q_{102} and Q_{103}, **2SK19**, where the incoming signal is mixedwitha signalfromthe heterodyne oscillator.The first heterodyne oscillator Q_{201} **2SC784**, oscillates the signal which varies between 55.5 and 84.5 MHz.

The product of the first mixerbecomes the firstIF signalof 54.5 through 55.5 MHz. The first IF signal is amplifiedby the firstIF passband amplifier Q_{104} and fed to the gate of the second mixer Q_{105}, **2SK19CR**, where the firstIF signal is mixedwith 52.5 MHz signal.The second mixer converts the first IF signalinto the second IF signalof 2.0 through 3.0 MHz.

Synthesizer oscillator Q_{301} **2SC372**, oscillates crystal controlled1 MHz signal.The 1 MHz signalis then fed to the harmonic generator D_{301} and D_{302}, **1N60**, which produces 3 to 32 MHz harmonicsfrom the 1 MHz crystal controlled signal. The harmonic signal is fed to the dual balanced pre-mixer Q_{106}, **SN76514**, where the harmonics are mixed with the signal from the first heterodyne oscillator Q_{201}. The output signal from the pre-mixer passes through the selective amplifier Q_{107}, Q_{108} and Q_{109}, **2SC784**, which eliminatesother signalsexcept the 52.5 MHz second heterodyne signal.

A part of the output fromthe selectiveamplifieris rectified by the detectors D_1 and D_2, **1S1555**, and the DC output voltage is amplifiedby the DC amplifier Q_{110}, **2SC372**, and then fed to the LOCK lamp driver Q_{111}, **2SC372**, which turns the LOCK lamp on when the synthesizeris unlocked.

The output signalfrom the firstIF amplifier Q_{104} is fed to the second mixer Q_{105}, **2SK 19,** where the incomingsignalis mixedwith the 52.5 Mhz signalfrom the selective amplifier. The output of the second mixer becomes second IF signalof 2.0 through3.0 MHz. The 2.0 to 3.0 MHz IF signal is then amplifiedby the second IF amplifier Q_{401} **3SK40**, and then fed to the third mixer Q_{402} **2SK19**. The thirdmixerconvertsthe second IF signal into455 kHz thirdIF signal.The VFO (maintuning)signal, which varies between 2,455 kHz and 3,455 kHz, is generated by the variable frequency oscillator Q_{403}, **2SC372**. and suppliedto the third mixerthroughthe buffer amplifier Q_{404}, **2SK19**. The 455 kHz IF signal from the thirdmixeris fed to the ceramicfilterwhichis tunedto 455 kHz and has ±3 kHz passband response to eliminate interference.

The signal is then amplifiedby the third amplifier Q_{405} and Q_{406}, **2SC372**, and fed to the appropriate detector. The AM signal is detected by balanced diode detector D_{402}, **1N6OAM**.

The balanced demodulator D_{403} through D_{406}, **IN6OAM**, is used for the detection of SSB and CW signals. The carrier signalfor SSB and the beat frequencysignalfor CW whichis generatedby the BFO oscillator Q_{408}, **2SK19**, are fed to the balanced demodulatorthroughbuffer amplifier, Q_{409}, **2SC372**. The MODE switch shifts the BFO frequency3 kHz lowerthan LSB positionfor USB and CW signal reception.

A part of the output fromthe last IF amplifier Q_{406} is fed to the AGC (Automatic Gain Control) rectifier D_{401}, **1N60**. The rectifiedAGC voltage is then amplifiedby the AGC amplifier Q_{407}, **2SC372**, and fed to the Q_{101}, Q_{401} and Q_{405} to control the gain of these stages automatically when the incoming signal strength is varied. Thus the receiveraudio output is not effectedby the variation of the inputsignalstrengthwhichmay be caused by phasing.The S-meter is placed in the emittercircuitof Q_{407} in whichthe emitter current changes in accordance with the incoming signal strength.

