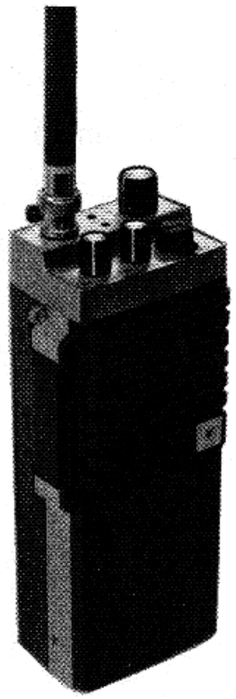
FTC-2003



The Yaesu model FTC-2003 provides high performance from a compact, completely portable package. Designed for operation within any 4 MHz range of the 134-174 MHz land mobile band, the FTC-2003 features 3 watts RF output and a flexible, quick-disconnect antenna. The FTC-2003 weighs only 400 grams, less batteries, and as many as three channels may be installed.

The FTC-2003 is operated from a NiCd battery pack, available from your Yaesu dealer. A battery charger and DC-DC converter unit are available options, in addition to a speaker/microphone and subaudible tone squelch unit.

SPECIFICATIONS : FTC-2003

GENERAL

Frequency Coverage:
134.00 MHz – 174.00 MHz
(All channels within 4 MHz range)

Number of Channels:
3

Operating Mode:
F3

Power Source:
NiCd Battery Pack @ 10.8V ±10%

Power Consumption:
Receive 200 mA
Receive (SQL) 40 mA
Transmit 800 mA

Case Size:
69 (H) x 49 (W) x 171 (D) mm

Weight:
400 g (Less batteries)

TRANSMITTER

Power Output:
3.0 Watts

Modulation:
Vector Phase Modulation

Frequency Multiplication:
x 12

Deviation:
±5 kHz

Maximum Bandwidth:
16 kHz

Spurious Emission:
–50 dB or Better

Output Impedance:
50 Ohms

Microphone:
Electro-Condenser

Transmitter Stability:
Within 10 ppm.

RECEIVER

Type:
Double Conversion Superheterodyne

First IF:
10.7 MHz

Second IF:
455 kHz

Sensitivity:
0.33 μV for 20 dB QS

Selectivity:
±20 kHz (–60 dB)

OPTIONS

1. Battery Charger NC-2
2. Tone Squelch Unit
3. Speaker-Microphone
4. Additional Channels

SEMICONDUCTOR COMPLEMENT

FET

3SK51	1	JF1033B	2

Transistors

2SA695D	4	2SC1311E	14
2SC710D	2	2SC1923O	4
MRF237	1	MRF515	1
2SC1209D	2	2SC1815Y	2

Silicon Diodes

1S1555	5	MI301	1

Germanium Diodes

1S188FM	2

Zener Diodes

WZ050	1	WZ061	1

LED

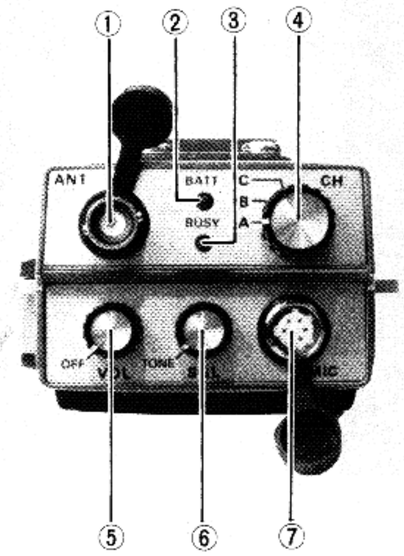
LN28RP	2

Design and specifications subject to change without notice.

CAUTION

WHEN OPERATING THE FTC-2003 FROM OTHER THAN THE NiCd BATTERY PACK, DO NOT EXCEED THE 10.8 VOLT DC LIMITATION. OPERATION OF THIS UNIT DIRECTLY FROM 13.8 VOLT POWER WILL CAUSE PERMANENT DAMAGE TO THE TRANSCEIVER.

CONTROLS, SWITCHES, AND CONNECTORS



(1) ANT

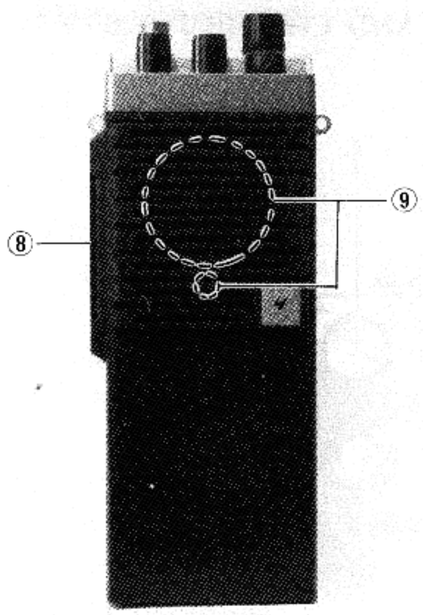
The antenna connector is a BNC type female jack, for quick connection and removal of the antenna.

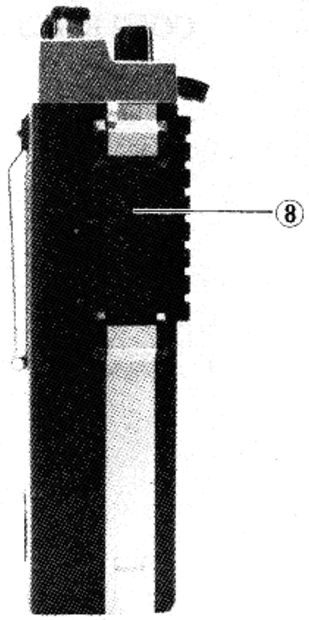
(2) BATT

The battery indicator will light up while you are transmitting, if the battery charge is sufficient. If this LED does not light up, the battery pack should be recharged as soon as possible.

(3) BUSY

The BUSY lamp will light up when a signal is being received. When the optional tone squelch unit is installed, this indicator will light up when a signal trips the main squelch, alerting the operator to the fact that the channel is occupied.





(4) CHANNEL

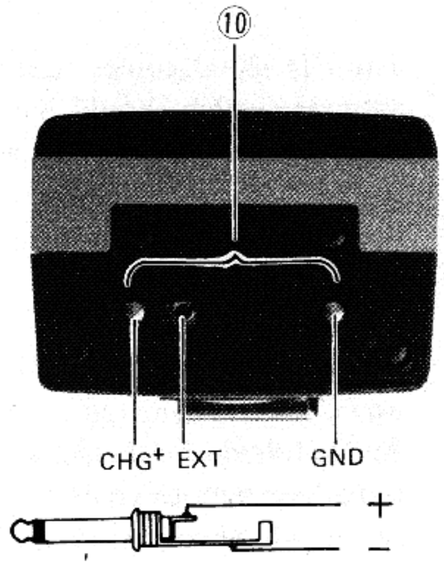
Up to three channels may be selected.

(5) VOL (Power switch)

This is the main volume and power on/off switch for the transceiver. When operation is completed, or when charging batteries, be certain to rotate this control completely into the click-stop, to avoid battery depletion.

