FRG-7000

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-7000

GENERAL DESCRIPTION

The model FRG-7000 is a high-performance, all solid state, communications receiver designed to cover the entire medium and high-frequency spectrum from 0.25 MHz - 29.9 MHz.

The FRG-7000 features a digital frequency display using large, bright digits for easy viewing. Also included is a 24-hour digital clock for both local and GMT time, with a timing feature for automatic receiver on/off switching.

The FRG-7000 is a triple-conversion superheterodyne receiver, utilizing a synthesized heterodyne oscillator known as the "Wadley Loop System," offering extremely stable receiver performance.

The IF filtering in the FRG-7000 provides a bandwidth of 3 kHz for SSB and CW (at 6 dB down), and 6 kHz for AM (at 6 dB down), thus providing superb rejection of unwanted interference.

The FRG-7000's switchable front-end attenuator and amplified AGC assist in reception under a variety of conditions, and the continuously variable audio filter provides for minimizing the high or low frequency audio response, as needed. A front panel recording jack plus relay connection jacks on the rear panel provide the flexibility demanded by the discriminating listener.

Plug-in circuit boards are used in the FRG-7000, providing high reliability and ease of servicing. FET's and IC's are used throughout the receiver, providing maximum performance within a compact cabinet.

A built-in AC power supply allows operation from 100/110/117/200/220/234 volts AC, 50/60 Hz. To reduce power consumption, the front panel lamps and digital display may be turned off.

The FRG-7000 is a precision-built instrument. Its performance, versatility, and reliability assure the discriminating listener of many hours of satisfying reception.

SPECIFICATIONS

Frequency Range:
0.25 MHz - 29.9 MHz

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

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

Selectivity:
SSB/CW ±1.5 kHz (−6 dB), ±4 kHz (−50 dB)
AM ±3 kHz (−6 dB), ±7 kHz (−50 dB)

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

Antenna Requirements:
Random wire 0.25 MHz - 1.6 MHz
50 Ohm unbalanced feed 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

Power Consumption:
AC 25 VA

Size:
360 (W), 125 (H), 295 (D) mm

Weight:
Approx. 7 kg

SEMICONDUCTOR COMPLEMENT

IC	SN76514N	2		μPC14305	1
	TA7205AP	1		μPC14308	2
	MC1416	2		NJM78L05A	1
	MC14011	1	FET	3SK40M	7
	MC14016	1		2SK19GR	8
	MC14027	1	Tr.	2SC372Y	8
	MC14081	1		2SC373	4
	MC14518B	1		2SC535A	1
	MC14519B	1		2SC784(O)	1
	MSM5502	1		2SC828	1
	MSM5592	1		MPS-A13	2
	SN7407N	2	Ge Diode	1S1007	11
	SN74LS00N	2	Si Diode	1S1555	17
	SN74LS90N	1		V06B	8
	SN74LS112N	1	LED	SL-103D	2
	SN74LS390N	1	LED Display	5082-7286	1
	SP8646B	1		5082-7740	5
	μPA56C	1			
	μPD546C-1(CPU)	1			

ACCESSORIES

The following accessories are packaged along with your FRG-7000:

(1) MINIATURE PHONE PLUG 2 ea.
For use in EXT SP or REC jacks.

(2) PHONE PLUG 1 ea.
For use with headphones.

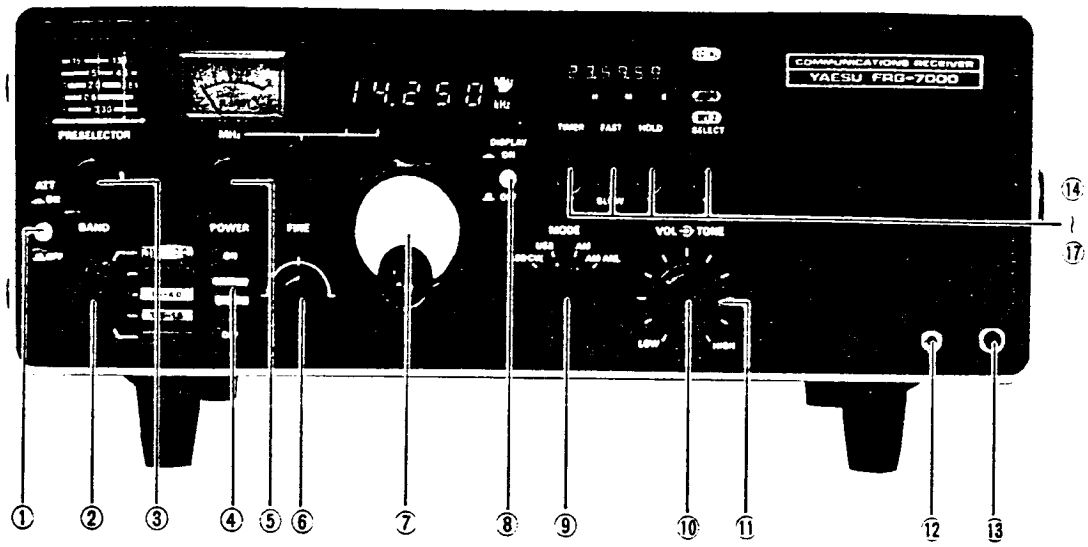
(3) RCA TYPE PLUGS 2 ea.
For use in control of station equipment through relay jacks on rear panel.

(4) UHF COAX PLUG 1 ea.
For connection to HF antenna using coaxial feedline.

(5) EXTRA FUSES 2 ea.
3 amp fuse plus another 1 amp or 0.5 amp fuse, depending on local supply voltage.

(6) WIRES 3M/10M 1 ea.
For indoor antennas.

CONTROLS AND SWITCHES



The FRG-7000 has been specifically designed for ease of operation. All controls have been adjusted at the factory to ensure peak performance. The operator may be unfamiliar with the operation of some of the controls, and improper settings thereof may result in poor reception. For this reason, please become throughly familiar with the function of every control before attempting to operate the receiver.

FRONT PANEL

(1) ATT (ON, OFF)

The ATT switch activates an attenuator for the receiver front end to minimize overloading under extreme conditions of strong adjacent signals. Maximum receiver sensitivity occurs with the ATT switch OFF.

(2) BAND

The BAND switch has five positions for selecting the proper preselector range for peaking the receiver circuits.

(3) PRESELECT

The preselector peaks the receiver circuits for maximum sensitivity on the frequency being received. The preselector bands are color coded to match the color code of the band switch, and the preselector control should be tuned to the frequency in use by observation of the calibration marks on the color coded scale, and by listening for maximum signal or noise strength from the speaker.

(4) POWER

This is the main on/off switch for the receiver. When it is in the OFF position, the timer circuit will turn the receiver on or off, according to the settings of SET 1 and SET 2 on the digital clock.

(5) MHz

The MHz control selects the 1 MHz band to be tuned for reception. When the control is not set correctly, e.g. between the 6 MHz and 7 MHz segments, the UNLOCK lamp will light to indicate that adjustment is needed.

(6) FINE

This control allows fine tuning of the received frequency.

(7) MAIN TUNING KNOB

This is the main tuning control for the receiver.

(8) DISPLAY (ON, OFF)

For conservation of energy, the front panel digital frequency display and lamps may be switched off with this button. The digital clock is not affected by this control.

(9) MODE (LSB/CW, USB, AM, AM/ANL)

This control selects the desired mode:

LSB/CW:	Lower sideband and CW
USB:	Upper sideband
AM:	Amplitude modulation
AM/ANL:	Amplitude modulation, automatic noise limiter

(10) VOL

This is the main volume control for the receiver.

(11) TONE

This control varies the audio filter so as to emphasize either high or low audio tones.

(12) REC

This jack is for recording purposes, and its output is set to approximately 50 mV, regardless of the setting of the volume control.

(13) PHONES

This is a standard 1/4" headphone jack. When the headphone plug is inserted into the jack, the internal speaker is cut off.

(14) TIMER

With proper setting of the SET 1 and SET 2 positions of the digital clock, placing the TIMER switch in the "down" position will allow automatic ON/OFF switching of the receiver by the digital clock.

(15) FAST/SLOW

This lever switch is used for setting the digital clock. The fast speed is used for rapid advancement of the indicated time, and the slow speed is used for the final, fine adjustment.

(16) HOLD

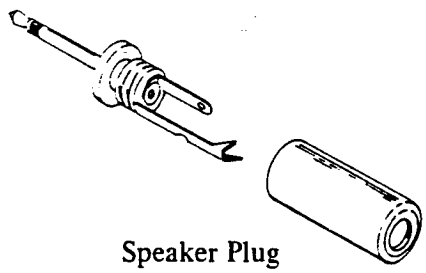
This lever switch will lock the digital clock on the indicated time. This switch is useful for alignment of the GMT and LOCAL indications, and also for time setting if the FAST/SLOW control advances the time too far.

(17) SELECT

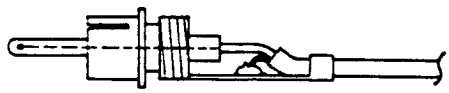
Each time the SELECT switch is pressed downward, the digital clock selection lamps are switched, corresponding to the change in the clock function. If the local time is being displayed (LOCAL lamp lighted), pressing the SELECT switch will cause the SET 1 lamp to light, and the clock will now display the time which has been programmed into the SET 1 position. Another press of the SELECT switch will cause SET 2 to be displayed, etc.

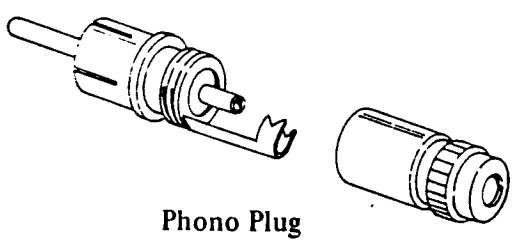
Speaker Connection
Via Headphone Plug

Phone Plug



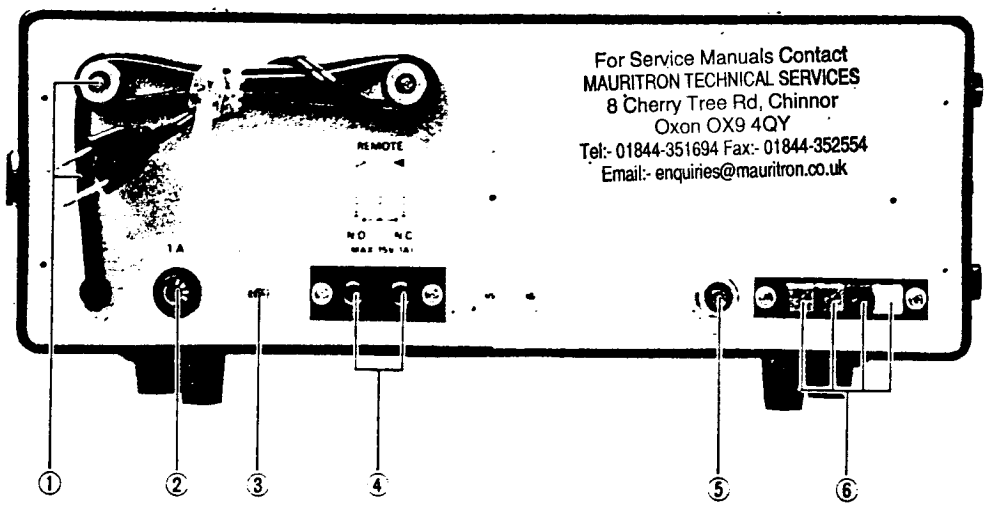
Speaker Plug





Phono Plug

REAR PANEL



(1) POWER CORD AND CORD HOLDER

The power cord may be wrapped around the cord holder for packing purposes.