The detected audio outputis fed throughthe MODE switch and the VOLUME control potentiometer VR_1 to the audio amplifier integrated circuit

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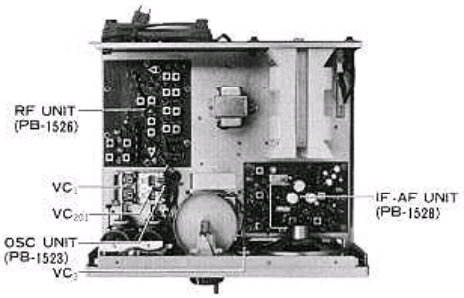
CIRCUIT DESCRIPTION (continued)

Q_{410}, **AN-214**, which utilizes OTL (Output Transformer Less) circuit delivering 3 watts to the speaker.

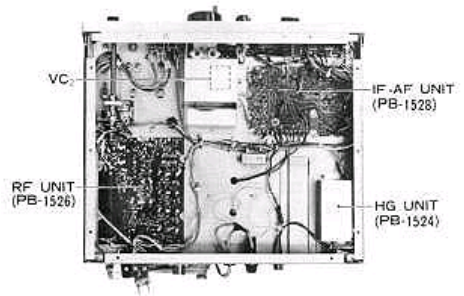
The power supply is designed to operate from either 100/110/117/200/220/234 volt AC 50/60 Hz or 12 volt DC (negative ground). For AC opera tion, +13.5 volts are supplied from full wave rectifier D_{408} and D_{409}, **VO6B.**



TOP VIEW

The 13.5 volts are used for audio amplifier stage.

The DC voltage in both AC or DC operation is supplied to the voltage regulator Q_{111}, **2SD313**, to obtain an extremely stable 10 volt DC supply which is used by the various circuits. The 10 volt DC is further regulated by zener diode D_{413}, **BZ-091**, at 9 volts, and then supplied to the oscillators and harmonic generator circuits. When the AC supply fails, the DC voltage may be automatically supplied to the circuit through the diode D_{410}, **VO6B**, which prevents the rectified DC voltage from flowing into the battery.



BOTTOM VIEW

FREQUENCY f	1ST OSC fo_1	1ST IF (fo_1-fi_1) fi_1	REF FREQ (1MHz x n) fh	2ND OSC (fo_1-fh) fo_2	2ND IF (fi_1-fo_2) fi_2	3RD OSC fo_2	3RD IF (fo_3-fi_2) fi_3
500kHz	55.5MHz	55.0MHz	3MHz	52.2MHz	2,500kHz	2,995kHz	455kHz
1,500	56.5	55.0	4	"	2,500	2,995	"
2,500	57.5	55.0	5	"	2,500	2,995	"
3,500	58.5	55.0	6	"	2,500	2,995	"
4,500	59.5	55.0	7	"	2,500	2,995	"
5,500	60.5	55.0	8	"	2,500	2,995	"
6,500	61.5	55.0	9	"	2,500	2,995	"
7,500	62.5	55.0	10	"	2,500	2,995	"
8,500	63.5	55.0	11	"	2,500	2,995	"
9,500	64.5	55.0	12	"	2,500	3,455	"
10,000	65.5	55.5	13	"	3,000	3,455	"
11,000	66.5	55.5	14	"	3,000	3,455	"
12,000	67.5	55.5	15	"	3,000	3,455	"
13,000	68.5	55.5	16	"	3,000	3,455	"
14,000	69.5	55.5	17	"	3,000	3,455	"
15,000	70.5	55.5	18	"	3,000	3,455	"
16,000	71.5	55.5	19	"	3,000	3,455	"
17,000	72.5	55.5	20	"	3,000	3,455	"
18,000	73.5	55.5	21	"	3,000	3,455	"
19,000	74.5	55.5	22	"	3,000	3,455	"
20,000	75.5	55.5	23	"	3,000	3,455	"
21,100	76.5	55.4	24	"	2,900	3,355	"
22,200	77.5	55.3	25	"	2,800	3,255	"
23,300	78.5	55.2	26	"	2,700	3,155	"

24,400	79.5	55.1	27	"	2,600	3,055	"
25,500	80.5	55.0	28	"	2,500	2,955	"
26,600	81.5	54.9	29	"	2,400	2,855	"
27,700	82.5	54.8	30	"	2,300	2,755	"
28,800	83.5	54.7	31	"	2,200	2,655	"
29,900	84.5	54.6	32	"	2,100	2,555	"

Table 3 Frequency Relationship

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MAINTENANCE & ALIGNMENT

The FRG-7 has been carefully aligned and tested at the factory using the precise test instruments before shipment and, with normal usage, it should not require other than the usual attention given to any electronic equipment. Service or replacement of major component may require substantial re alignment, however, under no circumstances, should realignment be attempted unless the operation of the receiver is fully understood and the malfunction has been fully analyzed and traced to misalignment. Service work should only be performed by experienced personnel using proper test equipment.

