INSTRUCTION MANUAL

COMMUNICATIONS RECEIVER

FRG-7

YAESU MUSEN CO., LTD.

TOKYO JAPAN

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"WARNING : TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE."

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-fi speaker will provide you with high quality audio output.

The FRG-7 includes a self-contained three way power supply for 117 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 "D" dry cells.

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

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 μV at S/N 10 dB
AM : Better than 2 μV 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:
117 volts AC 50/60 Hz, 12 volts DC external or internal dry cell UM-1 x 8

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:

1N60AM	9	1S1555	2
V06B	3		

Zener Diode:

WZ-110	1	BZ091	1

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 power supply is designed to operate from 117 volt AC 50/60 Hz or 12 volt DC.

CAUTION

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

The FRG-7 will operate satisfactorily from any 12 volt, negative ground battery source by connecting the DC power cord (cord 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.

Table 1 shows the power supply combination of FRG-7.

Power Source	1	2	3	4	5	6	7
AC Supply	○	–	–	○	○	○	–
External DC	–	○	–	X	–	X	○
Internal DC	–	–	○	–	X	X	X

○ 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 simple 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 resonant 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.

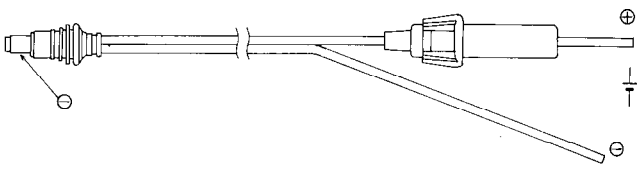
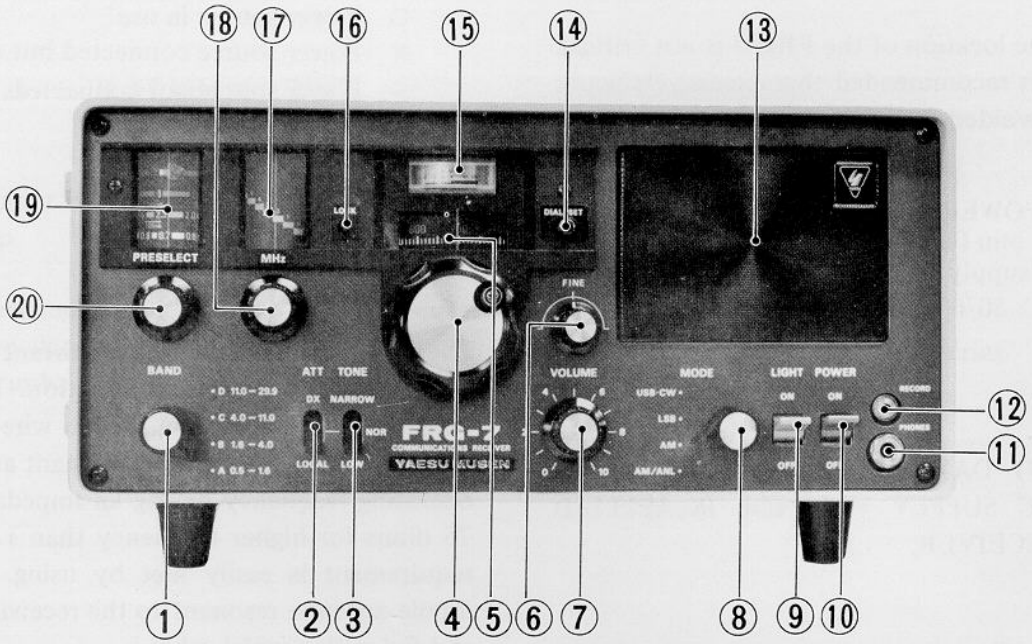


Fig.1 DC Power Cord

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) ATT (NOR, DX, LOCAL)

The ATT (attenuator) switch attenuates the incoming 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 and at LOW 250 Hz through 1500 Hz.

(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 USB·CW 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 modulated signal is heard and the Noise Limiter is put into the circuit in the AM/ANL position.

(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 both AC and DC operation.

(11) PHONES

Phone jack is provided for private listening and the speaker is disconnected when the plug is inserted 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 MHz control synthesizes heterodyne oscillator to the harmonics of 1 MHz crystal oscillator. The scale is calibrated in MHz with the frequency showing the correct setting of the heterodyne signal.

(19) (20) PRESELECT

The PRESELECTOR control tunes the receiver front end. The scale is calibrated with the frequency showing the correct setting for various bands.

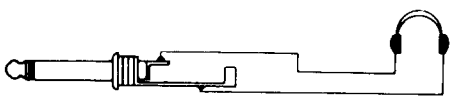
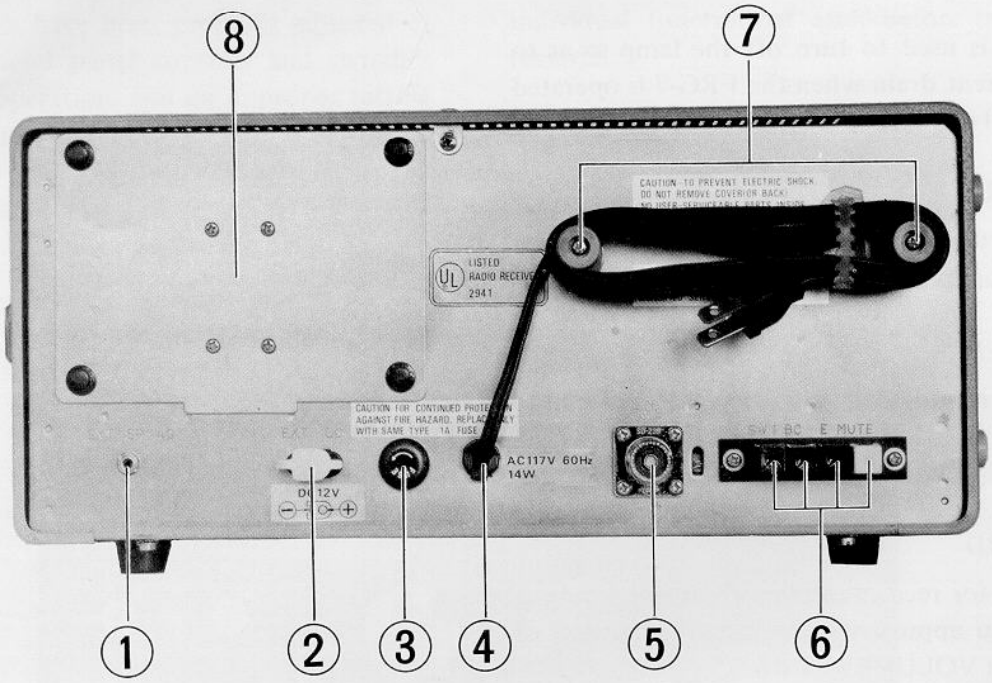


Fig. 2 Headphone Connection



REAR PANEL CONNECTION

(1) EXT SP

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 1 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 transmitting. Connect this terminal to ground for receiver muting.