(2) FUSE

For 100/110/117 volt operation, a 1 amp fuse should be installed here. For 200/220/234 volt operation, a 1/2 amp fuse should be installed. BE CERTAIN TO USE A FUSE OF THE PROPER RATING WHEN REPLACING FUSES.

(3) EXT SP

This jack is for connection of an external speaker. The impedance is 4 ohms, and insertion of a plug into this jack disables the internal speaker.

(4) REMOTE (N.O./N.C.) (N.O. = Normally Open; N.C. = Normally Closed)

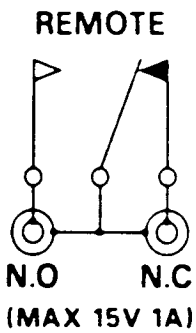
These two phono jacks are used for switching peripheral station equipment such as tape recorders, etc. When the TIMER switch is activated, and the clock passes the SET 1 time, the relay is activated. When the SET 2 time is passed, the relay returns to its normal state. With the TIMER switch off, the relay is in its normal state. The relay contacts are rated at 15 V at 1A.

(5) SW2

This is a standard UHF connector for coax-fed shortwave antennas.

(6) SW1, BC, E, MUTE

SW1 is a low-impedance connection for a random-length shortwave antenna.
BC is a high-impedance connection for a random-length shortwave antenna.
E is a ground connection.
MUTE is a connection for muting FRG-7000, as, for example, with an external standby switch. Shorting the MUTE terminal to ground will mute the receiver.



INSTALLATION

Carefully remove FRG-7000 from its carton, and inspect it for any signs of physical damage. Should any damage be observed, immediately notify the shipping company, stating the damage in detail. Save the carton and the packing material for possible future use.

LOCATION

In general, the location of the FRG-7000 is not critical. However, it is recommended that excessively warm locations be avoided.

The FRG-7000 is supplied with a multi-voltage power transformer (export model only). Thus, when moving to an area where the supply voltage is different from your accustomed supply voltage, your FRG-7000 may still be used. Before commencing operation initially, BE SURE THAT THE VOLTAGE MARKED ON THE REAR OF THE RECEIVER AGREES WITH THE LOCAL AC SUPPLY VOLTAGE.

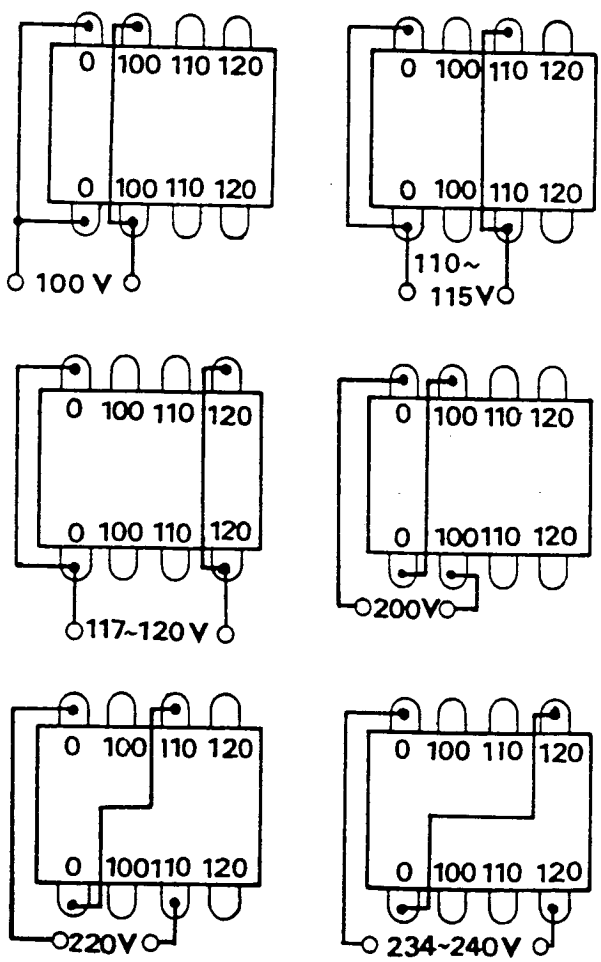


Fig.1 Transformer Primary Wiring

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE RECEIVER. THE WARRANTY DOES NOT COVER DAMAGE CAUSED BY IMPROPER AC SUPPLY VOLTAGE.

Should it become necessary to adapt the FRG-7000 to a different AC supply voltage, refer to the chart below for the proper connections. After modification, make a notation on the rear panel regarding the AC supply voltage in use.
If fuse substitution is required, be certain to use a fuse of the proper rating. For 100 - 117 volt operation, use a 1 amp fuse; for 200 - 234 volts, use a 1/2 amp fuse. The fuse holder is located on the rear apron. The counter unit also has a fuse of 3 amps (for all voltages). This fuse is installed inside the cabinet.

CAUTION

BE CERTAIN TO USE A FUSE OF THE PROPER RATING. WARRANTY DOES NOT COVER DAMAGE CAUSED BY USE OF AN IMPROPER FUSE.

ANTENNA AND GROUND

The antenna is the most important part of the communications receiver installation. The FRG-7000 is designed for use with a random-length antenna for 0.25 MHz - 1.6 MHz, and the antenna should be as long and high as possible. For 1.6 MHz - 29.9 MHz, maximum performance is secured through the use of a resonant antenna having an impedance of 50 to 75 ohms at the operating frequency. A center-fed dipole antenna cut for the desired frequency will easily satisfy this requirement, and it should be fed with coaxial cable. The length of a center-fed dipole can be determined by the formula

Length (feet) = 468/frequency (MHz)
Length (meters) = 142.5/frequency (MHz)

The FRG-7000 should be connected to a good earth ground. The ground lead should be of a heavy-gauge braided cable or wire, and should be connected to the terminal marked E on the rear panel of the receiver.

OPERATION

FREQUENCY SELECTION

The operating frequency is read directly from the digital display. All digits of the operating frequency are displayed, with resolution to 1 kHz. The main tuning dial provides rapid frequency change, and the fine tuning control allows ±2.5 kHz adjustment for precise zeroing on the desired station.

The main tuning dial tunes a 1 MHz range, and thus controls the last three digits of the displayed frequency (000 to 999). For setting the digital display to the desired frequency, rotate the MHz control until the desired MHz range is reached, then rotate the main tuning dial to set the last three digits of the displayed frequency. The MHz control is somewhat critical in adjustment, and care should be taken to adjust it so that the UN-LOCK lamp is not illuminated.

PRESELECTOR OPERATION

For peaking the receiver circuits for maximum sensitivity on the desired frequency, the pre-selector must be tuned to that frequency. The BAND switch should be rotated so that the pre-selector band appropriate for the operating frequency is selected. For example, for peaking for reception on 6.910 MHz, the 4.0 MHz - 11.0 MHz (green) range should be selected.

Next, rotate the PRESELECTOR control and observe the color-coded calibration of the pre-selector dial drum. The calibration marking should correspond to the operating frequency; precise adjustment is made by peaking the noise level or signal strength at the speaker, while carefully adjusting the PRESELECTOR control. The ATT switch should be OFF during peaking of the preselector.

Refer to Table 1 for details regarding the various switch and controls.

	Frequency	PRESELECT	Main Dial	BAND	MODE
Amateur	kHz 1,910	2.0 1.8	1.910 MHz	1.6~4.0	LSB · CW
	3,525	3.6 3.3	3.525 //	1.6~4.0	LSB · CW
	7,050	8 7	7.050 //	4.0~11.0	LSB · CW
	14,175	15 13	14.175 //	11.0~29.9	USB
	21,225	23 20	21.225 //	11.0~29.9	USB
	28,850	30 26	28.850 //	11.0~29.9	USB
Medium Wave	590	0.6	590 kHz	0.5~1.6	AM or AM/ANL
	980	1.0 0.9	980 //	0.5~1.6	AM or AM/ANL
	1,170	1.2 1.0	1.170MHz	0.5~1.6	AM or AM/ANL
WWV/JJY	2,500	2.6 2.3	2.500MHz	1.6~4.0	AM or AM/ANL
	5,000	5 4	5.000 //	4.0~11.0	AM or AM/ANL
	10,000	11 10 9	10.000 //	4.0~11.0	AM or AM/ANL
	15,000	17 15	15 000 //	11.0~29.9	AM or AM/ANL
Short Wave	3,925	4.0 3.6	3.925MHz	1.6~4.0	AM or AM/ANL
	5,980	6	5.980 //	4.0~11.0	AM or AM/ANL
	9,715	10 9	9.715 //	4.0~11.0	AM or AM/ANL
	11,705	12 11	11.705 //	11.0~29.9	AM or AM/ANL
	15,120	17 15	15.120 //	11.0~29.9	AM or AM/ANL
	17,880	20 17	17.880 //	11.0~29.9	AM or AM/ANL
	21,550	23 20	21.550 //	11.0~29.9	AM or AM/ANL

Table 1

BROADCAST BAND (0.5 MHz - 1.6 MHz) OPERATION

Special caution should be observed when attempting broadcast band reception, as the MHz control may appear to select more than one range for the segment of the band below 1 MHz. Use only the position of the MHz control immediately adjacent to the 1.0 MHz - 2.0 MHz band.

SHORTWAVE BROADCAST RECEPTION

International shortwave broadcast stations use the AM mode. Turn the POWER switch ON (TIMER switch OFF), place the MODE switch in the AM position, and select the desired frequency as described in the previous section. The VOLUME control should be adjusted for a comfortable listening level. The TONE control may be adjusted to provide the desired fidelity, and the FINE control will allow precise adjustment of the received frequency.

In the presence of extremely strong signals, the ATT switch may be placed in the ON position to prevent overload of the receiver front end. Should impulse noise be present, the MODE switch may be placed in the AM/ANL position.

AMATEUR BAND RECEPTION

SSB Voice Signals:

Virtually all amateurs use lower sideband (LSB) on the frequency bands below 7.3 MHz, and upper sideband (USB) above 14.0 MHz. Set the MODE switch to USB or LSB, as appropriate, and rotate the main tuning dial until a signal is clearly heard. The FINE control is extremely useful when tuning in SSB signals. The VOLUME and TONE controls should be adjusted for the clearest reception level.

CW (Morse Code Signals):

Amateur and commercial Morse Code transmissions may be received by placing the MODE switch in the LSB/CW position, and tuning the main dial and FINE controls for the desired listening tone.