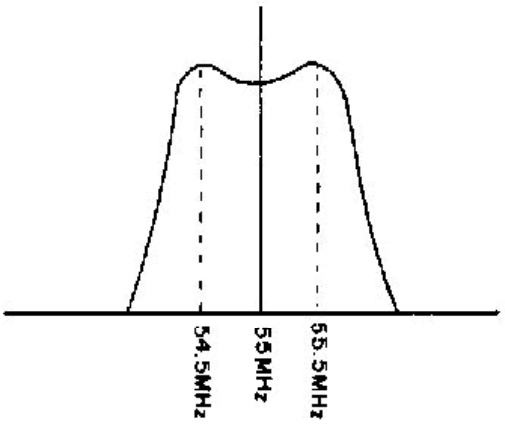

Fig. 5

TEST EQUIPMENT REQUIRED

(1) RF Signal Generator; Hewlett-Packard Model 606A or equivalent with one volt output at an impedance of *50* ohms and a frequency coverage to 30 MHz.

(2) Vacuum Tube Volt-Ohm Meter (VTVM): Hewlett-Packard Model 401B or equivalent VTVM with RE probe workable to 60 MHz.

(3) Sweep Generator and Oscilloscope workable to 60 MHz.

(4) Frequency Counter: Yaesu YC-355D or equivalent workable to 60 MHz.

RF UNIT PB-1526

(1) 55 MHz Passband Circuit, T_{105} ~ T_{108}

Set the BAND switch to D and the MHz dial to 20 MHz position. Disconnect the antenna. Connect the sweep generator output between TP $_{103}$ and TP $_{102}$ (ground), and the oscilloscope input between TP $_{104}$ and TP $_{105}$ (ground). Set the center frequency of the sweep generator to 55 MHz and align T $_{105}$ through T $_{108}$ until the scope indicates the curve shown in Fig. 5. Disconnect the sweep generator and the scope.

(2) Balanced Mixer, VR_{101}, TC_{106}

Set the BAND switch to A and the MHz dial to 0. Disconnect the antenna, and connect its output to antenna terminal. Tune the receiver to the internal spurious signal at 910 kHz. Adjust VR_{101} and TC_{105} for minimum S-meter indication.

(3) Antenna Coil and Trimmer, T_{101} ~ T_{104}

Connect the signal generator output to the antenna terminal SW_2 and connect SW_1 and BC terminals with a copper wire.

Set the signal generator to 0.5 MHz, the BAND to A and PRESELECT to 0.5. Tune the receiver to the signal generator signal. Adjust T $_{101}$ for maximum S-meter reading. Repeat this procedure at the frequencies shown in Table 4.

FREQ	BAND	PRESELECT	ALIGNMENT
0..5MHz	A	0.5	T101
1.6MHz	A	1.6	TC101
1.6MHz	B	1.6	T102
4.0MHz	B	4.0	TC102
4.0MHz	C	4.0	T103
11.0MHz	C	11.0	TC103
11.0MHz	D	11.0	T104
30.0MHz	D	30.0	TC104

Table 4

MAINTENANCE & ALIGNMENT (continued)

Disconnect the signal generator and the copper wire between SW_1 and BC.

(4) 52.5 MHz Selective Filter, T_{109} ~ T_{116}

Disconnectthe input from the oscillatorunit at TP 101. Connect the sweep oscillatoroutput between TP 107 and ground, and the scope between TP 109 and ground. Set the center frequency of the sweep generator to 52.5 MHz. Adjust T_{109} to T_{116} untilthe scope screen shows the curve shown in Fig. 6.

