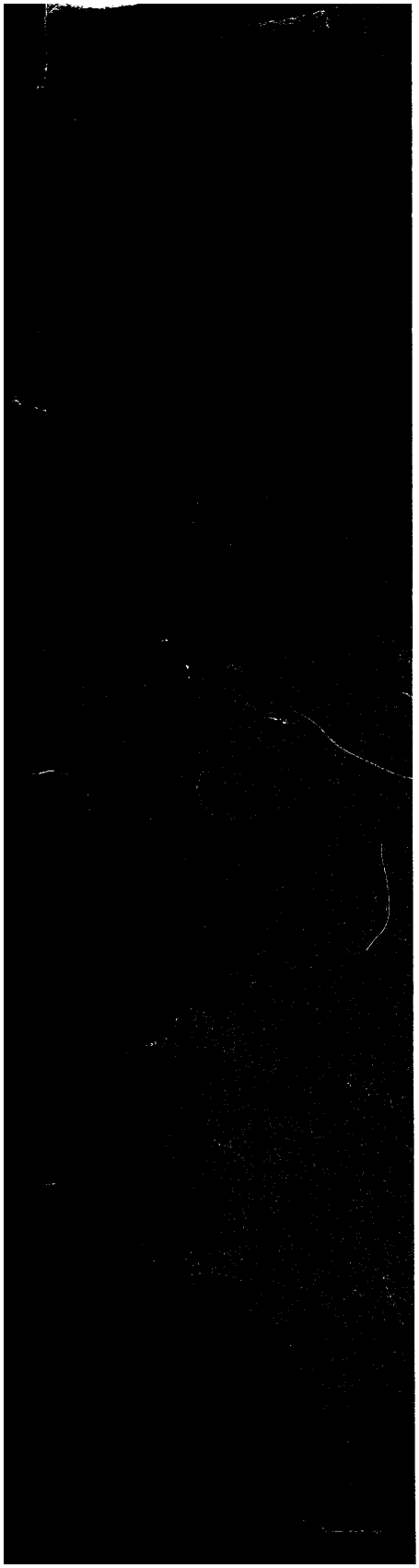


INSTRUCTION MANUAL

FT-77

YAESU MUSEN CO., LTD.
C.P.O. BOX 1500
TOKYO, JAPAN

TABLE OF CONTENTS

FT-77
THRIFTY HF TRANSCEIVER

GENERAL DESCRIPTION

The FT-77 is an all solid state transceiver for SSB and CW operation on all amateur bands between 3.5 and 30 megahertz. FM operation is also possible when the optional FM unit is installed. Nominal power output for SSB and CW is 100 watts (85 watts on 10 meters, 50 watts FM).

Utilizing the latest engineering and manufacturing advances garnered from recent technological developments, the FT-77 is intended to offer the essential modern operating features in the most economical, reliable and compact HF transceiver available today.

Reliability and quality control have been increased to a degree beyond that previously attainable in amateur equipment, while production costs have been reduced considerably, due to the new CAD/CAM (computer aided design/computer aided manufacturing) system employed for the designing and assembly of the FT-77. Computer-designed circuit board layouts ensure the high level of reliability in the smallest possible space, while automatic (robot) parts insertion and soldering vastly improve quality control and reduce costs.

The simplicity of the design of the FT-77 results in fewer parts that could cause problems, and the extremely compact size and convenient control layout make this transceiver ideal for mobile operation, or as the heart of a complete base station with the FP-700 AC Power Supply.

Special standard features not immediately obvious include dual selectable noise blankers, self-contained SWR metering, and the capabilities for simple addition of options such as a narrow CW filter, 25 kHz Marker Unit, fixed frequency crystal, FV-700DM digital scanning VFO and memory system, FTV-700 V/UHF Transverter, and the FC-700 Antenna Tuner.

Please read this manual carefully before operating the transceiver, so as to derive optimum performance and enjoyment from the FT-77.

SPECIFICATIONS

GENERAL

Frequency coverage:
All amateur bands between 3.5 and 29.9 MHz, including the three WARC bands

Operating modes:
A3J (LSB/USB), A1 (CW)
F3 (FM) optional

Power requirements:
13.5V DC; 1A receive, 20A transmit

Size:
240(W) x 95(H) x 300(D) mm,
including heat sink

Weight:
6 kg (13.2 lb)

TRANSMITTER

Power input:
240W DC for nominal 100W output (85W on 10 meter band)

Spurious radiation:
Less than -40 dB

Carrier suppression:
Better than 40 dB

Unwanted sideband suppression:
Better than 50 dB (W/1 kHz modulation)

Audio response:
350–2700 Hz (@ -6 dB)

Stability:
Less than 300 Hz drift during the first 30 minutes after a 10 minute warmup, less than 100 Hz every 30 minutes thereafter

Microphone input impedance:
500–600 ohms

RECEIVER

Circuit type:
Single conversion superheterodyne
(double conversion for FM, when installed)

Intermediate frequency:
8987.5 kHz (plus 455 kHz for FM)

Sensitivity:
0.3μV for 10 dB S+N/N (SSB and CW-W)
0.15μV for 10 dB S+N/N
(with CW-N option)
0.7μV for 12 dB SINAD
(FM, with FM option)

Image rejection:
More than 70 dB

IF rejection:
More than 50 dB

Selectivity (@ -6/-60 dB):
2.4/5 kHz for SSB, CW-W
600/1300 Hz with CW-N option
12/24 kHz with FM Unit option

Audio output:
3W (4-ohm internal speaker, @10% THD)

External speaker impedance:
4–16 ohms

SEMICONDUCTORS

FCD

FIP8B7	1

ICs:

MB3713	1
MC4044P	1
MC14011BCP	2
MSL9520RS	1
ND487C2-3R (Ring-Module)	1
TA7063P	1
TA7310P	1
VFO-1	1
μPC78L05	1
μPC78L08	1*
μPC7808H	1**

FETs:

2SK125	2
2SK241GR	2
3SK73GR	6

Transistors:

2SA733AQ	20
2SA1005K	19
2SB772Q	4
2SB774	5
2SC380TM-Y	8
2SC458C	18
2SC496-O	1
2SC732TM-GR	3
2SC1589	1**
2SC1923-O	4

Diodes:

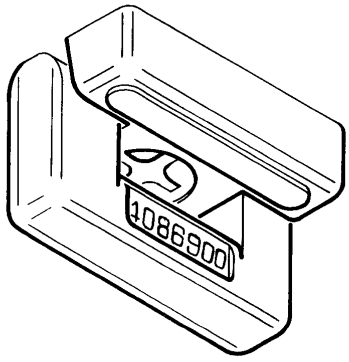
1S2236 (Varactor Diode)	1
ISS97 (Schottky Barrier Di.)	6
ISS106 (Schottky Barrier Di.)	14
1SV103 (Varactor Diode)	9
10D1 (Si Diode)	2
10D10 (Si Diode)	4**
MA162 (Si Diode)	5
MA190 (Si Diode)	120
MV11 (Varistor Diode)	1*
MV13 (Varistor Diode)	1
RD5.6EB2 (Zener Diode)	2
RD6.2EB2 (Zener Diode)	2
RD7.5EB1 (Zener Diode)	1
RD8.2EB1 (Zener Diode)	1
TLR210 (LED)	2
YZ033 (Zener Diode)	1
2SC1959Y	2
2SC2166	1*
2SC2290	2**
2SC2395	2**
2SC2407	1
2SC2458Y	18
2SC2509	2*
2SC2562Y	1
2SD235Y	1**
2SD882Q	1*

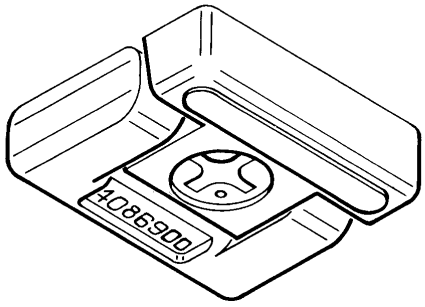
*: 10W MODEL
**: 100W MODEL

ACCESSORIES

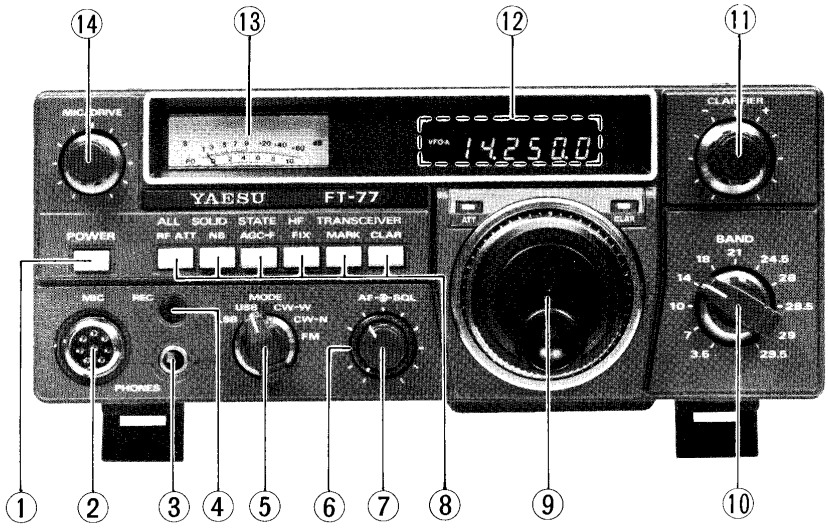
DC POWER cord	(T9014420)	1
FUSE 20A	(Q0000009)	1
LONG LEGS	(R3086910)	2
PAD	(R7088090)	2

On the bottom the Unit, the special front feet allow selection of two different viewing angles. In addition, a pair of extra-long legs are provided in the accessory package, as well as rubber slip-stop inserts. The standard legs can be replaced by the long legs by removing the screws affixing the feet, and exchanging legs. The low viewing angle will remain the same. The slip-stop inserts are intended for installation only when necessary to prevent slippage, such as when the Unit is located on top of another piece equipment. Of course, when the extension legs are lowered, the slip-stop inserts are not needed.





FRONT PANEL CONTROLS AND SWITCHES



1. POWER

Press this button to switch the transceiver ON (in position), and press again to switch OFF (out position).