(6) SQL

The receiver squelch control will silence the receiver when no signal is being received, thus reducing battery consumption to only 40 mA. This control should be advanced only to the point where the noise just disappears; excessive advancement of the squelch control will cause weak signals not to activate the receiver.



EXTERNAL CHARGER PLUG CONNECTIONS

(7) MIC

An optional speaker/microphone may be connected to this jack. Speaker impedance is 8 ohms, and the microphone impedance is 2000 ohms.

(8) PTT switch

Squeezing the PTT switch will activate the transmitter. Releasing the switch will allow receiver recovery.

(9) SPEAKER & MICROPHONE

Behind the opening in the front panel are the 8 ohm speaker and 2000 ohm condenser microphone.

(10) ACCESSORY TERMINALS

The CHG + and GND terminals allow connection to the Yaesu NC-1A battery charger and NC-2 Quick Charger. The EXT jack is for connection to an external charger (10.8 VDC @ 45 mA max).

ANTENNA CONSIDERATIONS

The FTC-2003 comes equipped with a flexible, helically wound antenna, which should be satisfactory for all portable applications. A different type of antenna may, however, be connected to the top panel BNC connector. This antenna must have an impedance of 50 ohms for proper operation.

EXTERNAL SPEAKER/MICROPHONE

An external speaker/microphone is available as an option, providing remote transmit and receive capability for the transceiver, which may be located in a backpack, etc.

BATTERY INFORMATION

The FTC-2003 is equipped with a NiCd battery pack. We do not recommend the use of other types of batteries with this transceiver. For safety in remote areas, always carry at least one extra battery pack, to avoid being without communications in emergency conditions.

When using the battery charger option, be certain to turn the transceiver off. Otherwise, charging time will be greatly extended.

DO NOT EXCEED 10.8 VOLTS AT THE BATTERY TERMINALS AT ANY TIME.

ENVIRONMENTAL PRECAUTIONS

The FTC-2003 is designed for use under a variety of environmental conditions. However, a few precautions will ensure long life of this transceiver, and they should be followed without fail.

The FTC-2003 is not packaged in a waterproof enclosure. As such, direct exposure to rain and/or high winds should be avoided. As well, extremely high temperatures are to be avoided. Do not store the FTC-2003 in the trunk of a car on an extremely hot day, or expose the transceiver directly to hot sunshine for extended periods of time. Extreme heat may cause warping of the case or damage to the solid state circuits.

Operation in cold weather presents problems of a different nature. The FTC-2003 can easily withstand cold temperatures, but NiCd batteries begin to show reduced voltage at 0°C. When skiing, or otherwise operating in a cold environment, keep the FTC-2003 inside your parka so as to maintain a reasonable battery temperature.

The case of the FTC-2003 is made of high strength ABS plastic, which is extremely resistant to impact damage. However, dropping the transceiver onto a concrete surface will likely crack the case, and may damage internal components. Keeping the transceiver inside a carrying case will help preserve the original condition of the transceiver, and will provide considerable shock absorption.

BE CAREFUL NOT TO SPILL CLEANING FLUID ON THE CASE OF THE TRANSCEIVER, AS THE ABS PLASTIC MAY BE PARTIALLY DISSOLVED BY SUCH CHEMICALS.

OPERATION

1. Place the VOL switch in the OFF position.
2. Install the antenna and battery pack.
3. Place the VOL switch in the ON position, and rotate the SQL control until receiver noise is heard.
4. Rotate the CHANNEL switch to an unused channel. Rotate the SQL control until the receiver noise is just silenced. Do not go past this threshold point, or else the receiver will not respond to weak signals.
5. For transmission, squeeze the PTT switch and speak into the front panel microphone in a normal voice. Release the PTT switch for receiver recovery.

TONE SQUELCH OPERATION

When the optional tone squelch unit is installed, rotation of the SQL control to the TONE position will activate the tone squelch circuit. In this mode, a subaudible audio tone will be superimposed on the transmitted signal. On receive, the receiver will remain muted until a similar subaudible tone is received on the incoming signal.

When a signal is present on the channel selected, but no subaudible tone is present on that signal, the BUSY LED will light up, alerting the operator to the fact that the channel is being used.

CHANNEL CHANGES

If new channels are to be installed, they may be installed by your Yaesu dealer, who can supply the proper crystals. The crystal frequency may be calculated by reference to the crystal chart on page 12 . If the crystal falls within the present 4 MHz range for the transceiver, the only alignment required will be to adjust the trimmer capacitor for each crystal, in order to set the frequency precisely.

If the new channel falls within the 22 MHz general range for the transceiver, but out of the 4 MHz operating range for the particular unit, then alignment of the receiver and transmitter tuned circuits may be required, in order to provide the proper performance. All channels must fall within a 4 MHz range.

If a totally new operating range is desired (e.g. from 134–154 MHz), some components must be changed. The transmitter and receiver strips may then be aligned, in order to secure the proper performance. Please refer to the chart below for details of the component changes required.

PARTS REQUIRING MODIFICATION

	FREQ. RANGE	C95	C98	C102	C105	C106	TC7
A.	134.00 MHz ~ 154.00 MHz	33PF	27PF	27PF	39PF	39PF	23PF
B.	142.00 MHz ~ 164.00 MHz	27PF	22PF	22PF	39PF	33PF	20PF
C.	152.00 MHz ~ 174.00 MHz	22PF	15PF	15PF	33PF	33PF	20PF

See CIRCUIT DIAGRAM.

CRYSTAL SPECIFICATIONS

	Receiver	Transmit
Type	HC-25/U	HC-25/U
Frequency (MHz)	$\frac{\text{RX Freq.} - 10.1}{9}$	$\frac{\text{TX Freq.}}{12}$
Tolerance	±10 PPM	±10 PPM
Parallel Capacitance	30 pF	30 pF
Drive level	5 mW	5 mW
Effective Resistance	Less than 20 ohms	Less than 20 ohms

In order to install new channels, the case must first be removed. Proceed as follows:

1. Remove the battery cover and battery pack. Locate screws A and B in the battery chamber. Refer to Fig. 1.
2. Remove screws A and B, and CAREFULLY remove the back of the transceiver. This will expose the next set of mounting screws, shown in Fig. 2.
3. Remove screws C and D, shown in Fig. 2, and CAREFULLY remove the front panel of the case. The crystal bank will now be easily identified, as shown in Fig. 3 and Fig. 4.

Locate the crystal sockets appropriate for the channel to be installed, and install the crystals, being careful to insert the TX crystal in the TX socket, and the RX crystal in the RX socket.

Zero the crystals on frequency, using the trimmer capacitors for each channel. Refer to Fig. 4 and the "Maintenance and Alignment" section for this step.

Check to make sure all channels are functioning properly, and carefully replace the case.