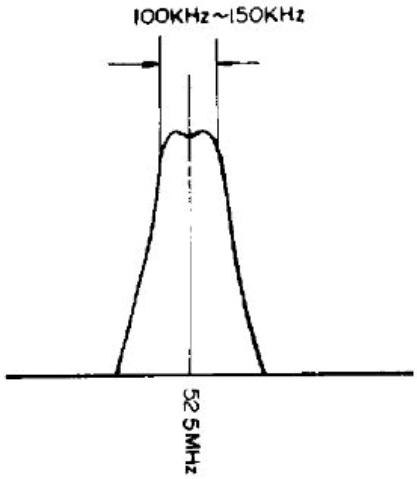

Fig. 6

Disconnect the sweep generator and scope and reconnect the wiring at TP 101. After completion of the above procedures make sure that the RF voltage between TP_{110} and ground is approximately 0.3 to 0.5 volt RMS. If not, repeat procedure.

(5) LOCK Level. VR_{102}

Adjust VR_{102} until the LOCK lamp turns off at any MHz setting of the MHz dial.

OSC UNIT PB-1523

(1) MHz Setting. T_{201} ~ TC_{201}

IF AF UNIT PB-1528

(1) Main Tuning Dial. T_{403} , TC_{403}

The following alignment should be done after warm-up of the receiver.

Set the dial hair line to the center of the dial window and FINE TUNING control to 12 o'clock position. When the main tuning dial is rotated until it stops over 1000 scale, ▲ mark should be within 5 m/m from the hair line.

Set the MODE switch to LSB and Mhz dial to 0. Set the main tuning dial to 1000, then beat tone willbe heard. Adjust T_{403} for zero beat. Set the main tuningdial to 0 and adjust TC_{403} for zero beat. Repeat above procedures until the tracking is completed.

(2) 2nd IF Tracking, TC_{401}, TC_{402}, T_{401}, T_{402}

Connect the signal generator to the antenna terminal SW_2 and sct it frequency to 7.1 MHz. Tune the receiver to the signal from the signal generator. Set the output voltage from the signal generator for S-3 reading on S-meter. Adjust TC_{401} and TC_{402} for maximum S-meter reading. Set the signal generator to 7.9 Mhz and tune tlw receiver to 7.9 MHz signal. Adjust TC_{401} and T_{402} for maximum S-meter reading. Repeat these procedures until the tracking is completed.

(3) 3rd IF, T_{404}, TC_{405}

Set the signal genenitor to 7.5 MHz and tune the receiver to this frequency. Adjust T_{404} and T_{405} for maximum S-meter reading. Adjust signal level so as not to satulate.

(4) S-meter Sensitivity, VR_{401}

Set the output level of the signal generator to 100 dB. And tune the receiver for maximum S-mcter reading. Adjust VR_{401} for S-meter full scale.

Connect the signal generator to antenna connector SW_2 and set its frequency to 3.5 MHz. Tune the receiver to the signal generator signal. Adjust T_{202} carefully until the LOCK lamp turns off at the center of 3 MHz scale on the MHz dial. Set the signal generator frequency to 27.5 MHz and tune the receiver to this signal. Carefully adjust TC_{201} until the LOCK lamp turns off at the center of 27 MHz scale on the MHz dial. Repeat above procedures until the LOCK lamp turns off at the center of every MHz scale. from 0 to 29 MHz. Disconnect the signal generator.

Disconnect the signal generator.

(5) BFO Frequency, T_{406}, TC_{404}

Connect a frequency counter to TP_{405}. Set the MODE switch to LSB. Adjus T_{406} for 457 kHz on the frequency counter reading. Set the MODE switch to USB/CW and adjust TC_{404} for 453 kHz.

