INSTRUCTION MANUAL FV-401

YAESU MUSEN CO., LTD.

TOKYO, JAPAN

FV-401 EXTERNAL VFO

GENERAL

Your FV-401 External VFO has been designed to provide versatile operation of the "F" Line Transceivers.

This unit eliminates the need for a separate receiver or transmitter in order to operate cross-band. For the contest operator, DX chaser, or Net Control Manager, the FV-401 becomes an indispensable adjunct to the station.

Selectable fixed crystal positions provide the Novice with legal operating facilities even during the beginning stages of joining the Ham community. To the Net Control Manager this feature assure exact net control frequency on any band.

Construction of the FV-401 reflects the mechanical rigidity required for long life and dependability. Instrument quality gears provide zero-backlash tuning and accurate frequency readout to less than 1 KHz. Circuit features such as FET oscillator and buffer stages combined with solid-state voltage regulation, guarantees excellent long term stability.

The FV-401 offers advantages to every operator whether Novice or Extra Class. We suggest that the following instructions be read thoroughly to attain maximum operator utilization of the FV-401.

THEORY OF OPERATION

The FV-401 is designed to cover the 80 through 10 meter amateur bands when operated with the FT-DX-400/500 with serial number higher than 313001, FT-DX-560/747 with serial number higher than 308001, and FT-DX-401/570/505 transceivers. The VFO uses a FET transistor 3SK22G as the VFO oscillator and 2SK-

19G as the first buffer, MK-10 as the crystal oscillator, silicon transistor 2SC372Y as the output amplifier and 2SC735Y as the amplifier stage. The silicon transistors 2SC372 and 2SC696 are used to provide voltage regulation. Both VFO and crystal oscillators operate between 8700 KHz and 9200 KHz. This unit may be operated from 6.3V AC or 12V DC power source.

The series-tuned Colpitts oscillator circuit (sometimes called Clapp circuit) is used to provide very low oscillator drift.
SSB switching (USB or LSB) in the transceiver is accomplished by changing carrier crystal frequency to either side of the filter center frequency (3180 KHz), thus the carrier is shifted approximately 3 KHz. This 3 KHz carrier shift is cancelled by shifting the VFO frequency an equal amount. Diode D401 connects TC-403 to the VFO tank circuit as determined by the setting of the transceiver mode switch. This circuit is inoperative when the FV-401 is operated with the FT-DX-400/500 transceiver.

The select switch (S1) selects either the VFO, or one of four crystals that may be installed in the FV-401. In VFO position, S1c connects VFO output to output amplifier stage and S1b supplies the DC voltage to VFO printed board PB-1056. DC

voltage to the crystal oscillator is disconnected. In all of the crystal positions, DC voltage to the crystal oscillator is supplied through Slb and the VFO circuit is disabled. The DC supply voltage to the VFO is supplied from the transceiver.

The operation switch S3 is located on the front panel and marked "NORMAL OPER" and "CROSS OPER" In the "NORMAL OPER", the DC voltage for the transceiver VFO is disconnected and FV-401 controls frequency for both receive and transmit independent of the transceiver VFO select switch.

In the "CROSS OPER", VFO select switch of the transceiver selects the VFO. In the "NOR" position of transceiver select switch, the internal VFO controls the frequency both transmit and receive. In the "RX EXT" position, FV-401 VFO controls receive frequency and the internal VFO controls transmit frequency. In the "TX EXT" position, FV-401 VFO controls transmit frequency and the internal VFO controls receive frequency.

This cross operation is possible for the model FT-DX-560/747 and FT-DX-401/570/505 transceivers. This operation is also possible for the FT-DX-400/500 transceiver with serial numbers 313001 or higher.

INSTALLATION

Power Requirements

When the FV-401 is operated together with the FT-DX-400/500, 560/747, 401/570/505, the power is supplied from the transceiver. 6.3V AC from the transceiver is rectified by D202, D201 voltage doubler rectifier circuit, and regulated by TR201 and TR202. DC 12V may also be used.

For the FT-DX-560/747 and FT-DX-401/570/505, 6.3 V AC is used for the pilot lamp, and rectified DC voltage is used for the output amplifier.

External Connection

Connect J1 output jack of FV-401 to J7 external VFO jack of the transceiver with coax cable supplied.