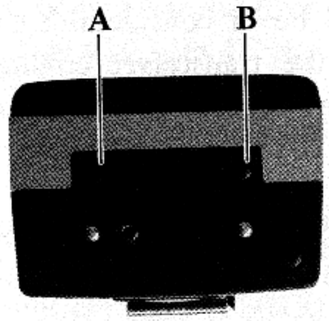


Fig. 1

Fig. 2

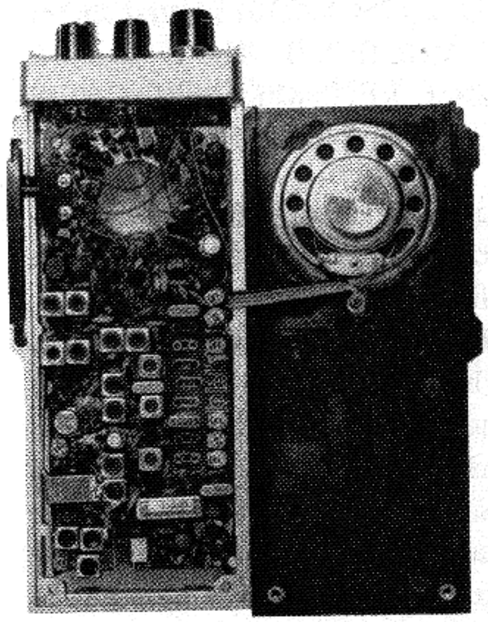
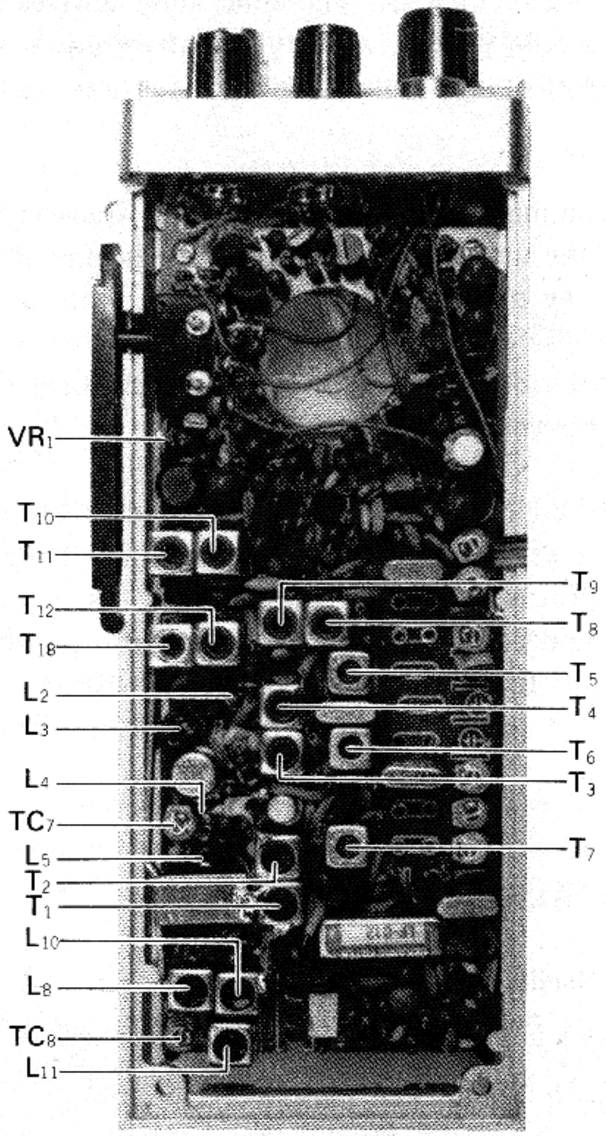


Fig. 3

Fig. 4



ALIGNMENT POINT

(2) Receive Channel Alignment

Connect a precision frequency counter to the emitter of Q_{10}, through a 10 pf capacitor. Adjust TC_1 for channel 1, TC_2 for channel 2, and TC_3 for channel 3, for the precise frequency desired for these channels. The correct frequency can be determined by

$$\text{Crystal Frequency} = \frac{\text{Operating Frequency} - 10.7\ \text{MHz}}{9}\ \text{MHz}.$$

(3) 10.7 MHz IF Transformer Alignment (I)

Connect a sweep generator with a center frequency of 10.7 MHz to the source of Q_2, and connect the diode detector of an oscilloscope to the emitter of Q_5. Adjust T_5 and T_6 until the pattern shown in Figure 5 is obtained.

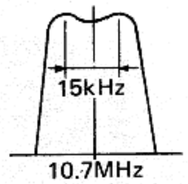


Fig. 5

(4) RF Amplifier Resonator

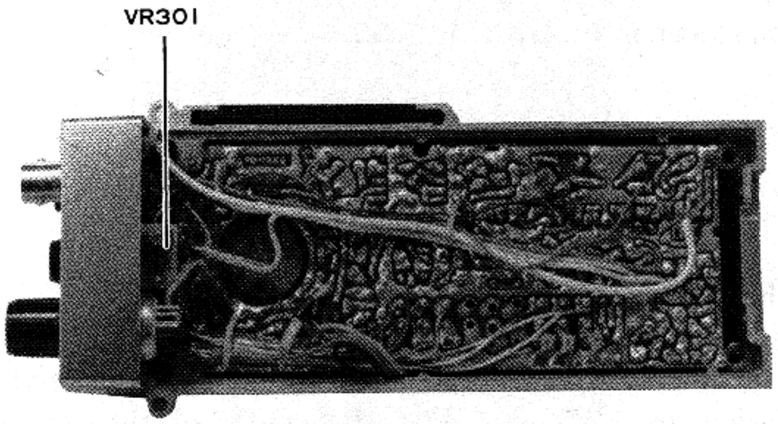
Connect a VHF signal generator to the antenna jack, and tune its output to a channel near the center of the transceiver operating range. Connect an audio millivoltmeter to the speaker output terminals. Use an attenuator in the line from the signal generator, if required.

Inject a 70 dB signal from the generator, and adjust the attenuator and voltmeter range, in order to note changes in the quieting level of the receiver. Peak T_1 through T_4 for maximum quieting on the input signal. Adjust the attenuator level, if necessary, to provide a usable signal level.

If you have no AC voltmeter, inject a 1 kHz 60% modulated RF signal from the signal generator. Adjust T_1 through T_4 for minimum background noise and best clarity of the input tone from the generator. Adjust the attenuation level as needed to provide meaningful observation of changes in transformer tuning.

(5) Tone Squelch (Option) Setting

Set the SQL control to the TONE position. Connect a precision VHF signal generator to the antenna jack, and tune its output to any channel. Inject a 0.25 μV signal, and adjust VR_{301} until the squelch just opens.



TRANSMITTER ALIGNMENT

Connect a dummy load to the antenna jack.

(1) Multiplier Stage Adjustment

a) Connect a DC voltmeter to the emitter of Q_{22}. While transmitting, adjust T_{10} and T_{11} for a maximum reading on the voltmeter. A nominal reading is 1 V DC.

b) Connect a DC voltmeter to the emitter of Q_{23}. Adjust T_{12} and T_{13} for a maximum reading on the voltmeter. A nominal reading is 1.5 V DC.

c) Connect the RF probe of a VTVM to the base of Q_{24}. Compress or spread open slightly the turns of L_2 and L_3 to secure a maximum indication on the VTVM.

(2) RF Output Peaking

Connect a dummy load/wattmeter to the antenna jack. Adjust TC_7 and TC_8 for a maximum reading on the wattmeter. With a full battery charge, power output should be approximately 3 watts.

