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Courtesy of Greg, VA3VFO
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INSTRUCTION MANUAL

FT-102

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

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FT-102
HF ALL MODE TRANSCEIVER



GENERAL DESCRIPTION

The FT-102 presents the amateur radio operator with a unique combination of the latest designs specifically directed toward the best receiver performance and transmitter signal purity that can be achieved with today's state-of-the-art electronics. All band coverage is provided for CW, SSB and SSTV operation and AM reception, while AM transmission and FM operation are possible when the optional AM/FM unit is installed.

PLL frequency synthesis provides both stable local and BFO signals, kept exceptionally clean by using six VCOs; while the all-new VFO design incorporates a special IC allowing remarkable stability and simplicity of construction.

The unique 24 VDC receiver front end employs four JFETs for the high I_{dss} RF amplifier and mixer, and the RF amplifier may be switched out of the circuit for those situations that call for extraordinarily wide dynamic range. IFs of 8.2 MHz and 455 kHz assure freedom from images while providing maximum potential for tailoring of the IF passband. A completely new circuit design is used to provide IF shift/width variations with just one control, while independently adjustable IF notch and audio peak filters are also included. The exceptional noise blanker circuit has its blanking pulse width adjustable from the front panel, vastly improving its effectiveness over other designs. Optional crystal filters are available for ten possible parallel or cascaded configurations to provide both narrow CW and SSB bandwidths from 270 Hz to 2.7 kHz, and 6 kHz for AM.

The audio stages of the transmitter include low-cut and high-cut filters for precise tailoring of the audio before it is applied to the modulator. An extra product detector enables monitoring of the transmitter IF, providing for accurate setting of the RF speech processor and audio filters so that the operator can optimize the signal for his personal voice characteristics. Dual front panel metering and a new ALC peak hold system take the guesswork out of tuning up, as well as saving valuable time. The final amplifier design incorporates three 6146B tubes with RF feedback to achieve an improvement in third-order IMD suppression over two-tube and solid state designs by approximately a factor of ten, leaving the FT-102 virtually in a class by itself concerning spectral purity of emissions.

This manual should be studied carefully in order to derive full performance and maximum enjoyment from the FT-102.

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SPECIFICATIONS

GENERAL

Frequency coverage:

Band	Range
1.8	1.8–2.0 MHz
3.5	3.5–4.0 MHz
7	7.0–7.5 MHz
10	10.0–10.5 MHz*
14	14.0–14.5 MHz
18	18.0–18.5 MHz
21	21.0–21.5 MHz
24.5	24.5–25.0 MHz
28, 29	28.0–29.9 MHz

Operating Modes:
LSB, USB(A3J/J3E); CW(A1/A1A); AM(A3/A3E) and FM(F3/F3E)**

Power requirements:
100, 117, 200, or 234 VAC, 50/60 Hz

Power consumption:
Receive: 95 VA (73 VA with heaters off)
Transmit: 440 VA *(for 100 W output)*

Dimensions (WHD):
368 x 129 x 309 (mm)

Weight:
Approx. 15 kg

TRANSMITTER

Power Input:	(1.8–25 MHz)	(28–29.9 MHz)
SSB, CW	240 W DC	160 W DC
AM**	80 W DC	80 W DC
SSTV, FM**	120 W DC	120 W DC

Carrier suppression:
Better than -40 dB at 14 MHz

Sideband suppression:
Better than -60 dB (14 MHz, 1 kHz tone)

Spurious radiation:
Better than -40 dB

Transmitter audio frequency response:
300–2900 Hz (-6 dB) adjustable

Third order intermodulation products:
Better than -40 dB (14 MHz, 100 W PEP)

Negative feedback level:
Approx. -6 dB at 14 MHz

Frequency stability:
Less than 300 Hz drift during the first 30 minutes after 10 minutes warm-up; less than 100 Hz every 30 minutes thereafter.

Modulation types:
A3J/J3E: balanced modulator
A3/A3E**: low level amplitude modulator
F3/F3E**: variable reactance modulator

Microphone input impedance:
Low, 200 to 600 ohms

RECEIVER

Image rejection:
Better than 70 dB from 1.8–21.5 MHz
Better than 50 dB from 24.5–29.9 MHz

IF rejection:
Better than 70 dB

AF output:
1.5 W minimum (8 ohms, 10% THD)

AF output impedance:
4–16 ohms

Selectivity: (-6 dB/-60 dB):
SSB, CW, AM; 2.7/4.8 kHz (with no optional filters), Width adjusts continuously from 2.7 kHz to 500 Hz (-6 dB)
Options:
SSB nar.; CW wide; 1.8/3.1 kHz with XF-8.2HSN filter
CW nar.; 600/1300 Hz with XF-8.2HC filter
CW nar.; 300/800 Hz with XF-8.2HCN filter
CW nar.; 500/1000 Hz with XF-455C filter
CW nar.; 270/600 Hz with XF-455CN filter
AM; 6/12.4 kHz with XF-8.2GA filter

IF notch depth:
Better than 40 dB

* No reception at 10.33 MHz ($f_{LO1}-f_{LO2}$)
** Optional AM/FM *Unit required for AM transmission and FM operation.*

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Sensitivity (worst case, in μV for 10 dB (S+N)/N, except FM):

	(RF AMP ON)	(RF AMP OFF)
SSB (no optional filters)	0.25	1.0
CW (no optional filters)	0.18	0.7
AM (no optional filters)	1.0	4.0
FM** (for 20 dB quieting)	0.4	3.0
CW (with APF on)	0.05	0.2
SSB (with XF-8.2HSN filter installed)	0.2	0.8
CW (with XF-8.2HC filter installed)	0.12	0.5

Dynamic range (with Width Control set for maximum IF width):

	(RF AMP ON)	(RF AMP OFF)
With no optional filters	90 dB minimum	95 dB minimum
With XF-8.2HC installed	95 dB minimum	100 dB minimum
With XF-8.2HCN installed	97 dB minimum	102 dB minimum

** Optional AM/FM Unit required for AM transmission and FM operation.
Specifications subject to change without notice or obligation.

ACCESSORIES

(supplied as standard)

AC POWER cord			1
2 wire, 2 prong plug		T9013280	
3 wire, 3 prong UL plug		T9013282	
3 wire, 3 prong Australian plug		T9013283	
3 wire, 2 prong EU plug		T9013284	
FUSE			2
6A (100–117V AC)		Q0000012	
3A (200–234V AC)		Q0000004	
PHONO PLUG	(STP-58)	P0090018	2
KEY PLUG	(SH3001)	P0090007	1
SPEAKER PLUG	(P2240)	P0090034	1
ACC I PLUG	(E6-701B-02)	P0090032	1
ACC II PLUG	(E5-702B-02)	P0090031	1
EXTENDER FOOT		R3054620	2
PAD		R3054630	2
PLASTIC TUNING TOOL		R3081530	1

TUBES AND SEMICONDUCTORS

Vacuum Tubes:

12BY7A	1
6146B	3

FCD:

FIP9E8	1

ICs:

AN6551	1
MC3359	1
MC4044	1
MC14011B	2
MC14022B	1
MC14081B	2
MC14518BCP	3
ND487C2-3R (Ring Module)	1
SN74LS90	1
SN74LS192	1
SN76514N	2
TA7060AP	1
TA7069P	1
TC5066	3
TC5070	1
TC5081P	1
TC5082P	2
VFO-1	1
μPC78L12	1
μPC78L15	1
μPC577H	1
μPC7808H	1
μPC7812H	2
μPC2002V	1
78L05	1

Transistors:

2SA496Y	1
2SA546AR	4
2SA639Q	1
2SA733Q	6
2SB705R	1
2SC380Y	8
2SC496Y	1
2SC535B	5
2SC732GR	2
2SC732TM-GR	2
2SC945Q	23
2SC1589	1
2SC1815BL	1
2SC1815GR	11
2SC1815Y	27
2SC1971	1
2SC2229	1
2SC2407	2

FETs:

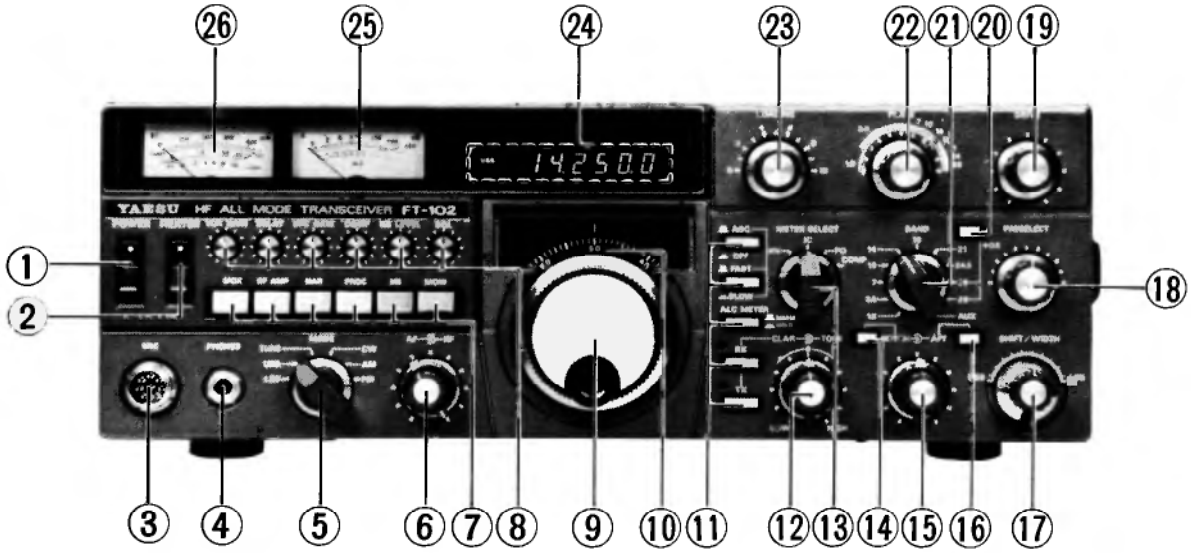
2SK19BL	2
2SK19GR	3
2SK19TM-GR	3
2SK19Y	2
2SK125Y	7
3SK73GR	8

Diodes:

1N60 (Ge Diode)	16
1N270 (Ge Diode)	4
1S1554 (Si Diode)	1
1S1555 (Si Diode)	175
1S2236 (Varactor Diode)	1
1SS53 (Si Diode)	72
1SS97 (Schottky Barrier)	30
1SV50 (Varactor Diode)	2
10D1 (Si Diode)	3
10D10 (Si Diode)	12
AW01-24 (Zener Diode)	1
BZ090 (Zener Diode)	2
FC52M (Varactor Diode	6
FC53M-4 (Varactor Diode)	1
FC63 (Varactor Diode)	1
GD4-203SRD (LED)	2
HZ3C1 (Zener Diode)	2
HZ5C2 (Zener Diode)	2
HZ6C1 (Zener Diode)	1
HZ9C1 (Zener Diode)	1
MV104 (Varactor Diode)	1
S4V10 (Si Bridge)	1
SM1-12 (Si Diode)	1
V06B (Si Diode)	1
WZ110 (Zener Diode)	1

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FRONT PANEL CONTROLS AND SWITCHES



(1) POWER

This is the main ON/OFF switch for the transceiver.

(2) HEATER

With this switch ON, heater voltage is applied to the driver and final amplifier, as well as the cooling fan. For receiving only, turn this switch OFF to conserve energy, if desired.

(3) MIC

Connect a 600 ohm impedance microphone to this 8 pin jack.

(4) PHONES

Connect your headphones (4—16 ohms impedance) to this standard phone jack. If you use stereo headphones with a three-conductor plug you will hear your signal in both ears, as with monaural headphones and a two-conductor plug. Inserting the plug into this jack will disable the speaker.

(5) MODE

This selector is used to determine the FT-102's mode of operation; LSB, USB, TUNE, CW, AM or FM. The TUNE position is used for adjustment of the final amplifier via the LOADING and PLATE controls. Transmission of AM and all operation of FM require the optional AM/FM unit.

(6) AF —⊙— RF

AF

This control adjusts the level of the audio gain of the receiver. Rotate this control clockwise to increase the volume.

RF

This control is the outer of these concentric knobs. Turn this knob clockwise to increase the gain of the RF and IF amplifiers via the AGC voltage. The fully clockwise position is the point of maximum gain, and this control is normally set in this position.

When the RF gain control is turned counter-clockwise from its maximum position the S-meter reading (during receive) will be changed. The minimum meter reading position will be moved up the scale, although the peak S-level of a given signal will remain the same as long as it is greater than the minimum S-meter position set by the control.

(7) Push Button Switches

Push these buttons once for the ON function, and push again for the OFF function (out position).

(A) MOX

This switch allows you to use two hands for adjusting the LOADING and PLATE controls when tuning the final amplifier (MODE selector in TUNE position).

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(B) RF AMP

Push this switch in to switch the RF amplifier ON for maximum sensitivity. In the presence of strong signals or on noisy bands, set this switch to the out (OFF) position for less noise and interference on the receiver.

(C) NAR

Press this switch to activate the narrow SSB or CW filter options (when installed), according to the mode selected by the MODE selector. The interaction of these controls is described in the Receiver Operation Section.

(D) PROC

This switch turns the transmitter RF speech processor on when pressed in.

(E) NB

Push this switch once to turn on the receiver noise blanker when encountering pulse-type interference. Otherwise this switch should be kept in the OFF (out) position for best receiver performance.

(F) MONI

Press this switch to monitor the IF signal via the speaker or headphones during transmission. This enables the operator to monitor the audio signal quality and adjustment of the transmitter. If the speaker is used for monitoring, audio feedback may cause oscillation or unstable VOX operation, requiring careful adjustment of the AF gain, MIC GAIN and VOX GAIN controls. This feedback can be avoided by use of headphones.

(8) Miniature Knobs

These six knobs are normally pressed into a recessed position in the front panel, conveniently placing them out of the way when adjustment is not required. To adjust these controls, press and release the knob you wish to adjust, and it will then pop out to a convenient position. Simply press the knob again to return it to the recessed position.

(A) VOX GAIN

This control adjusts the sensitivity of the VOX (voice-actuated transmit) circuit. Clockwise rotation increases the sensitivity of this circuit to the microphone input.
For CW testing or code practice, by rotating the VOX GAIN control fully counter-clockwise, you can monitor your CW keying via the sidetone oscillator without transmitting over the air.

(B) DELAY

This control adjusts the delay of the VOX switching circuit controlling transmit-to-receive switching, for use during VOX operation or for semi break-in CW delay.

(C) MIC GAIN

This control sets the gain of the microphone audio amplifier in the transmitter during SSB, AM and FM operation. Clockwise rotation increases the gain.

(D) COMP

During SSB transmission, when the PROC switch is ON, this control adjusts the compression level of the RF speech processor.

(E) NB LEVEL

This control adjusts the degree of blanking by the noise blanker circuit when the NB switch is ON. Turning this control clockwise actually increases the width of the blanking pulse, so it should be turned clockwise only to the point where the noise is removed, to avoid blanking too much of the desired signal.

(F) SQL

When the optional AM/FM unit is installed, this control will adjust the point at which the receiver is squelched during FM operation.



(9) TUNING KNOB

Rotate this knob to change the operating frequency. A new VFO design is used in the FT-102, incorporating a special IC developed particularly for the circuit to provide extra stability and VFO circuit simplicity. The tuning knob covers 18 kHz per revolution.

(10) DIAL

This analog dial rotates one full revolution every 100 kHz, and has markings at each 1 kHz, providing a convenient backup to the digital display.

(11) Push Button Switches

(A) AGC

This switch turns the AGC voltage ON or OFF, according to the needs of the operator. With the AGC OFF the S-meter will not function, although the receiver gain can be controlled manually by the RF GAIN control and the relative gain attenuation will then be indicated on the S-meter.

(B) FAST/SLOW

When the AGC switch is in the ON position, this switch selects the AGC decay rate according to the needs of the operator.

(C) ALC METER

This switch, when depressed, activates the "peak hold" circuit for use in adjusting the MIC GAIN and DRIVE controls during SSB transmission. The ALC meter needle will rise to the ALC peak level and hold this indication for one second, after which the needle will drop to zero (if mic input is stopped). When the ALC METER switch is in the NORMAL (out) position, the ALC meter will follow the average ALC voltage.

(D) RX

Depress this button to activate the clarifier function for the receive frequency. The LED indicator beside this button will then light to indicate that the receiver clarifier function is on.

(E) TX

This button activates the clarifier function for the transmit frequency, also indicated by the nearby LED. Either or both of the RX and TX clarifier functions can be used at one time.

(12) CLAR —⊙— TONE

CLAR

When the clarifier function is activated for either receive, transmit or both, this control allows the clarified frequency to be shifted up to plus or minus 2.5 kHz (or more) from the VFO frequency. The actual operating frequency (VFO ± clarifier offset) will be indicated by the display. When the RX and/or TX buttons are returned to the OFF (out) position the operating frequency will return to the original VFO frequency. When the CLAR control is set to the "0" position (straight up) the clarifier frequency is the same as the VFO frequency (no offset).

TONE

This control adjusts the high-cut audio filter in the receiver audio amplifier. Counterclockwise rotation attenuates high frequencies.

(13) METER SELECT

This selector switch determines the function of METER I (26) for monitoring transmitter parameters. It may be switched during transmission without causing damage to the circuitry.

HV

In this position, METER I will indicate the value of the high voltage present at the anodes of the final amplifiers on the innermost scale in hundreds of volts.

IC

With the METER SELECT switch in this position, METER I will indicate the sum total of the current through the cathodes of the final tubes on the outermost scale, in milliamperes.

PO

This function allows the meter to provide a relative indication of the output power to the antenna jack. As the indication is relative, no specific meter scale is provided.

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COMP

This position will cause the meter to indicate the compression, in decibels, of the speech processor when used for SSB transmission, on the second from outermost meter scale.

(14) NOTCH (push button)

This switch activates the IF notch filter when depressed.

(15) NOTCH —◉— APF (controls)
NOTCH

When the IF notch filter is activated this inner knob tunes the center frequency of the IF notch across the IF passband. Its adjustment is independent of the VFO frequency, IF shift/width setting, and the APF frequency.

APF

When the APF circuit is activated this outer knob tunes the center frequency of the audio peak filter. Its adjustment is also independent of the other controls.

(16) APF (push button)

During CW operation, depress this switch to activate the audio peak filter.

(17) SHIFT/WIDTH

This control consists of two knobs friction-coupled for most convenient control over the IF passband during SSB and CW reception. The flange of the round inner knob has a window cut out, through which may be seen a gray and/or black area connected to the outer paddle knob. To adjust the width of the IF passband, rotate one knob while holding the other stationary. The resulting width of the IF passband will then be indicated by the size of the gray zone showing in the window. Once this has been set, rotate both knobs together to shift the IF passband across the incoming signal. Rotating the knobs to the left will pass the upper sideband (USB), and rotating to the right will pass the lower sideband (LSB). Refer to the Operation Section of this manual for additional details.

(18) PRESELECT

This control tunes the driver stage for transmission at the operating frequency. When the RF amplifier is ON, this control also tunes the receiver input to the amplifier.

(19) DRIVE

During CW, AM, FM, and TUNE operation of the transmitter this control adjusts the level of the carrier. During SSB transmission, when the speech processor is in use, this control adjusts the drive level to the processor.

(20) +0.5

When the BAND selector is set to 28 or 29 MHz positions, pressing this button will shift the operating frequency up 500 kHz, so that the operating frequency range will then be 28.5–29.0 MHz or 29.5–29.7 MHz, respectively.

(21) BAND

This selector is used to set the operating frequency band.

(22) PLATE

This control tunes the capacitor in the final amplifier tank circuit. Resonant ranges for each band are marked on the scale, with the 1.8 MHz band range covering the whole scale, and the 3.5 MHz range also overlapping. The setting of this control is dependent upon the impedance of the load (antenna system), so settings may vary slightly for impedances other than 50 ohms.

(23) LOADING

This control matches the impedance of the final amplifier tank circuit with that of the load connected to the antenna jack.

(24) DISPLAY

The fluorescent display includes an indication of the operating mode as well as digital display of the operating frequency to the nearest 100 Hz. CW-N indicates narrow CW, CW-W indicates wide CW, and AM-N shows for all AM operation.

