THE QUALITY OF THIS MANUAL IS THE BEST THAT IS AVAILABLE

MAINTENANCE SERVICE MANUAL FRG-7700

YAESU MUSEN CO., LTD.

C.P.O. BOX 1500

TOKYO, JAPAN

YAESU ELECTRONICS CORP.

P.O. BOX 49

PARAMOUNT, CALIFORNIA, 90723

CONTENTS

PREFACE

The purpose of this manual is to provide the reader with information critical to the operation and maintenance of the FRG-7700 general coverage communications receiver. Technical details are geared for maximum comprehension by the technician or owner, rather than the design engineer. To this end, the descriptions have been kept brief, while photographs and drawings are utilized liberally.

Use of this manual is entirely at the owner's risk. While we believe the material presented herein to be correct and factual, we assume no liability for damage which may occur when this manual is used as a reference.

The FRG-7700 has had an enviable service record, and we trust that you will seldom have recourse to this manual. Should reference be necessary, though, we hope and trust that the information presented will be sufficient for your service needs.

Yaesu Musen Company, Ltd.
Tokyo, Japan

SECTION 1—GENERAL

ALL MODE COMMUNICATIONS RECEIVER
FRG-7700

GENERAL DESCRIPTION

The FRG-7700 is a revolutionary communications receiver for the most demanding shortwave listener. Using an advanced frequency synthesizer, the FRG-7700 provides reception over the range 150 kHz – 29.9 MHz, with provision for reception of AM, SSB, CW, and FM stations. In the AM mode, three bandwidths are available, allowing the operator to select the IF bandwidth most appropriate for the interference level and fidelity requirements of each listening period.

Available as an option for the FRG-7700 is Yaesu's exciting memory feature, which allows the storage and recall of up to twelve discrete frequencies. This allows the operator to watch several stations with pushbutton ease, thus eliminating the considerable effort involved in tuning manually for each of several stations one wants to watch. A memory backup feature is provided for the memory unit to perserve memories when power is removed (three penlight cells required, batteries not supplied).

The FRG-7700 features high sensitivity, excellent selectivity, digital plus analog display of the operating frequency, and a built-in digital quartz clock that can be programmed to turn the receiver on and off. A snooze timer is included in the clock feature. The timer may also be used to control peripheral equipment such as a tape recorder, for unattended recording of programs you might otherwise miss because you must be away from your station.

Top performance features include a highly effective noise blanker, selectable fast/slow AGC (Automatic Gain Control) circuit, an audio filter which may be adjusted to improve interference rejection, an easy-to-read S-meter, and two RF attenuators (one fixed, one continuously adjustable) for operation under very strong signal conditions. For FM operation, a squelch control will silence the receiver until a signal is received. Convenient interface jacks for tape recorder control, audio output to an external speaker or tape recorder, receiver muting, and for listening via headphones make the FRG-7700 truly the most versatile receiver to be made available to the shortwave listeners of the world.

We recommend that this manual be read carefully prior to operating the FRG-7700. With proper care in installation and operation, this receiver will provide you with many years of trouble-free operation.

SPECIFICATIONS

Frequency Range:
150 kHz – 29.999 MHz (30 bands)

Modes:
AM, SSB (USB, LSB), CW, FM

Sensitivity:

	AM	SSB/CW	FM
0.15MHz–0.3MHz	30μV/500Ω	3μV/500Ω	–
0.3MHz–2MHz	25μV/500Ω	2μV/500Ω	–
2MHz–29.999MHz	5μV/50Ω	0.5μV/50Ω	1μV/50Ω

Selectivity:

AM W (Wide)
12 kHz (–6 dB) 25 kHz (–50 dB)
AM M (Medium)
6 kHz (–6 dB) 15 kHz (–50 dB)
AM N (Narrow)
2.7 kHz (–6 dB) 8 kHz (–50 dB)
SSB/CW
2.7 kHz (–6 dB) 8 kHz (–50 dB)
FM
15 kHz (–6 dB) 30 kHz (–40 dB)

Stability:
Less than ±1 kHz from 1 to 30 minutes after power ON.
Less than ±300 Hz after 30 minutes warm-up.

Antenna Impedance:
0.15 MHz – 2 MHz BC 500 ohms (unbalanced)
2 MHz – 29.999 MHz, SW/BC 50 ohms (unbalanced)

Audio Output:
1.5 Watts (8 ohms, 10% THD)

Speaker Impedance:
8 ohms
4-16 ohms for external speaker or headphone

Power Requirement:
100/120/220/240 volts, AC 50/60 Hz

Power Consumption:

		With Memory Unit
Standby:	AC 10 VA	AC 10 VA
ON:	AC 33 VA	AC 39 VA

Size:
334(W) x 129(H) x 225(D) mm

Weight:
Approx. 6 kg
6.5 kg (with Memory Unit)

SEMICONDUCTOR COMPLEMENT

ICs:

HD10551P	2
MB8718	1
MB84040B	1
MC4044P	1
MC14024BCP	2
MC14046BCP	1
MC14069UBCP	1
MC14504BCP	1
MC14518BCP	2
MC14555BCP	1
MC14556BCP	1
MSM4023RS	1
MSM5524RS	1
μPB553C	1
μPC575C2F	1
μPD5101LC	6
μPC78L05A	1
SN16913P	3
SN74LS123	1
SN74LS192	4
SN74LS196	1
SN74LS290	1
SN74LS293	1
TA7061AP	1

FETs:

2SK107-3	2
2SK125	4
3SK73GR	8

Transistors:

2SA733AQ	17
2SC535A	1
2SC900E	4
2SC945AQ	70
2SC1047C	1
2SC1317R	1
2SC1384R	3
2SC1393L	2
2SC1674L	4
2SC1959Y	1
2SD288K	1
2SD882Q	3
MPS-A13	1

Diodes:

1N60	10
1S188FM	4
1SS53	64
10D1	1
FC52M	2
FC63	1
MV104	5
RD4.7EB2	1
RD5.6EB2	4
RD7.5EB1	1
RD9.1EB2	1
RD10EB1	1
S2V10	1
S2VB10F	1

LEDs:

TLG-208	1
TLY-205	2
TLY-208	1

* Including Memory Unit

Specifications subject to change without notice or obligation

ACCESSORIES

The following accessories are packaged along with the FRG-7700:

(1) AC Power Cable (T9013280) 1 ea.

(2) Extra fuses 100-120V 1A (Q0000002)
220-240V 0.5A (Q0000001)
2 ea.

(3) Wire for antenna (Q3000004) 10 m.

(4) Extender feet with pads (R3054620) 2 ea.

AVAILABLE OPTIONS

(1) Memory Unit

(2) Memory/Clock Backup Batteries (AA Size)

NOTE

In this manual, discussion of the memory feature will omit repetitive use of the word "option," in the interest of brevity. The standard FRG-7700 does not include the memory unit, which is available as an extra-cost option from your Yaesu dealer. The AA size penlight cells required to activate the memory backup feature are not supplied with the memory unit.

RECOMMENDED ACCESSORIES

The FRV-7700 is a high-performance crystal controlled VHF frequency converter, designed to match the FRG-7700 general coverage communications receiver. The three 10 MHz ranges on the VHF band are converted into 20*(18) – 30 MHz, allowing you to receive these frequencies with your FRG-7700.

The tunable high-Q resonators in both RF and IF sections eliminate most intermodulation and cross modulation problems, providing excellent receiver performance when working with weak signals.

The FRT-7700 is an ultra-compact antenna tuner for the FRG-7700 receiver. Designed for operation from 150 kHz to 30 MHz, the FRT-7700 will provide the proper impedance for the receiver, thus rejecting unwanted signals. A built-in attenuator, 60 dB maximum, prevents intermodulation and cross-modulation from occurring when strong signals are being carried to your receiver. Also, a two-section lowpass filter aids in the rejection of interference from strong signals above 2 MHz, when you are listening to bands in the 150 kHz to 500 kHz range.

FRV-7700 SPECIFICATIONS

Frequency coverage:

Model A – *118 – 130 MHz; 130 – 140 MHz; 140 – 150 MHz
Model B – *118 – 130 MHz; 140 – 150 MHz; 50 – 59 MHz
Model C – 140 – 150 MHz; 150 – 160 MHz; 160 – 170 MHz
Model D – *118 – 130 MHz; 140 – 150 MHz; 70 – 80 MHz
Model E – 140 – 150 MHz; 150 – 160 MHz; *118 – 130 MHz
Model F – 150 – 160 MHz; 160 – 170 MHz; *118 – 130 MHz

Sensitivity: (measured w/FRG-7700)

AM (M) – 2.5 μV for 10 dB S/N @ 1 kHz 30% MOD
AM (N) – 2.0 μV for 10 dB S/N @ 1 kHz 30% MOD
SSB/CW – 0.5 μV for 10 dB S/N
FM – 0.5 μV for 10 dB S/N @ 3.5 kHz Dev.

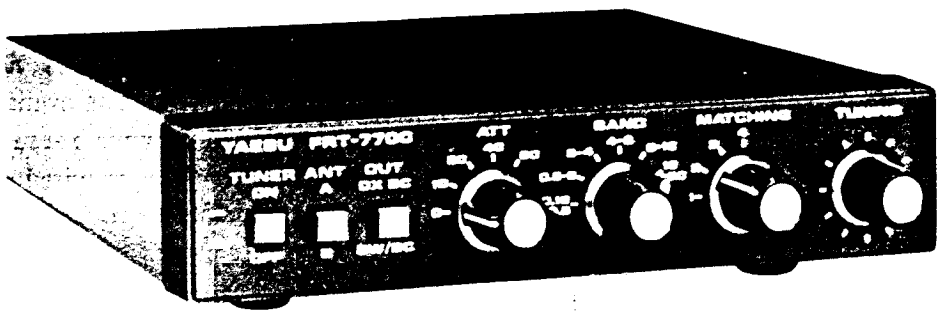
Size:

32(H) x 167(W) x 170(D) mm

Weight:

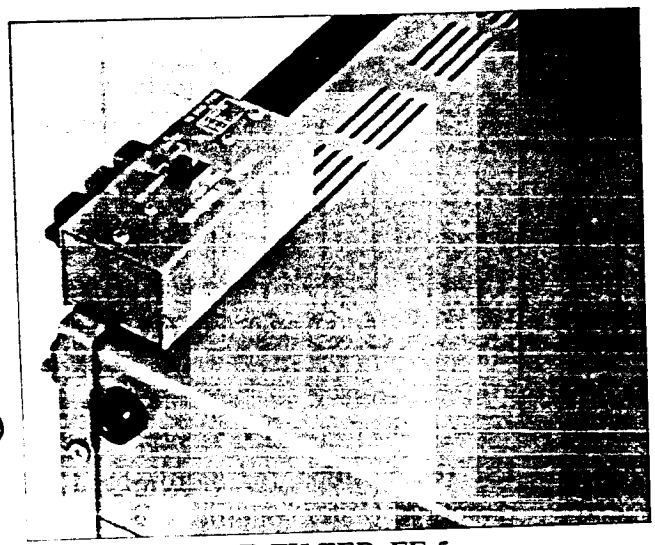
Approximately 800 g.

FRV-7700



FRT-7700

The FF-5 LF Filter can reject signals above 500 kHz, thus preventing cross-modulation and inter-modulation caused by strong broadcasting stations above 500 kHz. The installation of this filter onto your FRG-7700 can be done using the mounting bracket supplied.



LF FILTER FF-5

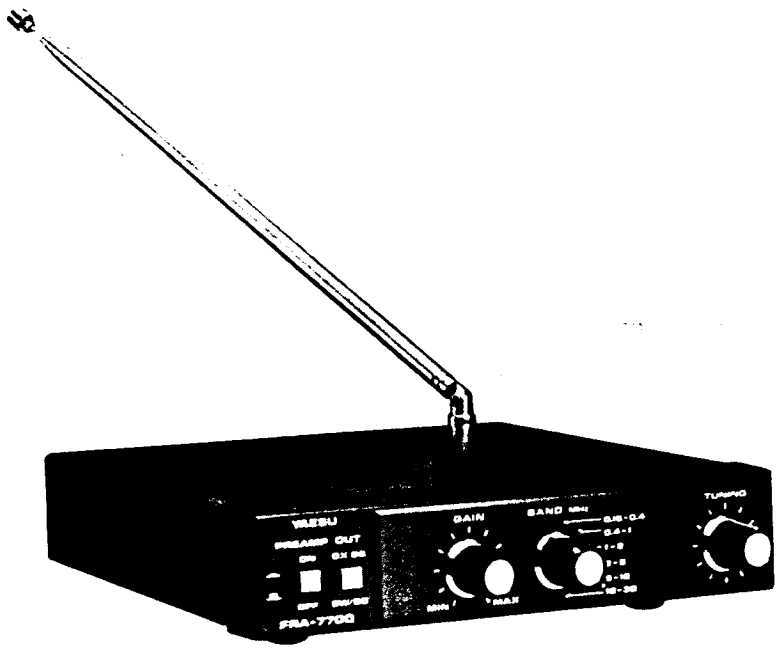
The YH-55 and YH-77 headphones are light in weight, and an extra-soft cushion makes for many hours of comfort. The audio response is shaped to match that of your receiver.

YH-55

YH-77

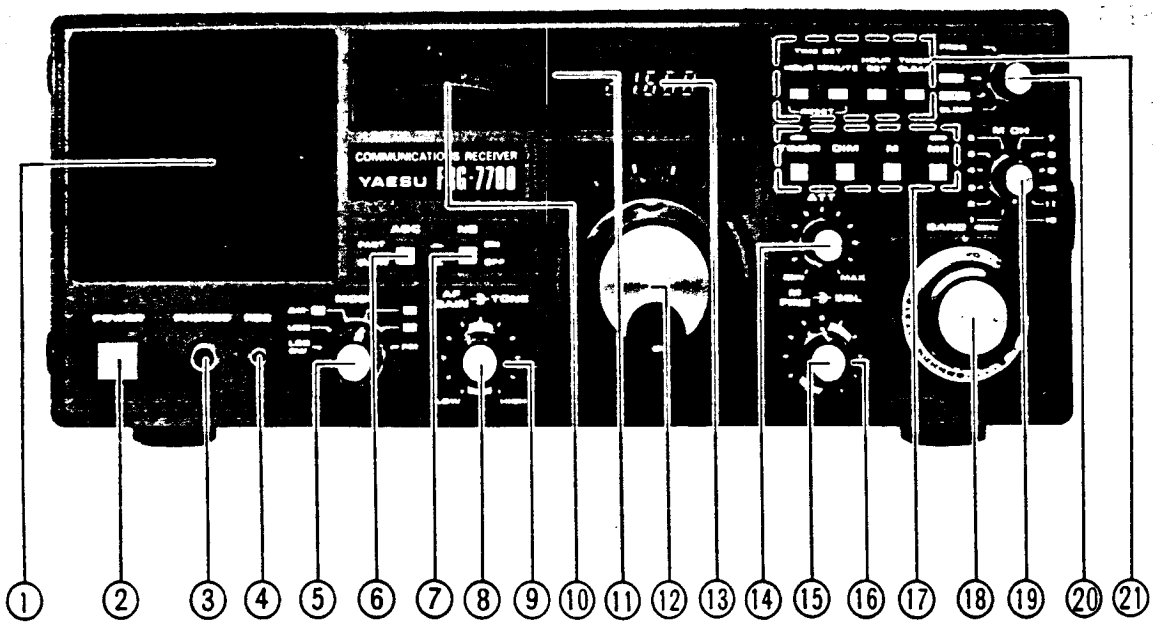
FRA-7700 ACTIVE ANTENNA

This active antenna unit is designed for use with the FRG-7700 general coverage receiver, allowing good quality reception of signals while using only the attached 1.2 meter telescoping antenna. The active antenna unit includes an RF preamplifier useful over the entire 150 kHz to 30 MHz range of the FRG-7700. Its gain is adjustable from the front panel allowing precise setting for optimum performance under a wide variety of reception situations.



FRA-7700

CONTROLS AND SWITCHES



FRONT PANEL

(1) SPEAKER

Internal speaker

(2) POWER

This is the main ON/OFF switch for the receiver. When the POWER switch is in the OFF position, on/off control may be exercised by the clock timer. See the "Operation" section for details.

(3) PHONES

This is a standard 1/4" headphone jack. When the headphone plug is inserted into this jack, the internal speaker is automatically cut off. The audio output impedance is 8 ohms.

(4) REC

This miniature phone jack is for recording purposes. The output level is approximately 100 mV (fixed), irrespective of the setting of the AF GAIN control.

(5) MODE

This control chooses the desired mode:

LSB/CW Use this position for lower sideband (LSB) and Morse Code (CW) reception.

USB Use this position for upper sideband (USB) reception. This position may also be used for CW reception, if desired.

AM N Use this position for narrow-band AM reception. Under conditions of extremely heavy adjacent frequency interference, this position of the mode switch may allow AM reception where a wider mode would be unusable. There will be some degradation in fidelity in the AM N position, however.

AM M For all-around AM reception, the AM M position of the mode switch may be used. Because of the wider bandwidth, the fidelity on the incoming signal is much better than with the AM N filter.

AM W Under clear band conditions, the AM W provides the widest bandwidth and best fidelity.

FM This position selects reception of FM signals.

(6) AGC

This switch allows selection of the optimum AGC (Automatic Gain Control) decay time. The SLOW position is normally used for AM reception, while the FAST position is normally chosen for Morse Code (CW) reception. For SSB reception, the optimum position is determined by band conditions and the adjacent-frequency interference level.

(7) NB

This switch, when pressed, activates the noise blanker for reduction in the level of interfering pulse-type noise.

(8) AF GAIN

The AF GAIN control varies the volume level from the speaker. Clockwise rotation increases the volume level.

(9) TONE

This control varies the high-frequency audio response. The variation in audio fidelity provided by the TONE control is highly useful in minimizing interference from heterodynes and other high-pitched noises that might ruin reception.

(10) S-METER

The S-meter provides a relative indication of the signal strength on the incoming signal. The upper scale is calibrated in S-units from S1 to S9, with stronger signals indicated in dB over S9. The lower scale is calibrated in S-units compatible with the SINPO code, as shown in Table 1.

(11) AM, PM

These are AM and PM indicators for the clock.

(12) MAIN DIAL

The main dial determines the operating frequency of the FRG-7700, in conjunction with the setting of the BAND switch.

(13) DIGITAL DISPLAY

The digital display indicates the operating frequency as well as the time. Selection of display of the frequency or time is made via the FUNCTION switch.

(14) ATT

The ATT (Attenuator) control, when rotated in a clockwise direction, reduces the gain of the receiver preamplifier, thus minimizing overloading of the receiver during conditions of extremely strong adjacent-frequency interference. Maximum receiver sensitivity occurs when the ATT control is rotated to the fully counterclockwise position.

(15) M FINE

This control allows fine tuning during memory operation. A frequency excursion of up to 1 kHz may be achieved using this control.

(16) SQL

The SQL (Squelch) control will silence the receiver until a signal is received. The SQL control is usable ONLY in the FM mode.

(17) CONTROL SWITCHES (TIMER, DIM, M, MR)

TIMER — Once the desired on/off timers are programmed into the clock, push this switch to activate the power control timer. In this mode, the digital clock timer will turn the receiver on and off.

DIM — This button, when pushed, will allow dimming of the meter lamp, the dial lamps, and the display intensity.

M — Push this button to store a frequency into memory.

MR — This button, when pushed, transfers frequency control from the main dial to the memory system. Push the button again to return to main dial tuning.

(18) BAND

This switch selects the desired 1 MHz segment within the HF spectrum, with calibrations from 0 MHz to 29 MHz. Also provided are preset marks for the HF amateur radio (ham) bands.

(19) M CH

This switch selects the desired memory channel.

(20) FUNCTION

This switch selects the Digital Display functions.

FREQ — All digits of the operating frequency are displayed with resolution to 1 kHz.

CLOCK — Time is displayed in a 12-hour format.

ON — The ON time, at which the receiver will be turned on, is displayed.

OFF — The OFF time, at which the receiver will be turned off, is displayed.

SLEEP — The remaining time of the sleep timer is displayed.

(Up to 59 minutes can be set for the sleep timer.)

(21) CLOCK SETTING SWITCHES

HOUR — This switch is used for setting hours on the clock and timer. Pressing this switch once will advance the reading by one hour. If this switch is held for more than two seconds, the hour reading will advance continuously.

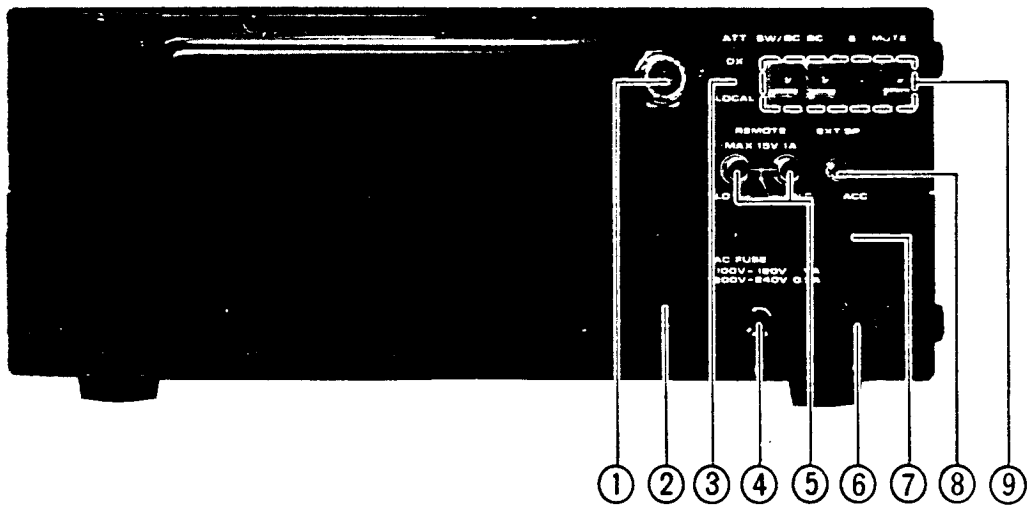
MINUTE This switch is used for setting minutes. The setting procedure is identical to that for setting hours.