(7) (8)

AC cord holder and the internal battery pack. Use eight "D" cells.

OPERATION

FREQUENCY SELECTION

The receiving frequency is selected by the combination 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	2 1 0	910	B1.6~4.0	USB · CW
	3,525	3.6 3.3 90mb	4 3 2	525	B1.6~4.0	LSB
	7,050	41mb 49	8 7 6	050	C4.0~11.0	LSB
	14,175	15 13 19mb	15 14 13	175	D11.0~29.9	USB · CW
	21,225	23 20 13mb	22 21 20	225	D11.0~29.9	USB · CW
	28,850	30 26 11mb	29 28 27	850	D11.0~29.9	USB · CW
Medium Wave	590	0.6	1 0	590	A0.5~1.6	AM or AM/ANL
	980	1.0 0.9	1 0	980	A0.5~1.6	AM or AM/ANL
	1,170	1.2 1.0	2 1 0	170	A0.5~1.6	AM or AM/ANL
WWV/JJY	2,500	2.6 2.3 120mb	3 2 1	500	B1.6~4.0	AM or AM/ANL
	5,000	5 4. 60mb	6 5 4	0	C4.0~11.0	AM or AM/ANL
	10,000	11 10 9 31mb	11 10	0	C4.0~11.0	AM or AM/ANL
	15,000	17 15 19mb	16 15 14	0	D11.0~29.9	AM or AM/ANL
Short Wave	3,925	4.0 3.6 75mb	4 3 2	925	B1.6~4.0	AM or AM/ANL
	5,980	6 49mb	6 5 4	980	C4.0~11.0	AM or AM/ANL
	9,715	10 9 31mb	9 8	715	C4.0~11.0	AM or AM/ANL
	11,705	12 11 25mb	12 11 10	705	D11.0~29.9	AM or AM/ANL
	15,120	17 15 19mb	16 15 14	120	D11.0~29.9	AM or AM/ANL
	17,880	20 17 16mb	18 17 16	880	D11.0~29.9	AM or AM/ANL
	21,550	23 20 13mb	22 21 20	550	D11.0~29.9	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 POWER 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.

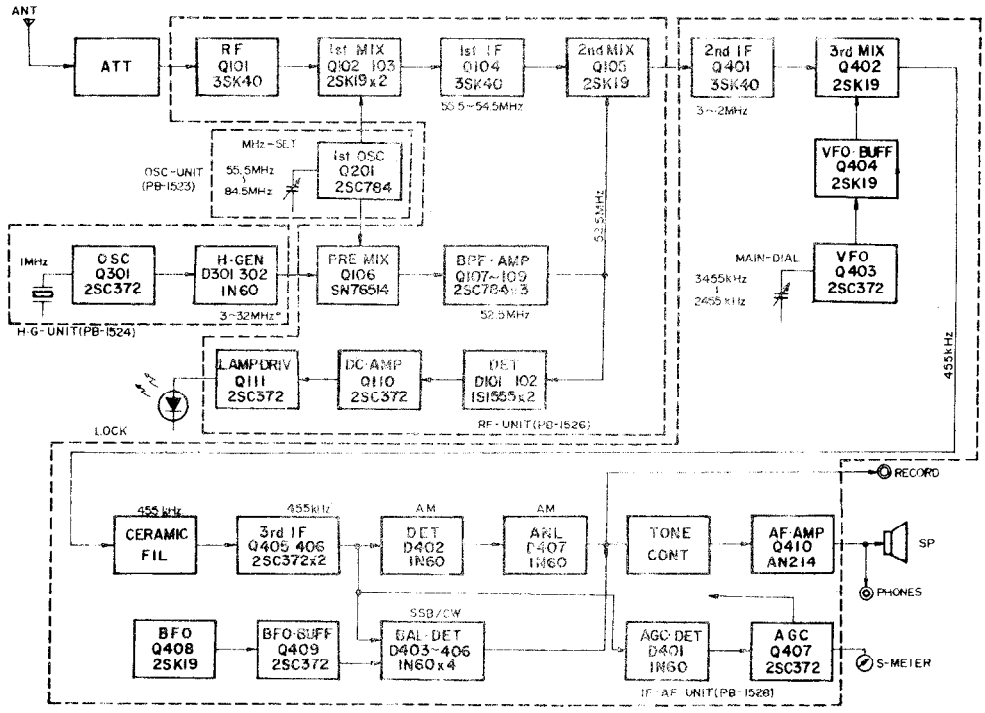


Fig.3 BLOCK DIAGRAM

CIRCUIT DESCRIPTION

The block diagram will provide you with a better understanding of 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 signal from the antenna is fed through the attenuator to the gate of the FET RF amplifier Q_{101}, **3SK40**. The amplified signal is fed through a low pass filter (cut off frequency 35 MHz) to the first balanced mixer consisting of Q_{102} and Q_{103}, **2SK19**, where the incoming signal is mixed with a signal from the 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 mixer becomes the first IF signal of 54.5 through 55.5 MHz. The first IF signal is amplified by the first IF passband amplifier Q_{104} and fed to the gate of the second mixer Q_{105}, **2SK19GR**, where the first IF signal is mixed with 52.5 MHz signal. The second mixer converts the first IF signal into the second IF signal of 2.0 through 3.0 MHz.

Synthesizer oscillator Q_{301}, **2SC372**, oscillates crystal controlled 1 MHz signal. The 1 MHz signal is then fed to the harmonic generator D_{301} and D_{302}, **1N60**, which produces 3 to 32 MHz harmonics from 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 eliminates other signals except the 52.5 MHz second heterodyne signal.

A part of the output from the selective amplifier is rectified by the detectors D_1 and D_2, **1S1555**, and the DC output voltage is amplified by 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 synthesizer is unlocked.

The output signal from the first IF amplifier Q_{104} is fed to the second mixer Q_{105}, **2SK19**, where the incoming signal is mixed with the 52.5 MHz signal from the selective amplifier. The output of the second mixer becomes second IF signal of 2.0 through 3.0 MHz. The 2.0 to 3.0 MHz IF signal is then amplified by the second IF amplifier Q_{401}, **3SK40**, and then fed to the third mixer Q_{402}, **2SK19**. The third mixer converts the second IF signal into 455 kHz third IF signal. The VFO (main tuning) signal, which varies between 2,455 kHz and 3,455 kHz, is generated by the variable frequency oscillator Q_{403}, **2SC372**, and supplied to the third mixer through the buffer amplifier Q_{404}, **2SK19**. The 455 kHz IF signal from the third mixer is fed to the ceramic filter which is tuned to 455 kHz and has ±3 kHz passband response to eliminate interference.