2. MICrophone Jack

This 8-pin connector includes connections for the transmitter audio input, PTT switch, and scanning controls (for use when the FV-700DM or FV-707DM External Scanning VFOs are connected).

3. PHONES Jack

Either stereo or monaural headphones using standard ¼-inch plugs may be connected to this jack. In either case, audio will be heard in both sides of the headphones while the internal speaker (and external speaker, if connected) will be disabled.

4. RECord Jack

This jack accepts a standard 2-conductor mini phone plug, and provides audio output for tape recording purposes at a constant level regardless of the setting of the AF volume control. The level is approximately 70mV_{rms} at 50K ohms impedance.

5. MODE Selector

The mode of operation for both the transmitter and receiver is selected by this switch. The CW-N position selects the optional narrow CW filter, when installed. Otherwise, operation in this mode is identical to CW-W. FM operation requires the optional FM Unit.

6. SQL (Squelch)

This control is used to set the threshold level for the receiver squelch during FM operation (when the FM Unit is installed). It is deactivated in the other modes.

7. AF (Volume)

Adjust this control for the desired volume level during receive.

8. Push Button Switches

RF ATT

When this button is depressed the receiver input is attenuated approximately 20dB, thus inhibiting overload from strong signals.

The ATT LED near the Tuning Knob will remain lit while the attenuator is in the circuit.

NB

When ignition noise or the woodpecker interferes with received signals, press this button to activate the noise blanker. The NB W-N switch under the top access panel can now be used to select the most effective blanking pulse for the type of noise encountered. When the blanker is not needed, this button should be set to the OFF (out) position.

AGC-F

Press this button to select fast AGC action for the receiver. When this button is not depressed, slow AGC is selected.

FIX

This button selects fixed-frequency operation when an optional fixed-frequency crystal is installed. When this button is pressed, the VFO is disabled and the letter "F" appears at the left side of the digital display. If this button is pressed when no crystal is installed (under the top access panel), the frequency display will be blank.

MARK

This button activates the optional Frequency Marker Generator, when installed. The Marker produces unmodulated calibration signals at the receiver input every 25 kHz throughout the range of the receiver.

CLAR

Press this button to activate the clarifier, which allows adjustment of the receiving frequency (via the CLARIFIER control) without changing the transmit frequency. The CLAR LED near the tuning knob will be lit when the clarifier is on.

9. Tuning Knob

Turn this knob to change the operating frequency of the transceiver. One full rotation corresponds with approximately 15 kHz of frequency change.

10. BAND Selector

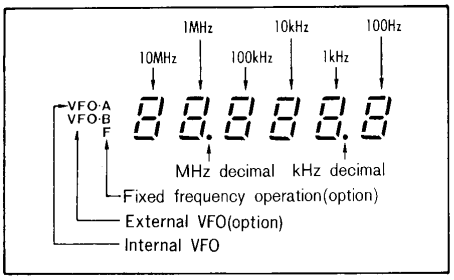
Set this selector to the desired operating band while receiving. Never change bands while transmitting, as this can damage the equipment.

11. CLARIFIER

When the clarifier system is activated by the CLAR push button, this control adjusts the receive frequency up to approximately ±2.5 kHz from the transmit frequency.

12. Digital Display

The operating frequency is shown here to the nearest 100 Hz. Also, on the left side of the display, the source of the frequency being displayed is indicated by either "VFO-A", indicating the FT-77 internal VFO; "VFO-B", indicating an external VFO such as the FV-700DM; or "F", indicating fixed frequency crystal control. In all cases, the displayed frequency is that of the carrier (or suppressed carrier), so the display will read differently depending upon the selected mode.



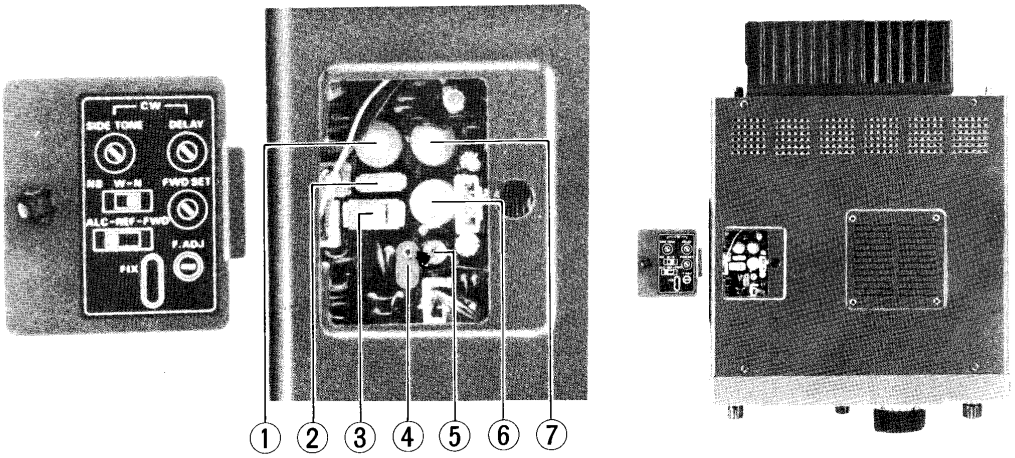
13. Meter

The meter indicates signal strength in S-units during receive, while either ALC, relative forward power output (FWD), or reflected power (REF) may be selected for indication during transmission (by the ALC-REF-FWD switch under the top access panel).

14. MIC/DRIVE

For SSB transmission, this control adjusts the gain of the transmit audio stages. For CW and FM, this control adjusts the transmitter drive power level.

TOP ACCESS PANEL CONTROLS



Labelling for these controls is provided on the inside surface of the top access panel cover. To open the cover, lift the center pin of the Nyloc latch slightly, and remove the small panel.

1. **SIDE TONE**

This control adjusts the volume level of the CW sidetone produced during CW operation.

2. **NB W-N**

This 2-position slide switch selects either wide or narrow blanking pulse widths for the noise blanker.

3. **ALC-REF-FWD**

This 3-position slide switch selects the function of the front panel meter during transmission.

4. **FIX**

This is the socket for an optional crystal when fixed frequency operation is desired.

5. **F. ADJ**

This control provides fine adjustment of the fixed frequency crystal oscillator for setting the transceiver to the exact frequency desired. It is deactivated unless an optional crystal is installed in the FIX socket.

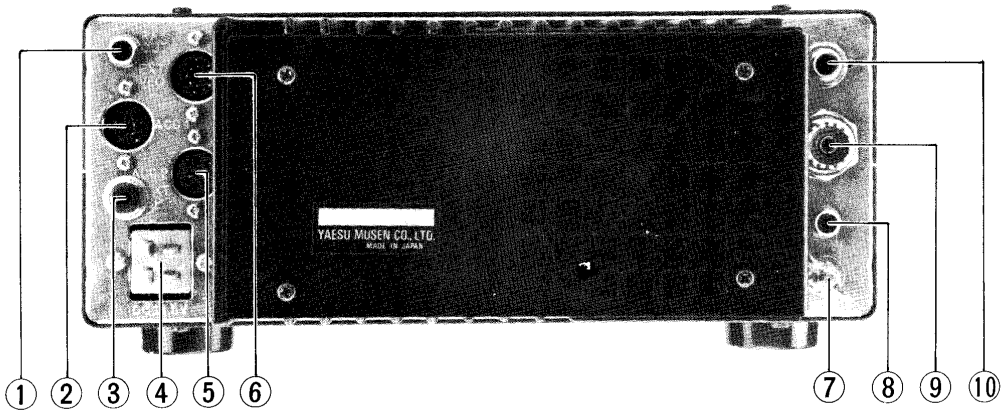
6. **FWD SET**

This control adjusts the sensitivity of the meter circuit used in the FWD and REF functions when measuring SWR.

7. **DELAY**

This control adjusts the transmit-to-receive switching time for semi break-in CW operation.

REAR PANEL CONNECTIONS



1. RF OUT

This RCA jack provides low level RF output for use with a transverter such as the FTV-700. Output is 220 mV_{rms} at 50 ohms.

2. ACC 1

This 6-pin DIN jack provides the switching and ALC connections necessary when using a phone patch or linear amplifier.

3. EXT SP

A 4–16 ohm external speaker may be connected to this 1/8-inch mini phone jack. Inserting a plug into this jack disables the internal speaker.

4. DC 13.5V

This connector accepts DC power for the transceiver. Never apply AC voltage here.

5. ACC 2

This 7-pin DIN jack provides up/down scanning control, TX audio input, PTT and TX13.5V signals for an external VFO such as the FV-700DM or FV-707DM.

6. EXT VFO

This 8-pin DIN jack accepts the frequency control signals from, and provides power for, an external VFO.

7. GND

This terminal should be connected to a good earth ground along with other station equipment for best performance and safety.

8. DC 8V

This RCA jack provides 8V DC for the FC-700 Antenna Tuner.

9. ANT

This is a type M connector for the antenna, antenna tuner or linear amplifier input. Only coaxial cable with the proper plug should be connected at this point. Impedance must be as close as possible to 50 ohms at the operating frequency for best performance.

10. KEY

This standard 2-conductor 1/4-inch phone jack is for connection of a straight key or electronic keyer output for CW operation. Key down current is 0.4mA (@< 0.5V), and key up voltage is 1.5V.

INSTALLATION

PRELIMINARY INSPECTION

Upon opening the packing carton, immediately give the transceiver a thorough visual inspection. Check to ensure that all controls and switches move freely, and that the cabinet is free from any signs of damage. If any damage is noticed, immediately document the damage completely and contact the shipping company. Save the packing carton and packing material for possible future use.

BASE STATION INSTALLATION

Power Supply

The FT-77 requires a power source of 13.5 (±1.5) volts DC, capable of up to 20 amps on voice peaks. The FP-700 Power Supply is designed for this purpose, and may be used with AC line voltages of 100, 110, 117, 200, 220 or 234 VAC. However, before the FP-700 or any other suitable power supply is connected to the transceiver or AC line, it should be inspected to ensure that the power transformer is properly connected for the local line voltage, and that the correct fuse is installed. The FP-700 requires a 6A fuse for 100, 110 or 117 VAC, or a 3A fuse for 200, 220 or 234 VAC. NEVER CONNECT AC POWER, OR DC VOLTAGE ABOVE 15V, TO THE FT-77.