HOUR SET

This switch, when pressed, resets the minute and second digits of the clock to zero. For example, if more than 30 minutes are displayed on the clock, pressing the HOUR SET button will advance the clock to the next hour. If less than 30 minutes have elapsed in the hour, pressing the HOUR SET button will zero the minutes and seconds, but leave the hour reading unchanged. This feature facilitates easy time setting.

TIMER CLEAR

This switch, when pressed, clears the remaining time before the programmed off time. After the timer turns the receiver on in the TIMER mode, you may push the TIMER CLEAR button to turn the receiver off. The following day, the receiver will turn ON again at the programmed time. In the sleep timer mode, pushing this switch will cause the remaining time to be zero, and the receiver will turn off.



REAR PANEL

(1) COAX ANT

This is a standard UHF type coaxial connector for shortwave and standard broadcast listening. This connector is wired in parallel with the SW/BC terminals.

(2) AC

The AC power cable should be connected at this point.

(3) ATT

The ATT (Attenuator) switch activates an attenuator in the incoming signal path when the LOCAL position is selected. For best receiver sensitivity, this switch should be placed in the DX position.

(4) AC LINE FUSE

For 100/120 volt operation, a 1 amp fuse should be installed here. For 200/240 volt operation, a 1/2 amp fuse should be installed here. When replacing fuses, be absolutely certain to use a fuse of the proper rating, as our warranty does not cover damage caused by use of an improper fuse.

(5) REMOTE (N.O./N.C.)

These RCA type jacks may be used for control of peripheral equipment such as tape recorders, etc. When the TIMER switch is activated, and the ON time is reached, the internal switching relay is activated. When the OFF time is reached, the relay returns to its normal condition. The normally open and normally closed jacks on the rear panel may then be used, according to the control requirements of your station equipment. See the "Operation" section for details.

(6) AC VOLTAGE SELECTOR

This is for selection of the proper input AC voltage. Set this selector for your local line voltage. If you have any question about your local line voltage, consult your local Yaesu dealer before attempting operation of this equipment.

(7) ACC

This is a 5 pin DIN accessory jack which affords access to AGC voltage, an 11 volt DC line, and the mute line.

(8) EXT SP

An external speaker may be connected via this jack. The audio output impedance is 4-16 ohms. Insertion of a plug into this jack automatically cuts off the internal speaker.

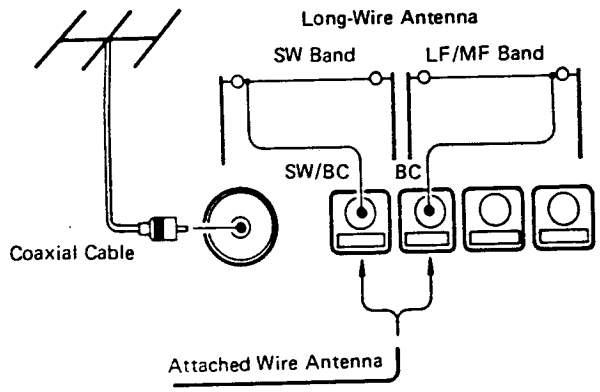
(9) SW/BC, BC, E, MUTE

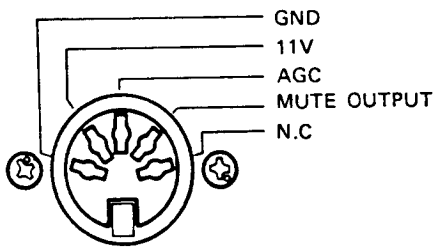
SW/BC is for connection to a long wire antenna for both shortwave and broadcast listening.

BC is for connection to a long wire antenna for broadcast band listening.

E is a ground connection.

MUTE provides a means of muting the FRG-7700 (an external standby switch). Shorting the MUTE terminal to ground will mute the receiver.





ACC CONNECTIONS

SINPO CODE

	Signal Strength S	Degrading Effect of Interference I	Noise N	Propagation Disturbance P	Overall Rating O
5	Excellent ✱ (60dB)	Nil ◉ (−40dB)	Nil (−40dB)	Nil ○ (0dB)	Excellent
4	Good (45dB)	Slight (−30dB)	Slight (−30dB)	Slight (10dB)	Good
3	Fair (30dB)	Moderate (−20dB)	Moderate (−20dB)	Moderate (20dB)	Fair
2	Poor (15dB)	Severe (−10dB)	Severe (−10dB)	Severe (30dB)	Poor
1	Barely Audible (0dB)	Extreme (0dB)	Extreme (0dB)	Extreme (40dB)	Unusable

Table 1

✱ RECEIVER INPUT LEVEL
◉ RATIO TO SIGNAL
○ DEPTH OF FADING, ECHO, ETC.

INSTALLATION

Best performance from this equipment can only be obtained if proper care is observed during installation. While the setup procedure for the FRG-7700 is extremely straightforward, permanent damage to the set can occur if improper voltage is applied to the unit or if external connections are improperly made. Before attempting operation of your FRG-7700, be certain to read the following sections carefully.

UNPACKING AND INITIAL INSPECTION

Carefully remove the FRG-7700 from its carton, and inspect it for any signs of physical damage. Rotate the knobs and push the switches, checking each for normal freedom of action. Should any damage be observed, document it carefully, and notify the shipping company immediately. Save the carton and foam packing material for possible use at a later date.

AC VOLTAGE SELECTION

Your FRG-7700 is supplied with a power transformer capable of operation from 100, 120, 220, or 240 volts, as these voltages are the ones most commonly used throughout the world. Your Yaesu dealer has taken care to make sure that your radio is set up for the voltage used in your area. However, in some parts of the world, more than one voltage is available for use. It is extremely important that the FRG-7700 not be subjected to an improper supply voltage.

Therefore, before connecting the power cord to the radio, make absolutely certain that the voltage specification marked on the rear panel of your receiver (lower right-hand corner) matches your local supply voltage. At the same time, check to make certain that a fuse of the proper rating is installed. For 100/120 volt operation, use a 1 amp fuse. For 220/240 volt operation, use a 1/2 amp fuse. The fuse holder is located on the rear panel. NEVER remove the fuse holder when the power cord is plugged into the wall outlet.

CAUTION

Be certain to observe the above precautions regarding power connections and fuses. Our warranty does not cover damage caused by improper supply voltage nor damage caused by use of an improper fuse.

To set the radio up for operation on a different voltage (as, for example, should you move from Europe to the United States), proceed as follows:

(1) Disconnect the power cord from the rear of the FRG-7700.

(2) Remove the label covering the voltage selector control on the rear panel of the receiver.

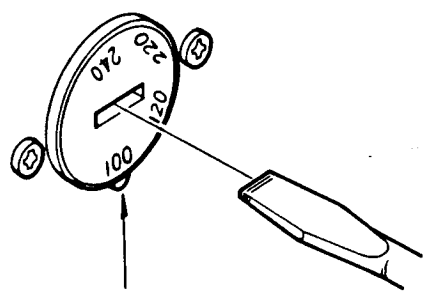
(3) Insert a screwdriver into the slot on the voltage selector. Rotate the selector until the proper voltage is at the very bottom of the selector, in line with the pointer.

(4) If a change is made from 100/120 volts to 220/240 volts, or vice versa, be certain that you install a fuse of the proper rating. For 100/120 volts, use a 1 amp fuse, and for 220/240 volts, use a 1/2 amp fuse.

(5) Make a small label to indicate the new voltage specification for the receiver, and secure it over the voltage selector.

(6) Connect the power cord to the rear panel "AC" jack, and plug the power plug into your wall outlet.

(7) If you have any doubt about your local supply voltage, ask your Yaesu dealer. Improper supply voltage must not be applied to this instrument.



AC VOLTAGE SELECTOR

BACKUP BATTERY INSTALLATION

Memory-equipped FRG-7700 receivers include a backup feature which will hold the memory even when the unit is unplugged from the supply voltage. The backup feature requires three AA size penlight cells (not supplied), which should be installed as shown in Figure 1. Be absolutely certain to observe the proper polarity of the batteries during installation.

Battery consumption is extremely low, but we recommend that the backup batteries be replaced once per year. If you have not used the FRG-7700 for a long time, we recommend that you inspect the penlight cells to ensure that no leakage from the batteries has occurred. Damage caused by battery leakage or improper battery polarity is not covered by our warranty.

Figure 1

GROUND CONNECTION

For best performance and safety, the FRG-7700 should be connected to a good earth ground. The ground lead should be a heavy-gauge braided cable or wire, and should be connected to the terminal marked "E" on the rear panel of the receiver.

ANTENNA INSTALLATION

The antenna is an important part of your station installation. Without a good antenna system, it will be difficult for you to take full advantage of your FRG-7700 receiver's many high-performance features. For best reception, please follow the guidelines presented below regarding antenna installation.

(1) Low Frequency (LF) and Medium Frequency (MF) Reception (Below 2 MHz Exclusively)

Good all-around reception will occur if a single long wire is connected to the BC terminal on the rear of the receiver. Insulate the wire at the far end, and at the point where it enters your house; ceramic insulators suitable for antenna installations are available from your Yaesu dealer. The wire itself may be either bare or insulated (plastic or vinyl covering on the wire), with the constraint that bare wire should not come in contact with trees or other obstructions.

In general, the antenna wire should be as long, high, and in the clear as possible. If these simple recommendations are followed, good reception will be easy to obtain.

(2) Shortwave (SW) Reception (Above 2 MHz Exclusively)

Maximum performance is secured in the shortwave bands through the use of a resonant antenna having an impedance of 50 ohms at the design frequency. A center-fed "dipole" antenna cut for the most-listened-to frequency will easily satisfy this requirement. Dipole antennas should be fed with coaxial cable, and suitable antenna kits are available from your Yaesu dealer.

However, the shortwave bands are quite wide, and no dipole antenna will be resonant throughout this entire frequency range. The best course of action, then, is to cut the legs of the dipole antenna to the longest (equal) lengths that your installation area will allow. This will provide an excellent listening system for your shortwave station.

Should you wish to cut your dipole antenna for optimum performance on a particular shortwave band, the formulas of interest are:

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

Notes Regarding Antenna Installations

For general reception (listening on both the LF/MF and shortwave bands), the antenna connection should be made to the SW/BC connector or to the coaxial antenna connector on the rear panel. If your primary interest is only on the LF/MF bands, then connect your antenna wire to the BC terminal. Do not connect one antenna to the SW/BC terminal (or coax connector) and another antenna to the BC connector at the same time; if you do, overloading or intermodulation distortion may be created, degrading receiver performance.

Use extreme caution when installing your antenna system. Every year, several people are electrocuted because their antenna touched a high-voltage wire providing their normal house current. It is extremely important that your shortwave antenna be located such that it cannot possibly come in contact with electric wires even in a disasterous windstorm.

REMOTE TERMINAL CONNECTIONS

The REMOTE terminals are connected to a relay, which is an electronically controlled switch. In the case of the FRG-7700, the switching relay is controlled by the clock timer, allowing you to control the operation of a tape recorder or other equipment simply by the proper setting of your FRG-7700 clock controls. The "N.O." terminal is "normally open," which means that the relay will cause no connection to be made from the center pin to ground until the timer activates the relay. The "N.C." terminal is "normally closed," which means that the relay contacts will cause a connection to be made between center pin and ground until the relay is activated; the relay will then open the connection.

Most tape recorders have a "footswitch" connection which allows external control. In some cases, this external on/off control line is incorporated into the microphone cord. Closing an external switch then allows the tape recorder to be turned on. To use this kind of tape recorder with the FRG-7700, connect a shielded cable from the tape recorder footswitch jack to the FRG-7700 "N.O." jack, and connect a shielded cable from the FRG-7700 "REC" jack on the front panel to the tape recorder "LINE IN" or "MIC" jack, depending on the levels accepted by your tape recorder. Remember that the REC jack on the FRG-7700 is not controlled by the AF GAIN control, but the EXT SP jack is: you may want to connect your audio input line differently for your particular requirements.

Details of the operation of the timer are included in the "Operation" section of this manual. Table 2 indicates the position of the relay contacts tied to the REMOTE terminal.

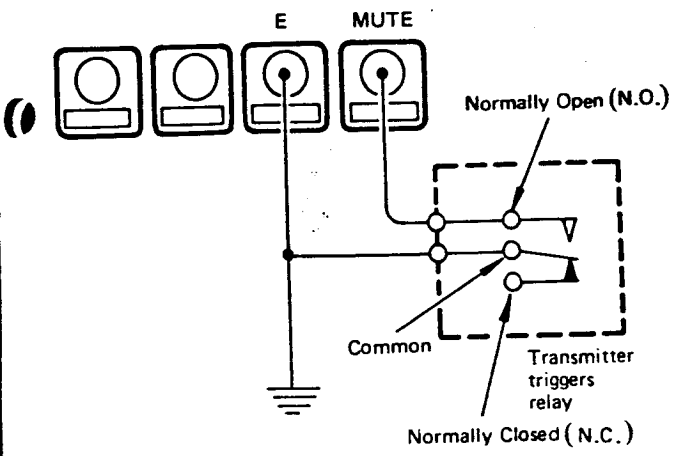
MUTE CONNECTION

When the FRG-7700 is used in conjunction with a transmitter, the MUTE terminal on the rear panel may be used to silence the receiver when transmitting. Do not forget to use a relay for external antenna switching between the receiver and transmitter. Shorting the MUTE terminal to ground will cause the receiver to be silenced.

TIMER FUNCTION	N.O. Terminal	N.C. Terminal	FRG-7700 (with POWER SW OFF)
ON TIMER	OPEN → CLOSED	CLOSED → OPEN	ON at the programmed time
OFF TIMER	CLOSED → OPEN	OPEN → CLOSED	OFF at the programmed time
SLEEP TIMER	OPEN → CLOSED	CLOSED → OPEN	OFF after the programmed period of time

→ When the timer is activated

Table 2



PHYSICAL LOCATION OF THE FRG-7700

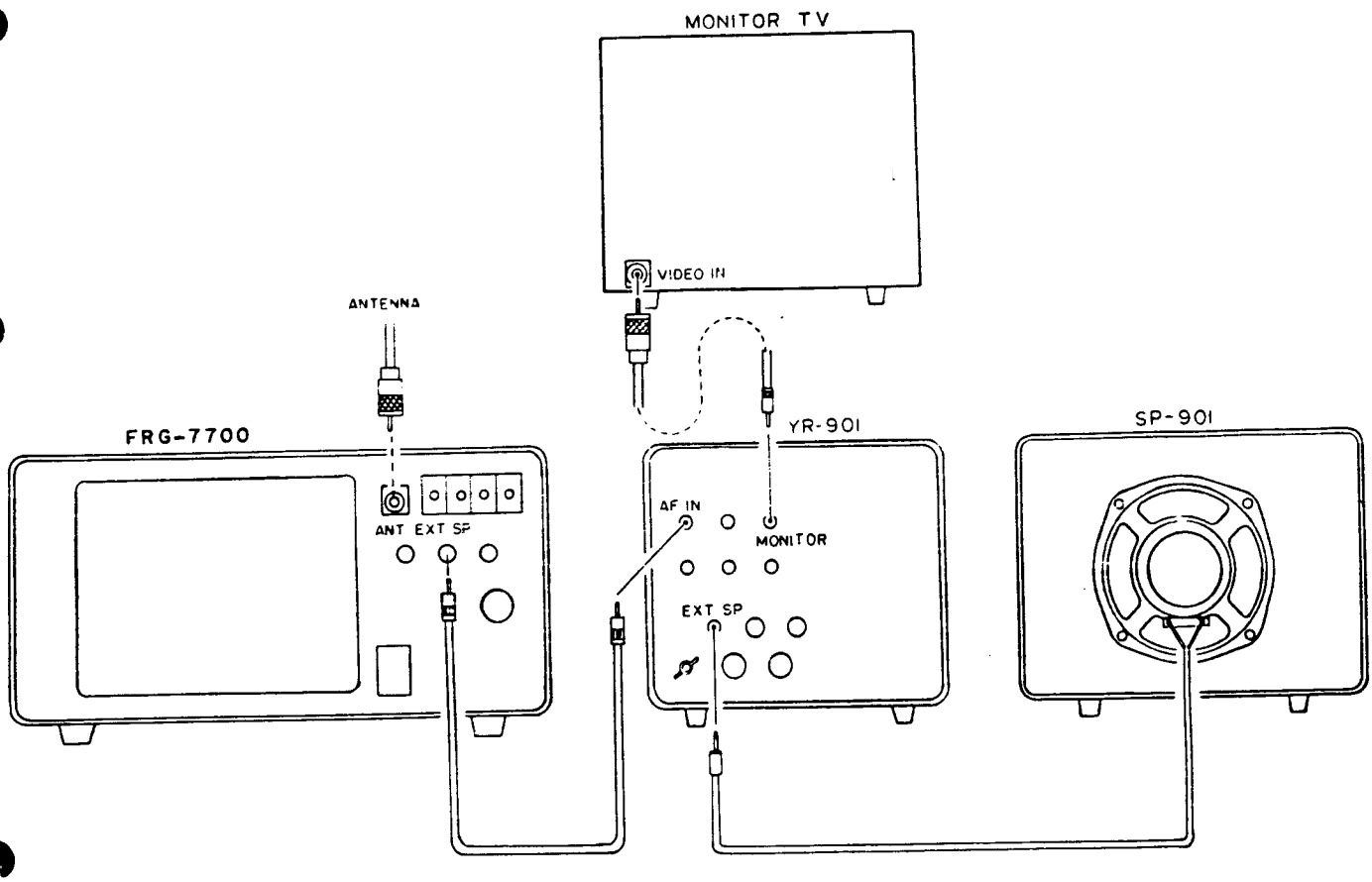
The FRG-7700 will perform well in any location that allows free passage of air around the cabinet. Solid state equipment such as the FRG-7700 should not, however, be used in extremely hot environments unless some provision is made (external fan, etc.) for keeping the station temperature less than 40° C.

INTERCONNECTION WITH YR-901 MORSE CODE/TELETYPE READER

The YR-901 is a high-performance computerized translator which will allow display on a video monitor of incoming Morse Code and/or teletype (RTTY) signals. The YR-901 and YVM-1 Video Monitor are options available from your Yaesu dealer.

Complete operation instructions are included with the YR-901. Please refer to the drawing below for details of the extremely simple interconnections required. Please note that the SP-901 speaker is not mandatory for use with the YR-901, as the latter includes a built-in speaker.

The YR-901 will allow you to see for yourself late-breaking teletype news as it comes from abroad on circuits used by the international news services. Amateur radio Morse Code and teletype communications, and a host of other exotic transmissions will unfold before you on the video screen. See your Yaesu dealer for details.



FRG-7700/YR-901/YVM-1/SP-901

MEMORY UNIT INSTALLATION

The optional Memory Unit is easily installed in a matter of minutes. Please follow the below instructions carefully, in order to make the proper connections.

(1) Remove the small cover from the rear panel of the receiver, as shown in Fig. 2.

(2) Connect the six plugs which are fastened to the cover to the appropriate jacks on the Memory Unit, as shown in Fig. 3.

(3) Mount the Memory Unit with the supplied self-tapping screws (4 pcs), as shown in Fig. 4, being sure that no wires from inside the unit are protruding.

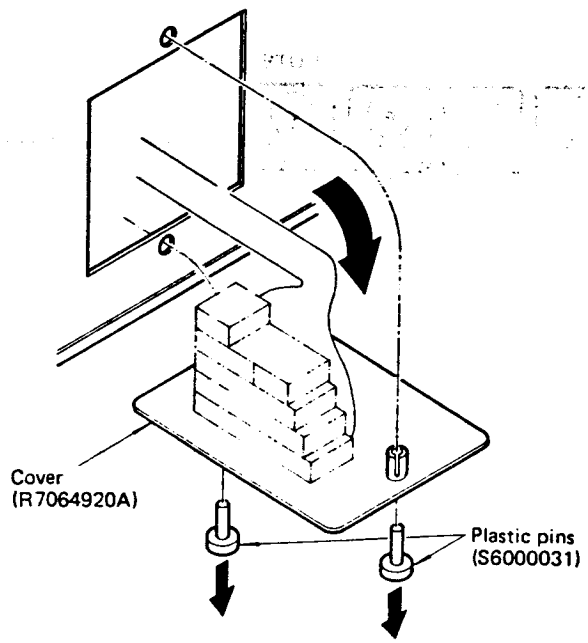


Figure 2

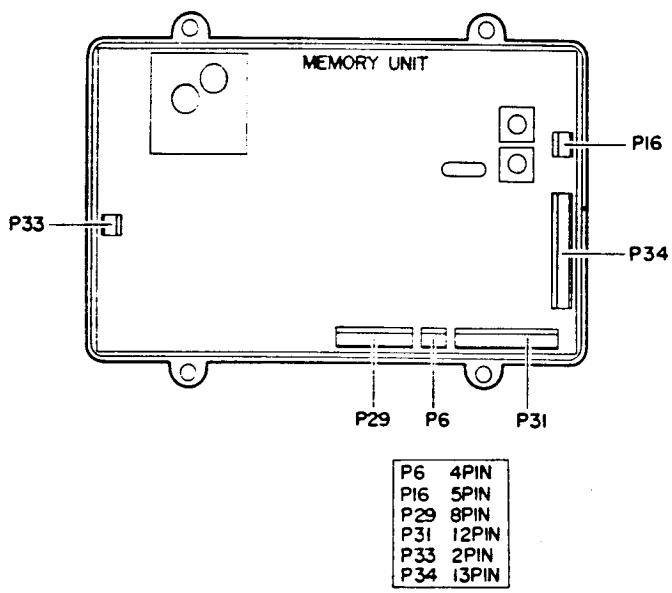


Figure 3

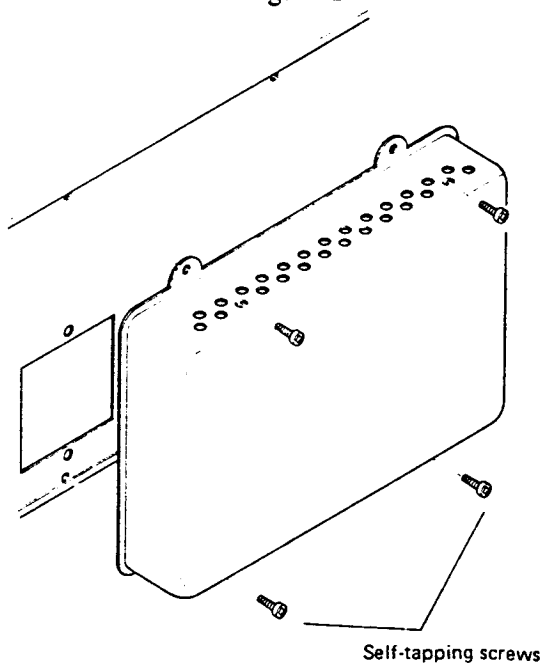


Figure 4

BOTTOM PANEL FEET

The feet on the bottom of the receiver may be changed, should you desire to change the viewing angle for the FRG-7700. The extender feet, packed in the accessory kit for the receiver, may be installed at the front or back, depending on the viewing angle desired. When repacking the receiver for shipping, be certain to replace the original feet. Refer to Figure 5 for mounting details for the bottom panel feet.