The signal is then amplified by 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}, **1N60AM**.

The balanced demodulator D_{403} through D_{406}, **1N60AM**, is used for the detection of SSB and CW signals. The carrier signal for SSB and the beat frequency signal for CW which is generated by the BFO oscillator Q_{408}, **2SK19**, are fed to the balanced demodulator through buffer amplifier, Q_{409}, **2SC372**. The MODE switch shifts the BFO frequency 3 kHz lower than LSB position for USB and CW signal reception.

A part of the output from the last IF amplifier Q_{406} is fed to the AGC (Automatic Gain Control) rectifier D_{401}, **1N60**. The rectified AGC voltage is then amplified by 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 receiver audio output is not effected by the variation of the input signal strength which may be caused by phasing. The S-meter is placed in the emitter circuit of Q_{407}, in which the emitter current changes in accordance with the incoming signal strength.

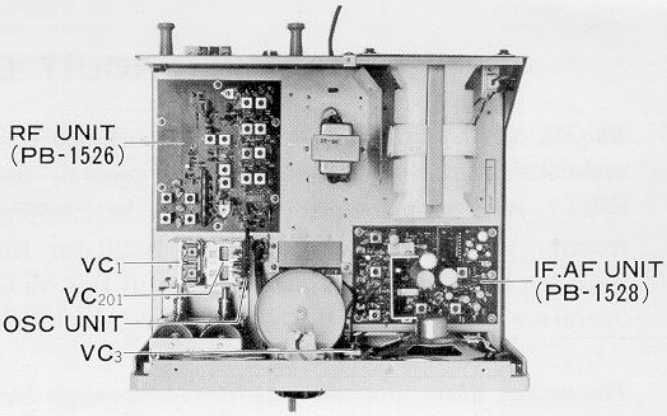
The detected audio output is fed through the MODE switch and the VOLUME control potentiometer VR_1 to the audio amplifier integrated circuit

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

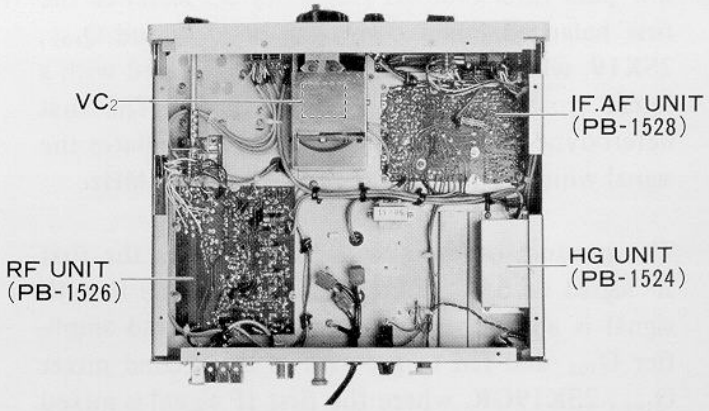
The power supply is designed to operate from 117 volt AC 50/60 Hz or 12 volt DC (negative ground). For AC operation, +13.5 volts are supplied from full wave rectifier D_{408} and D_{409}, **V06B**.

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}, **V06B**, which prevents the rectified DC voltage from flowing into the battery.



TOP VIEW



BOTTOM VIEW

FREQUENCY f	1ST OSC fo_1	1ST IF (fo_1-f) fi_1	REF FREQ (1MHz×n) fh	2ND OSC (fo_1-fh) fo_2	2ND IF (fi_1-fo_2) fi_2	3RD OSC fo_3	3RD IF (fo_3-fi_2) fi_3
500kHz	55.5MHz	55.0MHz	3MHz	52.5MHz	2,500kHz	2,955kHz	455kHz
1,500	56.5	55.0	4	〃	2,500	2,955	〃
2,500	57.5	55.0	5	〃	2,500	2,955	〃
3,500	58.5	55.0	6	〃	2,500	2,955	〃
4,500	59.5	55.0	7	〃	2,500	2,955	〃
5,500	60.5	55.0	8	〃	2,500	2,955	〃
6,500	61.5	55.0	9	〃	2,500	2,955	〃
7,500	62.5	55.0	10	〃	2,500	2,955	〃
8,500	63.5	55.0	11	〃	2,500	2,955	〃
9,500	64.5	55.0	12	〃	2,500	2,955	〃
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

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.

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 RF probe workable to 60 MHz.

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

(4) Frequency Counter; Yaesu YC-500 or equivalent workable to 60 MHz.

RF UNIT PB-1526

(1) 55 MHz Passband Circuit, $T_{105} \sim T_{108}$

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. 4. Disconnect the sweep generator and the scope.

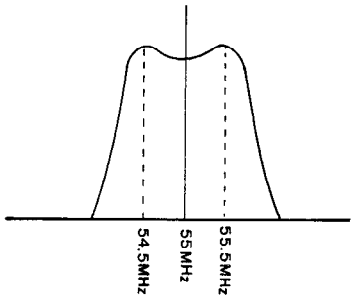


Fig.4

(2) Balanced Mixer, VR_{101}, TC_{105}

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, $T_{101} \sim T_{104}$, $TC_{101} \sim TC_{104}$

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

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

(4) 52.5 MHz Selective Filter, $T_{109} \sim T_{116}$

Disconnect the input from the oscillator unit at TP_{101}. Connect the sweep oscillator output 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} until the scope screen shows the curve shown in Fig. 5.

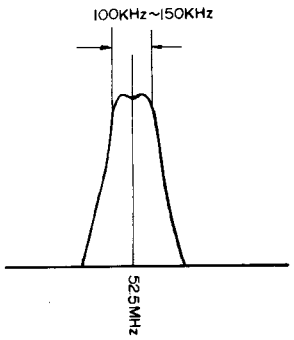


Fig.5

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}

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_{201} 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.

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 will be heard. Adjust T_{403} for zero beat. Set the main tuning dial 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 set its 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 the receiver to 7.9 MHz signal. Adjust T_{401} and T_{402} for maximum S-meter reading. Repeat these procedures until the tracking is completed.

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

Set the signal generator 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-meter reading. Adjust VR_{401} for S-meter full scale. Disconnect the signal generator.