Connect J2 POWER socket of the FV-401 to J8 VFO POWER socket of the FT-DX-560/747, 401/570/505 transceiver with the power cable supplied without any modification.

Connect J2 POWER socket of the FV-401 to J5 ACC socket of the FT-DX-400/500 transceiver with the power cable modefied as follows.

Power to the FV-401 is then supplied from the transceiver.

Modifications

In order to use the FV-401 with the FT-DX-400/500 transceiver, output circuit and the power cable of FV-401 should be modefied as follows :

(1) Output circuit modification ;-
Solder the 180 uuf mica capacitor in parallel with the capacitor C1, 820 uuf, which is connected between the output jack (J1) and ground, as illustrated in the **Figure 1.**

(2) Power cable modification;-
Replace the 7-pin plug with 11-pin accessory plug of the FT-DX-400/500 transceiver as illustrated in the **Figure 2.**

(3) Power socket modification ; —

Connect between Pin 2 and Pin 6 of the Power socket (J2).

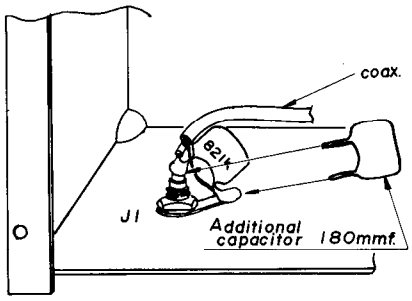


FIG. 1

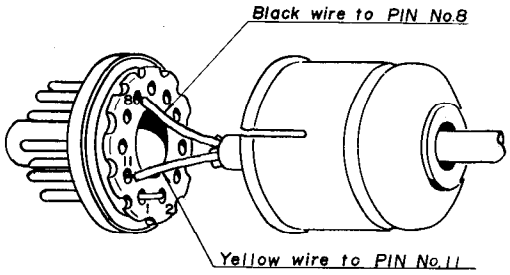


FIG. 2

TEST & ALIGNMENT

Equipment Required

1. FT-DX-400/500/560/747/401/570/505 Transceiver
2. Vacuum Tube-volt-ohm meter
3. Suitable alignment tools for capacitors

The VFO linearity has been aligned in the factory and it is not recommended to align the VFO linearity.

Temperature Compensating Adjustment

Since practically no heat is generated within the FV-401 cabinet, temperature compensation should not be necessary. In case of extreme ambient temperature change the temperature compensating capacitor may be adjusted to provide most adequate compensation.

Drift towards a lower dial reading with increasing temperature on 80 meters indicates insufficient compensation and compensating trimmer TC402 should be rotated clockwise to increase compensation. Drift towards a higher dial reading with increasing temperature indicates excessive compensation and TC402 should be rotated counter clockwise to decrease compensation.

Sideband Switching

For the operation with the FT-DX-560/747 or FT-DX-401/570/505 transceiver, set the FV-401 select switch to the VFO position and the operation to "NORMAL OPER" position. Set the mode switch on the transceiver to LSB and tune a calibrator marker at 3.8 MHz to zero beat with the FV-401 VFO. Change the mode switch to USB. The frequency obtained should be zero beat. If it is not, adjust TC403 for zero beat.

INTERCONNECTIONS

FT-DX-400/500

FT-DX-400/500 — **FV-401**

VFO Socket —(Coax)— VFO Out (J1)

ACC Plug (11p) — Power Plug (J2)

- Pin 8 —(E.)— Pin 1
- Pin 11 —(AC 6.3V)— Pin 5) short
- Pin 7)

FT-DX-560/747/401/570/505

FT-DX-560/747/401/570/505 — **FV-401**

VFO Socket —— VFO Out (J1)

VFO Power Plug (7p) — Power Plug (J2)

- Pin 1 —(E.)— Pin 1
- Pin 2 —(DC 9V)— Pin 2
- Pin 3 —(DC 9V)— Pin 3
- Pin 4 —(DC 9V)— Pin 4
- Pin 5 —(AC 6.3V)— Pin 5) short
- Pin 7)
- Pin 6 —(DC 260V or 0V)— Pin 8

OPERATION

The FV-401 External VFO dial presentation is identical to the transceiver. The main dial covers 500 KHz with 25 KHz readout. The tuning knob skirt provides 1 KHz readout. The dial on the skirt of the tuning knob may be adjusted to exact frequency by tuning to a known frequency, such as the 100 KHz marker crystal calibrator in the transceiver.