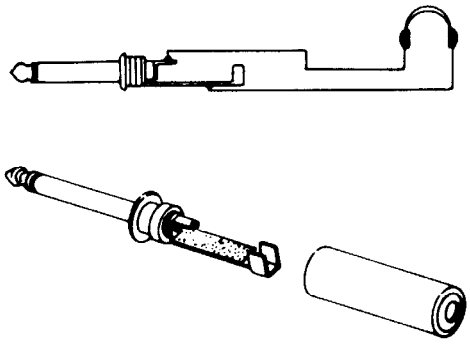
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(25) METER II

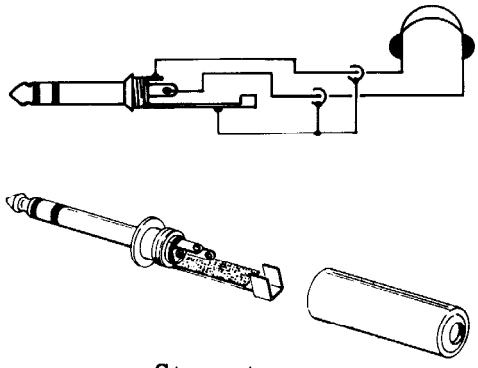
This meter indicates the received signal strength in S-units and decibels above S-9 on the upper scale during receive operation, and ALC level (peak or average) on the lower scale during transmission. The correct ALC operating range is indicated by the black zone at the left side of the scale.

(26) METER I

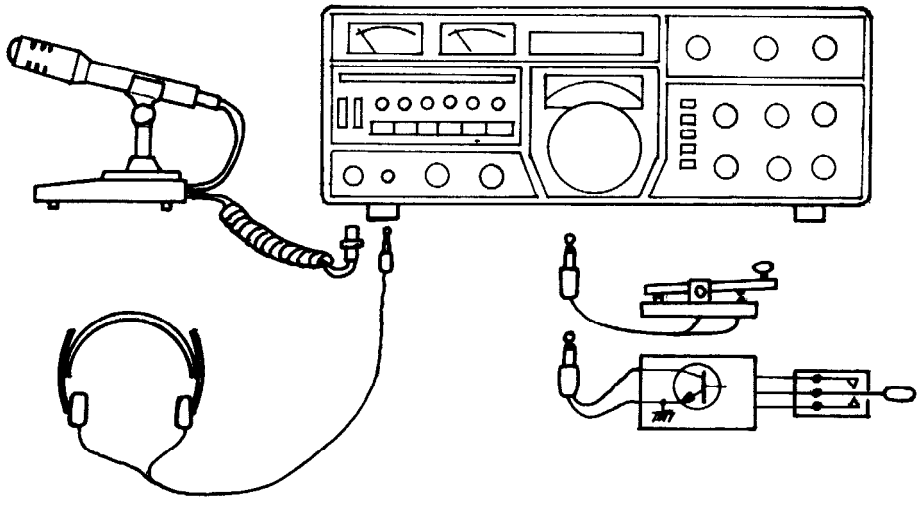
The function of this meter during transmission is determined by the position of the METER SELECT (13) rotary switch. During FM reception this meter functions as a discriminator indicator for tuning purposes using the second from innermost DISC scale, whereby received signals are tuned so that the meter indicates in the center of the scale. During reception of other modes this meter is not used.



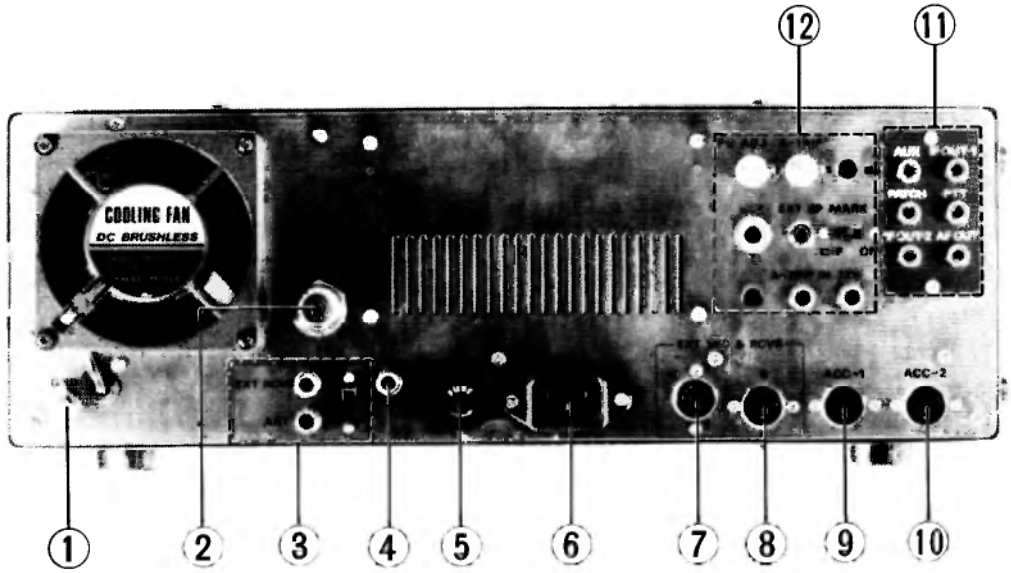
Monaural type



Stereo type



REAR PANEL CONNECTORS AND CONTROLS



(1) GND

For best performance and safety, use this stud to connect the transceiver to a good earth ground through a large braided cable not more than 10 feet long. Ground all other station equipment and accessories to this point.

(2) ANT (coaxial jack)

This standard SO-239 type jack is for connection to the coaxial feedline to the antenna, linear amplifier or antenna coupler. Never transmit without having a load with 50 ohms impedance at the operating frequency connected to this jack.

(3) RX ANT (jacks and switch)

EXT RCVR

This jack may be used to connect an external receiver to the main antenna (connected to the ANT (2) coaxial jack) for operation at the same time as the FT-102 receiver, such as for spotting during contest operation. This jack connects through the T-R relay so that is automatically disconnected from the antenna whenever the FT-102 is transmitting. However, special care must be exercised to ensure that no AC, DC or RF energy from a transmitter is ever applied to this jack, as the lamp fuse in the receiver input will blow.

ANT (RCA type jack)

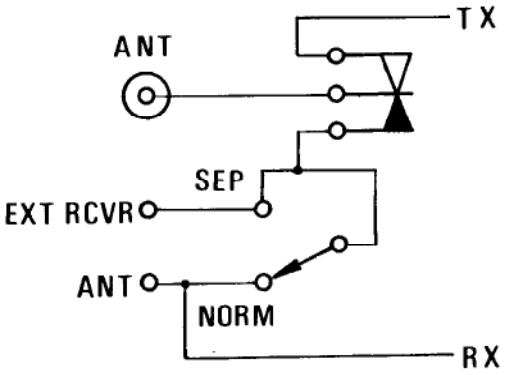
This jack is for connection of a separate antenna for receive only, such as during 1.8 MHz operation using a loop antenna for receiving. Again, special care must be exercised not to allow any power to be applied to this jack.

SEP/NORM (slide switch)

This switch enables the operator to select one of the following receiver/antenna arrangements:

SEP

Receive via external receiver (only) using main station antenna (connected to coaxial ANT jack). Transmit also on main antenna. In this switch position, the FT-102 receiver may be operated from another antenna connected to the ANT RCA jack, but can not use the main antenna.



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NORM

With the slide switch in this position the external receiver (jack) has no connection in the FT-102. However, the FT-102 receiver is connected to both the main antenna (coaxial ANT jack) through the T-R relay and to the ANT RCA jack. Therefore, no connections should be made to the ANT RCA jack if the operator intends to transceiver normally on the main antenna. Any connection to the ANT RCA jack will be connected in parallel with the main antenna during receive, and will function as an independent receive antenna during transmit.

(4) RF OUT

This RCA jack provides low level transmitter output for a transverter. Output signal level is approximately -6dBm (0.1Vrms) at 50 ohms.

(5) FUSE

This fuse holder may be opened with a Phillips screwdriver to replace the fuse. The fuse is a 6 Amp type (3 Amp for 200–234V operation) and must not be replaced with any other value except when changing the operating voltage as illustrated on page 16.

(6) AC

This three-pin connector accepts the AC line cord. Before connecting AC power make sure that the line voltage to be used agrees with the voltage that the FT-102 is wired for. If it is not, rewire the FT-102 power transformer for the available voltage, as shown on page 16. Never connect any DC voltage to this connector.

(7) EXT VFO

Use this DIN jack to connect an external VFO, such as the FV-102DM, to the transceiver.

(8) RCVR

An external receiver may be connected to this 7-pin DIN jack for muting, sidetone and scanning control signals from the FT-102. This jack is also used for the FV-102DM VFO, which then accepts external receiver system connections.

(9) ACC-1

This 6-pin DIN jack provides access to the control circuitry for connection of a transverter.

(10) ACC-2

This 5-pin DIN jack provides T-R switching and ALC control input connections for interconnection with a linear amplifier.

(11) RCA JACK BOARD

(A) AUX

This is an extra jack with no internal connections, provided for the operator's convenience. It may be easily wired to suit the needs of a particular station setup or for special operating requirements.

(B) PATCH

This jack provides for audio input to the transmitter, for connection of a phone patch such as that contained in the SP-102P.

(C) IF OUT-2

This jack provides wideband IF output from an early stage of the receiver for connection to a bandscope or spectrum analyzer.

(D) AF OUT

Constant level audio output from the receiver is available here for recording purposes. Signal level is approximately 400mV at 50k ohms, and is unaffected by the AF GAIN and TONE controls on the front panel.

(E) PTT

This jack is connected to the push-to-talk switching line, allowing external control of transmit-receive switching, such as via a footswitch. The transmitter is activated whenever the center contact of this jack is connected to ground.

(F) IF OUT-1

The receiver's narrowband 2nd IF signal can be monitored via this jack using a monitorscope.

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(12)

(A) **PO ADJ**

This potentiometer adjusts the sensitivity of METER I when used as a PO (power output) indicator. At the factory, this control is preset to provide 80% deflection of the meter when the transmitter is tuned for maximum power output into a 50 ohm dummy load.

(B) **A-TRIP**

This control sets the anti-trip threshold level at which speaker output ceases to activate the transmitter through the microphone during VOX operation.

(C) **KEY**

A manual key or output from an automatic keyer may be connected to this two-conductor jack for CW operation. Key-up voltage is +4V, and key-down current is 0.4mA.

(D) **EXT SP**

This two-conductor jack offers audio output for an external speaker, such as the SP-102 or the SP-102P. The internal speaker is disabled when a plug is inserted into this jack.

(E) **A-TRIP IN**

When an external receiver is used with the FT-102, and the VOX system is used for transmitting; audio output from the external receiver may be connected to this jack for the anti-trip circuit in the FT-102.

(F) **MARK**

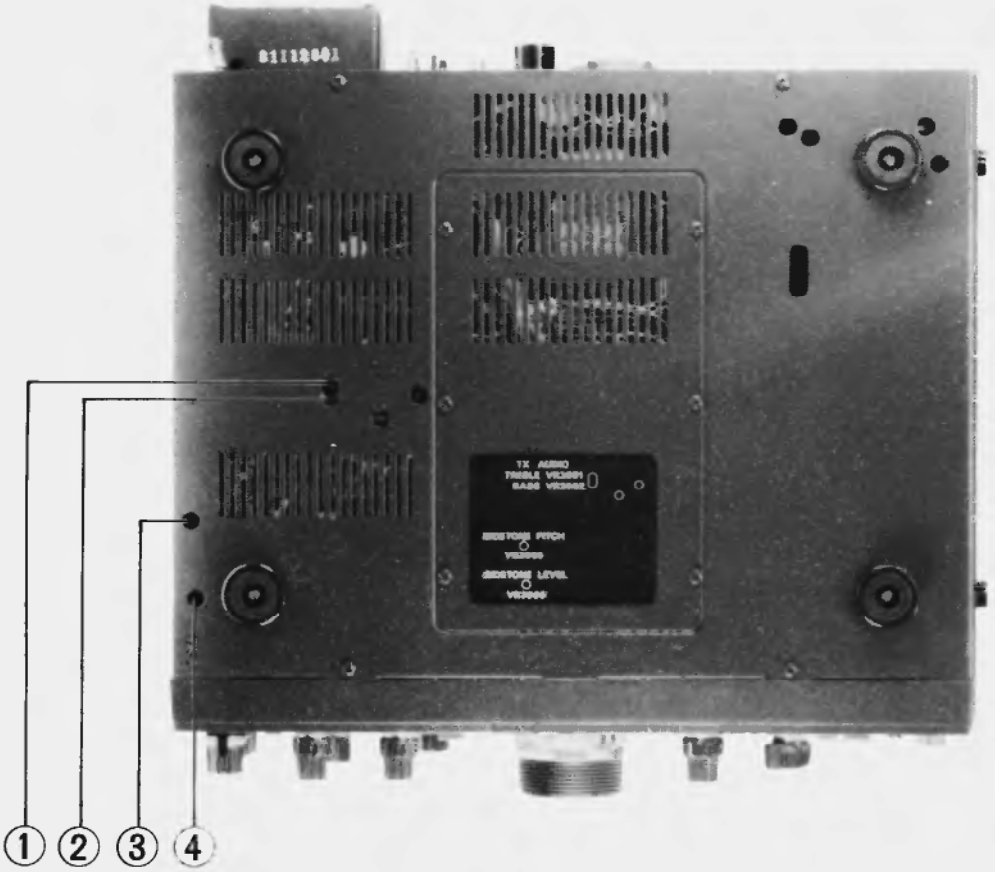
This switch activates the frequency marker generator in the receiver.

(G) **12V**

This jack provides low current 12V DC output for auxiliary equipment, such as the FC-102 antenna tuner. Maximum available current is 300 milliamperes.

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BOTTOM COVER CONTROLS



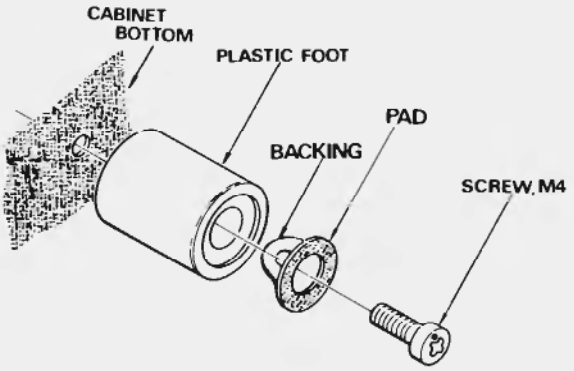
These potentiometers are accessible through holes in the bottom cover. Lay the transceiver on its side, and use the plastic tuning tool provided to make these adjustments.

(1), (2) TX AUDIO VR_{3001}, VR_{3002}

These controls are used for shaping the audio spectrum of the transmit audio from the microphone before it is applied to the modulator. VR_{3001} adjusts high frequency response and VR_{3002} adjusts low frequency response.

(3), (4) SIDETONE VR_{3005}, VR_{3006}

The CW sidetone oscillator pitch and volume are adjusted by these controls. VR_{3005} adjusts sidetone pitch, while VR_{3006} adjusts sidetone volume.

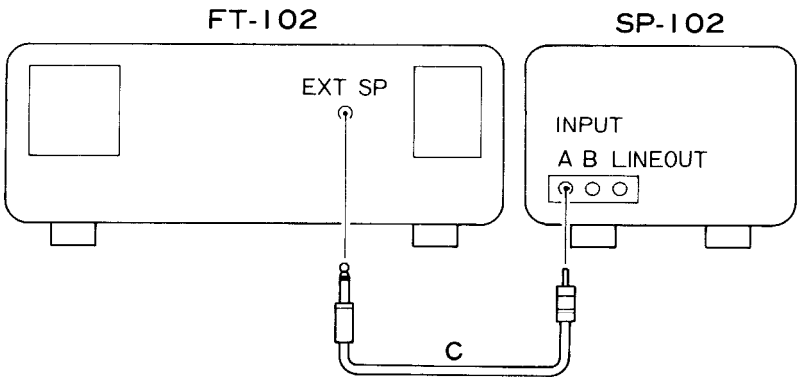


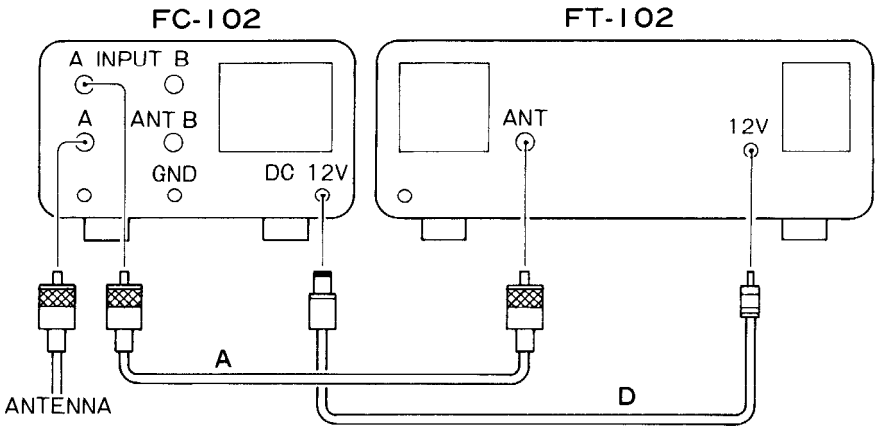
BOTTOM PANEL FEET

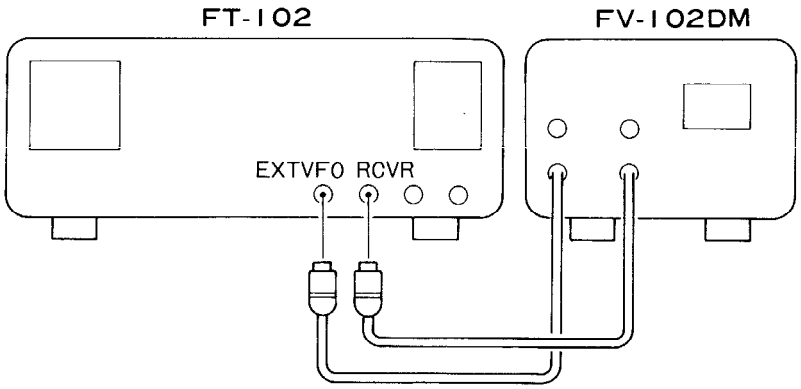
The feet on the bottom panel may be changed, if it is desired to change the viewing angle for the FT-102. In the accessory kit for your FT-102 there are two extender feet with mounting pads. These may be installed either in front or in back, according to the requirements of your station.

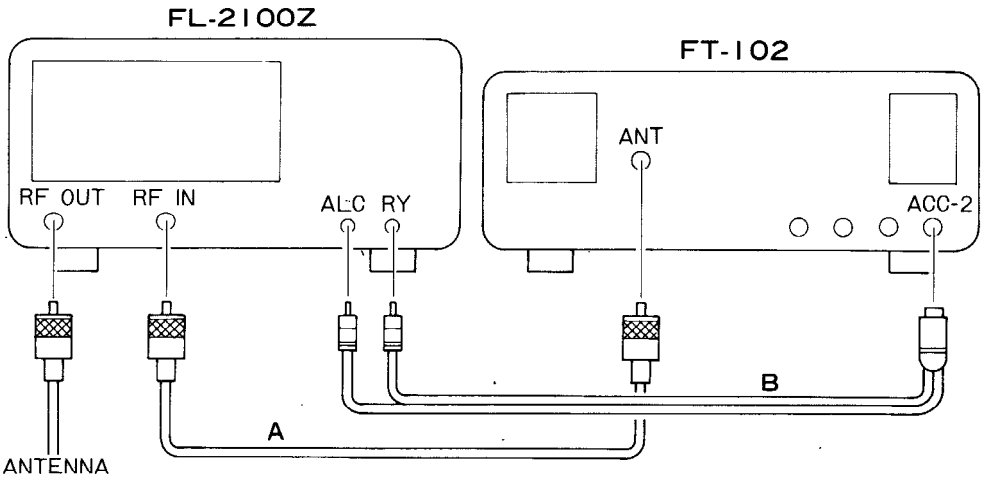
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INTERCONNECTIONS





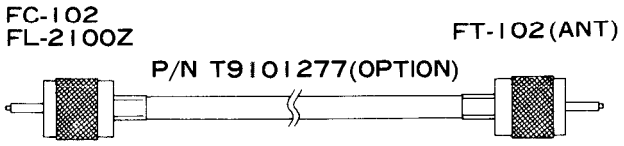




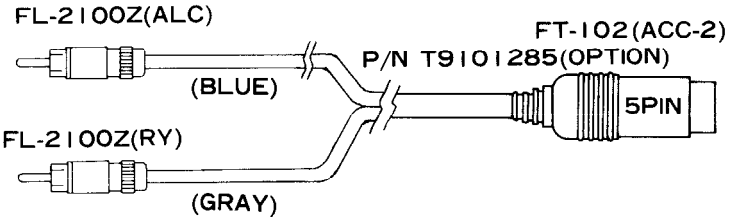
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INTERCONNECTION CABLE INFORMATION

A

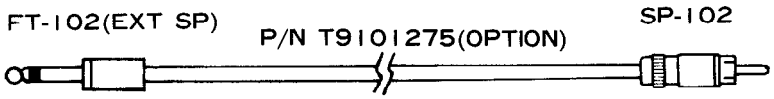


B

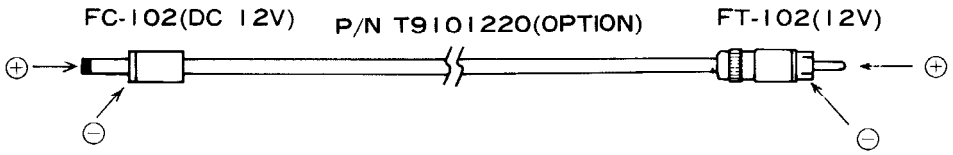


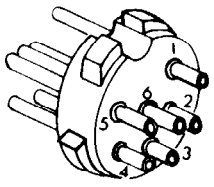
PIN
1. ALC inner conductor
2. ALC/RY outer conductor
3. RY inner conductor
4. ALC/RY outer conductor
5. ——

C



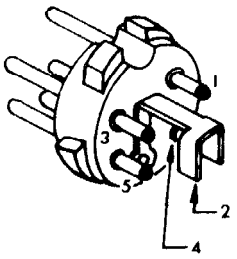
D





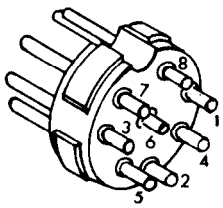
PIN No.
1. TX GND.
2. KEY-1.
3. 100kHz(REF.) OUT.
4. N.C.
5. RX GND.
6. GND.
Shell. GND.