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

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

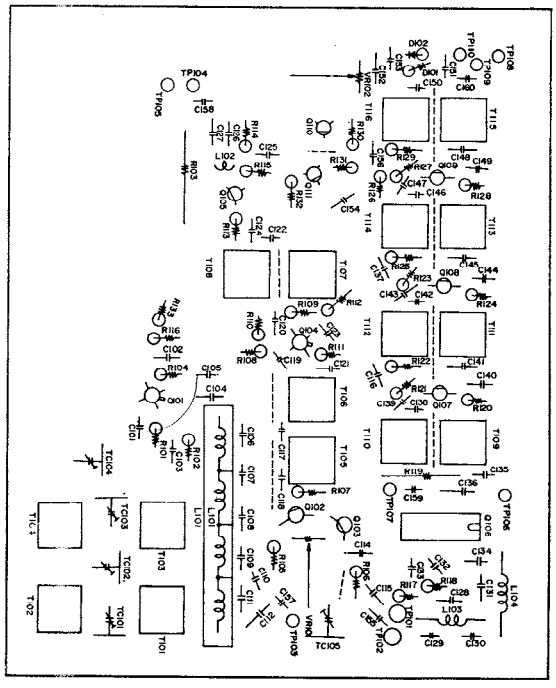
VOLTAGE CHART

	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_{107}	0.7	9.2	1.3	Q_{405}	4.3	8.5	5.0
Q_{108}	1.1	9.2	1.7	Q_{406}	1.4	9.1	2.0
Q_{109}	1.4	8.8	2.0	Q_{407}	0.01	8.7	0.3
Q_{110}	0	0.02	0.5	Q_{408}	1.4	6.8	0
Q_{111}	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

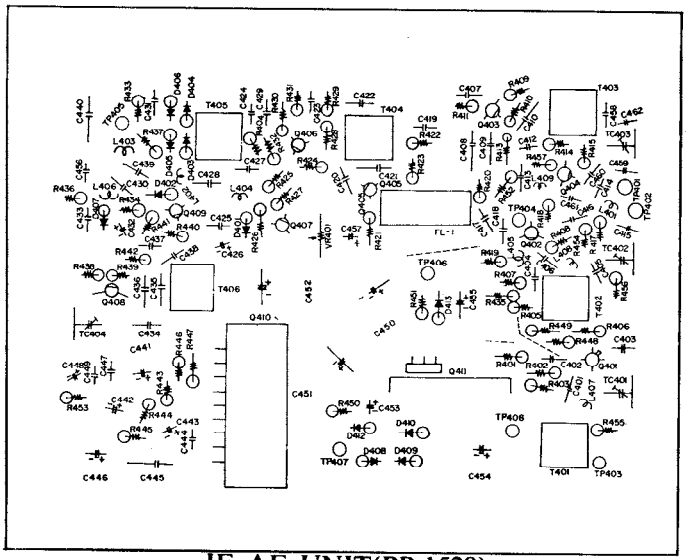
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q_{106}	0	8.2	8.2	4.2	2.6	0	0	0	2.2	4.1	4.1	4.2	7.3	0
Q_{410}	6.5	0	7.8	11.0	6.5	0	6.5	12	13.5	—	—	—	—	—

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

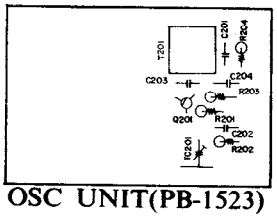
Table 5



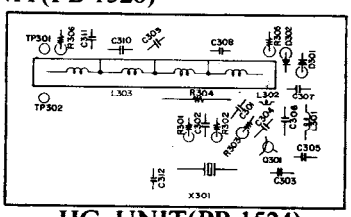
RF UNIT(PB-1526)



IF·AF UNIT(PB-1528)



OSC UNIT(PB-1523)



HG UNIT(PB-1524)

PARTS LIST

MAIN CHASSIS

PB	**PRINTED CIRCUIT BOARD**		
1390(A~Z)	LED BOARD		
1525(A~Z)	SWITCH BOARD		
1560(A~Z)	LAMP BOARD		
	DIODE		
D			
2,3	Si	V06B	
1	LED	SL-103	
R	**RESISTOR**		
	CARBON FILM		
1, 2		¼W	10Ω
5, 9		¼W	68Ω
3, 6, 12		¼W	100Ω
4		¼W	1KΩ
7, 11		¼W	3.3KΩ
10		¼W	10KΩ
8		¼W	22KΩ
	CARBON COMPOSITION		
13		½W	56Ω
14		½W	68Ω
15,16,17		½W	2.2MΩ
VR	**POTENTIOMETER**		
1	EVH-BOAS	20A14	10KA
C	**CAPACITOR**		
	CERAMIC DISC		
4		50WV	22PF(SL)
3		50WV	33PF(SL)
6, 7		50WV	0.047μF
	MYLAR		
2		50WV	0.02μF
1		50WV	0.068μF
	ELECTROLYTIC		
5		16WV	100μF
VC	**VARIABLE CAPACITOR**		
1		C123A119	300PF×2
2		C134ER20	320PF×3
3		TSN 150S×05	
PT	**TRANSFORMER**		
1		52-50	
CT	**CHOKE**		
1		50-11	
M	**METER**		
1		SH-44	
SP	**SPEAKER**		
1		SA-128	4Ω 2W
S	**SWITCH**		
1	ATT	ESL-3037	
4	TONE	ESL-3037	
2	BAND	ESR-E264R20	
3	MODE	ESR-E264R20	
5	POWER	8H2011	
6	LAMP	8H2011	
J	**CONNECTOR**		
1		JSO-239	
2		SQ-2450-03	
3		SG-8050-07	
4		SG-7814	
5		#9929	
6 (P-6)		#4003A	
7		SG-8050-07	
F	**FUSE**		
1		1 A	
FH	**FUSE HOLDER**		
1		SN-1301	
PL	**PILOT LAMP**		
1, 2, 3, 4, 5, 8		BQ041-32404A	
6, 7		BQ044-32433A	

RF UNIT

PB	**PRINTED CIRCUIT BOARD**		
1526(A~Z)			
Q	**IC, FET & TRANSISTOR**		
106	IC	SN76514N	
101, 104	FET	3SK40M	
102, 103, 105	FET	2SK19GR	
110, 111	Tr	2SC372Y	
107~109	Tr	2SC784R (O)	
D	**DIODE**		
101, 102	Si	1S1555	
R	**RESISTOR**		
	CARBON FILM		
132		¼W	100Ω
102, 103, 107, 111, 112 115, 125, 129		¼W	220Ω
119, 122		¼W	330Ω
118, 128		¼W	470Ω
104, 105		¼W	560Ω
117, 120, 124		¼W	1KΩ
114		¼W	3.3KΩ
126		¼W	4.7KΩ
136, 137		¼W	6.8KΩ
130		¼W	8.2KΩ
127		¼W	15KΩ
123		¼W	22KΩ
121		¼W	27KΩ
109, 110		¼W	33KΩ
116		¼W	39KΩ
133		¼W	47KΩ
101, 106, 108, 113, 131, 135, 138		¼W	100KΩ
134		¼W	330KΩ
	CARBON COMPOSITION		
135		⅛W	100KΩ
134		⅛W	330KΩ
VR	**POTENTIOMETER**		
102		EVL-S3A-B13	1KB
101		EVL-S3A-B53	5KB
C	**CAPACITOR**		
	CERAMIC		
159		50WV	1PF(CH)
117, 138, 142, 146		50WV	2PF(CH)
106, 109, 122, 160		50WV	3PF(CH)
111, 130, 150		50WV	5PF(CH)
128, 131		50WV	10PF(CH)
119		50WV	15PF(CH)
129, 157, 158, 161		50WV	22PF(CH)
110		50WV	27PF(CH)
107, 108		50WV	33PF(CH)
168		50WV	39PF(CH)
139, 143,		50WV	47PF(CH)
124		50WV	82PF(CH)
114		50WV	100PF(SL)

