

INSTRUCTION MANUAL

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YAESU MUSEN CO., LTD.

TOKYO JAPAN

FT-501 SSB DIGITAL TRANSCEIVER

The model FT-501 is a precision built, high performance SSB transceiver of advanced design providing SSB (USB and LSB selectable) and CW modes of operation. A digital frequency counter is incorporated for accurate frequency readout.

The transceiver operates at an input of 500 Watts PEP for SSB and 380 Watts DC for CW on 80 through 15 meters with slightly reduced input on 10 meters.

Solid-state devices are used extensively and two separate, specially designed 9 MHz crystal filters are used for upper and lower sideband generation, avoiding carrier frequency shift when changing sidebands.

VOX, break-in CW with sidetone, 100 KHz calibrator, noise blanker, clarifier and 15 MHz WWV/JJY are built-in as standard features. Provision is made for the installation of an optional 600 Hz CW filter. The CW filter is automatically selected when the mode switch is in CW position.

The FP-501 matching AC Power Supply with built-in speaker is available as an optional accessory.

SPECIFICATIONS

GENERAL

Frequency Range	:	3.5-4.0/7.0-7.5/14.0-14.5/21.0-21.5/28.0-28.5*/28.5-29.0/29.0-29.5*/29.5-30.0* MHz (* optional frequencies)
Modes	:	A ₁ , A _{3j} (USB or LSB)
Input Power	:	500 Watts PEP (SSB) 400 Watts 50% duty cycle (CW) (slightly lower on 10 meters)

Carrier Suppression	:	40 dB minimum
Sideband Suppression	:	50 dB at 1000 Hz minimum
Spurious Radiation	:	-40 dB minimum
Frequency Response	:	300 Hz - 2700 Hz $\pm$ 3 dB
Distortion Products	:	-30 dB minimum
Antenna Impedance	:	50 - 75 Ohm unbalanced
Frequency Stability	:	Less than 100 Hz in any 30 minute period after warmup
Sensitivity	:	0.3 μ V for 10 dB S/N
Selectivity	:	2.4 KHz at -6 dB (SSB,CW) 3.8 KHz at -60 dB 600 Hz at -6 dB (CW)* 1.2 KHz at -60 dB (* optional CW filter)
Image Rejection	:	50 dB minimum
IF Rejection	:	50 dB minimum
Audio Output	:	3 Watts @ 4 Ohm (10% distortion)
Power Requirements	:	Receive 140 VA Transmit 650 VA maximum
Power Source	:	FP-501 AC supply
Dimensions	:	350(W) x 292(D) x 160(H) m/m
Weight	:	10 Kg. approx.

TUBES & SEMICONDUCTORS

Tube	2 x 6KD6	1 x 6BZ6
	1 x 6GK6	1 x 6U8
	1 x 6EJ7	1 x 6CB6

Transistor	7 x 2SC711D	2 x 2SC710D
	5 x 2SC372Y	1 x 2SC697
	3 x 2SC373	1 x 2SA628A
	3 x 2SC735	
F. E. T.	3 x 2SK34E	1 x 2SK19GR
	2 x MK10D	
I. C.	3 x CA3053	1 x HA1306
	1 x TA7042M	
Diode	18 x 1S1007	1 x 1S334
	8 x 1S1555	1 x 1S188FM
	7 x 1S1941	1 x BZ110
	1 x 1S1943	1 x WZ060
	1 x 1S145 (1S236)	

COUNTER SECTION

Nixie Tube	6 x DG12M	
Transistor	5 x 2SC373	2 x 2SC735Y
	2 x 2SA628A	1 x 2SK19
I. C.	10 x SN7490N	2 x SN7486N
	6 x μ PB249D	1 x SN7472N
	4 x SN7475N	1 x SN7404N
	2 x SN7400N	1 x SN7403N
Diode	44 x 1S188FM	

INSTALLATION

Carefully remove the FT-501 Transceiver and FP-501 Power Supply from their cartons and examine them for any physical damage. Save both the boxes and packing material for future use.

It is recommended that excessively warm locations be avoided. The transceiver should be placed in a location that has adequate space to permit free air circulation through the cabinet openings.

A good ground should be connected to the terminal marked GND on the rear panel of the transceiver. It is not recommended that gas or electrical conduit pipes be utilized for a ground. The ground lead should be as heavy and short as possible.

The FT-501 is designed to match a 50 to 75 ohm load. Most commercial antennas and feed lines are designed for the range of 50 to 75 ohm. If the impedance deviates from this value, an antenna matching device should be utilized between the transceiver output and the antenna transmission line.

CAUTION =====

NEVER TRANSMIT WITHOUT HAVING PROPER ANTENNA OR DUMMY LOAD CONNECTED TO THE TRANSCEIVER ANTENNA CONNECTOR.

Connect the FT-501 to the FP-501 power supply with the power cable supplied with the transceiver.

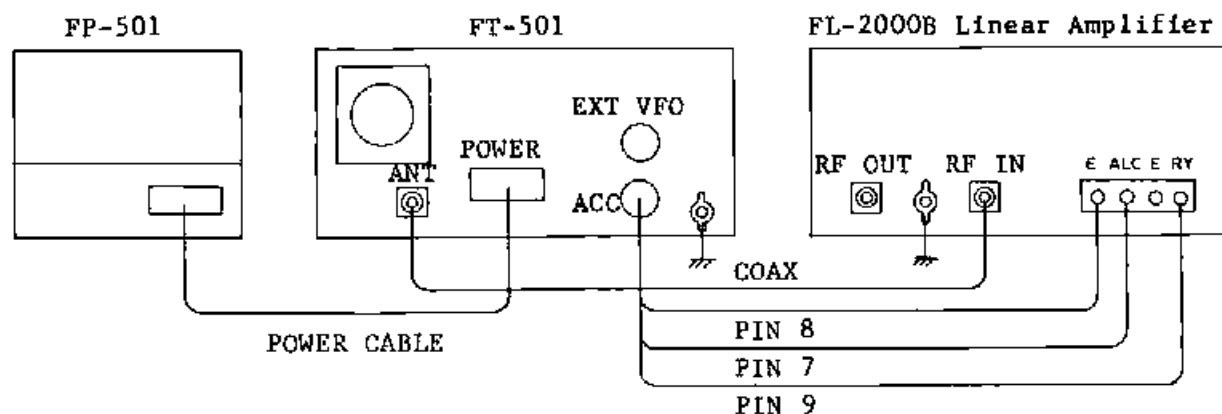
NOTE : The accessory plug must be installed in the appropriate socket for proper operation of the transceiver.

Before connecting the power supply to an AC power source, carefully examine for any visible damage. Check that all tubes and crystals are properly seated in their sockets and check the tuning controls and switches for complete freedom of rotation. Make sure that the AC supply voltage is the same as the voltage marked on the rear apron of the power supply chassis before connecting to the AC output. If not, rewire the transformer wiring as described in the Power Supply Section of this manual.

CAUTION =====

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

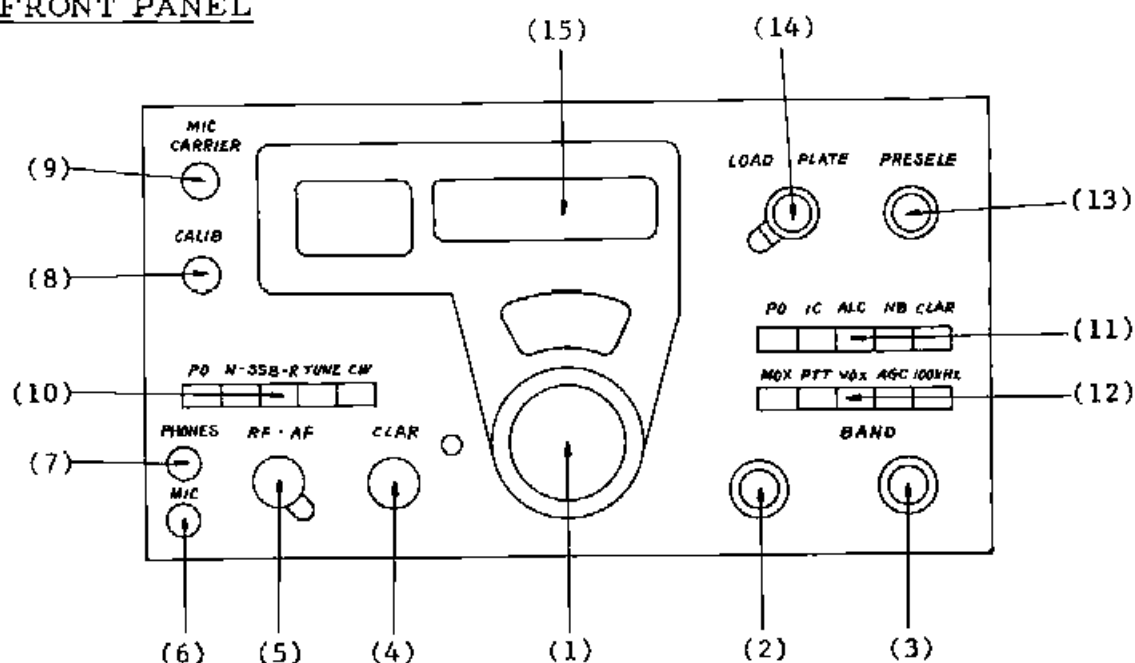
INTER-CONNECTION



CONTROLS & SWITCHES

The FT-501 transceiver has been designed for ease of operation. All adjustment controls have been preset at the factory. Improper setting of adjustment of some controls may result in a poor quality signal. The various front panel controls and their functions are described in the following section. Be certain that you understand thoroughly the function of each control before operating the transceiver.