Power Switch	Timer Switch		RECEIVER		REMOTE	
			SET-1	SET-2	N.O.	N.C.
OFF	OFF	OFF	OFF	OFF	OPEN	CLOSE
ON	OFF	ON	ON	ON	OPEN	CLOSE
OFF	ON	OFF	ON	–	CLOSE	OPEN
			–	OFF	OPEN	CLOSE
ON	ON	ON	OFF	–	CLOSE	OPEN
			–	ON	OPEN	CLOSE

Table 2

DIGITAL CLOCK OPERATION

The built-in digital clock will provide display of both your local time and Greenwich Mean Time (GMT). When the FRG-7000 is initially plugged in, the clock will indicate "00.00.00" and begin counting the seconds as they pass.

To set the clock to your local time, place the SELECT switch in the LOCAL position. Then use the FAST and SLOW switches to set the clock to the proper time. If desired, the clock may be set to some precise hour (for example, 11.00.00), and then the HOLD switch should be activated to hold the time at that point. When the time reaches exactly 11.00.00, release the HOLD switch, and the clock will resume counting. This technique is recommended for precise time calibration to a time standard such as WWV or JJY.

For setting to GMT time, it is recommended that the HOLD switch technique be used. Align the LOCAL time to a suitable point (e.g. 16.00.00) and activate the HOLD switch. Place the SELECT switch in the GMT position, and use the FAST and SLOW switch to calibrate the GMT clock with the GMT appropriate for the LOCAL time being held (e.g. 16.00.00 Eastern Standard Time = 21.00.00 GMT). Release the HOLD switch to start both clocks simultaneously.

The HOLD switch will freeze the time on both clocks. The FAST and SLOW switch will advance only the clock being displayed. The clock is operative as long as the FRG-7000 is plugged in.

TIMER OPERATION

The SET 1 and SET 2 positions of the SELECT switch may be set to provide automatic ON and OFF control of the FRG-7000. For example, if a favorite program starts at 0730 local time, 07.30.00 may be stored in the SET 1 position for automatically turning the receiver on at that time. When it is desired to turn the receiver off automatically, that time may be stored in the SET 2 position. The TIMER circuitry may also be used for controlling peripheral equipment such as a tape recorder, as the timer relay actuates the REMOTE jacks on the rear apron.

The timer circuitry has the effect of switching the condition of the receiver as determined by the POWER switch. That is, when the POWER switch is OFF, and the TIMER switch ON, the receiver will be OFF until the SET 1 time. Between the SET 1 and SET 2 times, the receiver will be ON, and between the SET 2 and SET 1 times the receiver will again be OFF.

When the POWER switch is in the ON position, these relations are reversed. That is, with the POWER switch ON, and the TIMER switch ON, the receiver will be ON until the SET 1 time. From the SET 1 time until the SET 2 time, the receiver will be OFF, and after the SET 2 time the receiver will be ON until the SET 1 time.

The REMOTE contacts are controlled by the TIMER relay. In the period between the SET 1 and SET 2 times, the normally open (N.O.) jack will be CLOSED, and the normally closed (N.C.) jack will be OPEN. With the TIMER switch OFF, regardless of the position of the POWER switch, the jacks are in their "normal" states.

For example, if you must be away from your station, but want to record a program, proceed as follows: preset the receiver to the proper frequency and peak the preselector, etc. Connect the FRG-7000 REC jack to the recording input of the tape recorder, and connect the tape recorder "footswitch" jack to the REMOTE N.O. jack. Align the SET 1 time to the start of the program, and the SET 2 time to the end of the program. Place the POWER switch in the OFF position, and the TIMER switch ON. Place the tape recorder in the record condition; it should not operate because the REMOTE N.O. jack is open. When the SET 1 time is reached, the FRG-7000 will turn on, the tape recorder will be activated, and both will operate until the SET 2 time (the end of the program).

CIRCUIT DESCRIPTION

The block diagram will provide you with a better understanding of this receiver. Basically, the FRG-7000 is a triple-conversion superheterodyne receiver utilizing a synthesized local oscillator for both the first and second mixers. The result is drift-free VFO operation.

The signal from the antenna is fed through the RF attenuator to the gate of the FET RF amplifier Q_{101} (3SK51-03). The amplified signal is fed through a low-pass filter (cutoff frequency 35 MHz) to the first balanced mixer, consisting of Q_{102} and Q_{103} (both 2SK19GR), where the incoming signal is mixed with a signal from the heterodyne oscillator. The first heterodyne oscillator, Q_{301} (2SC784O), provides a signal varying between 55.5 and 84.5 MHz.

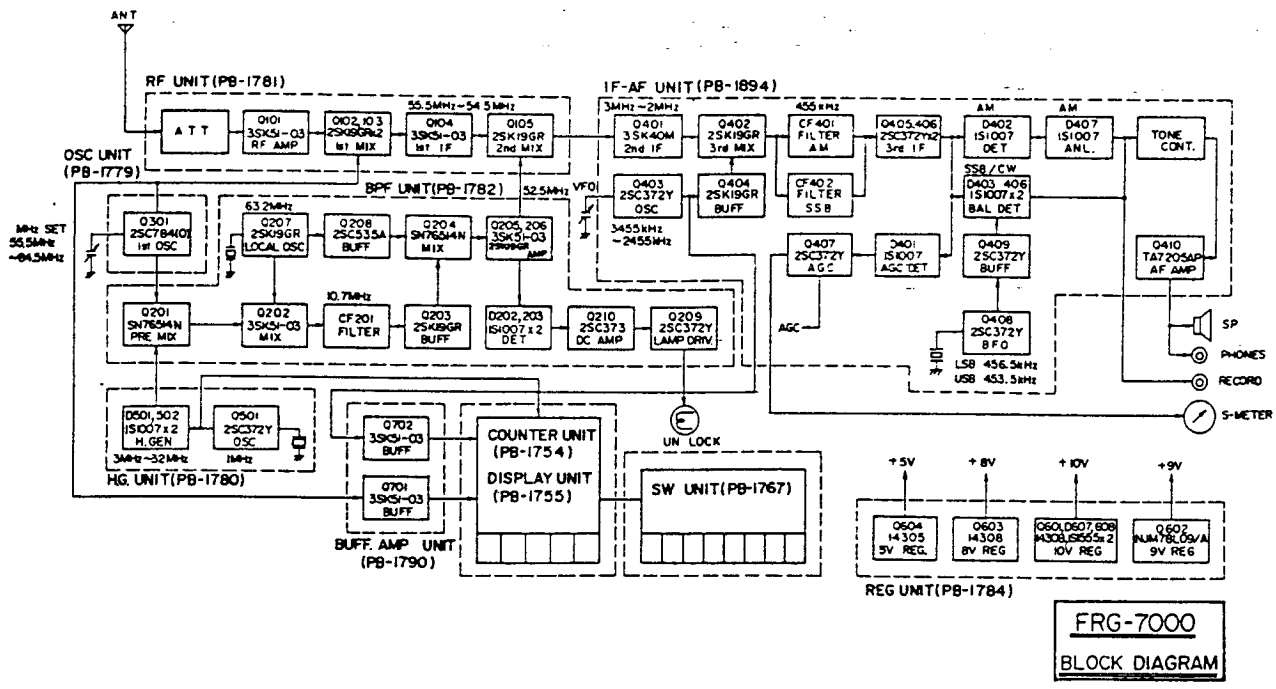
A 52.5 MHz heterodyne signal is produced as follows: the synthesized oscillator Q_{501} (2SC372Y) generates a 1 MHz signal, which is then fed to harmonic generator D_{501} - D_{502} (both 1S1007). This produces a series of harmonics from 3 to 32 NHz. This signal is fed to the first premixer, Q_{201} (SN76514), where the 55.5 MHz - 84.5 MHz and 3 MHz - 32 MHz signals are mixed, producing a 52.5 MHz signal.

The 52.5 MHz output signal from Q_{201} is fed to the second premixer Q_{202} (3SK51-03), where the 52.5 MHz signal is mixed with a 63.2 MHz signal generated by Q_{207} (2SK19GR), producing a 10.7 MHz IF signal.

The 10.7 MHz IF signal passes through a 10.7 MHz ceramic filter and is amplified by Q_{203} (2SK19GR) and fed to mixer Q_{204} (SN76514), where the 10.7 MHz signal is mixed with a 63.2 MHz signal generated by Q_{207}, producing a filtered 52.5 MHz signal.

The 52.5 MHz signal is then amplified by Q_{205} (3SK51-03) and Q_{206} (2SK19GR), and returned to the RF UNIT as the heterodyne signal for the second mixer, Q_{105} (2SK19GR). A portion of the output signal from Q_{206} is rectified by D_{202} (both 1S1007). The DC voltage is then amplified by Q_{210} (2SC372Y) and fed to the LOCK indicator driver Q_{209} (2SC372Y), which turns the LOCK lamp PL_3 on when the synthesizer is unlocked.

The 54.5 MHz - 55.5 MHz signal is mixed with the 52.5 MHz heterodyne signal by Q_{105} (2SK19GR), resulting in a 2 MHz - 3 MHz IF



BLOCK DIAGRAM

signal. This IF signal is amplified by Q_{401} (3SK40M) and fed to a third mixer Q_{402} (2SK19GR), where the IF signal is mixed with a 2455 kHz - 3455 kHz heterodyne signal, producing a 455 kHz third IF signal. The 2455 kHz - 3455 kHz heterodyne signal is generated by VFO oscillator Q_{403} (2SC372Y) and fed through buffer amplifier Q_{404} (2SK19GR) to Q_{402}. The 455 kHz IF signal is fed through a ceramic filter, CF-401, for AM, or CF-402 for SSB and CW, to eliminate adjacent-frequency interference.

The signal is then amplified by the third IF amplifier Q_{405} and Q_{406} (both 2SC372Y), and fed to the appropriate detector. The AM signal is detected by diode detector D_{402} (1S1007).

Balanced demodulator D_{403} - D_{406} (all 1S1007) is used for the detection of SSB and CW signals. The carrier signal for SSB and the beat frequency signal for CW (generated by BFO oscillator Q_{408} (2SC372Y)) are fed to the balanced demodulator through buffer amplifier Q_{409} (2SC372Y). The MODE switch shifts the BFO frequency for reception of an LSB or USB signal.

The output from the detectors is amplified by Q_{410} (TA7205AP) for delivery to the speaker.

A portion of the output from the last IF amplifier Q_{406} is fed to the AGC (Automatic Gain Control) rectifier D_{401} (1S1007). The rectified AGC voltage is then amplified by AGC amplifier Q_{407} (2SC372Y) and fed to Q_{101}, Q_{401}, and Q_{405} to control the gain of these stages automatically according to the strength of the received signal. Thus, the receiver output is not affected by variations in signal strength which may be caused by phase shift on the incoming signal. 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.