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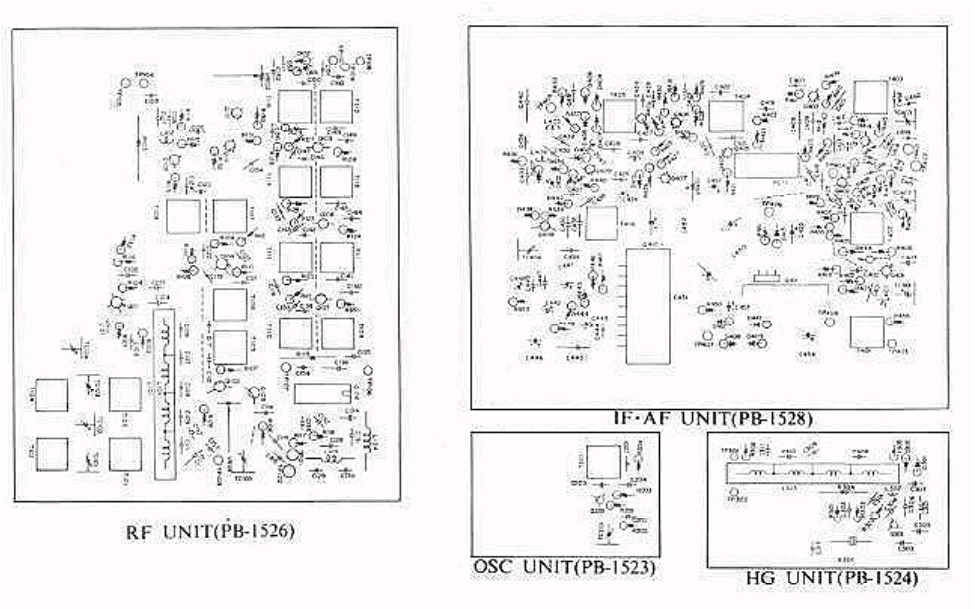
Voltage Chart

	E (S)	C (D)	B (G)		E (S)	C (D)	B (G)
Q_{101}	1.5	4.2	G_1 1.5 G_2 4.0	Q_{301}	0.2	8.0	-1.1
Q_{102}	1.6	9.0	0	Q_{401}	2.0	9.0	G_1 1.6 G_2 2.7
Q_{103}	2.2	9.0	0	Q_{402}	1.8	9.2	0
Q_{104}	0.5	9.0	G_1 0 G_2 4.5	Q_{403}	1.8	3.5	2.1
Q_{105}	2.0	9.2	0	Q_{404}	0.5	7.8	0
Q_{106}	0.7	9.2	1.3	Q_{405}	4.3	8.5	5.0
Q_{107}	1.1	9.2	1.7	Q_{406}	1.4	9.1	2.0
Q_{108}	1.4	8.8	2.0	Q_{407}	0.01	8.7	0.3
Q_{109}	0	0.02	0.5	Q_{408}	1.4	6.8	0
Q_{110}	0	9.5	0.02	Q_{409}	2.2	7.0	3.3
Q_{201}	1.8	7.7	1.2	Q_{411}	9.5	13.5	10.0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q_{106}	0	8.2	8.2	4.2	2.6	0	0	0	2.2	4.1	4.1	4.2	7.3	0
Q_{410}	6.5	0	7.8	11.0	6.5	0	6.5	12	13.5	-	-	-	-	-

BAND .... 4.0 ~ 11.0 MHz .... 7 MODE .... USB/CW Measured with VTVM Values are in VOLTS DC



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Part List

MAIN CHASIS			5		MJ-164
PB Printed Circuit Board			6 (P-6)		#4003A
1390 (A ~ Z)	Lamp Board		7		SG-8050-07
1525 (A ~ Z)	Switch Board				
1569 (A ~ Z)	LED Board				
			F Fuse		
			1		0.5 A
D Light Emitting Diode					
1	SL-103				
			FH Fuse Holder		
			1	SN01301	
R Resistor					
CARBON FILM					
1, 2	¼ W	10 Ohm	**RF UNIT**		
5, 9	¼ W	68 Ohm	**PB Printed Circuit Board**		
3, 6, 12	¼ W	100 Ohm	1526 (A ~ Z)		
4	¼ W	1 KOhm			
7, 11	¼ W	3.3 KOhm	**Q IC, FET & Transistor**		
10	¼ W	10 KOhm	106	IC	SN76514N
8	¼ W	22 KOhm	101, 104	FET	3SK40M
CARBON COMPOSITION			102, 103, 105	FET	2SK19GR
13	½ W	56 Ohm	110, 111	Tr	2SC372Y
14	½ W	68 Ohm	107 ~ 109	Tr	2SC784R (O)
			D Diode		
VR Potentiometer			101, 102	Si	1S1555
1	EVH-BOAS 20A14	10 KA			
			PL Pilot Lamp		
			1, 2, 3, 4, 5, 8		BQ041-32404A
C Capacitor			6, 7		BQ154-33811A
CERAMIC DISC					
4	50 WV	22 PF (SL)			
3	50 WV	33 PF (SL)	**R Resistor**		
MYLAR			CARBON FILM		
2	50 WV	0.03 mF	132	¼ W	100 Ohm
6, 7	50 WV	0.047 mF	102, 103, 107, 111, 112	¼ W	220 Ohm
1	50 WV	0.068 mF	115, 125, 129		
			119, 122	¼ W	330 Ohm
			118, 128	¼ W	470 Ohm
			104, 105	¼ W	560 Ohm
VC Variable Capacitor			117, 120, 124	¼ W	1 KOhm
1	C123A119	300 PF x 2	114	¼ W	3.3 KOhm
2	C134ER20	320 PF x 2	126	¼ W	4.7 KOhm
3	TSN 150S x 05	5 PF	136, 137	¼ W	6.8 KOhm
			130	¼ W	8.2 KOhm
PT Transformer			127	¼ W	15 KOhm
1	52-51 (51-50)		123	¼ W	22 KOhm
			121	¼ W	27 KOhm