ACC-1



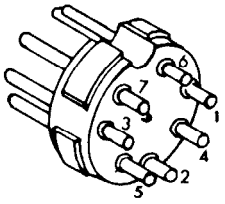
PIN No.
1. ALC.
2. GND.
3. TX GND.
4. GND.
5. RX GND.
Shell. GND.

ACC-2



PIN No.
1. +8V.
2. +12V.
3. +500kHz.
4. TX 12V.
5. CW 8V.
6. EXT VFO IN.
7. GND.
8. SAMPLE IN.

EXT VFO/RCVR A



PIN No.
1. UP.
2. FAST.
3. GND.
4. DWN.
5. MUTE.
6. SIDE TONE OUT.
7. 100kHz (REF.) OUT.

EXT VFO/RCVR B

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INSTALLATION

The FT-102 is designed to be a single-unit station for fixed or portable operation from AC power. Power supply connections providing for operation from a variety of source voltages are available. Please read the following sections carefully, so as to ensure proper installation of your new transceiver.

PRELIMINARY INSPECTION

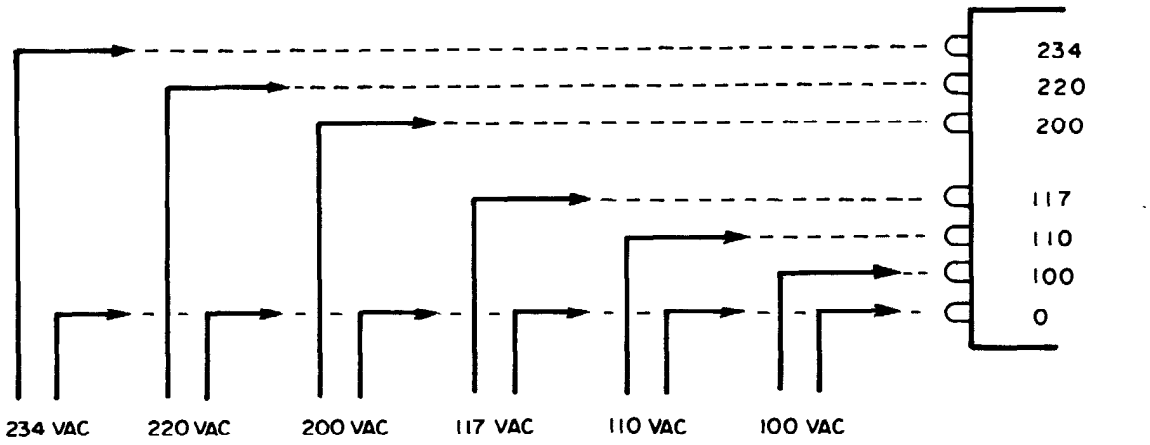
Upon opening the packing carton, immediately give the transceiver a thorough visual inspection. Check to see that all controls and switches are working freely, and inspect the cabinet for any signs of damage. If any damage has been sustained, immediately contact the shipping company, and document the damage completely. Save the packing carton and foam packing material for possible use at a later date.

POWER CONNECTION

The FT-102 is designed for use in many areas of the world, using supply voltages that may differ from your local supply voltage. For this reason, be absolutely certain that the voltage specification marked on the rear of the transceiver agrees with the local AC supply voltage. THIS INSPECTION MUST BE MADE BEFORE CONNECTING THE AC POWER CORD TO THE REAR APRON OF THE TRANSCEIVER. If the transceiver is wired for another supply voltage, change the connections to the primary of the power transformer as shown below. Also change the label on the rear panel.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE TRANSCEIVER. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY APPLICATION OF IMPROPER SUPPLY VOLTAGE. DO NOT CONNECT THE AC POWER CORD TO A DC POWER SOURCE.



POWER TRANSFORMER PRIMARY CONNECTIONS

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TRANSCEIVER LOCATION AND GROUND

In any station installation, an important consideration is adequate air circulation around the final amplifier compartment. Do not place books or papers on or around the cabinet, and do not place the FT-102 on top of another heat-generating device such as linear amplifier. Avoid heat ducts and window locations that might expose the transceiver to direct sunlight.

Ground the transceiver using a heavy braided cable of the shortest length possible. Cold water pipes are generally not satisfactory as grounding points; it is better to use earth rods with the grounding cable securely connected to each point in the ground system.

ANTENNA CONSIDERATIONS

The FT-102 is designed for use with an antenna system presenting a 50–75 ohm resistive load at the antenna jack. While the transmitter output circuitry is designed for uniform response within this impedance range, significant departures from the 50–75 ohm specification will result in seriously degraded transceiver performance, and may result in damage to the final amplifier tubes.

If an open-wire feedline is used, or if the input impedance of the antenna system presents a higher or lower impedance than specified, some sort of antenna tuner must be used to provide the proper impedance for the transceiver. See your Yaesu dealer for details of the FC-102 antenna coupler.

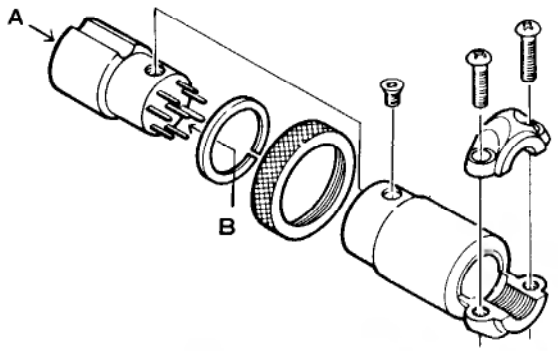
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MICROPHONE INFORMATION

The eight pin microphone jack includes provision for external scanning when the FV-102DM external VFO is used with the transceiver, as well as microphone and PTT input. The Yaesu models YM-34, -35, -36, -37, and -38 can all be used with the FT-102, while the MD-1B8 desk top microphone and MH-1B8 hand microphone are especially recommended where use of the scanning feature is anticipated, and the MH-1A8 hand microphone for similar performance without scanning controls.

If you use a non-Yaesu microphone, be certain to connect the microphone plug correctly. The nominal microphone input impedance is 600 ohms.

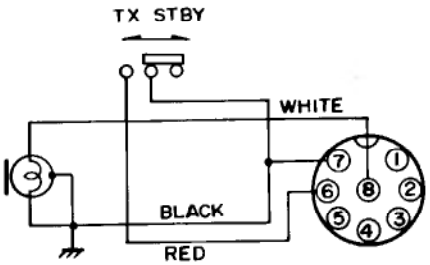


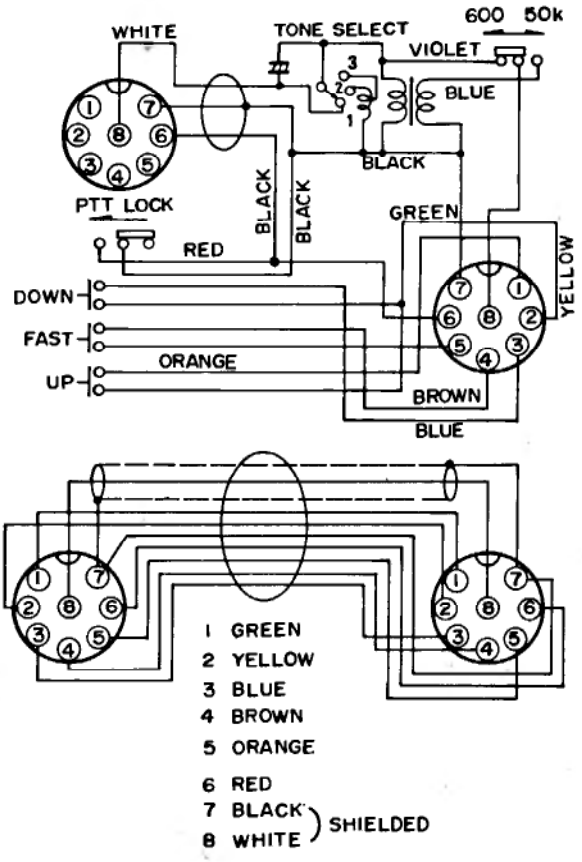


MD-1B8

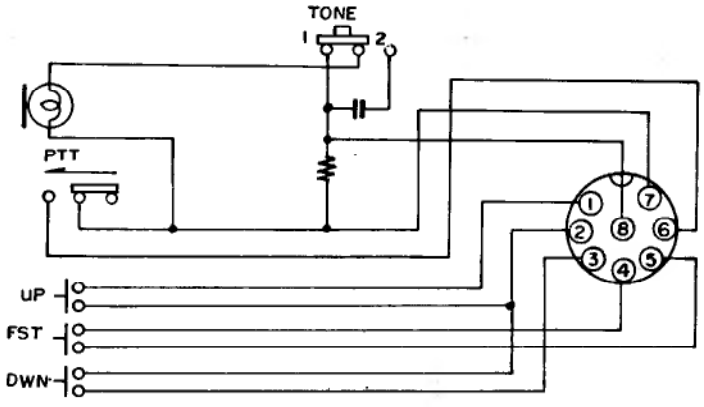


MH-1B8





MD-1B8 MICROPHONE CONNECTIONS

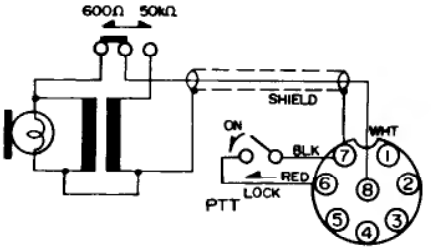


MH-1B8 MICROPHONE CONNECTIONS

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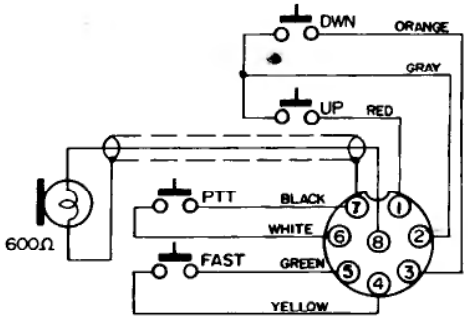
YM-34



YM-34 MICROPHONE CONNECTIONS



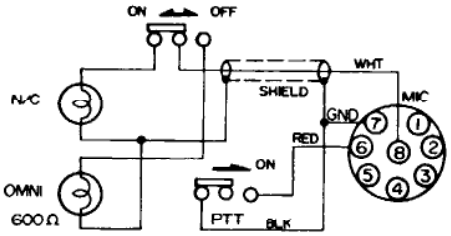
YM-35



YM-35 MICROPHONE CONNECTIONS



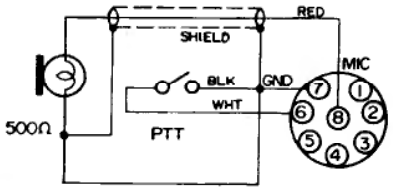
YM-36



YM-36 MICROPHONE CONNECTIONS



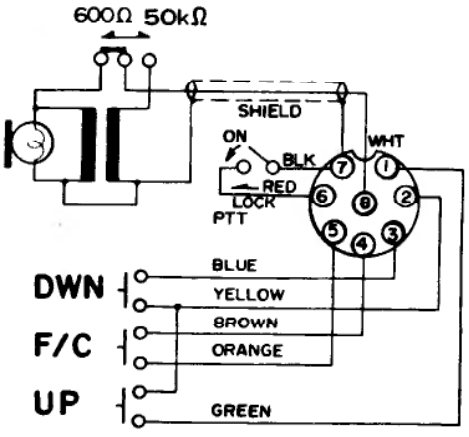
YM-37



YM-37 MICROPHONE CONNECTIONS



YM-38



YM-38 MICROPHONE CONNECTIONS

OPERATION

The tuning procedure for this transceiver is not complicated. However, some functions are unique to the FT-102, and are not contained in other transceivers. Therefore, to obtain maximum performance, set up your transceiver for operation according to the following procedures.

Before inserting the AC plug into the wall outlet, the following procedure must be performed.

1. Connect a proper antenna or a dummy load, having an impedance of 50 ohms at the operating frequency, to the coaxial ANT jack on the rear panel.

2. To the front panel microphone jack connect a 600 ohm impedance microphone (if desired), or for CW operation a manual key or external keyer may be connected to the KEY jack. For detailed pin connections to the microphone plug or keyjack, refer to the diagrams on pages 9 and 18. Your Yaesu dealer can provide a suitable microphone for your requirements.

3. If desired, headphones may be connected to the PHONES jack on the front panel. The impedance of the headphones should be 4–16 ohms.

4. Before inserting the AC plug from the transceiver into the wall outlet, ensure that the transceiver power switch is off and be certain your FT-102 AC voltage requirements match your local line voltage.

FREQUENCY INDICATION

Frequency readout on the FT-102 is by digital as well as analog displays. The analog readout dial provides resolution to 1 kHz while the digital display provides resolution to 100 Hz.
To match the analog frequency indication to the digital display, simply hold the VFO dial knob stationary with one hand while rotating the calibrating ring on the dial knob until the indications match. The CLAR button must be OFF (out) when this adjustment is made.

RECEIVER OPERATION

(1) Preset the controls and switches as follows:

POWER	OFF
HEATER	OFF
MODE	USB (above 10 MHz) or LSB
AF	Counterclockwise
RF	Fully clockwise
MOX	OFF (out)
RF AMP	ON (in)
NAR	OFF (out)
NB	OFF (out)
SQL	Counterclockwise
AGC	ON (out)
FAST/SLOW	FAST (out)
RX	OFF (out)
TX	OFF (out)
TONE	Center (12 o'clock) position
NOTCH	OFF (switch out)
APF	OFF (switch out)
SHIFT/WIDTH	Center positions
PRESELECT	Center position
BAND	Desired band

(2) Turn the POWER switch ON. The meters and analog display should light up, and the operating frequency and mode will appear on the digital display. Adjust the AF gain control for a comfortable listening level, and adjust the PRESELECT control for maximum receiver noise or signal level. The PRESELECT control may require repeaking if the operating frequency is changed considerably. (When the RF AMP is OFF the PRESELECT control will not affect reception, but it must always be peaked for transmission, as described later.)

(3) If an incoming signal is drifting or transmitting on a slightly different frequency, the RX clarifier function may be activated by pushing the RX button. The nearby LED will illuminate, and the receive frequency may then be offset up to about ±2.5 kHz. The digital display will now indicate the clarified receive frequency, while the analog display will indicate the original frequency (no offset).

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(4) When pulse-type noise is encountered, turn the NB switch ON. Now rotate the NB LEVEL control to an effective point. The best setting of the noise blanker is the point at which the noise pulses just disappear to allow copying of the signal.

(5) Whenever strong signals are encountered or band noise is high enough to keep the S-meter above several S-units, the RF AMP may be switched off, thereby increasing the superb strong-signal handling capability of the receiver. The RF gain control, normally kept at its most clockwise position, may be adjusted to provide additional attenuation and a preset AGC level, which will be indicated on the S-meter. This will serve to block those signals weaker than the preset S-meter level, while passing stronger signals.

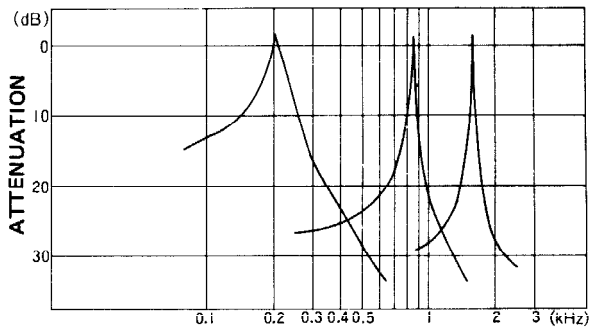
(6) AGC time constant selection is accomplished by the FAST/SLOW switch, when the AGC switch is ON. The FAST/SLOW switch will have no effect when the AGC switch is OFF, and the S-meter will also be disabled (except for RF gain indication, as mentioned above).

(7) Adjust the TONE control to obtain the most pleasing audio for the particular mode of operation and speaker (or headphones) in use. Different speakers and headphones have different audio response characteristics which can be compensated by this control, while the different bandwidths used for different modes may have their associated "bassiness" or "hissing" attenuated.

(8) When an interfering heterodyne appears, such as from a broadcast station, CW signal or "tuner upper" during SSB operation; a beat between two close AM stations during AM operation; or a second CW signal during CW operation; press the NOTCH button and gradually tune the NOTCH control to remove the heterodyne. Tune slowly, as the setting of this control is critical.

(9) During CW operation under crowded or weak-signal conditions the APF filter can be activated, filtering out all but a very small slice of audio frequencies. Use this feature after tuning the SHIFT/WIDTH for optimum setting, when the remaining passband is still crowded or the noise level is still disagreeable. Press the APF button and carefully tune the APF control for peaking (by ear or audio scope) of the desired signal. Note that practically all noise and QRM has vanished; however, it is important to bear in mind that signals blocked by the APF are still producing AGC action, so the S-meter may not be used for peaking. Switch the APF OFF when tuning to a new frequency of adjusting the SHIFT/WIDTH. The APF feature can be used at the same time as the NOTCH filter, but only during CW operation.

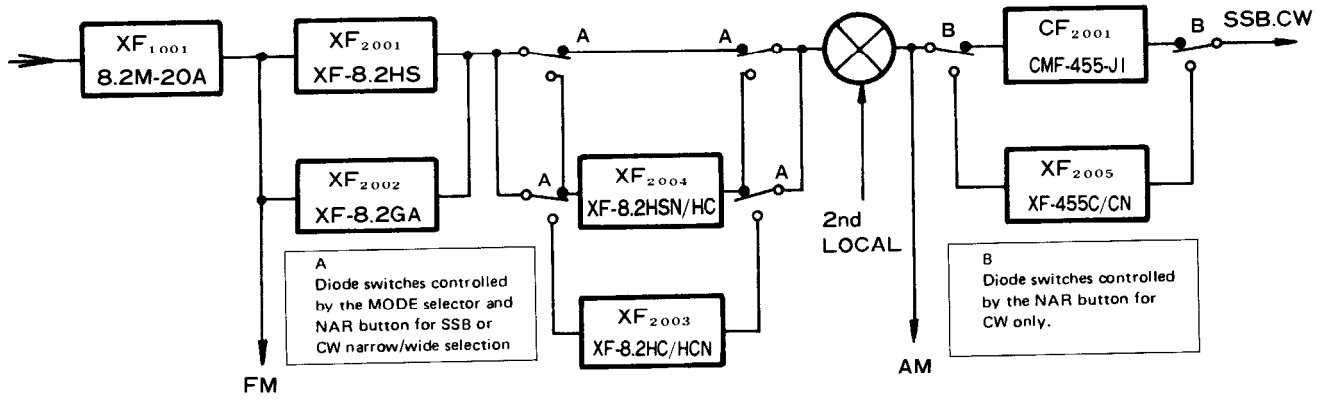
APF RESPONSE



(10) A variety of optional IF filters allow the operator to choose from several possible filter configurations for both CW and SSB narrow bandwidths as shown in the chart. When narrow filters are installed, simply press the NAR button to select the appropriate narrow filter for the particular mode in use. When in the CW mode, the display will indicate CW-N or CW-W for narrow or wide bandwidth. AM is always indicated by AM-N.