FRONT PANEL



- (1) MAIN TUNING DIAL The VFO tuning knob is located directly below the digital counter. It is used in combination with the BAND switch to determine the actual frequency of operation. The VFO drive mechanism consists of a precise, spring loaded, split gear system in combination with a planetary drive unit that provides zero backlash at low tuning rates. Each revolution of the tuning knob results in a frequency change of 16 KHz as indicated on the scale in the dial window.
- (2)(3) BAND The bands are marked in MHz. Green colors indicate that the green color scale is to be used on VFO dial scale. The 28 MHz range is selected by knob (3) when knob (2) is at its full clockwise position.
- (4) CLARIFIER This control is for receiver off-set tuning. It provides ± 5 KHz variation of receiver tuning when the CLARIFIER switch (12) is depressed. With the CLARIFIER switch in the OFF position, the receiving and transmitting frequencies are coincidental.
- (5) RF GAIN/AF GAIN The RF GAIN controls the sensitivity of the receiver, and AF GAIN controls the audio output to the speaker.
- (6) MIC The microphone jack is designed to accept a standard 1/4", 3 contact, T. R. S. type plug. The tip is for relay control, the ring for microphone audio, and the sleeve for the ground connection. A high impedance microphone be used.
- (7) PHONE The headphone jack is designed to accept low impedance, 4 ohm headphones.
- (8) CALIB This control calibrates the frequency read-out against the 100 KHz marker signal. With the transceiver in the receive mode and the 100 KHz calibrator is turned on with switch (11), the main tuning knob may be adjusted for a zero beat. The CALIB control should then set to obtain an exact 100 KHz digital readout.

(9) CARRIER The CARRIER control adjusts the level of carrier for CW and MIC GAIN for SSB operation. (This control of the early FT-501 adjusts only the level of carrier for CW.)

(10) MODE SWITCH

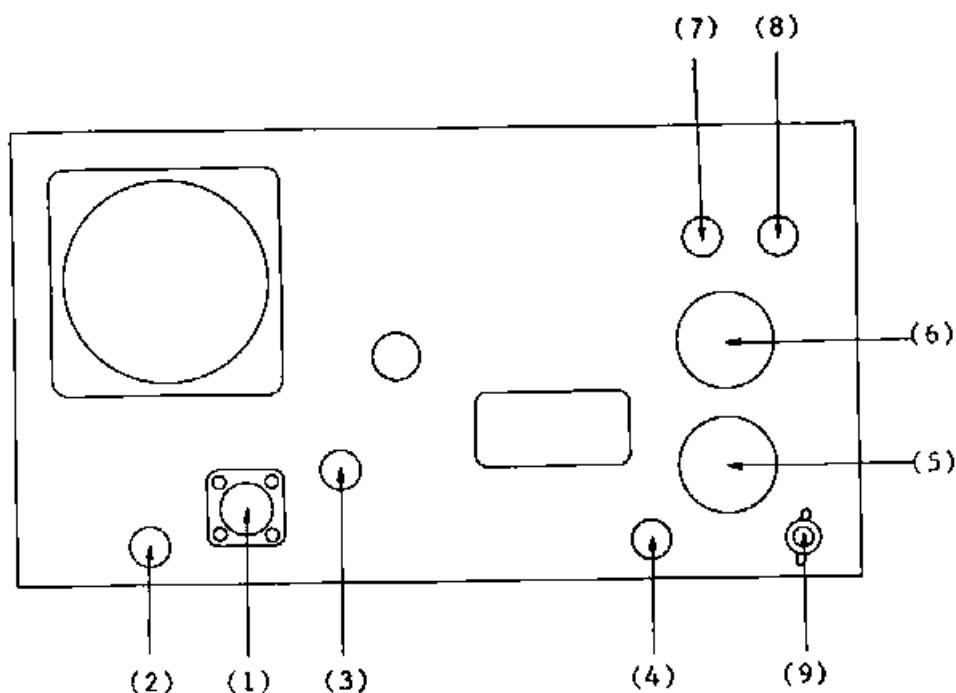
- POWER AC power is connected to the power supply when this switch is depressed and turns off in the open position.
- N-SSB-R This position selects the sideband mode. In the normal (N) position, LSB mode is used on 3.5 and 7 MHz, and USB on 14, 21 and 28 MHz. In the reverse (R) position, USB is used on 3.5 and 7 MHz, and LSB on 14, 21 and 28 MHz.
- TUNE Places the TX in the tune-up mode.
- CW Selects the CW mode.

(11)(12) FUNCTION SWITCH

- PO/IC/ALC Selects the appropriate meter function for transmitter metering.
- NB The noise blanker is placed into the circuit when this switch is depressed.
- CLAR This switch activates the clarifier.
- MOX When depressed, this activates the transmitter.
- PTT This activates the microphone Push-to-Talk switch.
- VOX This activates the VOX.
- AGC This selects the AGC decay time-constant. When depressed, a longer time-constant is selected.
- 100 KHz This activates the calibrator which provides a marker signal every 100 KHz.

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|------------------|--|
| (13) PRESELECTOR | This controls the RF tuning of the receiver and the drive tuning of the transmitter. |
| (14) LOAD/PLATE | This adjusts the PA plate tuning and loading. |
| (15) DIAL | Digital frequency counter readout. |

REAR PANEL



- | | |
|-----------------|--|
| (1) ANT | Coaxial connector for antenna connection. |
| (2) RF OUT | Low-level output from the driver stage may be obtained through this jack for the use of optional equipment, such as our FTV-650 transverter. |
| (3) RECEIVE ANT | An optional receiver may be used through this jack. |
| (4) KEY | This jack provides for the connection of a key for CW operation. |

(5) ACC

Accessory socket:

Pin 1 : 6KD6 Heater Pin 2 : 12.6 VAC
Pin 3 : +150 VDC Pin 4 : +300 VDC
Pin 5 : +800 VDC Pin 6 : -100 VDC
Pin 7 : ALC Pin 8 : E
Pin 9 : Connects to Pin 10 on TX.
Pin 10 : Relay Common
Pin 11 : Connects to Pin 10 on RX.

(6) EXT VFO

Socket for external VFO connection.

(7) EXT SP

Jack for connection of 4 ohm external speaker.

(8) PATCH

Input jack for phone patch connection.
Impedance : 5 K ohms.

(9) GND

Ground connection.

INTERNAL CONTROLS

DELAY

Adjusts "hold on" or delay time of the VOX relay.

ATRIP

Adjusts VOX antitrip level.

VOX

Adjusts VOX sensitivity.

RELAY

Adjusts operating level of VOX relay.

BIAS

Adjusts bias on PA tubes.

MIC

Adjusts Mic Gain. (This control is provided only to the early FT-501.)

OPERATION

Before operating the transceiver, be sure that all cable connections are correct and that an antenna of correct frequency and impedance within the range of pi-network (50 - 75 ohm) is connected to the transceiver. The AC power plug should not be connected until all preliminary checks are made. The "Aux" plug provided, should be in the accessory socket.

Set the controls as follows:

POWER ----- Off.
SSB ----- N (normal position) depressed.
RF GAIN ----- Fully clockwise.
AF GAIN ----- Desired listening level.
CLAR ----- 12 o'clock position.
BAND ----- Desired band.
MOX/VOX/100 KHz-- Open position.
PTT/AGC ----- Depressed position.
PO/ALC/NB/CLAR-- Open position.
IC ----- Depressed position.
PRESELECTOR ----- 12 o'clock position.
CARRIER----- Fully counter-clockwise position.
CALIB ----- 12 o'clock position.

Turn on the power to the transceiver by depressing the POWER switch. The panel lamps should light and the counter should read the operating frequency. Adjust the AF GAIN until receiver noise is heard in the speaker. Peak the PRESELECTOR for maximum S-meter reading and tune slowly for a desired signal.

INITIAL ADJUSTMENT

Dial Calibration;

SSB --- Depress the CALIB switch. Rotate the main tuning knob to the nearest 100 KHz point, where an audio note will be heard. Very slowly rotate the tuning knob in the direction that causes the audio note to decrease in frequency until a zero beat is obtained. Read the frequency readout in the counter window. Adjust the CALIB knob until the counter shows the exact multiple of the 100 KHz readout. The transceiver is now properly calibrated. Note that the CLARIFIER

switch should be in the open position. The counter reads the received frequency so that if the CLARIFIER is ON, then the actual transmitted frequency will differ from that indicated on the counter.