Make certain that the POWER switch on the front panel of the FT-77 is OFF (out) before connecting power to the transceiver, and double check to make sure that the polarity of the connections is correct before switching the transceiver on.

NOTICE

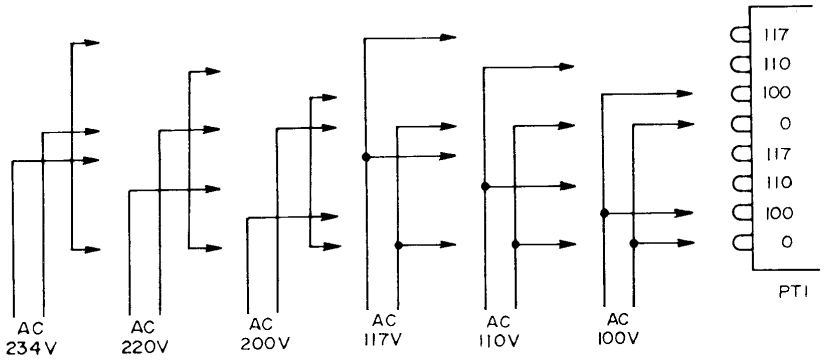
THE FOLLOWING ABUSES MAY CAUSE DAMAGE TO THE EQUIPMENT WHICH WILL VOID THE WARRANTY:

1. CONNECTION OF AC VOLTAGE OR IMPROPER DC VOLTAGE DIRECTLY TO THE TRANSCEIVER.
2. INCORRECT (REVERSED) POLARITY POWER CONNECTION.
3. USE OF AN IMPROPER FUSE.

Ground and Location

In base station installations the GND terminal on the rear panel of the FT-77 should be connected by a heavy braided cable to a good earth ground. Best performance will usually result when the grounding cable is less than 10 feet (3 meters) long, where possible. All station equipment should be connected to the same grounding point close to the transceiver, or linear amplifier, if used.

Locate the transceiver so that air can flow freely around the heat sink, and under and over the case. Whenever possible, use the front feet in their extended position as shown on page 4, and avoid placing papers or books on top of the transceiver. Do not place the FT-77 on top of a heat generating device such as a linear amplifier.



FP-700 POWER TRANSFORMER PRIMARY CONNECTIONS

Antenna

The FT-77 is designed for use with any antenna system which has a 50-ohm resistive impedance at the operating frequency. An automatic final protection (AFP) circuit is included in the transmitter stages to protect the final transistors by automatically reducing the transmitter power output when a high SWR is present. At an SWR of 2:1 for example, only about 90% of the full rated output power will be available.

In spite of this protection circuit, the FT-77 should never be switched to transmit when no antenna or dummy load is connected. Use 50-ohm coaxial cable to connect the transceiver to the antenna or load, and if the SWR is too high to permit the desired output power, connect an antenna tuner such as the FC-700 between the transceiver and the antenna.

MOBILE INSTALLATION
(Negative Ground Vehicles Only)

The DC cable for mobile installation is supplied with the transceiver. Please review the NOTICE on the previous page before making power connections. For best results, the DC cable should be connected directly to the vehicle battery, rather than to the ignition circuitry or accessory circuitry. Route the cable as far away from ignition cables as possible, while still keeping the DC cable length as short as practical. Cut off any unnecessary length of the cable in order to keep cable losses to a minimum.

Make certain that the cable is not connected to the transceiver until after the proper connections are made to the battery: the RED cable lead to the POSITIVE battery terminal, and the BLACK lead to the NEGATIVE terminal. The Power Plug Connector Wiring (page 11) shows the proper polarity of the connections to the FT-77. The positive RED wire must include a 20 amp fuse.

Before connecting the DC cable to the transceiver, check the voltage across the battery terminals with the engine running fast enough to show a charge. If this voltage exceeds 15 volts the automobile voltage regulator must be adjusted to reduce the charging voltage. Once the charging voltage at the battery terminals is determined to be correct, make sure that the POWER switch on the front panel of the FT-77 is OFF, and connect the DC cable to the transceiver.

Always check to ensure that the FT-77 POWER switch is in the OFF (out) position before starting the engine.

Mounting

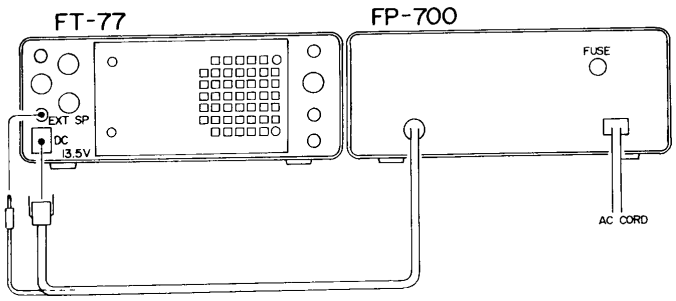
The optional MMB-16 Mobile Mounting Bracket is available for under-dash installation. This bracket can be used to mount the FT-77 alone, or the FT-77 plus the FV-700DM External Scanning VFO or FC-700 Antenna Tuner; or all three together. See page 23 for installation details.

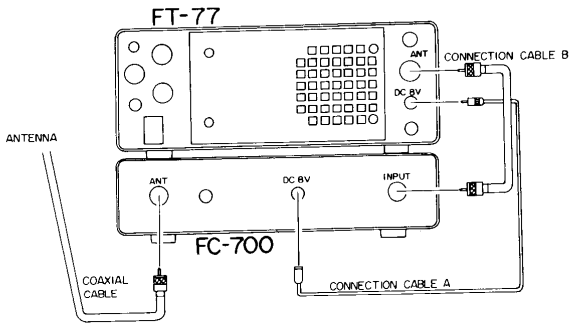
The mobile mounting position should allow about 8 inches (20 cm) of clearance around the heat sink to permit free air circulation. Avoid locations directly in the path of the heater ducts.

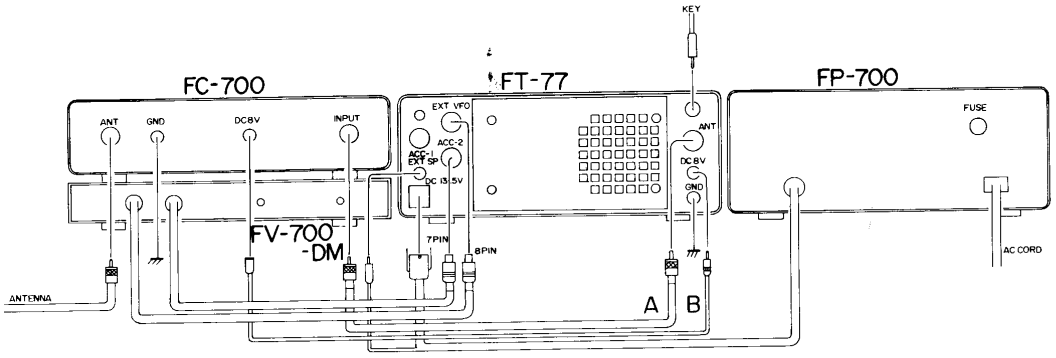
Mobile Antenna

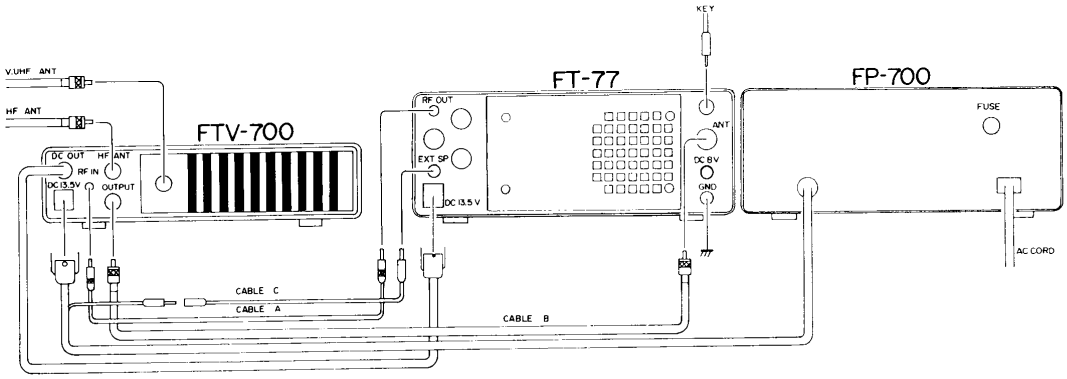
Please review the Antenna paragraphs in the preceding Base Station Installation section. An antenna tuner such as the FC-700 is particularly desirable for mobile installations, where the shortened antenna elements have very narrow bandwidth. Yaesu offers the RSL series of HF mobile antennas.

INTERCONNECTIONS

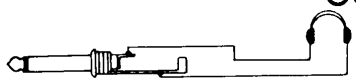




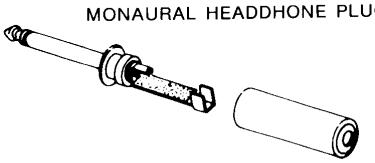


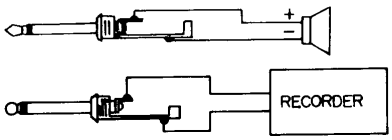


CONNECTOR WIRING

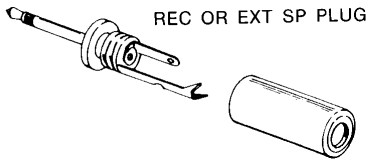


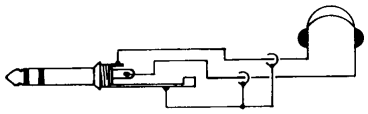
MONAURAL HEADDHONE PLUG



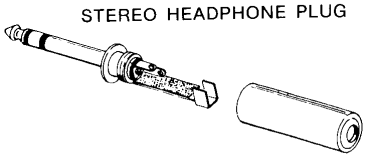


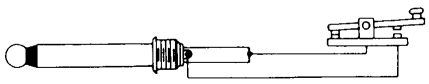
REC OR EXT SP PLUG



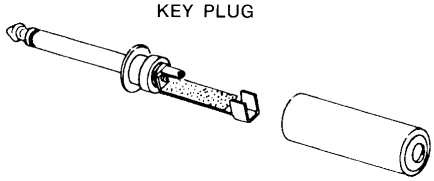


STEREO HEADPHONE PLUG

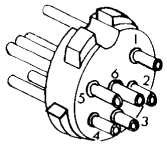




KEY PLUG



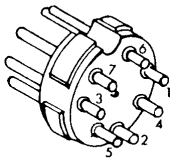
ACC-1 PLUG



PIN No.