147, 166, 167	50WV		0.001μF
101～105, 112, 113	50WV		0.01μF
115, 116, 118, 120, 121, 123			
125, 127, 135～137, 140			
141, 144, 145, 148, 149			
151, 156, 162～165,			
126, 132,～134	50WV		0.047μF

TC	TRIMMER CAPACITOR		
101	ECV-1ZW	20×32	20PF
102～104	ECV-1ZW	40×32	40PF

L	INDUCTOR	
102	RFC	68μH
101	LPF	#220051
103		#220053
104		#220054

T	TRANSFORMER	
101		#220046
102		#220047
103		#220048
104		#220049
105～116		#220050

OSC UNIT

PB	PRINTED CIRCUIT BOARD
1523(A～Z)	

Q	TRANSISTOR	
201	2SC784(O)	

R	RESISTOR		
	CARBON FILM		
204		¼W	100Ω
203		¼W	1KΩ
202		¼W	4.7KΩ
201		¼W	22KΩ

C	CAPACITOR		
	CERAMIC		
203		50WV	22PF(CH)
204		50WV	33PF(CH)
201, 202		50WV	0.01μF

VC	VARIABLE CAPACITOR	
201	C521	30PF×2

TC	TRIMMER CAPACITOR		
201	ECV-1ZW	10×32	10PF

T	TRANSFORMER	
201	#220052	

HG UNIT

PB	PRINTED CIRCUIT BOARD
1524(A～Z)	

Q	TRANSISTOR	
301	2SC372Y	

D	DIODE	
301, 302	Ge(GB)	1N60FM(1S1007)

X	CRYSTAL	
301	HC-6/U	1MHz

R	RESISTOR		
305, 306		¼W	100Ω
303, 304		¼W	220Ω
302		¼W	10KΩ
301		¼W	100KΩ

C	CAPACITOR		
	DIPPED MICA		
302		50WV	180PF
	CERAMIC		
310		50WV	8PF(CH)
311		50WV	15PF(CH)
312		50WV	22PF(CH)
306, 309		50WV	27PF(CH)
308		50WV	33PF(CH)
305		50WV	68PF(CH)
301, 303, 304, 307		50WV	0.01μF

L	INDUCTOR	
302	RFC	4.7μH
301	RFC	1mH
303	LPF	#220051

IF・AF UNIT

PB	PRINTED CIRCUIT BOARD
1528(A～Z)	

Q	IC, FET & TRANSISTOR	
410	IC	AN-214
401	FET	3SK40M
402, 404, 408		2SK19GR
403, 405～407, 409		2SC372Y
411		2SD313

D	DIODE	
401～407	Ge(GB)	1N60FM
408～409	Si	V06B
413	Zener	BZ091
412	Zener	WZ110

FL	CERAMIC FILTER	
401	455kHz	LFC-6

R	RESISTOR		
	CARBON FILM		
430		¼W	15Ω
451		¼W	33Ω
406, 415, 423, 432, 442		¼W	100Ω
444		¼W	120Ω
407, 419, 424, 433, 437		¼W	220Ω
441, 452		¼W	
450		¼W	390Ω
431, 448		¼W	470Ω
404, 426, 445		¼W	560Ω
411, 422, 438		¼W	1KΩ
420		¼W	1.5KΩ
413, 449, 453, 454, 457		¼W	2.2KΩ
417, 418, 429, 439		¼W	3.3KΩ
427		¼W	3.9KΩ
403, 428		¼W	10KΩ
447		¼W	15KΩ

410, 425, 443	¼W	18KΩ
446	¼W	22KΩ
409	¼W	33KΩ
401, 455, 456	¼W	47KΩ
405, 440	¼W	68KΩ
402, 408, 414, 434	¼W	100KΩ
435	¼W	150KΩ
421	¼W	220KΩ

