

Yaesu FTV-650 Six meter transverter

Owners Manual, Maintenance & Alignment



Yaesu FTV- 650B

Yaesu made 2 models of this transverter the earlier version used tubes in the receiver and transmitter sections while the FTV-650B shown above used solid state components in the receiver, but still used a 12BY7A driver into the 6146 final amplifier.

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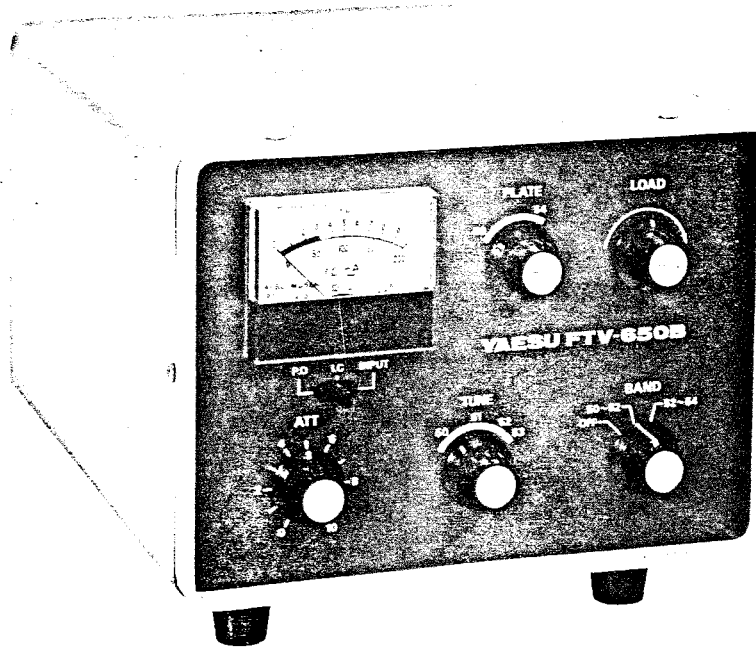
INSTRUCTION MANUAL

FTV-650B

YAESU MUSEN CO., LTD.

TOKYO JAPAN

FTV-650B
SIX METER TRANSVERTER



The Model FTV-650B is a hybrid six meter transverter designed for six meter operation in conjunction with the FT-101, FL-101/FR-101 and FT-201 series, high frequency SSB/CW/AM transceiver.

The FTV-650B derives optimum performance from the combined advantages of solid state devices and tubes. The low noise and high gain MOS FET provides the superior receiver front end and the tubes provide high power output. The resulting power output into the 50 ohm load is 25 watts PEP.

The spurious radiations are extremely reduced or eliminated by the use of dual balanced mixer. The entire six meter band is divided into two segments.

HF and VHF antenna is automatically changed by a switch on the front panel.

SPECIFICATIONS

TRANSMITTER

| | |
|--------------------|----------------------|
| Input Frequency | 28 - 30 MHz |
| Input Voltage | 3 Volts RMS |
| Input Impedance | 1 kilo ohms |
| PA Input | 50 Watts PEP |
| Output Frequency | 50 - 52, 52 - 54 MHz |
| Output Impedance | 50 ohm unbalanced |
| Spurious Radiation | Less than -50 dB |

RECEIVER

| | |
|--------------------|---|
| Frequency Range | 50 - 52, 52 - 54 MHz |
| Antenna Impedance | 50 ohm unbalanced |
| Sensitivity | 0.5 uV at S/N 10 for SSB 1 uV at S/N 10 for AM |
| Spurious Response | 50 dB or better |
| Internal Spurious | 0 dB or better |
| Output Frequency | 28 - 30 MHz |
| Output Impedance | 50 ohm unbalanced |
| Power Requirements | AC 12.6 V 2A DC 150 V 5mA 300 V 50mA 600 V 150mA 100 V 10mA |

TUBES AND SEMICONDUCTORS

| | | |
|------|-------------|---|
| Tube | 12BY7A | 1 |
| | S2001/6146B | 1 |

| | | | | |
|---------------|---------|---|---------|---|
| Semiconductor | MC1496G | 1 | 2SC372Y | 1 |
| | 2SK19Y | 1 | 3SK35GR | 1 |
| | 2SC373 | 1 | 2SC741 | 1 |
| | 2SC784R | 1 | 2SD313 | 1 |
| | V06B | 1 | WZ060 | 1 |
| | RD8.2EB | 1 | 1S188FM | 4 |
| | 1S1941 | 2 | | |

INSTALLATION

The FTV-650B transverter has been primarily designed in electrically and in style for the combination use with our FT-101/FT-201 transceiver or FL-101/FR-101 transmitter-receiver.

The power is supplied through the HF equipment using the power cable supplied.

The transverter should be placed in a location that has adequate space to permit free air circulation through the cabinet opening.

The antenna and its location are the most important consideration. The antenna should always be as high and in clear as possible, and a minimum distance of 10 feet should be maintained between the VHF and other antennas. The most popular antenna types are either a quarter wave length whip with unity gain or a 5/8 wave length whip with a base matching device affording approximately 3.5 dB gain. A multi-element Yagi antenna is also widely used for the DX communications.

To minimize loss in the antenna system, use the shortest length of coaxial cable that is practical, avoiding any sharp angles or kinks. Use type RG-8/U cable if the transmission line length exceeds 25 feet, while RG-58/U may be used for shorter lengths.

The transverter should be connected to a good ground. The ground lead should be connected to the terminal marked GND located on the rear panel of the transverter.