Turn the tuning knob for zero beat with the 100 KHz marker. Holding the tuning knob firmly to maintain zero beat, rotate the skirt until the zero mark corresponds with the indice mark. The dial will now agree with 100 KHz zero beat frequency.

Operation Switch

The operation switch controls, the operation of the FT-DX-560/747/401/570/505 transceivers and the FV-401 as follows :

FV-401 "NORMAL OPER" : In the "NORMAL OPER" position, select switch in the transceiver has no effect on the transceiver VFO. In this position the FV-401 controls both transmit and receive frequencies of the transceiver, i.e. the FV-401 takes the place of the internal VFO in the transceiver.

FV-401 "CROSS OPER" : In the "CROSS OPER" position, select switch in the transceiver recovers its function. In the "NOR" position, the transceiver acts as a transceiver with its built-in VFO. In the "TX EXT" position, the FV-401 VFO controls frequency in transmit and the transceiver VFO controls receive frequency. In the "RX EXT" position, the FV-401 VFO controls frequency in receive and the transceiver VFO controls frequency in transmit.

For the operation with the FT-DX-400/500 transceiver, the operation switch of the FV-401 is independent with the operating frequency. The VFO which determines operating frequency is selected by the SELECT switch of the transceiver.

VFO SELECT switch of the transceiver : In " INT " position, the transceiver work as a transceiver with its built-in VFO.
In "RX EXT" position, the FV-401 VFO controls receive frequency and transceive VFO controls frequency in transmit.
In "TX EXT" position, the FV-401 VFO controls transmit frequency and transceive VFO controls frequency in receive.
In the "EXT" position, the FV-401 VFO controls both transmit and receive frequencies.

Select Switch

In the VFO position, the FV-401 operates as a variable frequency oscillator. In th CH1, CH2, CH3 and CH4 positions, the FV-401 operates as a crystal controlled oscillator on one of four frequencies.

Crystals are inserted into sockets on the chassis of the FV-401 which correspon to the SELECT switch. No crystals are supplied with the FV-401.

CRYSTAL CONTROL OPERATION

The crystal holders accept standard HC-6/U type crystals. All crystal frequencies fall between 8700 KHz and 9200 KHz. To permit proper frequency adjustment for SSB operation, trimmer capacitor has been connected in parallel to each crystal. Adjustment of this trimmer will change the crystal frequency about 1 KHz.

The correct crystal frequency for any desired operating frequency, may be determined by the following formula :

$$Fx = (Fl + Fc) - Fo$$

Fx =(Fl + Fc)− Fo, where Fx is the crystal frequency, Fo is the desired operating frequency, and the constant (Fl + Fc) is taken from the table.

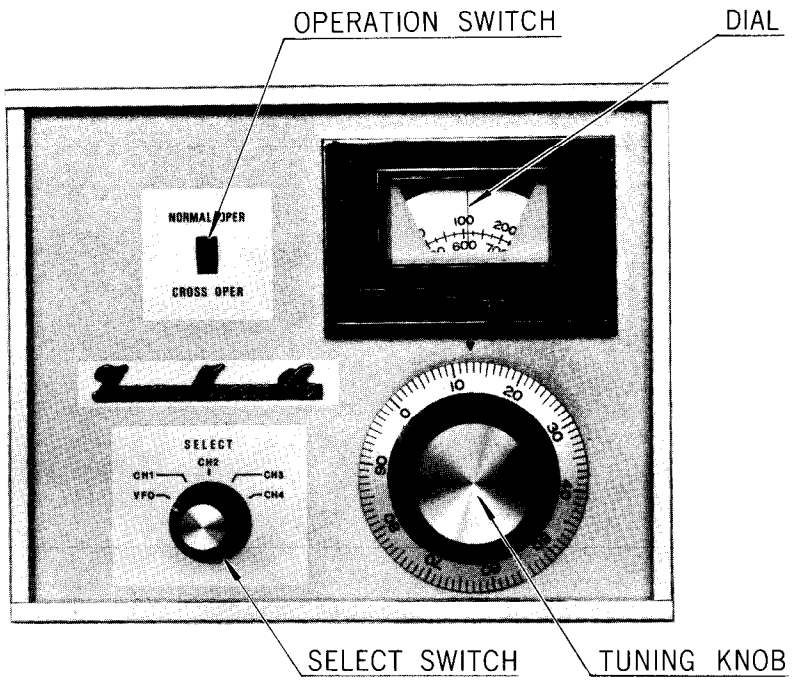
BAND	USB	LSB
	(Fl + Fc)	(Fl + Fc)
80	12698.5	12701.5
40	16198.5	16201.5
20	23198.5	23201.5
15	30198.5	30201.5
10A	37198.5	37201.5
10B	37698.5	37701.5
10C	38198.5	38201.5
10D	38698.5	38701.5