(3) Deviation Adjustment

Connect a deviation meter to the antenna receptacle, and connect an audio signal generator to the microphone input terminal. Apply a 1 kHz 15 mV signal, and adjust VR_1 for a ±4.7 kHz deviation indication on the meter.

(4) TX Frequency Adjustment

Connect a precision frequency counter through a 10 pf capacitor to the emitter of Q_{19}. Adjust TC_4 for channel 1, TC_5 for channel 2, and TC_6 for channel 3, to provide a correct frequency indication on the counter. The crystal frequencies should be determined from

$$\text{Crystal Frequency} = \frac{\text{Operating Frequency}}{12} \text{ MHz.}$$

If a precision VHF frequency counter is available, the frequency may be read directly my coupling loosely to the antenna or dummy load.

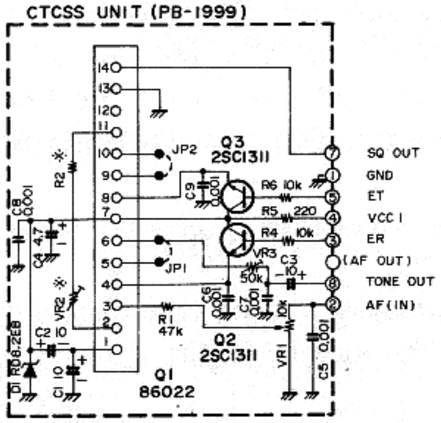
OPTIONAL TONE SQUELCH (CTCSS) INSTALLATION

The optional Tone Squelch unit can be supplied complete with IC and all components, or minus the IC and frequency determining parts.

To install the CTCSS board, first remove the rear panel of the transceiver, as detailed on page 12. Now remove the bottom cover, as shown in Fig. 1 and Fig. 2.

Install the tone squelch board as shown in Fig. 6 , and secure it with the two bolts supplied. Connect the wires in the harness to the main transceiver board at points A, B, C, D, E, F, and G as shown in Figs. 8 and 9 .

In order to change the tone squelch frequency, some parts must be changed. Please refer to the chart below for the correct component values. Tone squelch adjustment is detailed on page 20.



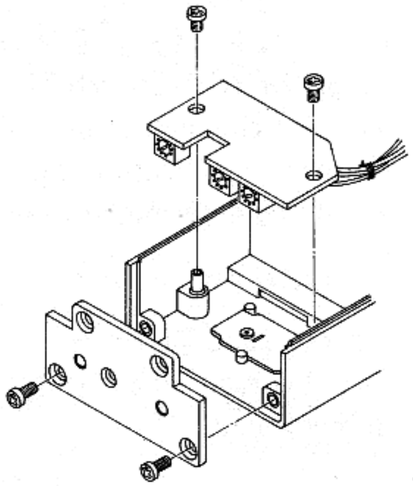


Fig. 6

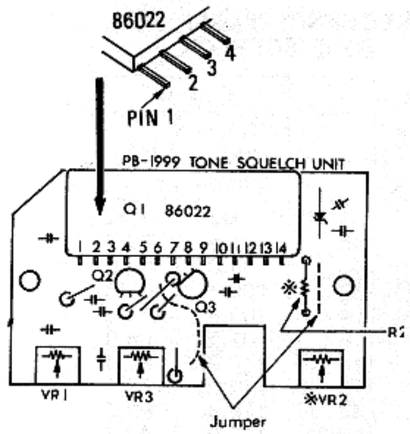
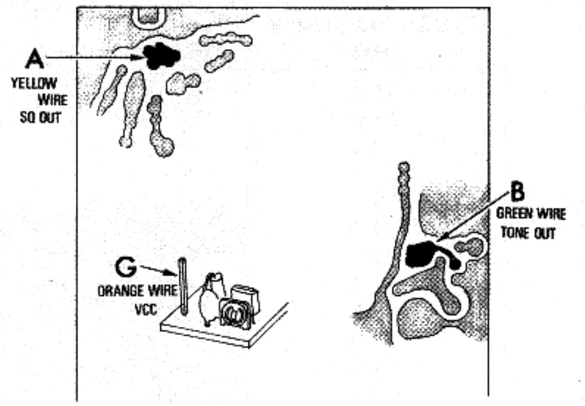
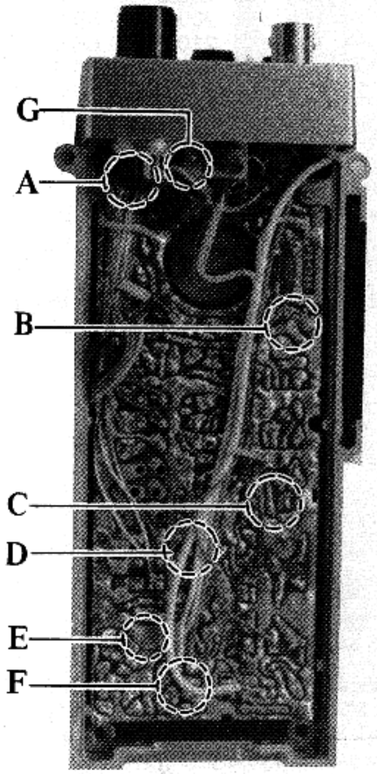