1. ALC
2. RY N.C.
3. COMMON
4. N.O.
5. PATCH OUT
6. PTT

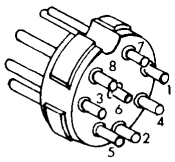
ACC-2 PLUG



PIN No.

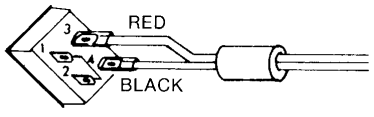
1 FAST CNTL (MIC)
2 DOWN CNTL (MIC)
3 PTT
4 KEY SW
5 UP CNTL (MIC)
6 TX 13.5V
7 —

EXT VFO PLUG

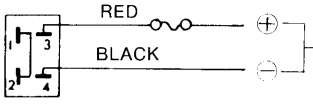


PIN No.

1	E	5	VFO/FIX 8V
2	TX 8V	6	13.5V
3	E	7	EXT VFO IN
4	8V	8	MEMORY OUT



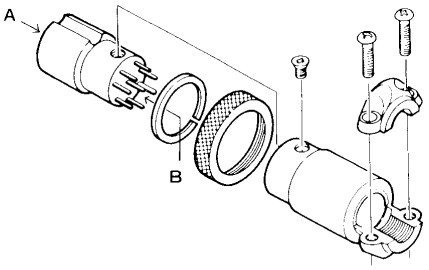
POWER PLUG

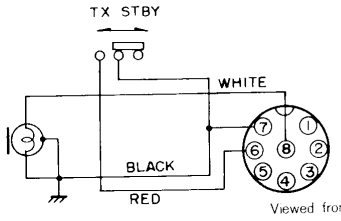


FUSE 6A (FT-77S)
20A (FT-77)

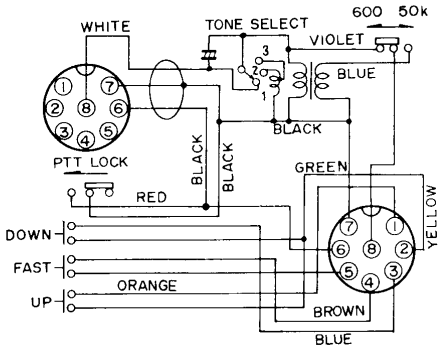
BATTERY TERMINALS

MICROPHONE CONNECTIONS (Microphones optional)

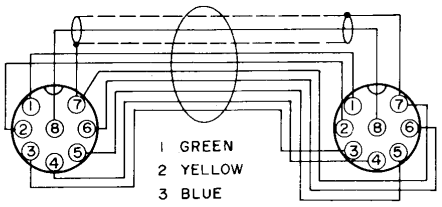




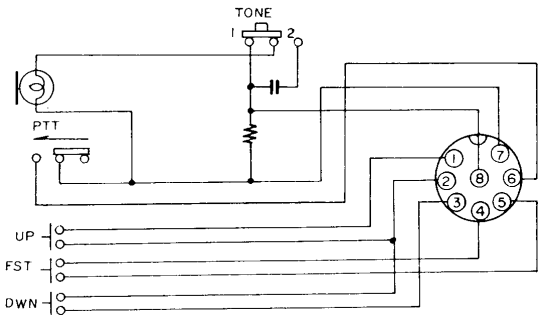
Viewed from "A" side



MD-1B8

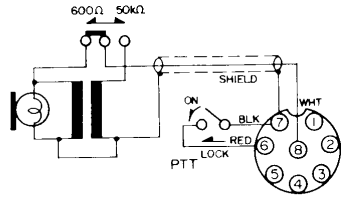


Viewed from "B" side



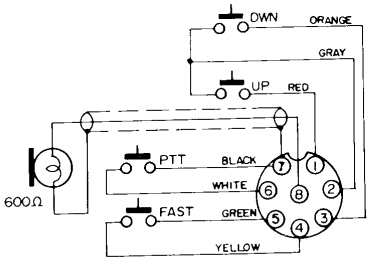
MH-1B8

YM-34



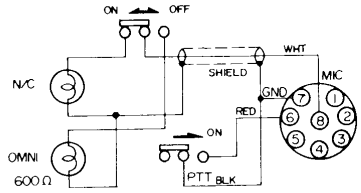
YM-34 MICROPHONE CONNECTIONS

YM-35



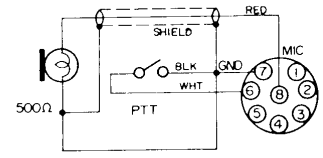
YM-35 MICROPHONE CONNECTIONS

YM-36

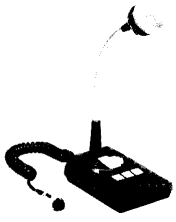


YM-36 MICROPHONE CONNECTIONS

YM-37

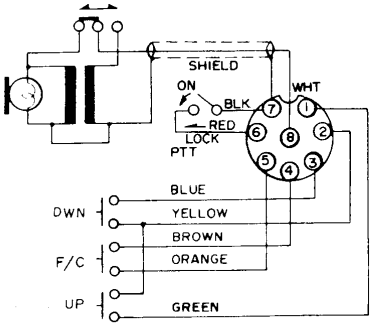


YM-37 MICROPHONE CONNECTIONS



YM-38

600Ω 50kΩ



YM-38 MICROPHONE CONNECTIONS

OPERATION

The all solid state design of the FT-77 makes the tuning procedure very simple. However, care should be exercised to follow the proper procedure to ensure that spurious signals are not transmitted.

Before switching the transceiver on, check that all interconnections, power supply voltage and fuse are correct.

RECEIVING

1. Preset the controls and switches as follows:

   MODE ..... USB (above 10 MHz), or LSB
   AF ..... adjust as needed
   Push Buttons.. all OFF (out)
   BAND ..... as desired

2. Be certain that the antenna is connected to the ANT jack, and then switch on the Power Supply, and finally the transceiver POWER switch.

3. Adjust the AF control for comfortable volume, and rotate the Tuning Knob to obtain the desired frequency on the Digital Display.

RF Attenuator

If very strong signals are encountered, distortion or intermodulation may occur in the receiver. In many cases this can be remedied by depressing the RF ATT button to activate the attenuator. This may also prove helpful when very high noise levels are present, such as low frequency reception with a very large antenna. The ATT LED above the Tuning Knob will be lit whenever the RF ATT is on.

Noise Blanking

When pulse type noise is received, press the NB button to activate the noise blanker. Automobile ignition noise and other short-pulse noise generated by electrical discharge, such as from electric motors, is most effectively blanked when the NB W-N switch (under the top access panel) is set to the "N" position. Noise with a longer pulse duration, particularly from the "woodpecker" over-the-horizon radar, is most effectively blanked by setting the NB W-N switch to "W". However, some degradation of received signal quality may also be noticed when this position is used and the noise is not present. Best performance is obtained by setting the NB W-N switch to the position most needed for the individual operator's location and requirements, and then only pressing the NB button when blanking is required.

Automatic Gain Control (AGC)

Press this button for normal CW reception, or when fast fading (QSB) is noticed on the received SSB signal. Also, when tuning around for weak signals the AGC-F (depressed) position may be useful. For regular SSB QSOs with reasonably strong stations the most comfortable reception will generally be found with this button in the out (slow AGC) position. During FM operation this button will effect the speed of the S-meter while having no effect on the received signal itself.

FIXed Frequency Operation

When an optional fixed frequency crystal is installed (in the FIX socket under the access panel), pressing the FIX button will cause the frequency control of the FT-77 to change from the VFO to the crystal. The digital display will also show an "F" at the left side, instead of "VFO-A" which appears normally when the internal VFO is in operation. Please refer to page 18 for operating details and instructions on how to determine which crystal to install.

MARKer Operation

When the optional Marker Unit is installed, pressing this button will cause steady carrier signals to appear at every 25 kHz point throughout the tuning range of the transceiver. These signals are useful for checking frequency alignment. During normal operation, however, the MARK button should be in the off (out) position, or unwanted mixer products may make reception difficult. Also, the MARKer generator may produce some low-level signals at odd frequencies. These can be identified by their level, and should be ignored.

CLARifier

During normal tuning, the CLAR button should be off (out), and the CLARIFIER control set to the 12 o'clock position. After making two-way contact with another station the CLAR button may be

pressed and the CLARIFIER control adjusted for the most pleasant receiving tone. This will not affect the transmitting frequency of the FT-77, so the other operator will not be forced to retune. If the transmitting frequency of the other station drifts, simply follow his signal with slight adjustment of the CLARIFIER control.

When the contact is finished, before changing frequency or taking another call, return the CLARIFIER control to the 12 o'clock position and set the CLAR button to the off (out) position. This will extinguish the CLAR LED.

CW Reception

When the optional CW-N filter is installed, the width of the receiver passband will be narrowed whenever the MODE selector is set to CW-N. Use the CW-W position to make stations easy to hear while you tune, and then switch to CW-N when the desired station is heard. Notice that the desired station may be lost unless it is first tuned to produce an audio tone close to 800 Hz (the frequency of the sidetone oscillator, heard on transmit). Tuning the received station for an 800 Hz tone ensures that, when transmitting, the signals will be on the same frequency.

When the CW-N position is selected interfering background stations and noise will be greatly reduced.

FM Reception (optional)

The only controls necessary for FM reception are the Tuning Knob, AF and SQL controls. The RF ATT button may still be helpful for very strong signals, and the FIX button may be used if the optional crystal is installed. All other controls are disabled. To adjust the SQL (squelch) control, tune to a clear frequency and adjust the control to the point where the noise just disappears. Now, when the transceiver is tuned to a station transmitting FM, the squelch will open and the station will be heard clearly.