CW --- An 8999.3 KHz crystal is used for TUNE and CW transmission and a 9000 KHz crystal is used for reception of CW signal to produce 700 Hz beat tone. Therefore, the counter reads a received frequency of 700 Hz different than the actual transmitted frequency. The actual transmitting frequency is 700 Hz lower on 14, 21 and 28 MHz bands and 700 Hz higher on 3.5 and 7 MHz bands as compared with the frequency readout indicated by the counter.

Transmitter Tuning;

The transmitter should be tuned into a 50 ohm dummy load but it may be tuned directly into an antenna provided that the frequency is clear and no interference will result to other stations. Take care to ensure that the transmitter frequency is set within the frequency limit of the band in use.

CAUTION =====

DO NOT OPERATE THE TRANSMITTER WITHOUT A LOAD
CONNECTED TO ANTENNA CONNECTOR.

Set the controls as follows:

TUNE ----- Depressed position.
CARRIER ----- Fully counter-clockwise.
PLATE ----- Desired band marked on panel.
LOADING ----- 9 o'clock position.
METER----- IC position.

PRETUNING

1. Adjust the PRESELECTOR for maximum noise output from receiver speaker.
2. Depress the MOX switch.

3. Advance the CARRIER control clockwise until the meter indication rises just above normal idle current (50 mA).
4. Peak the PRESELECTOR control for a maximum meter reading. If the meter reading exceeds 0.2 Amp. (200 mA), reduce the CARRIER control.
5. Rotate the PLATE control for a minimum meter reading (dip the plate).
6. Return the MOX switch to the open position by repressing the PTT switch.

The transmitter is now pretuned for the desired frequency. Final tuning is accomplished by carefully observing the following tuning procedure.

FINAL TUNING

C A U T I O N =====

EXCEEDING THE TIME LIMITS NOTED DURING FINAL TUNING MAY RESULT IN DESTRUCTION OF THE FINAL OUTPUT TUBES.

1. Depress the IC, TUNE and PTT switches.
2. Momentarily set the transceiver to transmit condition by depressing the MOX switch and increase the CARRIER control until the meter indicates 300 mA and adjust the PRESELECTOR for maximum meter reading. Depress the PTT switch. The maximum MOX switch depressed time should not exceed 10 seconds. If above procedures are not completed in 10 seconds, then repeat the procedure after a 20 second open interval in order to protect the final tubes against damage.
3. Rotate the CARRIER control fully clockwise. Depress the PO switch. Momentarily depress the MOX switch (maximum ten seconds) and increase or decrease the LOADING slightly for maximum meter reading. Depress the PTT switch.
4. Momentarily depress the MOX switch, adjust the PLATE for maximum meter reading with the meter switch in the PO position.

5. Repeat steps (3) and (4) until a maximum meter reading is obtained.

It is recommended that the transceiver be operated at 80% of the "off resonance" plate current. To establish this recommended condition, check the IC current as follows:

Depress the IC switch. Momentarily depress the MOX switch, detune the PLATE tuning momentarily, observe the maximum IC reading, and then tune the PLATE and observe the minimum plate current (dip). The dip current should be 20% less than the maximum off resonance current. If not, repeat procedures (3) and (4) while changing the LOAD setting to obtain the above operating condition.

During the tuning period, the final tubes screen grid voltage is reduced by a series resistor in order to protect the tubes.

The transmitter is now peaked for maximum output. Return the CARRIER control to zero and set the MODE switch to the desired operating position.

SSB OPERATION

After the completion of the tuning procedure, depress the MODE switch for normal (N) or reverse (R) operation. In addition, depress the ALC switch and the MOX switch. The meter now shows a full scale indication. Adjust the CARRIER/MIC GAIN control until the meter kicks down to the mid-scale area of the green colored portion when speaking into the microphone normally. On some bands, the meter deflection may be very small and this is a normal operating condition. Depress the operation switch for desired mode: MOX (manual), PTT (Push-to-Talk) or VOX (voice controlled). For VOX operation, depress the VOX switch and adjust the VOX gain control, located on the bracket under the top cover of the cabinet, until your voice actuates the transmitter. Set the ANTITRIP control to the minimum setting required to prevent the speaker output from tripping the VOX. Do not use more VOX gain or ANTITRIP gain than necessary. Adjust the DELAY control for suitable release time.

When the VOX does not operate properly, the following adjustment procedure should be followed carefully:

Depress the VOX switch. Set the VOX gain, ANTITRIP, RELAY and DELAY controls in a fully counter-clockwise position. Advance the RELAY control slowly clockwise until the relay trips the transceiver into the transmit condition. Then slowly rotate the RELAY control

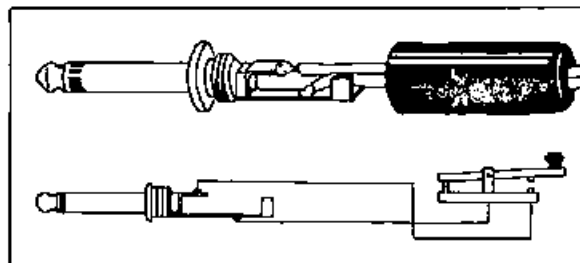
counter-clockwise and set it to a point slightly beyond the position that allows the receiver to recover. This is the proper setting for the relay sensitivity control. After setting the relay sensitivity control as above, then follow the VOX adjustment described in this section.

NOTE : When the meter is set to IC, voice modulation peaks will indicate 250 to 300 mA. Actual peak current, however, is approximately 2 times this indicated value.

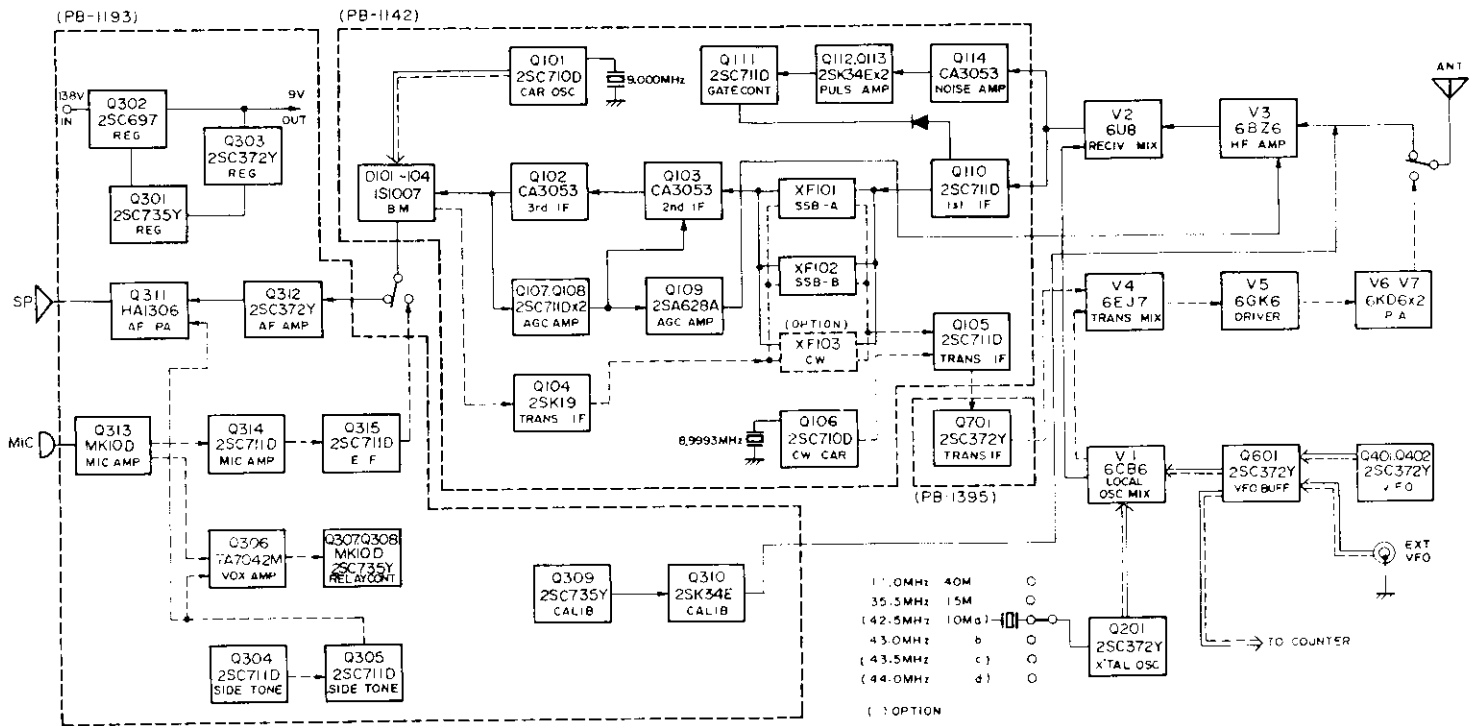
CW OPERATION

Using one of the two plugs supplied with the accessory pack, connect a key as illustrated below. Most relay-type automatic keyers can be connected to the transceiver for break-in operation without modification. Set up transceiver as described in the transmitter tuning by adjusting the CARRIER control to the desired power output. After completion of the final tuning, insert a key into the jack on the rear apron of the transceiver. Depress the push-button switch marked CW and MOX. The transceiver is now set up for manual CW operation. After completing a CW transmission, the PTT switch must be depressed for a receive condition. For break-in operation, simply depress the VOX switch and adjust the VOX gain and DELAY controls to the desired level.