INTER CONNECTIONS

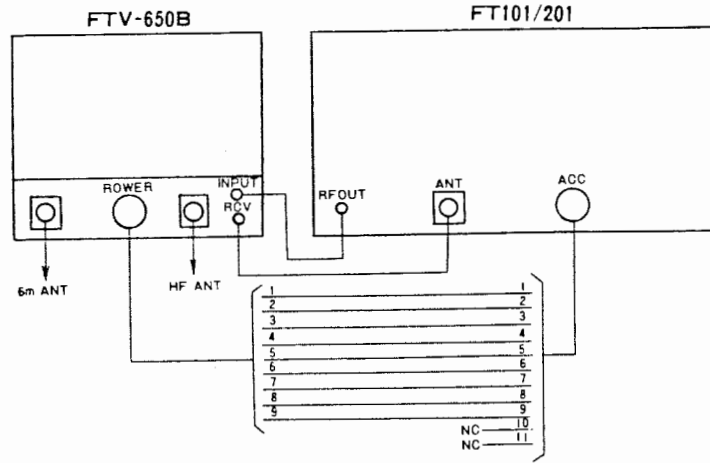


Fig. 1

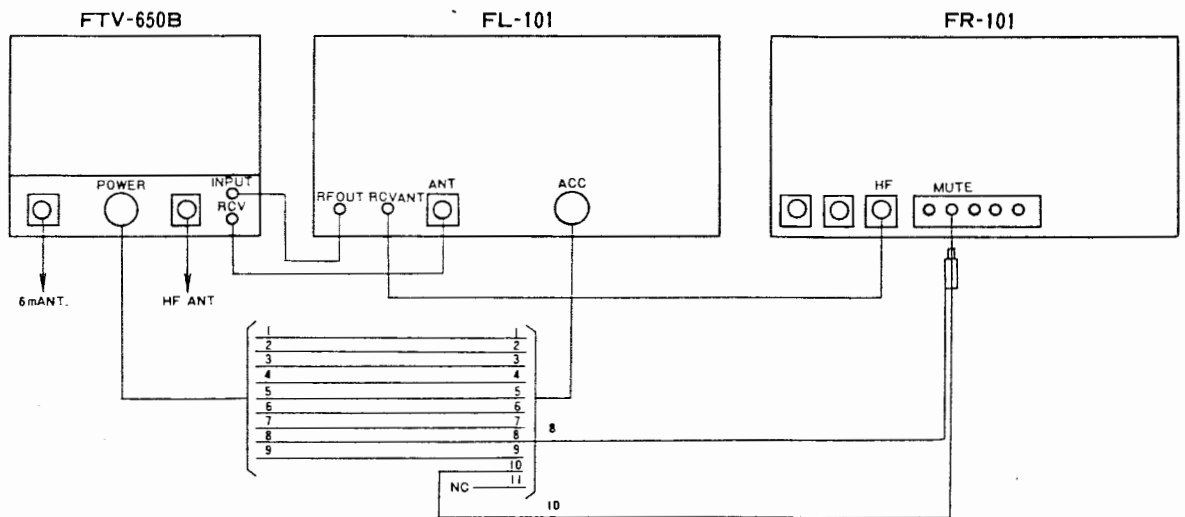


Fig. 2

CONTROLS AND SWITCHES

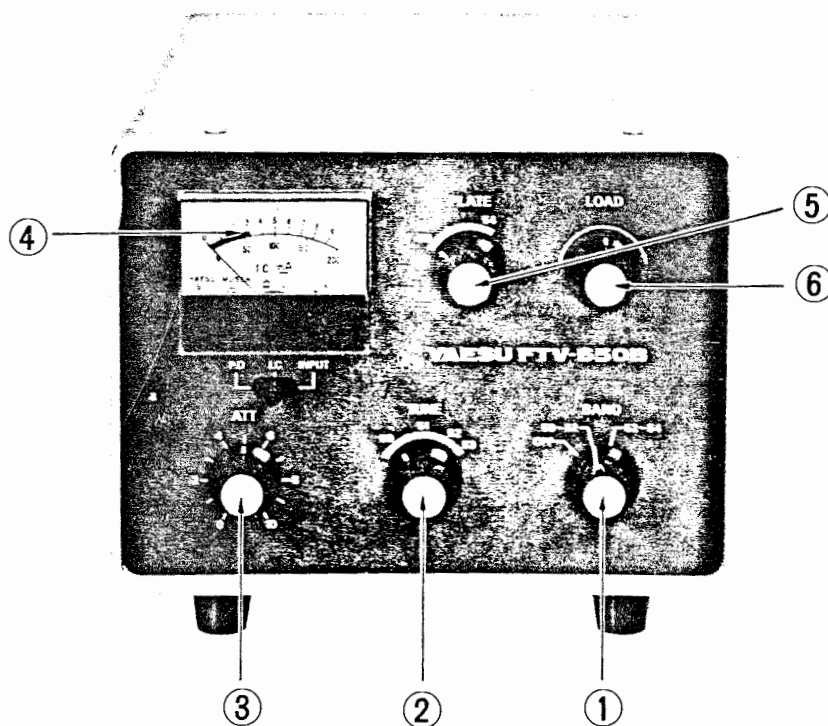


Fig. 3 : Front Panel

- | | |
|-----------|--|
| (1) BAND | The BAND switch is a three position switch that selects six meter amateur band. In the "OFF" position, the HF antenna is automatically connected to the HF transmitter. |
| (2) TUNE | This control tunes the signal circuit for both transmit and receive for optimum performance. |
| (3) ATT | This control adjusts the input level of the receiver signal. |
| (4) METER | This switch selects the meter mode to read the PA cathod current, relative power output and exciter input level. |
| (5) PLATE | This control tunes the plate circuit of the final amplifier. |
| (6) LOAD | This control tunes the output circuit of the pi network to match the impedance of antenna. |

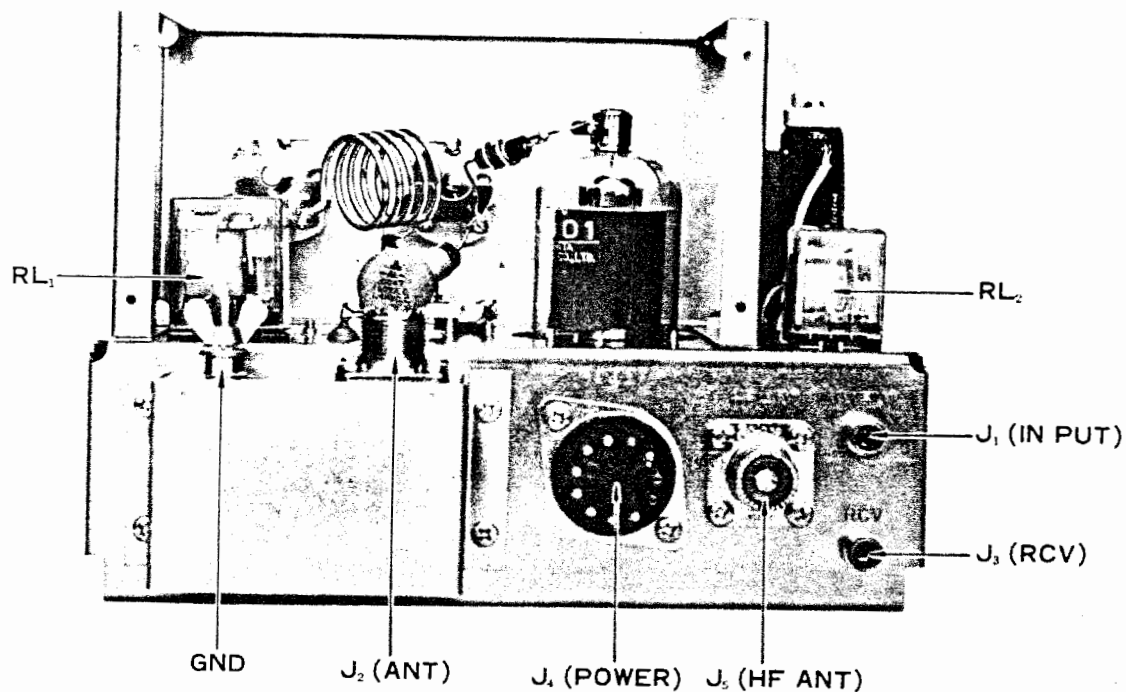


Fig. 4 : Rear Panel

- | | |
|----------------|--|
| (1) J1 INPUT | 28 MHz signal is supplied through this jack. |
| (2) J3 RCV | At receive, this jack connects the converted VHF signal to the receiver antenna connector. |
| (3) J5 HF ANT | HF antenna is connected to this connector. |
| (4) J4 POWER | The necessary voltages are supplied through this jack from the main HF equipment. |
| (5) J2 VHF ANT | 6 meter antenna is connected here. |
| (6) GND | Ground terminal |

OPERATION

The tuning procedure of the transverter is not complicated, however, care should be exercised when tuning to insure peak performance of the two combined equipment, transverter and HF equipment. The following paragraphs describe the procedure for receiver and transmitter tuning. It is assumed that the interconnection has been completed as shown on page 4.