FM stations may be found on HF generally above 29 MHz, or on the upper portions of the 50, 144 and 430 MHz bands (when using the FTV-700 V/UHF Transverter with the FT-77).

TRANSMITTING

The solid state transmitter in the FT-77 requires no tuning once the transmitting frequency has been selected. However, there are certain precautions that must be taken at all times to avoid damage to the transceiver.

Never transmit without having a dummy load, or antenna tuned to the operating frequency, connected to the transceiver. If there is any doubt about using a particular antenna at a certain frequency, check the SWR, as described on page 17.

When transmitting, never move the BAND or MODE selectors, as this will probably damage the selector and/or the final transistors.

When transmitting CW at full power, do not hold the key down continuously for more than 30 seconds. If it is necessary to transmit continuously for close to 30 seconds, let the transceiver cool in the receive state for at least 2 minutes before transmitting again. Output power will be automatically reduced if the temperature of the final transistors becomes too high.

Never transmit when using an antenna without first listening for a few minutes to make sure the frequency is clear. This will avoid accidental interference to other stations.

The FT-77 is equipped with a cooling fan inside of the heat sink, which will be activated automatically when the final transistors reach a certain temperature. Transmission may be continued, but power may decrease if the transmission is long. The fan will stop when the temperature of the finals drops.

SSB

Before transmitting, preset the BAND and MODE selectors to the desired operating band and sideband (USB above 10 MHz, or LSB). Open the top access panel and set the ALC-REF-FWD switch to ALC. Also preset the MIC/DRIVE control to midrange, and tune to the desired operating frequency. For proper results, a 50-ohm dummy load or antenna tuned for the operating frequency must be connected.

If using an antenna, first listen to make sure that the frequency is not already occupied, and then press the PTT (push-to-talk) switch on the microphone. The Meter, indicating ALC, should not deflect until the operator speaks.

While speaking into the microphone, adjust the MIC/DRIVE control, if necessary, so that the ALC deflection on the Meter remains just within the ALC zone at the left half of the scale (corresponding to the blue zone on the lower SWR scale). If the ALC indication is erratic and cannot be adjusted properly, check the SWR as described on the next page. During transmission, periodically check the ALC indication to make sure that the Meter is not deflecting into the RED zone on voice peaks.* If it does, simply readjust the MIC/DRIVE control. Intentionally setting the MIC/DRIVE control higher will not increase power output, but may cause distortion of the transmitted signal, as well as illegal spurious radiation. Be careful.

CW

Connect the key or electronic keyer output line to the KEY jack on the rear panel. Set the MODE selector to CW-W or CW-N, and select the BAND and operating frequency desired. Preset the MIC/DRIVE control to midrange, and make sure that a dummy load or proper antenna is connected to the ANT jack. Preset the ALC-REF-FWD switch under the access panel to the ALC position.

If using an antenna, check first to make sure the frequency is clear, and then close the key. Adjust the MIC/DRIVE control, if necessary, to the point where the ALC indication on the Meter is just at the upper edge of the ALC zone, but not into the RED zone*. This setting indicates full power CW. If it is not possible to obtain this reading, check the SWR as described on the next page.

* For lower power operation the MIC/DRIVE control may be set for any level where the ALC indication is lower . . . an excellent practice after making contact with another station, whenever the signal is strong enough. This will lengthen the life of the equipment as well as minimize possible interference to others.

The SIDE TONE control under the access panel can be adjusted for the desired volume of the sidetone signal when the key is closed.

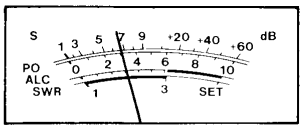
The transmit-to-receive switching time for CW operation can be adjusted by the DELAY control under the access panel. The proper setting will depend on the CW speed of the operator, and on personal preference for semi break-in operation. Of course the PTT switch on the microphone may be used for transmit/receive switching instead, or a footswitch can be connected between ground and pin 6 of the ACC-1 jack (or pin 3 of the ACC-2 jack) on the rear panel for PTT control.

FM (requires optional FM Unit)

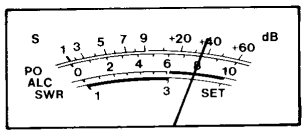
Please review the paragraphs on FM reception. Power output during FM transmission must be limited to about 50 watts, because of the semi-continuous duty cycle which would cause rapid overheating of the final transistors if driven for higher power. Of course this limitation does not apply when the FT-77 is used with a VHF/UHF transverter, but for FM transmission in the 28–29.7 MHz range, please limit the output power as described here.

After setting the BAND and MODE selectors to the proper positions, preset the ALC-REF-FWD switch to ALC, and the MIC/DRIVE control to about midrange. Make sure that a dummy load or properly matched antenna is connected to the ANT jack.

If using an antenna, first listen to make sure the frequency is clear, then press the PTT switch on the microphone and adjust the MIC/DRIVE control, if necessary, to obtain an ALC indication in the middle of the ALC zone (corresponding with the blue SWR zone). Release the PTT switch.



Now move the ALC-REF-FWD switch to FWD, press the PTT switch, and adjust the FWD SET control (also under the access panel) to obtain a Meter indication exactly at the right edge of the Meter scale (SET mark). Finally, rotate the MIC/DRIVE control counterclockwise until the Meter indicates "8" on the PO scale. Release the PTT switch.



The FT-77 is now set for 50 watts FM output. Note the exact position of the MIC/DRIVE control for future operation in the same frequency range with the same antenna. The PO Meter indication should be "8" or less as long as the FWD SET control is not readjusted; otherwise the above procedure will need to be repeated.

If an external wattmeter is used with the FT-77, simply set the MIC/DRIVE control for 50 watts on the wattmeter. The rest of the procedure is then not required.

CHECKING AND MEASURING SWR

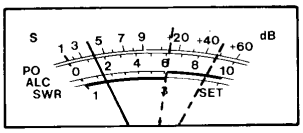
These procedures allow checking and measurement of the relative amount of power being applied to the load (connected to the antenna jack), versus the amount being reflected back to the transmitter. A properly matched antenna system will have little or no reflected power, even when full transmitting power is applied. The first procedure is for checking SWR when the quality of the load (antenna plus feedline) is unknown or in doubt for use at a particular frequency. The second procedure may be used when the quality of the load SWR is known to be close to 50 ohms, and a more accurate measurement is desired. Each requires that either a microphone or a straight CW key be connected. If using an electronic keyer that does not permit constant key-down, it should be unplugged.

SWR Check

Under the access panel, preset the ALC-REF-FWD switch to the FWD position, and rotate the FWD SET control fully clockwise. Set the MODE selector to a CW position, and tune the transceiver to the frequency at which the SWR is to be checked. (The SWR will be generally different for different frequencies, unless the load is a dummy load.) Reduce the MIC/DRIVE control to the fully counterclockwise position.

Wait to make sure that the frequency is clear of traffic, and then press the PTT switch on the microphone and/or close the key, if connected. Gradually advance the MIC/DRIVE control until the Meter deflects just to the right edge of the scale (SET mark). Now move the ALC-REF-FWD switch to the REF (center) position, and note the Meter indication. Release the PTT switch or key.

If the Meter indicated to the right of the blue zone on the lower Meter scale (SWR), the antenna system is not properly matched to the transceiver for operation on the test frequency. This procedure only applies about five to ten watts to the antenna system, so it would not damage the transceiver, but high power transmission must be avoided at this frequency into this load.



SWR indications around the right end of the blue zone (marked "3") indicate poor antenna matching. However, an antenna tuner such as the FC-700 can be used to tune the antenna system to provide the proper match. Of course, this will not improve the quality of the antenna system itself, so it is better to correct the antenna of feedline mismatch first, if possible.

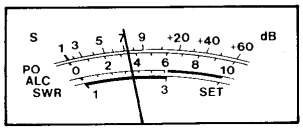
Little or no deflection of the Meter indicates a matched antenna system for use at this frequency. Perform the following procedure for an accurate measurement at full power if the REF indication was low.

SWR Measurement

If the quality of the load (antenna plus feedline) is unknown or in doubt for the test frequency, perform the preceding SWR Check first.

Under the access panel, preset the ALC-REF-FWD switch to ALC. Before transmitting, set the MODE selector to a CW position, and tune the transceiver to the frequency at which the SWR is to be measured. During the following steps, do not hold the transmitter keyed for more than 30 seconds.

Wait to make sure that the frequency is clear of traffic, and then press the PTT switch on the microphone and/or close the key, if connected. Adjust the MIC/DRIVE control to obtain a Meter indication in the middle of the ALC zone (also the middle of the blue SWR zone), and return to receive.



Move the ALC-REF-FWD switch to the FWD position, and adjust the FWD SET control (also under the access panel) while again keying the transmitter, to obtain a Meter deflection just exactly to the right edge of the Meter scale (SET mark). Now move the ALC-REF-FWD switch to the REF (center) position, and note any Meter deflection. Return to receive.

If the Meter indicated to the right of the blue zone on the lower Meter scale (SWR), the antenna system is too far from the required 50-ohm impedance to be used at this frequency.

If the Meter indicated around the right end of the blue SWR scale (marked "3"), a poor match is present. Power output with an SWR of 3 is about 75% of full power, decreasing rapidly for higher SWR indications. An antenna tuner may be used to match the antenna system more closely, thus providing more power at this frequency.

No SWR Meter deflection indicates a 1:1 SWR, and full power will be delivered to the load. Notice that this will only occur at the frequency(ies) where the antenna system is perfectly matched.

FIXed Frequency Operation (requires optional crystal)

By installing an optional crystal in the FIX socket beneath the top access panel, the operating frequency of the FT-77 will be fixed whenever the FIX button on the front panel is pressed.

One crystal will produce a fixed frequency on each band of the transceiver, and thus only the kilohertz digits are fixed. However, the kilohertz digits will not be the same for all bands. For example, if 21.2500 MHz is fixed in the USB mode, the fixed operating frequency in the 10, 14, 18, 21, 28.0 and 29.0 MHz bands will be xx.2500 MHz. In the 24.5, 28.5 and 29.5 MHz bands the fixed frequency will be xx.7500 MHz (because of the automatic 500 kHz offset for these three bands). In the 7 MHz band the fixed frequency will be 7.2470 MHz (because the transceiver automatically offsets the USB mode from the LSB mode by 3 kHz to follow the natural carrier offset). In the 3.5 MHz band the fixed frequency will be 3.7470 MHz, because of the combination of the above two reasons (plus 500 and minus 3 kHz).