The CW sidetone level may be adjusted by rotating the tone level potentiometer (VR302) located on the main printed circuit board (refer to AF Board Top View on page 22).



CIRCUIT DESCRIPTION



FT-501 BLOCK DIAGRAM

The block diagram and the circuit description are provided to give you a better understanding of this transceiver. The transceiver consists of a single-conversion receiver and an exciter transmitter. Many sections are common to both the receiver and the transmitter. For an clearer understanding of the circuit, the receiver and the transmitter sections will be described separately.

RECEIVER SECTION

The signal from the antenna terminal passes through the antenna relay and is fed to the control grid of the RF amplifier tube (6BZ6), V3. The signal is then amplified and fed to the control grid of the pentode section of the receiver mixer tube (6U8), V2. The local oscillator signal is coupled to the cathode circuit of the mixer through the other half of V2; a triode section. The IF output signal from the plate of the mixer is then amplified by a first IF amplifier

(2SC711D), Q110 and fed to a 9 MHz crystal filter. One of the two SSB filters is automatically placed into the signal path by the diode switch when the sideband is selected by the mode switch.

The IF signal is then amplified by two stages; IF amplifier (CA3053), Q102 and Q103. The output from Q102, the third IF amplifier, is fed through T102 to the ring demodulator (1S1007), D1 to D4, for SSB and CW reception. The carrier signal is generated by (2SC710D), Q101 and fed through T101 to the ring demodulator.

The demodulated audio signal is connected to the audio amplifier (2SC372Y), Q312, and (HA1306), Q311 which functions as a direct coupled amplifier and delivers 3 Watts of audio power to a 4 ohm load.

A portion of the mixer output signal is fed to the noise amplifier (CA3053), Q114, and the noise pulses are amplified by the pulse amplifier (2SK34E), Q112 and Q113. The noise pulse is applied to the base of the noise blanker driver (2SC711D), Q111. The gate diode (1S1555), D117, grounds the output of the first IF amplifier whenever a noise pulse exists.

The output from the last IF amplifier (CA3053), Q102, is rectified by D114 and D115 to produce the AGC (Automatic Gain Control) voltage. This rectified voltage is then amplified by (2SC711D x 2), Q107, Q108 and automatically controls the gain of the second IF amplifier (CA3053), Q103. The output from Q108 is further amplified by an AGC amplifier (2SA628A), Q109 and controls the gain of the RF amplifier (6BZ6), V3.

The AGC voltage developed by the signal is fed to the amplifier (2SC711D), Q107 and Q108, to provide a meter deflection proportional to the input signal strength. The meter is calibrated in the customary "S" unit scale. A meter indication of S9 represents approximately 50 microvolts at the antenna terminal.

Crystal controlled oscillator (2SC735Y), Q309, oscillates at the 100 KHz crystal frequency for dial calibration. The 100 KHz marker signal is amplified by (2SK34E), Q310, and coupled to the receiver RF amplifier. Trimmer capacitor, TC301, is used to calibrate the 100 KHz crystal frequency against WWV or JJY.

TRANSMITTER SECTION

The speech signal from the microphone is fed to the first Mic amplifier (MK10D), Q313. The input impedance at the Mic jack is 50 K ohms. This signal is controlled in amplitude by the MIC GAIN control

which is connected between Pins 5 and 8, and is then amplified by the second microphone amplifier (2SC711D), Q314. The signal is then applied to an emitter follower (2SC711D), Q315, through the contacts of the change-over relay and finally to the ring modulator, D101 to D104.

The carrier oscillator (2SC710D), Q101, is crystal controlled and generates a 9 MHz carrier signal. The output from this oscillator is fed to the balanced ring modulator. For SSB operation, carrier balance is obtained by potentiometer, VR101, and a trimmer capacitor, TC102. The double sideband, suppressed carrier output from the ring modulator is amplified by the first transmitter IF amplifier, (2SK19), Q104, and fed to one of the SSB crystal filters, which are selected automatically by the mode switch, depending upon whether USB or LSB operation is desired. The output from the crystal filter is amplified by the transmitter, second IF amplifier (2SC711D), Q105.

For CW operation, the CW carrier oscillator (2SC710D), Q106, generates a 8,999.3 KHz, crystal controlled signal, and this signal is amplified by (2SC711D), Q105, through the CARRIER control, VR8, located on the front panel.

The amplified IF signal is fed to the transmitter mixer (6EJ7), V4, where it is mixed with the local oscillator signal fed to the control grid, to produce the transmitted frequency. The transmitter signal is fed to the grid of the transmitter driver (6GK6), V5, where it is amplified to a level sufficient to drive the final linear amplifier (6KD6 x 2), V6 and V7. Neutralization of the power amplifier is accomplished by feeding back a small amount of output through TC3 to the bottom of the driver plate coil. Output power from V6 and V7 is fed through a pi-network to the antenna.

A part of RF output voltage is rectified by D4 to indicate relative power output when the meter switch is placed in the PO position. The ALC (Automatic Level Control) voltage is obtained by (1S1941 x 2), D2 and D3, and controls the gain of the IF amplifier stages to prevent the final stages from being overdriven.

The signal from the first microphone amplifier is coupled through the VOX GAIN control potentiometer, VR2, to the VOX amplifier (TA7042M), Q306. The signal is amplified by Q306 and fed to the VOX rectifier. The positive DC voltage from the rectifier is applied to the gate of the VOX relay control transistors (MK10D), Q307, and (2SC735Y), Q308, causing them to conduct and actuate the VOX relay, RL1.

The antitrip circuit provides a threshold voltage to prevent the speaker output from actuating the transceiver into the transmit function.

The receiver audio output voltage is connected through the ANTITRIP control potentiometer, VR3, to the antitrip amplifier (TA7042M), Q306, and fed to the rectifiers to deliver a negative DC voltage which reduces the gain of the VOX control transistor thus providing the necessary antitrip threshold. VR4 provides coarse adjustment for the relay sensitivity. Relay hold time is determined by the DELAY control, VR5.

The tone oscillator (2SC373), Q304, operates when the MODE switch is placed in the CW position. It is a phase-shift oscillator operating at approximately 800 Hz. The tone output is amplified by (2SC373), Q305, and is controlled by the keying circuit. It is coupled through the SIDETONE level control, VR302, to the receiver audio amplifier for sidetone monitoring in CW operation. The output from Q305 is also coupled to the VOX amplifier, Q306, for break-in CW operation.

The 13.6 V DC from the rectifier is supplied to a voltage regulator circuit (2SC735Y), Q301, (2SC697), Q302, and (2SC372Y), Q303, which generates a stable 9 Volt DC supply being fed to the various circuits. The regulated voltage is supplied to the CLARIFIER control, VR9, to offset the receiver tuning frequency to ± 5 KHz on either side of the transmitted frequency. VR11 permits adjustment of the receive and transmit frequency so that they coincide with the CLARIFIER is set at zero or in the OFF position.

HETERODYNE OSCILLATOR SECTION

The FT-501 transceiver utilizes a "premix heterodyne system" where the VFO signal is premixed with a crystal controlled signal to be used as the local heterodyne signal.

The VFO module board is installed on the VFO chassis. The VFO utilizes (2SC372Y), Q401, as an oscillator and (2SC372Y x 2), Q402 and Q601, as a buffer which provide isolation and amplification of the VFO signal. The VFO generates a 5000 to 5500 KHz signal. A pass-band filter circuit at the buffer output is tuned to pass the 5000 to 5500 KHz range signal.

Varicap diode (1S145), D401, permits the receiver offset tuning. The VFO output voltage is fed to the control grid of the local oscillator mixer (6CB6), V1, which functions as a buffer for 80 and 20 meter bands.

Crystal oscillator (2SC372Y), Q201, generates a 11 MHz signal for the 40 meter, a 35.5 MHz for the 15 meter, a 42.5 MHz for 10A, a

43.0 MHz for 10B, a 43.5 MHz for 10C and a 44.0 MHz for 10D bands. When the BAND switch is set to the 40 meter band, the local oscillator mixer (6CB6) mixes the VFO signal with the 11 MHz crystal controlled signal to produce a 16 - 16.5 MHz heterodyne signal; for 15 meters, 30 - 30.5 MHz; and for 10 meters, 37.0 - 39.0 MHz.

This heterodyne signal is mixed with the incoming signal in the receiver mixer (6U8) to produce a 9 MHz IF signal, and with the 9 MHz IF in the transmitter mixer producing the transmitting signal.

BAND	XTAL (MHz)	MIXED FREQ. (MHz)
80	-	5.0 -- 5.5
40	11.0	16.0 -- 16.5
20	-	5.0 -- 5.5
15	35.5	30.0 -- 30.5
10A	42.5	37.0 -- 37.5
10B	43.0	37.5 -- 38.0
10C	43.5	38.0 -- 38.5
10D	44.0	38.5 -- 39.0

FREQUENCY COUNTER

The frequency counter contains all elements of the counter including the frequency converter.