INITIAL CHECK

Before connecting the HF equipment to a power source, carefully examine the unit for any visible damage. Check that all tubes are firmly in place and the controls and switches are operating normally. Ensure that the interconnection has been completed.

FREQUENCY SELECTION

The frequency is determined by the main tuning dial of the HF equipment in conjunction with the transverter BAND switch setting. The transverter BAND switch selects two bands, 50 through 52 MHz and 52 through 54 MHz. The HF equipment covers 2 MHz in four segments. The frequency relation between the transverter and the HF equipment is as follows:

| Transverter | HF Equipment | | | |
|-------------|--------------|-------------|-------------|-------------|
| | 10A | 10B | 10C | 10D |
| 50 - 52 MHz | 50.0 - 50.5 | 50.5 - 51.0 | 51.0 - 51.5 | 51.5 - 52.0 |
| 52 - 54 MHz | 52.0 - 52.5 | 52.5 - 53.0 | 53.0 - 53.5 | 53.5 - 54.0 |

RECEIVE

Set the BAND switches of both transverter and HF equipment for a desired band and tune to the signal by the main tuning dial of the HF equipment. Peak the TUNE control for maximum S-meter reading.

TRANSMIT

Set the transverter BAND switch to the OFF position. Prior to tuning the transverter, the HF equipment must be tuned to the 10 meter band with

a dummy load connected to the HF antenna terminal of the transverter.

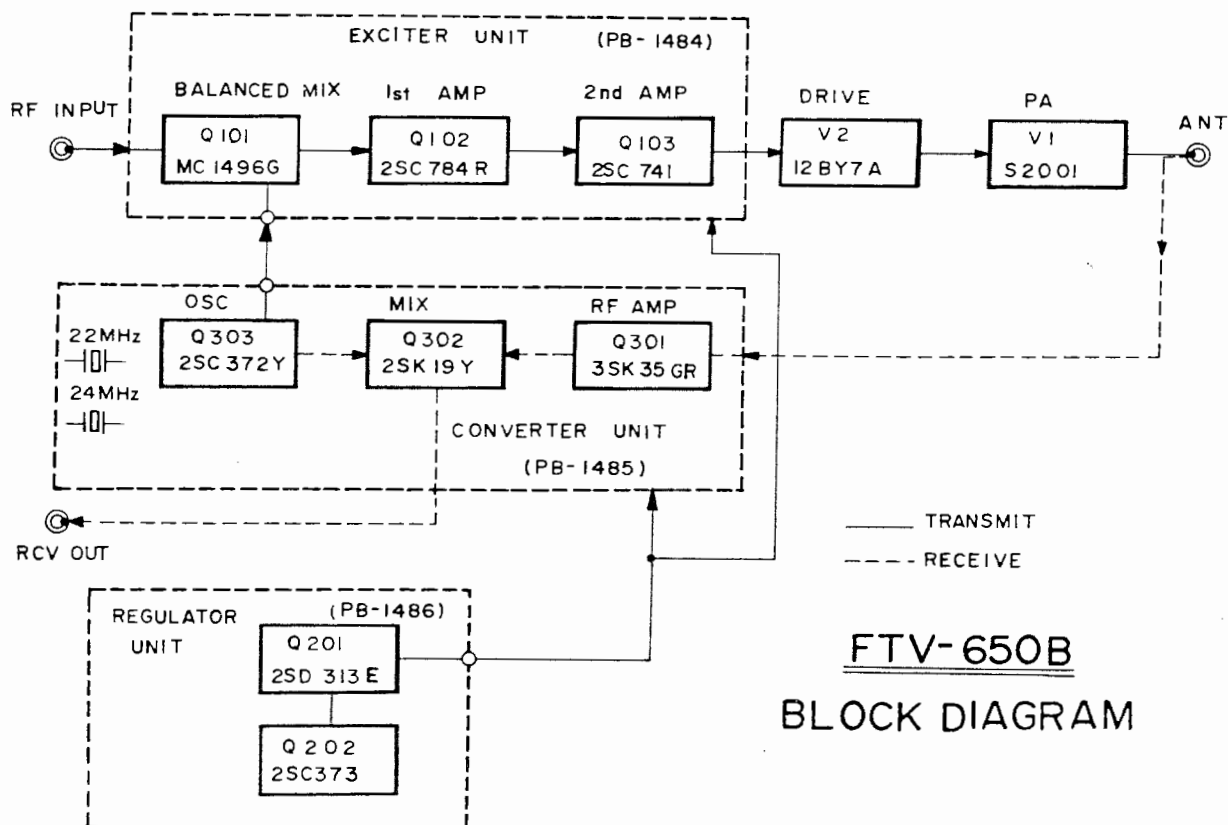
After the completion of the HF equipment tune up, set the transverter meter switch to the INPUT position and the BAND switch to a desired segment. Wait for 30 seconds for warm up of the tubes.

Set the HF equipment to the transmit mode. Peak the preselector or drive control of the HF equipment for maximum input meter reading. Adjust the MIC GAIN or CARRIER control until the meter indication stays in the green portion of the scale at the maximum drive. Set the meter switch to the IC position and tune the TUNE control for maximum IC reading. Set the meter switch to the PO position and adjust the PLATE and LOADING controls for maximum PO meter indication. The meter indicates 80 mA at the maximum input when the meter switch is set to the IC position.

It is recommended to set the meter switch to the INPUT position and observe the meter indication so as not to exceed the green portion during the operation. On the AM mode, set the CARRIER control until the meter shows 1/4th of the green scale with the meter switch at the INPUT position and adjust the MIC GAIN control until the meter slightly kicks up at the voice peak.

CIRCUIT DESCRIPTION

The block diagram and following circuit description will provide you with a better understanding of this transverter.



RECEIVER

The 50 MHz input signal from the antenna is fed through the antenna relay and RF attenuator to the converter printed board, PB1485. The signal passes through the 28 MHz trap, consisting of L306 and C303, and fed to the RF amplifier Q301, 3SK35GR, MOS FET.

The amplified signal is heterodyned by the mixer Q302, 2SK19Y, with the signal delivered from the heterodyne crystal oscillator Q303, 2SC372Y, and produces the IF signal of 28 MHz.

The heterodyne oscillator Q303, 2SC372Y, generates the 22 MHz or 24 MHz crystal controlled signal which is selected by the diode switch.

The heterodyne signal is also fed to the mixer stage in the transmitter section of the transverter.

TRANSMITTER

The 28 MHz signal from the HF transmitter is fed to the dual balanced mixer Q101, MC1496G, where the incoming signal is heterodyned with the local oscillator signal producing a 50 MHz transmitting signal. The spurious signal generation is extremely reduced by the use of the dual balanced mixer.

The 50 MHz signal from the mixer is fed to the grid of transmitter driver V2, 12BY7A, where it is amplified to a level sufficient to drive the final linear amplifier V1, S-2001. Neutralization of the power amplifier is accomplished by feeding back a small amount of the output through a neutralizing capacitor, VC4, to the 12BY7A plate circuit. The driver stage is also neutralized by C17. The final output is fed through the pi network, antenna relay and low-pass filter consisting of L10, L11, C22, C23 and C24 to the antenna terminal. A small portion of the RF output voltage is delivered through C401 to the RF rectifier D401 to indicate the relative power output.

The ALC (automatic level control) voltage is obtained by D1 and D2, 1S1555, and supplied through the power-socket to the exciter stage to control the driving level.