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RECEIVE IF FILTER SELECTIONS

SHIFT/WIDTH CONTROL OPERATION

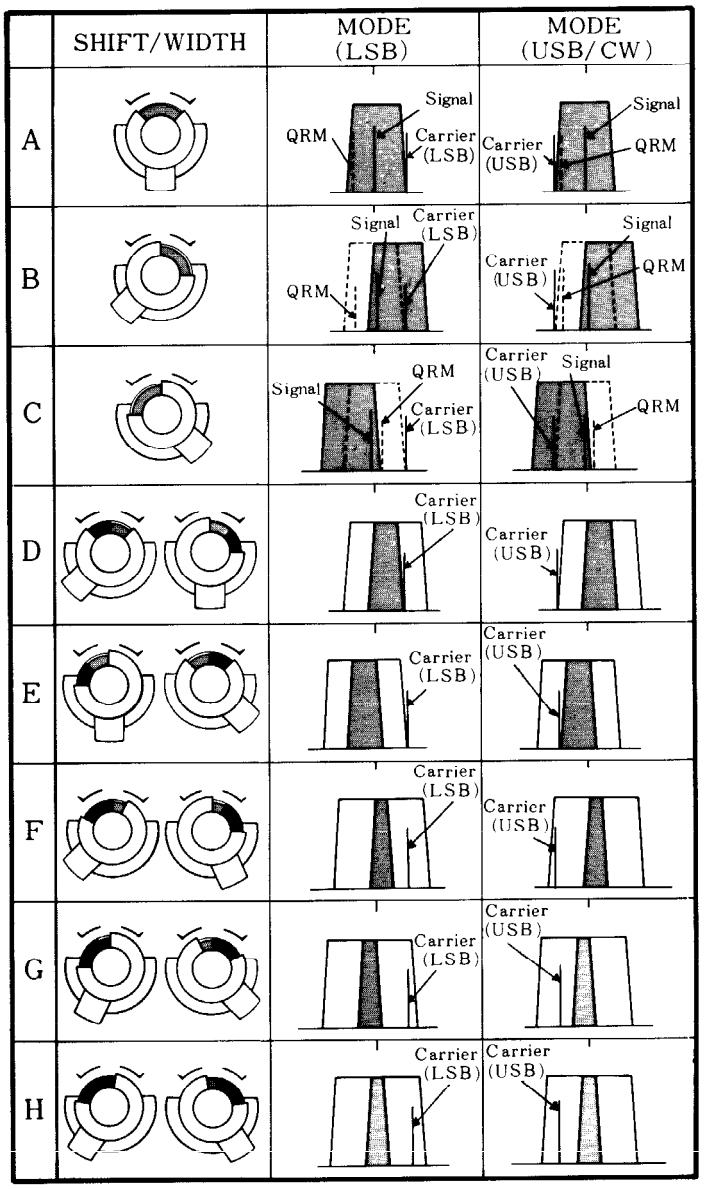
The variable bandwidth and IF shift feature allows the setting of optimum bandwidths and passband frequency selection during SSB and CW reception, for minimized QRM and peaked signal-to-noise ratio under all conditons.

The two friction-coupled controls are normally aligned so that the window in the skirt of the round inner knob is straight up, while the paddle of the control is straight down, causing the entire exposed area within the window to be the gray portion of the paddle control. Note that neither knob adjusts shift or width alone, but that the adjustment of either affects both shift and width. The size of the gray area exposed through the window represents the selected width of the passband, while the position of this exposed gray area relative to the 12 o'clock position (straight up) represents the position of the IF passband relative to the true carrier frequency of the signal.

To use the SHIFT/WIDTH system most effectively, narrow the WIDTH to the estimated optimum (the bandwidth that will eliminate the QRM or QRN without removing too much of the desired signal). This bandwidth will depend on the relative strengths and transmit carrier frequencies of the signals, as well as the noise level; and will require some experimentation to achieve the optimum setting. The special control configuration allows you to narrow the bandwidth while at the same time shifting the passband using only one hand to control both functions easily. First grasp the round knob and rotate it slightly while holding the paddle stationary with one finger. Observe the gray area through the control window, and notice that a black area comes into view from one side of the window. This black area represents that portion of the original bandwidth that is now blocked by the filter, while the remaining gray area represents the remaining passband.

Secondly, rotate the round knob and paddle together (by turning either) to shift the (narrowed) passband across the received signal's bandwidth. Note that as the remaining exposed gray area is positioned to the left of center the upper sideband signals will pass, while to the right of center the lower sideband signals will pass. If QRM is still present the size of the exposed gray area may be further reduced, but the passband will become too narrow to permit readability if the exposed gray area is made too small.

It will be noticed that the width of the passband may be narrowed much more for CW than for SSB to still maintain readability. With practice the operator will quickly find that the SHIFT/WIDTH system can be used for reducing or eliminating most types of QRM, including heterodynes near the edge of the passband that may be outside of the range of the NOTCH filter. Also, when band noise is high, the bandwidth can be adjusted so as to eliminate a large portion of the noise while still passing the signal. During AM operation the width feature is disabled, but the shift feature will still prove useful for eliminating interference.



TRANSMITTER OPERATION

The following tuning procedure must be performed prior to commencing transmission on the desired band and mode. Please study this entire procedure carefully before operating the transmitter, as incorrect setting of some controls may damage the transceiver. Do not exceed 30 seconds of key-down time during tuning; and if it is necessary to do so for close to 30 seconds, let the final amplifier cool in the receive mode for one or two minutes. Whenever transmitting (in any mode), never change the setting of the MODE or BAND selectors, as severe damage to the transceiver may result. These selectors may only be changed when receiving.

Make sure that a 50 ohm load is properly connected to the coaxial ANT jack. This may be a dummy load or an antenna that is resonant at the transmitting frequency. Never transmit without a load, but when using an antenna always make sure that the operating frequency is clear of other signals before tuning up or transmitting.

(1) Preset the controls and switches as follows:

HEATER	OFF
MODE	TUNE
MOX	OFF (out)
PROC	OFF (out)
MONI	OFF (out)
VOX GAIN	Counterclockwise
DELAY	Counterclockwise
MIC GAIN	Counterclockwise
COMP	Counterclockwise
RX	OFF (out)
TX	OFF (out)
METER SELECT	IC position
PRESELECT	Midrange
DRIVE	Counterclockwise
BAND	As desired
PLATE	Match with band
LOADING	0

(2) Turn the POWER and HEATER switches both ON. Wait one minute for the tubes to reach operating temperature.

(3) When tuning into a dummy load, turn the MARK switch (rear panel) and the RF AMP ON, tune the transceiver to the nearest MARK frequency, and adjust the PRESELECT control for peak indication on METER II. If using an antenna, turn the RF AMP switch ON and tune the PRESELECT control for a peak in background noise, or for a peak on the S-meter of a signal on a nearby frequency.

(4) Momentarily depress the MOX switch or PTT switch on the microphone, if connected, and observe the IC indication on METER I. If you pressed the MOX switch you must press it again to return to receive. The meter should indicate approximately 75 to 80 milliamperes (final grid bias). If the indication is far from this range, BIAS ADJ potentiometer VR_{8001} on RECT A Unit (PB-2352) should be adjusted after the tubes have fully warmed up.

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(5) Set the DRIVE control to about the 9 o'clock position. Key the transmitter and adjust the PRESELECT control slightly while watching the IC indication on METER I for a peak reading, then return to receive. It may be necessary to increase the DRIVE control slightly beyond the 9 o'clock position to obtain a discernable peak.

For the following steps we strongly recommend that tune-up transmissions be limited to about five seconds each. A simple way to accomplish this is to first place the fingers of your right hand on the control that is to be adjusted before keying the transmitter. Adjust the control slightly back-and-forth while watching the indication on METER I for the desired dip or peak (make sure you know which). This should be done quickly, and you will see that only slight movement of the control is required. Immediately press the MOX switch (or release the PTT switch) to return the transceiver to receive.

Correctly tuning the transmitter for the desired power output may take some time and practice at first, but once the operator becomes familiar with the equipment the entire procedure will take only a few seconds. Take your time, but keep the transmissions short to preserve the lives of the final tubes.

(6) Key the transmitter and tune the PLATE control slightly for an IC dip, and return to receive. It is normal for the final (tuned) position of this control to be slightly different from the band marking, but if a dip is not easily obtained within the range of the control the antenna and feedline should be checked for high SWR at the operating frequency, as the correct impedance is not being presented to the ANT jack.

(7) While observing the ALC indication on METER II, key the transmitter and advance the DRIVE control so that the needle of METER II indicates straight up, and return to receive.

(8) Advance the LOADING control to position 1. Now key the transmitter and again tune the PLATE control slightly for an IC dip on METER I. Return to receive.

(9) Repeat step (8) until the IC dip is at exactly 300 mA (350 mA on the 1.8 MHz band), each time advancing the LOADING control slightly higher until its setting is approximately matches that shown in the Loading Position Table. Again, if there is a problem acheiving the dip (with the PLATE control), or if the dip is far above or below 300 mA, the antenna and feedline should be checked.

When the above procedure is performed correctly the IC indication on METER I will be 300 mA when the PLATE control is tuned for a dip, and the ALC indication on METER II will be approximately straight up. The transmitter is now tuned for optimum signal purity and moderate loading of the final amplifier tubes, providing an output power of about 100 watts. This tune-up procedure is recommended whenever SSB operation or any mode of operation with a linear amplifier is contemplated.

LOADING POSITIONS

BAND	FREQUENCY	POSITION
1.8	1.8MHz	1.0
	1.9MHz	3.0
	2.0MHz	9.0
3.5	3.5MHz	2.0
	4.0MHz	6.0
7	7.0MHz	2.5
	7.5MHz	3.5
10	10.0MHz	3.0
	10.5MHz	4.5
14	14.0MHz	2.8
	14.5MHz	3.0
18	18.0MHz	2.0
	18.5MHz	3.0
21	21.0MHz	3.0
	21.5MHz	3.3
24.5	24.5MHz	3.5
	25.0MHz	3.8
28	28.0MHz	3.5
28.5	28.5MHz	3.8
29	29.0MHz	4.0
29.5	29.5MHz	4.2

NOTE: LOADING positions are nominal. Minor variations from positions shown are to be expected.

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Note: Although it is possible to tune the final stage of the transmitter for higher output power (by adjusting the DRIVE, PLATE and LOADING controls for peak power output), this is generally not recommended because the purity of the output signal, particularly IMD, will degenerate below specified values; and the lives of the final tubes will be shortened.

SSB OPERATION

Once the above tune-up is completed, set the MODE selector to either LSB (below 10 MHz) or USB, the MIC GAIN control to the 12 o'clock position, and the METER SELECT switch to IC. Connect the microphone to the MIC jack, and depress the PTT switch at the microphone. Speak into the microphone the word "four" while observing the ALC indication on METER II. Now press the ALC METER button to activate the "peak hold" system, and note whether the ALC indication is beyond the black zone at the left side of the ALC scale on METER II (while speaking). The needle will hold position for about one second before dropping; so, if the needle deflects into the red zone, reduce the MIC GAIN slightly and speak into the microphone again to obtain another reading. This technique can be repeated until the ALC indication is exactly at the high edge of the black zone.

For VOX operation, advance the VOX GAIN control gradually while speaking into the microphone normally (without depressing the PTT switch), until your voice activates the transmitter. If audio from the speaker trips the VOX (with headphones disconnected), advance the A-TRIP control on the rear panel slightly clockwise. The DELAY control may be adjusted to obtain the desired VOX delay before automatically switching back to receive after you have finished speaking. For stable operation of the VOX, do not advance the VOX GAIN or A-TRIP controls more than necessary.

To adjust the audio characteristic of the transmitter to your voice, insert the plug from your headphones into the PHONES jack, and set the transceiver on its side. Now push the MONI button, and adjust VR_{3001} and VR_{3002} through the bottom cover while speaking normally into the microphone and listening in the headphones. VR_{3001} controls high frequency attenuation, while VR_{3002} controls low frequency attenuation. If the ALC level has already been set, some readjustment of the MIC GAIN control may be necessary to obtain the correct ALC level.

SPEECH PROCESSOR ADJUSTMENT

Connect headphones, if available, to the PHONES jack and push the MONI button ON. Set the METER SELECT switch to the COMP position, and push the PROC button to activate the speech processor. Keep the MIC GAIN control at the same setting as obtained above in the SSB Operation procedure, and set the COMP control to the 12 o'clock position. Observe the ALC indication on METER II while speaking the word "four" into the microphone, adjusting the DRIVE control to obtain a peak ALC indication within the first (leftmost) division of the black zone on the ALC scale (do not adjust MIC GAIN). Now listen to your signal in the transmitter IF while adjusting the COMP control for the amount of processing desired. The COMP indication on METER I should not exceed 5 or 10 dB. If the ALC indication on METER II advances further, reduce the DRIVE control setting slightly to maintain signal purity. Notice that if the COMP control is set too high the signal-to-noise ratio of the transmitted signal will be reduced. If the ALC level is set higher than one division in the black zone, IMD products may increase.

CW OPERATION

After completing the tune-up procedure, insert the two conductor plug from your key or electronic keyer into the KEY jack on the rear panel. Key up voltage is plus 4 volts, and key down current is 0.4 mA. The operator may select any power output desired up to the maximum rating of the transmitter by adjusting the DRIVE control (but not beyond the point where the ALC indication on METER II exceeds one division). Also, the DRIVE control should not be advanced clockwise beyond the point where the IC indication on METER I reaches 350 mA (or 200 mA above 28 MHz).

For CW operation without an external amplifier, when a small amount of additional power is necessary, you may switch the METER SELECT switch to PO, advance the DRIVE control fully clockwise, and adjust the PLATE and LOADING controls for

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peak PO indication on METER I. However, if you operate CW with the ALC indication on METER II peaking higher than about the first division at the left side of the black ALC zone some distortion of the keying waveform may result.

The VOX circuit may be used to provide semi break-in operation, with the DELAY control providing adjustment of the T-R switching delay. Alternatively, T-R switching may be accomplished by the MOX button, or by an external control (such as a footswitch) connected to the PTT jack on the rear panel.

The CW sidetone may be activated by pushing the MONI button ON. Sidetone pitch can be adjusted by VR_{3005} accessible through a hole in the bottom cover, while sidetone volume can be adjusted by VR_{3006}.

For receiving, various optional narrow CW filter configurations may be installed and activated by pushing the NAR button. The SHIFT/WIDTH controls may also be used to select the desired passband, or the APF filter can be activated for very narrow filtering.

CW SPOT USING SIDETONE REFERENCE

The CW pitch potentiometer, VR_{3005}, may be used to align the CW sidetone for CW spotting purposes. The correct alignment procedure will be shown, then the operation technique outlined.

1) Connect a receiver or transceiver to the FT-102 EXT ANT jack. When using a transceiver such as the FT-901DM, connect the cable from the FT-901DM RCV ANT jack to the FT-102 EXT ANT jack.

2) Connect a dummy load to the FT-102 ANT jack. Set the MODE switch to CW.

3) Set the FT-102 to 14.100 MHz, and likewise set the external receiver to 14.100 MHz. Push the MARK button to activate the calibrator signal.

4) Tune both the FT-102 and the external receiver so that a comfortable beat note (approximately 700 Hz) is obtained. Zero beat the two tone so that the two receivers are precisely tuned to the same frequency.

5) Set the MONI switch to ON to activate the CW sidetone. Set the DRIVE control fully counterclockwise, and set the VOX control to the MOX position.

6) Key the transmitter, and adjust the gain controls on the external receiver so that it is not overloaded. Noting the beat note of the transmitted signal from the FT-102, adjust VR_{3005} so that the sidetone pitch is exactly the same as that produced by the transmitter. The sidetone now becomes a reference spotting signal during CW operation.

Operation

1) Let us say that DX1DX is operating on 14.002 MHz, working stations around his frequency. Locate the station working DX1DX, and close your key while in the receive mode. Tune the transceiver to align the sidetone note with that of the station working DX1DX; you will now be zero beat with that station.

2) Push the RX button ON, and tune the CLAR control to DX1DX's frequency. When you call DX1DX, you will be precisely on the same frequency as the previous station, giving you a better chance of working DX1DX.

AM OPERATION

1) An optional 6 kHz AM filter, the XF-8.2GA, is available from your Yaesu dealer. If this filter is not installed, the received bandwidth on AM will be 2.9 kHz. For transmitting AM the Optional AM/FM unit must be installed.

2) After preliminary tune-up, set the MODE switch to AM and the METER switch to IC. Rotate the MIC GAIN and DRIVE controls fully counterclockwise.

3) Close the microphone PTT switch, and advance the DRIVE control until the IC meter reaches a reading of 100 mA.

4) Advance the MIC GAIN control to the 12 o'clock position. Use the MONI function to set MIC GAIN precisely, but do not advance the MIC GAIN control too far, or

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spurious responses may result. If the IC meter deflects downward during voice peaks, the DRIVE level should be reduced until meter movement is just noticeable.

5) In the AM mode, the RF speech processor, ALC meter and the variable IF bandwidth features are disabled, though the IF shift feature will prove useful for reducing QRM.

FM OPERATION

The FT-102 can operate in the FM mode if the optional AM/FM unit is installed. The FM mode is useful for operation on the 10 meter band through a repeater. Also, when you use a transverter with the FT-102, you can enjoy FM operation on the VHF and UHF bands.

1) Set the MODE switch to FM, and the METER switch to IC. Set the DRIVE control fully counterclockwise.

2) Depress the microphone PTT switch, and advance the DRIVE control until the reading on the IC meter reaches 200 mA. During FM operation, periodically check the IC meter to be sure the IC reading does not exceed 200 mA.

3) Set the MIC GAIN control between the 12 o'clock and maximum positions, according to the microphone in use. In the FM mode the RF speech processor and SHIFT/WIDTH controls are disabled.

4) The receiver SQL control may be used to silence the receiver during standby periods when no signals are being received. While listening on an unoccupied frequency, advance the SQL control until the background noise is just silenced. Do not go beyond this threshold point too far, or the receiver will not respond to weak signals.

SSTV OPERATION

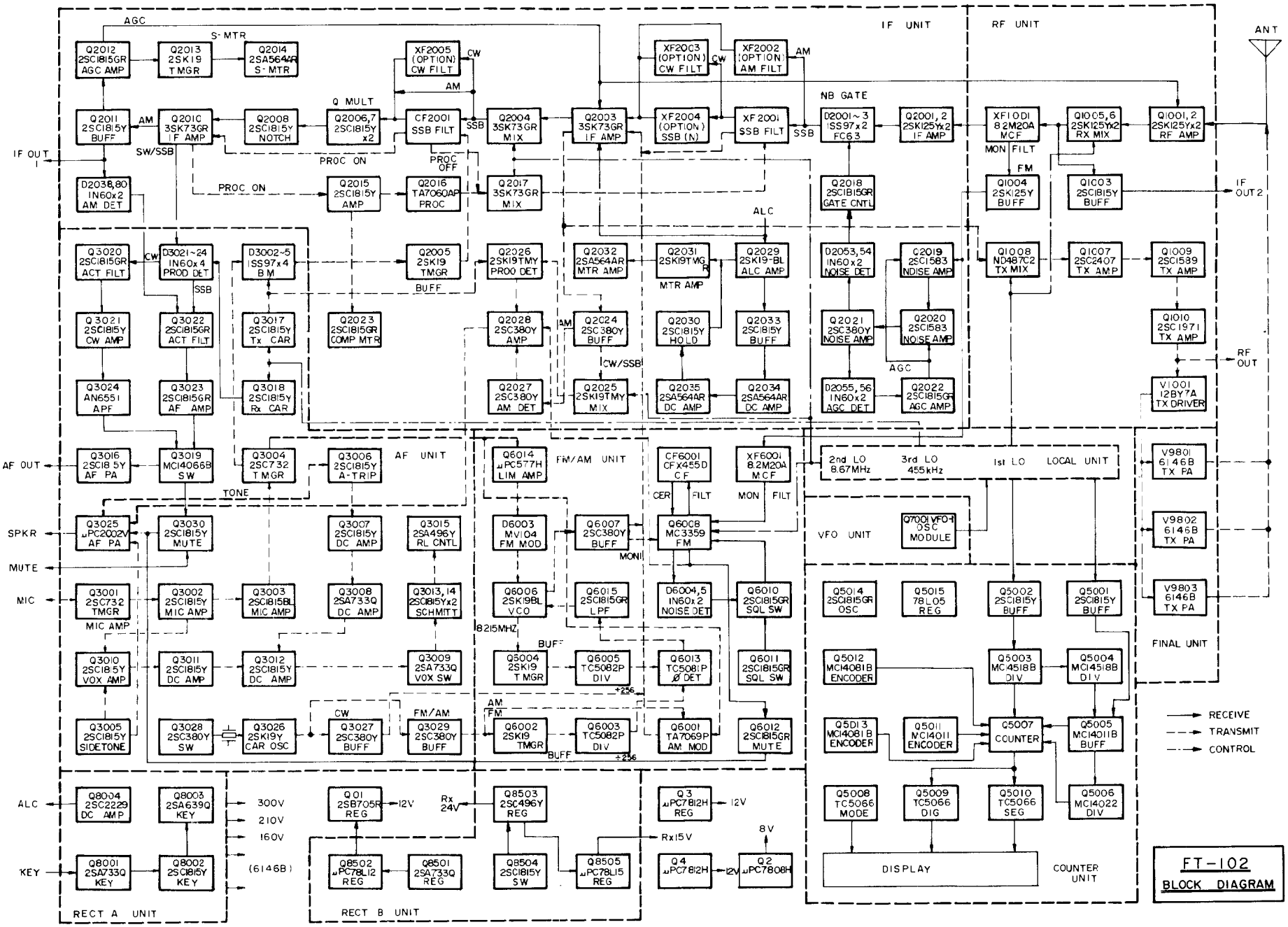
Slow-scan television operation is easily accomplished using the FT-102. Proper adjustment involves techniques outlined previously for SSB and FM operation.