The standard frequency oscillator (clock) is composed of the 1 MHz crystal controlled oscillator, IC-521-4 and IC-521-6. The 1 MHz signal output is divided by the divider chain, IC-520 through IC-515.

The Q output from IC-515 is delayed through IC-521-3 and applied to a one shot multivibrator composed of IC-514-4 and IC-521-2.

The output from IC-514-4 and IC-521-2 produces both memory and reset pulses, and the former is applied to IC-502, IC-505, IC-508, and IC-511, and the latter is applied to IC-503, IC-506, IC-509, IC-512, and IC-513.

The signal from the VFO is converted by the mixer Q507 (2SK19), for direct "on frequency" readout by the counter for each frequency band.

For 7.0 and 14.0 MHz bands, Q503 (2SC373), generates a 12 MHz, crystal controlled signal to produce a 17,000 - 17,500 KHz signal, when mixed with the VFO signal.

For 3.5, 21.0 and 28.0 MHz bands, Q501 (2SC373), generates 11.25 MHz and this signal is doubled in frequency to 22.5 MHz by the doubler amplifier, Q502 (2SC373). This 22.5 MHz signal produces 17,000 - 17,500 KHz with the 5,000 - 5,500 KHz VFO signal. The 17,000 - 17,500 KHz signal is then amplified by Q508 (2SC373), and applied through gate circuit, IC-514, to the counter chain IC-513, IC-503, IC-506, IC-509, and IC-512. The counter operates by counting the number of pulses of the input signal which pass through the gate for a given period of time. The first counter, IC-513, counts 10 Hz. Each IC counts to 10 and then starts again automatically. Each time one IC counts to 10, and it feeds one pulse to the next IC. Thus, IC-503 counts 100 Hz, IC-506 counts 1 KHz and so on. The binary-coded decimal output from IC-503, IC-506, IC-509 and IC-512, is fed to IC-502, IC-505, IC-508 and IC-511, which are buffers and also perform the memory function.

The output from IC-502 - IC-511 is fed to IC-501, IC-504, IC-507 and IC-510, which convert the binary coded decimal into decimal numbers and select the necessary cathode in the indicator tubes to show a particular number. Mega-Hertz indicators, V505 and V506, are controlled by Q509, Q510 and IC-526. These select the proper cathode when the BAND switch is selected.

IC-522-3, IC-522-4, IC-523-4 and IC-525 add 500 KHz to the counter reading when the BAND switch is set to the bands that start from 500 KHz, such as 3.5, 28.5 and 29.5 MHz.

When the VFO frequency is outside its range, the output from IC-511 controls IC-522-1, IC-522-2 and IC-523-1 to produce blanking pulses to flicker the indicator tubes.

ALIGNMENT

WARNING

DANGEROUS VOLTAGES ARE PRESENT. EXTREME CARE IS ESSENTIAL. BE SURE THAT ALL POWER IS DISCONNECTED BEFORE WORKING INSIDE THE CHASSIS. CHECK FOR ANY HIGH VOLTAGE REMAINING IN THE FILTER CAPACITORS BY SHORTING THE HIGH VOLTAGE LINES TO THE GROUND WITH AN INSULATED SCREWDRIVER.

The transceiver has been aligned and calibrated at the factory with accurate test equipment and should not require further alignment. However, service or replacement of any major components may require subsequent realignment, but do not attempt to make any such alignment without a thorough knowledge of the circuit operation and the proper test equipment.

TEST EQUIPMENT REQUIRED

A stable, standard signal generator, a vacuum tube volt-ohm-meter with RF probe, a general coverage communication receiver, and a 300 Watts dummy load are required for complete alignment.

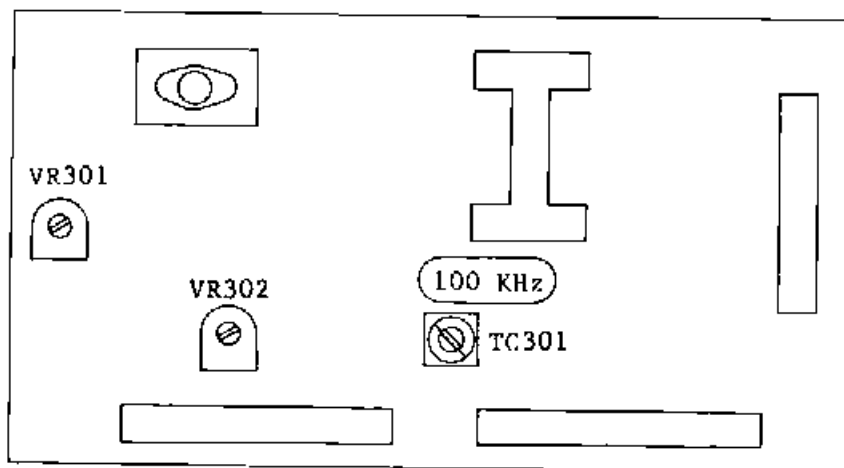
VOLTAGE & RESISTANCE MEASUREMENT

The table lists the socket voltages and resistance of all tubes and transistors. These values are measured with a VTVM when all tubes installed in their respective sockets.

All measurements are made from the socket pins or transistor leads to ground. Before taking resistance measurements, always turn off the power, remove the AC plug and completely discharge all filter capacitors.

VOLTAGE REGULATOR

Measure the regulated voltage at Pin 15 of the printed board. It should be exactly 9 Volts. If not, adjust VR301, located on the printed circuit board, for 9 Volts. If the output can not be brought up to 9 Volts, it may be due to a faulty component on the printed circuit board, such as the transistors or zener diode or a supply voltage below 11 Volts.



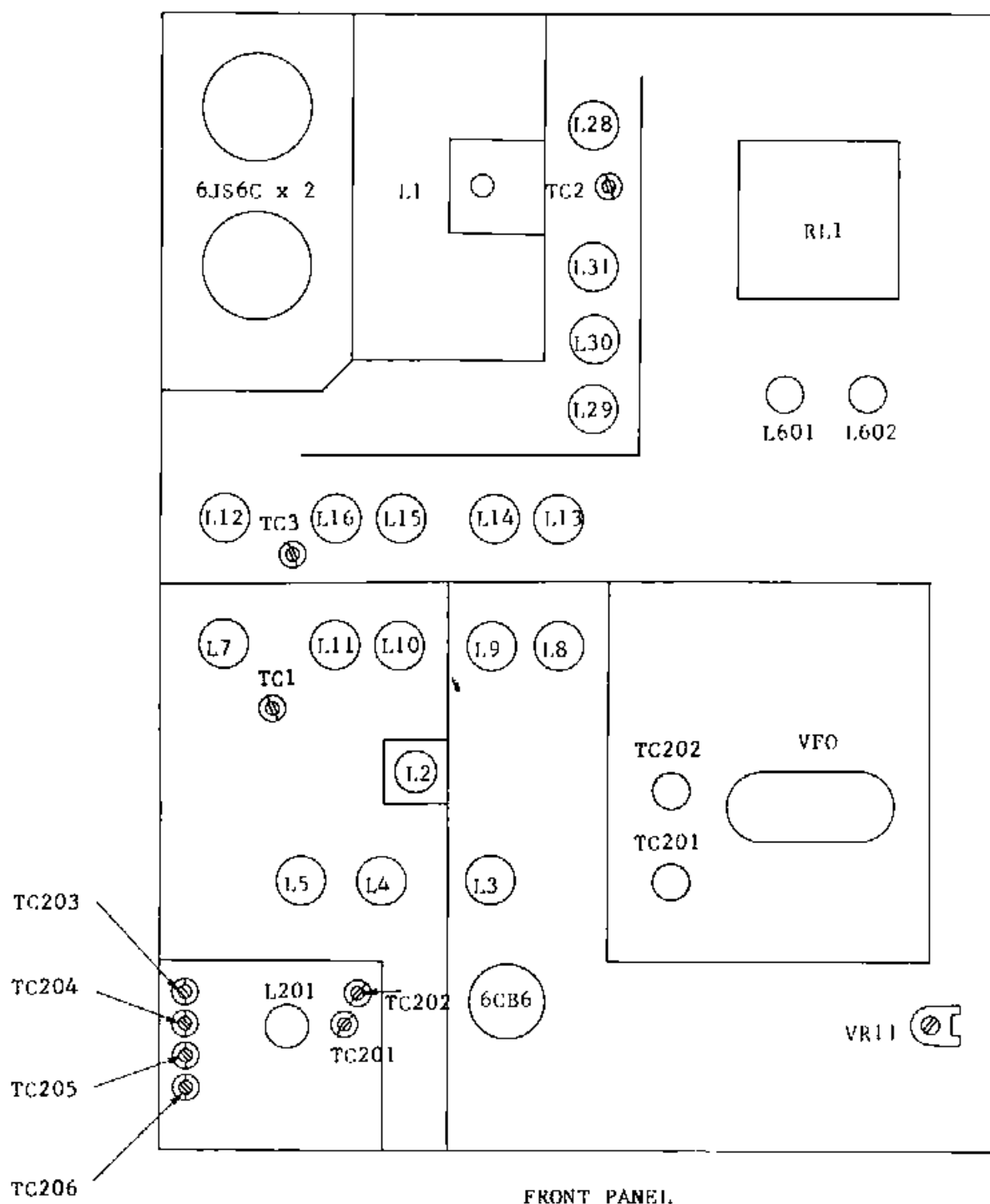
AF Board Top View

VFO

The VFO generates a 5,000 to 5,500 KHz signal. For alignment, turn off the crystal heterodyne oscillator by setting the BAND switch to the 3.5 MHz band and set the CLARIFIER control to the OFF position.