To determine the correct crystal frequency (F_X) that will provide the desired fixed operating frequency (F_O) for a certain mode, use the following formula:

$$F_X = F_L - F_O,$$

where F_L is the frequency of the local oscillator for the desired operating band, listed in the Table below.

MODE / BAND	USB	LSB	CW, FM
3.5MHz	8995.5	8998.5	8996.2
7.0MHz	12495.5	12498.5	12496.2
10.0MHz	15498.5	15501.5	15499.2
14.0MHz	19498.5	19501.5	19499.2
18.0MHz	23498.5	23501.5	23499.2
21.0MHz	26498.5	26501.5	26499.2
24.5MHz	29998.5	30001.5	29999.2
28.0MHz	33498.5	33501.5	33499.2
28.5MHz	33998.5	34001.5	33999.2
29.0MHz	34498.5	34501.5	34499.2
29.5MHz	34998.5	35001.5	34999.2

FL(kHz)

The other requirements for the crystal are as follows:

Holder type:	HC-25/U
Load Capacitance:	30 pF
Equiv. Series Resistance:	25 ohms (maximum)
Shunt Capacitance:	7 pF (maximum)
Drive Level	5 mW

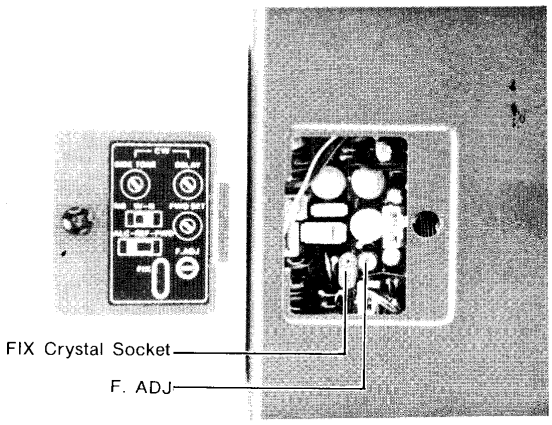
Notice that all crystals, regardless of intended operating frequency, will be between 5.0 and 5.5 MHz, since this is the range of the VFO.

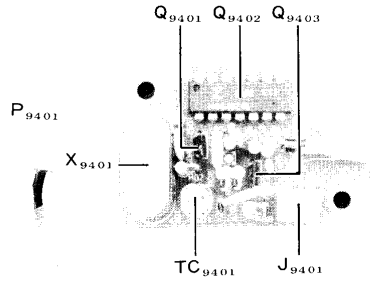
Once the proper crystal has been selected and installed, depress the FIX button on the front panel and adjust the F.ADJ control under the access panel to "trim" the crystal oscillator to the precise frequency as displayed (make sure that the MODE selector is set to the intended operating mode first).

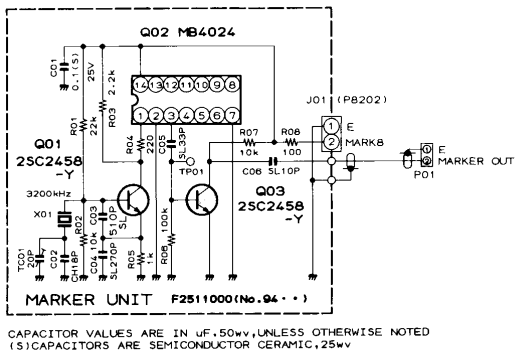
Marker Calibration (optional unit required)

For highly accurate frequency determinations, the optional crystal Marker Unit can be installed. Then by pressing the MARK button on the transceiver, a marker signal will appear at each multiple of 25 kHz throughout the frequency range of the transceiver.

To calibrate the Marker itself, let the transceiver, with antenna connected, warm up for at least 30 minutes. Then set the MODE selector to either USB or LSB, and tune the dial to zero beat with the time and frequency standard station (WWV or similar) at 10 MHz. Press the MARK button and adjust the trimmer capacitor on the Marker Unit, if necessary, to zero beat the Marker signal. In performing this calibration, make sure that the MARK button is off (out) when tuning the dial to 10 MHz, and do not touch the dial once the MARK button has been switched on (or it will not be possible to obtain the necessary zero beat).







INSTALLATION OF OPTIONS

CW Narrow Filter Installation
(Filter XF-8.9KC, Kit number D2000019)

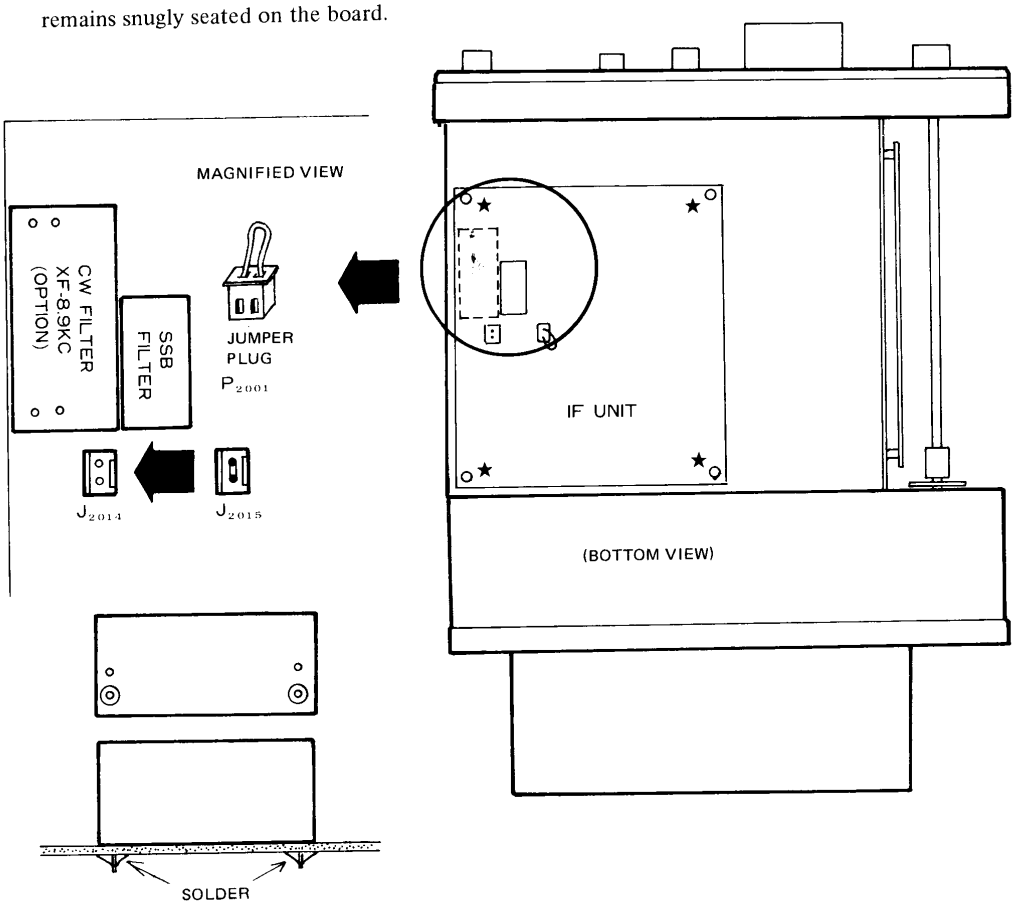
1. Place the transceiver upside down on the work surface. Remove the nine screws affixing the bottom cover, and remove the cover.

2. Referring to the diagram below, locate the IF Unit, and remove the four screws (★) holding it in place.

3. Stand the transceiver on its side so that the IF Unit is uppermost, and gently pull the top edge of the IF Unit out just enough to allow space for soldering the filter terminals. Install the filter from the component side, and solder the filter terminals while making sure that the filter remains snugly seated on the board.

4. Return the transceiver to the upside down position, and locate jumper plug P_{2001}. Remove this plug from J_{2015} and install it in J_{2014}. (Do not move this plug to J_{2014} unless the narrow CW filter is installed.)

5. Replace the IF Unit and its four screws, making sure that no wires are pinched, and then replace the bottom cover and its nine screws.



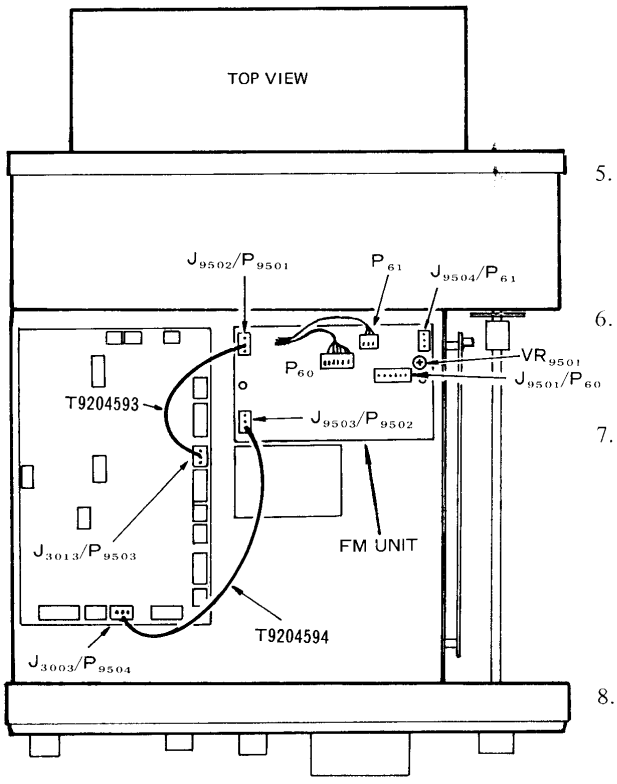
FM Unit Installation

Requires:

Kit number D3000233, consisting of:
- One FM Unit circuit board assembly C025120A
- One cable and connector assembly T9204593
- One cable and connector assembly T9204594
- Two self-tapping screws for mounting

Note: The connector plugs on the cable assemblies are marked with two numbers which correspond to the last two digits of the circuit part number; for example, P_{9501} is marked 01.