1) Set the MODE switch to USB or LSB, per the band in use. Connect the audio output from your SSTV generator into the rear panel PATCH jack, and connect the audio input for the SSTV decoder to the SP or AF OUT jack, depending on the impedance requirement of your terminal.

2) Receive operation is identical to that for SSB operation. Use the receive clarifier, as needed, for minor receive frequency adjustments without changing the transmitter frequency.

3) To transmit, leave the microphone gain control in the same position as for SSB operation. Close the PTT switch, and adjust the output level from your SSTV generator such that the ALC meter needle stays within the ALC range. Now adjust the MIC GAIN control so that the IC meter reading is 150 mA or less. Check the IC reading periodically to ensure that this level is not exceeded.

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CIRCUIT DESCRIPTION

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

RECEIVER

The RF input signal from the coaxial antenna jack is fed through T-R relay RL_{9601} on the Relay Unit (PB-2354), and then passed through the NORM/SEP switch (S_9), when in the NORM position, to the external antenna jack, lamp fuse and highpass filter; before being applied to the RF Unit. When S_9 is in the SEP position the signal from RL_{9601} connects through S_9 to EXT RCVR jack J_3.

RF UNIT (PB-2342)

The incoming signal from pin 2 of J_{1004} is fed through RL_{1001} (RF amplifier on/off relay) to the preselector tank circuit selected by the bandswitch, and then through T-R relay RL_{1002} to the gate of RF amplifier Q_{1002} (2SK125Y). AGC is applied to the gate of the other RF amplifier, Q_{1001} (2SK125Y), as the signal is passed from Q_{1002} through Q_{1001}, and then through RF amplifier relay RL_{1003} and T-R relay RL_{1004} to the bandpass filter selected also by the bandswitch. When the RF amplifier is switched off the signal is passed directly from RL_{1001} to RL_{1003}. From the bandpass filter the signal is fed through T-R relay RL_{1005} and transformer T_{1031} to the active balanced mixer, Q_{1005} and Q_{1006} (2SK125Y), where the incoming signal is mixed with the first LO signal from the Local Unit. The resulting 8.2 MHz product is passed through transformer T_{1030}, 20 kHz monolithic crystal filter XF_{1001} and transformer T_{1029} to deliver the IF signal, filtered of IMD causing products, to the IF Unit.

A sample of the wideband IF signal at T_{1030} is buffered by Q_{1003} (2SC1815Y) for external monitoring via the IF OUT-2 jack. A sample of the slightly filtered IF signal at T_{1029} is buffered by Q_{1004} (2SK125Y) for delivery to the noise blanker circuit on the IF Unit and the FM receiver circuit in the AM/FM Unit, if installed. Q_{1001} through Q_{1006} all operate from the 24 VDC supply.

IF UNIT (PB-2343A)

The 8.2 MHz IF signal from the RF Unit is amplified by first IF amplifiers Q_{2001} and Q_{2002} (2SK125Y), which are also operated from the 24 VDC supply to maintain excellent large signal handling performance. The amplified first IF signal is then passed through the noise gate, composed of Schottky diodes D_{2001}, D_{2002} (1SS97) and varactor D_{2003} (FC63); before being applied to the first set of crystal filters. SSB and CW signals are passed through 2.9 kHz BW 8-pole crystal filter XF_{2001} (XF-8.2HS), while AM signals are passed through optional 6 kHz BW 3-pole monolithic ceramic filter XF_{2002} (XF-8.2GA), when installed. If XF_{2002} is not installed, AM signals pass through XF_{2001}. When the NAR button is pressed on the front panel, CW signals are next passed through one of the optional narrow second filters in location XF_{2003}; 600 Hz BW 8-pole crystal filter XF-8.2HC, or 300 Hz BW 8-pole crystal filter XF-8.2HCN, depending upon which is installed. Also, when the NAR button is pressed in the SSB mode, SSB signals are passed through one of the optional narrow SSB second filters in location XF_{2004}; another 2.9 kHz BW 8-pole crystal filter XF-8.2HS, or 1.8 kHz BW 8-pole crystal filter XF-8.2HSN, depending upon which is installed.

All signals from XF_{2001} (and AM signals from XF_{2002}, if installed) are delivered to second IF amplifier Q_{2003} (3SK73GR) when the NAR button is off or the optional second filters are not installed; otherwise, CW and SSB narrow signals from the second filters are applied to Q_{2003} after narrow filtering. After amplification, the filtered 8.2 kHz IF signal is applied to second mixer Q_{2004} (3SK73GR), where it is heterodyned with the 8.67 MHz second LO signal from the Local Unit, producing the 455 kHz second IF. SSB and CW signals are then filtered by third filter CF_{2001}, 2.9 kHz BW 3-pole ceramic (CMF455J1); unless optional CW narrow third crystal filters are installed at XF_{2005} (either 500 Hz BW 8-pole filter XF-455C or 270 Hz BW 8-pole filter XF-455CN) and the NAR button is pressed.

AM signals bypass these filters and are fed (as are the SSB or CW signals from the third filter bank) through the Q-multiplier composed of Q_{2006}

and Q_{2007} (2SC1815Y) and notch filter Q_{2008} (2SC1815Y) to 455 kHz IF amplifier Q_{2010} (3SK73GR). A portion of the amplified signal is then buffered by Q_{2011} and fed to the narrowband IF OUT-1 jack, AM detectors D_{2038} and D_{2080} (1N60), and AGC detectors D_{2039} and D_{2040} (1N270). The remainder of the amplified signal from Q_{2010} is delivered to the product detector on the AF Unit. The detected AM signal from D_{2038} is delivered to the AF Unit for filtering and amplification. The detected AGC signal from D_{2039} is amplified by Q_{2012} (2SC1815GR), a portion of the output of which is fed back to IF amplifier Q_{2003} and RF amplifier Q_{1001} for gain control, while another portion is further amplified by S-meter amplifiers Q_{2013} (2SK19TMGR) and Q_{2014} (2SA564AR) before delivery through T-R relay RL_{2001} to METER II.

AF UNIT (PB-2344)

The SSB or CW 455 kHz IF signal is detected at D_{3021}–D_{3024} (1N60), which also receives the 455 kHz third LO from the Local Unit after buffering at Q_{3018} (2SC1815Y). The CW audio product is then passed through an active CW filter, Q_{3020} (2SC 1815GR), amplifier Q_{3021} (2SC1815GR), and APF filter Q_{3024} (AN6551); while the SSB audio product and detected AM are passed through active filter Q_{3022} (2SC1815GR) and amplifier Q_{3023} (2SC1815GR); after which each signal is applied to analog switch Q_{3019} (MC14066B), which selects the appropriate mode via the MODE selector for further amplification. Finally, the selected output is fed through muting switch Q_{3030} (2SC1815Y) to audio power amplifier Q_{3025} (μPC2002V), and from there to the speaker. A portion of the output signal from Q_{3019} is diverted through amplifier Q_{3016} for auxiliary output at the AF OUT jack on the rear panel.

NOISE BLANKER (IF UNIT)

Buffered output from 20 kHz BW filter XF-1001 is amplified by Q_{2019} and Q_{2020} (2SC1583), as well as Q_{2021} (2SC380TMY), before being applied to noise detectors D_{2053} and D_{2054} (1N60). A portion of the output from Q_{2021} is also rectified by D_{2055} and D_{2056} (1N60) and amplified at Q_{2022} (2SC1815GR) for feedback to Q_{2019} and Q_{2020} as noise blanker AGC. The time constant of this AGC is adjusted by the NB LEVEL control on the front panel.

Output from the noise detector is buffered by gate control Q_{2018} (2SC1815GR) before being applied to the noise gate D_{2001}–D_{2003}, mentioned earlier, and located between the first IF amplifier and the first bank of crystal filters.

FM RECEIVE (OPTIONAL AM/FM UNIT PB-2347)

A portion of the buffered IF signal from Q_{1004} (after 20 kHz BW filter XF_{1001}) is delivered through another 20 kHz BW filter (XF_{6001}) on the AM/FM Unit to the mixer section of Q_{6008} (MC3359), which also contains limiter amplifier, discriminator, noise amplifier, and AFC sections. In the mixer section the filtered receiver IF is mixed with the 8.67 MHz second LO signal delivered from the Local Unit, resulting in a 455 kHz second IF. This signal is passed through ceramic filter CF_{6001} and fed to the IF limiter amplifier section of Q_{6008}, where amplitude variations are removed from the signal. The signal is then applied to the discriminator section of Q_{6008}, resulting in an audio output coinciding with frequency shift in the 455 kHz IF signal.

When no carrier is present in the 455 kHz IF, the high frequency noise present at the discriminator output is amplified by the noise amplifier section of Q_{6008} and rectified by noise detectors D_{6004} and D_{6005} (1N60). The resulting DC voltage is passed through the SQL control on the front panel and back to squelch switches Q_{6010} and Q_{6011} (2SC1815GR), which turn off the audio output from Q_{6008} when no carrier is present.

When a signal is received the audio output from Q_{6008} is delivered to audio amplifier Q_{3025} on the AF Unit, unless the MUTE line is grounded, in which case Q_{6012} (2SC1815GR) grounds the output signal from Q_{6008}. AFC output from Q_{6008} is filtered and delivered through the METER SELECT switch to METER I for discriminator tuning indication.

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TRANSMITTER

SSB MODE (AF UNIT, PB-2344)

The speech signal from the microphone jack is amplified by Q_{3001} (2SC732TMGR) and Q_{3002} (2SC1815Y), whence a portion of the speech signal is diverted for VOX operation. The remaining signal from Q_{3002} is further amplified by Q_{3003} (2SC1815BL) and passed through adjustable TX tone filters to tone amplifier Q_{3004} (2SC732-TMGR). A portion of the output from Q_{3004} is diverted to the optional AM/FM Unit, when installed; while the remainder is applied to the balanced ring modulator composed of Schottky diodes D_{3002}–D_{3005} (1SS97).

The balanced modulator also receives a 455 kHz LO signal from the Local Unit after buffering by Q_{3017} (2SC1815Y), and the resulting modulated IF is delivered to the IF Unit.

VOX, ANTI-TRIP (AF UNIT, PB-2344)

A portion of the amplified speech signal from Q_{3002} is amplified for VOX operation by Q_{3010} (2SC1815Y), and then rectified by D_{3014} (1N60) to produce a DC voltage whose level varies with the speech input at the microphone. This DC is amplified at Q_{3011} (2SC1815Y), and further amplified at Q_{3012} (2SC1815Y) before being applied to switch Q_{3009} (2SA733). The switched output of Q_{3009} then controls a Schmitt trigger composed of Q_{3013} and Q_{3014} (2SC1815Y), which in turn switches relay control Q_{3015} (2SA496Y) to drive T-R relays RL1 and RL2 on the main chassis.

The anti-trip signal is derived from a sample of the output from audio amplifier Q_{3025}, or from an external source via the A-TRIP IN jack on the rear panel. This signal is amplified by Q_{3006} (2SC-1815Y) and then rectified by D_{3011} to produce a DC voltage whose level varies with the audio output from the receiver. This DC is amplified by Q_{3007} (2SC1815Y) and Q_{3008} (2SA733) before being fed into the VOX control circuit at Q_{3012} to counter the VOX DC voltage that may be produced by audio at the microphone.

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IF UNIT (PB-2343A)

The double sideband modulated signal from the AF Unit is buffered by Q_{2005} (2SK19TMGR) and passed through ceramic SSB filter CF_{2001} to mixer Q_{2017} (3SK73GR), unless the speech processor is on, in which case the filtered remaining sideband from CF_{2001} is amplified by second IF amplifier Q_{2010} (also used in receive) and Q_{2015} (2SC1815Y), a portion of the output of which is diverted to amplifier Q_{2023} (2SC1815GR) for COMP indication on METER I. The remainder of the output from Q_{2015} is clipped by limiter amplifier Q_{2016} (TA7060P) before being applied to mixer Q_{2017}.

The 8.7 MHz second LO signal from the Local Unit is mixed with the modulated 455 kHz signal at Q_{2017} to produce an 8.2 MHz IF, which is then filtered through XF_{2001} in the first bank of filters and amplified by Q_{2003} (also used in receive) before delivery to the RF Unit.

MONI

A portion of the output of IF amplifier Q_{2003} is buffered by Q_{2024} (2SC380TMY) and fed to transmit monitor mixer Q_{2025} (2SK19TMY), which is also fed the second LO signal from the Local Unit. The 455 kHz output of Q_{2025} is then demodulated at Q_{2026} (2SK19TMY), which is also fed a portion of the third LO signal from the Local Unit after buffering at Q_{3017} on the AF Unit. The resulting audio signal from Q_{2026} is amplified by Q_{2028} (2SC380TMY), which also amplifies a sample of the audio output from FM detector Q_{6008} delivered from the optional AM/FM Unit when FM transmission occurs, as well as amplifying the output of monitor AM detector Q_{2027} (2SC-380TMY) which receives IF input from Q_{2024}. The output of amplifier Q_{2028} is delivered to final audio amplifier Q_{3025} on the AF Unit for output to the speaker or headphones.

RF UNIT (PB-2342)

The modulated, filtered 8.2 MHz IF is applied to balanced mixer module Q_{1008} (ND487C2) along with the first LO signal from the Local Unit, resulting in an output signal at the operating frequency. This signal is first amplified by Q_{1007} (2SC2407), followed by Q_{1009} (2SC1589) and Q_{1010} (2SC1971) before application to driver tube V_{1001} (12BY7A). A sample of the input to the

driver is made available for transverter excitation at the RF OUT jack on the rear panel.

Output from V_{1001} is resonated by the preselector on the band selected by the BAND switch, and then delivered to the Final Unit.

On the Final Unit (PB-2355) the transmit signal is brought up to full power at V_{9801}–V_{9803} before delivery through the final tank circuit on the main chassis to the Relay Unit (PB-2354). On the Relay Unit the signal is fed through T-R relay RL_{9601} to the coaxial ANT jack, with a sample delivered through the PO ADJ potentiometer on the rear panel and the METER SELECT switch to METER I.

CW MODE

The CW carrier is generated by crystal oscillator Q_{3026} (2SK19TMGR), activated by analog switch Q_{3019} in the CW, AM and FM modes through Q_{3029} (2SC380TMY). Output for CW operation is buffered by Q_{3027} (2SC380TMY) and applied through amplifier Q_{2003} on the IF Unit to balanced mixer Q_{1008} on the RF Unit as for SSB operation. Final amplification is the same.

The key lead from the key jack activates sidetone oscillator Q_{3005} on the AF Unit, and also controls switches Q_{8001} (2SA733Q), Q_{8002} (2SC1815Y) and Q_{8003} (2SA639Q) to turn the biases to the tubes on and off. Q_{8002} also keys post TX mixer amplifier Q_{1007} on the RF Unit, while Q_{8001} also controls the 12V CW TX line to CW carrier oscillator Q_{3026}, and offers a keyed control point at pin 2 of the ACC1 jack. The sidetone oscillator provides an output to audio amplifier Q_{3025}, and another output to VOX amplifier Q_{3010} to activate the VOX circuit for semi break-in CW control.

AM MODE (OPTIONAL AM/FM UNIT PB-2347)

A portion of the amplified and filtered speech audio from tone amplifier Q_{3004} on the AF Unit is delivered to AM modulator Q_{6001} (TA7069P) on the AM/FM Unit, which also receives a carrier signal from carrier oscillator Q_{3026} buffered by Q_{3029} (2SC380Y), also on the AF Unit. The modulated AM output is then delivered through IF amplifier Q_{2003} on the IF Unit to final transmit mixer Q_{1008} on the RF Unit, as for SSB and CW, and final amplification is the same.

FM MODE (OPTIONAL AM/FM UNIT PB-2347)

The signal from tone amplifier Q_{3004} on the AF Unit is also delivered to limiter amplifier Q_{6014} (μPC577H) on the AM/FM Unit, where the audio signal amplitude is amplified and limited to a preset level, preventing over-deviation. This signal is then applied to varactor diode pair D_{6003} (MV104) to phase modulate 8.2 MHz VCO (voltage controlled oscillator) Q_{6006} (2SK19BL), serving as part of a PLL (phase-locked loop). One portion of the VCO output is buffered by Q_{6004} (2SK19TMGR) and then divided by 256 at Q_{6005} (TC5082P) for application to phase detector Q_{6013} (TC5081P). Carrier oscillator Q_{3026} on the AF Unit delivers its signal, after buffering by Q_{3029}, to buffer Q_{6002} (2SK19TMGR); which signal is then divided by 256 at Q_{6003} (TC5082P), and applied to phase detector Q_{6013} along with the signal from Q_{6005}. Q_{6013} then presents a DC output voltage proportional to the phase difference between the divided carrier signal and the divided VCO signal, which is passed through active filter Q_{6015} (2SC1815GR) back to modulator varactor D_{6003}, thus locking the VCO frequency to that of the carrier oscillator.

The remainder of the frequency modulated signal from VCO Q_{6006} is buffered by Q_{6007} (2SC380-TMY) and delivered through IF amplifier Q_{2003} on the IF Unit to second transmit mixer Q_{1008} on the RF Unit. A sample of the buffered VCO output from Q_{6006} is also delivered to the input of FM receive detector Q_{6008} for IF monitoring of transmitted FM signals.

ALC CIRCUIT–RECT A UNIT (PB-2349A) and IF UNIT (PB-2343A)

On RECT A Unit the grid bias to the final power amplifiers is sampled by Q_{8004} (2SC2229). A resulting DC voltage appears whenever the grids of the final tubes are driven positive with respect to the bias voltage, as grid current then begins to flow through R_{8021}, appearing as a voltage drop that is then amplified by Q_{8004} for delivery to the IF Unit.

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On the IF Unit a portion of this ALC voltage is fed to one gate of second IF amplifier Q_{2003}, varying the gain of this stage to limit the drive level to the RF Unit and final amplifiers during transmission. The incoming ALC voltage is also amplified by Q_{2029} (2SK19BL), a portion of whose output is applied through meter amplifiers Q_{2031} (2SK19TMGR) and Q_{2032} (2SA564A) for delivery through T-R relay RL_{2001} to METER II during transmission. The remainder of the output from Q_{2029} is buffered by Q_{2033} (2SC1815Y) and amplified by DC amplifiers Q_{2034} and Q_{2035} (2SA564AR) which, together with Q_{2030} (2SC-1815Y), make up the peak hold circuit. Q_{2030} gives a constant voltage output proportional to the charge retained at capacitor C_{2155}, which is charged by the ALC voltage from Q_{2033} when the ALC METER Peak Hold switch on the front panel is depressed. The constant output from Q_{2030} is then fed to meter amplifier Q_{2031} in the same fashion as normal ALC for meter indication.