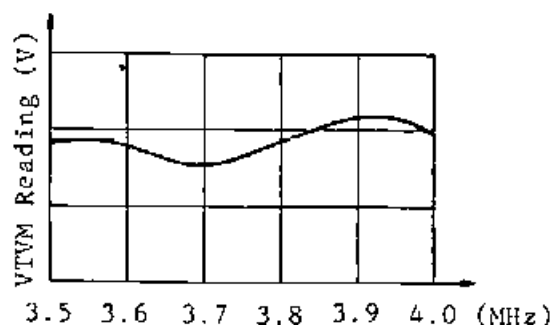
The use of a frequency counter is recommended for accurate frequency alignment, however, alignment can be accomplished, with the 100 KHz calibrator signals heard when the CALIBRATOR is ON.

The coarse alignment is accomplished by an adjustment of TC-401. A split-stator type trimmer, TC-402, is utilized for temperature compensation. If TC-402 is ever adjusted, then TC-401 should be readjusted to maintain proper calibration. When the temperature compensation is not adequate, adjust TC-402 in either direction and observe the amount and the direction of the compensation to determine right setting of TC-402 for the most adequate compensation. The cut and try method is necessary to determine the proper temperature compensation adjustment. For precise adjustment of dial linearity, a careful adjustment by bending the rotor plates of main tuning capacitor, VC401, is necessary.



Bottom View

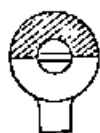
Connect the RF probe of a VTVM to the control grid of the premixer tube (6CB6), V1. Set the BAND switch to 80 meter band. Align L601 and L602 for the band-pass characteristics shown below:



HETERODYNE CRYSTAL OSCILLATOR

Disconnect the plug from the VFO socket, J5, in order to disable the VFO. Connect the RF probe of a VTVM to the cathode of V1 (6CB6). Set the BAND switch to the 40 meter band and TC201 to half capacitance shown below:

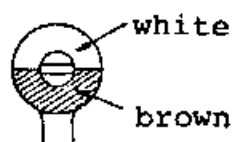
Maximum



Middle



Minimum



Capacitance of Ceramic Trimmer

Align L202 for a 0.7 Volt VTVM reading.

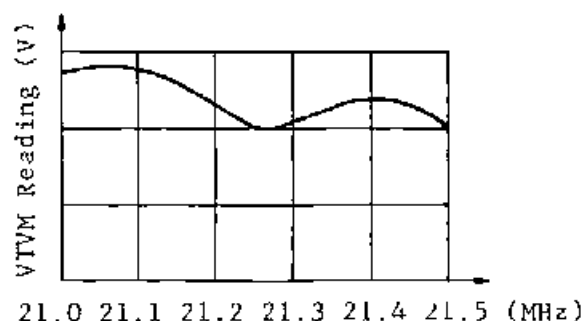
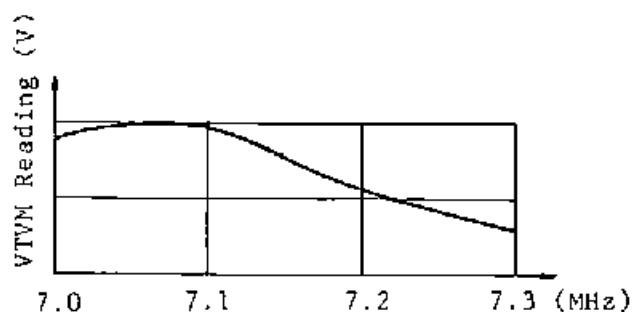
Set the BAND switch to 21 MHz. Adjust TC202 for a 0.7 Volt VTVM reading. Set the BAND switch to 28.5 MHz band and adjust TC204 for a 0.4 Volt VTVM reading. Adjust TC203 (28.0 MHz band), TC205 (29.0 MHz band), and TC206 (29.5 MHz band), to obtain a 0.4 Volt injection voltage.

After the alignment, re-install the VFO plug into J5.

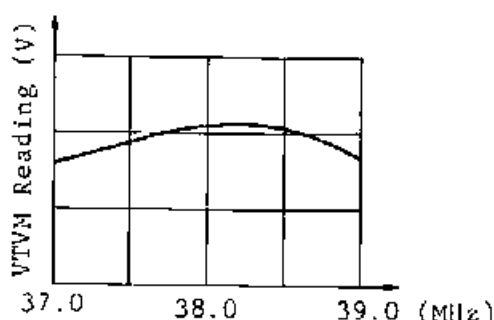
PREMIXER OUTPUT COIL

Connect the RF probe of a VTVM to the cathode of the receiver mixer tube (6U8), V2. Set the BAND switch to 7.0 MHz band and the VFO to 7,000 KHz. Temporarily solder a 470 ohm resistor in parallel with the secondary winding of the output coil L5.

Adjust the primary core of L5 for a maximum VTVM reading (approximately 0.05 Volt). Remove the 470 ohm resistor. Temporarily solder a 100 ohm resistor in parallel with the primary coil which was aligned above. Set the VFO to 7,300 KHz. Adjust the secondary core of L5 for a maximum VTVM reading (approximately 0.3 Volt). Remove the 100 ohm resistor. Set the BAND switch to 21 MHz band, and the VFO to 21.0 MHz. Peak the primary core of L4 for a maximum VTVM reading. Set the VFO to 21.5 MHz and peak the secondary core of L4. Adjust the primary and secondary cores alternately to achieve a unity output (approximately 0.3 Volt or more) over the entire VFO range.



Set the BAND switch to 28.5 MHz band and remove the 43.0 MHz heterodyne crystal from its socket. Connect a signal generator to the cathode of V1 (6CB6), and set the signal generator to 38 MHz. Adjust the output to give a 0.5 - 0.6 Volt VTVM reading. Temporarily solder 500 ohm resistor in parallel with the secondary of L3 and peak the primary of L3. Remove the resistor from the secondary terminals and solder it in parallel with the primary coil and peak the secondary of L3 for maximum VTVM reading. Remove the temporarily soldered resistor from the coil. Check the band pass characteristics by varying the frequency of the signal generator from 37 MHz to 39 MHz.



Disconnect the signal generator. Insert the 43.0 MHz crystal back into its socket. The VTVM should now show a 0.4 Volt output. Disconnect the VTVM.

The temporary termination of the coils was done to avoid the interaction of the other coil winding.

The pre-mixer output alignment should be done very carefully so as to avoid the generation of unnecessary spurious signals.

BAND	HETERODYNE FREQUENCY (MHz)	INJECTION VOLTAGE (V)
80	5.0 -- 5.5	0.7
40	16.0 -- 16.5	0.3
20	5.0 -- 5.5	0.4
15	30.0 -- 30.5	0.4
10A	37.0 -- 37.5	0.4
10B	37.5 -- 38.0	0.4
10C	38.0 -- 38.5	0.4
10D	38.5 -- 39.0	0.4

Local Injection at Mixers

FINAL AMPLIFIER NEUTRALIZATION

When replacing the final tubes, it is often necessary to readjust the bias to give correct idle current and check the neutralization. We recommend the use of only selected Yacsu Musen tubes which are generally available from your local dealer or service center.

C A U T I O N =====

HIGH VOLTAGES ARE PRESENT ON UNDERSIDE OF THE CHASSIS AND INSIDE THE FINAL OUTPUT COMPARTMENT. EXTREME CAUTION SHOULD BE TAKEN WHILE MAKING ADJUSTMENTS WITH THE WIRING EXPOSED.

1. Connect a 50 ohm dummy load to the antenna, and depress the IC meter switch.
2. Locate TC4, the neutralization variable capacitor shaft located on the underside of the chassis in the final amplifier section.
3. Check the final amplifier idle current in SSB mode (Normal or Reverse) and adjust the BIAS potentiometer, VR10, for an idle current of 60 mA.
4. Tune up the transceiver at 29 MHz (a counter reading of 28.999). With the MODE switch in TUNE and FUNCTION switch in the MOX position, advance the CARRIER control until meter reads 100 mA in the IC position.
5. Rotate the PLATE TUNING control and observe for a dip as indicated on the meter. If the dip is not prominent, reduce the loading slightly by rotating the LOAD control clockwise for better indication. As the PLATE control is rotated, the meter should rise equally and smoothly on either side of the maximum dip indication.
6. Observe which side of the dip rises abruptly. Set the PLATE control slightly to this side of the dip and maintain the meter reading at 100 mA.
7. Using a nonmetallic tuning wand, rotate the neutralization capacitor shaft very slightly and carefully in the direction which reduces the current shown on the meter. Repeat steps (6) and (7) until the meter indicates a smooth and equal rise on either side of the maximum dip point.