For Example :

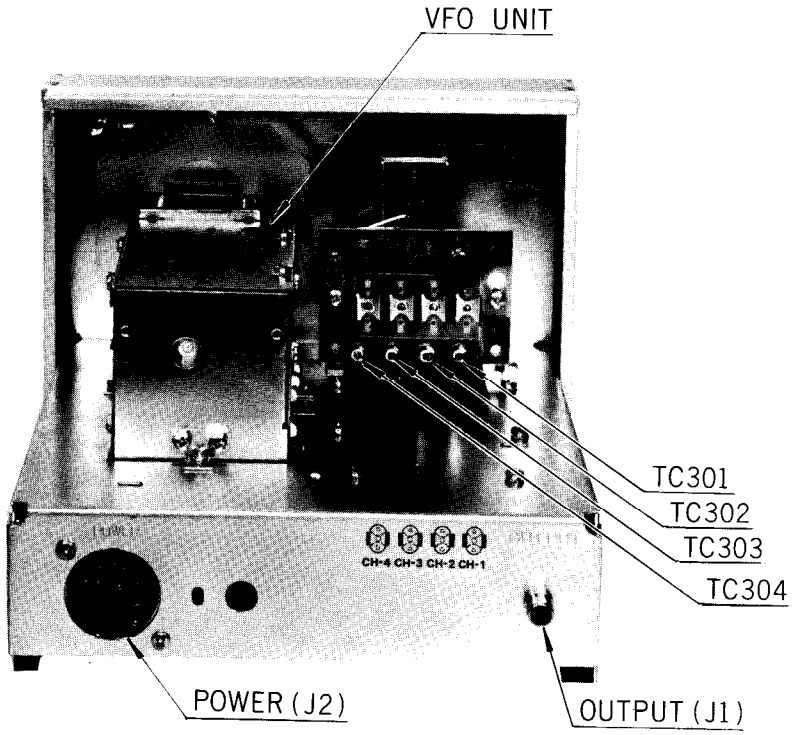
Find the proper crystal for operation at 3900 KHz LSB on the 80 meter band.

From the table find the constant (Fl + Fc) for LSB operation on this band. The constant is 12701.5, therefore ;

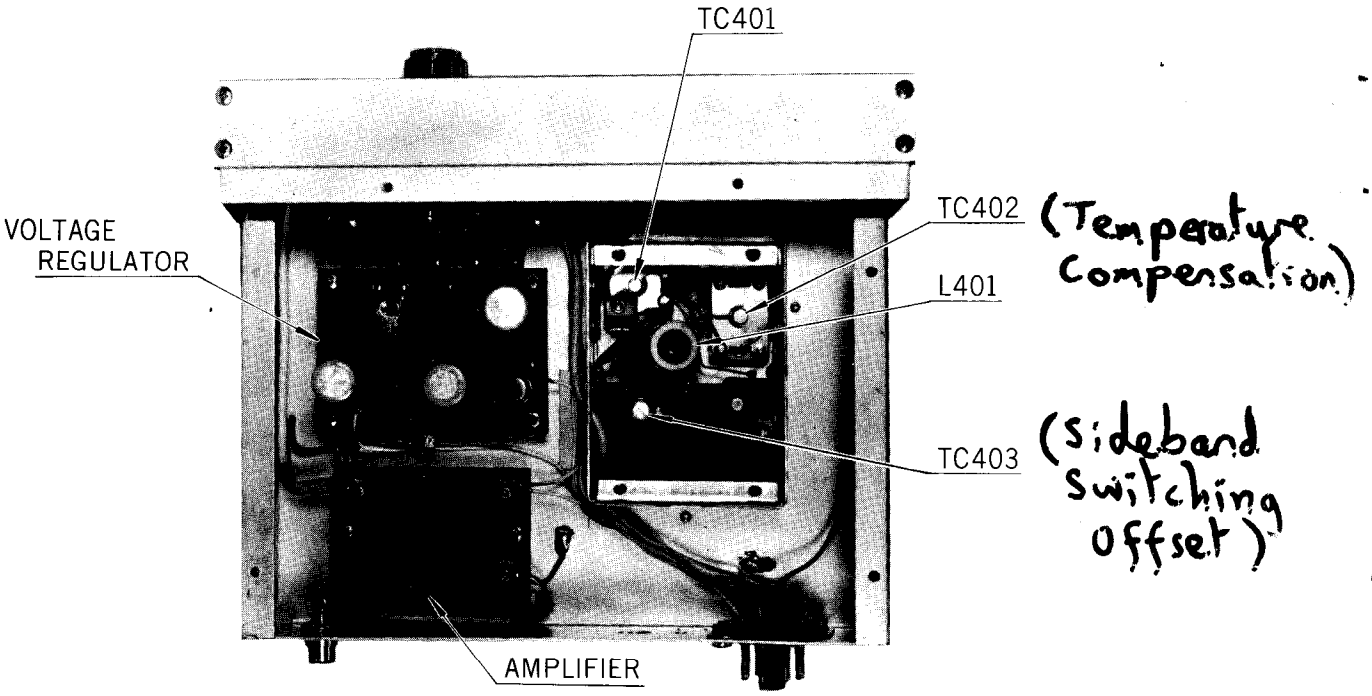
$$Fx = 12701.5 - 3900$$
$$Fx = 8801.5 \text{ KHz}$$