COMMON CIRCUITS

LOCAL UNIT (PB-2345)

For the following description refer to the Local Unit Block Diagram and the Frequency Relationships chart on the following pages.

Bandswitching signals from the BAND selector are delivered through the Counter Unit to J_{4001} on the Local Unit, selecting one of the six VCOs, Q_{4001} through Q_{4006} (2SC945Q) for the band of operation. The selected VCO oscillates at the first LO frequency, and provides output through buffer Q_{4007} (2SC535B) to buffer Q_{4008}, (2SC2407) which is also controlled by the unlock signal. Q_{4008} provides first LO output at J_{4002} for delivery to the RF Unit.

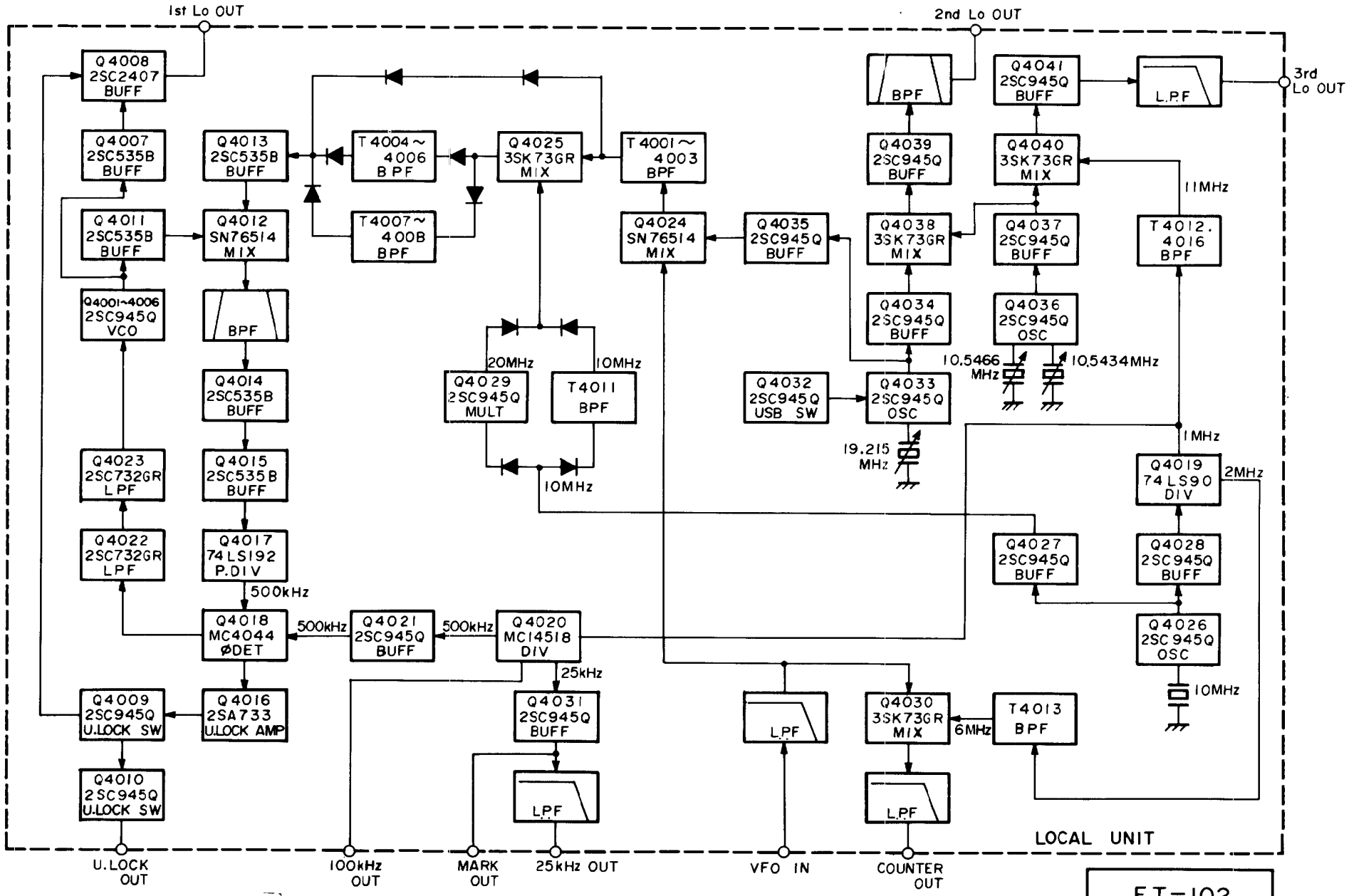
A portion of the VCO signal is buffered by Q_{4011} (2SC535B) and applied to PLL mixer Q_{4012} (SN76514), which also receives a 13.715 to 34.215 MHz PLL local signal from buffer Q_{4013} (2SC535-B), whose frequency is determined by the band, mode, IF Shift and VFO setting for the operating frequency. The 1.0 to 4.0 MHz output from PLL mixer Q_{4012} is then passed through a bandpass filter and buffered by Q_{4014} and Q_{4015} (2SC535B) before being fed to programmable divider Q_{4017} (74LS192). Q_{4017} is programmed by bandswitching signals to provide an output of 500 kHz, regardless of the operating frequency. This output is applied to phase detector Q_{4018} (MC4044), which also receives a 500 kHz reference signal derived from 10 MHz crystal oscillator Q_{4026} (2SC945Q), buffered first by Q_{4028} (2SC945Q) and then divided by 10 at Q_{4019} (74LS90), and again by 2 at Q_{4020} (MC14518) before final buffering at Q_{4021} (2SC945Q). Q_{4018} provides a DC output proportional to the phase difference between the VCO-derived input and the reference-derived input; which is then delivered through active lowpass filters Q_{4022} and Q_{4023} (2SC732GR) to the varactor in the selected VCO, thus locking the VCO frequency to the reference oscillator.

If the output from phase detector Q_{4018} is too great to allow locking of the VCO, an unlock signal is delivered through amplifier Q_{4016} (2SA733) to unlock switch Q_{4009} (2SC945Q), which disables first LO buffer Q_{4008}, removing the first LO signal from the RF Unit. A portion of the switching signal from Q_{4009} also switches Q_{4010} (2SC945Q), which delivers a blinking command signal to the Counter Unit, causing the display to blink whenever the PLL is unlocked.

The PLL local signal is derived from 10 MHz reference oscillator Q_{4026} and 19.21 MHz VCXO Q_{4033} (2SC945Q), along with VFO input. Output from VCXO Q_{4033}, shifted appropriately for the selected operating mode by Q_{4032} (2SC945Q), and according to the IF Shift function, is buffered by Q_{4035} (2SC945Q) and applied to PLL local first premixer Q_{4024} (SN76514), which also receives a 5.0 to 5.5 MHz signal delivered from the VFO Unit (or EXT VFO jack) through a low pass filter. The 13.715 to 14.215 MHz output from premixer Q_{4024} is then filtered through a bandpass filter composed of T_{4001} through T_{4003} before being delivered to the PLL mixer (for those bands below 14 MHz).

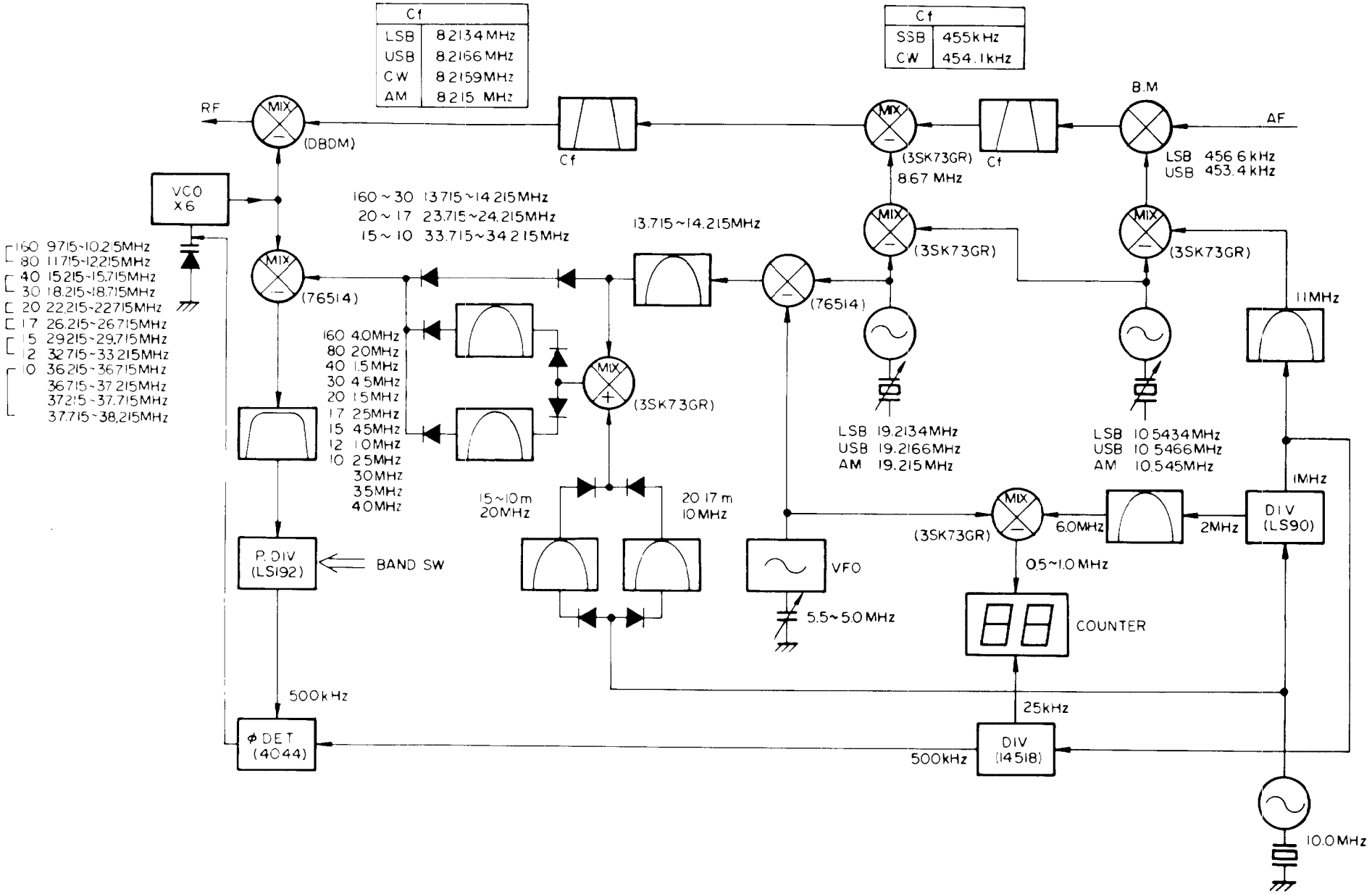
For operating on bands above, and including, the 14 MHz band; the 13.715 to 14.25 MHz filtered signal is applied to PLL local second premixer Q_{4025} (3SK73GR), which also receives a 10 MHz signal filtered through bandpass filter T_{4011} (for operating frequencies between 14 and 21 MHz), or a 20 MHz signal from times 2 multiplier Q_{4029} (2SC945Q) for operating frequencies on or above

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FT-102
BLOCK DIAGRAM

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FT-102 FREQUENCY RELATIONSHIPS

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21 MHz. Both the 10 and 20 MHz signals are derived from 10 MHz VCXO Q_{4026}, through buffer Q_{4027} (2SC945Q). The output of second premixer Q_{4025} is then passed through one of two bandpass filter networks, composed of T_{4004} through T_{4006} or T_{4007} and T_{4008} for the 14 and 18; or 21, 24.5 and 28 MHz bands, respectively. The filtered output from the appropriate bandpass filter is then buffered through Q_{4013} and applied to PLL mixer Q_{4012} as before. Frequency and filter selection is made through diode switches by commands from the BAND selector.

The 8.67 MHz second LO signal is derived from the 19.215 MHz VCXO and the signal from another 10.54 MHz VCXO (actual center frequency, 10.5466 MHz for USB, or 10.5434 MHz for LSB, and 10.545 MHz for AM; with continuous frequency adjustment by the Width system). The output of this 10.54 MHz VCXO, Q_{4036} (2SC945Q), is buffered by Q_{4037} (2SC945Q) and applied to second LO mixer Q_{4038} (3SK73GR), which also receives a signal from 19.215 MHz VCXO Q_{4033} after buffering by Q_{4034} (2SC945A). The 8.67 MHz output from mixer Q_{4038} is then buffered by Q_{4039} (2SC945Q) and passed through a bandpass filter for delivery to the IF Unit from J_{4008} and to the AM/FM Unit from J_{4009}.

The 455 kHz third LO signal is derived from 10 MHz reference oscillator Q_{4026} and 10.54 MHz VCXO Q_{4036}. The 10 MHz signal, after buffering by Q_{4028} and division by 10 at Q_{4019} (mentioned in the PLL description) has its 1 MHz square pulse signal filtered through a bandpass filter composed of T_{4012} and T_{4016}, to provide an 11 MHz signal for third LO mixer Q_{4040} (3SK73GR). Q_{4040} also receives a portion of the buffered 10.54 MHz signal from Q_{4037}, thus providing an output at 455 kHz, buffered by Q_{4041} (2SC945Q) and passed through a lowpass filter for delivery from J_{4011} to the AF Unit.

This unique frequency derivation scheme allows the Shift function to tune the second LO, at 19.215 MHz VCXO Q_{4033}, while the Width function synchronously tunes the second LO and third LO, commonly derived from 10.54 MHz VCXO Q_{4036}.

Sample data to the Counter Unit for frequency display is derived from both the VFO signal and 10 MHz reference oscillator Q_{4026}. Reference divider Q_{4019} provides a 2 MHz square pulse for this purpose, which is filtered at T_{4013} to provide a 6 MHz signal to counter sample mixer Q_{4030} (3SK73GR), which also receives the VFO signal after lowpass filtering. The resulting 0.5 to 1.0 MHz mixer product is passed through another lowpass filter before delivery from pin 1 of J_{4013} to the Counter Unit.

A clock signal for the Counter Unit is also derived from 10 MHz reference oscillator Q_{4026} after division by 10 at Q_{4019}, further division by 40 at Q_{4020} (both mentioned in the PLL description), buffering by Q_{4031} (2SC945Q) and lowpass filtering. This 25 kHz signal is brought out for the Counter Unit at J_{4013}, pin 3; while a portion of the signal before filtering is delivered from J_{4014} to the receiver input at the EXT ANT jack on the rear panel, providing a MARK signal for the receiver when the MARK button is depressed. Second reference divider Q_{4020} also provides a 100 kHz signal delivered from J_{4015} to the EXT VFO jack and the ACC-1 receptacle on the rear panel.

VFO UNIT (PB-2348)

Variable frequency oscillator module Q_{7001} (VFO-1) provides an output of approximately 4.95 to 5.55 MHz in accordance with the setting of tuning variable capacitor VC_{7001}; paralleled with temperature compensating capacitors and trimmers, and clarifier varactor D_{7001} (1S2236); whose capacitance is varied by changes in the clarifier control voltage adjusted from the CLAR control when the CLAR function is activated on either transmit or receive. Output from Q_{7001} is fed through a bandpass filter before delivery from pin 1 of J_{7001} to the Local Unit.

COUNTER UNIT (PB-2346A)

The 0.5 to 1.0 MHz sample signal from the Local Unit is buffered by Q_{5001} (2SC1815Y) and again by a gate in Q_{5005} (MC14011B) before being applied to Q_{5006} (MC14022B) for gating and division by 8. Output from Q_{5006} is then applied to pin 37 of LSI Counter Q_{5007} (TC5070).

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The 25 kHz clock signal from the Local Unit is buffered by Q_{5002} (2SC1815Y) and divided by 25 and by 50 at Q_{5003} (MC14518B). The resulting 1 kHz output is applied to SCAN CLOCK pin 22 of Q_{5007}, while the 500 Hz output is passed to Q_{5004} (MC14518B) for further division by 10 and by 50. These outputs are summed in Q_{5005}, resulting in a gating pulse for Q_{5006} and LOAD PRESET input to pin 32 of Q_{5007}. The 10 Hz output from Q_{5004} is also delivered through a gate in Q_{5005} to provide a STORE pulse to pin 16 of Q_{5007}; and to Q_{5006} for gating control.

Preset Data for Q_{5007} is furnished by the bandswitch through encoders Q_{5012} and Q_{5013} (MC14081B), and by the mode selector through Q_{5011} (MC14011) for a 700 Hz CW shift and plus 500 kHz for appropriate band selections. Digit driver Q_{5009} and segment driver Q_{5010} (both TC5066) pass the output of Q_{5007} to fluorescent display DS_{5001} (F1P9E8), while Q_{5008} (TC5066) passes mode display information to DS_{5001}.

The 8 volt DC bus is regulated by Q_{5015} (78L05) to provide the 5V supply for the ICs, while the 8V bus is applied directly to the DC-DC converter formed by oscillator Q_{5014} (2SC1815Y) and T_{5001} (E142), supplying negative 10 volts DC for the display and for delivery from J_{5006} to the -10 volt DC bus.

RECTIFIER A UNIT (PB-2349A)

Power transformer PT01 delivers 120, 190, and 250 VAC for rectification on RECT A Unit. The 120V input is rectified by D_{8006} (10D10) and then filtered to provide grid biases for the driver and final tubes. VR_{8001} adjusts the bias voltage for the finals, and the biases are keyed as described in the CW Transmit Operation description. The 190V input is rectified by D_{8002} and D_{8003} (10D10) and then filtered, after which a portion is pulled down to 180 VDC for screen voltage to driver V_{1001} on the RF Unit. The remainder is passed through diodes D_{8004} and D_{8005} (10D10) to provide 210 VDC for the screen grids of the final amplifiers. The 250V input is rectified by D_{8001} (SM1-12) and then filtered before delivery (as 300 VDC) to the plate of driver V_{1001} on the RF Unit.

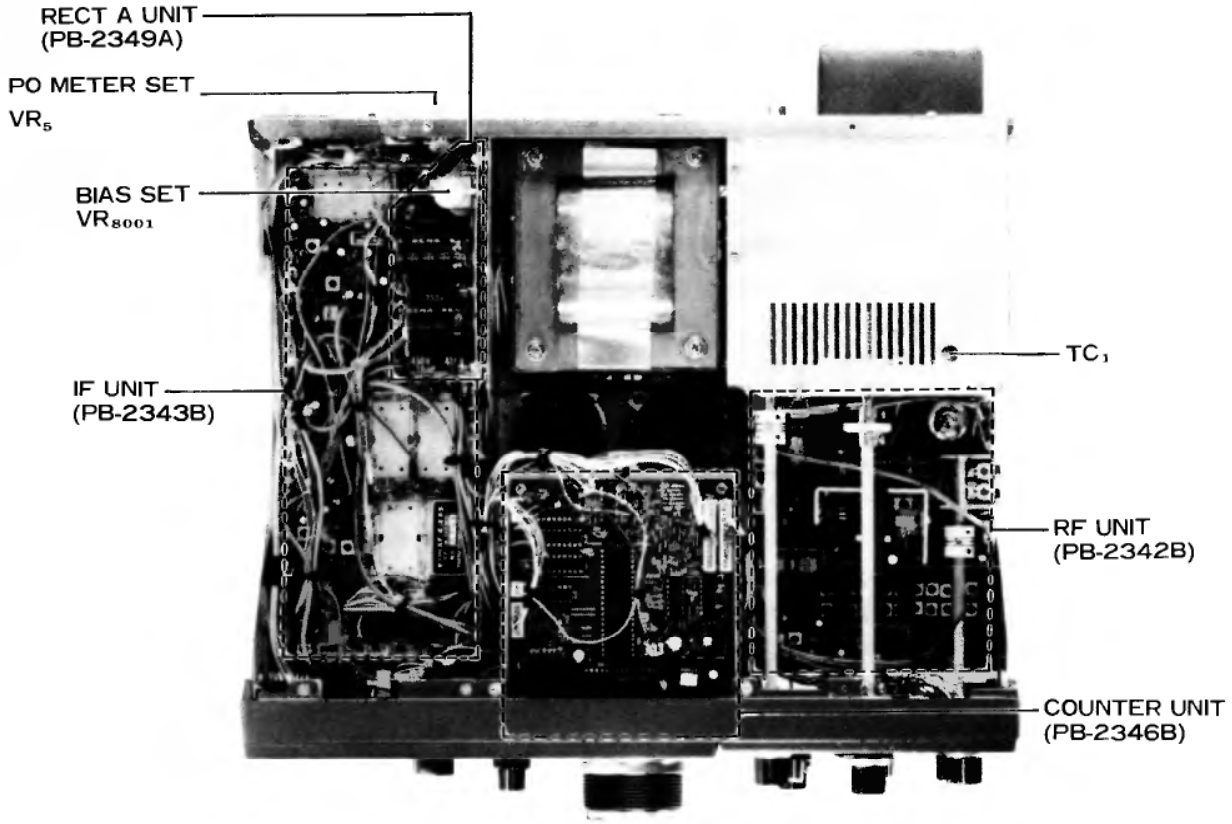
RECTIFIER B UNIT (PB-2350)

Bridge rectifier D1 (S4V10) on the main chassis delivers 15 volts DC to this board, where it is filtered and regulated by Q_{8501} (2SA733), Q_{8502} (μPC78L12) and Q1 (2SB705R on the main chassis), providing 12 VDC as the general VCC supply to all other Units, and to the cooling fan through the HEATER switch. On the main chassis, a portion of the 15 VDC present at the emitter of Q1 is diverted to regulators Q3 and Q4 (μPC7812H); Q3 thus providing 12 VDC for the panel lamps, and Q4 providing 12 VDC to pin 2 of the EXT VFO jack on the rear panel for the external VFO supply.