The final compartment cover must be in place to supply the RF shielding required during these neutralization procedures.

TRANSMITTER MIXER/DRIVER & RECEIVER FRONT END

The final amplifier idle current must be set to 60 mA before extensive operation of the transceiver is attempted. It will be assumed that the signal generator stages of the transceiver are functioning properly. Use the internally generated signal of the transceiver to align the transmitter mixer and driver stages and a standard signal generator to align the receiver front end.

1. Connect the 50 ohm dummy load to the antenna connector. Tune up the transceiver at 29 MHz (28,999 KHz) as follows:

Set the BAND switch to 10B, the VFO to the upper end (counter reads 28,999 KHz), the PRESELECTOR to 12 o'clock position and the FUNCTION switch to MOX. Advance the CARRIER control and tune the final amplifier. Maintain a resonant plate current (IC) of 100 mA with the CARRIER control. Peak the cores of L8 and L13 for a maximum output to the dummy load. Reduce the transmitter output to zero with the CARRIER control.

2. Set the transceiver to the receive mode by depressing the PTT switch. Adjust the RF GAIN control to maximum, the AF GAIN control to a normal listening level, and switch the CLARIFIER and NOISE BLANKER to OFF. Do not change the VFO and PRESELECTOR settings as set up in step (1). Remove the dummy load from the antenna connector. Connect a standard signal generator (SSG) output to the antenna connector. Tune up SSG to 28.999 MHz and adjust it for approximately 1000 Hz beat note. Use just enough SSG output (approximately 1 micro Volt for an 1 S unit) to avoid developing AGC voltage (no S-meter indication). Peak L29 for maximum audio output. Disconnect the SSG from antenna connector and re-connect the dummy load to the antenna connector.
3. Set the BAND switch to 3.5 MHz, the PRESELECTOR to the 2 position, the VFO to 3,500 KHz and the FUNCTION switch to MOX. Advance the CARRIER control and tune the final amplifier. Maintain a meter reading of 100 mA with the CARRIER control as described in step (1). Peak the cores of L7 and L16 for maximum output. Reduce the output to zero with the CARRIER control.
4. Set the FUNCTION switch to the receive mode by depressing the PTT switch. Connect the SSG in place of the dummy load, tune to 3,500 KHz and obtain 1000 Hz beat note. Peak core of L28 for maximum audio output.
5. Set the BAND switch to 21 MHz, the PRESELECTOR to the 12 o'clock position and the VFO to 21,250 KHz. Accomplish the above described procedures by using L9 and L14 for transmitting power output and L30 for the receiver front end alignment.
6. Set the BAND switch to 14 MHz, the PRESELECTOR to the 12 o'clock position and the VFO to 14,250 KHz. Accomplish the above procedures by using L10 and L15 for transmitting power output and L31 for the receiver front end alignment.
7. Set the BAND switch to 7.0 MHz, the PRESELECTOR to the 1 o'clock position and the VFO to 7,000 KHz. Connect the dummy

load to the antenna connector. Peak the cores of L11 and L16 for maximum output. Set the FUNCTION switch to the receive mode by depressing the PTT switch, and peak TC2 for a maximum background noise output from the speaker. Depress the MOX switch. Adjust the PRESELECTOR for maximum output. Adjust the CARRIER control to maintain 50 Watts output. Check for maximum transmitter output at the same PRESELECTOR setting for maximum background noise output in the receive mode. If not, set the PRESELECTOR for maximum output (1 position), in transmitting mode, and depress the PTT to the receive mode. Adjust TC1 and TC2 for maximum background noise.

NOTE : When the SSG is not available, the receiver antenna coil may be peaked for maximum background noise output from the speaker.

C A U T I O N =====

EXTREME CARE SHOULD BE TAKEN SO AS NOT TO TRANSMIT INTO THE SIGNAL GENERATOR. THIS WILL RESULT IN PERMANENT DAMAGE TO SSG ATTENUATOR.

IF AMPLIFIER

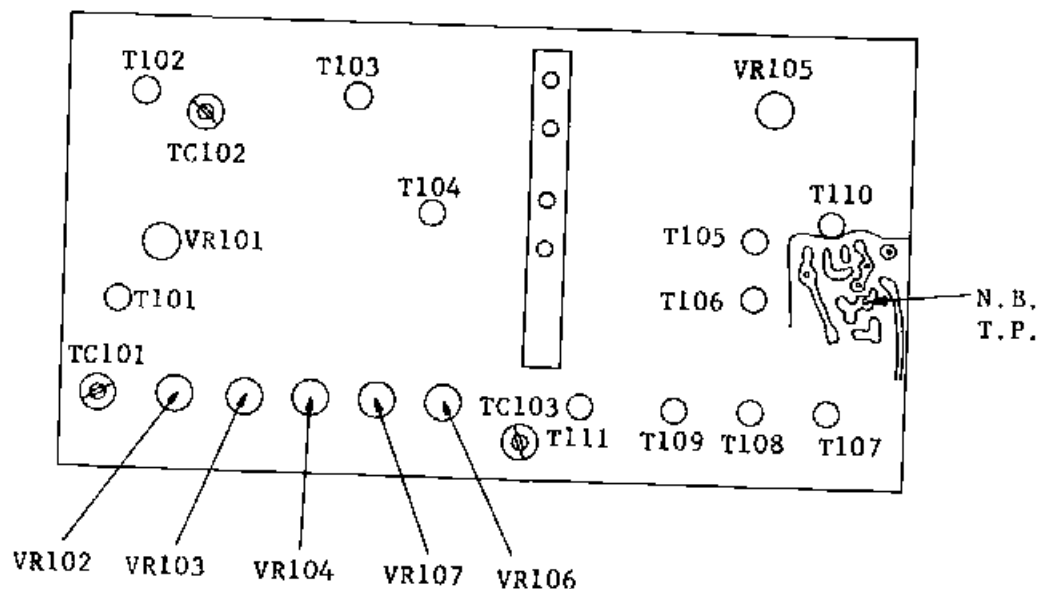
Set the transceiver to SSB in the receive mode. Connect the SSG to the pentode control grid of receive mixer tube V2 (6U8). Set the frequency to exactly 9 MHz. Carefully set the SSG frequency to the SSB filter frequency of the transceiver. Peak T107, T108, T109, T105, T104, T103 and T102 for a maximum S-meter reading. Use just enough SSG output to read S-meter indication in order to avoid saturation.

NOISE BLANKER T110

Connect the positive lead of the VTVM to the test point and negative lead to the chassis ground. Receive a 7100 KHz marker signal and detune the main tuning dial slowly until beat tone is not heard. Adjust T110 for maximum VTVM reading.

CARRIER OSCILLATOR

Connect the RF probe of the VTVM to the test point and set T101 for an 80 percent of maximum VTVM reading (approximately 0.6 Volt). Adjust TC101 so that the receiver noise is heard at same pitch when the SSB switch is changed from Normal to Reverse position.



IF Board Bottom View

TRANSMITTER IF T106

Adjust T106 for maximum power output.

CW CARRIER OSCILLATOR

Connect the VTVM RF probe to the center arm of the CARRIER control potentiometer, VR8. Adjust T111 for approximately 0.5 Volt VTVM indication when the CARRIER control is in a fully clockwise position. Adjust TC103 to 8999.3 KHz.

TRAP COIL

Set the BAND switch to the 7 MHz band and the PRESELECTOR to the fully clockwise position. Connect the SSG to the antenna terminal. Set the SSG output to 1 milli Volt at exactly 9 MHz. Adjust the trap coils L1 and L2, for minimum audio output from the speaker.

S-METER

Set the transceiver to SSB Normal and the RF GAIN control to a fully clockwise position in the receive mode. Disconnect the antenna from the antenna connector. Adjust VR107 for zero set of the S-meter. Rotate the RF GAIN control fully counter-clockwise and adjust VR106 for full scale S-meter indication.

AGC THRESHOLD

Connect the VTVM positive (+) lead to the control grid of V3 (6BZ6), the RF amplifier tube and the negative (-) lead to the chassis. Carefully observe the VTVM reading while rotating the AGC THRESHOLD control potentiometer, VR104. The VTVM reading will show a negative voltage at a fully counter-clockwise position. Rotate the potentiometer arm clockwise until VTVM shows plus (+) 0.3 Volt.

ALC METER SET

Tune the transceiver to SSB in the transmit mode. Depress the ALC meter switch and adjust the ALC potentiometer, VR102, for a full scale indication without modulation.

CW SIDETONE LEVEL

Adjust VR302 to a normal sidetone monitor listening level while in CW mode.

CLARIFIER

Turn on the CALIB and tune the transceiver to a 14.1 MHz marker signal. Depress the CLARIFIER switch and set the CLAR control to zero (12 o'clock position). Adjust VR11, a 50 K ohm potentiometer located behind the CLAR control, for a zero beat.