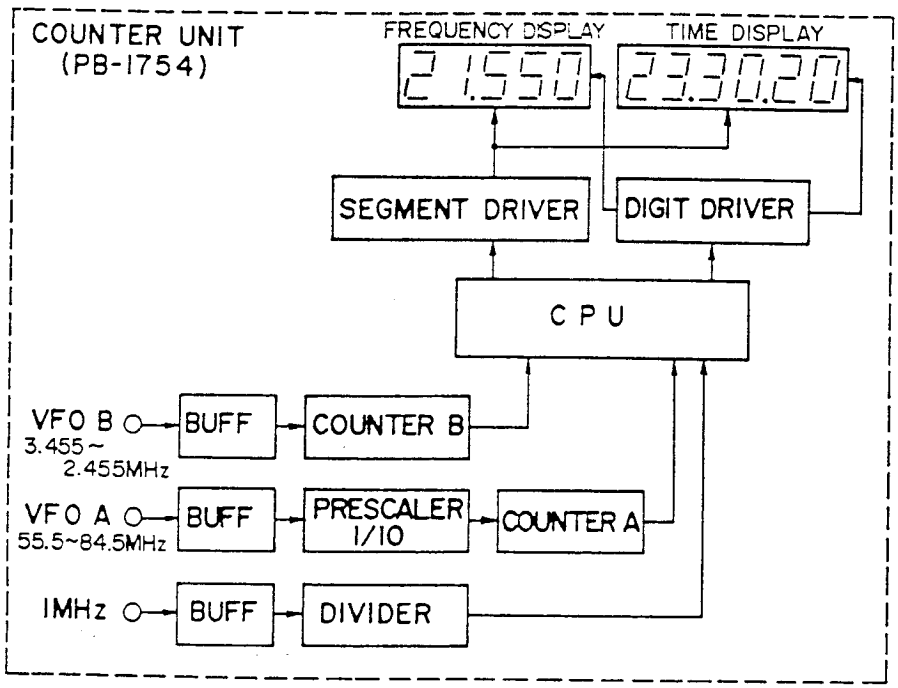
The 55.5 MHz - 84.5 MHz and 2455 kHz - 3455 kHz signals are amplified, respectively, by buffer amplifiers Q_{701} and Q_{702} (both 3SK51-03), and fed to the counter to display the received frequency.

FREQUENCY f	1ST OSC fo_1	1ST IF (fo_1-fi_1) 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

The counter unit utilizes a 4-bit microcomputer unit (CPU) to display the frequency being received. The CPU also drives the digital clock, which displays both local and GMT time. The clock section of the CPU controls the timer function for ON/OFF control of the receiver and peripheral station equipment.

The regulated power supply consists of four regulators: Q_{601} (14308), Q_{602} (NJM 78L09A), Q_{603} (14308), and Q_{604} (14305), to deliver stabilized voltages of 10V, 9V, 8V, and 5V to various circuits in the receiver.



MAINTENANCE & ALIGNMENT

GENERAL

The FRG-7000 has been carefully aligned and tested at the factory prior to shipment, and, with normal usage, it should not require other than the usual attention given to electronic equipment. Service or replacement of a major component many entail substantial realignment; under no circumstances, however, should realignment be attempted unless the operation of the receiver is fully understood and the malfunction has been definitely attributed to misalignment rather than component failure. Service work should be performed by experienced personnel using proper test equipment.

(1) Local Oscillator T_{207}

Connect a VTVM between TP_{202} and TP_{204} (ground). Adjust T_{207} for 0.6V RMS as indicated on the VTVM. Connect a frequency counter to TP_{202}, and make sure that the output frequency is 63.2 MHz.

(2) Output level T_{201} - T_{206}

Connect a VTVM between TP_{108} and TP_{109} (ground). Set the FRG-7000 MHz control to 29 MHz. Carefully adjust the MHz control for a maximum VTVM reading. Then peak T_{201} - T_{201} for a maximum VTVM reading.

(3) Harmonic generator TC_{501}

Connect a frequency counter between TP_{502} and TP_{501} (ground), and adjust TC_{501} for a reading of 1 MHz. The output voltage at TP_{502} should be approximately 0.2V RMS.

(4) Oscillator Unit T_{301}, TC_{301}

Connect a frequency counter between TP_{107} and TP_{104} (ground). Set the FRG-7000 MHz control to the fully counterclockwise position. Adjust T_{301} for a reading of 54.0 MHz on the counter. Set the MHz control to the fully clockwise position, and adjust TC_{301} for a reading of 85.2 MHz on the counter. Repeat the above adjustments, if necessary, until the UNLOCK lamp turns off at every 1 MHz incremental advancement of the MHz control.

(5) VFO Frequency T_{403}, TC_{403}

This alignment should be performed after the receiver has been allowed to warm up 30 minutes. Connect a frequency counter between TP_{402} and TP_{404} (ground). Set the main tuning knob to the fully clockwise position, and adjust T_{403} for a reading of 2380 kHz on the counter. Set the main tuning knob next to the fully counterclockwise position, and adjust TC_{403} for a counter reading of 3480 kHz. Repeat this adjustment, if necessary, until complete tracking is accomplished The output voltage at TP_{402} should be 0.3V - 0.6V RMS.

(6) Second IF Alignment T_{401}, T_{402}, TC_{401}, TC_{402}

Connect a signal generator between TP_{105} and TP_{106} (ground). Set the MODE switch to the AM position, and set the signal generator output frequency to 2.1 MHz (the FRG-7000 display should indicate 900 kHz). Peak T_{401} and T_{402} for a maximum S-meter reading.

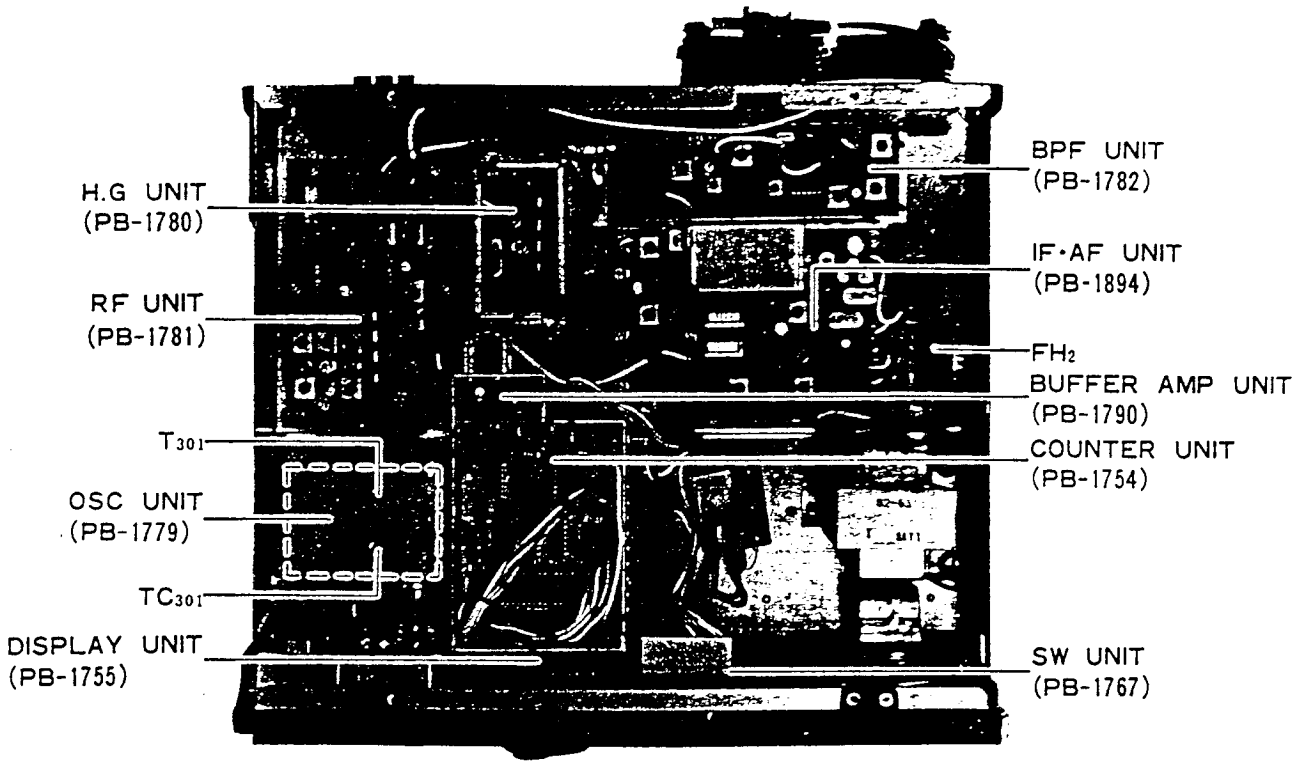
Set the signal generator to 2.9 MHz (the FRG-7000 digital display should indicate 100 kHz). Peak TC_{401} and TC_{402} for a maximum S-meter reading. Repeat the above adjustments until complete tracking is accomplished.

(7) Third IF Alignment T_{404}, T_{405}

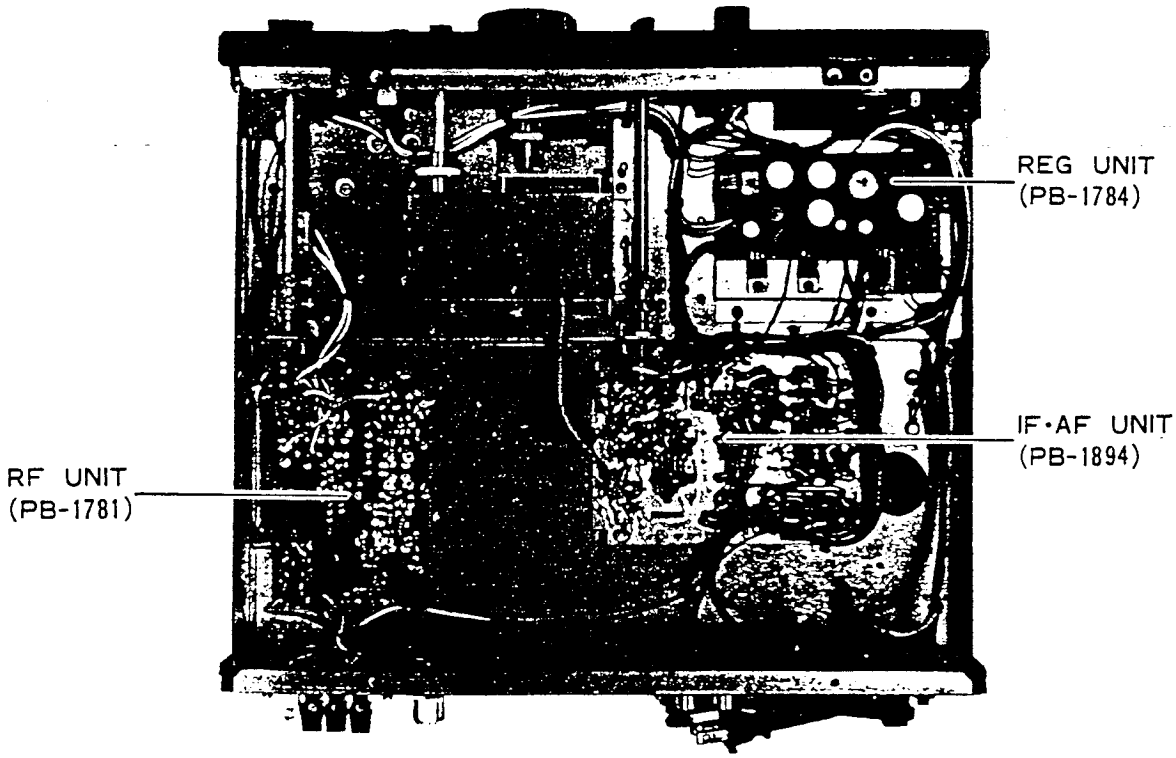
Connect a signal generator to TP_{401} and TP_{406} (ground), and set its output to 2.9 MHz (the FRG-7000 digital display should indicate 100 kHz). Peak T_{404} and T_{406} and T_{405} for a maximum S-meter reading.