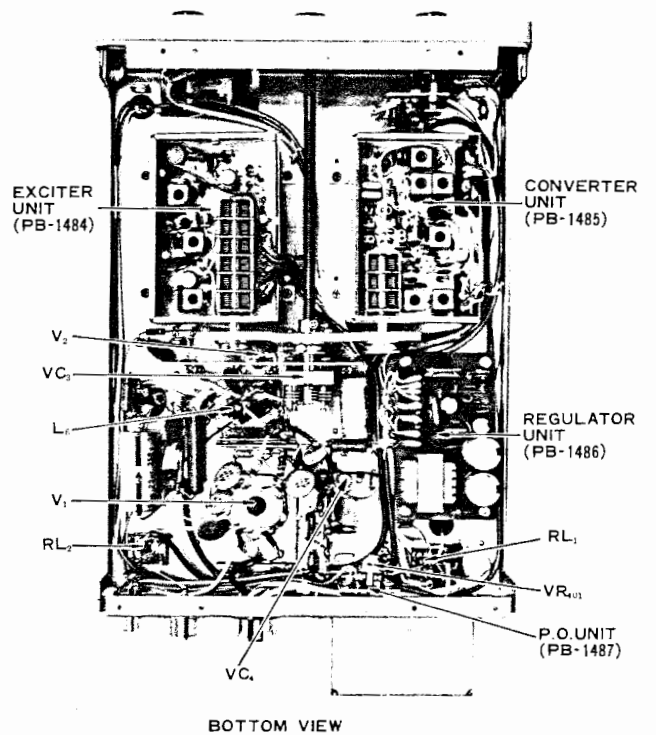
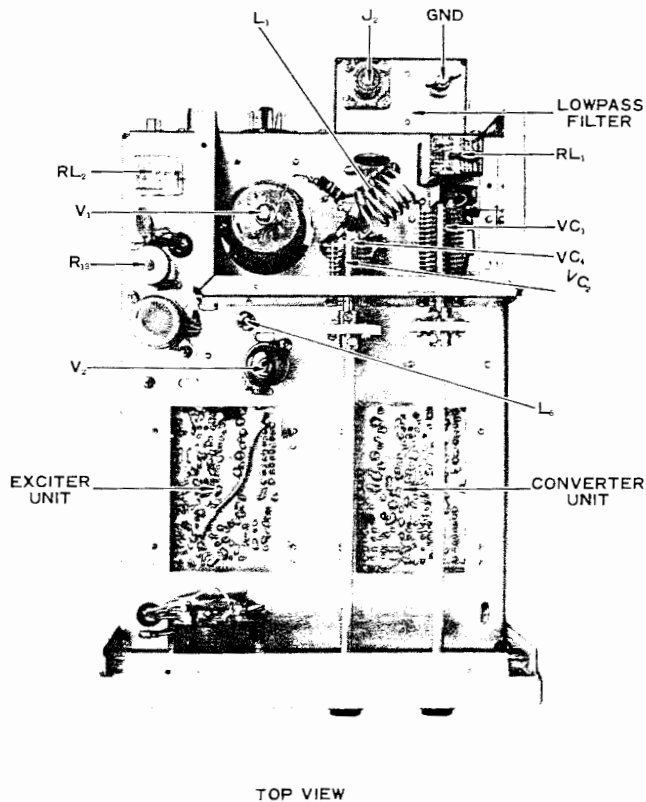
POWER SUPPLY

The power is delivered through the power socket, J4, from the main HF transmitter.

The socket is connected as follows:

| | | | |
|------------------|-------|-----------------|-------|
| Pin 2 : AC 12.6V | 3.5A | Pin 3 : DC 150V | 30 mA |
| Pin 4 : DC 300V | 50mA | Pin 5 : DC 600V | 150mA |
| Pin 6 : DC 100V | 200mA | Pin 7 : ALC | |
| Pin 8 : Ground | | | |

The relay and transistor voltage is obtained from the heater supply voltage. For AC operation, the heater supply voltage is rectified by D201, V06B, for the low DC supply. The low DC voltage is regulated by Q201, 2SD313, and Q202, 2SC373, for the transistor use.



MAINTENANCE AND ALIGNMENT

The FTV-650B transverter has been carefully aligned and tested at factory prior to shipment. With normal usage, it should not require other than the usual attention given to electronic equipment. Service or replacement of a major component may require subsequent realignment, but under no circumstances should realignment be attempted unless the operation of the transceiver is fully understood, and the malfunction has been analyzed and definitely traced to the misalignment.

Service work should only be performed by experienced personnel, using the proper test equipment.

TEST EQUIPMENT REQUIRED

- (1) RF signal generator with one volt output at an impedance of 50 ohms and a frequency coverage to 60 MHz.
- (2) Vacuum Tube Volt Meter (VTVM), Hewlett-Packard Model 401B, or equivalent with an RF probe workable up to 60 MHz.
- (3) Dummy load, Yaesu YP-150, or equivalent with 50 ohm non-reactive load rated at 150 watts average power.

BIAS ADJUSTMENT

Set the transverter/transmitter to SSB mode without modulation. Adjust VR202 on the regulator unit for 30mA idle current on transmit.

NEUTRALIZATION

When replacing the final amplifier tube, it may be necessary to reset the bias to give the correct idle current and check the neutralization.

CAUTION

HIGH VOLTAGES ARE PRESENT ON UNDERSIDE OF THE CHASSIS AND INSIDE OF FINAL COMPARTMENT. USE GREAT CARE WHILE MAKING ADJUSTMENT.

- (1) Connect a dummy load to the antenna and set the meter to IC position.
- (2) Locate TC4 capacitor shaft in the final amplifier compartment.

- (3) Check the final amplifier idle current in the SSB mode and adjust as described before.
- (4) Tune up the transverter at 54 MHz and adjust the CARRIER control until the meter IC reads 60mA.
- (5) Rotate the PLATE tuning control and observe the dip indicated on the meter. If the dip is not prominent, reduce the loading control slightly 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) Determine which side of the dip rises abruptly. Set the PLATE control slightly to this side of the dip keeping the meter reading below 60mA.
- (7) Using a nonmetallic tuning wand, adjust the neutralization capacitor, VC4, very slightly in the direction which reduces the current shown on the meter.
- (8) Repeat the steps (6) and (7) until the meter indicates a smooth and equal rise on either side of the maximum dip point.

Note: The final compartment cover must be in the place to supply the RF shielding required during the neutralization procedure.

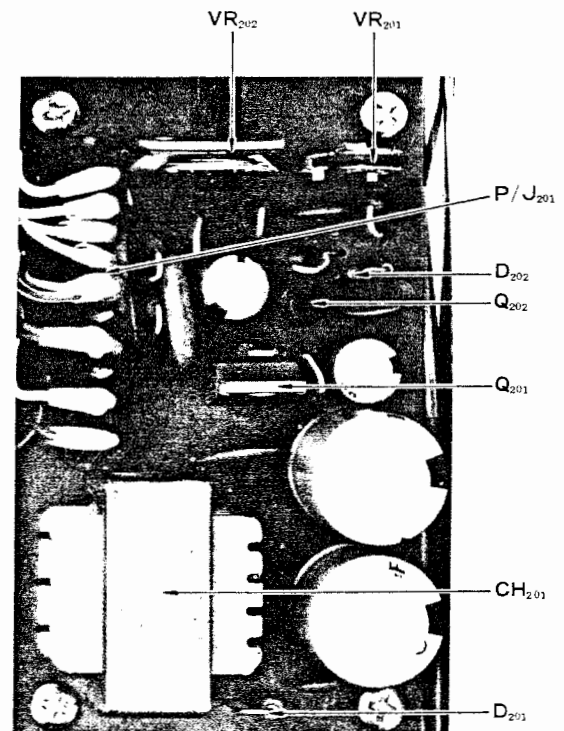
VOLTAGE REGULATOR

Connect a VTVM DC probe between pin 4 of PJ201 (positive) and ground (negative). Adjust VR201 for exactly 9 volt reading on the VTVM.