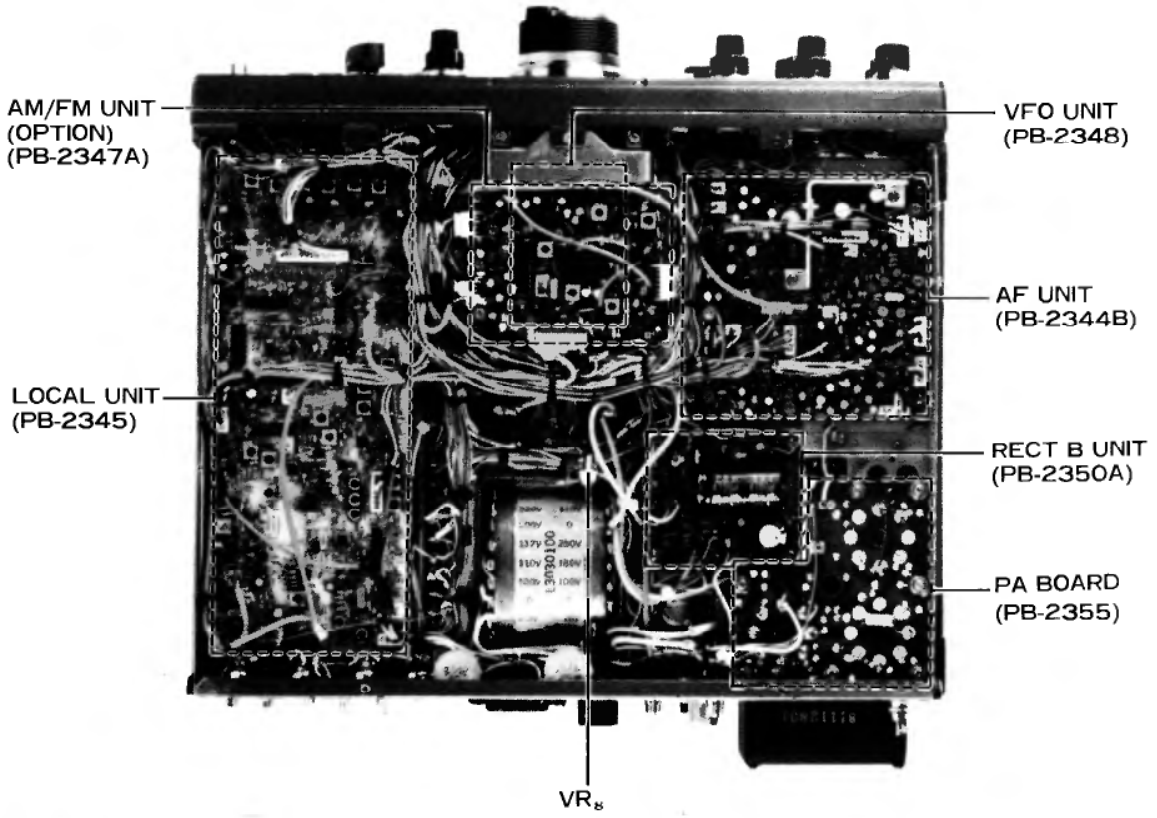
AC voltage from the heater winding of the power transformer is rectified by D_{8505} (V06B) and filtered by capacitor C_{8509}, where the filtered 15 VDC from bridge rectifier D1 is added to result in about 26 VDC. This voltage is regulated by Q_{8503} (2SC496Y) and zener diode D_{8507} (AW01-24) to provide 24 VDC for the receiver front end circuits on the RF and IF Units. A portion of the 24 VDC is further regulated by Q_{8505} (78L15) to provide 15 VDC for the Width Control system. During transmission, 12 VDC is applied to Q_{8504} (2SC1815Y), which then grounds the base of Q_{8503}, dropping the 24 VDC and 15 VDC lines to zero and thus disabling the sensitive receiver front end and the Shift/Width function.

The power transformer 320 VAC winding connects to the Rectifier B Unit, where the AC is rectified by D_{8501} through D_{8504} (10D10) and then doubled by capacitors C5 and C6 (on the main chassis) to result in 900 VDC for the plate circuit of the final amplifiers. Also, when a plug is not inserted into the EXT VFO jack on the rear panel, 8 VDC is delivered from the 8 VDC supply bus (regulated from the 12 VDC VCC bus by Q2 (μPC14308H), on the main chassis) to zener diode D_{8506}, producing 6 VDC for delivery to the VFO Unit.

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TOP VIEW



BOTTOM VIEW

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MAINTENANCE & ALIGNMENT

The following Alignment Procedure for the FT-102 is divided into two separate sections. The first section covers the various alignments and adjustments that may be made by the owner, as these do not require sophisticated test equipment outside of the FT-102 itself and standard tools and equipment normally found in the ham shack. The second alignment section covers the sometimes critical and tedius adjustments, which must not be performed without the proper test equipment conforming to the specifications called for in the test equipment list. If you do not have, or are not familiar with this test equipment; or have any doubts about its use in these specific applications, you should not attempt any of the alignment procedures in this section. Unless you are experienced with alignment of these types of circuits and thoroughly understand their operation, let the alignments covered in the second section be performed by your authorized Yaesu dealer's service department.

Every FT-102 has been completely aligned at the factory prior to shipment. However, your particular operating environment may call for some readjustments, such as VOX, Anti-trip, Monitor Volume, or Sidetone Pitch. Yaesu's design engineers have made a special effort to make these controls, and all of the adjustments that might require readjustment due to shipping and environmental variations, readily accessible to the user through the plastic circuit board cover under the cabinet's top cover. Under normal use, no other alignment should be necessary. Service or realignment of a major component may require substantial adjustment; under no circumstances, though, should realignment be attempted unless the operation of the transceiver is fully understood, the malfunction has been carefully analyzed, and the fault has definitely been traced to misalignment. Sudden difficulties are almost always caused by component failure rather than misalignment.

SECTION I

The following adjustments can be made by removing the top cover of the FT-102, The controls are labelled on the plastic cover over the pc boards, and can be adjusted with a small screwdriver. You will need to have on hand a microphone, CW key, headphones and, for the Carrier Balance adjustment, and external receiver in order to make these adjustments.

VOX Circuit

A. Antitrip level setting

1. Tune in a signal on the FT-102 receiver, and adjust the AF GAIN control for a normal listening level. Position the microphone near the speaker, with the MODE switch in the SSB mode. Increase the VOX GAIN control on the front panel until the speaker output causes the VOX relay to switch the transceiver to transmit. Set the A-TRIP control (VR_6), located on the rear apron, to the point that will just prevent the speaker output from tripping the VOX relay.

2. Now place the microphone in the normal operating position, and speak into the microphone to see if your voice will activate the VOX relay. If not, VR_6 may be advanced too far.

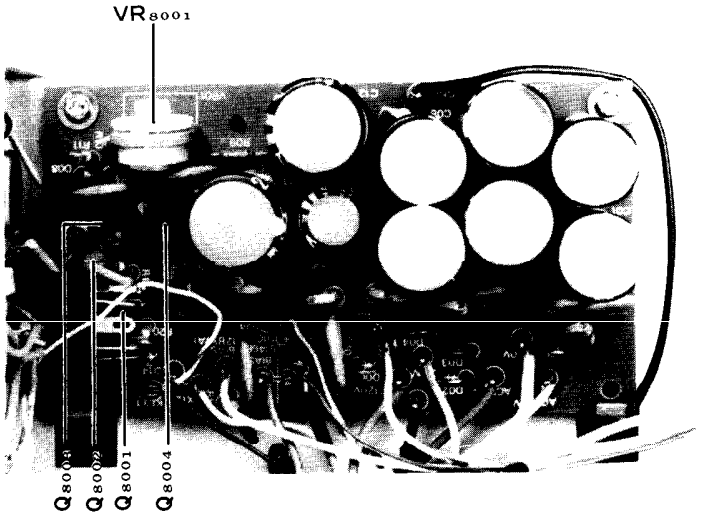
B VOX relay delay setting

1. Adjust the DELAY control on the front panel for the desired delay time. This may require a different setting for phone and CW operation, owing to differing operating techniques. For CW or phone operation using a footswitch, the VOX GAIN control should be rotated fully counter-clockwise to the (PTT position).

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Final Amplifier Bias Adjustment

1. Set the MIC GAIN fully counterclockwise, and the MODE selector to USB or LSB. Set the METER SELECT to IC. Turn the HEATER switch ON and let the final tubes warm up for a few minutes.



RECT. A UNIT

2. Observe the indication on the IC scale of METER I while depressing the MOX button to key the transmitter. IC (grid current) should be 75 mA.

3. If the IC reading is more than ±10% from this figure, adjust VR_{8001} on the RECT A Unit (PB-2342A).

FINAL AMPLIFIER NEUTRALIZATION

Important Note: For this alignment, use a NON-METALLIC tuning wand.

1. Set the BAND switch to 29, set the tuning dial to 29 MHz, and tune into a dummy load for approximately 70% full output power.

2. Set the METER switch to IC, and observe the dip in the cathode current. The dip should occur at the same point that maximum power output (measured on the dummy load wattmeter) occurs. If this is not the case, adjust TC_1, located inside the final amplifier cage, for the required coincidence of maximum power output and dip on the IC meter.

CAUTION

HIGH VOLTAGES ARE PRESENT ON THE UNDERSIDE OF THE CHASSIS AND INSIDE THE FINAL AMPLIFIER COMPARTMENT. USE GREAT CARE WHILE MAKING ADJUSTMENTS IN AREAS OF EXPOSED WIRING.

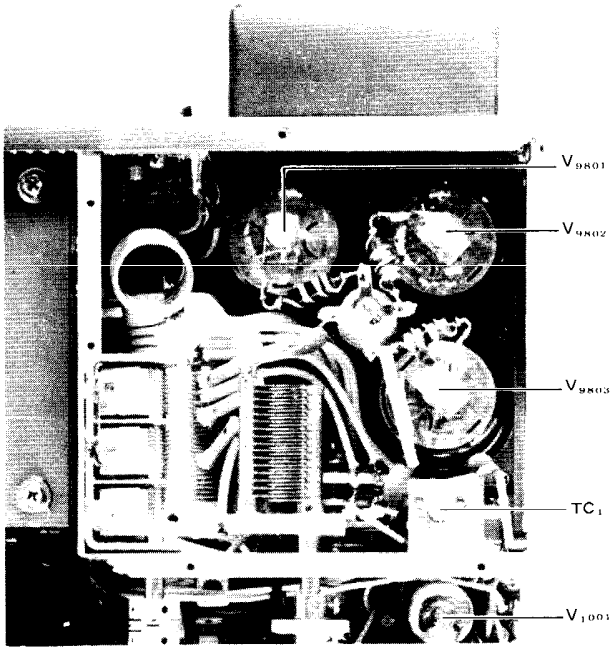
Note

The final amplifier enclosure must be in place to provide the required RF shielding during the neutralization procedure.

PO Meter Adjustment

1. Tune the transmitter for maximum power output at 14.250 MHz into a dummy load.

2. Set the METER SELECT switch to PO, and adjust VR_5 on the rear panel for 80% deflection (or as desired).



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Carrier Balance

1. Set the MODE selector to USB and tune the transceiver to the 14 MHz band.

2. Set the MIC GAIN control fully counter-clockwise (minimum), and disconnect the microphone from the MIC jack.

3. Press the MOX switch.

4. Tune an external receiver to the same frequency as the FT-102, and adjust CARRIER BALANCE control VR_{3003} for minimum signal at the external receiver.

5. Switch the MODE selector to LSB, and repeat step 4.

6. Switch back and forth from LSB to USB several times while adjusting VR_{3003} to obtain an equal minimum output in the two modes.

CW Sidetone Pitch and Level

(See page 13 of this manual)

Transmit Audio Characteristic

(See page 13 of this manual)

SECTION II

ALIGNMENT EQUIPMENT REQUIRED

The following precision test equipment is required for the alignment procedures in this section:

Frequency Counter
YC-500E (YAESU) or equivalent
Signal Generator
HP 8640B (Hewlett Packard) or equivalent
DC Voltmeter
HP 4304B " "
VTVM with RF probe
HP 3406A " "
AF VTVM
HP 400E " "
In-line Wattmeter
Bird 43 "
Dummy Load (200 W)
Bird 8343-200 "
Oscilloscope
HP 1222A (Hewlett Packard) or equivalent
Spectrum Analyzer
HP 141T " "
8552B " "
8553B " "
Distortion Meter
HP 334A " "
Audio Generator
HP 200CD " "
Linear Detector
HP 8901A " "

LOCAL UNIT ALIGNMENT (PB-2345)

10 MHz Reference Oscillator

1. Connect the RF probe of the VTVM to TP_{4003} and adjust transformer T_{4013} for maximum deflection on the meter (approx. 100 mV rms).

2. Connect the frequency counter to TP_{4003} and adjust trimmer TC_{4001}, if necessary, to obtain a reading of 6.000 MHz on the counter.

10.5 MHz SSB Carrier Oscillator

1. Set the SHIFT/WIDTH controls to their center positions, and connect the frequency counter to TP_{4007}.

2. Set the MODE selector to LSB, and adjust TC_{4002} for 10.5434 MHz on the counter.

3. Set the MODE selector to USB, and adjust TC_{4003} for 10.5466 MHz on the counter.

4. Preset potentiometer VR_{4004} fully counter-clockwise and connect the DC voltmeter across the outer terminals of VR_{4004}. Adjust VR_8 on the main chassis to obtain 0 volts on the meter.

19.2 MHz Local Oscillator

1. Connect the frequency counter to TP_{4006}, set the MODE selector to LSB, and adjust VR_{4005} for 19.2134 MHz on the counter.

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2. Set the MODE selector to USB and adjust VR_{4006} for 19.2166 MHz on the counter.

3. Repeat steps 1 and 2 until the counter shows the exact frequency indicated for each mode.

Shift/Width Tracking

1. Connect the frequency counter to TP_{4007} and preset the SHIFT/WIDTH controls to their center positions.

2. Set the MODE selector to LSB and check for a frequency of 10.5434 MHz on the counter.

3. Rotate the SHIFT/WIDTH controls 90° clockwise, record the counter frequency, and calculate the difference between this and the frequency noted in step 2.

4. Connect the frequency counter to TP_{4006}, return the SHIFT/WIDTH controls to their center positions, and note the counter frequency. For LSB, this should be 19.2134 MHz.

5. Repeat step 3, using the frequency noted in step 4.

6. Compare the two difference frequencies calculated in steps 3 and 5, and adjust VR_{4004} if these frequencies are not the same. Repeat the above procedure after adjustment of VR_{4004}.

AM Carrier Frequency Check

1. Set the MODE selector to AM and connect the frequency counter to TP_{4007}. Key the transmitter and check the counter for 10.545 MHz ±1 kHz.

2. Connect the counter to TP_{4006} and key the transmitter while checking for 19.215 MHz ±1 kHz.

SSB Carrier Point

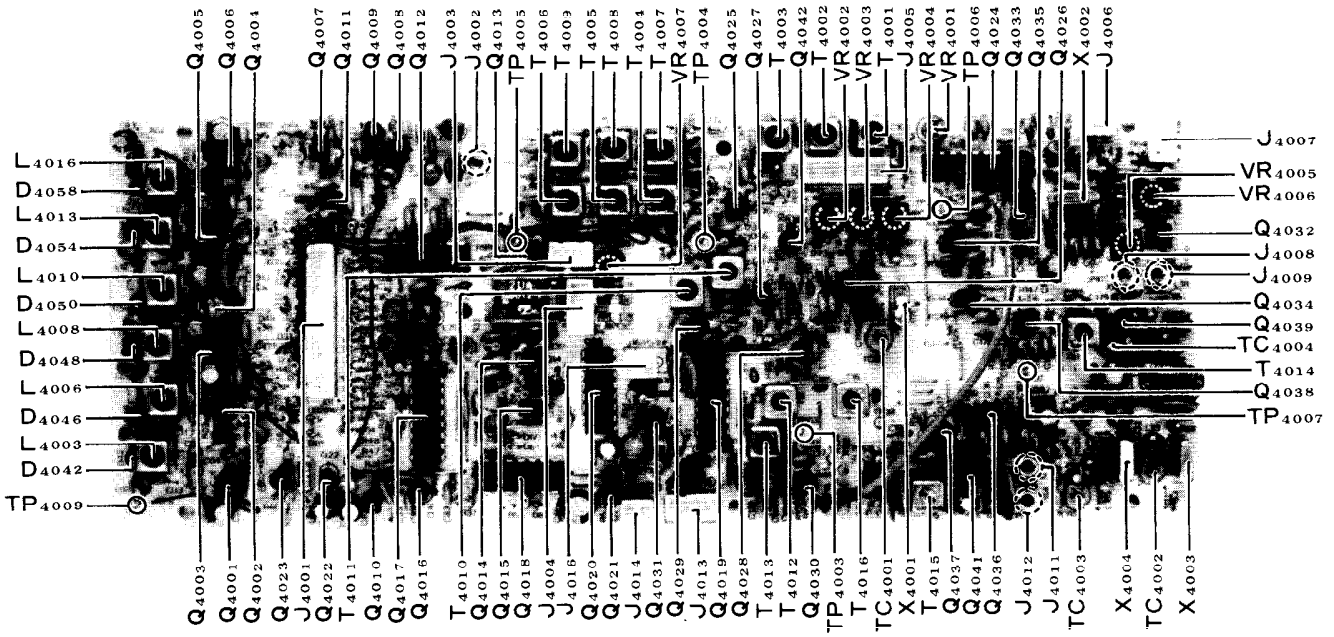
1. Set the MODE selector to USB, and connect the frequency counter to TP_{4007}.

2. Key the transmitter and adjust potentiometer VR_{4003} for 10.5466 MHz on the counter.

3. Now connect the frequency counter to TP_{4006}, key the transmitter, and adjust potentiometer VR_{4002} for 19.2166 MHz on the counter.

4. Set the MODE selector to LSB and check TP_{4007} for 10.5434 MHz and TP_{4006} for 19.2134 MHz with the counter during transmission.

5. Connect the Audio signal generator to pin 8 of the MIC jack (pin 7 is ground), and Connect the Oscilloscope to the TP_{3005} on AF unit. Set the AG for 1 kHz @ 2 mV, MIC



LOCAL UNIT

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gain to 9 o'clock, and HEATER off. Key the transmitter and note the amplitude of the scope display. Now change the AG frequency to 300 Hz (2 mV) and adjust VR_{3002} for the same amplitude on the scope.

6. Retune the AG to 1 kHz, and switch the HEATER on, 14 MHz band. Tune up the transmitter for 100 watts output, adjusting the signal generator output level to obtain this power output with the MIC GAIN control at the 12 o'clock position.

7. Now adjust the audio generator frequency to 300 Hz while maintaining a constant generator output level. If the ALC indication on METER II does not change during this audio frequency change, check the output power level, which should now be 25 watts. If necessary, adjust VR_{4005} for 25 watts output. If the ALC indication changes, repeat step 5 with the MIC GAIN control set lower and the signal generator level correspondingly higher.

8. Return to receive, switch the MODE selector to USB and repeat step 6, adjusting VR_{4006}, if necessary, to obtain 25 watts output.

PLL Local Coil

1. Connect the RF probe of the VTVM to the TP shown in the chart at the bottom of the page. Set the receiver to the frequency shown, and adjust the transformer indicated for the corresponding reading on the VTVM.