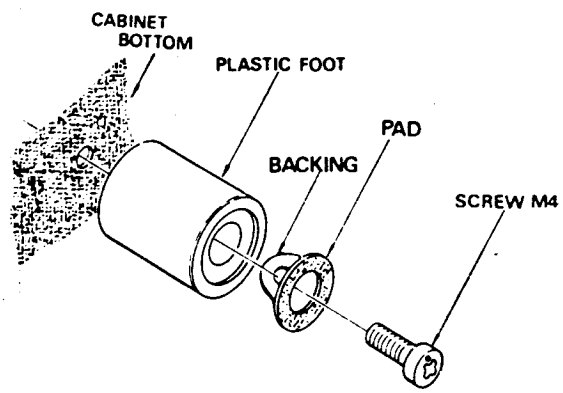
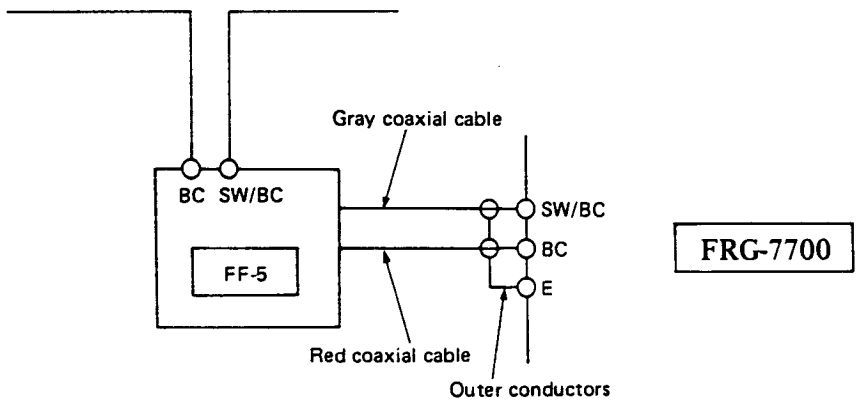


Figure 5

FF-5 INSTALLATION PROCEDURE

When connecting the FF-5 to your FRG-7700, proceed using the following installation procedure.

1. Remove the two feet mounted on the connector side of the FF-5.
2. Referring to Figure 1, fix the supplied mounting bracket to the FF-5 with the screws removed in Step 1.
3. Remove the two screws on the left, rear side of the cabinet, and secure the mounting bracket of the FF-5 in place, as shown in Figure 2.
4. Connect center conductor of the gray coaxial cable from the FF-5 to the SW/BC terminal on the rear panel of the FRG-7700.
5. Connect the center conductor of the red coaxial cable to the BC terminal on the rear panel of the FRG-7700.
6. Connect both outer conductors of the gray and red coaxial cables to Terminal E of the FRG-7700.



CONNECTIONS

BC Terminal

This terminal can be used to receive weak signals below 2 MHz. However, when receiving local stations, your antenna should be connected to the SW/BC terminal.

SW/BC Terminal

This connector will accept the connection of both antennas to receive above and below 2 MHz. Normally, an antenna is connected to this terminal.

OPERATION OF THE SWITCH

SW/BC Position

When you receive signals above 2 MHz, or strong signals below 2 MHz, the switch should be placed in this position. While set in this position, your antenna should be connected to the SW/BC terminal.

BC Position

Set the switch to the BC position when receiving weak signals below 2 MHz. If the signal is receiving interference from strong stations on other frequencies, use the ATT switch on the rear panel of the FRG-7700 to help reduce the interference.

While the switch is in the BC position, your antenna connection should be made to the BC terminal.

150 – 500 kHz Position

When you receive weak signals in the range of 150 – 500 kHz, set the switch to this position and connect your antenna to the BC terminal. Signals which may cause interference in this range will be rejected.

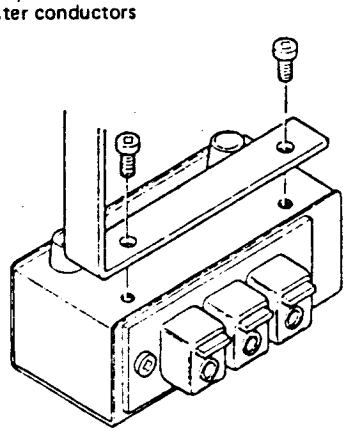


Fig. 1

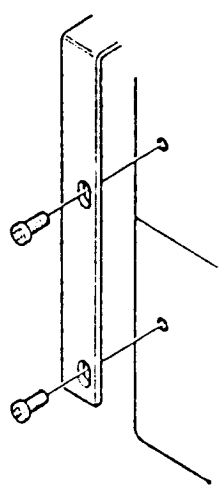


Fig. 2

FRT-7700 INSTALLATION PROCEDURE

1. Connect the center conductor of the gray coaxial cable coming from the rear panel of the FRT-7700 to the SW/BC terminal on the rear panel of the FRG-7700. Connect the center conductor of the red coaxial cable to the BC terminal. Both outer conductors of the coaxial cables should be connected to terminal E.

2. Your antenna should be connected to the ANT B terminal for normal operation. This terminal accepts incoming signals from 150 kHz to 30 MHz. However, the ANT B terminal is best utilized when you are interested in receiving weak signals in the range of 150 kHz to 500 kHz.

   The coaxial receptacle (SO-239) is connected parallel to the ANT B terminal in the FRT-7700. If your antenna feeder has a coax plug, it should be connected to the coaxial receptacle.

OPERATION

1. Set your FRG-7700 for normal operation on the frequency you desire.

2. Preset the controls and switches as follows:
   TUNER – OFF
   ATT – 0 (dB)
   BAND – Desired band
   MATCHING – 3

3. Tune the FRG-7700 to your desired signal.

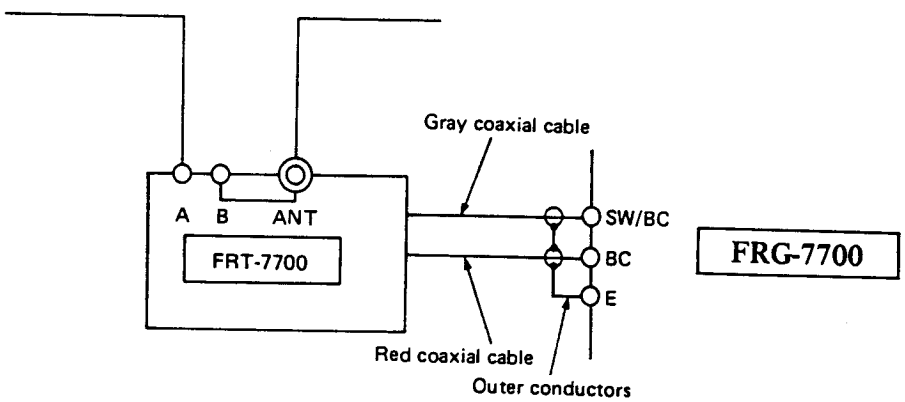
4. Push the TUNER switch on, and adjust the TUNING control for maximum deflection on the S-meter.

5. Change the position of the MATCHING selector to the point where the S-meter reaches maximum deflection.

6. Repeat the adjustments in Steps 4 and 5 until a maximum S-meter reading is obtained. In some cases, the best sensitivity is obtained at either one range above or below the specified coverage of the BAND switch, a trick you might try when you are unable to obtain sufficient sensitivity.

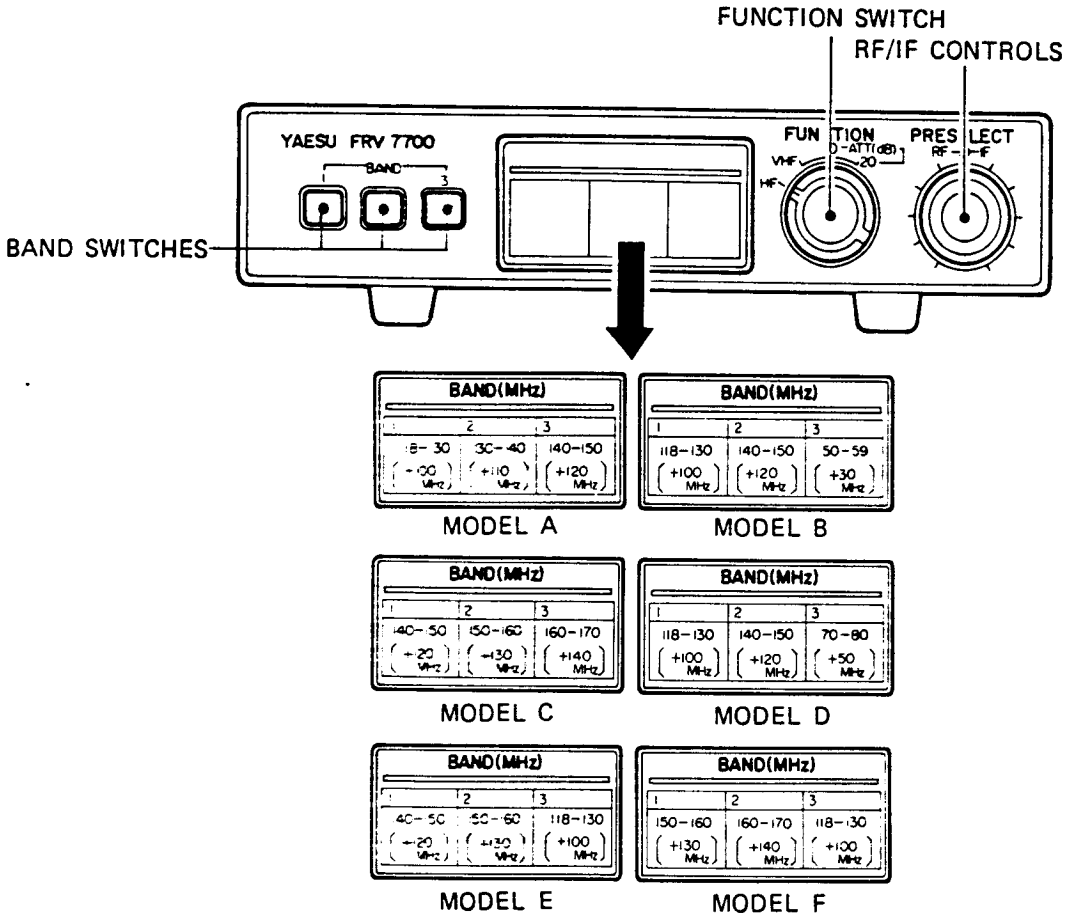
7. When your receiving station receives interference from strong signals, try reducing all incoming signals by adjusting the ATT control, until you find a position where you can receive the signals clearly.

8. When weak signal reception below 2 MHz is desired, push the OUT switch to DXBC, and the weak signals will be clearly received.



FRV-7700 INSTALLATION PROCEDURE

FRONT PANEL SWITCHES AND CONTROLS



BAND Switches

These three switches select the desired coverage, shown on the front panel.

FUNCTION Switch

This switch activates the FRV-7700, and in the 10 or 20 dB ATT position the receive signal is attenuated. When this switch is placed in the HF position, the FRV-7700 is switched off and the HF antenna is connected through the FRV-7700.

RF and IF Controls

These controls tune the RF and IF resonators exactly to your receive frequency, providing maximum sensitivity and rejection of unwanted signals. During operation, adjust these controls for a maximum S-meter reading on each frequency.

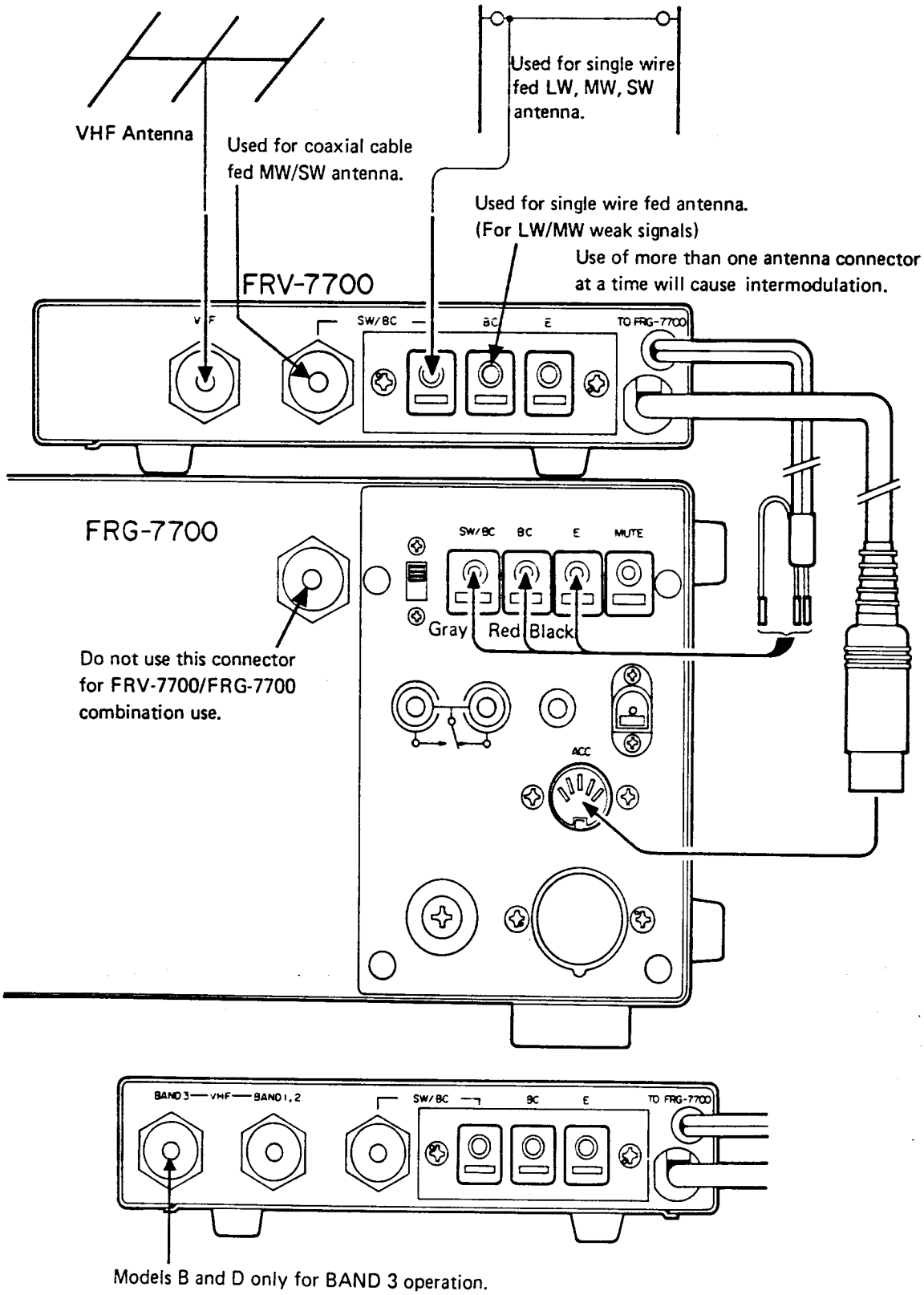
REAR PANEL CONNECTIONS

VHF

This jack accommodates the antenna for the VHF band.

SW/BC, BC, E

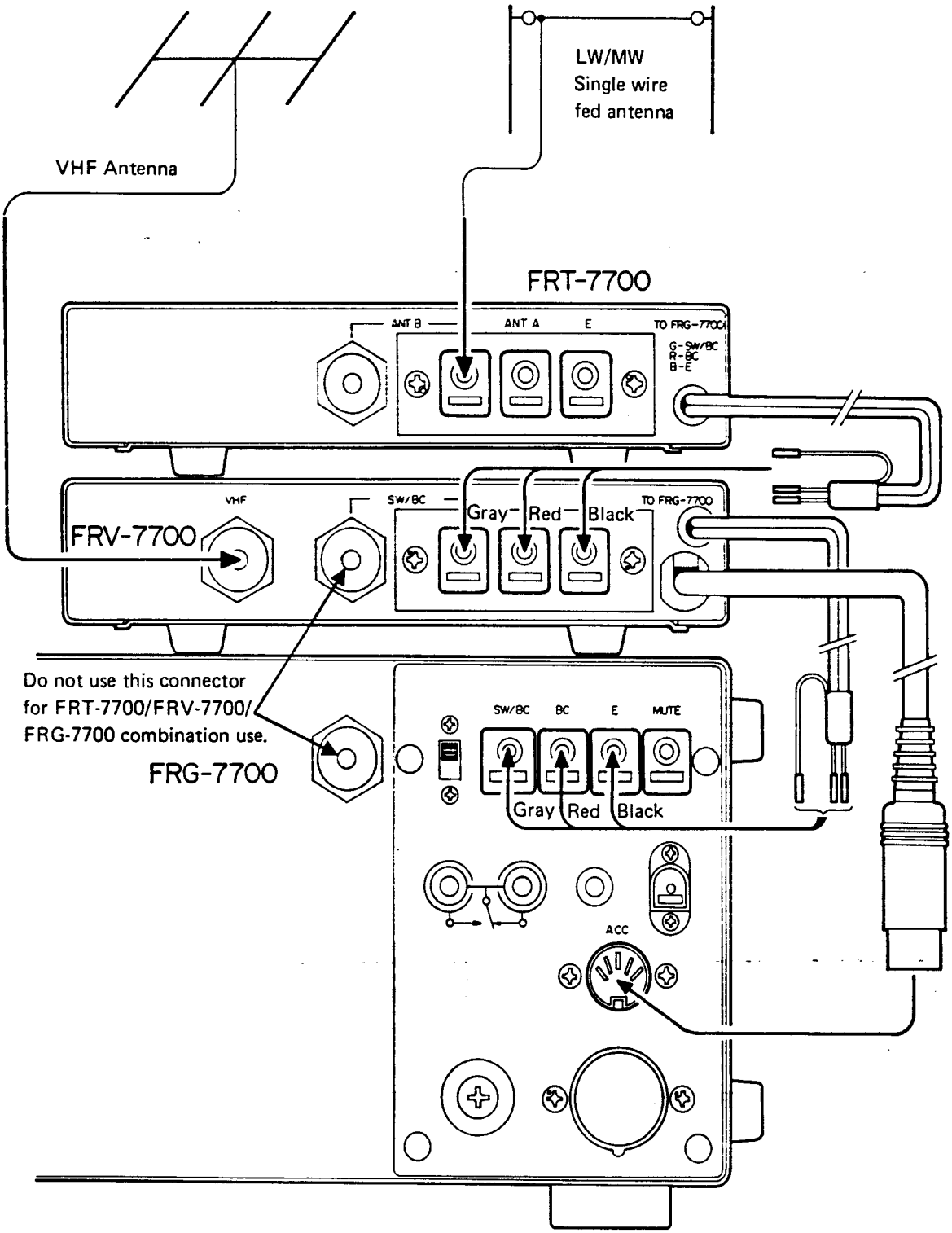
These terminals accommodate antennas for BC and HF bands. When the FUNCTION switch is in the HF position, the signal from the antenna connected to these terminals is fed through the FRV-7700 to the FRG-7700. Antenna connection should be done in the same manner as that of the FRG-7700 (refer to the FRG-7700 Instruction Manual).