RECEIVER CONVERTER

The following procedures should be done under the receive condition.

- (1) Connect a RF probe between pin 1 of PJ301 and ground.
- (2) Set the BAND switch to the 52-54 MHz segment. Peak L305 for maximum VTVM reading.
- (3) Set the BAND switch to the 50-52 MHz, and peak TC301 for maximum VTVM reading.



REG UNIT (PB-1486)

- (4) Repeat the steps (2) and (3) until the VTVM reading shows the same value when the BAND switch is changed.

CAUTION

L303 AND L304 ARE ADJUSTED AT FACTORY TO OBTAIN THE FLAT BAND PASS RESPONSE BETWEEN 28 AND 30 MHZ BY USING A SWEEP GENERATOR AND IT IS NOT RECOMMENDED TO ALIGN THESE COILS UNLESS THE SWEEP GENERATOR IS AVAILABLE.

- (5) Set the transverter/receiver to 50 MHz receive mode. Set the TUNE control to 50 MHz. Connect the signal generator output to the antenna jack, J2. Set the frequency of the signal generator to 50 MHz. Peak L301 and L302 for maximum S-meter reading. Reduce the signal generator output when the S-meter reading exceeds S-9.
- (6) Set the signal generator frequency to 29.0 MHz and the main receiver to 29.0 MHz reception. Peak the trap coil, L306, for minimum S-meter reading. If the dip is not prominent, increase the signal generator output.

EXCITER

During the EXCITER, DRIVER and PA tunings, the IC should not exceed 60 mA and the continuous mode of more than 10 seconds may result in the destruction of the final tube.

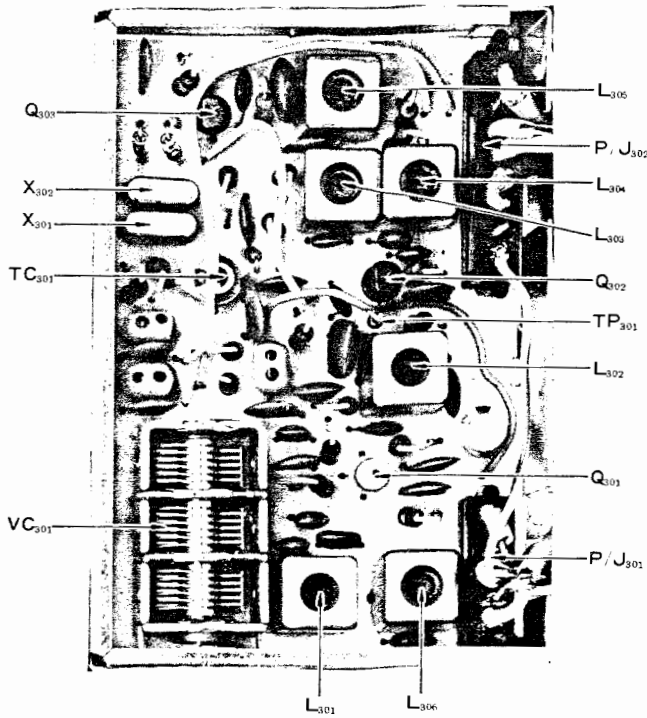
- (1) Set the BAND switch to the 52 - 54 MHz segment.
- (2) Connect a RF probe between TP101 and ground. Adjust TC101 for 120 mV VTVM reading.
- (3) Connect the RF probe between pin 9 and ground. Set the transverter/transmitter to the transmit mode on CW at 52 MHz. Adjust the CARRIER control for 3V VTVM reading. Set the VR101 until the transverter meter indicates the upper end of green portion with the meter switch set to the INPUT position.
- (4) Connect the RF probe between TP102 and ground. Set the transverter/transmitter to 50 MHz and peak L101, L102 and L103 for maximum VTVM reading on transmit.

DRIVER COIL

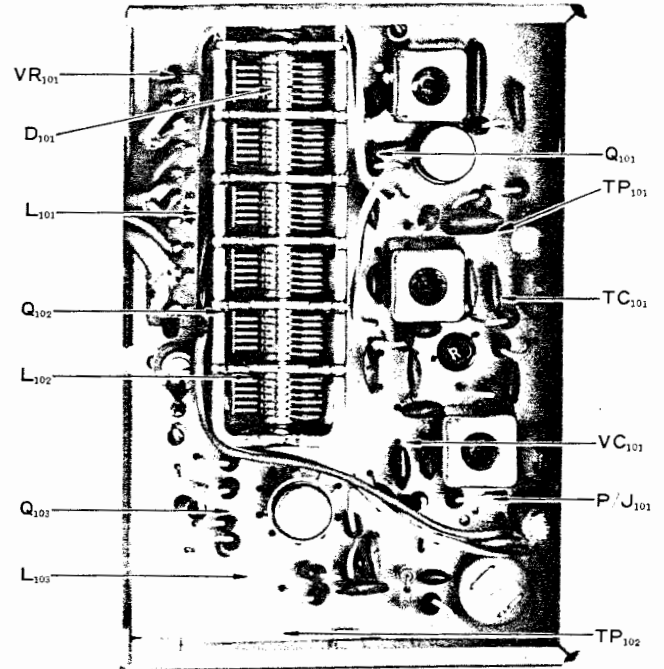
Set the meter switch to the IC position and peak L6 for maximum IC reading.

PO METER ADJUSTMENT

Connect a dummy load to the ANTENNA jack. Tune up the transverter/transmitter to 25 watts output. Set the meter switch to the PO position. Adjust VR401 for the meter reading of 0.8.



CONVERTER UNIT (PB-1485)



EXCITER UNIT (PB-1484)

VOLTAGE CHART

TUBES

T: Transmit R: Receive

| | P | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | |
|--------------|-----|-----|---|---|-----------|-----------|-----|-----|------------|------------|-----|-----|-----------|-----------|-----|-----|-----|-----|---|---|
| | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R |
| V1 S2001 | 650 | 700 | 0 | 0 | AC 6.3 | AC 6.3 | 210 | 260 | 0 | 0 | -50 | -80 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| V2 12BY7A | - | - | 0 | 0 | -44 | -44 | 0 | 0 | AC 12.6 | AC 12.6 | 0 | 0 | AC 6.3 | AC 6.3 | 330 | 350 | 160 | 180 | 0 | 0 |

Measured with VTVM DC20 k ohm/V, AC 8 k ohm/V

SEMICONDUCTORS

Power Supply Unit

| | E | | C | | B | |
|-----------------|-----|-----|-----|-----|-----|-----|
| | T | R | T | R | T | R |
| Q201 2SD313E | 9.0 | 9.2 | 14 | 16 | 9.6 | 9.7 |
| Q202 2SC373 | 6.0 | 6.0 | 9.6 | 9.7 | 6.5 | 6.5 |