			109, 110	¼ W	33 KOhm
CT Choke			116	¼ W	39 KOhm
1	50-51		133	¼ W	47 KOhm
			101, 106, 108, 113, 131, 135	¼ W	100 KOhm
			134	¼ W	330 KOhm
M Meter			123	¼ W	390 KOhm
1	KM-005		CARBON COMPOSITION		
			135	1/8 W	100 KOhm
			134	1/8 W	330 KOhm
SP Speaker			**VR Potentiometer**		
1	SA-128		102	EVL-S3A-B13	1 KB
			101	EVL-S3A-B53	5 KB
S Switch			**C Capacitor**		
1	ATT	ESL-3037	CERAMIC		
4	TONE	ESL-3037	159	50 WV	1 PF (CH)
2	BAND	ESR-E264R20	117, 138, 142, 146	50 WV	2 PF (CH)
3	MODE	ESR-E264R20	106, 109, 122, 160	50 WV	3 PF (CH)
5	POWER	8H2011	111, 130, 150	50 WV	5 PF (CH)
6	LAMP	8H2011	128, 131	50 WV	10 PF (CH)
			119	50 WV	15 PF (CH)
			129, 157, 158, 161	50 WV	22PF (CH)
J Connector			110	50 WV	27 PF (CH)
1		JSO-239	107, 108	50 WV	33 PF (CH)
2		SQ-2450-03	139, 143, 168	50 WV	47 PF (CH)
3		SG-8050-07	112414	50 WV	83 PF (CH)
4		SG-8481	114	50 WV	100 PF (SL)

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Part List (continued)

147, 166, 167	50 WV	0.001 MF	301, 302	Ge	1N60FM
101 ~ 105, 112, 113 115, 116, 118, 120, 121, 123 125, 127, 135 ~ 137, 140 141, 144, 145, 148, 149 151, 156, 162 ~ 165	50 WV	0.01 MF			
			X Crystal		
			301	HC-5/U	1MHz
126, 132 ~ 134	50 WV	0.047 MF			
			R Resistor		
			305, 306	¼ W	100 Ohm
TC Trimmer Capacitor			303, 304	¼ W	220 Ohm
101	ECV-1ZW 20x32	20 PF	302	¼ W	10 KOhm
102 ~ 104	ECV-1ZW 40x32	40 PF	301	¼ W	100 KOhm
L Inductor			**C Capacitor**		
102	RFC	68 MH	DIPPED MICA		
101	LPF	#220051	302	50 WV	180 PF
103		#220053	CERAMIC		
104		#220054	310	50 WV	8 PF (CH)
			311	50 WV	15 PF (CH)
			312	50 WV	22 PF (CH)
T Transformer			306, 309	50 WV	27 PF (CH)
101		#220046	308	50 WV	33 PF (CH)
102		#220047	305	50 WV	68 PF (CH)
103		#220048	301, 303, 304, 307	50 WV	0.01 MF
104		#220049			
105 ~ 106		#220050			
			L Inductor		
			302	RFC	4.7 mH
OSC UNIT			301	RFC	1 mH
PB Printed Circuit Board			303	LPF	#220051
1523 (A ~ Z)					
			IF * AF UNIT		
Q Transistor			**PB Printed Circuit Board**		
201		2SC784R (O)	1528 (A ~ Z)		
R Resistor			**Q IC, FET & Transistor**		
CARBON FILM			410	IC	AN-214
204	¼ W	100 Ohm	401	FET	3SK40M
203	¼ W	1 KOhm	402, 404, 408		2SK19GR
202	¼ W	4.7 KOhm	403, 405 ~ 407, 409		2SC372Y
201	¼ W	22 KOhm	411		2SD313
C Capacitor			**D Diode**		
CERAMIC			401 ~ 407	Ge	1N60FM