1. Remove the eight screws affixing the top cover, and remove the cover carefully; disconnecting the speaker leads before pulling the cover away.



2. Referring to the diagram below, locate the correct position for mounting the FM Unit; in particular, notice the location of Jack J_{9503}. With this positioned as shown in the diagram, affix the FM Unit in place with the self-tapping screws provided, while making sure that no wires or connectors are trapped beneath the Unit.

3. Locate 6-pin Plug P_{60} and 3-pin plug P_{61} in the transceiver, and connect them to J_{9501} and J_{9504} on the FM Unit, respectively, as shown in the diagram.

4. Connect the cable assembly connector plugs to the jacks on the AF Unit and FM Unit as follows:

   Connect P_{9503} to J_{3013} on the AF Unit
   Connect P_{9501} to J_{9502} on the FM Unit
   Connect P_{9504} to J_{3003} on the AF Unit
   Connect P_{9502} to J_{9503} on the FM Unit

   Double check these connections and compare with those shown in the diagram. Also note the routing of the two new cables shown in the drawing, and route these in the same way.

5. This completes the installation. place the top cover near the transceiver and reconnect the speaker wires. Connect the power source, and switch the transceiver on.

6. With no antenna connected, set the MODE selector to FM, and preset the SQL control to the 1 o'clock position.

7. Referring to the figure at the left, locate VR_{9501}, and carefully adjust it to the squelch threshold point where receiver noise is just silenced. Do not adjust any other components on the FM unit, as it was carefully aligned at the factory. However, should realignment be required, refer to page 38 of the Instruction Manual.

8. Replace the top cover and its eight screws.

Marker Unit Installation

Requires:

One Marker Unit kit number D3000234, composed of:

One Marker Unit number C025110A
Two self-tapping screws

1. Remove the eight screws affixing the top cover, and remove the cover carefully; disconnecting the speaker leads before pulling the cover away.

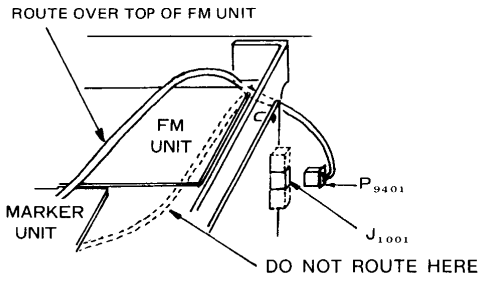
2. Referring to the diagram below, mount the Marker Unit using the two screws supplied, noting in particular the location of J_{9401}, which should be nearest the front panel. Use care not to trap any wires or connectors under the Unit.

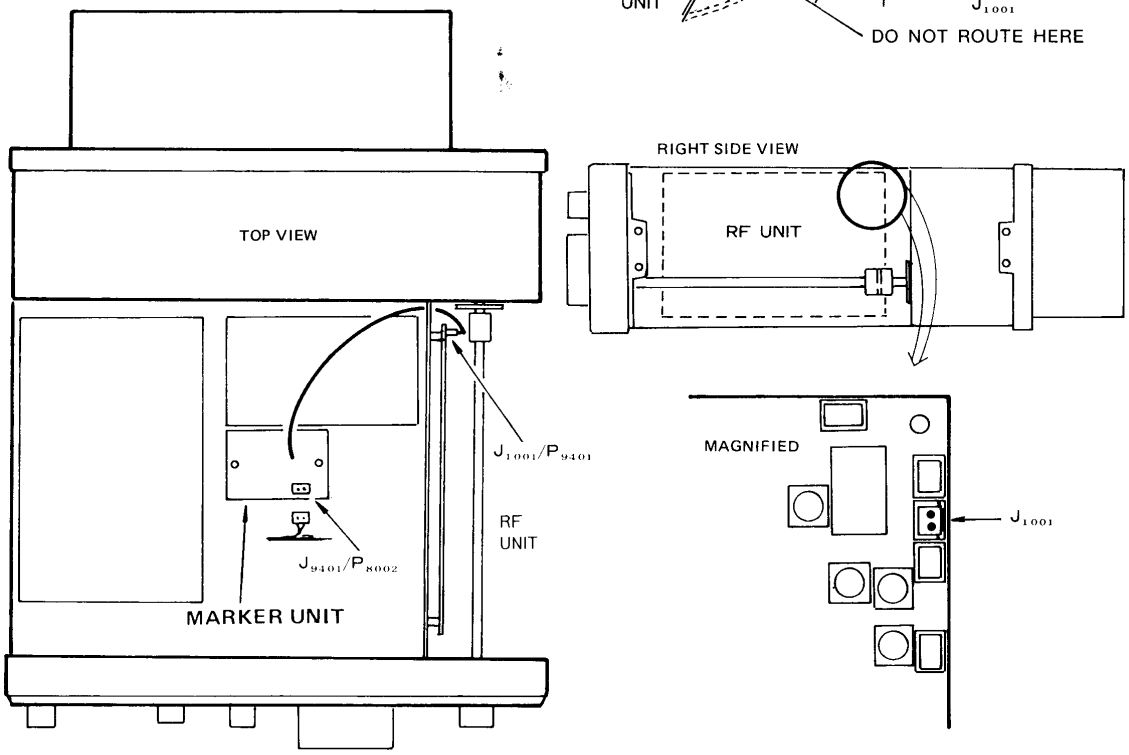
3. Connect P_{8002} in the transceiver to J_{9401} on the Marker Unit.

4. Referring to the drawings below, route the the output cable exactly as shown. Notice that this cable must be routed over the top of the FM Unit, if installed. Connect P_{9401} on the end of this cable to J_{1001} on the RF Unit (mounted vertically at the right side of the chassis).

5. Check and align the Marker Unit as described on page 19.

6. Reconnect the speaker wires and replace the top cover and its eight screws. Installation is now complete.





MMB-16 MOBILE MOUNTING BRACKET

The MMB-16 is designed to permit simple, convenient mobile installation of Yaesu compact HF mobile transceivers and accessory equipment. When used with the FT-77 Transceiver, the matching FV-700DM or FV-707DM External VFOs and FC-700 or FC-707 Antenna Tuners may also be installed.

1. Note that the transceiver and accessories have three mounting holes in each side, only two of which are used for mobile mounting. Select which two holes to use according to the desired distance that the equipment is to project forward of the bracket in the final mounting position.

2. If installing the transceiver with accessories, preassemble the slotted mounting brackets to the side plates using the four small screws. If installing the transceiver only, the mounting brackets are not needed.

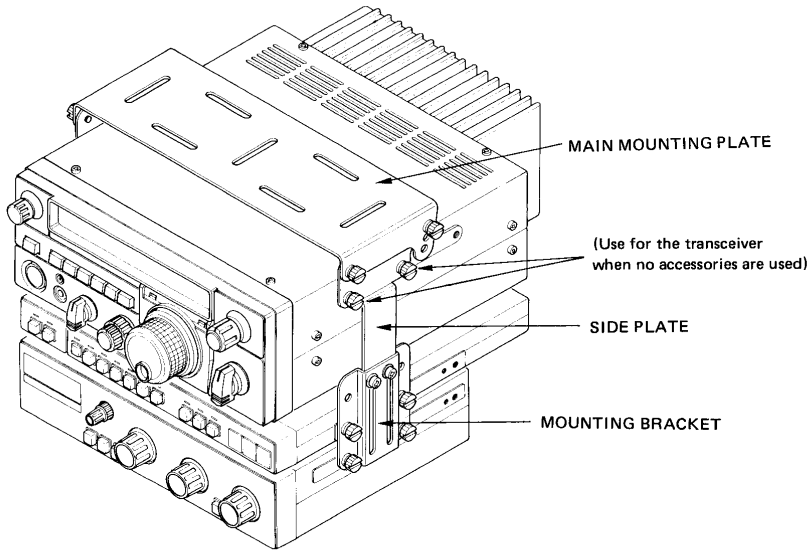
3. If installing the transceiver with accessories, stack the equipment in the desired order and bolt the side plate/bracket assemblies to the equipment.

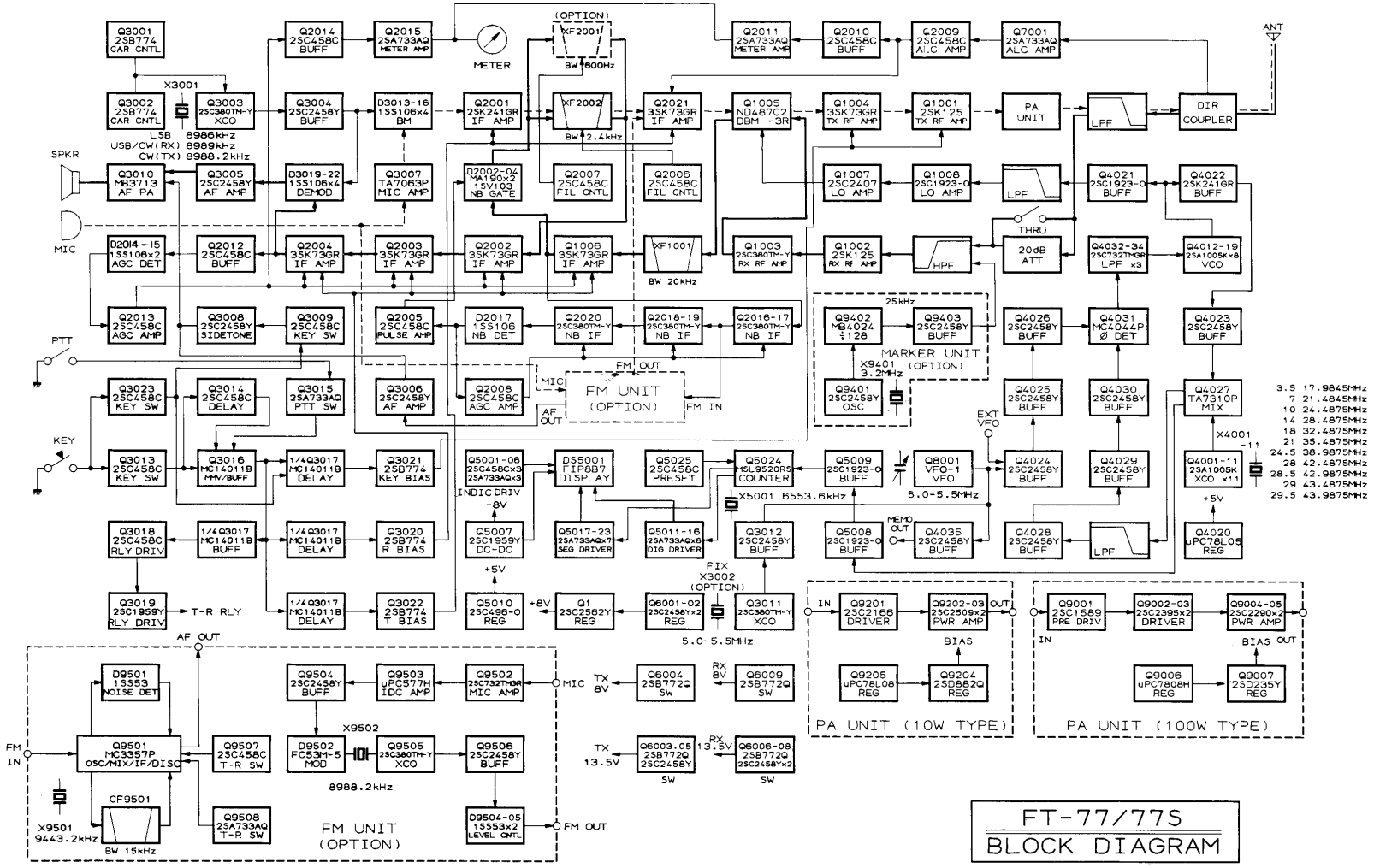
   If installing the transceiver only, bolt the side plates to the transceiver using the lower holes in the side plates.