Converter Unit

| | E (S) | | C (D) | | B (G1) | | (G2) | |
|-----------------|-------|-----|-------|-----|--------|------|------|-----|
| | T | R | T | R | T | R | T | R |
| Q301 3SK35GR | 0 | 0.8 | 9.0 | 9.0 | -1.4 | 0 | 4.0 | 4.0 |
| Q302 2SK19Y | 0 | 1.5 | 9.0 | 9.0 | -1.5 | 0 | - | - |
| Q303 2SC372Y | 1.5 | 1.5 | 6.5 | 6.5 | 1.75 | 1.75 | - | - |

Exciter Unit

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|---|
| | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R | T | R |
| Q101 MC1496G | 2.4 | 2.4 | 2.2 | 2.2 | 2.2 | 2.2 | 2.4 | 2.4 | 1.1 | 1.1 | 8.5 | 8.5 | 5.6 | 5.6 | 5.6 | 5.6 | 8.5 | 8.5 | 0 | 0 |

| | E | | C | | B | |
|-----------------|-----|------|-----|-----|------|------|
| | T | R | T | R | T | R |
| Q102 2SC784R | 1.0 | 1.25 | 8.8 | 9.0 | 1.5 | 1.7 |
| Q103 2SC741 | 0.3 | 1.25 | 8.4 | 9.0 | 0.95 | 1.15 |

Voltage & Resistance Chart for Printed Boards

| | Exciter Printed Board | | Power Supply Printed Board | | Converter Printed Board | | | |
|----|---------------------------|----------------|----------------------------|----------------|---------------------------|----------------|---------------------------|----------------|
| | PJ101 | | PJ201 | | PJ301 | | PJ302 | |
| | Resis- tor(Ω) | Voltage (V) | Resis- tor(Ω) | Voltage (V) | Resis- tor(Ω) | Voltage (V) | Resis- tor(Ω) | Voltage (V) |
| 1 | 0 | 0 | 3 | AC 12.6 | 0 | 0 | 36 | 9.2 |
| 2 | E | E | 15 | 16 | E | E | E | E |
| 3 | 36 | 9.2 | 16 | 14.5 | 2k * | 12 * | 0 | 0 (-3.2) |
| 4 | E | E | 36 | 9.2 | 0 * | 0 * | E | E |
| 5 | 20k | 0 | E | E | E | E | 0 | 0 |
| 6 | E | E | 0 | 0 (-3.2) | 50 | 0 | - | - |
| 7 | 9k | 1.25 (0) | 30k | -140 (-130) | E | E | - | - |
| 8 | E | E | 19k | -80 (-50) | 0 | 0 (-3.2) | - | - |
| 9 | ∞ | 0 | 9k | -40 (0) | - | - | - | - |
| 10 | - | - | 10k | -46 (-4.6) | - | - | - | - |