OPERATION SWITCH
DIAL
NORMAL OPER
CROSS OPER
100
200
600
SELECT
CH2
CH1
CH3
VFO
CH4
0
10
20
30
40
50
60
70
80
90
SELECT SWITCH
TUNING KNOB

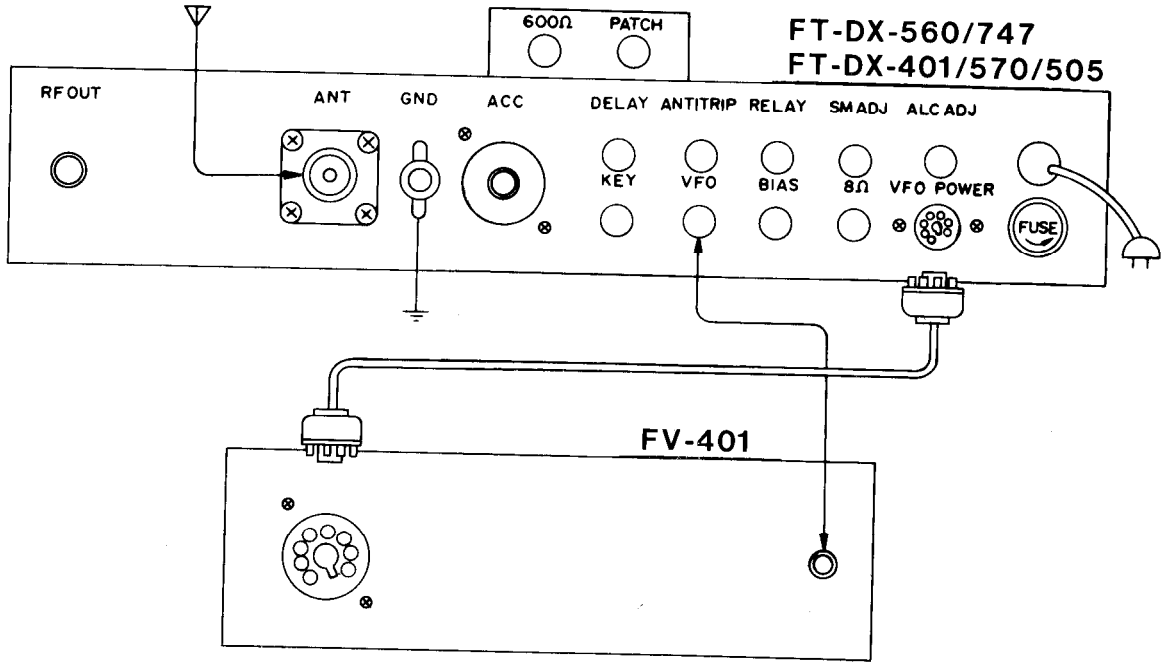
FRONT VIEW


VFO UNIT
TC301
TC302
TC303
TC304
CH-4 CH-3 CH-2 CH-1
POWER (J2)
OUTPUT (J1)