4. Temporarily bolt the main mounting plate to the side plates, and determine the proper mounting location in the vehicle. This must allow for several inches of clearance around the heat sink, and sufficient clearance for all cables (front and rear) and controls. In general, all of the equipment is designed to function properly regardless of the mounting position, but it should not be mounted directly in the path of the vehicle heater vents, nor where it could interfere with driver vision or vehicle operation.

5. Now remove the main mounting plate, and use it as a template to locate the mounting holes on the vehicle. Use a 3/16 inch (4.8 mm) bit for drilling the holes.

6. Affix the main mounting plate to the vehicle as shown in the diagram, and then finally affix the side plates, with the equipment affixed, to the main mounting plate. Notice that there are three possible positions for the rear bolt, allowing several choices of mounting angle.





FT-77/77S

BLOCK DIAGRAM

CIRCUIT DESCRIPTION

The block diagram and following circuit description will provide a better understanding of the design and function of this transceiver. Refer to the schematic diagrams for specific component details.

RECEIVER

LPF Unit (F2509104)

The RF input signal from the coaxial antenna jack is fed to the LPF Unit, where it is passed through directional CM coupler T_{7001} to the rotary arm of bandswitch wafer (b) of S_{7001}, which is part of the ALC Unit. One of five lowpass filters is selected according to the bandswitch setting, and the filtered signal is then fed from wafer (a) of S_{7001} through T-R relay RL_{7001}, and delivered to the RF Unit.

RF Unit (F2509101)

The incoming signal is passed through lamp fuse PL_{1001} and attenuator relay RL_{1001}, and then along with the Marker signal (if installed and activated), through a highpass filter and diode switches to one of eight bandpass filters (selected by control signals from the bandswitch).

From the bandpass filter the signal is applied to RF amplifier Q_{1002} (**2SK125**), and from there through amplifier/buffer Q_{1003} (**2SC380TM-Y**) before additional filtering through one of another eight bandpass filters. From this second filter the signal is applied to ring mixer module Q_{1005} (**ND487C2-3R**), where it is mixed with the appropriate local signal. The local signal is delivered from the PLL Unit; filtered, and then amplified by Q_{1008} (**2SC1923-O**) and Q_{1007} (**2SC2407**) before application to the mixer.

The resulting 9 MHz mixer product is passed through crystal filter XF_{1001} (20 kHz bandwidth) to IF amplifier Q_{1006} (**3SK73GR**), and then delivered to the IF Unit.

IF Unit (F2510101)

A portion of the 9 MHz signal from the RF Unit is fed to the noise blanker circuit, consisting of noise amplifier pairs Q_{2016}, Q_{2017} and Q_{2018}, Q_{2019} (all **2SC380TM-Y**), and then Q_{2020} (**2SC380TM-Y**). After amplification the noise is detected by D_{2017} (**1SS106**) a portion of the output of which is amplified by Q_{2008} (**2SC458C**) and applied to the noise amplifiers for AGC. The remainder of the detected noise from D_{2017} is applied to pulse amplifier Q_{2005} (**2SC458C**), which controls noise blanker gate $D_{2002}-D_{2004}$ (**MA190** x 2, and **1SV103**). For FM reception, the signal is extracted after amplification by Q_{2016} and Q_{2017}, and delivered to the optional FM Unit (when installed).

The remainder of the 9 MHz signal from the RF Unit is applied directly to the noise blanker gate, and is passed through whenever a noise pulse has not switched the gate off. The signal is then passed through 8-pole monolythic crystal filter XF_{2002} (**8F-2.4D**, 2.4 kHz bandwidth), or though optional 8-pole narrow CW crystal filter XF_{2001} (XF8.9KC, 600 Hz bandwidth), when installed and selected by the mode switch. Q_{2007} (**2SC-458C**) performs the necessary filter switching upon command from the MODE selector (when the optional filter is installed).

From the filter the signal is amplified by Q_{2002}, Q_{2003} and then Q_{2004} (all **3SK73GR**) before delivery to the AF Unit for demodulation. A portion of the output of Q_{2004} is buffered by Q_{2012} (**2SC458C**) and the AGC is detected by D_{2014} and D_{2015} (**1SS106**). This DC voltage is amplified by Q_{2013} (**2SC458C**) and fed to IF amplifiers Q_{2002}, Q_{2003} and Q_{2004}, as well as to Q_{1006} on the RF Unit, to control the gain of these stages. A portion of the AGC voltage is buffered by Q_{2014} (**2SC458C**), and amplified by Q_{2015} (**2SA733AQ**) for delivery to the S-meter.

AF Unit (F2510102)

After final IF amplification by Q_{2004}, the signal is delivered to ring demodulator D_{3019}–D_{3022} (all **1SS106**) on the AF Unit. The demodulator also receives the carrier signal generated by carrier oscillator Q_{3003} **(2SC380TM-Y)** after buffering by Q_{3004} **(2SC2458Y)**, the frequency of which is determined by crystal X_{3001} and carrier controller Q_{3002} **(2SB774)**. Thus the carrier oscillator frequency is 8986 kHz for LSB, and 8989 kHz for USB and CW (receive).

The resulting audio product from the demodulator is amplified by Q_{3005} **(2SC2458Y)** and finally by AF power amplifier module Q_{3010} **(MB3713)** before delivery to the speaker or headphones.

FM Unit (F2512000, option)

The wideband IF signal extracted from the first noise blanker amplifiers on the IF Unit is delivered to Q_{9501} **(MC3357P)**, which contains a local oscillator, mixer, IF amplifier, limiter and discriminator. Crystal X_{9501} sets the local oscillator to 9443.2 kHz, and the mixer within Q_{9501} thus produces an internal IF at 455 kHz. This is passed out through ceramic filter CF_{9501} (15 kHz bandwidth), and then back to a limiting amplifier in Q_{9501}. The limiter amplifier delivers the signal to the discriminator, also within Q_{9501}, which provides an audio output in response to changes in frequency of the input signal. This audio is delivered to the AF Unit, where it is amplified first by Q_{3006} **(2SC2458Y)** and then AF power amplifier module Q_{3010} for delivery to the speaker or headphones.

A portion of the audio output from the discriminator section of Q_{9501} is high-pass filtered and fed to noise detector D_{9501} **(1SS53)**, and then back to Q_{9501} for amplification. When no carrier is present in the receiver passband a high level of high frequency noise appears at the discriminator output, and this is detected by D_{9501}, the amplified output of which squelches off the audio output from Q_{9501} to the AF Unit.

Marker Unit (F2511000, option)

Crystal oscillator Q_{9401} **(2SC2458Y)** generates a 3200 kHz signal, which is divided by 128 at Q_{9402} **(MB4024)**. The resulting 25 kHz square wave is buffered by Q_{9403} **(2SC2458Y)** and delivered to the receiver front end (just after the attenuator relay) on the RF Unit.

TRANSMITTER

The following transmitter section descriptions are organized according to mode.

SSB

Transmitter audio input from the microphone is passed through the MIC/DRIVE control to microphone amplifier Q_{3007} **(TA7063P)** on the AF Unit, and then applied to balanced ring modulator D_{3013}–D_{3016} (all **1SS106**). The carrier signal from buffer Q_{3004} is also applied to the modulator, the frequency of which is shifted slightly for the selected sideband as described in the Receiver description.

The resulting double-sideband 9 MHz output from the modulator is delivered to the IF Unit, where it is amplified by Q_{2001} **(2SD241GR)** and then applied to SSB filter XF_{2002}. The filter removes the unwanted sideband, and the remaining sideband is then amplified by Q_{2021} **(3SK73GR)** and delivered to the RF Unit.

On the RF Unit the signal is applied to ring mixer module Q_{1005}, along with the local signal (described in the Receiver description and PLL Unit description to follow). The output of the mixer at the desired transmit frequency is passed though one of eight bandpass filters selected by control signals from the bandswitch, and then amplified further by Q_{1004} **(3SK73GR)**. The signal is again filtered by one of another eight bandpass filters, and then amplified further by Q_{1001} **(2SK125)** before delivery to the PA Unit.

On the PA Unit (PB-2013B) the signal is amplified by predriver Q_{9001} **(2SC1589)**, and drivers Q_{9002} and Q_{9003} (both **2SC2395**) before final amplification by Q_{9004} and Q_{9005} (both **2SC2290**). Bias current for the finals is derived from the TX13.5V line by Q_{9006} **(μPC7808H)** and Q_{9007} **(2SD235Y)**.