VR POTENTIOMETER		
401	EVL-S0A B32	300Ω B

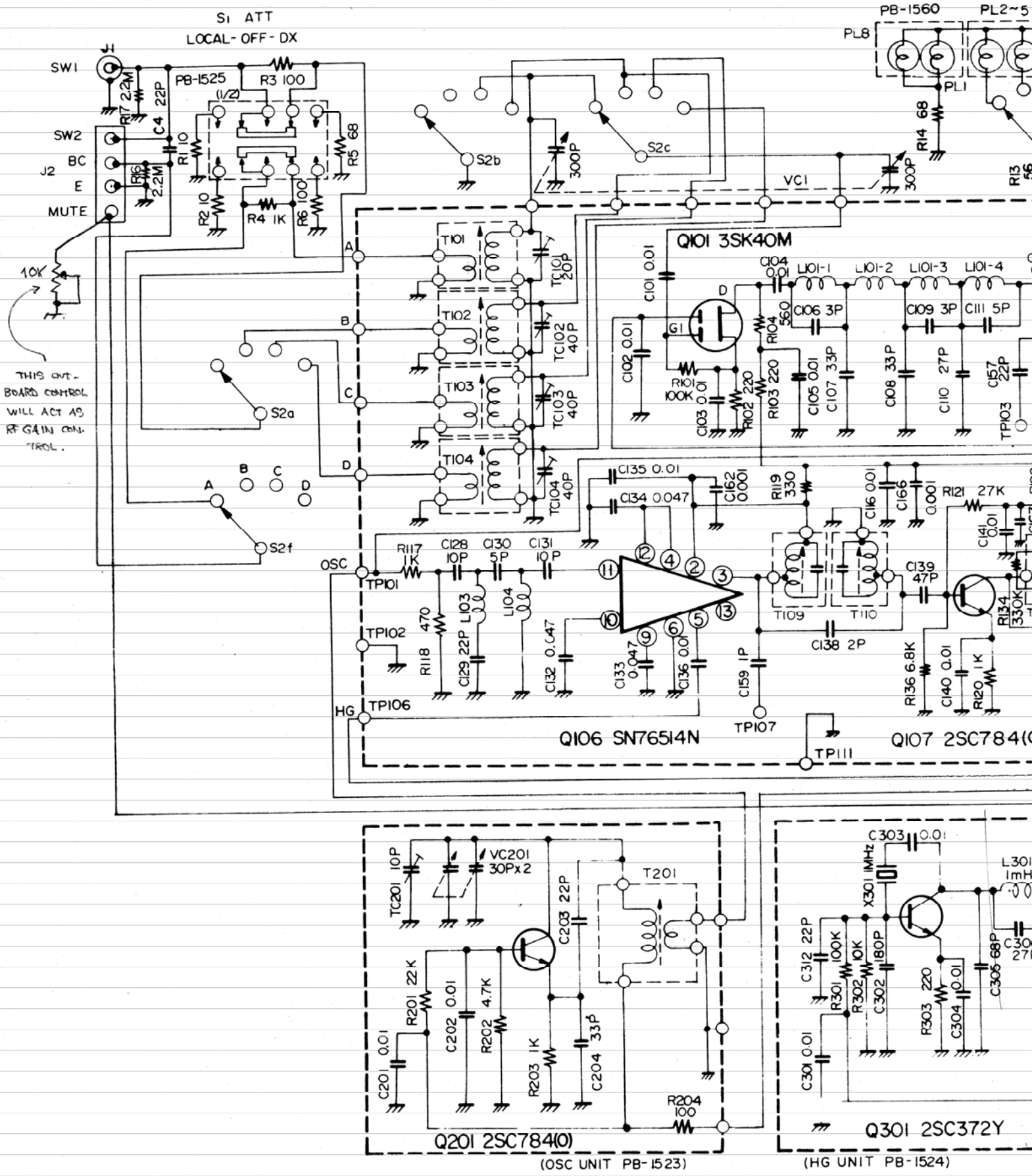
C CAPACITOR		
DIPPED MICA		
462	50WV	20PF
458	50WV	33PF
434	50WV	100PF
410	50WV	120PF
435, 436	50WV	620PF
409	50WV	680PF
408	50WV	1000PF
CERAMIC		
420, 424	50WV	1PF(CH)
438	50WV	10PF(CH)
412	50WV	22PF(CH)
459	50WV	100PF(UJ)
427, 428,	50WV	100PF(SL)
415	50WV	150PF(SL)
414	50WV	220PF(SL)
430	50WV	0.001μF
401, 402, 405～407 416, 417, 422, 425, 431 439, 461	50WV	0.01μF
403, 404, 413, 418, 419 421, 423, 429, 437, 461	50WV	0.047μF
MYLAR		
444	50WV	0.003μF
456	50WV	0.0047μF
433	50WV	0.01μF
447, 449	50WV	0.03μF
440, 445	50WV	0.2μF
ELECTROLYTIC		
448	16WV	1μF
432, 457	16WV	2.2μF
453, 455	16WV	10μF
442, 443	16WV	33μF
426	16WV	47μF
441, 446, 454, 463	16WV	100μF
450～452	16WV	1000μF

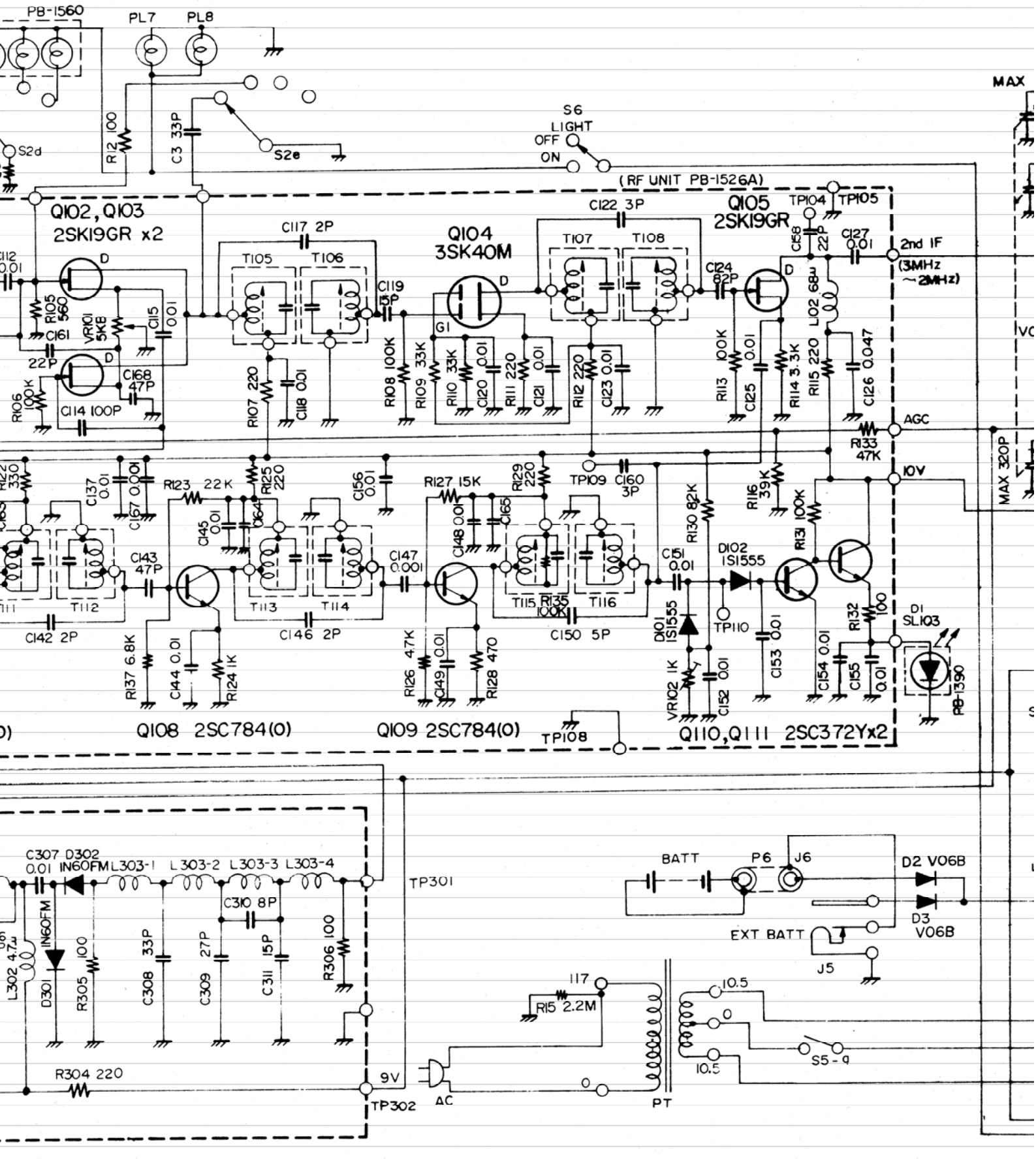
TC TRIMMER CAPACITOR			
403, 404	ECV-1ZW	20×32	20PF
401, 402,	ECV-1ZW	50×32	50PF