(8) S-meter Sensitivity VR_{401}

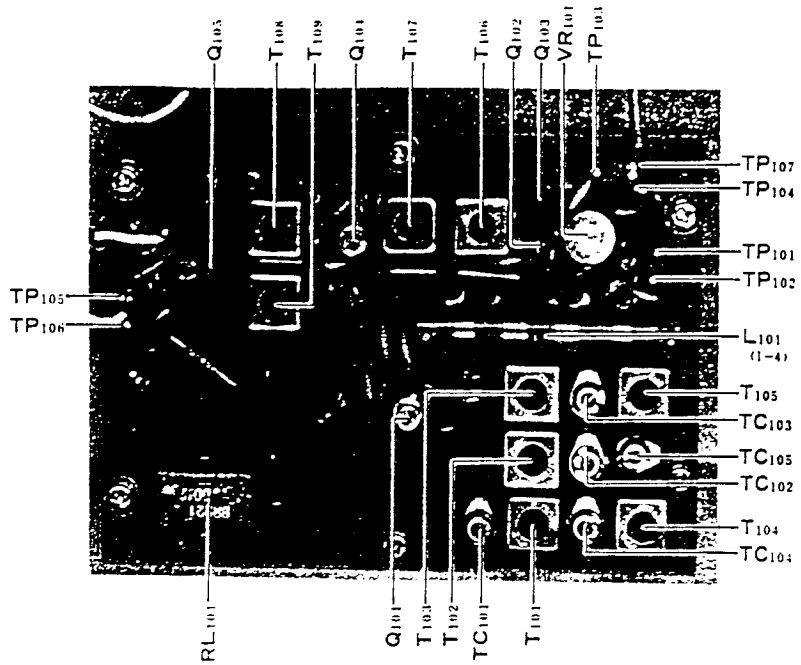
Connect a signal generator to SW2, and apply an 11 MHz 100 dB signal. Tune the receiver to 11 MHz, and adjust VR_{401} for a full scale reading on the S-meter.



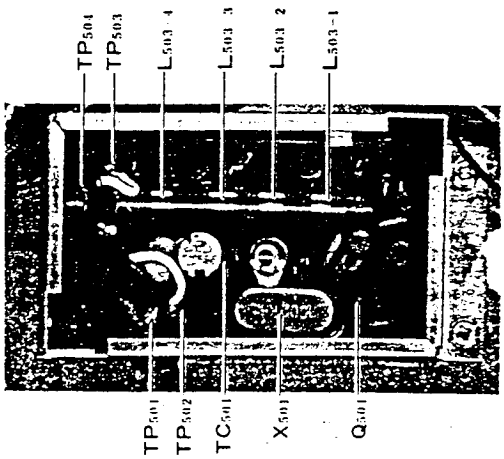
TOP VIEW



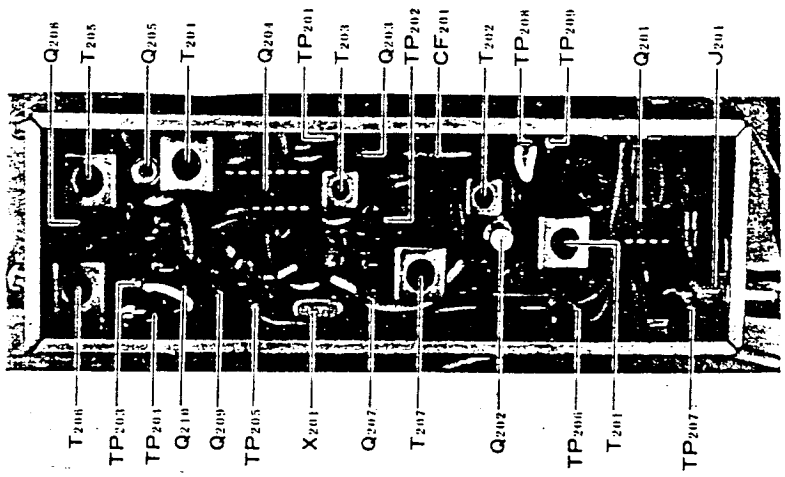
BOTTOM VIEW



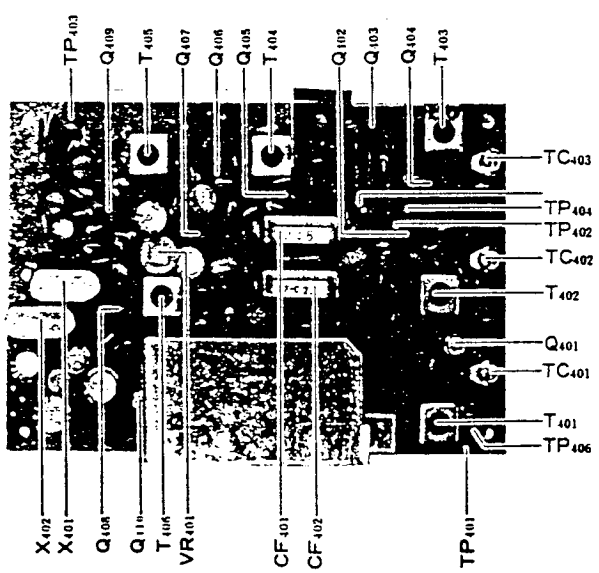
RF UNIT(PB-1781)



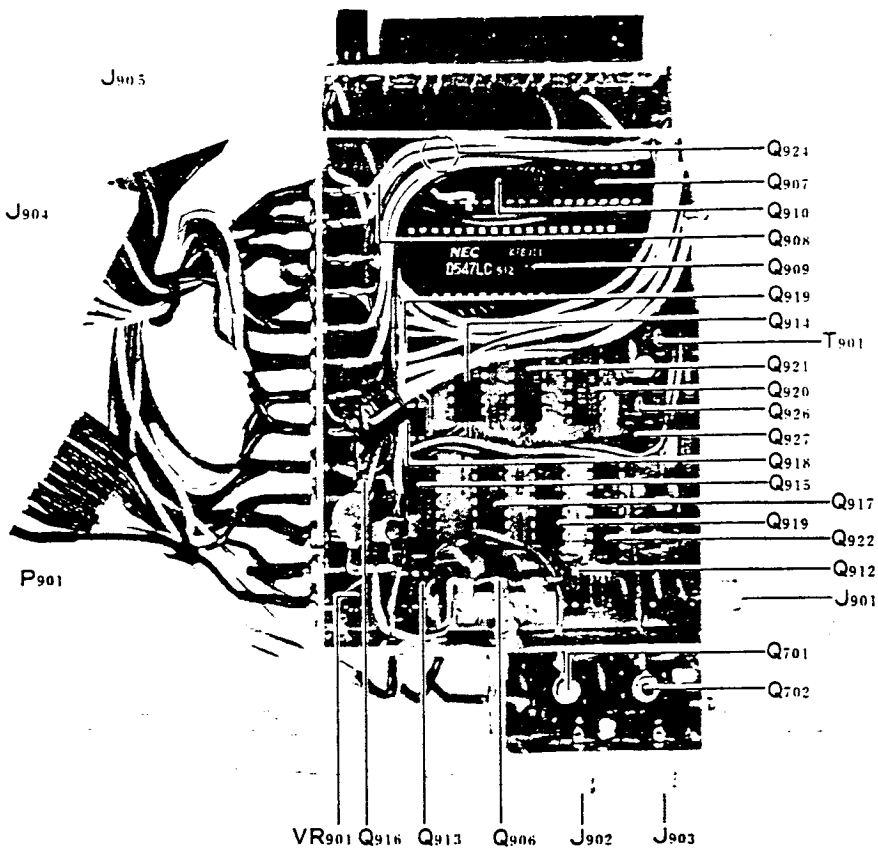
H.G.UNIT(PB-1780)



BPF UNIT(PB-1782)



IF·AF UNIT(PB-1894)



COUNTER UNIT(PB-1754)

PARTS LIST

MAIN CHASSIS

Symbol No.	Part No.	Description
		RESISTOR
R5	40143470	Carbon film 1/4W VJ 47Ω
R3, 6	41143680	" " " TJ 68Ω
R1	41143222	" " " " 2.2kΩ
R2	40143223	" " " VJ 22kΩ
R4	42124120	" composition 1/2W GK 12Ω
R7, 8, 9	42124225	" " " " 2.2MΩ
R10	44204339	Wire wound 2W 3.3Ω
		POTENTIOMETER
VR1	49800104	DM10A 10kΩB/10kΩB
		CAPACITOR
C2	31820050	Ceramic disc 50WV 5PF CH
C3	30820103	" " " 0.01μF
C1	36825104	Mylar " 0.1μF
C4	34220108	Electrolytic 25WV TT 1000μF
		VARIABLE CAPACITOR
VC1, 2	39000078	CY-31A 335PF x 2
VC3	39000079	TSN 150Sx04-1 4PF
		POWER TRANSFORMER
PT1	52000062	52-62
		METER
M1	74000380	KTC-024
		SPEAKER
SP1	76000022	SM-92Y 4Ω 4W
		SWITCH
S1	62000002	ESR-E365R20A
S2	62000020	ESR-E264R20
S3	65000012	PW-22
S4	65000038	PW-42
S5	64000053	8H2011
		RECEPTACLE
J1	68000011	M-BR-06D
J2	68040006	SQ2450-03
J3, 5	68020012	SG8050-07
J4	68030002	SG7814
J6	80043741	UP-021

		FUSE
F1	73000013	1A (100V~117V)
	73000012	0.5A (200V~234V)
F2	73000003	3A
		FUSE HOLDER
FH1	69030005	SN-1301
FH2	69030003	F3294
		PILOT LAMP
PL1, 2, 13, 14	14000033	BQ-034-22529A
PL3, 9~12	14000031	BQ-034-22527A
PL4~8	14000032	BQ-034-22528A