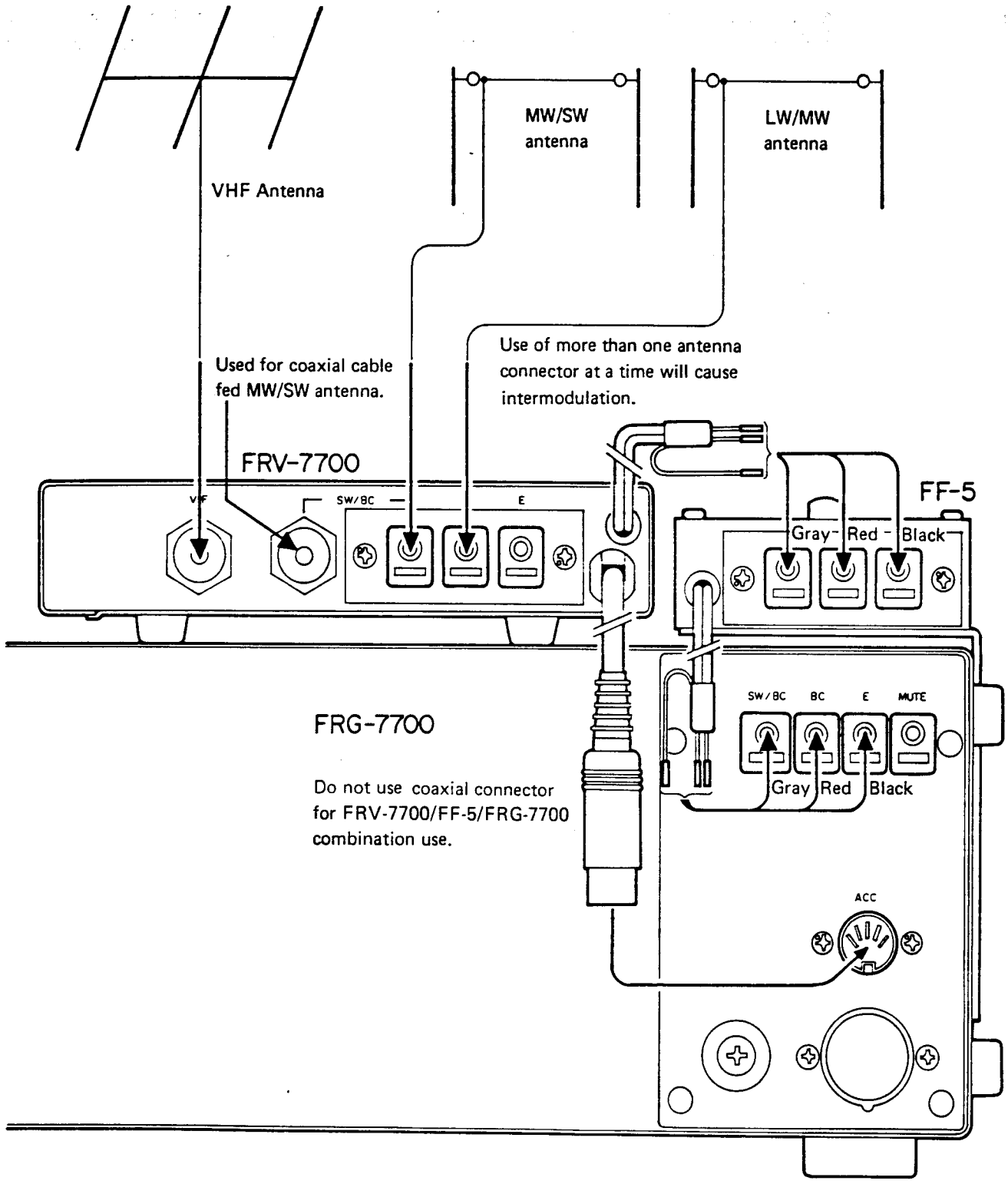
FRV-7700/FRG-7700 INTERCONNECTIONS

Connect the GRAY wire to the SW/BC terminal on the FRG-7700, the RED wire to the BC terminal and the BLACK wire to the E terminal.

Connect the DIN plug to the ACC jack on the FRG-7700 rear panel, which provides AGC voltage, the source voltage of the FRV-7700. When the FRV-7700 is used with the FRG-7700, make no antenna connections to this jack, so as to avoid any signal feeding directly from this jack to the receiver.



FRT-7700/FRV-7700/FRG-7700 INTERCONNECTIONS



FRV-7700/FF-5/FRG-7700 INTERCONNECTIONS

OPERATION

The frequency conversion provided by the FRV-7700 is shown on the front panel. The FRV-7700 uses the 18–30 MHz portion of your FRG-7700 as its tuning range, transforming it up to the VHF frequency by shifting it the amount shown in parentheses in the BAND table.

For example, on Model A, Band 2 provides a frequency shift of +110 MHz. Thus, when tuning 20–30 MHz on your FRG-7700, the converted frequency is 130–140 MHz. Likewise, on Model A, Band 3 causes a conversion of +120 MHz, producing a tuning range of 140–150 MHz when you tune 20–30 MHz on your FRG-7700.

Look at the examples below. Push Band 3 to select 140–150 MHz. Now tune the FRG-7700 to 25.000 MHz. The resulting frequency will be 145.000 MHz, in the middle of the 2 Meter Amateur Radio band.

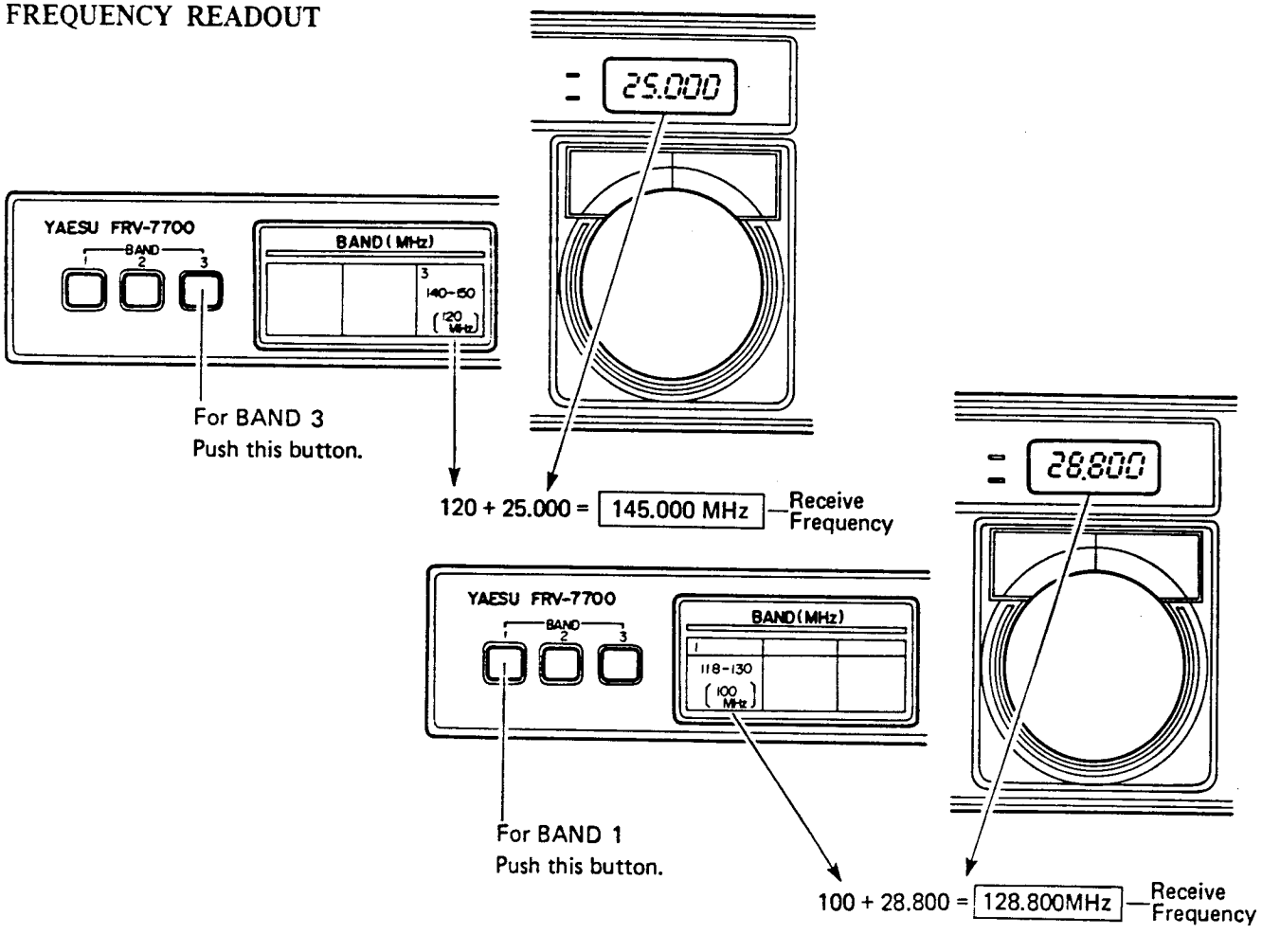
Taking another example, push the BAND 1 switch to engage a +100 MHz conversion. Tune the FRG-7700 to 28.800 MHz, and the resultant frequency received will be 128.800 MHz.

For normal operation, set the FUNCTION switch to VHF, and set the FRG-7700 BAND switch as needed to produce the desired frequency in accordance with the BAND switch engaged on the FRV-7700. Turn the FRG-7700 POWER switch ON.

Adjust the FRV-7700 RF GAIN and IF GAIN controls for maximum deflection on the FRG-7700 S-meter while listening to an incoming signal. This peaking of these controls will ensure maximum sensitivity and rejection of out-of-band signals.

When extremely strong signals are present, you may want to activate the 10 dB or 20 dB attenuator to reduce cross-modulation or intermodulation products which may be hampering reception. These signals are characterized by occasional squealing, unintelligible signal quality. Set the FUNCTION switch to either the 10 dB or 20 dB position, as necessary, to reduce the interference level.

FREQUENCY READOUT



FRA-7700
INSTALLATION AND OPERATION

1. On the end of the cable from the FRA-7700 connect the wire with the grey tab to the SW/BC terminal on the FRG-7700, and the wire with the red tab to the BC terminal. Similarly, connect the wire with the black tab to the E terminal on the FRG-7700. Connect the DIN plug from the FRA-7700 to the ACC jack.

2. Preset the controls and switches on the FRA-7700 as follows:
   PREAMP ..... ON
   OUT ..... SW/BC position
   GAIN ..... fully clockwise
   BAND ..... as desired

3. Fully extend the telescoping antenna on the FRA-7700.

4. Set the FRG-7700 to receive the desired frequejcy (as in step 2).

5. Adjust the TUNING control on the FRA-7700 for a peak in the signal on the receiver. If this peak occurs at either the fully clockwise or counterclockwise positions of the TUNING control, set the BAND switch to an adjacent position and tune again for a peak.

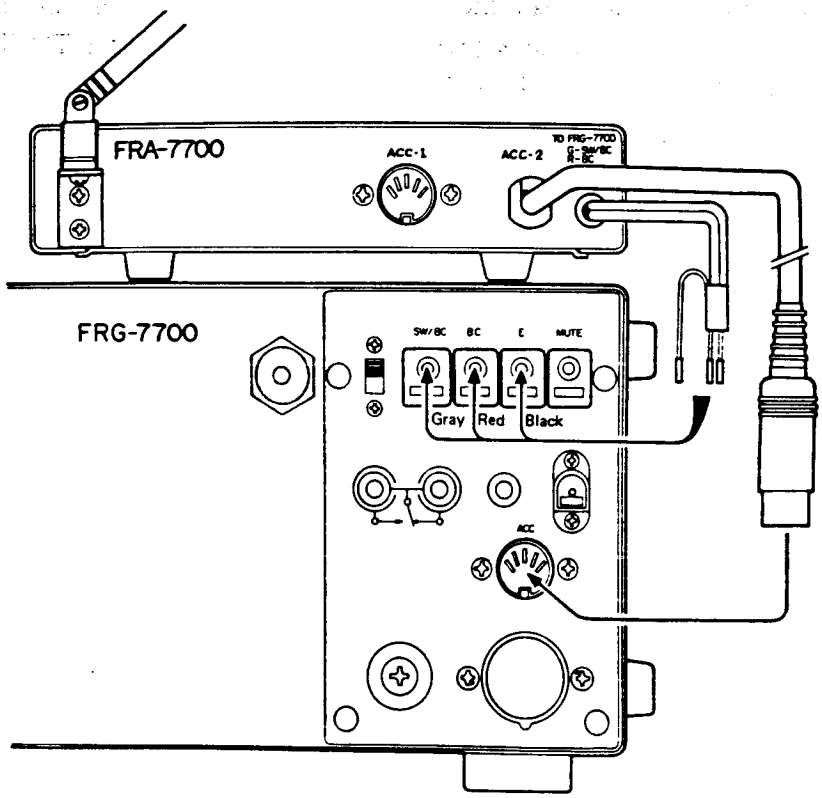
6. Adjust the angle and position of the telescoping antenna for maximum signal.

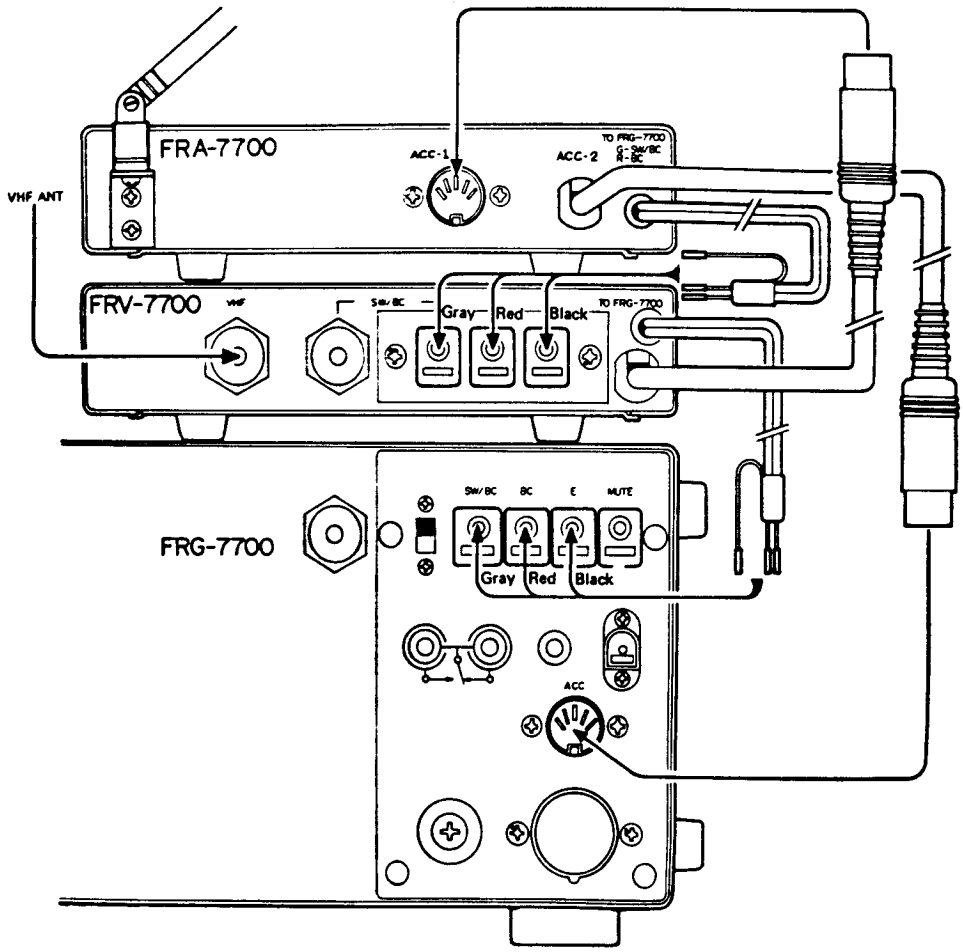
7. If a strong signal on a nearby frequency interferes with your desired signal, reduce the GAIN control setting to minimize the interference.

8. When you attempt to receive very weak signals on frequencies below 2 MHz, set the OUT switch to the DX BC position.

Note:

If you have the FRA-7700 connected to the receiver and switched OFF, such as when listening to strong local signals or through another antenna, you may need to set the BAND switch and TUNING control on the FRA-7700 to peak the received signal (even though the FRA-7700 is switched off).


FRA-7700
ACC-1
ACC-2
TO FRG-7700
G-SW/BC
R-BC
FRG-7700
SW/BC
BC
E
MUTE
Gray
Red
Black
ACC


FRA-7700
ACC-1
ACC-2
TO FRG-7700
G-SW/BC
R-BC
VHF ANT
FRV-7700
VHF
SW/BC
Gray
Red
Black
TO FRG-7700
FRG-7700
SW/BC
BC
E
MUTE
Gray
Red
Black
ACC

OPERATION

Operation of the FRG-7700 is extremely straightforward. However, the owner should read these pages carefully so as to derive maximum performance from this equipment. Before attempting operation, make certain that all power, antenna, and ground connections have been made correctly.

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 BAND switch is calibrated in 1 MHz steps, from 0 MHz through 29 MHz, with an additional 10 steps being provided for instant presetting to the bands containing the amateur radio (ham) bands.

To select a frequency, first set the BAND switch to the desired 1 MHz segment, then rotate the main dial to select the last three digits of the frequency. A coarse frequency determination may also be made through the main dial window, which is calibrated every 10 kHz.

AM BROADCAST RECEPTION

(1) Virtually all commercial broadcast stations in the MF and HF bands use the AM (Amplitude Modulation) mode of operation. To begin, turn the power switch on, and set the mode switch to AM M (AM mode, medium bandwidth).

(2) Tune in an AM station to the point where the S-meter reading reaches a maximum.

(3) If there is very heavy interference, you may wish to set the mode switch to the AM N (AM mode, narrow bandwidth) position. This will provide maximum rejection of adjacent-frequency interference, although the narrower bandwidth will cause some loss of fidelity. Conversely, if there is very little interference, you may switch to the AM W (AM mode, wide bandwidth) position. This will provide maximum fidelity.

(4) The TONE control on the front panel may be used to vary the audio response characteristics of the receiver. For example, if you are troubled by a high-pitched "heterodyne" signal, rotate the TONE control in a counter-clockwise direction to reduce this interference.

(5) When extremely strong signals are encountered, the operator may want to reduce the level of these signals. Rotate the ATT (Attenuator) control on the front panel clockwise to reduce the strength of the incoming signals. Should you desire to activate the fixed 20 dB attenuator, set the rear panel ATT switch to LOCAL. For most listening, though, leave this switch set to the DX position.

(6) For reduction in impulse-type noise (automobile ignition, etc.), push the NB (Noise Blanker) switch. This circuit is highly effective in minimizing this type of interference.

(7) An Automatic Gain Control (AGC) circuit is included in your FRG-7700. This feature keeps signal strengths adjusted to a constant level under conditions of fading. When rapid fading conditions are encountered, you may want to set the AGC switch to FAST, as the use of the SLOW position might cause a weak signal to be obliterated by an adjacent-frequency station which is much stronger. With some experience, the operator will soon learn the proper settings of the MODE and AGC switches for operation under a variety of conditions.

AMATEUR RADIO (HAM) BAND RECEPTION

Amateur radio operators use a variety of operating modes on the HF bands. However, your FRG-7700 is well equipped to receive the various types of ham signals encountered in day-to-day operation.

SSB Voice Signals

(1) Amateur radio operators use lower sideband (LSB) on the bands below 10 MHz, and upper sideband (USB) above 10 MHz. Set the mode switch accordingly.

(2) Turn the power switch on. The meter lamp and digital display will become illuminated.

(3) Rotate the ATT control fully counterclockwise, and adjust the AF GAIN control for a comfortable listening level.

(4) Now rotate the main tuning dial until a voice signal is found. Careful adjustment of the main tuning dial will result in excellent clarity on the incoming SSB signal. Under conditions of rapid fading, set the AGC switch to FAST.

(5) When pulse-type ignition noise is encountered, push the NB switch.

(6) Adjacent frequency interference may be reduced substantially by counterclockwise rotation of the TONE knob. Also, advancing the ATT knob in a clockwise direction may result in some reduction of interference from a strong adjacent station; such a station may be so strong that the AGC control may cause the receiver to be "pumped," and reduction of the receiver front end gain will reduce this effect.

(7) Note that the bandswitch contains nine bands which correspond to the amateur radio allocations. This allows simplified band changing when listening to amateurs. The 10, 18, and 24 MHz bands, newly assigned to the amateur service, are not yet approved for amateur operation in most countries, and no amateur operations will be heard until action is taken by the governments involved.

Morse Code (CW) Reception

Morse Code transmissions may be received by placing the mode switch in either the USB or LSB/CW position. The operator may find that adjacent-frequency interference conditions are better in one or the other of the above modes, and that position should be used until conditions change. The main tuning dial should be rotated until a comfortable listening pitch is obtained.

Frequency Modulation (FM) Reception

Frequency modulation operation is becoming more popular on the 29 MHz amateur band. Also, the operator may wish to use the FRG-7700 with a VHF/UHF converter, for listening to FM repeater operation on the VHF and/or UHF bands. Set the mode switch to FM, and rotate the main tuning dial until the best fidelity on the incoming signal is obtained.

For FM operation, the front panel squelch (SQL) control should be advanced to the point where the receiver is just silenced when no signal (only noise) is being received. This will allow silent monitoring during long periods when no stations are active.

MEMORY OPERATION

The memory feature provides a means of storing frequencies you may want to recall at a later time. Up to twelve stations may be stored in memory. Here is the simple procedure for memory storage and recall:

(1) Set the M FINE control to the 12 o'clock position. Rotate the M CH switch to memory channel 1.

(2) Tune the receiver to the desired station, being careful to tune for best clarity and fidelity. Press the M (Memory) button. The station is now stored. Continue tuning for additional stations, if desired, and store them in the other memory channels.

(3) To recall a station previously stored, rotate the M CH switch to the appropriate channel, and press the MR (Memory Recall) button. If several stations are stored in the various memory channels, simply rotate the M CH switch to the desired channel.

(4) To return control to the main tuning dial, simply push the MR button again. The MR lamp will turn off, and normal tuning will again be possible. The stations stored in memory will not be lost if you release the MR switch; just press it again to return to the memory.

(5) Note that stations on different bands may be stored in memory. Once stored, they may be recalled without the need to rotate the band switch to the appropriate band. In other words, you may store stations in the 11 MHz, 15 MHz, and 21 MHz bands as you tune them in using the band switch and main tuning dial; once you press the MR button, you only need to rotate the M CH switch to recall these stations, with no change in the position of the bandswitch required.

(6) The M FINE control may be used to provide fine tuning of ±1 kHz from a memorized frequency. This may be necessary should the memorized station begin to drift, or should propagation conditions cause new interference to appear on frequency. Judicious use of the AM N position of the mode switch, along with the M FINE control, will provide solid copy on many stations that might otherwise be obliterated by interference.

DIGITAL CLOCK OPERATION

The built-in digital quartz clock is a highly accurate timepiece which adds convenience and flexibility to your FRG-7700 station. The clock will operate so long as the receiver is plugged in, and it will also operate off of the memory backup batteries. When the receiver is initially plugged in, the clock will indicate AM 1:00 and will begin counting. Setting the time is a simple procedure, as shown below.

Example: set the clock to 5:25:00 PM

(1) Place the FUNCTION switch in the CLOCK position, then push and hold the HOUR SET button. The minutes and seconds will reset to zero. Tune in WWV at 10 MHz (or another international time standard) on the receiver. When the time standard ticks off the start of a new minute, release the HOUR SET button. This will align the count of the seconds to the international time standard.