Fig. 7





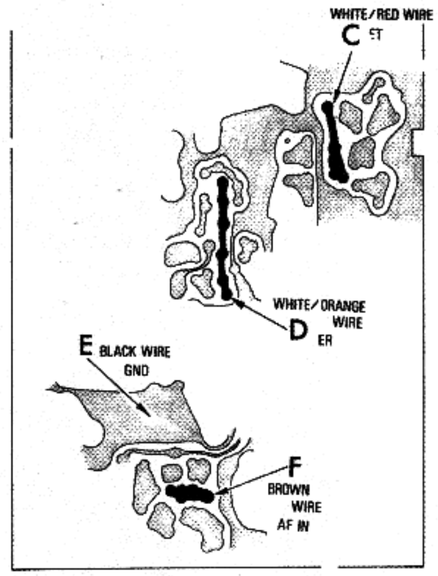


Fig. 8

TUNING RESISTORS

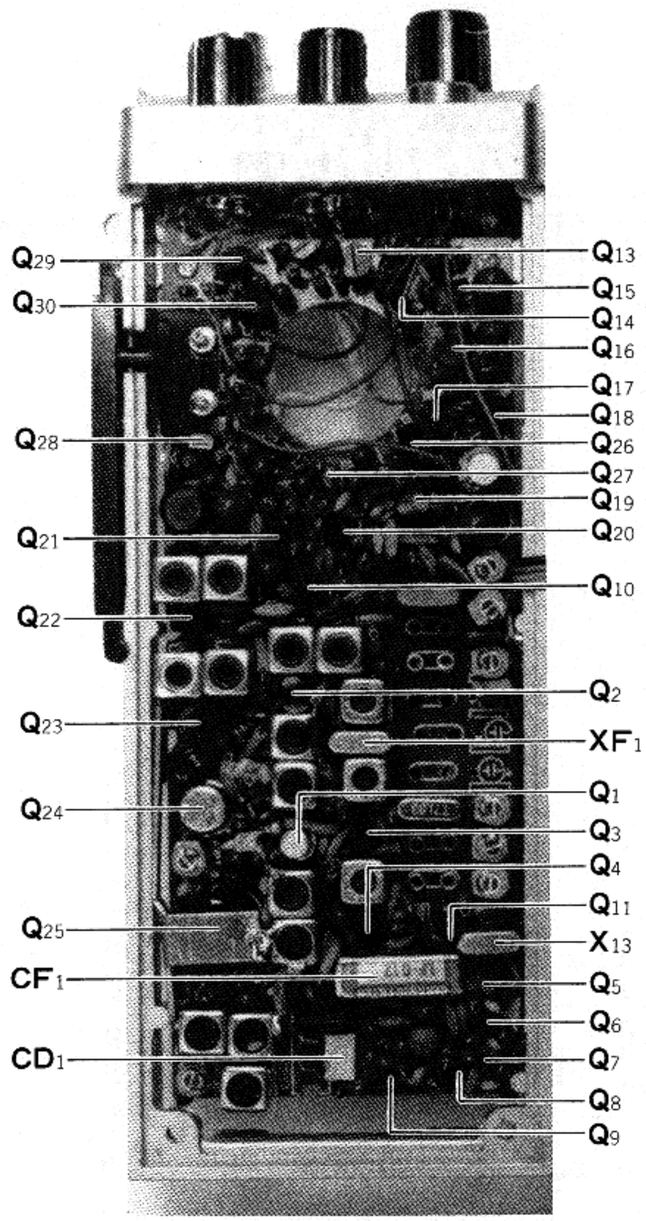
CTCSS Frequency (Hz)	Tuning R (kOhms)
67.0	180.441
71.9	156.684
74.4	146.331
77.0	136.616
79.7	127.517
81.0	123.456
82.5	119.008
85.4	111.062
88.5	103.418
90.0	100.000
91.5	96.748
94.8	90.129
100.0	81.000
103.5	75.614
107.2	70.484
110.9	65.860
114.8	61.461
118.8	57.392
123.0	53.539
127.3	199.934
131.8	186.515
136.5	173.892
141.3	162.278
146.2	151.582
151.4	141.349
156.7	131.949
162.2	123.152
167.9	114.932
169.0	113.441
173.8	107.261
179.9	100.111
186.2	93.451
188.0	91.670
192.8	87.162
203.5	78.237
209.0	74.174
210.7	72.982
218.1	68.113
225.7	63.603
233.6	59.374
241.8	55.415
250.3	51.715

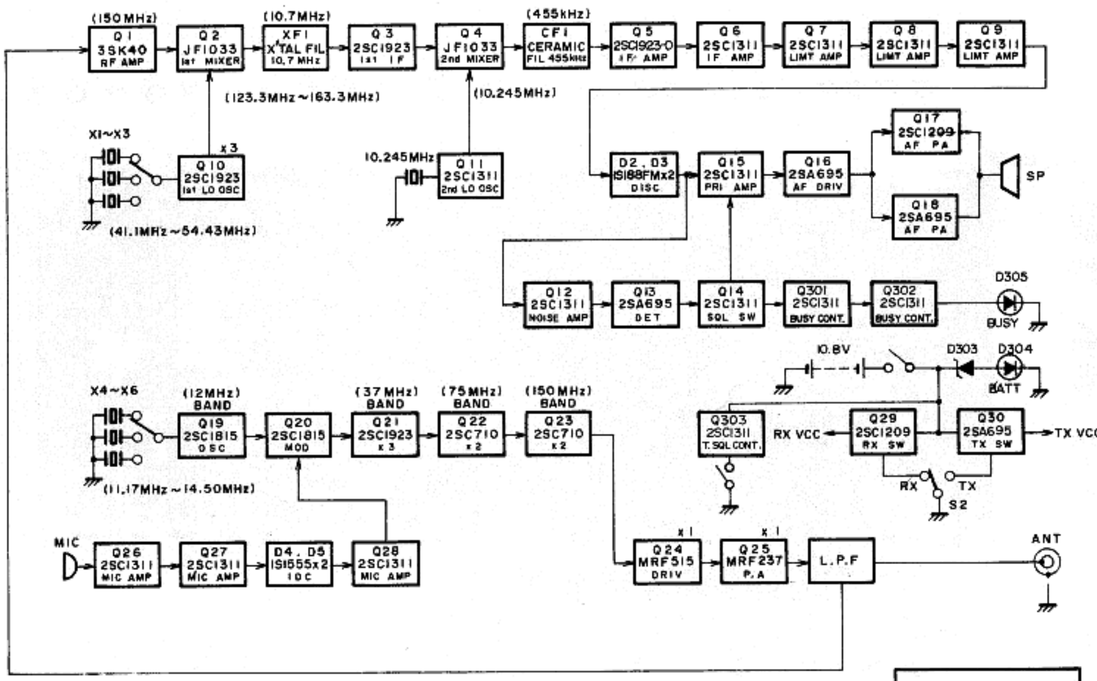
FREQUENCY TABLE FOR TONE SQUELCH

Table A		Table B	
Tone frequency	R_{1002}	Tone frequency	R_{1002}
(Hz)	(kΩ)	(Hz)	(kΩ)
67.0	165	91.5	88.7
71.9	143	94.8	84.5
74.4	133	100	75.0
77.0	124	103.5	71.5
79.7	118	107.2	64.9
81.0	113	110.9	60.4
82.5	110	114.8	56.2
85.4	102	118.8	52.3
88.5	95.3	123.0	49.9
90.0	93.1	186.2	86.6
127.3	182	188.0	84.5
131.8	169	192.8	80.6
136.5	158	203.5	71.5
141.3	150	209.0	68.1
146.2	137	210.7	66.5
151.4	130	218.1	63.4
156.7	121	225.7	59.0
162.2	113	233.6	54.6
167.9	105	241.8	51.1
169.0	105	250.3	47.5
173.8	97.6		
179.9	93.1		

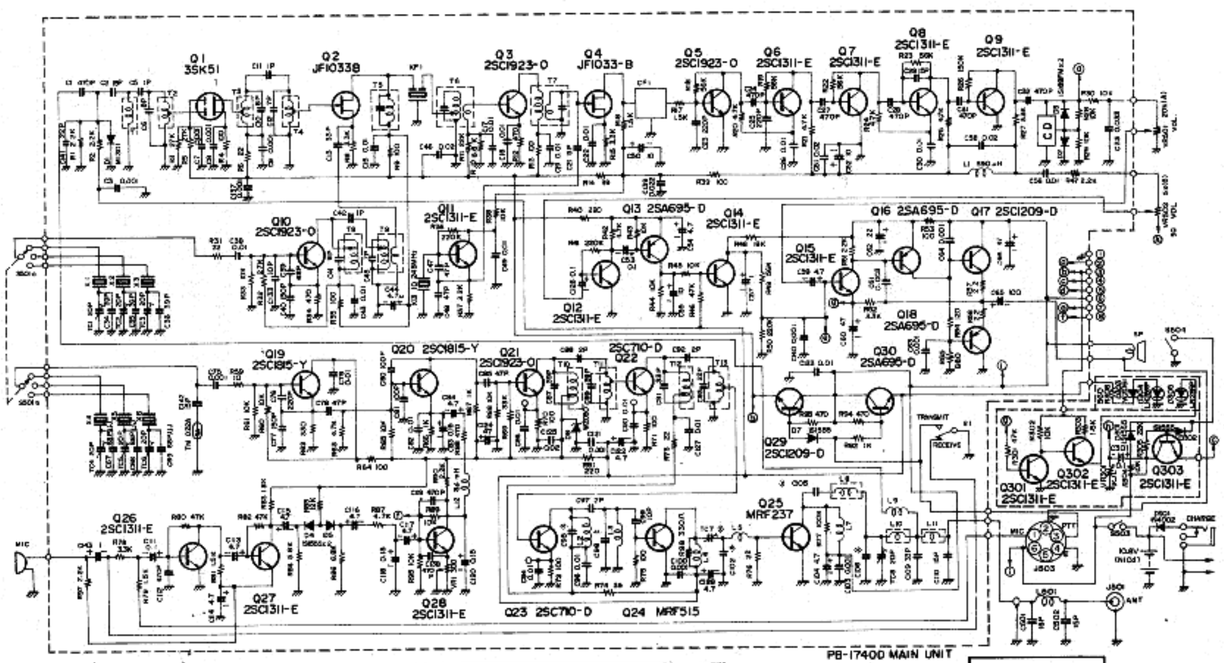
Note: 1. Please use 1% tolerance metallic film resistors.
2. VR_{1002} value: when using table A, 20 kΩ; table B, 10 kΩ