203	50 WV	22PF (CH)	408 ~ 410	Si	V06B
204	50 WV	33 PF (CH)	413	Zener	BZ091
201, 202	50 WV	0.01 MF	412	Zener	WZ110
VC Variable Capacitor			**FL Ceramic FIlter**		
201	C521	30PFx2	401	455 KHz	LFC-6
TC Trimmer Capacitor			**R Resistor**		
201	ECV-1ZW 10x32	10 PF	CARBON FILM		
			430	50 WV	15 Ohm
			451	50 WV	32 Ohm
T Transformer			406, 415, 423, 432, 442	50 WV	100 Ohm
201		#220052	444	50 WV	120 Ohm
			407, 419, 424, 433, 437	50 WV	220 Ohm
			441, 452		
HG Unit			450	50 WV	390 Ohm
PB Printed Circuit Board			431, 448	50 WV	470 Ohm
1523 (A ~ Z)			404, 436, 445	50 WV	560 Ohm
			411, 422, 438	50 WV	1 KOhm
			420	50 WV	1.5 KOhm
Q Transistor			413, 449, 453, 454, 457	50 WV	2.2 KOhm
301		2SC372Y	417, 418, 427, 429, 439	50 WV	3.3 KOhm
			427	50 WV	3.5 KOhm
			403, 428	50 WV	10 KOhm
D Diode			447	50 WV	15 KOhm

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Part List (continued)

410, 425, 443	¼ W	18 KOhm
446	¼ W	22 KOhm
409	¼ W	33 KOhm
401, 445, 456	¼ W	47 KOhm
405, 440	¼ W	68 KOhm
402, 408, 414, 434	¼ W	100 KOhm
435	¼ W	150 KOhm
421	¼ W	220 KOhm
VR Potentiometer		
401	EVL-S0A-B32	300 Ohm B
C Capacitor		
DIPPED MICA		
462	50 WV	20 PF
458	50 WV	33 PF
434	50 WV	100 PF
410	50 WV	120 PF
435, 436	50 WV	620 PF
409	50 WV	680 PF
408	50 WV	1000 PF
CERAMIC		
420, 424	50 WV	1 PF (CH)
438	50 WV	10 PF (CH)
412	50 WV	22 PF (CH)
459	50 WV	100 PF (UJ)
427, 428	50 WV	100 PF (SL)
415	50 WV	150 PF (SL)
414	50 WV	220 PF (SL)
430	50 WV	0.007 MF
401, 402, 405 ~ 407 416, 417, 422, 425, 431 439, 461	50 WV	0.01 MF
403, 404, 413, 418, 419 421, 423, 429, 437, 461	50 WV	0.047 MF
MYLAR		
444	50 WV	0.003 MF
456	50 WV	0.0047 MF
433	50 WV	0.01 MF
447, 449	50 WV	0.03 MF
440, 445	50 WV	0.2 MF
ELECTROLYTIC		
448	16 WV	1 MF
432, 457	16 WV	2.2 MF
453, 455	16 WV	10 MF
442, 443	16 WV	33 MF

426	16 WV	47 MF
441, 446, 454, 463	16 WV	100 MF
450 ~ 452	16 WV	1000 MF
TC Trimmer Capacitor		
403, 404	ECV-1ZW 20x32	20 PF
401, 402	ECV-1ZW 50x32	50 PF
L Inductor		
407, 408	RFC	4.7 mH
401	RFC	27 mH
409	RFC	100 mH
405	RFC	1 mH
402 ~ 404, 406	RFC	3.9 mH
T Transformer		
401		#220060
402		#220061
403		#220062
404, 405		R12-4097
406		R12-4099

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