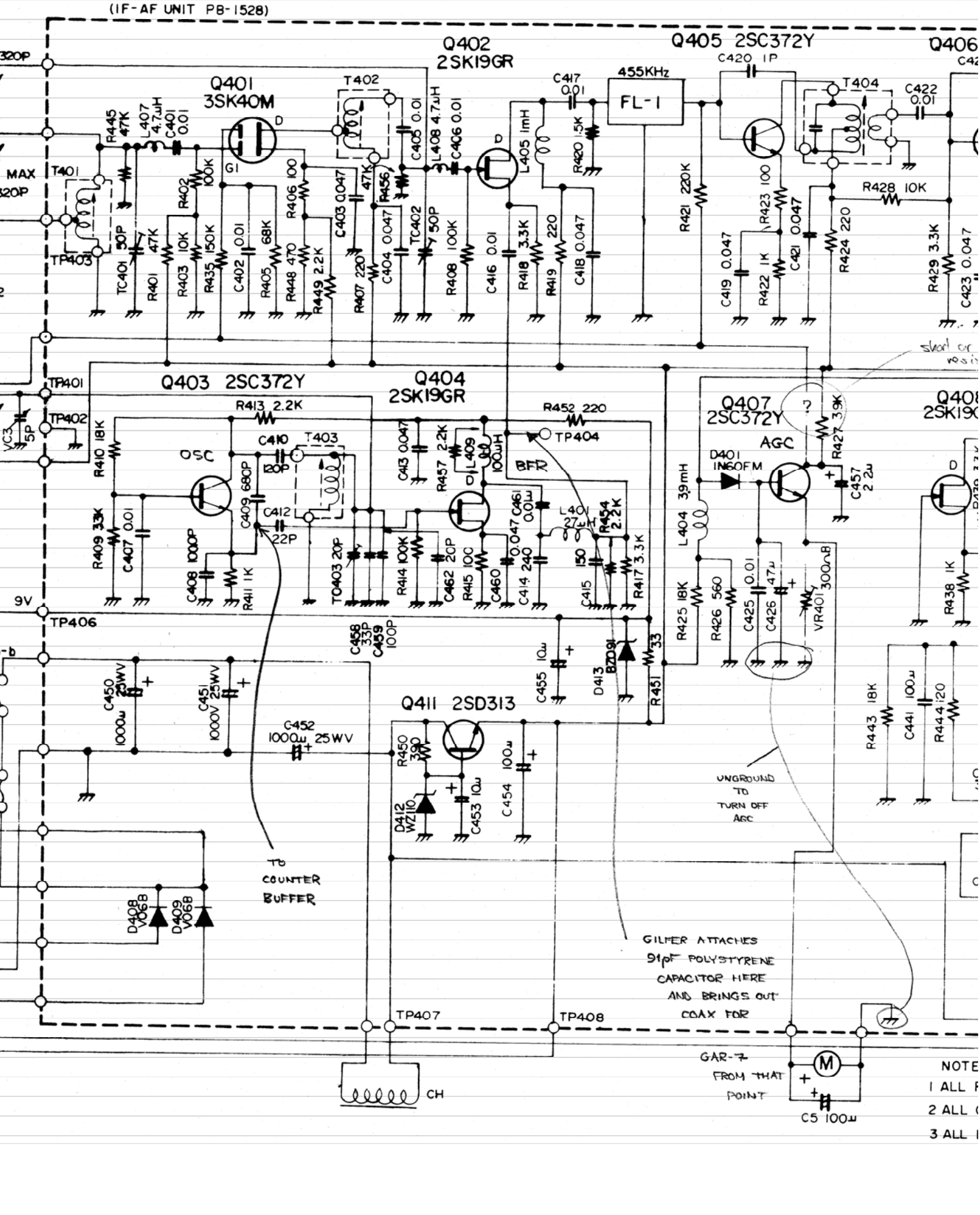
L INDUCTOR		
407, 408	RFC	4.7μH
401	RFC	27μH
409	RFC	100μH
405	RFC	1mH
402～404, 406	RFC	3.9mH

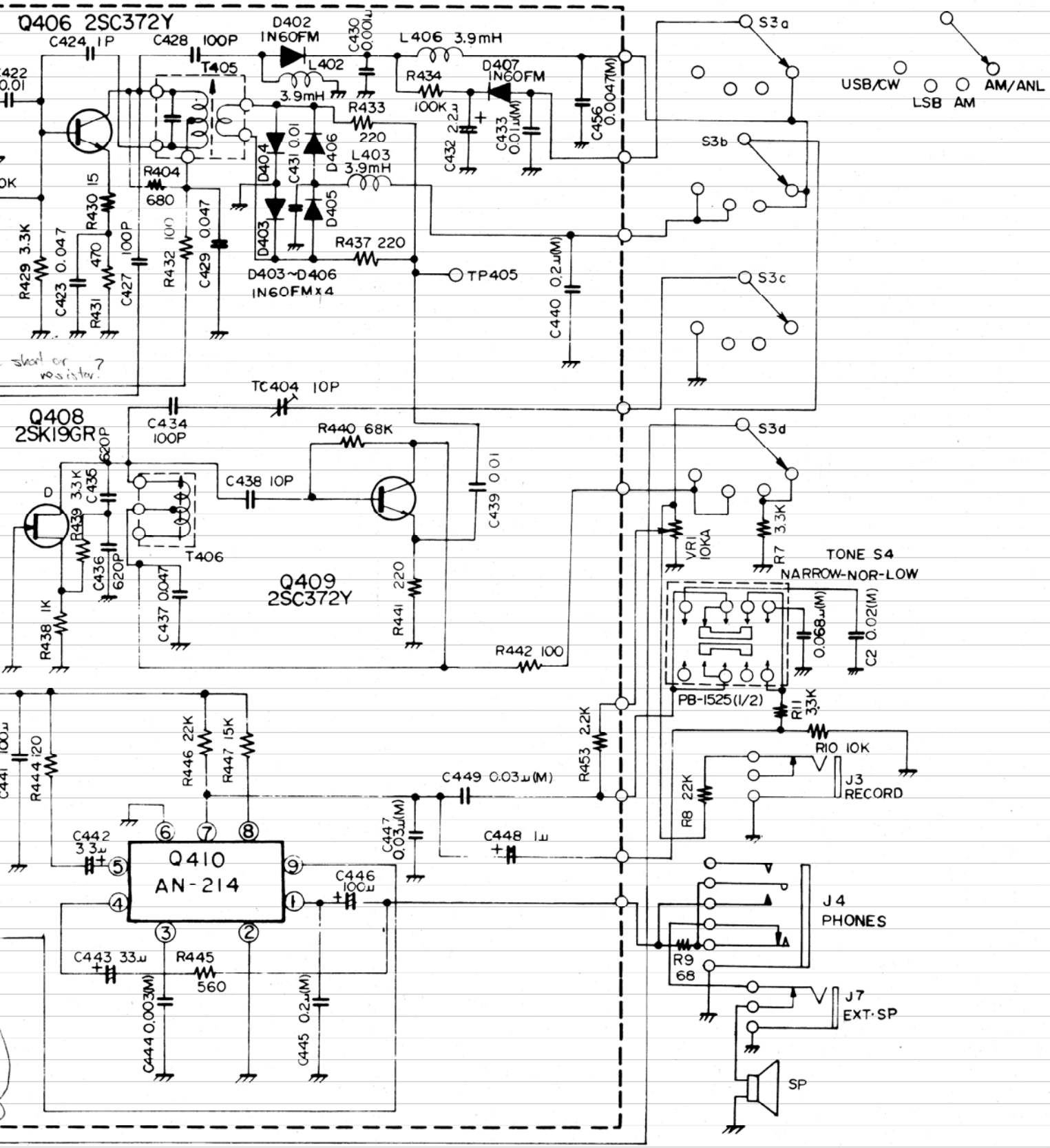
T TRANSFORMER	
401	#220060
402	#220061
403	#220062
404, 405	R12-4097
406	R12-4099