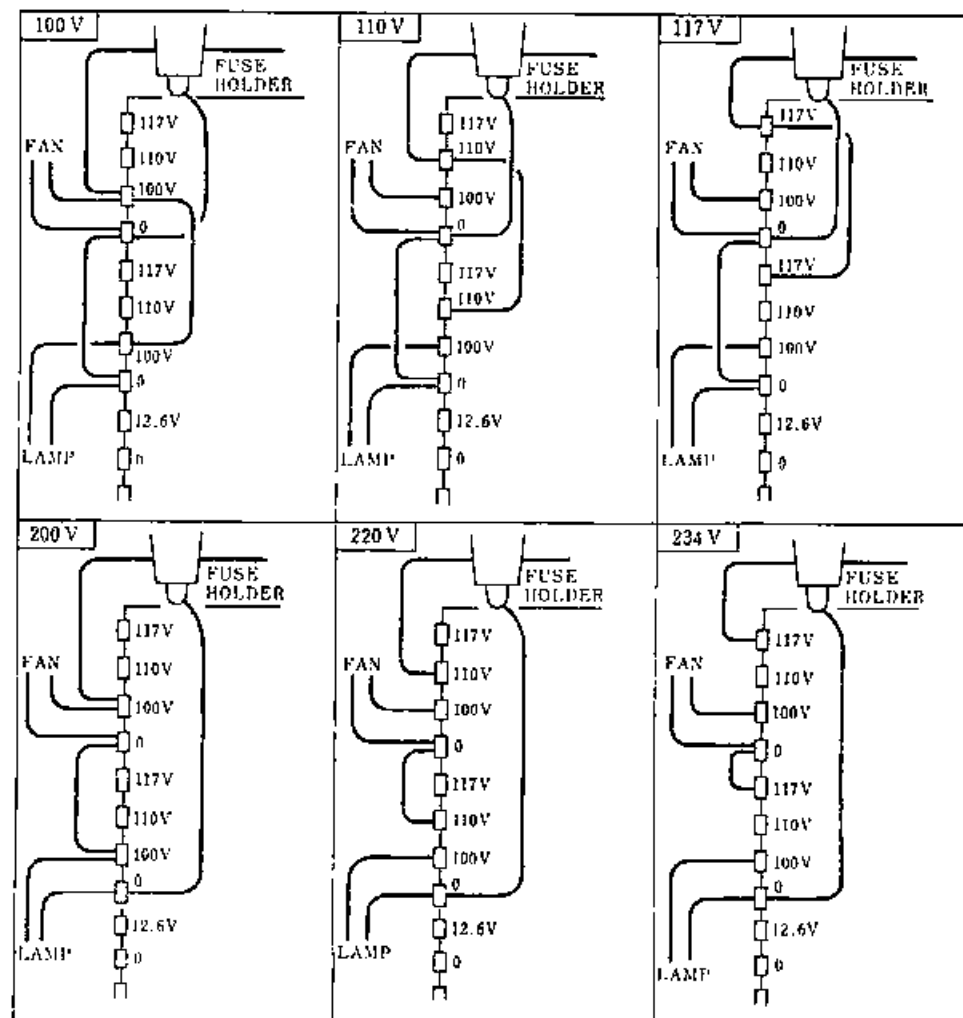
FP-501 AC POWER SUPPLY WITH SPEAKER

The FP-501 AC Power Supply is designed specifically for the FT-501 Digital Transceiver. A dynamic speaker is included in the power supply cabinet. Refer to a circuit diagram for details.

SPECIFICATIONS

Supply Voltage	:	100/110/117/200/220 or 234 Volts AC 50/60 Hz.
Speaker	:	3 Watts input power
Semiconductors	:	3 x Transistor 15 x Diode
Dimensions	:	210(W) x 292(D) x 160(H) m/m
Weight	:	10 Kg. approx.

Note that the primary winding is split into two windings for the purpose of multi-voltage operation. Please refer to the following wiring changes for operation on various line voltages.



POWER TRANSFORMER CONNECTION

VOLTAGE CHART

NOTE : (1) Values are DC voltage unless noted.

(2) *values are DC voltage measured with VTVM.

(3) ▲values are AC voltage.

(4) Band Switch set to 80 meter and Mode Switch to SSB Normal position.

TUBE

	V1 (6CB6)		V2 (6U8)		V3 (6BZ6)		V4 (6EJ7)		V5 (6GK6)		V6 (6KD6)		V7 (6KD6)	
	R	T	R	T	R	T	R	T	R	T	R	T	R	T
1	0	0	170	168	0.5	-18	0	2	0	8	6.0▲	6.0▲	E	E
2	3.4	3.4	0	-75	2.0	0	-80	0	-80	0	0	0.02	0	0.02
3	E	E	120	168	12.0▲	12.0▲	0	2	E	E	175	170	175	170
4	6.0▲	6.0▲	6.0▲	6.0▲	6.0▲	6.0▲	E	E	6.0▲	6.0▲	E	E	E	E
5	165	165	E	E	170	168	6.0▲	6.0▲	12.0▲	12.0▲	-80	-45	-80	-45
6	172	172	175	170	102	0	E	E	NC	NC	NC	NC	NC	NC
7	E	E	3.6	0	E	E	360	310	370	330	NC	NC	NC	NC
8			10	0			0	110	330	280	NC	NC	NC	NC
9			4.7	-70			E	E	E	E	-80	-45	-80	-45
10											E	E	E	E
11											175	170	175	170
12											12.0▲	12.0▲	6.0▲	6.0▲
P											820	760	820	760

IF UNIT (PB-1142)

	Q101 (2SC710D)		Q105 (2SC711D)		Q106 (2SC710D)		Q107 (2SC711D)	
	R	T	R	T	R	T	R	T
E	3.0	3.0	0	1.85	0	0	0.4	0
C	9.0	9.0	0	8.5	0	0	9.0	0
B	0.54	0.54	0	2.25	0	0	0.6	0.5
	Q108 (2SC711D)		Q109 (2SA628A)		Q110 (2SC711D)		Q111 (2SC711D)	
	R	T	R	T	R	T	R	T
E	0	0	0.65	0	1.25	3.0	0.04	0.04
C	7.6	0	0.55	-25	12.0	14.0	14.0	14.0
B	0.4	0	E	E	1.8	2.4	0.54	0.54
	Q104 (2SK19GR)		Q112 (2SK34E)		Q113 (2SK34E)			
	R	T	R	T	R	T		
D	0	8.4	7.4	7.4	0.54	0.54		
G	0	0	0	0	0	0		
S	0	1.4	3.6	3.6	E	E		

IF UNIT (PB-1142)

IF AMP. UNIT
(PB-1395)

	Q102 (CA3053)		Q103 (CA3053)		Q114 (CA3053)			Q701 (2SC372Y)	
	R	T	R	T	R	T		R	T
1	0	0	0	0	3.1	3.1	E	0.9	0.9
2	2.3	0	2.3	0	3.8	3.8	C	9.0	9.0
3	E	E	E	E	E	E	B	1.5	1.5
4	1.85	0	1.9	0	3.1	3.1			
5	6.2	0	6.2	0	10.0	10.0			
6	9.0	0	8.5	0	13.8	13.8			
7	7.0	0	7.6	0	11.0	11.0			
8	0	0	0	0	3.1	3.1			

(20 K Ohm/V DC)

AF UNIT (PB-1193)

	Q301 (2SC735Y)		Q302 (2SC697)		Q303 (2SC372Y)		Q304 (2SC372Y)		Q305 (2SC372Y)			
	R	T	R	T	R	T	R	T	R	T		
E	9.6	9.6	9.0	9.0	6.0	6.0	0	0	0	0		
C	14.0	14.0	14.0	14.0	10.0	10.0	0	0	0	0		
B	10.0	10.0	9.6	9.6	6.6	6.6	0	0	0	0		
	Q308 (2SC735Y)		Q309 (2SC372Y)		Q312 (2SC372Y)		Q314 (2SC711D)		Q315 (2SC711D)			
	R	T	R	T	R	T	R	T	R	T		
E	0	0	0	0	0.16	0	0	0.3	0	4.6		
C	0	0	0	0	7.0	0	0	4.0	0	9.0		
B	0.44	0.44	0	0	0.64	0	0	0.82	0	4.4		
	Q307 (MK10D)		Q310 (2SK34E)		Q313 (MK10D)							
	R	T	R	T	R	T						
D	0.44	0.44	0	0	7.0	7.0						
G	0	0	0	0	0	0						
S	0	0	0	0	1.25	1.25						
	Q306 (TA-7042M)						Q311 (1A-1306)					
	R	T	×	R	T	×	R	T	×	R	T	
1	0.78	0.78	7	1.1	1.1	1	7.8	7.8	6	4.8	4.8	
2	0.1	0.1	8	6.6	6.6	2	7.1	7.1	7	12.0	12.0	
3	0.4	0.4	9	0.82	0.82	3	2.0	2.0	8	E	E	
4	NC	NC	10	5.8	5.8	4	3.8	3.8	9	7.8	7.8	
5	E	E	11	8.0	8.0	5	4.0	4.0	10	14.0	14.0	
6	0.48	0.48	12	8.0	8.0							