(2) Push the HOUR button to advance the hour digit to 5:00. If the HOUR button is held for more than two seconds, the hour digits will advance rapidly until the HOUR button is released.

(3) Push the MINUTE button to advance the minute digit to 25. When the MINUTE button is pressed and held, the digits will advance rapidly, in the same manner as the hour digit.

(4) The clock should be accurate within 15 seconds per month. When setting the clock, be certain that the appropriate AM/PM digit is illuminated.

TIMER OPERATION

Four timer functions are available. They are:

ON Timer
In this mode, the receiver is turned on at a pre-programmed time.

OFF Timer
In this mode, the receiver is turned off at a pre-programmed time.

ON/OFF Timer
In this mode, both the on and off times are preset for power control of the receiver.

SLEEP Timer
In this mode, you may set a listening time of up to 59 minutes, after which the receiver will turn off.

To set the timer for on/off automatic control of the FRG-7700, proceed as follows (example–on time 10:30 AM, off time 11:30 AM)

(1) Set the POWER switch to OFF, and set the function switch to the ON position.

(2) Set the display to 10:30 AM by pushing the HOUR and MINUTE buttons, in the same way as you did when you preset the clock earlier.

(3) Set the function switch to OFF. Set the display to 11:30 AM by pushing the HOUR and MINUTE buttons.

(4) Push the TIMER switch to activate the timer. The FRG-7700 will turn on at 10:30 AM, and turn off at 11:30 AM. Be certain to observe the AM or PM lamps when programming the on and off times.

(5) If you want to turn the receiver off before the programmed off time, push the TIMER CLEAR button.

To set the sleep timer, proceed as follows:

(1) Turn the POWER switch OFF, and set the function switch to the SLEEP position.

(2) Push the MINUTE switch once. This will cause the sleep time to count back from the 59 minute mark by one minute. Holding the MINUTE button down will cause the time to change rapidly, in the same manner as described earlier. If you set the display to 40, the receiver will stay on for 40 minutes, then shut off.

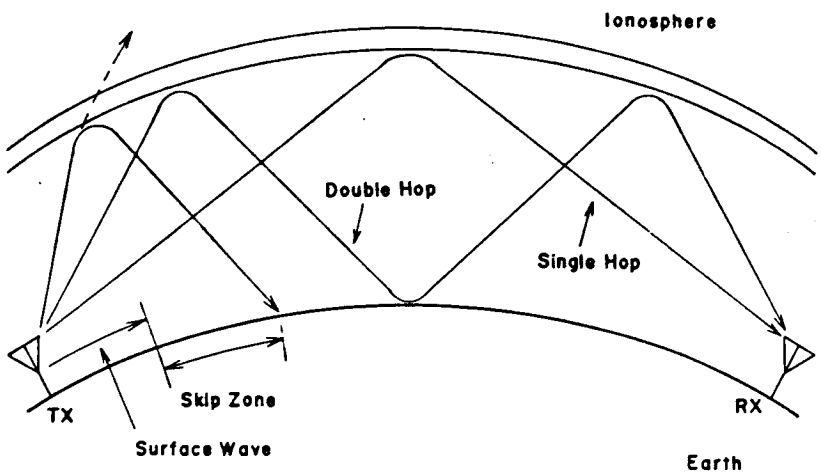
(3) If you want to turn the receiver off before the programmed off time, push the TIMER CLEAR button.

NOTES REGARDING PROPAGATION OF SHORTWAVE SIGNALS

While a complete discussion of the physics of shortwave radio signal propagation is well beyond the scope of this manual, some guidelines are presented below to help you to choose the optimum listening frequency for the time of day and the time of year in which you are operating. This discussion will also help you when you are reading the schedules of overseas broadcast stations; you will soon be able to know instantly why you cannot expect to hear Tokyo on 3.9 MHz at 1:00 in the afternoon.

Shortwave signals are transmitted by huge stations running many thousands of watts of power. Their antenna systems are elaborate and expensive. But all of this equipment would be useless were it not for a property of the ionosphere (a layer of the atmosphere high above the earth) which causes signals to be reflected back to earth when they strike the ionosphere.

Depending on several factors, including the time of day, the time of year, and the current state of solar activity (determined primarily by "sunspots"), the optimum frequency for reflection over a particular distance will change. Another aspect that can be noted is that, for a particular frequency on which you are operating, the distance over which signals will be propagated will change. Thus, in order to hear stations 12,000 km away over a long period of time on a particular day, you will likely have to change your operating frequency (consistent with the broadcast station schedules!) in order to take advantage of changing propagation conditions.



As a general rule, daytime propagation conditions will be best on frequencies from about 12-14 MHz and higher. Propagation at night will generally be best on the 2-15 MHz bands. These general rules often have exceptions, of course; during periods of high solar activity, the 21 MHz band may, for example, be excellent for long-distance propagation well into the night. However, it would be highly unusual for the bands below about 8 MHz to support transoceanic propagation throughout the daytime period.

When reading broadcast station schedules, one must consider not only the time of day at one's own location, but also the time of day at the transmitter location. Let us examine the example of two broadcast stations, one in Tokyo and one in Moscow, both operating on 6 MHz at 6:00 PM local time (for our example, let us say that you live in New York City, USA). Because there are night-time conditions across most, if not all, of the North Atlantic path that a signal would follow on its way from Moscow to New York, one would normally have a good chance of receiving the broadcast from Moscow. However, the path from Tokyo to New York is largely a daylight path, and our rule of thumb discussed earlier would tell us that it would be difficult, if not impossible, to hear Tokyo at that time on that frequency.

However, if one reads further down the schedule of the Tokyo schedule, a broadcast on 15 MHz at the same time may be found. The 15 MHz region (±5 MHz) is a middle ground which often supports round-the-clock propagation. You would have a much better chance of hearing Tokyo on 15 MHz, because the path is largely over daylight.

Broadcast station managers are well aware of this phenomenon, and this is the reason why their schedules indicate "North American Service" or "Programming Beamed at Southeast Asia." They take propagation conditions into consideration, and aim their antennas carefully, so as to have the best chance of reaching their target area at a time when people will be at home to listen.

The time of year is important for several reas
For example, at 4:00 PM in New York in June,
sun is still high in the sky. But at 4:00 PM
December, twilight is fast approaching, and ni
time conditions are taking over on the Nc
Atlantic path. Broadcast station managers ad
their schedules so as to use the lower frequen
(below 10 MHz) more heavily in the wi
months, because of the increased distance cove
by darkness during the winter.

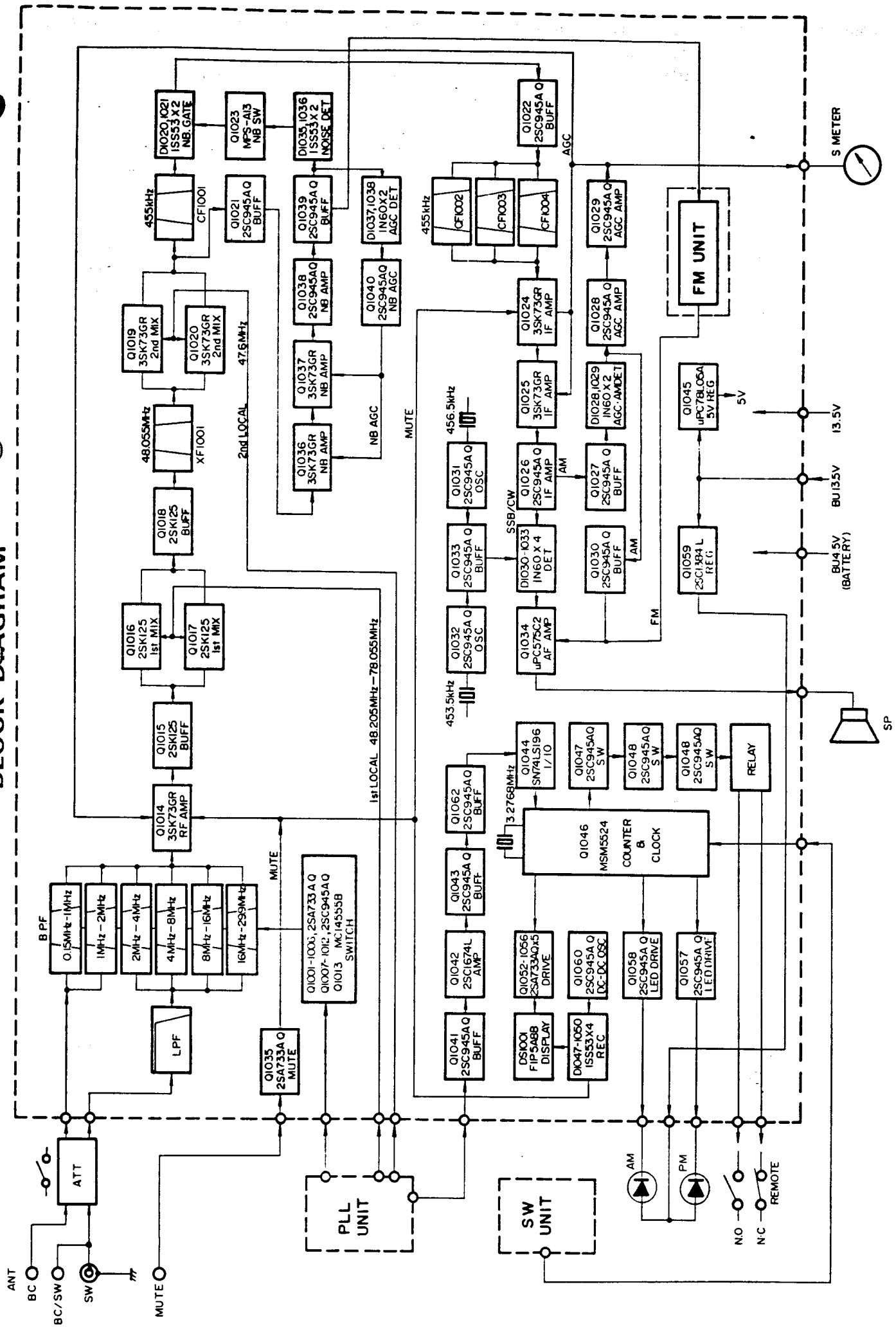
Signals do not always follow the shortest dista
from point A to point B (called the "Great Cir
path). They sometimes follow a bent path, or
exactly the opposite of the great circle. This is v
it is sometimes possible to hear Tokyo fr
New York on 7 MHz late in the afternoon
the winter, even though the Great Circle p
is in daylight; the signals are traveling alon
darkness path around the world. The fact t
many stations are louder, and that the tr
mitting antenna may not be beamed on
optimum path at that time, makes recept
extremely difficult. But this is the excitemen
shortwave listening—hearing the unexpected. Un
tough conditions such as this, the AM-N (nar
bandwidth) position of the mode switch will pr
itself to be a highly useful feature.

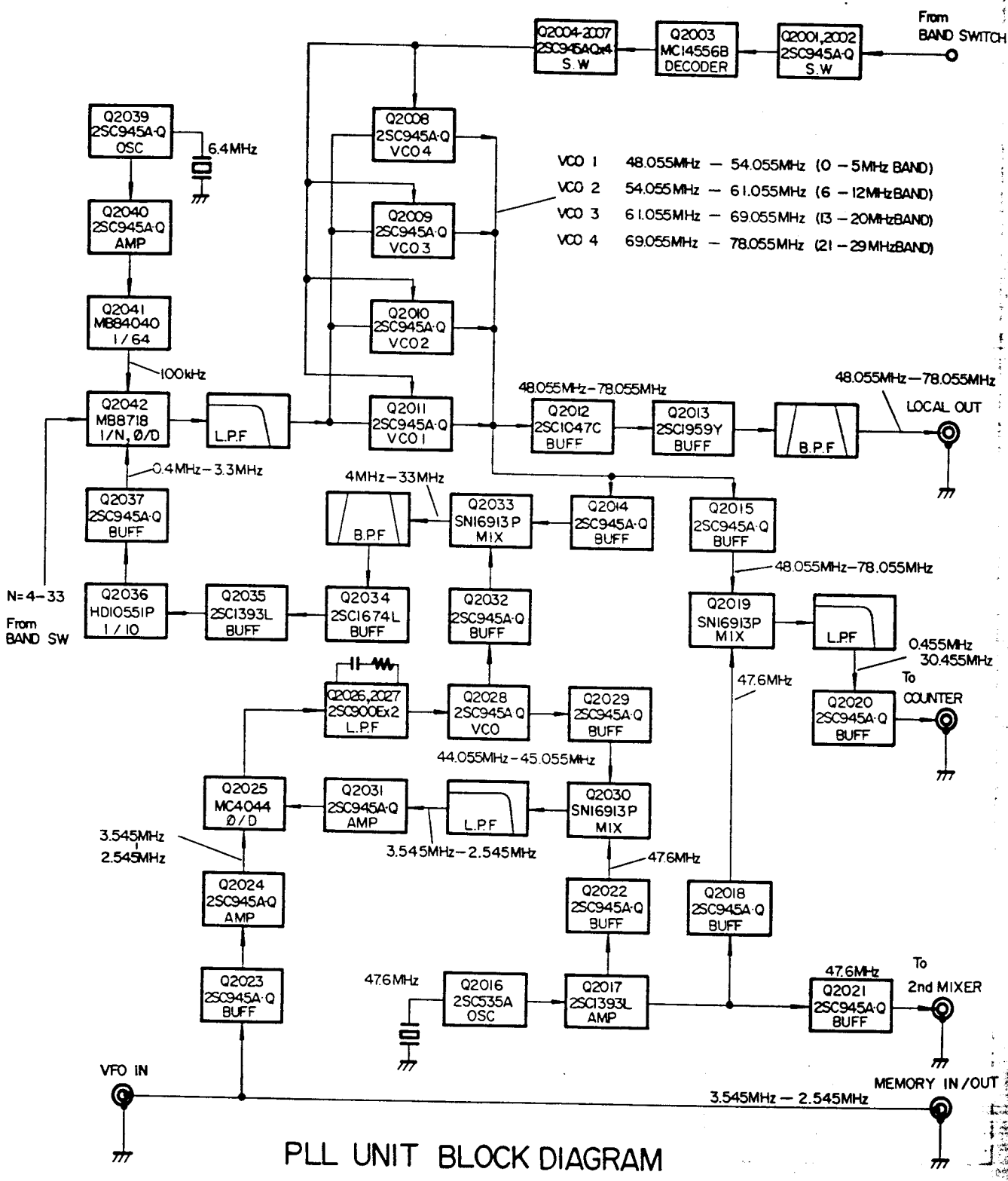
To conclude our discussion on propagation co
tions, we would stress the following general ru
First, use the higher frequencies (15 MHz and
as your main daylight bands. Secondly, use the
frequencies (below 15 MHz) as your prime ni
time bands. Thirdly, look for peaks in propagat
when there is sunrise or sunset at one end
another of a propagation path. For example, lo
for a peak in 26 MHz propagation towards
East for the hour or so after your sunrise,
toward the West around your sunset.

Careful planning of your operating times, pro
choice of listening frequencies, and diligent st
of schedules from overseas broadcast stations
pay rich dividends in entries in your log bo
We hope that this section will have helped
understand the fascinating world of shortw
radio propagation better.

SECTION 2—TECHNICAL NOTES

BLOCK DIAGRAM





PLL UNIT BLOCK DIAGRAM

CIRCUIT DESCRIPTION

Reference to the block diagram and the following circuit description will provide you with a better understanding of the design of this receiver. The FRG-7700 is a superheterodyne receiver using up-conversion to a first IF (Intermediate Frequency) of 48 MHz. Synthesized local oscillators are used for both the first and second mixers, providing a high degree of frequency stability.

RECEIVER SIGNAL FLOW

The RF (Radio Frequency) signal from the antenna is fed through the defeatable RF attenuator to the MAIN Unit. The signal is passed through a low-pass filter (f_C = 30 MHz), consisting of L_{1001}, C_{1001}, C_{1002}, and then through bandpass filters for the following ranges: 150 kHz – 1 MHz, 1 – 2 MHz, 2 – 4 MHz, 4 – 8 MHz, 8 – 16 MHz, and 16 – 30 MHz. Selection of the filter to be used is provided by diode switches D_{1001}–D_{1012} (1SS53), which are driven by Q_{1013} (MC14555). Q_{1001}–Q_{1006} (2SA733), and Q_{1007}–Q_{1012} (2SA945A-Q), according to the setting of the band switch.

The signal is then amplified by RF amplifier Q_{1014} (3SK73GR), a dual-gate MOS FET with superior linearity and low noise figure. The amplified signal is then fed through buffer Q_{1015} (2SK125) to the first mixer, where the RF signal is mixed with the first local oscillator signal (48.055 – 78.055 MHz) delivered from the PLL Unit, resulting in a 48.055 MHz first IF. This up-conversion technique provides superior image rejection characteristics when compared with conventional designs.

The first IF signal is amplified by Q_{1018} (2SK125) and fed through crystal filter XF_{1001}, which has a 20 kHz bandwidth at –6 dB, providing protection from in-band intermodulation distortion while allowing sufficient bandwidth for effective noise blanking. The signal is then delivered to the second mixer, where the 48.055 MHz first IF signal is mixed with a 47.6 MHz local oscillator signal from the PLL Unit, producing a 455 kHz second IF signal.

The 455 kHz signal is passed through a ceramic filter, CF_{1001} (20 kHz/–6 dB) and noise blanker gate diodes D_{1020}/D_{1021} (1SS53) to the main IF filters: CF_{1002} (SSB/AM-N), CF_{1003} (AM-M), and CF_{1004} (AM-W), with filter selection made via the mode switch. The filtered IF signal is then delivered to the main IF amplifier chain, consisting of Q_{1024}, Q_{1025} (3SK73GR), and Q_{1026} (2SC945A-Q).

In the SSB and CW modes, the IF signal is coupled to the product detector, a diode ring demodulator consisting of D_{1030}–D_{1033} (1N60), which converts the IF signal into audio using the carrier signal delivered from Q_{1033} (2SC945A-Q). The audio signal is fed to the audio amplifier, Q_{1034} (μPC575C2), which delivers 1.5 watts of audio power to the speaker.

In the AM mode, the IF signal is coupled from Q_{1026} via C_{125} to buffer amplifier Q_{1027} (2SC945A-Q). The signal is then detected at D_{1028}/D_{1029} (1N60), and the resulting audio signal is fed to the audio amplifier via buffer amplifier Q_{1030} (2SC945A-Q).

NOISE BLANKER CIRCUIT

A portion of the output from the second mixer is fed through buffer Q_{1021} (2SC945A-Q) to amplifiers Q_{1036}, Q_{1037} (3SK73GR) and Q_{1038}, Q_{1039} (2SC945A-Q). When a carrier or noise-free modulated signal is received, the IF signal is rectified by D_{1037} and D_{1038} (1N60), producing a DC voltage. The DC voltage is amplified by Q_{1040} (2SC945A-Q) and fed to gate 2 of Q_{1036} and Q_{1037}, controlling the gain of those stages.

When pulse noise is received, D_{1035} and D_{1036} (1SS53) rectify the IF signal, producing a DC voltage which controls the noise blanker switching diodes (D_{1020}/D_{1021}). Noise pulses have a very short duration, but extremely high amplitude. Because of the very slow time constant of the AGC circuit feeding back to Q_{1036} and Q_{1037}, these short duration pulses will not induce AGC action, and those stages will operate at full gain. When a pulse is received, however, Q_{1023} biases D_{1020} and D_{1021} to block the signal path momentarily.

When a noise pulse and a desired signal are received simultaneously, the blanking action is not impaired, because the relative amplitude difference between the desired signal and the noise pulse is high.

AGC CIRCUIT

A portion of the output from the AM detector is fed to DC amplifiers Q_{1028} and Q_{1029} (2SC945A-Q). This amplified DC voltage is applied to gate 2 of the RF and IF amplifiers, controlling the gain of those stages.

MUTE CIRCUIT

Q_{1035} is normally in the "ON" state, providing normal bias voltage to gate 1 of Q_{1014} and Q_{1024}. When the MUTE terminal is shorted to ground, Q_{1035} turns off, removing the bias voltage from the above transistors, thus silencing the receiver.

CLOCK AND DIGITAL DISPLAY CIRCUIT

A Large Scale Integration (LSI) chip, Q_{1046} (MSM5524), controls both the display of the operating frequency and the time. An 0.455 – 30.455 MHz signal from the PLL Unit is amplified by Q_{1041}, Q_{1042}, and Q_{1043} (2SC1674L), then fed through divider (1/10) Q_{1044} (SN74LS196) to the LSI chip. The output from Q_{1046} is fed to the flourescent display tube, (DS1001), through segment drivers Q_{1052}–Q_{1058} (2SA733A-Q). Q_{1060} and Q_{1061} act as a DC-DC converter, providing –25 volts DC for the display tube.

The timer control output from the LSI activates relay RL_{1001}, which controls the receiver main power supply ON/OFF function. RL_{1001} also is connected to the REMOTE terminals on the rear panel of the receiver, for control of peripheral station equipment.

PLL CIRCUIT

The first and second local signals (48.055 – 78.055 MHz and 47.6 MHz, respectively) are generated by the dual-loop PLL (Phase Locked Loop) circuit.

A 44.055 – 45.055 MHz signal is generated by VCO (Voltage Controlled Oscillator) Q_{2028} (2SC945A-Q) in PLL Loop 1. This signal feeds mixer Q_{2030} (SN16913P), where the VCO signal is mixed with a 47.6 MHz signal generated by crystal oscillator Q_{2016} (2SC535A), producing a 3.545 – 2.545 MHz signal which is fed to phase detector Q_{2025} (MC4044P). The phase detector compares the phase of the input signal with that of the VFO signal delivered via Q_{2024} (2SC945A-Q); any phase difference is converted to a DC control voltage, which is fed to varactor diodes in the VCO circuit, in order to correct the phase difference and lock the input signal with the VFO signal.