NOTE:
Tuning resistors are metal film, 50 ppm/°C and ±0.1% tolerance. Stable trim pots of comparable quality may also be used in series with ±1.0% tolerance resistors.





FTC-2003
BLOCK DIAGRAM



PB-17400 MAIN UNIT

FTC-2003
CIRCUIT DIAGRAM

	C95	C98	C102	C105	C106	TC7
A (34 ~ 154MHz	33P	27P	27P	39P	39P	33P
B (142 ~ 164MHz	27P	22P	22P	36P	33P	20P
C (152 ~ 174MHz	22P	15P	15P	33P	33P	20P

NOTES
1. ALL FIXED RESISTORS IN Ω. 1/4W UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN μF UNLESS OTHERWISE NOTED.

INSTRUCTION MANUAL

FTC-2003

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

YAESU MUSEN USA, INC.
P.O. BOX 498,
PARAMOUNT, CALIFORNIA 90723

YAESU

E3430079

THEORY OF OPERATION

Reference to the block diagram will be of considerable help in understanding the operation of the transceiver circuitry. Please refer to the schematic diagram for specific component details.

The FTC-2003 utilizes a transmitter strip, as well as a double conversion receiver strip. The FTC-2003 is designed for operation from an internal NiCd battery pack.

RECEIVER

The signal from the antenna is fed through a low-pass filter consisting of C_{501}, C_{502}, L_{501}, C_{110}, and L_{11}, as well as diode switch D_1, to the MOS FET RF amplifier, Q_1 **(3SK51)**. The amplified VHF signal is then heterodyned with the local oscillator signal supplied from Q_{10} **(2SC19230)** in first mixer Q_2 **(JF1033)**, producing a 10.7 MHz first IF. The IF signal is then passed through crystal filter XF_1, which has a 6 dB bandwidth of ±7.5 kHz, and fed to IF amplifier Q_3 **(2SC1923)**.

The filtered IF signal appears at the gate of second mixer Q_4 **(JF1033)**, where the 10.7 MHz signal is heterodyned with a 10.245 MHz local signal delivered from Q_{11} **(2SC1311)**, producing a 455 kHz second IF. The 455 kHz signal is passed through ceramic filter CF_1, which has a 6 dB bandwidth of ±5.5 kHz, and fed to second IF amplifiers Q_5 and Q_6 **(2SC1311)**. The ceramic filter minimizes degradation of receiver performance caused by spurious responses, and it sets the working bandwidth for following stages. The amplified IF signal is delivered to the three-stage limiter amplifier, Q_7–Q_9 **(2SC1311)**, in which any traces of amplitude modulation are removed. The IF signal is then delivered to the discriminator.

The discriminator, D_2/D_3 **(1S188FM)**, produces an audio output in response to a corresponding change in the frequency of the 455 kHz IF signal. The audio signal is then amplified by Q_{15} **(2SC1311)**, Q_{16} **(2SA695)**, Q_{17} **(2SC1209)**, and Q_{18} **(2SA695)**, providing 500 mW of audio to the speaker.

When no carrier is present in the 455 kHz IF, the high frequency noise at the discriminator output is amplified by noise amplifier Q_{12} **(2SC1311)** and detected by Q_{13} **(2SA695)**, producing a DC voltage. This voltage activates a switch, Q_{14} **(2SC1311)**, which grounds the base of Q_{15}, silencing the receiver. When a carrier is present in the 455 kHz IF, the noise is removed from the discriminator, and the audio amplifier stages return to normal operation.

TRANSMITTER

The transmitter section produces a frequency modulated signal. The audio signal from the microphone is amplified by Q_{26} and Q_{27} **(2SC1311)**, the passed to the instantaneous deviation control **(IDC)**, where both positive and negative peaks are clipped by D_4 and D_5 **(1S1555)**. The output from the IDC is fed to VR_1, which sets the input level for microphone amplifier Q_{28} **(2SC1311)**. The amplified signal is then passed to the modulator.

A 12 MHz fundamental signal is generated by Q_{19} **(2SC1815)**. The fundamental signal is fed to the base of Q_{20} **(2SC1815)**; the signal appearing at the emitter of Q_{20} is a vector phase modulated signal, because of the reactance variation produced in accordance with the speech input from Q_{28}.

The low-level signal is then multiplied by a total factor of 12 in the frequency multiplier stages, Q_{21} (2SC1923), Q_{22} **(2SC710)**, and Q_{23} **(2SC710)**. The VHF signal is then delivered to driver transistor Q_{24} **(MRF515)**, and amplified by power amplifier Q_{25} **(MRF237)**, the output of which is fed through a low-pass filter to the antenna. Power output is approximately three watts.

CONTROL CIRCUITRY

In the receive mode, the PTT switch connection causes Q_{29} **(2SC1209)** to conduct, providing Vcc to be applied to the receiver section. In the transmit mode, the conduction of Q_{30} **(2SA695)** causes Vcc to be applied to the transmitter circuit, while D_7 causes the base of Q_{29} to be grounded, thus disabling the receiver.

The microphone is grounded when the PTT switch is released. When the optional external speaker/microphone is used, the internal microphone is disabled.

When a signal is received by the main squelch system, a portion of the DC voltage appearing at Q_{14} is used to switch Q_{301} and Q_{302} **(2SC1311)** on, causing the BUSY LED to become illuminated.

In the transmit mode, the DC voltage from the battery is sampled by zener diode D_{303} **(WZ061)**. When the battery level is above 8 volts, D_{303} will conduct, causing the BATT indicator LED to become illuminated, providing an indication of satisfactory battery charge.

MAINTENANCE AND ALIGNMENT

The FTC-2003 has been carefully aligned and tested at the factory prior to shipment. The solid state devices used in the FTC-2003 should provide many years of trouble-free service, if the transceiver is not abused, and if routine maintenance is carried out.