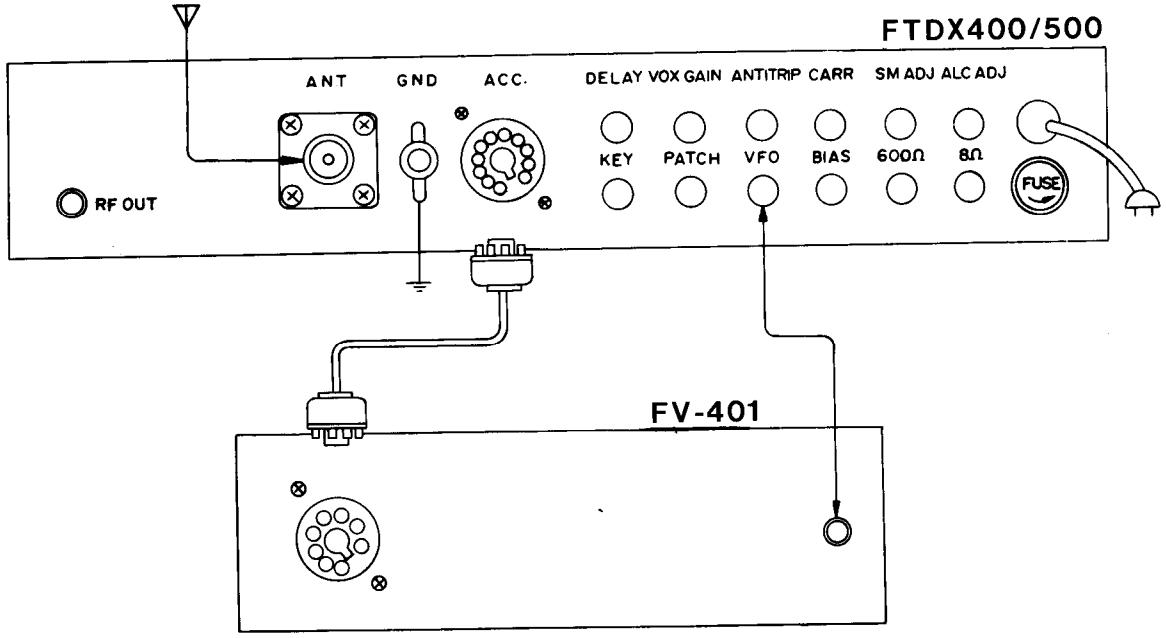
REAR VIEW

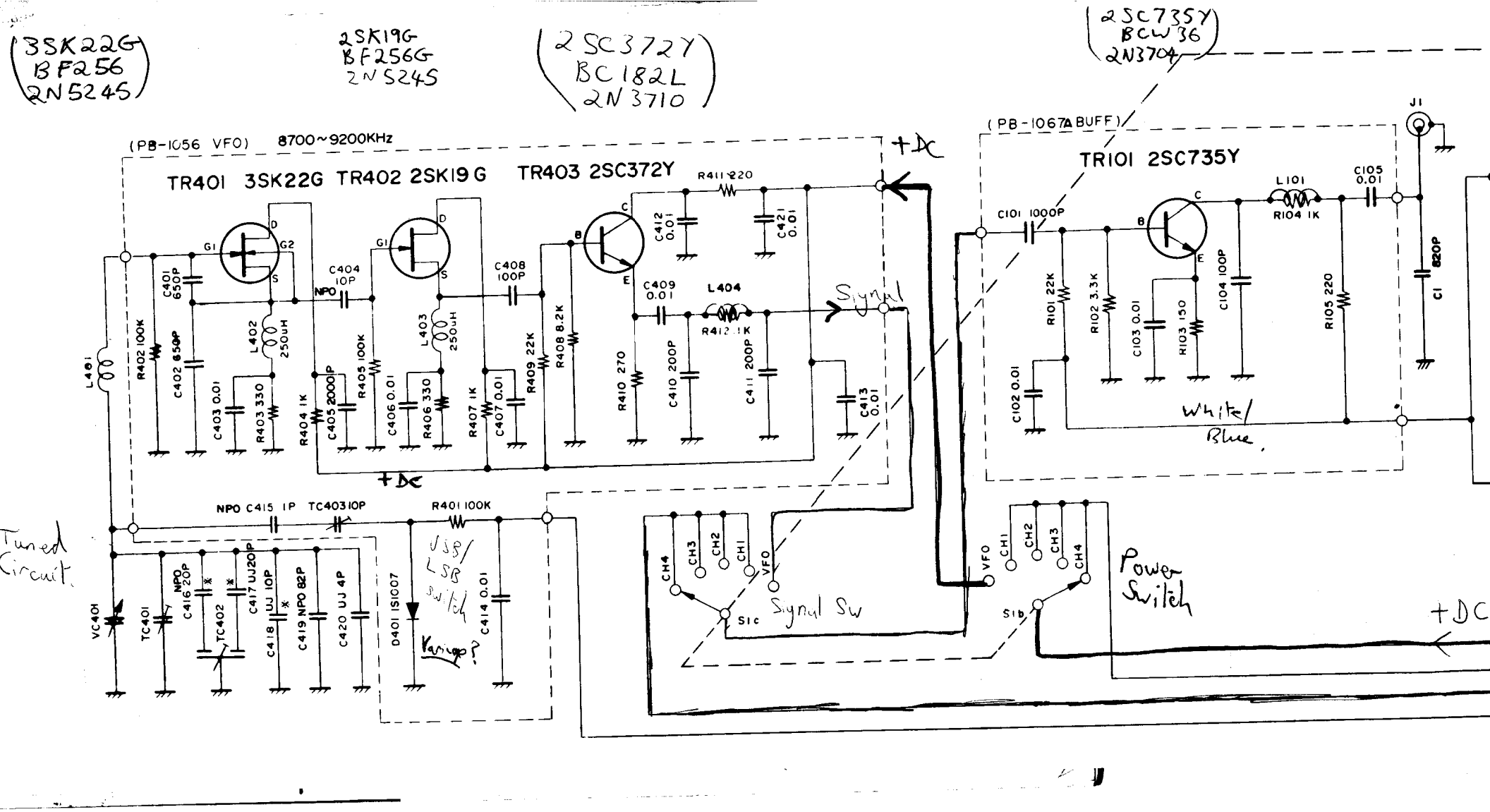

TC401
VOLTAGE REGULATOR
TC402
(Temperature Compensation)
L401
TC403
(Sideband Switching Offset)
AMPLIFIER