In PLL Loop 2, there are four VCO circuits which are selected by the bandswitch, with the net result being an output signal of 48.055 – 78.055 MHz. This signal is fed to mixer Q_{2033} (SN16913P), where the input signal is mixed with the 44.055 – 45.055 MHz signal delivered from PLL Loop 1, producing a 4 – 33 MHz signal. This signal is fed through divider (1/10) Q_{2036} (HD10551P) to phase detector Q_{2042} (MB8718), which also contains a programmable divider.

Phase detector Q_{2042} compares the phase of the signal from the onboard programmable divider and that of the 100 kHz reference signal generated by Q_{2039}, Q_{2040} (2SC945A-Q), and Q_{2041} (MB84040), producing an error-correcting DC voltage. The dividing ratio of the programmable divider is selected by the bandswitch. The error-correction voltage is fed to varactor diodes in VCO/1 – VCO/4, thus locking a highly stable 48.055 – 78.055 MHz signal, which will be used as the first local signal. The VCO output is fed through buffers Q_{2012} (2SC1047C) and Q_{2013} (2SC1959Y) prior to delivery to the first mixer.

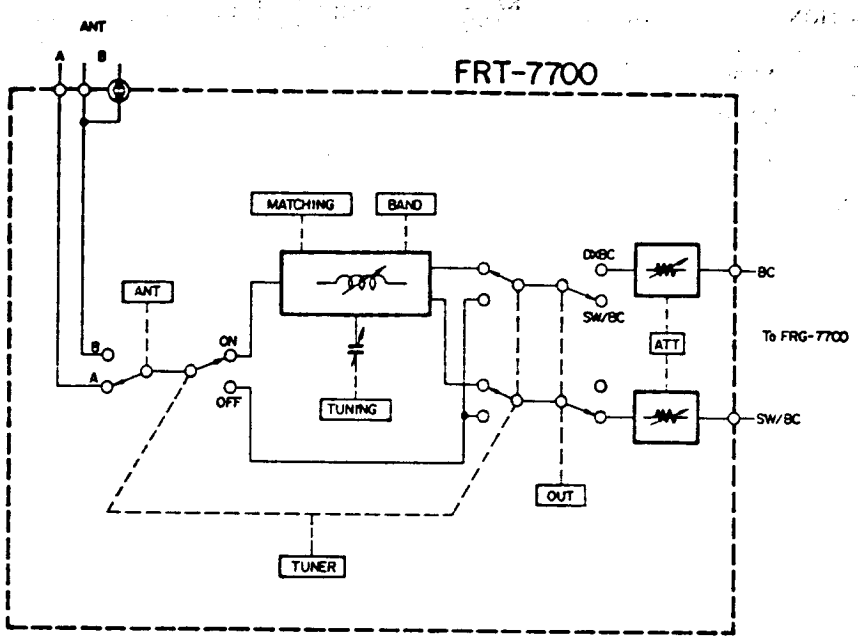
The second local signal (47.6 MHz) is generated by Q_{2016}, then amplified by Q_{2017} (2SC1393L) and fed through buffer Q_{2021} (2SC945A-Q) prior to delivery to the second mixer.

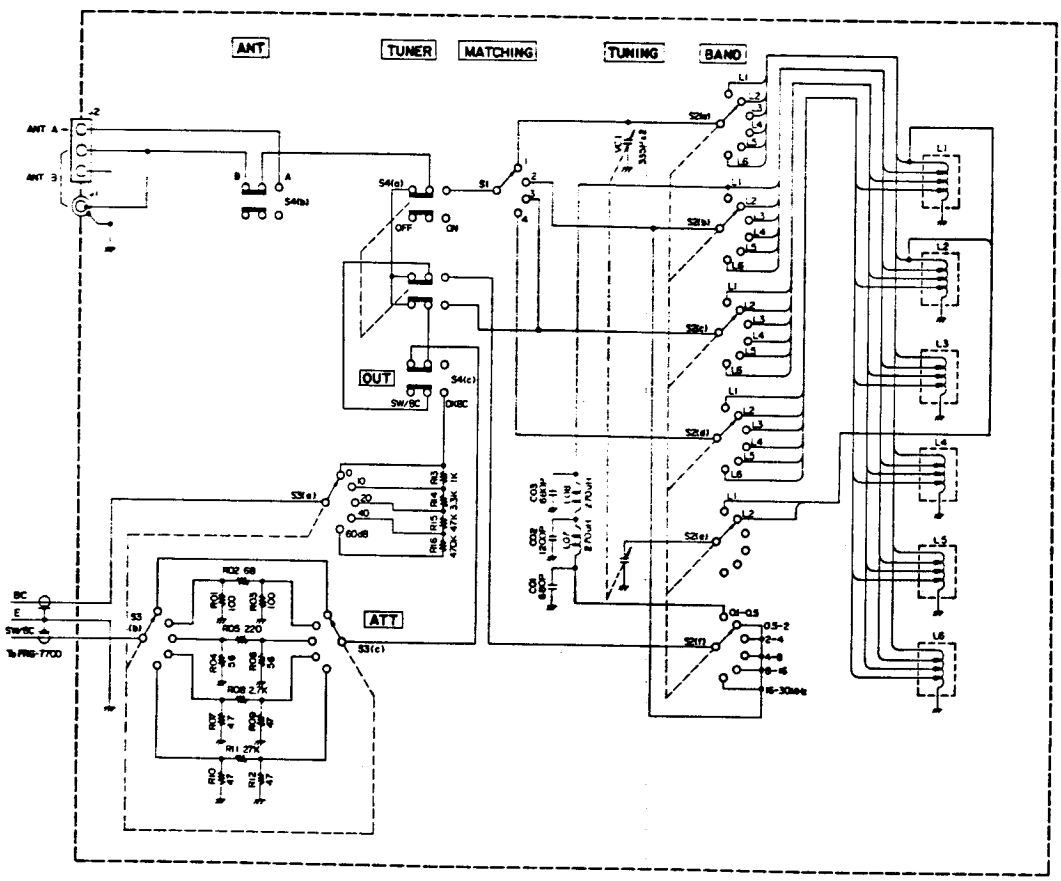
A portion of the first local signal is fed to mixer Q_{2019} (SN16913P), where the signal is mixed with the 47.6 MHz second local signal, producing a signal at 0.455 – 30.455 MHz which is fed to the LSI chip in the counter for display of the operating frequency.

CRYSTAL DATA

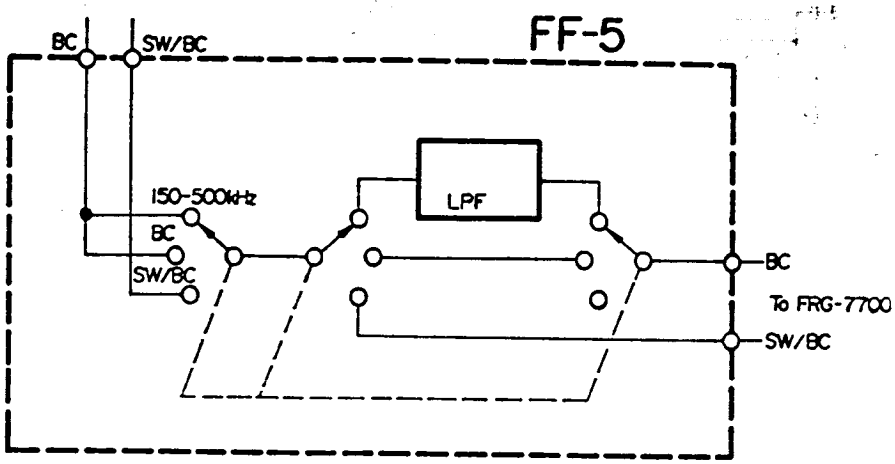
FUNCTION		HOLDER	RANGE (MHz)	MODE	LOAD C	EFFECTIVE RESISTANCE	DRIVE LEVEL
MAIN UNIT	X1001	HC-18/U	3.2768	Fundamental	30pF	150Ω	3mW
PLL UNIT	X2001	HC-18/U	47.6	3rd Overtone	20pF	25Ω	2mW
PLL UNIT	X2002	HC-18/U	6.4	Fundamental	30pF	30Ω	3mW
MEMORY UNIT	X6001	HC-18/U3P	16.434	Fundamental	30pF	15Ω	3mW

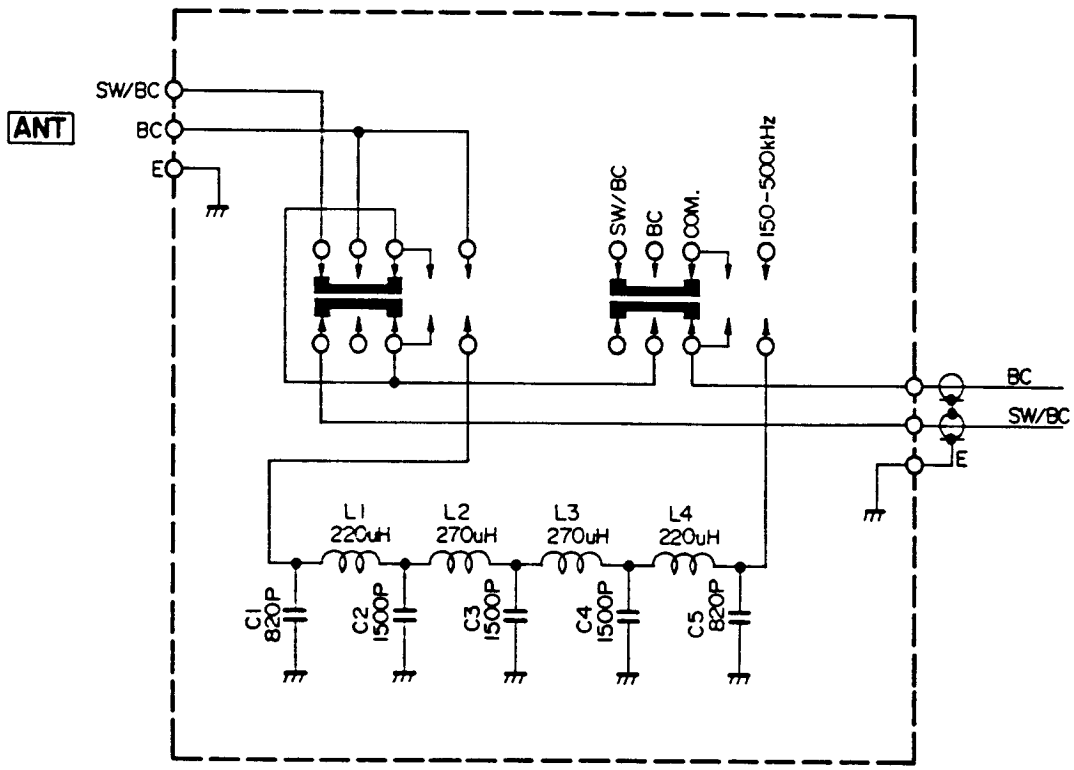
FRT-7700





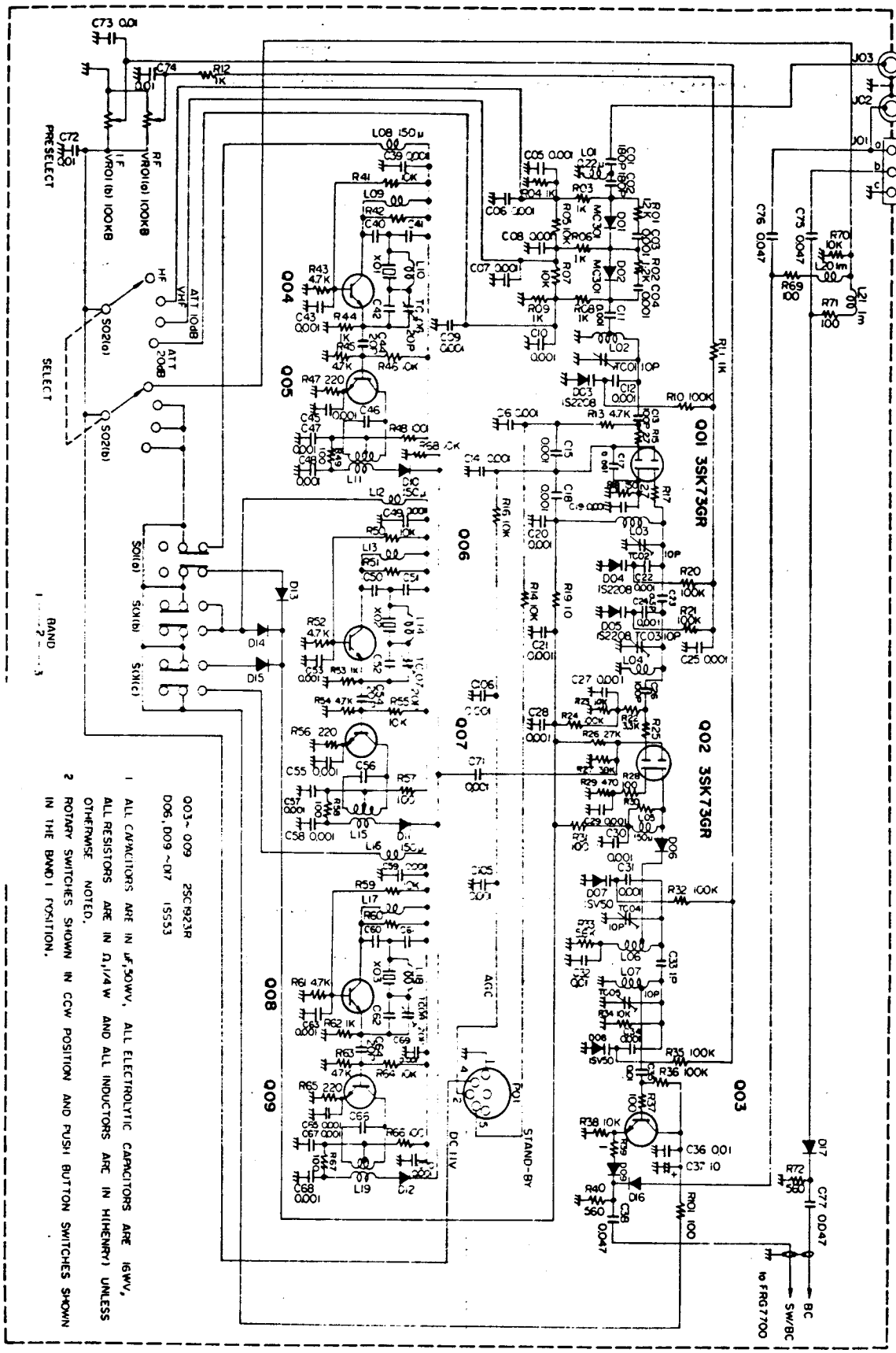
FRT-7700
CIRCUIT DIAGRAM





FF-5
CIRCUIT DIAGRAM

FRV-7700(A.C)



1 ALL CAPACITORS ARE IN μF, 50WV, ALL ELECTROLYTIC CAPACITORS ARE 16WV, ALL RESISTORS ARE IN Ω, 1/4 W AND ALL INDUCTORS ARE IN MICROHENRY UNLESS OTHERWISE NOTED.

2 ROTARY SWITCHES SHOWN IN CCW POSITION AND PUSH BUTTON SWITCHES SHOWN IN THE BAND 1 POSITION.

Q03~ Q09 2SC1923R
D06, D09~D17 1S553

TYPE	A	B	C
X 01	100MHz		120MHz
X 02	110MHz		130MHz
X 03	120MHz		140MHz

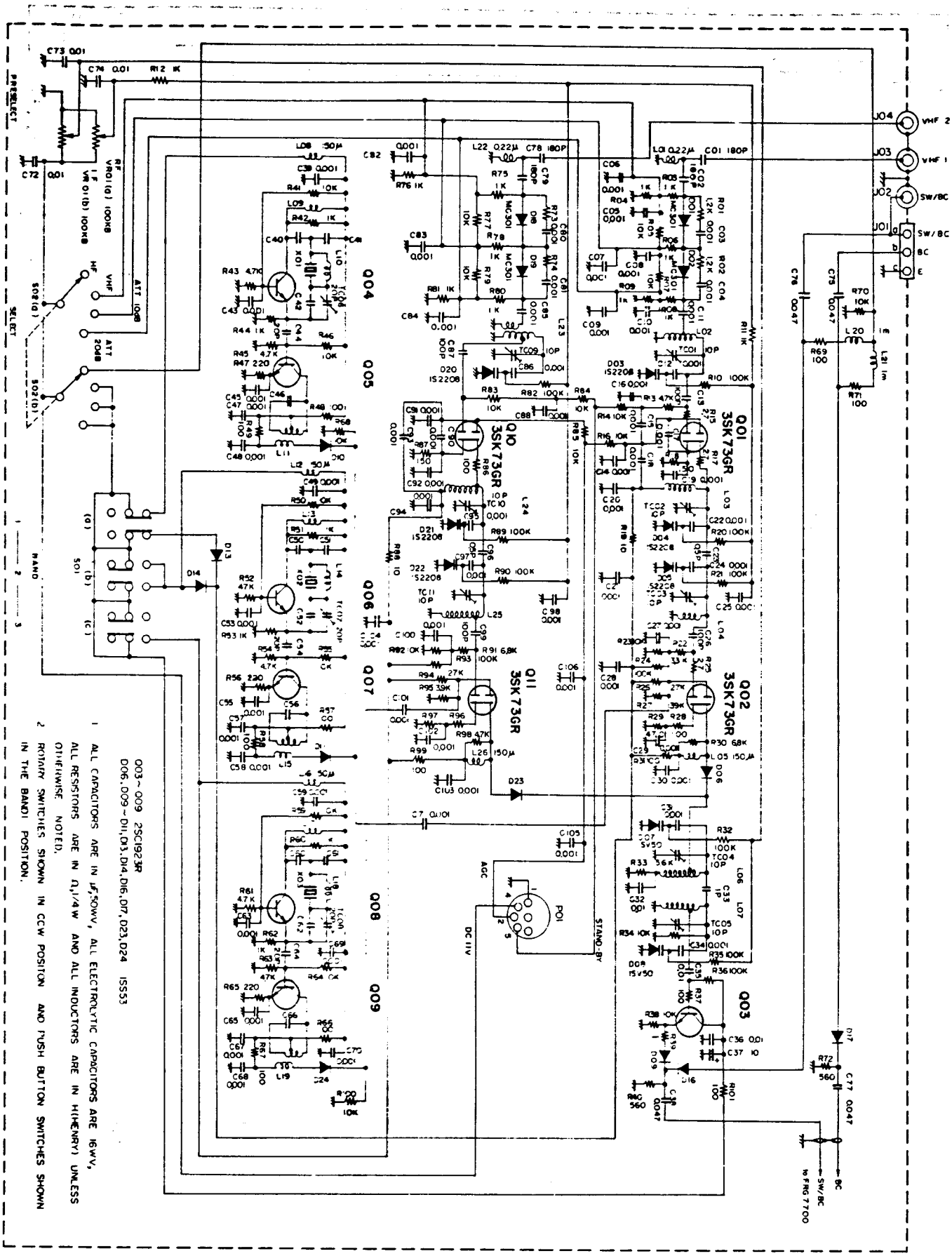
RESISTOR			
R 25	2.7	10	
R 30	68 K	47 K	
R 42	1 K	1 K	
R 51	1 K	2.2 K	
R 60	1 K	2.2 K	

CAPACITOR			
C 40	36P	24P	
C 41	36P	20P	
C 42	20P	24P	
C 46	24P	16P	
C 50	27P	16P	
C 51	27P	16P	
C 52	20P	20P	
C 56	20P	13P	
C 60	24P	15P	
C 61	24P	15P	
C 62	20P	20P	
C 66	16P	10P	

INDUCTOR		
L 10	0.33μ	0.33μ
L 14	0.33μ	0.22μ
L 18	0.33μ	0.22μ

FRV-7700
CIRCUIT DIAGRAM

FRV-7700(B.D)



1 ALL CAPACITORS ARE IN μF,50WV, ALL ELECTROLYTIC CAPACITORS ARE 16WV, ALL RESISTORS ARE IN Ω,1/4W AND ALL INDUCTORS ARE IN MHENRY1 UNLESS OTHERWISE NOTED.