ACCESORIES	
EXTERNAL SPEAKER PLUG	P2240
RECORD PLUG	P2240
PHONES PLUG	SH3010
DC POWER CORD with 1A FUSE	#240027
ANTENNA WIRE A	#250003
ANTENNA WIRE B	#250004
FUSE	1A


S1 ATT
LOCAL - OFF - DX
SW1
SW2
J2
BC
E
MUTE
J1
PB-1525
R3 100
(1/2)
R17 2.2M
C4 22P
R1 10
R16 2.2M
R5 68
R2 10
R4 1K
R6 100
10K
THIS OUT-BOARD CONTROL WILL ACT AS RF GAIN CONTROL.
S2a
S2b
S2c
S2f
300P
VC1
PB-1560
PL2~5
PL8
PL1
R14 68
R13 56
Q101 3SK40M
T101
T102
T103
T104
TC101 20P
TC102 40P
TC103 40P
TC104 40P
C101 0.01
C102 0.01
C103 0.01
C104 0.01
R101 100K
R102 220
R103 220
R104 560
C105 0.01
C106 3P
C107 33P
C108 33P
C109 3P
C110 27P
C111 5P
C157 22P
TP103
L101-1
L101-2
L101-3
L101-4
OSC
TP101
TP102
TP106
HG
R117 1K
C128 10P
C130 5P
C131 10P
R118 470
C129 22P
L103
L104
C132 0.047
C133 0.047
C134 0.047
C135 0.01
C136 0.01
C162 0.001
R119 330
C116 0.01
C166 0.001
R121 27K
C139 47P
C138 2P
T109
T110
R134 330K
C141 0.01
R136 6.8K
C140 0.01
R120 1K
C159 1P
TP107
TP111
Q106 SN76514N
Q107 2SC784(
VC201 30Px2
TC201 10P
T201
C203 22P
R201 22K
C202 0.01
R202 4.7K
C201 0.01
R203 1K
C204 33P
R204 100
Q201 2SC784(0)
(OSC UNIT PB-1523)
C303 0.01
X301 1MHz
L301 1mH
C312 22P
R301 100K
R302 10K
C302 180P
R303 220
C304 0.01
C305 68P
C301 0.01
Q301 2SC372Y
(HG UNIT PB-1524)


PB-1560
PL7
PL8
R12 100
C3 33P
S2d
S2e
S6
LIGHT
OFF
ON
(RF UNIT PB-1526A)
Q102, Q103
2SK19GR x2
Q104
3SK40M
Q105
2SK19GR
C122 3P
T107
T108
TP104
TP105
C58 22P
C127 0.01
2nd IF
(3MHz ~ 2MHz)
C117 2P
T105
T106
C119 5P
C124 82P
L102 68μ
C112 0.01
R105 560
C161 22P
VR101 5KB
C115 0.001
C168 47P
C114 100P
R106 100K
R107 220
C118 0.01
R108 100K
R109 33K
R110 33K
C120 0.01
R111 220
C121 0.01
R112 220
C123 0.01
R113 100K
C125 0.01
R114 3.3K
R115 220
C126 0.047
AGC
R133 47K
10V
MAX
MAX 320P
R122 330
C137 0.01
C167 0.001
R123 22K
R125 220
C145 0.01
C144
C156 0.01
R127 15K
R129 220
TP109
C160 3P
C148 0.01
C165
R130 82K
R116 39K
R131 100K
C151 0.01
D102 1S1555
D101 1S1555
TP110
C153 0.01
R132 100
D1 SLI03
PB-1390
C154 0.01
C155
0.01
VR102 1K
C152 0.01
C143 47P
T112
T113
T114
T115
T116
R135 100K
C150 5P
C147 0.001
C142 2P
C146 2P
R137 6.8K
C44 0.01
R124 1K
R126 4.7K
C49 0.01
R128 470
Q108 2SC784(0)
Q109 2SC784(0)
TP108
Q110, Q111 2SC372Yx2
C307 0.01
D302 IN60FM
L303-1
L303-2
L303-3
L303-4
TP301
C310 8P
L302 4.7μ
D301 IN60FM
R305 100
C308 33P
C309 27P
C311 15P
R306 100
R304 220
9V
TP302
BATT
P6
J6
D2 V06B
D3 V06B
EXT BATT
J5
117
R15 2.2M
AC
PT
10.5
0
10.5
S5-9


(IF-AF UNIT PB-1528)
Q401 3SK40M
Q402 2SK19GR
Q403 2SC372Y
Q404 2SK19GR
Q405 2SC372Y
Q407 2SC372Y
Q411 2SD313
455KHz
FL-1
T401
T402
T403
T404
TP401
TP402
TP403
TP404
TP406
TP407
TP408
OSC
BFR
AGC
D401 IN60FM
D408 V06B
D409 V06B
D412 WZ110
D413 BZ091
VR401 300Ω B
CH
9V
TO COUNTER BUFFER
UNGROUND TO TURN OFF AGC
GILFER ATTACHES 91pF POLYSTYRENE CAPACITOR HERE AND BRINGS OUT COAX FOR GAR-7 FROM THAT POINT
C5 100μ
NOTE
1 ALL
2 ALL
3 ALL



NOTE

1 ALL RESISTORS ARE IN 1/4W UNLESS OTHERWISE NOTED.

2 ALL CAPACITORS ARE IN μF UNLESS OTHERWISE NOTED.

3 ALL ELECTROLYTIC CAPACITORS ARE 16WV UNLESS OTHERWISE NOTED

FRG-7

CIRCUIT DIAGRAM


YAESU