Periodic cleaning of the interior of the transceiver may be required if the unit is used in a dusty environment. A vacuum cleaner may be used to remove loose dirt, while a small brush will help in dislodging caked-in dirt. The exterior may be wiped with a damp cloth as needed. Never use cleaning fluid on the exterior of the transceiver, though.

Should reduced power output or degraded receiver sensitivity indicate the need for alignment, we recommend that the transceiver be returned to your Yaesu dealer, as he has the test equipment and expertise required to perform proper servicing. Any attempt to align this transceiver without the proper knowledge or test equipment may result in degraded performance.

RECEIVER ALIGNMENT

(1) Local Oscillator

Connect the RF probe of a VTVM to the source of Q_2. Adjust the cores of T_8 and T_9 for maximum indication on the VTVM.

FTC-2003 PARTS LIST		
MAIN CHASSIS		
Symbol	Parts No.	Description
		DIODE
D501	G2090032	Silicon Diode 1N4002
		POTENTIOMETER
VR501	J60800028	V12M4-1(6x5)S15SB5kΩ 5kΩB
VR502	J60800032	V12M4-1(6x5)S15SA20kΩ20kΩA
		CAPACITOR
C501, 502	K00179032	Ceramic 50WV SL 15pF
		INDUCTOR
L501	L0020334	#220334
		SPEAKER
SP	M4090026	VS-50-P 8Ω, 0.5W D=50mm
		SWITCH
S501	N0190027	MR-3~3
		MICROPHONE
MIC	M3290001	EM-76
		CONNECTOR
J501	P1090050	UG-625B/U
J502	P1090051	SG8512
J503	P1090052	SR30-10R-6S

MAIN UNIT			
Symbol No.	Parts No.	Description	
PB-1988	F0001988	Printed Circuit Board	
		IC, FET & TRANSISTOR	
Q2, 4	G3090020	FET	JF1033-B
Q1	G4800510C	"	3SK51-03
Q13, 16, 18, 30	G3106950D	Tr	2SA695D
Q22, 23	G3307100D	"	2SC710D
Q17, 29	G3312090D	"	2SC1209D
Q6~9, 11, 12, 14, 15, 26~28	G3313110E	"	2SC1311-E
Q19, 20	G3318150Y	"	2SC1815-Y
Q3, 5, 10, 21	G3319230O	"	2SC1923-O
Q25	G3090001	"	MRF-237
Q24	G3090013	"	MRF-515
		DIODE	
D2, 3	G2001880F	Germanium	1S188FM
D4, 5, 7	G2015550	Silicon Diode	1S1555
D1	G2090033	"	MI30I
D6	G2090025	Zener Diode	WZ050
		Thermistor	
Th1	G9090002		D-22A
		CRYSTAL	
X1, 2, 3	H0102220	HC-25/U	#210222
X4, 5, 6	H0102230	"	#210223
X13	H0100720	HC-18/U	10,245MHz
		MONOLITHIC FILTER	
XF1	H1101970	FMT-15A	

		CERAMIC FILTER		
CF1	H3900070	LF-C12		
		CERAMIC DISCR		
CD1	H7900010	455D		
		RESISTOR		
R98	J10216331	Carbon Composition		
			1/8W GK	330Ω
R57, 58	J10246229	"	¼W GK	2.2Ω
R59	J10246100	"	"	10Ω
R6, 31, 73, 76	J10246220	"	"	22Ω
R14, 74	J10246390	"	"	39Ω
R4, 9, 13, 35, 39, 53, 64, 70~72, 75	J10246101	"	"	100Ω
R54	J10246121	"	"	120Ω
R40, 91	J10246221	"	"	220Ω
R62	J10246331	"	"	330Ω
R12, 34, 88, 93, 94	J10246471	"	"	470Ω
R55	J10246681	"	"	680Ω
R2, 66, 67, 92	J10246102	"	"	1kΩ
R16, 17, 79, 81	J10246152	"	"	1.5kΩ
R83	J10246182	"	"	1.8kΩ
R1, 37, 47, 51, 90, 97	J10246222	"	"	2.2kΩ
R8, 15, 27, 52, 78	J10246332	"	"	3.3kΩ
R20, 21, 24, 25, 42, 63, 87	J10246472	"	"	4.7kΩ
R84	J10246562	"	"	5.6kΩ
R10, 86	J10246682	"	"	6.8kΩ
R28~30, 33, 38, 43~45, 60, 61, 65, 68, 89, 95	J10246103	"	"	10kΩ
R85	J10246123	"	"	12kΩ

R48	J10246183	Carbon Composition		
			¼W GK	18kΩ
R11	J10246223	"	"	22kΩ
R3, 5, 32	J10246273	"	"	27kΩ
R69	J10246333	"	"	33kΩ
R46, 80, 82	J10246473	"	"	47kΩ
R18, 19, 22, 23, 49	J10246563	"	"	56kΩ
R77	J10246104	"	"	100kΩ
R26	J10246154	"	"	150kΩ
R36, 41, 50	J10246224	"	"	220kΩ
		CAPACITOR		
C5, 11, 42	K00179024	Ceramic	50WV SL	1PF
C92, 97	K00179025	"	" "	2PF
C88	K00179039	"	" "	2PF
C21	K00179027	"	" "	5PF
C12	K00179028	"	" "	7PF
C6, 10	K00179029	"	" "	8PF
C99	K00179031	"	" "	10PF
C2, 29, 110	K00179032	"	" "	15PF
C141	K00179033	"	" "	22PF
C13, 109	K00179034	"	" "	33PF
C78, 85	K00179038	"	" "	47PF
C80, 81	K00179036	"	" "	100PF
C23, 25	K00179037	"	" "	220PF
C45	K02179038	"	" CH	7PF
C41	K02179039	"	" "	8PF
C142	K02179040	"	" "	15PF
C93	K02179034	"	" "	22PF
C91	K02179035	"	" "	33PF
C87, 89	K02179041	"	" "	39PF
C47, 48	K02179036	"	" "	47PF
C34~36	K02179042	"	" "	56PF
C39	K02179037	"	" "	68PF
C40, 77	K04179001	"	" PG	150PF
C133	K03179001	"	" TH	10PF
C67~69	K06179024	"	" UJ	68PF
C76	K06179022	"	" "	220PF

C1, 27, 28, 31, 32, 112, 119, 138	K10179003	Ceramic	50WV	B	470PF
C24	K10179005	"	"	"	470PF
C3, 8, 9, 63, 64, 75, 100, 103, 121, 137, 140	K10179001	"	"	"	0.001μF
C7	K10179004	"	"	"	0.001μF
C17, 30, 38, 43, 56, 79, 82, 86, 90, 94, 96, 123, 127	K13179001	"	"	F	0.01μF
C15, 18, 19, 22, 26, 49	K13179004	"	"	"	0.01μF
C46, 58, 139	K13179002	"	"	"	0.022μF
C51, 125	K13179005	"	"	"	0.022μF
C95 *1	K02179030	Ceramic	50WV	CH	33PF
*2	K02179029	"	"	"	27PF
*3	K02179043	"	"	"	22PF
C98 *1	K02179044	"	"	"	27PF
*2	K02179034	"	"	"	22PF
*3	K02179040	"	"	"	15PF
C102 *1	K00179040	"	"	SL	27PF
*2	K00179033	"	"	"	22PF
*3	K00179032	"	"	"	15PF
C105 *1	K00179041	"	"	"	39PF
*2	K00179041	"	"	"	39PF
*3	K00179034	"	"	"	33PF
C106 *1	K00179041	"	"	"	39PF
*2	K00179034	"	"	"	33PF
*3	K00179034	"	"	"	33PF
C144 *1	K00179026	"	"	"	3PF
*2		Not used			
*3		"	"		
		*1 134 ~ 154 MHz *2 142 ~ 164 MHz *3 152 ~ 174 MHz			