RF UNIT

Symbol No.	Parts No.	Description
	017811AZ	RF board with components
PB-1781A	60417811	P.C. Board
		FET
Q102, 103, 105	22800195	2SK19GR
Q104	23800401	3SK40M
Q101	22800513	3SK51-03
		DIODE
D101	21015550	Silicon 1S1555
		RESISTOR
R121	40143100	Carbon film 1/4W VJ 10Ω
R119	40143330	" " " " 33Ω
R120	40143470	" " " " 47Ω
R107, 122	40143101	" " " " 100Ω
R102, 108, 113, 116, 124	40143221	" " " " 220Ω
R103	41143221	" " " TJ 220Ω
R104, 105	40143561	" " " VJ 560Ω
R112	40143681	" " " " 680Ω
R115	40143152	" " " " 1.5kΩ
R110,	40143103	" " " " 10kΩ
R111	40143273	" " " " 27kΩ
R118	40143393	" " " " 39kΩ
R117	40143473	" " " " 47kΩ
R101, 106, 109, 114, 123	40143104	" " " " 100kΩ

		POTENTIOMETER			
VR101	49905472	SR19R 4.7kΩB			
		THERMISTOR			
TH101	29090005	D-22A			
		CAPACITOR			
C119	31820020	Ceramic disc 50WV 2PF CH			
C106, 109, 124	31820030	" " " 3PF "			
C111	31820050	" " " 5PF "			
C120	31820150	" " " 15PF "	Q201, 204	25000104	IC SN76514N
C113, 114, 126	31820220	" " " 22PF "	Q203, 206, 207	22800195	FET 2SK19GR
C110, 130	31820270	" " " 27PF "	Q202, 205	23800513	3SK51-03
C107, 108, 117	31820330	" " " 33PF "	Q209	22303724	Transistor 2SC372Y
C125	31820820	" " " 82PF "	Q210	22303730	2SC373
C116	31829101	" " " 100PF SL	Q208	22305351	2SC535A
C132	30820102	" " " 0.001μF			
C101~105, 112, 115, 118, 121~123, 127	30820103	" " " 0.01μF			
					DIODE
C128, 133	30820473	" " " 0.047μF	D202, 203	21010070	Germanium 1S1007
C131	33824470	Dipped mica " 47PF	D201	21015550	Silicon 1S1555
C129	33824151	" " " 150PF			
					CRYSTAL
			X201	71500189	HC-18/U 63.2MHz
		TRIMMER CAPACITOR			
TC102	39000002	ECV-1ZW 20x32 20PF			
TC101, 103~	39000004	" 40x32 40PF			**CERAMIC FILTER**
105			CF201	71200020	10.7MF-S23 (SFG-10.7MA)
		TRANSFORMER			
T101	55003293	R12-5830 #220360			**RESISTOR**
T102	55003200	R12-5828 #220046	R224	40143470	Carbon film 1/4W VJ 47Ω
T103	55003201	R12-5781 #220047	R207~209, 214~217	40143101	" " " " 100Ω
T104	55003202	R12-5707 #220048			
T105	55003203	R12-5694 #220049	R210	40143151	" " " " 150Ω
T106~109	55003204	R12-1041B #220050	R206	40143221	" " " " 220Ω
			R 219, 223	40143331	" " " " 330Ω
			R202, 220	40143471	" " " " 470Ω
			R201	40143102	" " " " 1kΩ
		INDUCTOR	R222	40143472	" " " " 4.7kΩ
L101	55003212	#220051	R204, 212, 221, 225	40143103	" " " " 10kΩ
L103	53020018	Micro inductor 10μH			
L102	53020008	" " FL5H 68μH	R203	40143273	" " " " 27kΩ
			R211	40143333	" " " " 33kΩ
			R205, 213, 218	40143473	" " " " 47kΩ
		RELAY			
RL101	70000035	BR221D012 12V			
					CAPACITOR
		US PIN PLUG	C203, 240	31820050	Ceramic disc 50WV 5PF CH
P101	67020007	SQ4052	C201, 204, 212, 226	31820100	" " " 10PF"
	91100008	Wrapping terminal C	C202	31820220	" " " 22PF"

BPF UNIT

Symbol No.	Part No.	Description
	017821AZ	BPF unit with components
PB-1782A	60417821	P.C. Board

C213, 233, 236, 238	31820101	Ceramic disc 50WV 100PF CH
C209, 210, 216, 220, 223, 235, 239	30820102	" " " 0.001μF
C206, 214, 217~219, 221, 222, 224, 227, 229~232, 234, 237, 241	30820103	" " " 0.01μF
C205, 207, 208, 211, 215, 225, 228	30820473	" " " 0.047μF
		TRANSFORMER
T201, 204~206	55003294	#220361
T207	55003295	#220362
T202, 203	55003296	#220187
		INDUCTOR
L201	55003206	#220053
L202	55003207	#220054
L204, 206	53020013	Micro inductor 150μF
L203, 205	53020001	" " 1mH
		US PIN JACK
J101	68020008	SQ3056
	91100008	Wrapping terminal C

OSC UNIT

Symbol No.	Part No.	Description
	017791AZ	OSC board with components
PB-1779A	60417791	P.C. Board
		TRANSISTOR
Q301	22307843	2SC784 O
		RESISTOR
R304	40143101	Carbon film 1/4W VJ 100Ω
R303	40143821	" " " " 820Ω
R302	40143472	" " " " 4.7kΩ
R301	40143223	" " " " 22kΩ

		CAPACITOR
C301	31827070	Ceramic disc 50WV 7PF UJ
C304	31827220	" " " 22PF "
C305	31827330	" " " 33PF "
C302, 303	30820103	" " " 0.01μF
C307, 308	30820473	" " " 0.047μF
		VARIABLE CAPACITOR
VC301	39000074	C343C 15PFx4
		TRIMMER CAPACITOR
TC301	39000001	ECV-1ZW 10x32 10PF
		TRANSFORMER
T301	55003208	#220052
		INDUCTOR
L301	53010003	Micro inductor 250μH

IF, AF UNIT

Symbol No.	Parts No.	Description
	018940AZ	IF, AF unit with components
PB-1894	60418940	P.C. Board
		IC, FET & TRANSISTOR
Q410	25000162	IC TA7205AP
Q402, 404	22800195	FET 2SK19GR
Q401	23800401	FET 3SK40M
Q403, 405~409	22303724	Transistor 2SC372Y
		DIODE
D401~407	21010070	Germanium 1S1007
D408~411	21015550	Silicon 1S1555
Q403, 405~407, 409	22303724	Transistor 2SC372Y
		CRYSTAL
X401	71600035	HC-6/W 456.5kHz
X402	71600034	" 453.5kHz
		CERAMIC FILTER
CF401	71200012	LF-C6
CF402	71200021	LF-C2A
		RESISTOR
R429	40143150	Carbon film 1/4W VJ 15Ω
R439	40143470	" " " " 47Ω
R432, 445, 454	40143101	" " " " 100Ω

R420, 421	41143101	Carbon film 1/4W TJ	100Ω	C438, 444	32824510	Dipped mica 50WV	51PF
	40143121	" " " "	120Ω	C458	32824820	" " "	82PF
R408, 410, 414, 424, 426, 433, 435, 437, 453	40143221	" " " "	220Ω	C460	32824121	" " "	120PF
				C435	32824271	" " "	270PF
				C441	32824391	" " "	390PF
R401	40143331	" " " "	330Ω	C432	32824471	" " "	470PF
R430	40143471	" " " "	470Ω	C462	32824681	" " "	680PF
R449	40143561	" " " "	560Ω	C431, 463	32824102	" " "	1000PF
R431	40143681	" " " "	680Ω		36825332	Mylar "	0.0033μF
R425, 440, 458	40143102	" " " "	1kΩ	C427	36825472	" "	0.0047μF
R416	40143152	" " " "	1.5kΩ	C426	36825103	" "	0.01μF
R415, 418, 419, 422, 455, 457	40143222	" " " "	2.2kΩ	C437	36825223	" "	0.022μF
				C436	36825333	" "	0.033μF
R413, 417, 428, 451	40143332	" " " "	3.3kΩ	C416, 420, 422, 442, 468	36825473	" "	0.047μF
R448	40143392	" " " "	3.9kΩ	C445	36825104	" "	0.1μF
R452	40143472	" " " "	4.7kΩ	C428	36825224	" "	0.22μF
R411	40143822	" " " "	8.2kΩ		34220105	Electrolytic 16WV	1μF
R427	40143103	" " " "	10kΩ	C425, 447	34220225	" "	2.2μF
	40143153	" " " "	15kΩ	C439	34220226	" "	22μF
R450, 460	40143183	" " " "	18kΩ		34220336	" "	33μF
	40143223	" " " "	22kΩ	C442, 446, 448	34220476	" "	47μF
R459	40143333	" " " "	33kΩ	C440, 467, 469	34220107	" "	100μF
R406	40143393	" " " "	39kΩ				
R404	40143473	" " " "	47kΩ				
R402	40143563	" " " "	56kΩ				
R436	40143683	" " " "	68kΩ				
R412, 434, 441, 456	40143104	" " " "	100kΩ			**TRIMMER CAPACITOR**	
				TC403	39000002	ECV-1ZW 20x32	20PF
R405	40143154	" " " "	150kΩ	TC401, 402	39000005	ECV-1ZW 50x32	50PF
R423, 438	40143224	" " " "	220kΩ				
						TRANSFORMER	
				T401	55003209	R12-5783	#220060
				T402	55003210	R12-5780	#220061
		THERMISTOR		T403	55003211	R12-5775	#220062
TH401	29090005		D-22A	T404, 405	54140970	R12-4097	#220101
				T406	54140990	R12-4099	#220156
						INDUCTOR	
		POTENTIOMETER		L401, 402	53020022	Micro inductor FL4H	4.7μH
VR401	49905471	SR19R	470ΩB	L414	53020024	" " FL5H	27μH
				L415	53020023	" " FL5H	100μH
				L403	53020001	" " FL5H	1mH
				L404, 406, 407, 410~412	53020003	" " FL7H	3.9mH
		CAPACITOR					
C415, 419	31820010	Ceramic disc 50WV	1PF CH	L405, 408, 409, 413, 416	53030003	" (shielded) S6-392	3.9 mH
C434	31820070	" " "	7PF CH				
C430	31820100	" " "	10PF CH				
C461	31820220	" " "	22PF CH				
C465	31820270	" " "	27PF CH			**US PIN PLUG**	
C459	31827820	" " "	82PF UJ	P401	67020007	SQ4052	
C421, 423	31829101	" " "	100PF SL				
C453	31829151	" " "	150PF SL		91100008	Wrapping terminal C	
C454	31829221	" " "	220PF SL				
C424	30820102	" " "	0.001μF		80022070	Heat sink	
C401, 402, 406, 407, 409~414, 418, 429, 449, 450, 464, 466	30820103	" " "	0.01μF				
C403, 404, 405, 408, 417, 433, 451, 452, 455, 457, 470	30820473	" " "	0.047μF	**HG UNIT**			
				Symbol No.	Parts No.	Description	
					017801AZ	HG unit with components	
				PB-1780A	60417801	P.C. Board	
C456	32824200	Dipped mica "	20PF				