2 ROTARY SWITCHES SHOWN IN CCW POSITION AND PUSH BUTTON SWITCHES SHOWN IN THE BAND1 POSITION.

003~009 2SC1923R
D06,D09~D11,D13,D14,D16,D17,D23,D24 1SS53

TYPE	B	D
X'TAL		
X01	100MHZ	100MHZ
X02	120 MHZ	120MHZ
X03	30MHZ	50MHZ

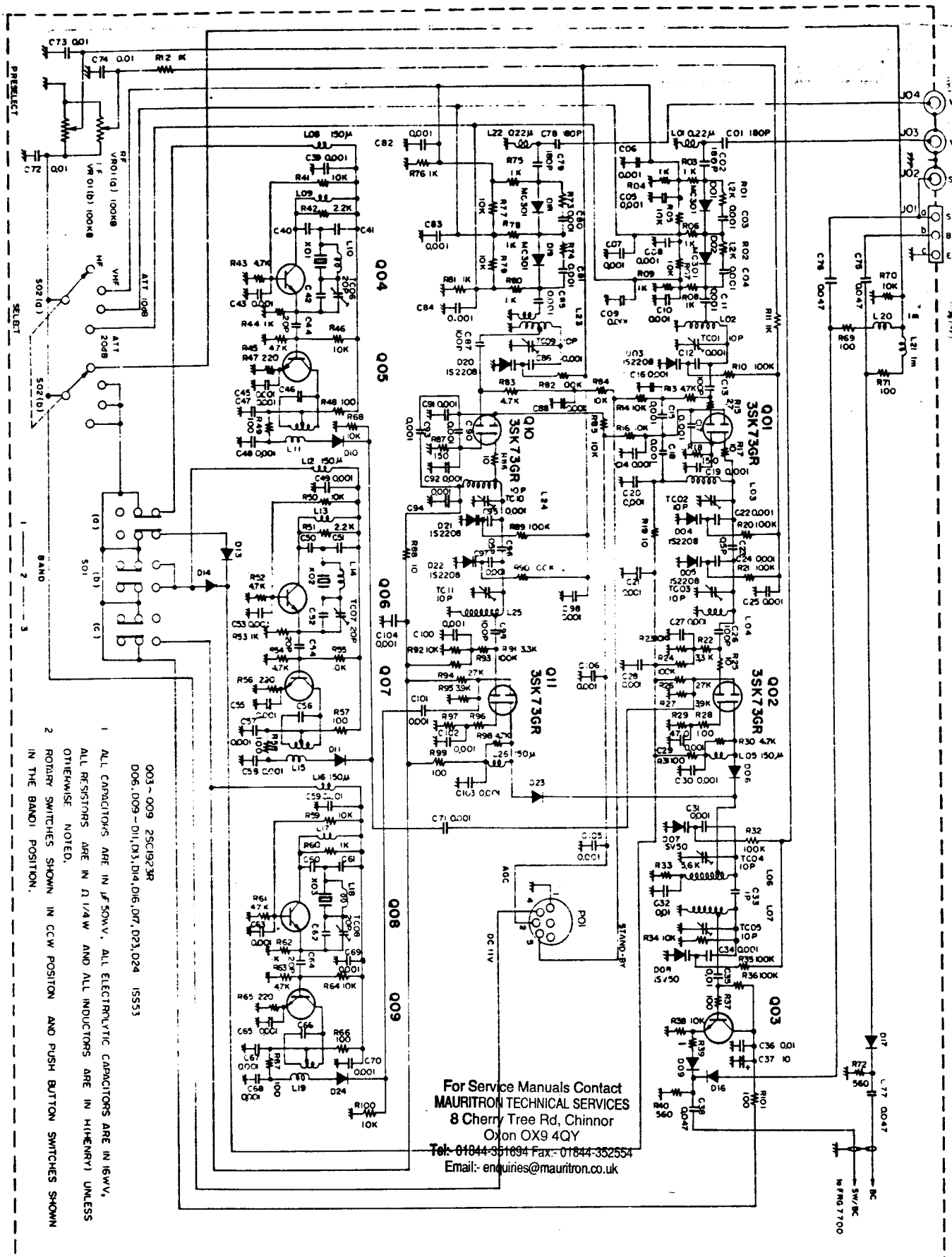
RESISTOR		
R73	22C	330
R74	220	1K
R96	390	220
R97	180	330

CAPACITOR		
C40	36P	36P
C41	36P	36P
C42	20P	20P
C46	24P	24P
C50	24P	24P
C51	24P	24P
C52	20P	20P
C56	16P	16P
C60	75P	15P
C61	75P	15P
C62	20P	20P
C66	36P	12P

INDUCTOR		
L10	0.33 μ	0.33 μ
L14	0.33 μ	0.33 μ
L18	4.7 μ	1.8 μ

FRV-7700
CIRCUIT DIAGRAM

FRV-7700(E.F)



1 ALL CAPACITORS ARE IN μF 50WV, ALL ELECTRYLYTIC CAPACITORS ARE IN 16WV, ALL RESISTORS ARE IN Ω 1/4W AND ALL INDUCTORS ARE IN HENERY) UNLESS OTHERWISE NOTED.

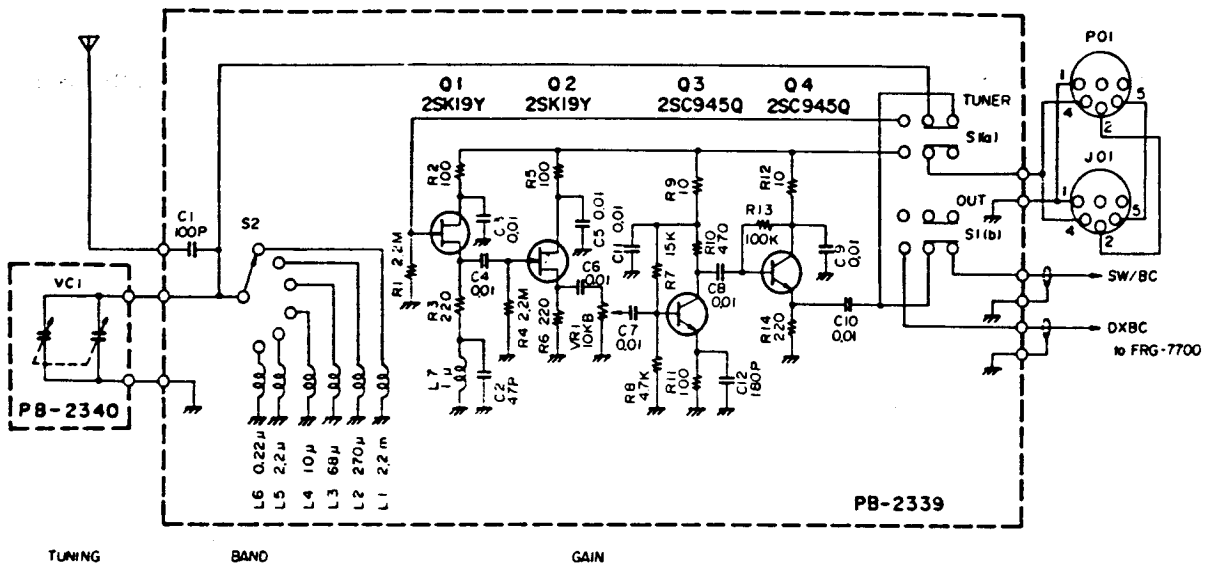
2 ROTARY SWITCHES SHOWN IN CCW POSITON AND PUSH BUTTON SWITCHES SHOWN IN THE BAND1 POSITION.

Q03 ~ Q09 2SC1923R
D06, D09 ~ D11, D13, D14, D16, D17, D23, D24 1SS53

TYPE	E	F
X'TAL		
X01	120MHZ	130MHZ
X02	130 MHZ	140MHZ
X03	100MHZ	100MHZ
RESISTOR		
R73	1.2K	1.2K
R74	1.2K	1.2K
R96	100	100
R97	470	470
CAPACITOR		
C40	24 P	16 P
C41	24 P	16 P
C42	20 P	20 P
C46	16 P	13 P
C50	16 P	15 P
C51	16 P	15 P
C52	20 P	20 P
C56	13 P	10 P
C60	36 P	36 P
C61	36 P	36 P
C62	20 P	20 P
C66	24P	24P
INDUCTOR		
L10	0.22 μ	0.22μ
L14	0.22 μ	0.22 μ
L18	0.33 μ	0.33μ

FRV-7700
CIRCUIT DIAGRAM

FRA-7700



1. ALL CAPACITORS ARE IN μF 50WV, ALL RESISTORS ARE IN Ω 1/4W, ALL INDUCTORS ARE IN H(HENRY), UNLESS OTHERWISE NOTED.
2. ROTARY SWITCH IS SHOWN IN CCW POSITION AND PUSH BUTTON SWITCHES ARE SHOWN IN THE RELEASED POSITION.

FRA – 7700
CIRCUIT DIAGRAM

MODIFICATIONS

DC POWER SUPPLY OPERATION (DC KIT INSTALLATION)

A. **Required Parts (included w/kit)**

1 pc.	C5300842	DC Jack Assembly
1 pc.	P1090139	DC Plug
2 pcs.	U00107007	Screws
2 pcs.	U60001001	Nut
2 pcs.	U71050001	Spring Washer

B. Modification Procedure

1. Remove the handle mounted on the right side of the cabinet.
2. Remove the six screws retaining the bottom cover and carefully set the panel to one side.
3. Disconnect the battery clip connected to the backup battery case.
4. Remove the four plastic pins that are fastened to the rear panel terminal board, as shown in Figure 2-1.
5. Grasp the terminal board and remove the small plastic cover to expose the DC Jack cutout, as shown in Figure 2-2.
6. Install the DC Jack assembly as shown in Figure 2-3.
7. Re-install the terminal board with the four plastic pins.
8. Insert plug P_{40} into Jack J_2 as shown in Figure 2-4.
9. Reconnect the battery clip to the backup battery case, and replace the bottom cover, re-installing the six screws removed in Step 2.
10. The DC power cord may now be wired as shown in Figure 2-5. A supply capable of providing 13.5 volts DC at 1.2 amp (min.) is required.

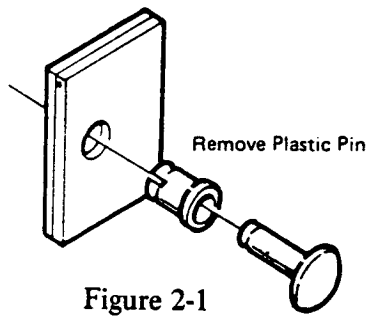


Figure 2-1

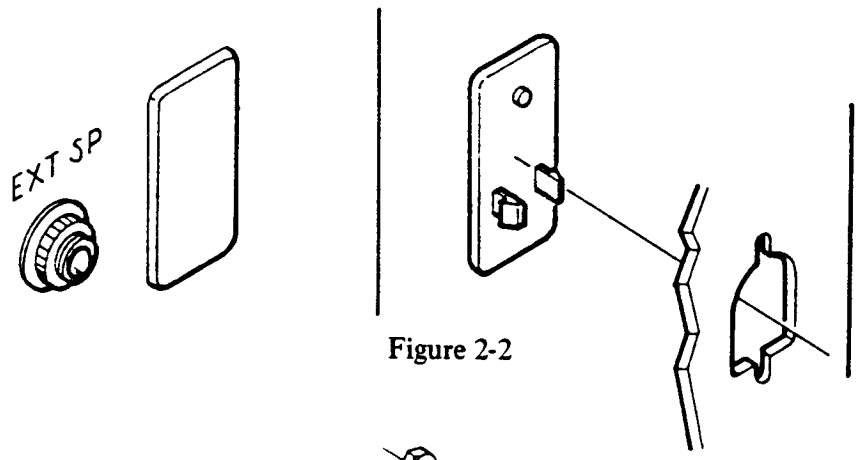


Figure 2-2

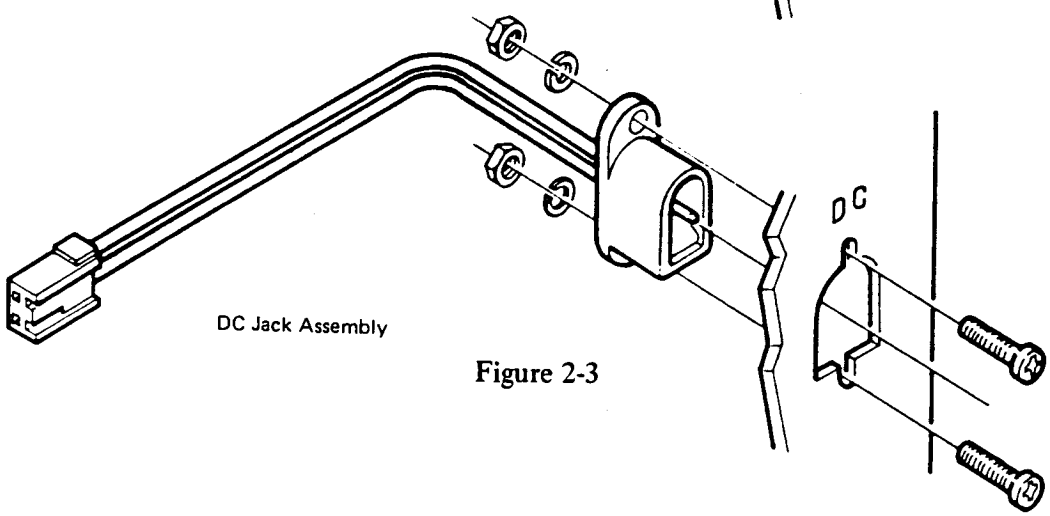


Figure 2-3

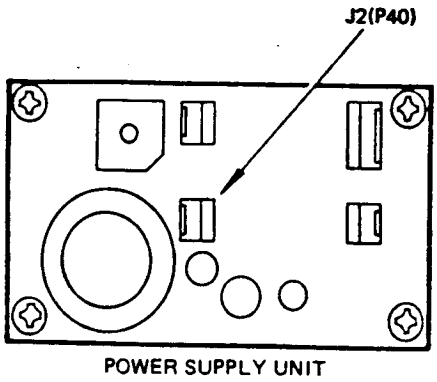


Figure 2-4

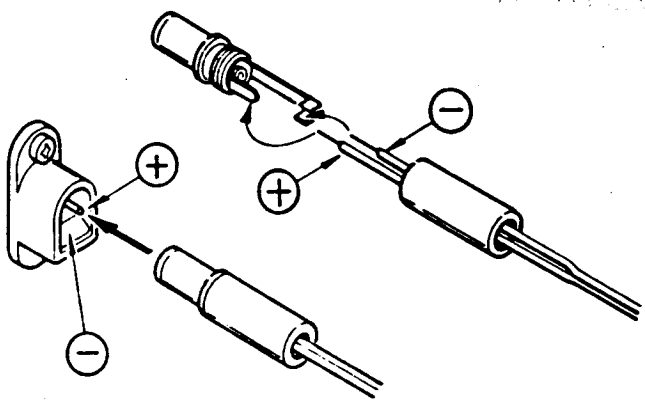


Figure 2-5

MEMORY FREQUENCY 1kHz ERROR

The following modification will correct the 1 kHz error in frequencies recalled from the memory function. It will also eliminate the audible beat occuring during memory operation.

Parts Needed

1N60 germanium diode	2 pcs.
1/4 watt 3.3Kohms resistor	1 pce.

Modification Procedure

1. Cut the upper pattern on PB-2175, as shown in Figure 2-6.
2. Install and solder the two 1N60 diodes and the 3.3 Kohm resistor as shown in Figure 2-6.

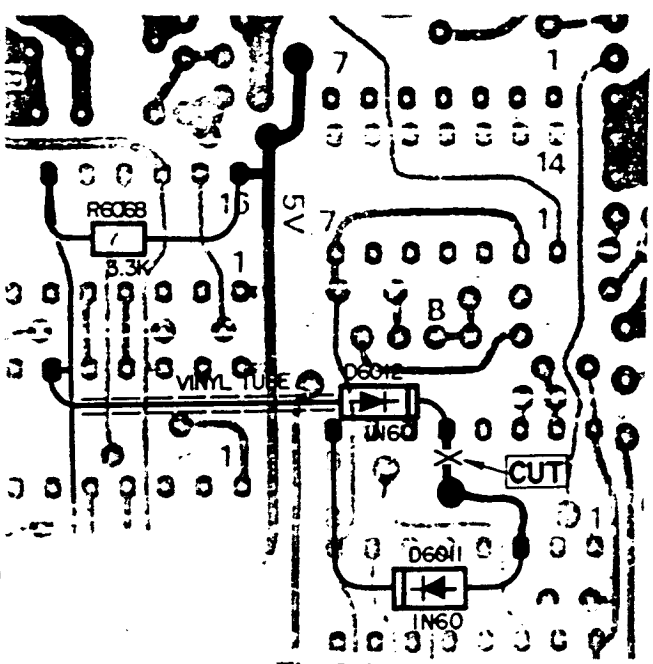


Fig. 2-6

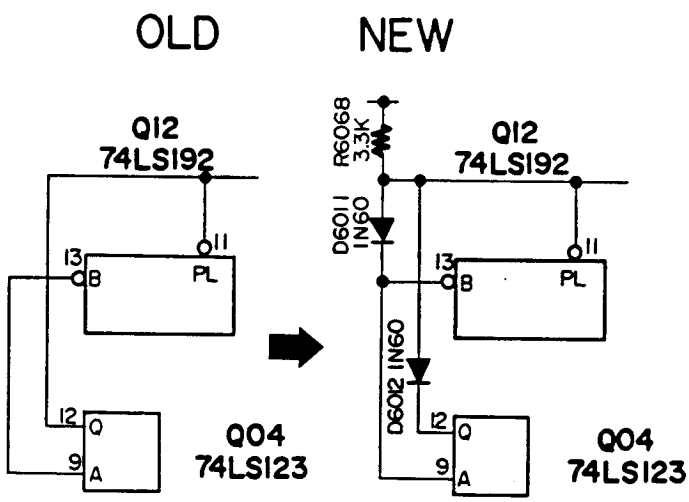


Fig. 2-7

PERFORMANCE IMPROVEMENT FOR EARLY MODEL

This modification will provide additional power switch protection against rush current that occurs when the power switch is turned on. Please be advised that the IC MC 14504 (lot number "7944", Fig. 2-8) has been reported by the supplier as defective, and must be replaced.

MODIFICATION PROCEDURE

1) Remove the carrying handle on the left side of the receiver, then the top cover, and finally the bottom cover.
2) Remove all connectors on the PLL unit.
3) Remove the band switch knob and unscrew the nut securing the band switch, from the outside of the receiver.
4) Remove the eight screws on the PLL unit, and take the PLL unit out of its chassis.
5) Cut all the pins of Q_{2038} from the component side, and unsolder the pins, as shown in Fig. 2-9.
6) Install the new MC 14504 in the correct position, and solder its pins.
7) Replace the PLL unit in its chassis with the eight screws previously removed. Secure the band switch and the band switch knob into place.
8) Reconnect all connectors removed from the PLL unit in step 2.

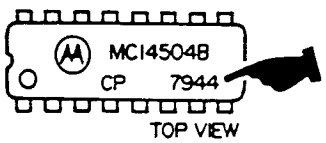


Figure 2-8

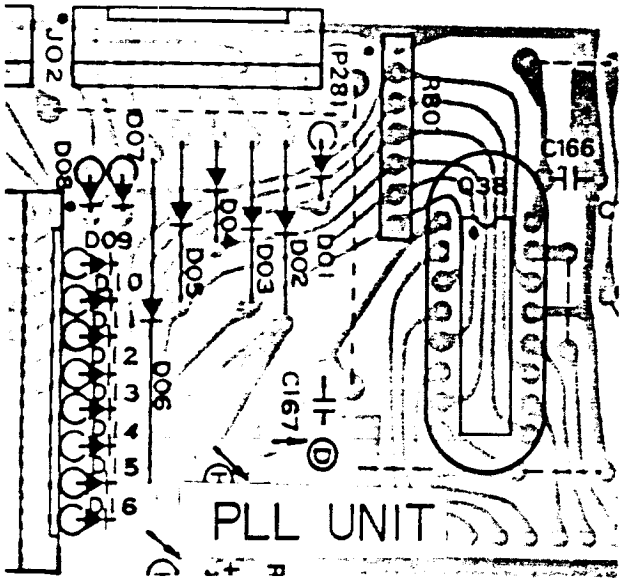


Figure 2-9

9) Disconnect P_{01}, P_{05}, P_{13} and P_{15} on the main unit from their jacks, and remove the eight screws from the main unit.
10) Tilt the main unit toward the front panel, in order to expose the solder side of the board.
11) Unsolder the cathode of D_{1034} from the pattern, and pull the lead from the component side, as shown in Fig. 2-10.
12) Insert through the hole and solder one lead of a 1/2 W, 6.8 (or 5.6) ohm resistor to the point where the cathode of D_{1034} was removed.
13) Solder the other lead of the resistor to the cathode lead of D_{1034} on the component side, as shown in Fig. 2-11.
14) Replace all connectors previously removed from the main unit.
15) Secure the main unit back on to the chassis with the eight screws.
16) Close the receiver by replacing the top cover, bottom cover, and then the carrying handle.