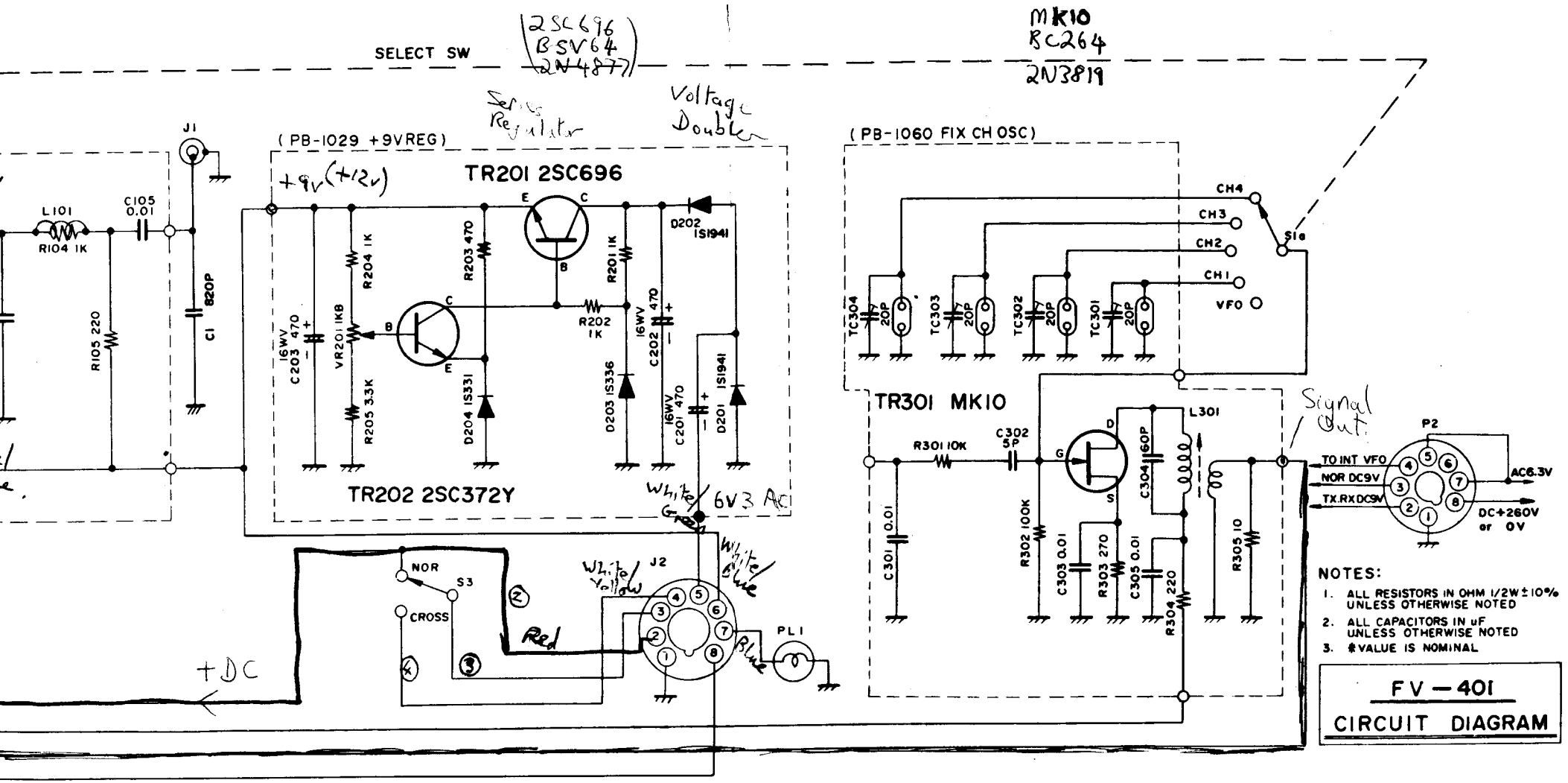
BOTTOM VIEW


600Ω
PATCH
FT-DX-560/747
FT-DX-401/570/505
RF OUT
ANT
GND
ACC
DELAY
ANTITRIP
RELAY
SM ADJ
ALC ADJ
KEY
VFO
BIAS
8Ω
VFO POWER
FUSE
FV-401

9040
8050


FTDX400/500
ANT
GND
ACC.
DELAY VOX GAIN ANTITRIP CARR
SM ADJ ALC ADJ
KEY
PATCH
VFO
BIAS
600Ω
8Ω
FUSE
RF OUT
FV-401


3SK22G
BF256
2N5245
2SK19G
BF256G
2N5245
2SC372Y
BC182L
2N3710
2SC735Y
BCW36
2N3704
(PB-1056 VFO) 8700~9200KHz
TR401 3SK22G TR402 2SK19G TR403 2SC372Y
(PB-1067Δ BUFF)
TR101 2SC735Y
+DC
Signal
Tuned Circuit
VSB/LSB Switch
Varicap?
Signal Sw
Power Switch
White/Blue
VFO
CH1
CH2
CH3
CH4
S1A
S1B
S1C
L401
L402 250uH
L403 250uH
L404
L101
R401 100K
R402 100K
R403 330
R404 1K
R405 100K
R406 330
R407 1K
R408 8.2K
R409 22K
R410 270
R411 220
R412 1K
R101 22K
R102 3.3K
R103 150
R104 1K
R105 220
C401 650P
C402 650P
C403 0.01
C404 10P NPO
C405 2000P
C406 0.01
C407 0.01
C408 100P
C409 0.01
C410 200P
C411 200P
C412 0.01
C413 0.01
C414 0.01
C421 0.01
C101 1000P
C102 0.01
C103 0.01
C104 100P
C105 0.01
C1 820P
NPO C415 1P
TC403 10P
VC401
TC401
NPO C416 20P
TC402
C417 UJ20P
C418 UJ 10P
C419 NPO 82P
C420 UJ 4P
D401 1S1007
J1



NOTES:

1. ALL RESISTORS IN OHM 1/2W ± 10% UNLESS OTHERWISE NOTED
2. ALL CAPACITORS IN uF UNLESS OTHERWISE NOTED
3. * VALUE IS NOMINAL

FV-401
CIRCUIT DIAGRAM

YAESU