		TRANSISTOR
Q501	22303724	2SC372Y
		DIODE
D501, 502	21010070	Germanium 1S1007
		CRYSTAL
X501	71600026	HC-6/W 1MHz
		RESISTOR
R505, 506	40143101	Carbon film 1/4W VJ 100Ω
R503	40143221	" " " " 220Ω
R502	40143103	" " " " 10kΩ
R501	40143104	" " " " 100kΩ
		CAPACITOR
C502, 510	31820080	Ceramic disc 50WV 8PF CH
C511	31820150	" " " 15PF "
C509, 514	31820270	" " " 27PF "
C508	31820330	" " " 33PF "
C506	31820680	" " " 68PF "
C501, 504, 505, 507	30820103	" " " 0.01μF
C503	33824820	Dipped mica " 82PF
C512	34220476	Electrolytic 16WV TW 47μF
		TRIMMER CAPACITOR
TC501	39000004	ECV-1ZW 40x32 40PF
		INDUCTOR
L503	55000012	#220051
L502	53020022	Micro inductor FL4H 4.7mH
L501	53020001	" " FL5H 1mH
L504	53020003	" " FL7H 3.9mH
		US PIN PLUG
P501, 502	67020007	SQ4052
	91100008	Wrapping terminal C

REG UNIT

Symbol No.	Part No.	Description
	017841AZ	Regulator unit with components
PB-1784A	60417841	P.C. Board
		IC
Q604	25000105	μPC 14305
Q601, 603	25000116	μPC 14308
Q602	25000170	NJM 78L09A
		DIODE
D607, 608	21015550	Silicon 1S1555
D601~606	21090022	" V06B
		RESISTOR
R602	42124220	Carbon composition 1/2W GK 22Ω
		CAPACITOR
C610, 611	30820473	Ceramic disc 50WV 0.047μF
C605	34220336	Electrolytic 16WV 33μF
C604, 607, 608	34220107	" " 100μF
C606, 609	34220108	" " 1000μF
C601~603	34320108	" 25WV 1000μF
		RELAY
RL601	70000036	AW 62209 HB2-DC 6V
		MINI CONNECTOR
J601 (with wire)	68110008	5047-11 #240063A
	91100008	Wrapping terminal C

BUFFER AMP UNIT

Symbol No.	Part No.	Description
	017901AZ	Buffer board with components
PB-1790A	60417901	P.C. Board
		FET
Q701, 702	23800401	3SK40M

		RESISTOR			SWITCH
R703, 709	40143221	Carbon film 1/4W VJ 220Ω	S801	64000107	SLE 72251
R704	40143152	" " " " 1.5kΩ	S802	64000103	SLE 62251
R710	40143272	" " " " 2.7kΩ	S803	64000106	SLE 82301
R702, 707	40143333	" " " " 33kΩ	S804	64000108	SLE 64251
R705, 708	40143473	" " " " 47kΩ			
R701, 706	40143474	" " " " 470kΩ			
					MINI CONNECTOR
			J801	68060008	3024-15C
			P801, 802	67150008	5048-15A
			P803	68150006	3094-15A
		CAPACITOR			
C701~704	30820103	Ceramic disc 50WV 0.01μF			
C705	36226105	Tantalum 16WV 1μF			
C706	32821102	Feed thru 50WV 0.001μF			
	91001102	Seal terminal A102			
	91100008	Wrapping terminal C			

SWITCH UNIT

Symbol No.	Part No.	Description
	017671AZ-	Switch board with components
PB-1767A	60417671	P.C. Board
		IC & TRANSISTOR
Q801	25000114	IC MC14011
Q803	25000176	MC14016
Q802	25000156	MC14027
Q804	25000093	MC14081
Q805~808	22303730	Transistor 2SC373
Q809	21090147	Display 5082-7286
		DIODE
D801~806	21015550	Silicon 1S1555
		RESISTOR
R802~806	42184103	Carbon composition 1/8W GK 10kΩ
R801	42184473	" " " " 47kΩ
		CAPACITOR
C802	30820102	Ceramic disc 50WV 0.001μF
C801	30820473	" " " 0.047μF
C804	33824470	Dipped mica " 47PF
C803	36326685	Tantalum 20WV 6.8μF

COUNTER UNIT

Symbol No.	Part No.	Description
	017541AZ	Counter unit assembly with Buffer Display board
PB-1754A	60417541	P.C. Board
PB-1755	60417550	P.C. Board
		IC & TRANSISTOR
Q907, 910	25000143	IC MC1416
Q918	25000160	MC14518
Q919	25000174	MC14519
Q920	25000053	MSM5502
Q912	25000067	MSM5592
Q915, 923	25000140	SN74LS00N
Q914, 921	25000171	SN7407N
Q917	25000072	SN74LS90N
Q913	25000170	SN74LS112N
Q922	25000161	SN74LS390N
Q916	25000159	SP8646
Q908	25000157	μPA56C
Q909	25000158	μPA547C-1
Q906	25000172	NJM78L05A
Q926, 927, 928	22303730	Transistor 2SC373
Q911	22308282	2SC828
Q924, 925	22390001	MPSA13
Q901~905	21090135	Display 5082-7740
		DIODE
D901, 902, 905	21015550	Silicon 1S1555
D903, 904	21090091	LED SL103D
		RESISTOR
R922, 949~955	40143390	Carbon film RD1/4(F) 39Ω
R924, 928, 93C, 956	40143221	" " " 220Ω
R958	40143271	" " " 270Ω
R903, 908, 909, 919	40143102	" " " 1kΩ
R907, 925, 926	40143222	" " " 2.2kΩ

R902	40143332	" " " 3.3kΩ			US PIN JACK
R918	40143472	" " " 4.7kΩ	J901~903	68020008	SQ3056
R927, 929, 959	40143562	" " " 5.6kΩ			
R910~917	40143103	" " " 10kΩ			
R920, 923, 939~941	40143223	" " " 22kΩ			
					IC SOCKET
R901	40143273	" " " 27kΩ	QS901~905	68140005	314-AG37D
R957	40143563	" " " 56kΩ	QS906	68420001	116-42-30-114
R904, 906, 931	40143104	" " " 100kΩ			
R905	40143154	" " " 150kΩ			
R942	47000003	Block resistor 220Ωx7		67200003	Board joint 163740
R932	47000007	" " 22kΩx7			

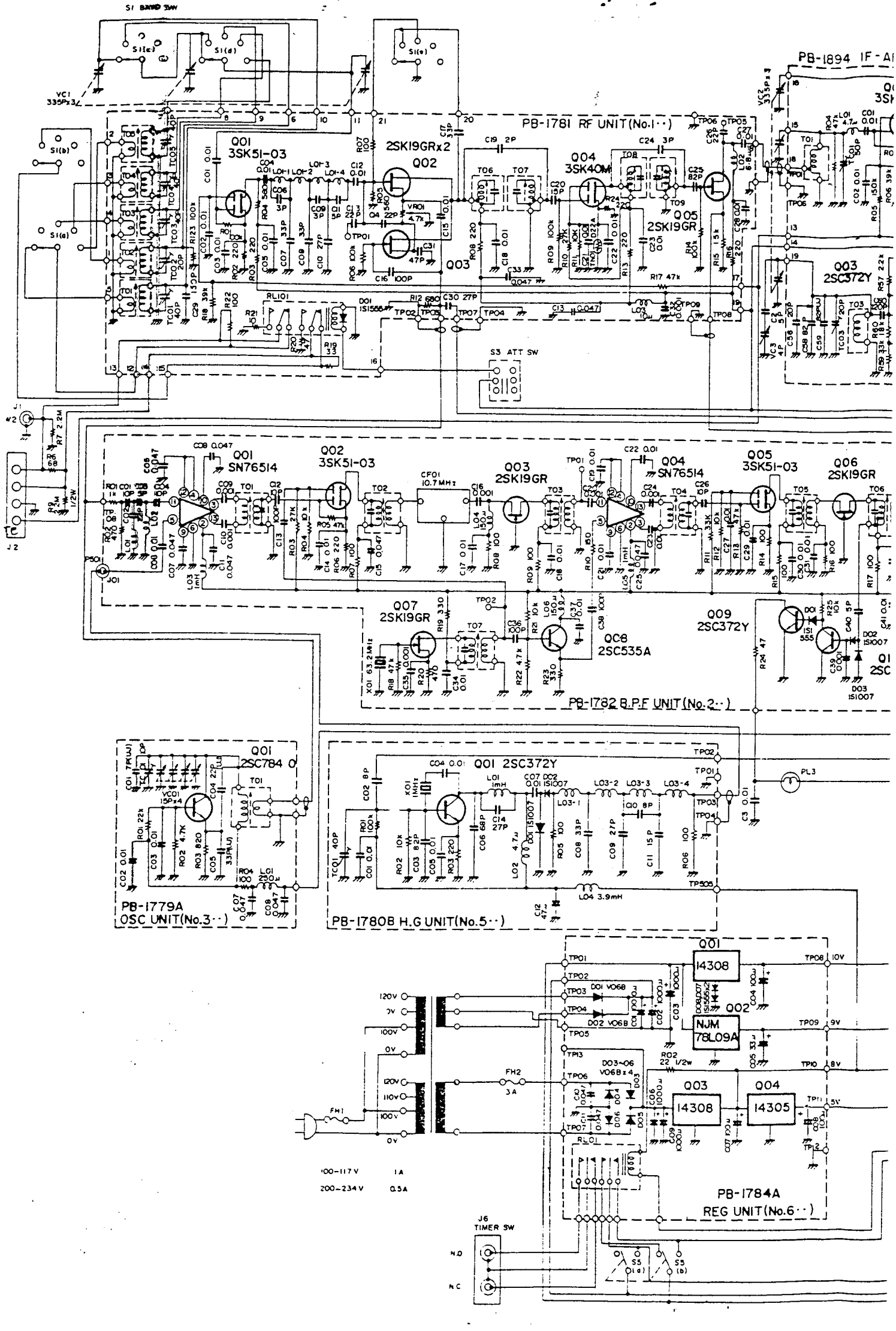
ACCESSORIES

Symbol No.	Part No.	Description
	67020003	Record plug & external Speaker plug P2240
	67020002	Headphone plug SH3001
	67020001	RCA Pin plug CN7017P
	67000005	Antenna plug MP-5
	96000025	Antenna wire A #250003
	96000026	Antenna wire B #250004
	73000013	Fuse (F1) 1A (100V~117V)
	73000012	0.5A (200V~234V)
	73000003	Fuse (F2) 3A