C61	K50177332	Mylar Film	50WV	0.0033μF
C33	K50177333	"	"	0.033μF
C65	K70107107	Tantalum	10WV	100μF
C44, 54, 59, 84, 104, 113~117, 122, 128	K70127475	"	16WV	4.7μF
C50, 52, 55	K70127106	"	"	10μF
C62	K70127226	"	"	22μF
C60, 66, 124	K70127476	"	"	47μF
C57, 143	K70147105	"	25WV	1.0μF
C53, 111, 126	K70167104	"	35WV	0.1μF
C83, 118, 120	K70167154	"	"	0.15μF
		TRIMMER CAPACITOR		
TC1~8	K91000029	ECV-1ZW 20x53N		20PF
		INDUCTOR		
L1	L1190028	FL-5H391K		390μH
L2, 3	L0020336			#220336
L4	L0020423			#220423
L5	L0020337			#220337
L6	L0020426	(R76)		#220426
L7	L0020339	(R77)		#220339
L8	L0020340			#220340
L9	L0020341			#220341
L10, 11	L0020342			#220342
L12		8RB		36mH
		Shield Case		
		TRANSFORMER		
T1~4	L0020429			#220429
T5~7	L0190001	85PC-2874A		
T8	L0020344			#220344
T9	L0020345			#220345
T10	L0020346			#220346

T11	L0020347	#220347
T12	L0020343	#220343
T13	L0020348	#220348
		SWITCH
S1	N7090003	Micro Switch AH2504
	B4047910A	Heat Sink
	B4052990	X-tal Socket

BUSY, LED UNIT

Symbol No.	Parts No.	Description
PB-1992	F0001992	Printed Circuit Board
PB-1993	F0001993	"
		TRANSISTOR
Q301~303	G3313110E	Silicon Transistor 2SC1311E
		DIODE
D301, 302	G2015550	Silicon Diode 1S1555
D303	G2090007	Zener Diode WZ061
D304, 305	G2090080	LED LN28RP
		RESISTOR
R306	J10246561	Carbon Composition ¼W GK 560Ω
R303	J10246152	" " 1.5kΩ
R302, 304	J10246103	" " 10kΩ
R305	J10246223	" " 22kΩ
R301	J10246473	" " 47kΩ
		POTENTIOMETER
VR301	J51713102	EVN-A0A-A00B13 1kΩB

		CAPACITOR
C301	K70167104	Tantalum 35WV 0.1μF

ACCESSORIES

Symbol No.	Parts No.	Description
ANT		Antenna
		Battery pack
		Shoulder strap

TONE SQUELCH UNIT (OPTION)

Symbol No.	Parts No.	Description
PB-1999	F0001990	Printed Circuit Board
		IC & Transistor
Q501	G1090178	IC 86022
Q502, 503	G3313110E	Tr 2SC1311E
		DIODE
D501	G2090042	Zener RD-8.2EB
		RESISTOR
R505	J10246221	Carbon Composition ¼W GK 220Ω
R504, 506	J10246103	" " 10kΩ
R501	J10246473	" " 47kΩ
R502		
*1 (67.0Hz)	J20249035	¼W 165kΩ ±1%
*2 (71.9Hz)	J20249032	" 143kΩ "
*3 (74.4Hz)	J20249030	" 133kΩ "
*4 (77.0Hz)	J20249028	" 124kΩ "
*5 (79.7Hz)	J20249026	" 118kΩ "
*6 (81.0Hz)	J20249025	" 113kΩ "
*7 (82.5Hz)	J20249024	" 110kΩ "
*8 (85.4Hz)	J20249022	" 102kΩ "
*9 (88.5Hz)	J20249020	" 95.3kΩ "
*10 (90.0Hz)	J20249019	" 93.1kΩ "
*11 (91.5Hz)	J20249018	" 88.7kΩ "

*12 (94.8Hz)	J20249016	¼W 84.5kΩ ±1%
*13 (100.0Hz)	J20249014	" 75.0kΩ "
*14 (103.5Hz)	J20249013	" 71.5kΩ "
*15 (107.2Hz)	J20249010	" 64.9kΩ "
*16 (110.9Hz)	J20249008	" 60.4kΩ "
*17 (114.8Hz)	J20249006	" 56.2kΩ "
*18 (118.8Hz)	J20249004	" 52.3kΩ "
*19 (123.0Hz)	J20249002	" 49.9kΩ "
*20 (127.3Hz)	J20249037	" 182kΩ "
*21 (131.8Hz)	J20249036	" 169kΩ "
*22 (136.5Hz)	J20249034	" 158kΩ "
*23 (141.3Hz)	J20249033	" 150kΩ "
*24 (146.2Hz)	J20249031	" 137kΩ "
*25 (151.4Hz)	J20249029	" 130kΩ "
*26 (156.7Hz)	J20249027	" 121kΩ "
*27 (162.2Hz)	J20249025	" 113kΩ "
*28 (167.9Hz)	J20249023	" 105kΩ "
*29 (169.0Hz)	J20249023	" " "
*30 (173.8Hz)	J20249021	" 97.6kΩ "
*31 (179.9Hz)	J20249019	" 93.1kΩ "
*40 (186.2Hz)	J20249017	" 86.6kΩ "
*41 (188.0Hz)	J20249016	" 84.5kΩ "
*42 (192.8Hz)	J20249015	" 80.6kΩ "
*43 (203.5Hz)	J20249013	" 71.5kΩ "
*44 (209.0Hz)	J20249012	" 68.1kΩ "
*45 (210.7Hz)	J20249011	" 66.5kΩ "
*46 (218.1Hz)	J20249009	" 63.4kΩ "
*47 (225.7Hz)	J20249007	" 59.0kΩ "
*48 (233.6Hz)	J20249005	" 54.6kΩ "
*49 (241.8Hz)	J20249003	" 51.1kΩ "
*50 (250.3Hz)	J20249001	" 47.5kΩ "
		POTENTIOMETER
VR501	J50724103	PN822H 103V 10kΩB
VR503	J50724503	PN822H 503V 50kΩB
V502 *A (67.0Hz ~ 90.0Hz)	J50724203	PN822H 203V 20kΩB
*B (91.5Hz ~ 123.0Hz)	J50724103	PN822H 103V 10kΩB

*C (127.3Hz ~ 179.9Hz)	J50724203	PN822H 203V 20kΩB
		CAPACITOR
C505 ~ 509	K10179001	Ceramic disk 50WV 0.001μF B
C504	K70127475	Tantalum 16WV 4.7μF
C501 ~ 503	K70127106	" " 10μF
		MINIATURE SOCKET
	P1090093	2-331272-5
	R7053250	Cushion