* values are nominal

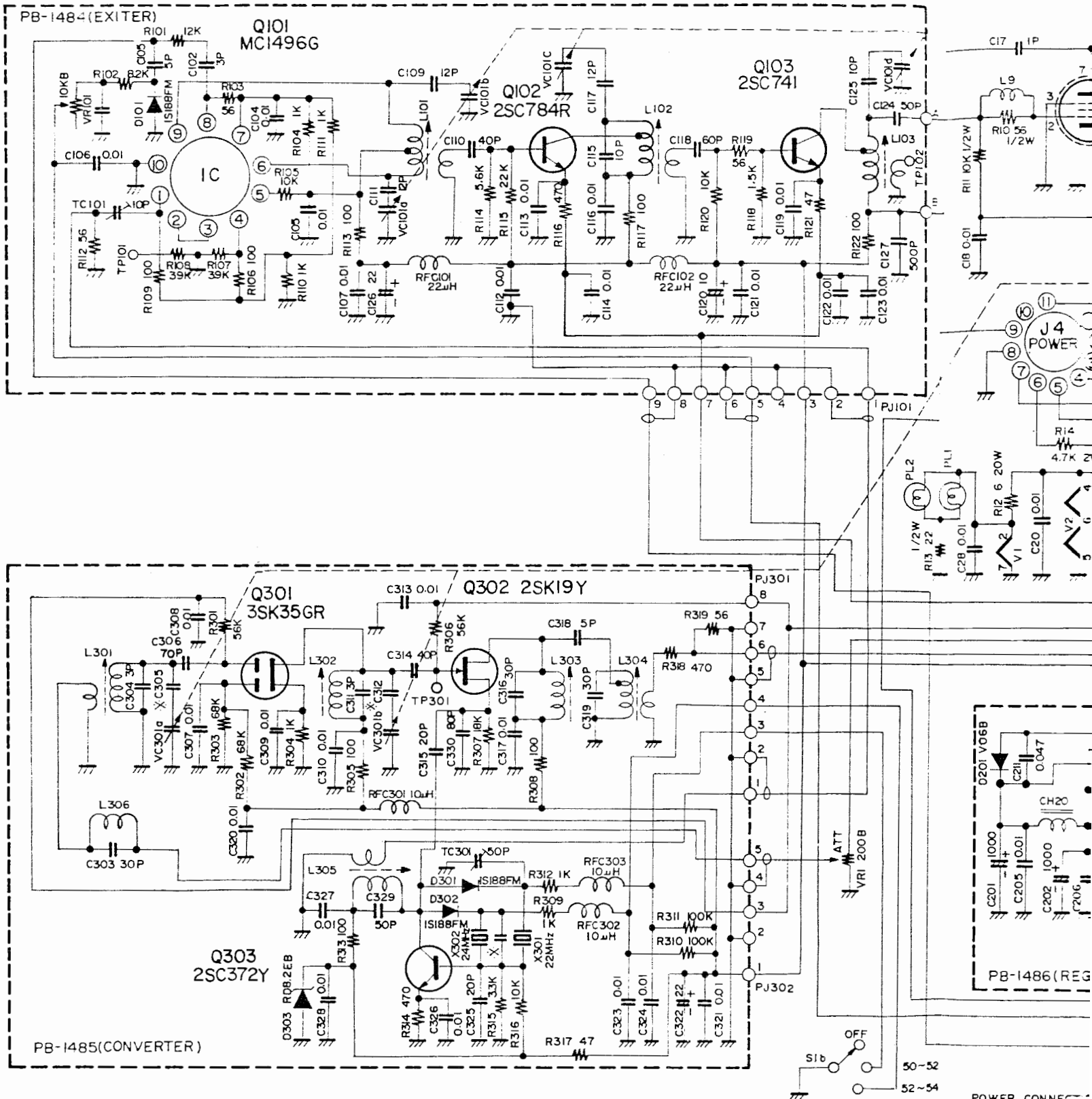
() voltage on transmit

PARTS LIST

| MAIN CHASSIS | | | S-SWITCH | | |
|-----------------------|---------------|-----------|--------------------------|--------------------|-----------|
| V-VACUUM TUBE | | | 1a | HEATER | AM-5116 |
| 1 | S2001 | 1.1465 | 1b | BAND | 1-1-3 |
| 2 | 12BY7A | | 2 | METER | SLE-12301 |
| D-DIODE | | | J-CONNECTOR | | |
| 1, 2 | Si | 1S1941 | 1, 3 | CN7017 | |
| R-RESISTOR | | | 2, 5 | JSO239 | |
| CARBON COMPOSITION | | | 4 | PA603B | |
| 13 | 1/2 W | 22Ω | M-METER | | |
| 5, 9, 10 | 1/2 W | 56Ω | 1 | S-45 | 47819C1 |
| 1 | 1 W | 56Ω | REG UNIT | | |
| 8 | 1/2 W | 1KΩ | PB-PRINTED CIRCUIT BOARD | | |
| 7, 11 | 1/2 W | 10KΩ | 1486 (A~Z) | | |
| 6 | 1/2 W | 22KΩ | Q-TRANSISTOR | | |
| METAL FILM | | | 202 | | 2SC373 |
| 14 | 2 W | 4.7KΩ | 201 | | 2SD313 |
| 3 | 5 W | 4.7KΩ | D D-DIODE | | |
| 2 | 5 W | 15KΩ | 201 | Si | V06B |
| WIRE WOUND | | | 202 | Zener | WZ061 |
| 4 | METER SHUNT | | R-RESISTOR | | |
| 12 | 20W | 6Ω | CARBON FILM | | |
| VR-POTENTIOMETER | | | 203 | 1/4 W | 470Ω |
| 1 | EVH-B7AS15B22 | 200ΩB | 207 | 1/4 W | 820Ω |
| C-CAPACITOR | | | 201, 202, 204 | 1/4 W | 1KΩ |
| MICA | | | 206 | 1/4 W | 3.3KΩ |
| 2 | 1KV | 150PF | 205 | 1/4 W | 4.7KΩ |
| 1 | 3KV | 1000PF | 208 | 1/4 W | 33KΩ |
| DIPPED MICA | | | 209 | 1/4 W | 1MΩ |
| 17, 26 | 500WV | 1PF | VR-POTENTIOMETER | | |
| 15 | 500WV | 3PF | 201 | TR-11R | 1KB |
| 14 | 500WV | 20PF | 202 | V18K | 20KB |
| 22, 24 | 500WV | 50PF | C-CAPACITOR | | |
| 23, 27 | 500WV | 70PF | CERAMIC DISC | | |
| 13 | 500WV | 150PF | 205, 207, 208 | 50WV | 0.01μF |
| 8 | 500WV | 2000PF | 206, 210, 211 | 50WV | 0.047μF |
| CERAMIC DISC | | | 209 | 500WV | 0.01μF |
| 3, 5~7, 10~12 | 500WV | 0.01μF | ELECTROLYTIC | | |
| 16, 18~20, 28, 32 | | | 203 | 16WV | 33μF |
| 21, 33 | 500WV | 0.047μF | 204 | 16WV | 47μF |
| 25 | 1.4KV | 0.0047μF | 201, 202 | 16WV | 1000μF |
| MYLAR | | | CH-CHOKE | | |
| 9 | 50WV | 0.1μF | 201 | SA2-10615 | |
| ELECTROLYTIC | | | J&P-CONNECTOR | | |
| 29 | 250WV | 22μF | 201 | 128-10-10-181 P(S) | |
| 4 | 350WV | 20μF | L-INDUCTOR | | |
| VC-VARIABLE CAPACITOR | | | PO METER UNIT | | |
| 10 | KC-10P | | PB-PRINTED CIRCUIT BOARD | | |
| 2 | MTS-015 | | 1487 (A~Z) | | |
| 3 | MTS-020 | | D-DIODE | | |
| 1 | MTS-100 | | 401 | Ge | 1S188FM |
| L-INDUCTOR | | | R-RESISTOR | | |
| 1 | TANK | | 402 | 1/4 W | 560Ω |
| 2 | RFC | | 401 | 1/4 W | 1KΩ |
| 3 | RFC | 56·1W2T | VR-POTENTIOMETER | | |
| 4, 8, 9 | RFC | 56·1/2W2T | 401 | TR-11R | 10KB |
| 5, 7, 12 | RFC | TV 245 | RL-RELAY | | |
| 6 | DRIVE | | 1 | | |
| 10, 11 | LPF | | 2 | | |
| 13 | RFC | 250μH | MX-2P | | |
| RL-RELAY | | | RABK-4PDC 12V 104T | | |
| 1 | MX-2P | | | | |
| 2 | RABK-4PDC | 12V 104T | | | |