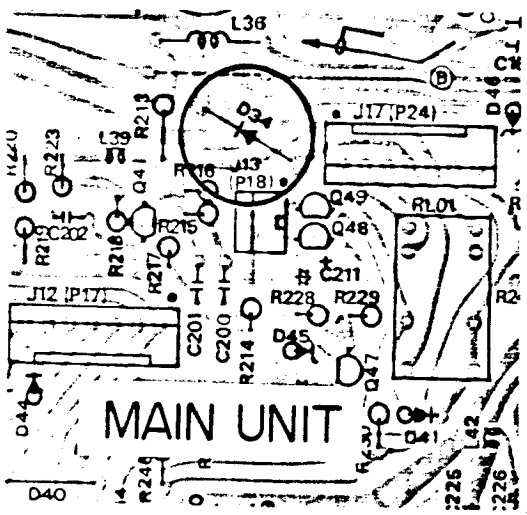


Figure 2-10

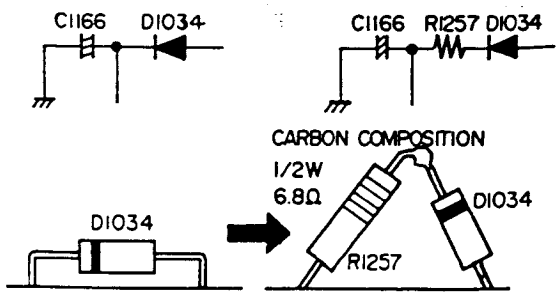
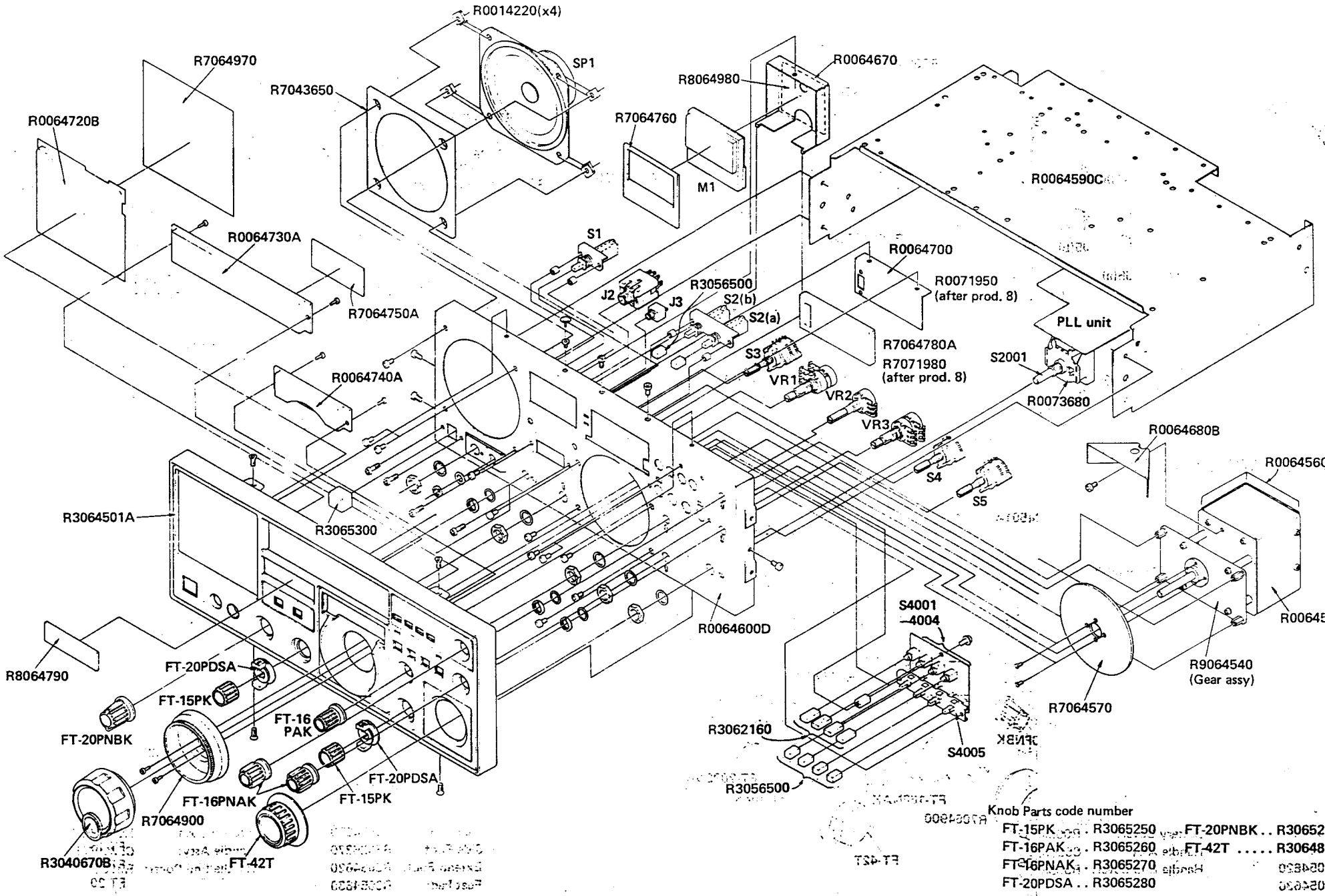


Figure 2-11

SECTION 3—SERVICING

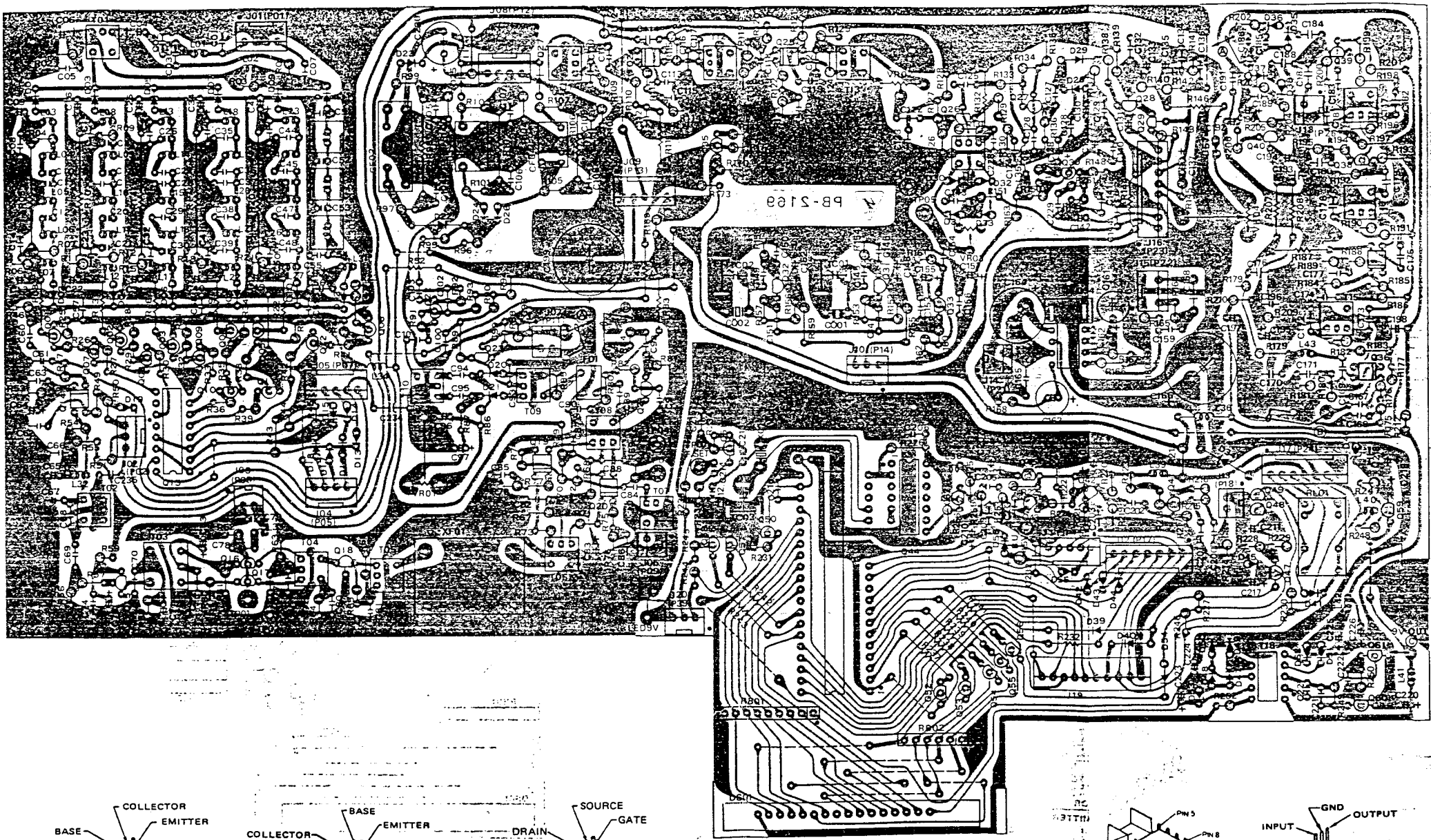
FRONT PANEL REMOVAL



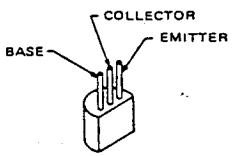
Knob Parts code number

FT-15PK	R3065250	FT-20PNBK	R3065290
FT-16PAK	R3065260	FT-42T	R3064870
FT-16PNAK	R3065270		
FT-20PDSA	R3065280		

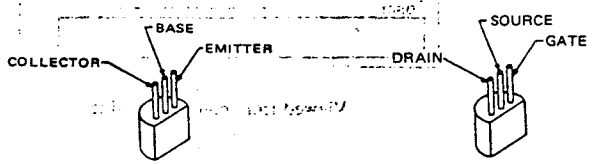
PARTS LAYOUT MAIN UNIT(PB-2169)



Viewed from component side

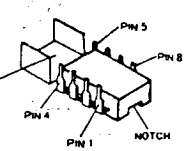


2SA733
2SC945
2SC1384
2SC1674L

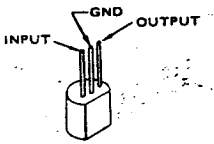


MPS-A13

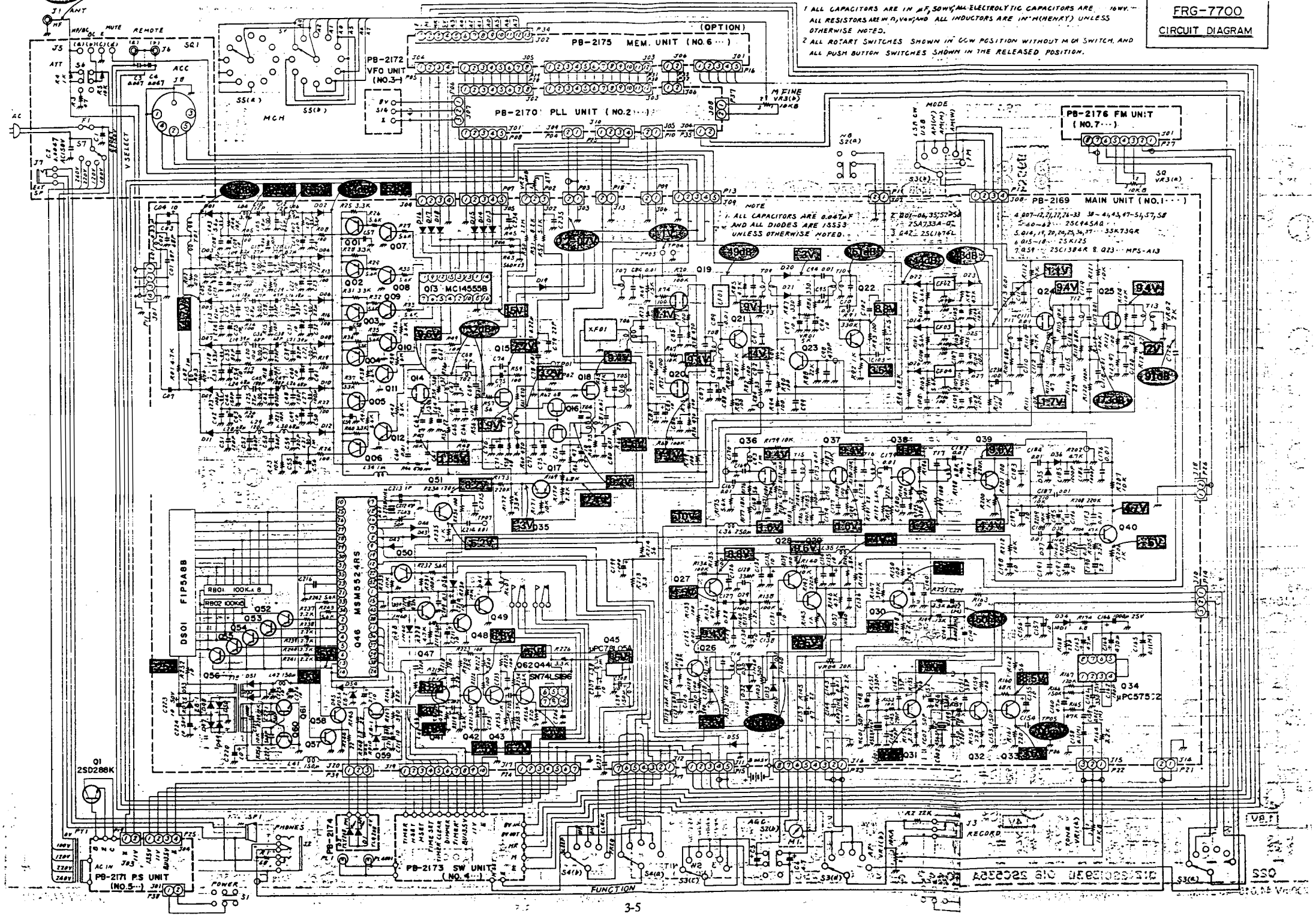
2SK125



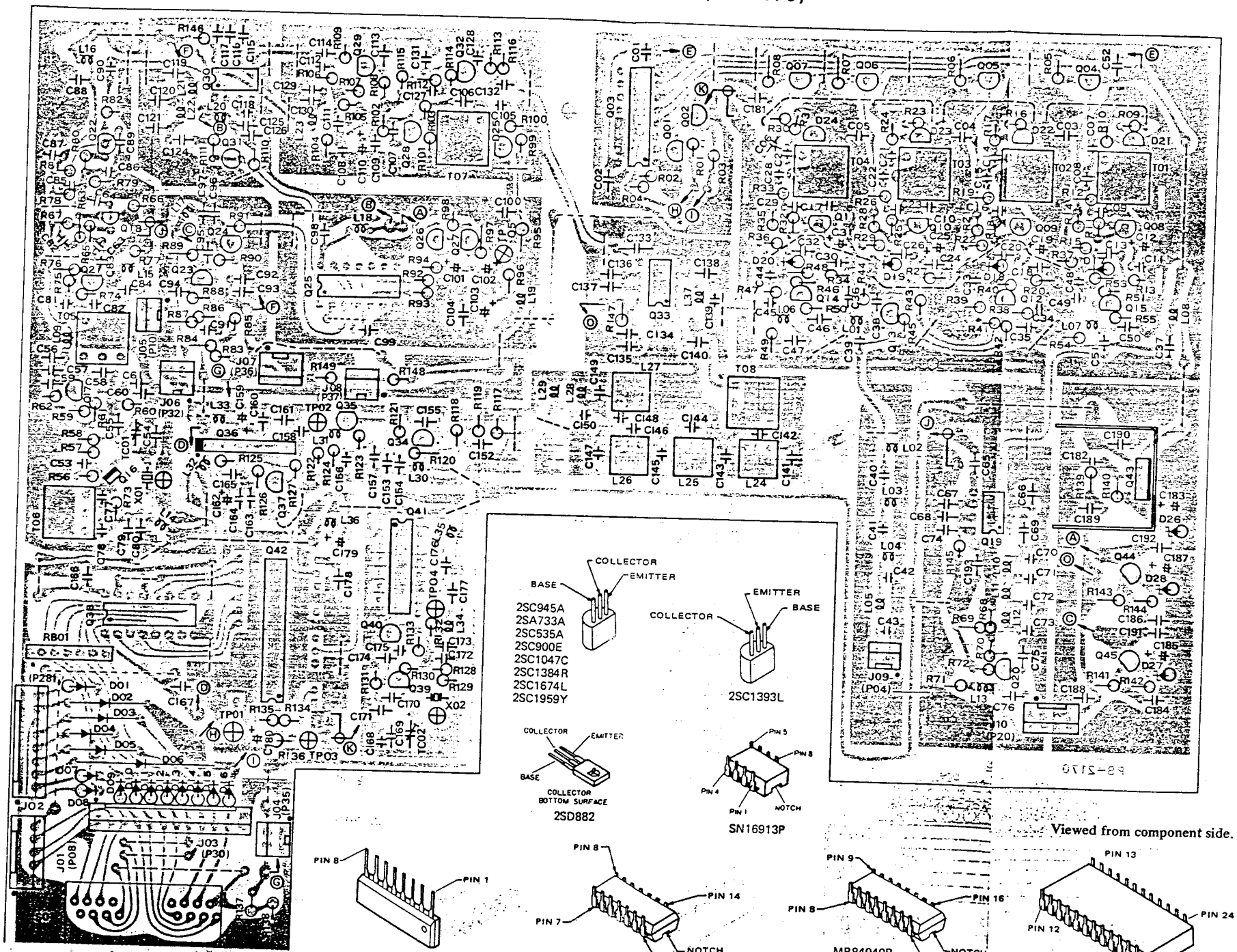
μPC575C2



78L05/08

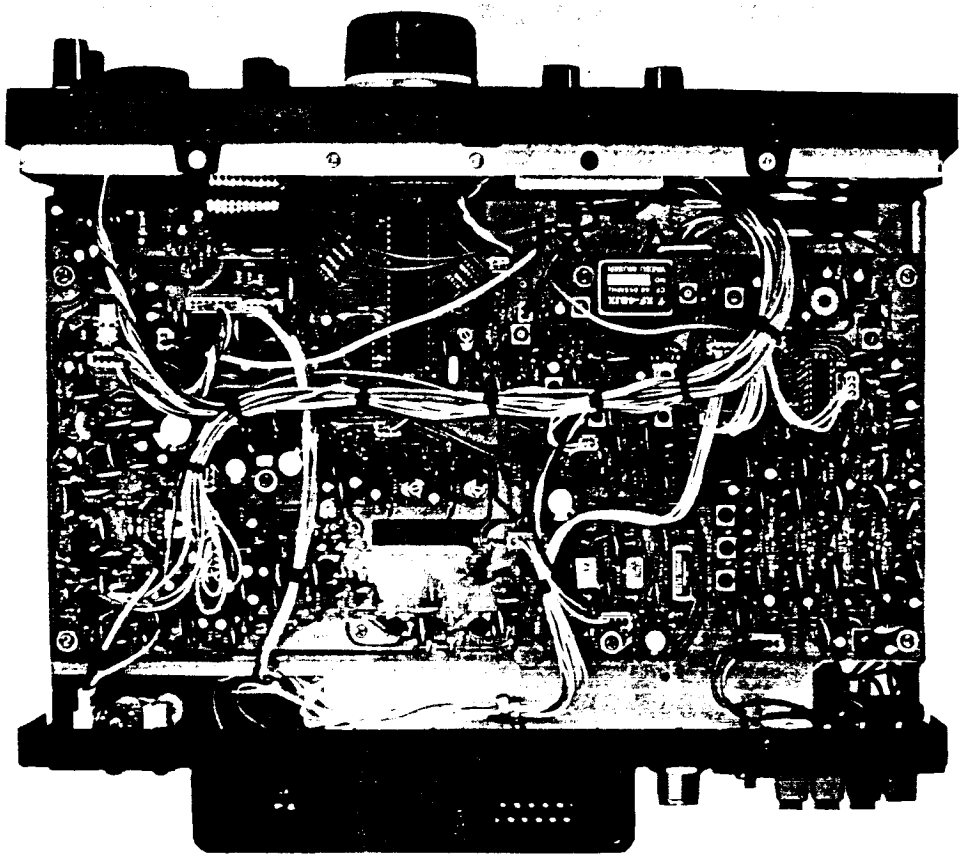

FRG-7700
CIRCUIT DIAGRAM
PB-2175 MEM. UNIT (NO.6···)
(OPTION)
PB-2172 VFO UNIT (NO.3···)
PB-2170 PLL UNIT (NO.2···)
PB-2176 FM UNIT (NO.7···)
PB-2169 MAIN UNIT (NO.1···)
PB-2171 P.S UNIT (NO.5···)
PB-2173 SW UNIT (NO.4)
PB-2174
Q1 2SD288K
DSOI FIP5A8B
Q46 M5M5524RS
Q45 μPC78L05A
Q62044
SN74LS86
Q34 μPC575C2
Q13 MC145558
XF01
NOTE
1. ALL CAPACITORS ARE 0.047μF AND ALL DIODES ARE 1SS53 UNLESS OTHERWISE NOTED.
2. Q01-06, 35, 52 2SA733A-Q
3. Q42 2SC1674L
4. Q07-12, 21, 27, 24-33 38-41, 43, 47-54, 57, 58
5. Q40-42 2SC945AQ
6. Q15-18 2SK125
7. Q39 2SC1384R & Q23 MPS-A13
1 ALL CAPACITORS ARE IN μF, 50WV, ALL ELECTROLYTIC CAPACITORS ARE 16WV. ALL RESISTORS ARE IN Ω, 1/4W, AND ALL INDUCTORS ARE IN μH (HENRY) UNLESS OTHERWISE NOTED.
2 ALL ROTARY SWITCHES SHOWN IN CCW POSITION WITHOUT MCH SWITCH, AND ALL PUSH BUTTON SWITCHES SHOWN IN THE RELEASED POSITION.

PARTS LAYOUT PLL UNIT(PB-2170)

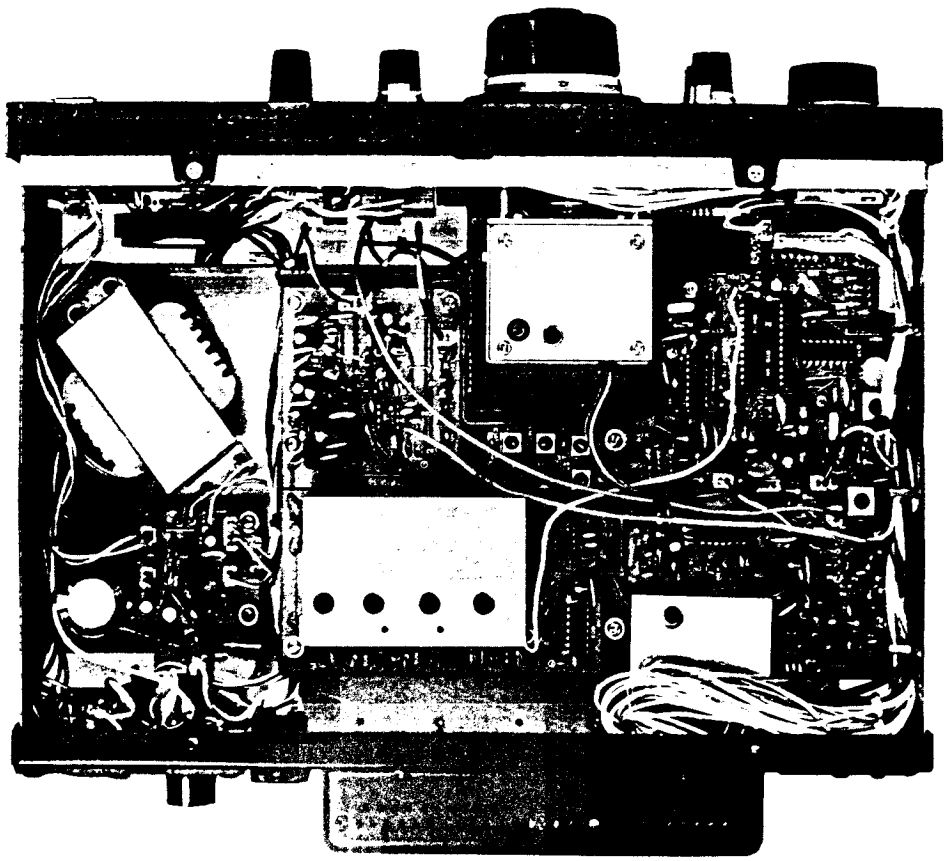


Viewed from component side.

BOARD LAYOUT



Top View



Bottom View