		POTENTIOMETER	
VR901	49800083	PH822H501 500ΩB	
		CAPACITOR	
C901, 902, 904, 912, 913, 942	30820103	Ceramic disc 50WV 0.01μF	
C908, 910	30820473	" " " 0.047μF	
C944	33824300	Dipped mica " 30PF	
C907	33824151	" " " 150PF	
C903, 905	36133104	Mylar 100WV 0.1μF (B32560-A11045)	
C906	36824102	Styrol 50WV 1000PF	
C909, 911	36326685	Tantalum 20WV 6.8μF	
C914~941	32821102	Feed thru 50WV 0.001μF	
C943	34220107	Electrolytic 16WV TW 100μF	
		TRANSFORMER	
T901	55003084	7MC-312162NO #220188	
		INDUCTOR	
L901, 902	55003069	#220012	
		MINI CONNECTOR	
P901	67110004	5048-11A	
J904 with wire	68150007	5047-15 #240061	
J905 with wire	68150008	5047-15 #240062	

WORLD TIME CONVERSION CHART IN HOURS

Japan	Eastern Australia. Melbourne, Sydney.	New Caledonia. New Zealand.	International Date Line Fiji Islands.	Nome. Alaska. Samoa Islands.	Hawaii. Midway Islands.	Eastern Alaska. Dawson	Pacific Standard Time. Los Angeles. Seattle. Juneau.	Mountain Standard Time. Calgary. Denver. Phoenix.	Central Standard Time. Chicago. Costa Rica.	Eastern Standard Time. Montreal. New York. Peru.	Atlantic Standard Time. Argentina. Nova Scotia.	Greenland. Rio de Janeiro. Brazil	Azores	Iceland. Canary Islands.	GMT	Central Europe. Berlin, Geneva. Stockholm. Vienna.	Eastern Europe. Athens. Cape Town. Cairo. Moscow	Arabia. Armenia. Ethiopia. Madagascar.	Mauritius. Iran. Reunion Island.	Central Russia. Bombay. India.	Calcutta. Novosibirsk Russia. Tibet.	Sumatra. Thailand. Laos.	Philippines. Perth.
9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	0000	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM
10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	0100	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM
11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	0200	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM
Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	0300	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM
1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	0400	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon
2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	0500	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM
3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	0600	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM
4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	0700	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM
5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	0800	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM
6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	0900	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM
7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	1000	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM
8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	1100	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM
9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	1200	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM
10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1300	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM
11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	1400	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	1500	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM
1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	1600	5PM	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night
2AM	3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	1700	6PM	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM
3AM	4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	1800	7PM	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM
4AM	5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	1900	8PM	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM
5AM	6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	2000	9PM	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM
6AM	7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	2100	10PM	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM
7AM	8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	2200	11PM	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM
8AM	9AM	10AM	11AM	Noon	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	2300	Mid Night	1AM	2AM	3AM	4AM	5AM	6AM	7AM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Q03
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Q03 2SC372Y
S3 ATT SW
PB-1782 B.P.F UNIT(No.2··)
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Q02 3SK51-03
Q03 2SK19GR
Q04 SN76514
Q05 3SK51-03
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Q07 2SK19GR
Q08 2SC535A
Q09 2SC372Y
PB-1779A OSC UNIT(No.3··)
Q01 2SC784
PB-1780B H.G UNIT(No.5··)
Q01 2SC372Y
PB-1784A REG UNIT(No.6··)
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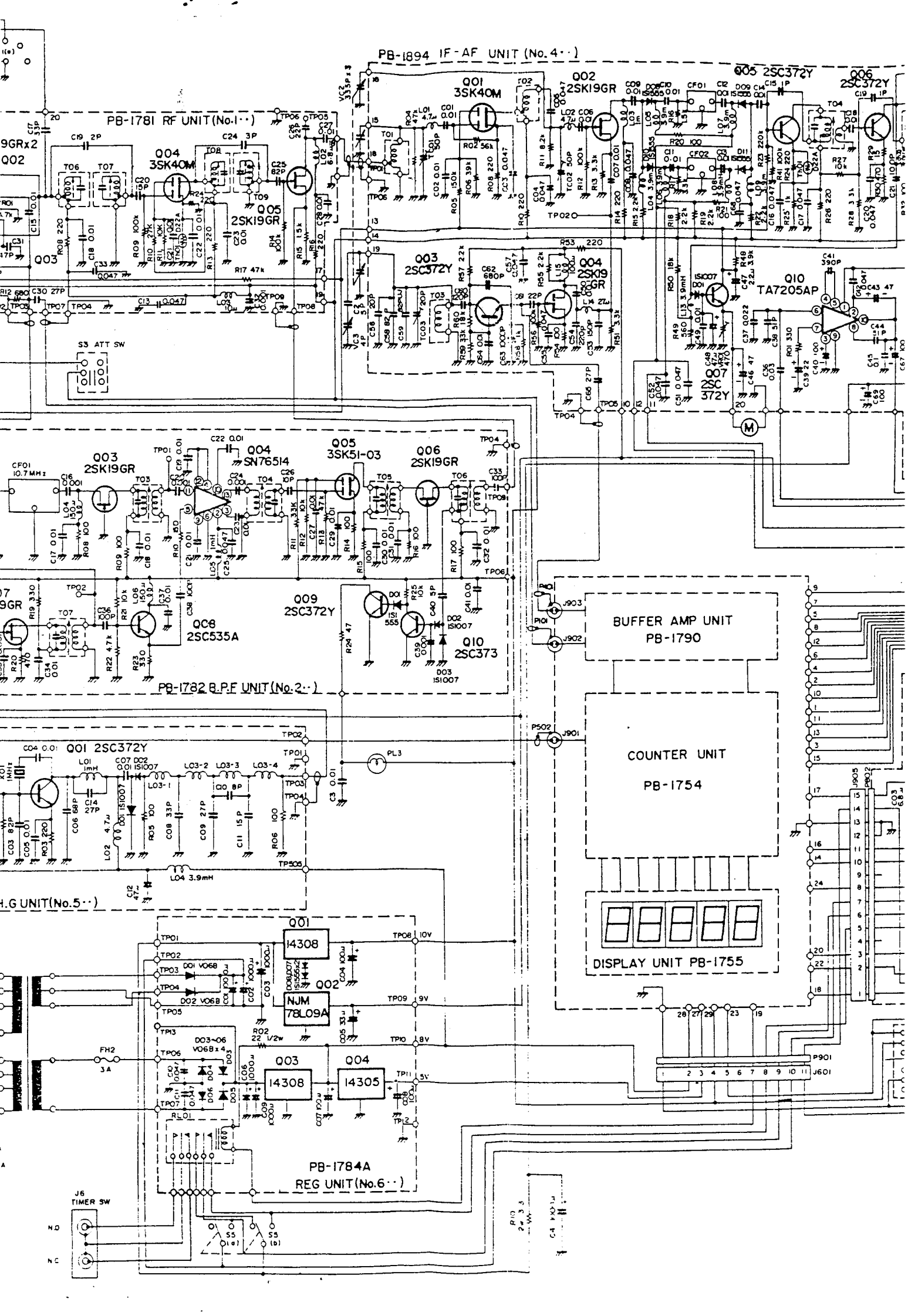
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PB-1781 RF UNIT (No.1··)
PB-1782 B.P.F UNIT (No.2··)
PB-1784A REG UNIT (No.6··)
BUFFER AMP UNIT PB-1790
COUNTER UNIT PB-1754
DISPLAY UNIT PB-1755
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Q002 2SK19GR
Q003 2SC372Y
Q004 2SK19GR
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Q006 2SC372Y
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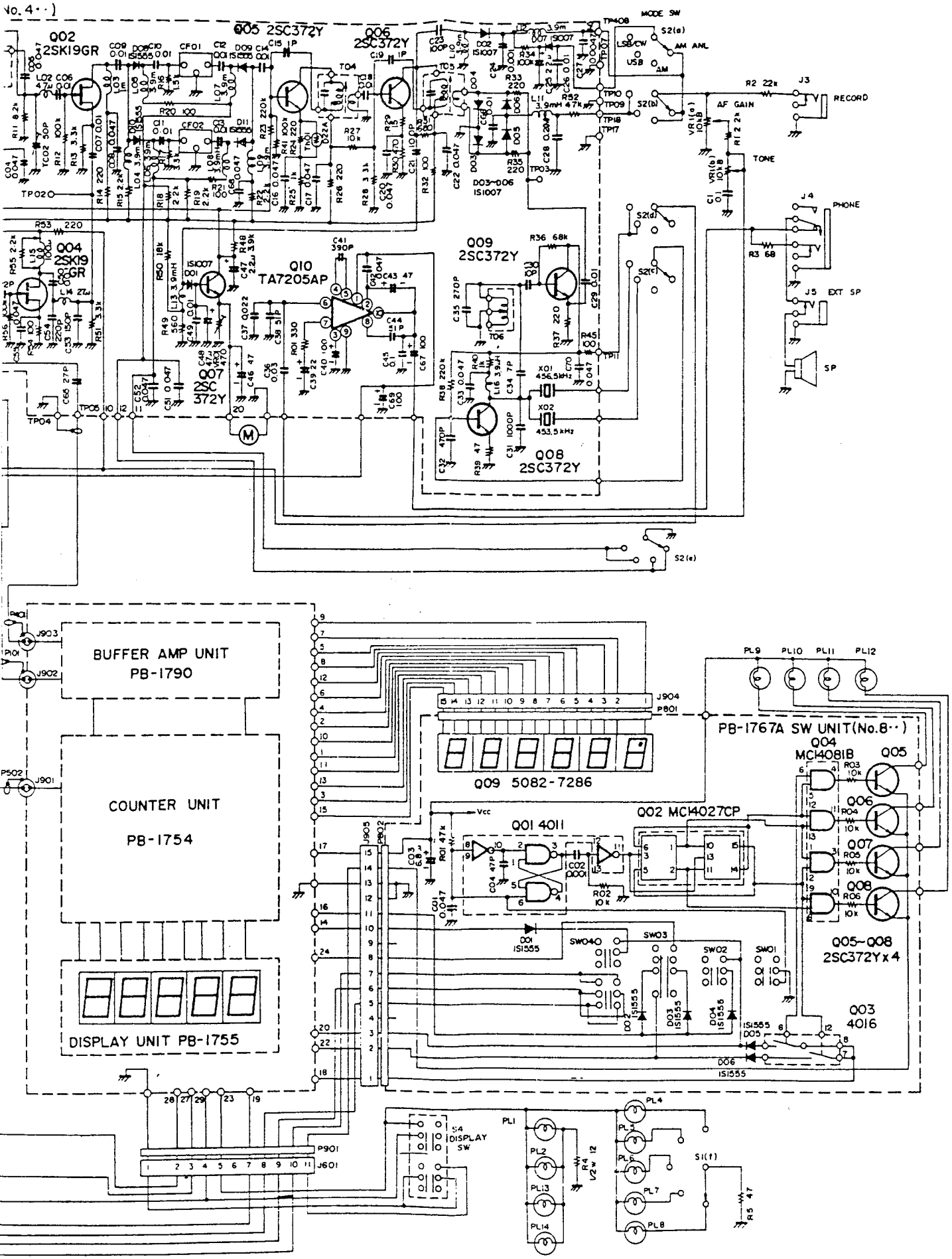

FRG-7000
CIRCUIT DIAGRAM