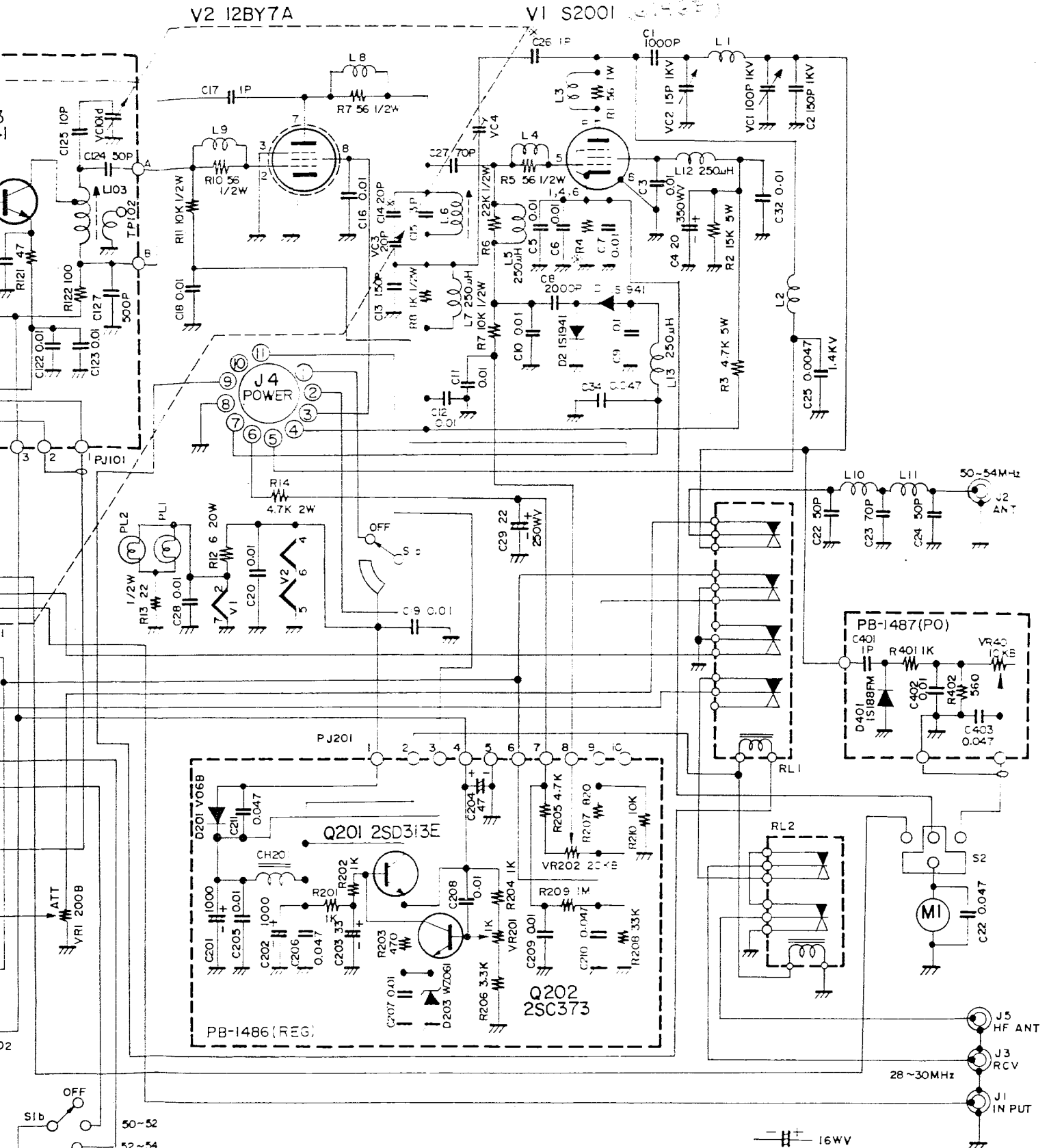
| | | | | | |
|---------------------------------|-----------------|---------------|-------------------------------|------------------|---------------|
| C-CAPACITOR | | | Q-FET & TRANSISTOR | | |
| 401 | DIPPED MICA | | 301 | FET | 3SK35GR |
| | 500WV | 1PF | 302 | " | 2SK19Y |
| | CERAMIC DISC | | 303 | Tr | 2SC372Y |
| 402 | 50WV | 0.01 μ F | | | |
| 403 | 50WV | 0.047 μ F | | | |
| | | | D-DIODE | | |
| | | | 301, 302 | Ge | 1S188FM |
| | | | 303 | Zener | RD8.2EB |
| EXCITER UNIT | | | | | |
| PB-PRINTED CIRCUIT BOARD | | | X-CRYSTAL | | |
| 1484 (A~Z) | | | 301 | HC-18/U | 22MHz |
| | | | 302 | HC-18/U | 24MHz |
| Q-IC & TRANSISTOR | | | | | |
| 101 | IC | MC-1496G | | | |
| 103 | Tr | 2SC741 | | | |
| 102 | " | 2SC784R | | | |
| D-DIODE | | | | | |
| 101 | Ge | 1S188FM | | | |
| R-RESISTOR | | | | | |
| CARBON FILM | | | | | |
| 121 | $\frac{1}{4}$ W | 47 Ω | 317 | $\frac{1}{4}$ W | 47 Ω |
| 103, 112, 119 | $\frac{1}{4}$ W | 56 Ω | 319 | $\frac{1}{4}$ W | 56 Ω |
| 106, 109, 113, 117, 122 | $\frac{1}{4}$ W | 100 Ω | 305, 308, 313 | $\frac{1}{4}$ W | 100 Ω |
| 116 | $\frac{1}{4}$ W | 470 Ω | 314, 318 | $\frac{1}{4}$ W | 470 Ω |
| 104, 110, 111 | $\frac{1}{4}$ W | 1K Ω | 304, 309, 312 | $\frac{1}{4}$ W | 1K Ω |
| 118 | $\frac{1}{4}$ W | 1.5K Ω | 307 | $\frac{1}{4}$ W | 1.8K Ω |
| 114 | $\frac{1}{4}$ W | 5.6K Ω | 315 | $\frac{1}{4}$ W | 3.3K Ω |
| 102 | $\frac{1}{4}$ W | 8.2K Ω | 316 | $\frac{1}{4}$ W | 10K Ω |
| 105, 120 | $\frac{1}{4}$ W | 10K Ω | 301, 306 | $\frac{1}{4}$ W | 56K Ω |
| 101 | $\frac{1}{4}$ W | 12K Ω | 302, 303 | $\frac{1}{4}$ W | 68K Ω |
| 115 | $\frac{1}{4}$ W | 22K Ω | 310, 311 | $\frac{1}{4}$ W | 100K Ω |
| 107, 108 | $\frac{1}{4}$ W | 39K Ω | | | |
| VR-POTENTIOMETER | | | C-CAPACITOR | | |
| 101 | SR19R | 10KB | DIPPED | | |
| | | | 302 | 50WV | 1PF |
| | | | 304, 311 | 50WV | 3PF |
| | | | 301 | 50WV | 4PF |
| | | | 318, 331 | 50WV | 5PF |
| | | | 312 | 50WV | 10PF |
| | | | 305 | 50WV | 12PF |
| | | | 315, 325 | 50WV | 20PF |
| | | | 303, 316, 319 | 50WV | 33PF |
| | | | 314 | 50WV | 39PF |
| | | | 329 | 50WV | 51PF |
| | | | 306 | 50WV | 68PF |
| | | | 330 | 50WV | 82PF |
| C-CAPACITOR | | | CERAMIC DISC | | |
| DIPPED MICA | | | 50WV | | |
| 102 | 50WV | 3PF | 307~310, 313, 317, | 50WV | 0.01 μ F |
| 101 | 50WV | 5PF | 320, 321, 323, 324, 326~328 | | |
| 115, 125 | 50WV | 10PF | ELECTROLYTIC | | |
| 109, 111, 117 | 50WV | 12PF | 322 | 16WV | 22 μ F |
| 110 | 50WV | 39PF | | | |
| 118 | 50WV | 60PF | | | |
| 124 | 500WV | 51PF | | | |
| 127 | 500WV | 510PF | | | |
| CERAMIC DISC | | | TC-TRIMMER CAPACITOR | | |
| 103~107, 112~114 | 50WV | 0.01 μ F | 301 | ECV-1ZW | 50P32 |
| 116, 119, 121~123 | | | VC-VARIABLE CAPACITOR | | |
| ELECTROLYTIC | | | 301~303 | C332A | |
| 120 | 16WV | 10 μ F | | | |
| 126 | 16WV | 22 μ F | | | |
| TC-TRIMMER CAPACITOR | | | P&J-CONNECTOR | | |
| 101 | ECV-1ZW | 10P32 | 301 | 128-8-10-181S(P) | |
| | | | 302 | 128-5-10-181S(P) | |
| VC-VARIABLE CAPACITOR | | | L-INDUCTOR | | |
| 101 | C365A | | 301, 302 | 1034 | |
| | | | 303~306 | 4423 | |
| L-INDUCTOR | | | RFC RF CHOKE | | |
| 101 | MIX | 1032 | 301~303 | | 10 μ H |
| 102, 103 | RF | 1034 | | | |
| RFC | | | | | |
| 101, 102 | | 22 μ H | | | |
| J&P-CONNECTOR | | | | | |
| 101 | 128-9-10-181 | S(P) | | | |
| CONVERTER UNIT | | | | | |
| PB-PRINTED CIRCUIT BOARD | | | | | |
| 1485 (A~Z) | | | | | |

V2 12BY7A



PB-1486 (REG)

- POWER CONNECTIONS:
- PIN2 AC12.6V
 - PIN3 DC150V
 - PIN4 DC300V
 - PIN5 DC600V
 - PIN6 DC-100V
 - PIN7 ALC
 - PIN8 EARTH



POWER CONNECTION (J4)

- PIN2 AC12.6V
- PIN3 DC150V
- PIN4 DC300V
- PIN5 DC600V
- PIN6 DC100V
- PIN7 ALC
- PIN8 EARTH

NOTE

- 1 ALL RESISTORS IN Ω, 1/4W ±10% UNLESS OTHERWISE NOTED.
- 2 ALL CAPACITORS IN μF UNLESS OTHERWISE NOTED.
- 3 X VALUE IS NOMINAL.

**FTV - 650B
CIRCUIT DIAGRAM**