PLL VCV

1. Connect the VTVM (set for DC) to TP_{4009}. Set the receiver to the frequency indicated in the chart and adjust the corresponding coil for the indicated DC voltage on the meter.

FT-102 Freq	Coil	VDC
2.0MHz	L_{4003}	6V ±0.1V
7.5MHz	L_{4006}	6V ±0.1V
14.5MHz	L_{4008}	6V ±0.1V
18.5MHz	L_{4010}	2V ±0.1V
21.5MHz	L_{4013}	6V ±0.1V
30.0MHz	L_{4016}	2V ±0.1V

Third Local Circuit

1. Connect the RF probe of the VTVM to TP_{3010} on the AF Unit.

2. Adjust transformers T_{4012}, T_{4015} and T_{4016} for peak indication on the VTVM (at least 350 mVrms).

Second Local Circuit

1. Connect to the RF probe of the VTVM to connector J_{4008} and adjust T_{4014} for peak indication on the VTVM (250–350 mVrms).

Clarifier

1. Set the CLAR control to the 12 o'clock position, and the CLAR button OFF.

2. Note the display frequency, and press the CLAR button ON. If the display frequency changes, adjust VR_{4007} to remove the offset.

1.875 MHz Trap

1. Tune the transceiver to 1.875 MHz and adjust TC_{4004} for minimum level of the internal spurious signal.

PLL LOCAL COIL ALIGNMENT POINTS

TP	Freq.	Transformer	VTVM Reading
TP_{4004}	14.250 MHz	T_{4011}	Peak (repeak after T_{4009}, below)
TP_{4004}	28.250 MHz	T_{4010}	" " " "
TP_{4005}	7.250 MHz	T_{4001}, T_{4002}, T_{4003}	Peak (40–50 mV rms, avoid resonance at 20 MHz)
TP_{4005}	14.250 MHz	T_{4004}, T_{4005}, T_{4006}	" (approx. 100 mV rms, avoid resonance at 30 MHz)
TP_{4005}	28.250 MHz	T_{4007}, T_{4008}, T_{4009}	" 200–300 mV rms
TP_{4005}	14.250 MHz	T_{4011}	"
TP_{4005}	28.250 MHz	T_{4010}	"

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RF UNIT ALIGNMENT (PB-2342)

1. Connect the sweep generator output to J_{1001} (TX IN), and connect the oscilloscope to RF OUT jack J_5 on the rear panel. Turn the HEATER switch OFF.

2. Key the transmitter and adjust the appropriate transformer for each band according to the the following chart to obtain the correct 3dB bandwidth with minimum ripple, as displayed on the scope. Ripple should not exceed 3dB.

Band	Adjust	Passband (-3 dB)
1.8	T_{1011}, T_{1022}	1.8– 2.0 MHz
3.5	T_{1013}, T_{1014}	3.5– 4.0 MHz
7.0	T_{1015}, T_{1016}	7.0– 7.3 MHz
10.0	T_{1017}, T_{1018}	10.0–10.5 MHz
14.0	T_{1019}, T_{1020}	14.0–14.5 MHz
18.0	T_{1021}, T_{1022}	18.0–18.5 MHz
21.0	T_{1023}, T_{1024}	21.0–21.5 MHz
24.5	T_{1025}, T_{1026}	24.5–25.5 MHz
28/29	T_{1027}, T_{1028}	28.0–29.9 MHz

1. Connect the SSG to the ANT terminal, or alternatively, switch the MARK signal ON (rear panel switch).

2. Set the FT-102 to the band and frequency shown in the following chart, and set the PRESELECT control to the position indicated. Switch the RF AMP ON.

Preselector

3. Adjust the transformer indicated in the chart for maximum S-meter reading.

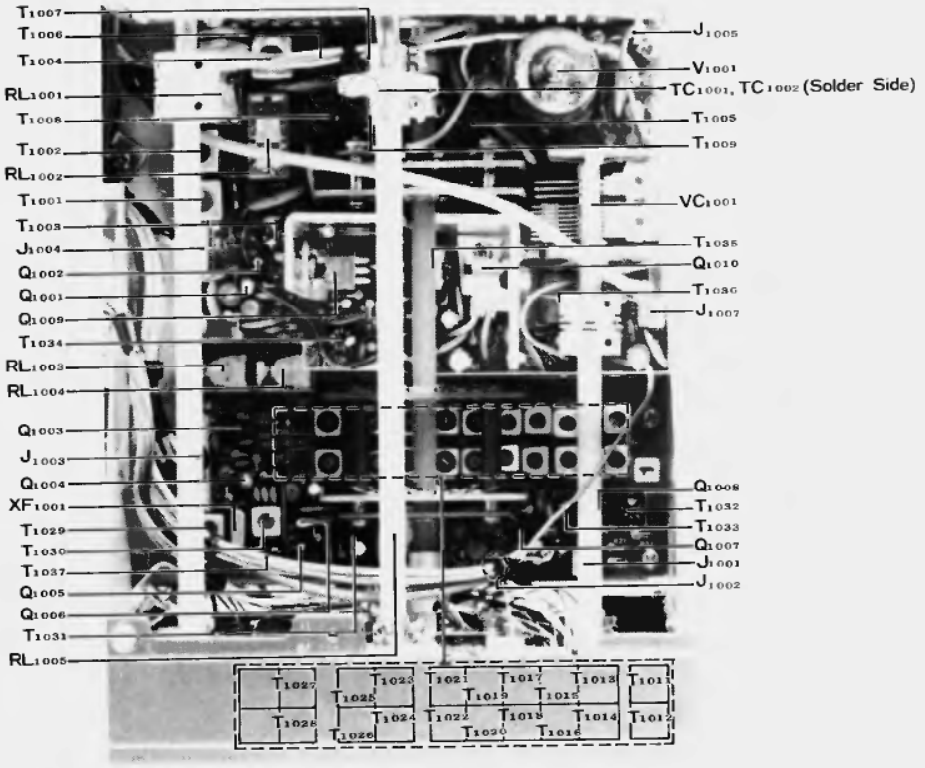
Band	Frequency	Preselect	Transformer	S-meter Reading
3.5	4.000 MHz	8	T_{1004}	Maximum
7.0	7.000 MHz	5	T_{1005}	
10.0	10.000 MHz	6	T_{1006}	
14.0	14.500 MHz	8	T_{1007}	
21.0	21.500 MHz	8	T_{1008}	

4. Remove the SSG and connect the dummy load to the ANT terminal. Set to 29.5 MHz band, 30.000 MHz, PRESELECT to 8, key the transmitter and adjust T_{1009} for maximum power output.

5. Reconnect the SSG to the ANT terminal and adjust TC_{1001} for maximum RX S-meter indication.

6. Remove the SSG and connect the dummy load to the ANT terminal. Set to 28.5 MHz band, 28.500 MHz, and key the transmitter. Adjust the PRESELECT control for maximum power output, and leave at this setting for the next step.

7. Repeat step 5, adjusting TC_{1002}.



RF UNIT

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First Mixer

1. Tune the transceiver to 14.250 MHz and turn the RF AMP and MARK ON. Adjust T_{1029} and T_{1030} for maximum S-meter deflection.

8.215 MHz IF Trap

1. Connect the SSG to the ANT jack on the FT-102, and tune both to 7.300 MHz. With the RF AMP ON, adjust the PRESELECT control for peak sensitivity.

2. Retune the SSG to 8.215 MHz, and set the output level to 100dBμ.

3. Adjust T_{1001} and T_{1002} for minimum indication on the S-meter.

IF UNIT ALIGNMENT (PB-2343)

Receiver IF Transformers

1. Tune in the MARK signal or SSG signal on any band and adjust T_{2001} through T_{2005}, T_{2007} through T_{2010}, and T_{2018} for peak S-meter deflection.

Noise Blanker

1. Connect the VTVM (set for DC) to TP_{2014}, and connect the SSG to J_{2004}. Set the SSG output for 8.215 MHz at 60dBμ.

2. Set the NB LEVEL control on the front panel to the 12 o'clock position, and adjust T_{2014} and T_{2015} for minimum deflection on the VTVM.

Notch Filter

1. Connect the SSG to the ANT terminal and set the output level to 60dBμ at the transceiver frequency. Now adjust the VFO dial to obtain a beat note of approximately 1.6 kHz.

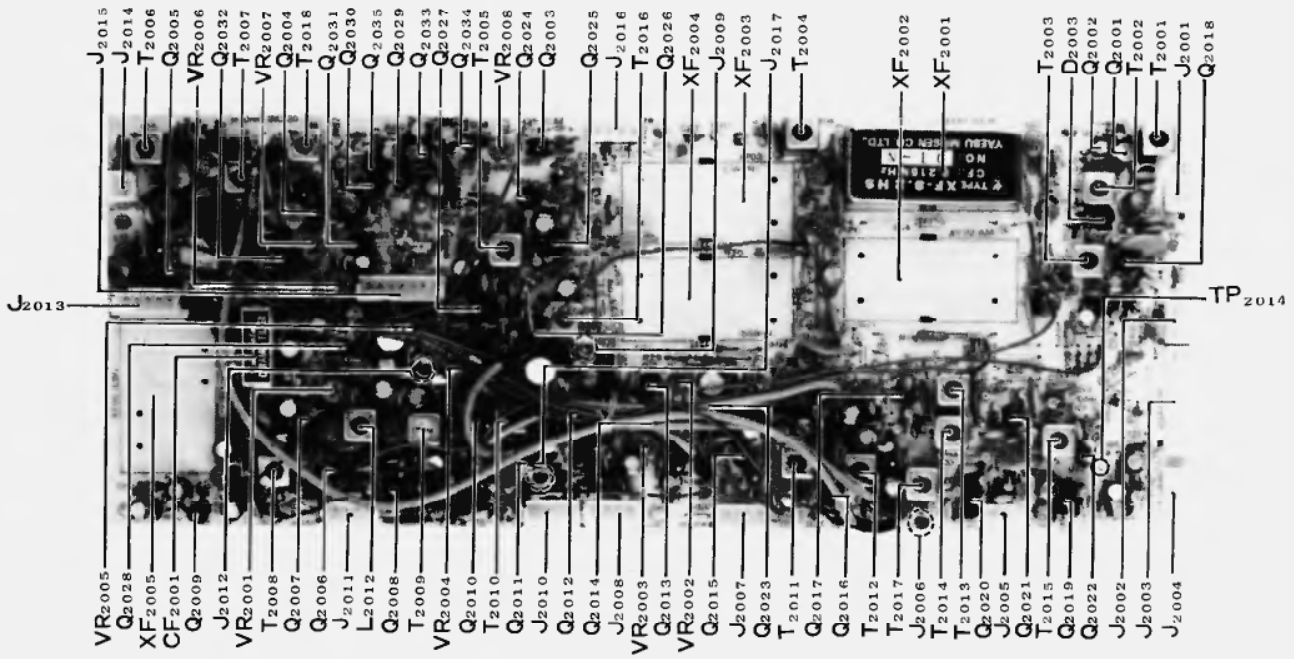
2. With the NOTCH switch ON and the NOTCH control set to the 12 o'clock position, adjust L_{2012} and VR_{2001} for minimum S-meter deflection.

S-Meter

This alignment should only be performed (later) after all other receiver adjustments have been completed.

1. Set the transceiver frequency to 14.250 MHz and remove any input from the ANT jack. Adjust VR_{2002} to zero the S-meter (METER II).

2. Connect the SSG to the ANT terminal, and set the output for 40dBμ at 14.250 MHz. With the RF AMP ON, adjust VR_{2003}, if necessary, to obtain a reading of S-9 on the S-meter.



IF UNIT

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Transmitter IF

1. With the transceiver frequency at 14.250 MHz, connect the audio generator to the MIC jack and apply a 1 kHz tone at 10 mV. Connect the dummy load to the ANT jack.

2. In the SSB mode, tune the transmitter for about 50% of maximum power output, and then, with the PROC OFF, adjust T_{2005}, T_{2006}, T_{2013} and T_{2017} for peak power output indication (reduce the MIC GAIN, if necessary, to retain about 50% of full output).

3. Press the PROC button, and adjust T_{2011} and T_{2012} also for peak output power.

ALC Meter

1. With the same setup as step 1 of the Transmitter IF Alignment and the MODE selector in USB, set the MIC GAIN control fully counterclockwise.

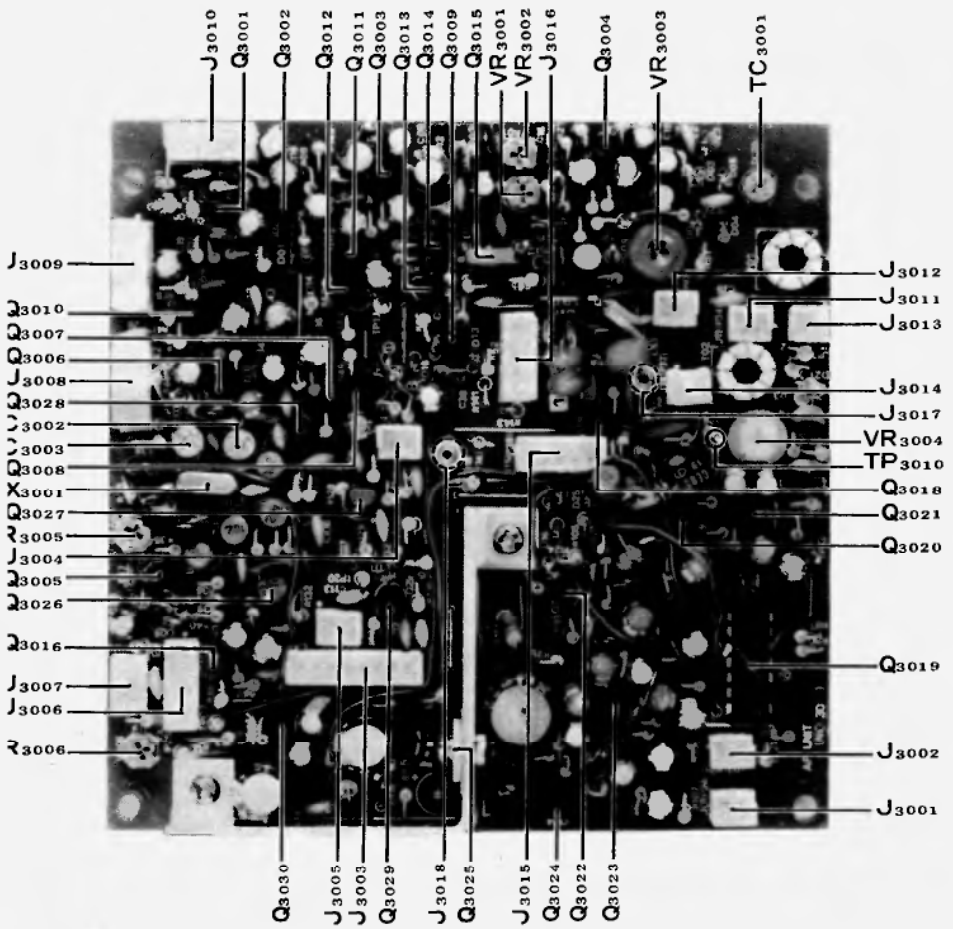
2. Set the ALC METER switch to OFF, key the transmitter, and adjust VR_{2006} to the threshold point where the ALC indication on METER II is just at the edge of the left end of the scale.

3. Advance the MIC GAIN control also to the threshold point where ALC indication just begins, and tune the PRESELECT, LOADING and PLATE controls for maximum power output. Again set the MIC GAIN control to the ALC threshold point.

4. Now increase the output level of the audio generator to 30 mV. Adjust VR_{2007}, if necessary, to obtain an ALC meter indication at the right edge of the black ALC zone.

ALC Peak Hold Delay

1. Connect a microphone to the MIC jack and depress the ALC METER button to activate the peak hold circuit. Speak into the microphone and adjust VR_{2008} for the desired hold time on the ALC meter (METER II).



AF UNIT

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AF UNIT ALIGNMENT (PB-2344)

CW Carrier Frequency

1. Connect the frequency counter to pin 1 of J_{3004}, and connect the dummy load to the ANT jack. Set the MODE selector to CW.

2. Key the transmitter and adjust TC_{3003} for 8.2166 MHz on the counter.

TX Carrier Balance

1. Set the FT-102 and a separate monitor receiver to 14.250 MHz. Remove the microphone from the MIC jack, and set the MODE selector to USB.

2. Key the transmitter and adjust VR_{3003} and TC_{3001} alternately while switching from USB to LSB to obtain the minimum carrier output in both modes, as indicated on the external receiver.

RX Carrier Balance

1. Remove all connections from the ANT jack. With the FT-102 set to 14.250 MHz, adjust VR_{3004} for minimum S-meter deflection.

CW Transmit Frequency

1. Set the FT-102 to the CW mode (do not use the TUNE position for this adjustment), and connect the frequency counter to RF OUT jack J_5 on the rear panel.

2. Tune the transmitter for slight power output into the dummy load, and adjust TC_{3003}, if necessary, to match the counter frequency with the display frequency (±100 Hz maximum).

AM Carrier Frequency

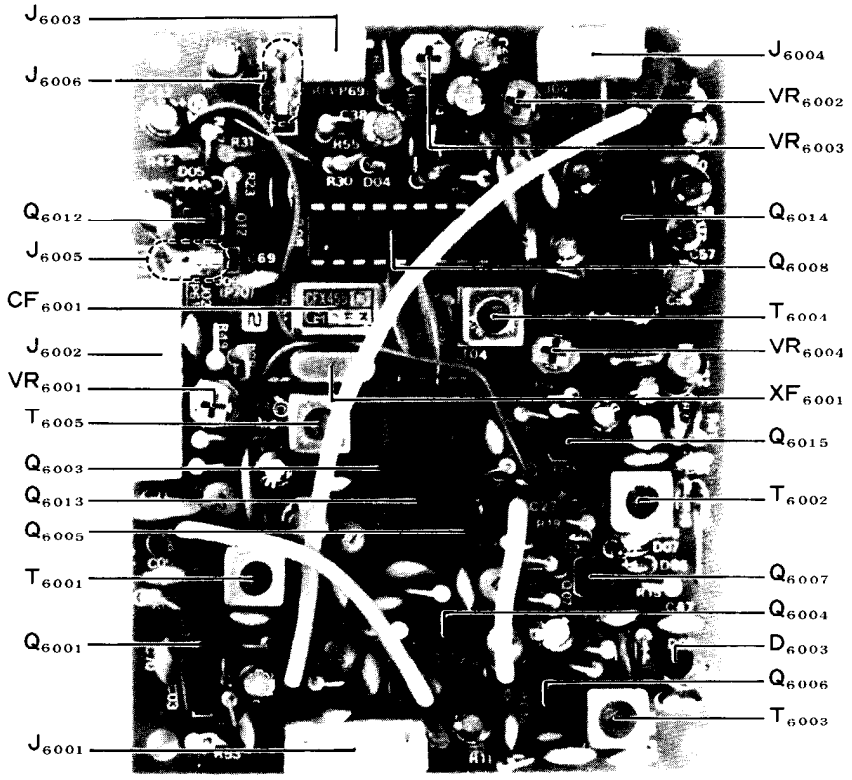
1. Connect the frequency counter to pin 1 of J_{3005} on the AF Unit, and set the MODE selector to AM.

2. With the dummy load connected to the ANT jack, key the transmitter and adjust TC_{3002} on the AF Unit for 8.215 MHz on the counter.

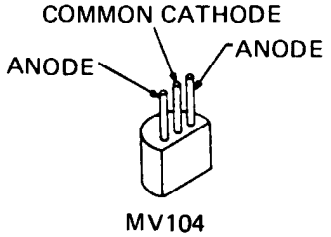
AM/FM UNIT ALIGNMENT (PB-2347, option)

FM IF

1. Set the SQL control fully counterclockwise, and set the SHIFT/WIDTH controls to their center positions.



AM/FM UNIT



MV104

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2. Tune the transceiver and SSG to 29 MHz. Set the SSG output for 1 kHz modulation and 3.5 kHz deviation, and connect to the ANT jack on the FT-102. Set the SSG output level for an indication of S-9 on METER II.

3. Connect the AF millivoltmeter to the speaker terminals, and adjust T_{6004} and T_{6005} for maximum indication on this meter.

DISC Meter

1. Set up the FT-102 and SSG as in step 2 of the preceding FM IF alignment procedure.

2. Set VR_{6003} for center indication on the DISC meter scale of METER I.

3. Check the DISC meter alignment by tuning the VFO dial first up and then down equal amounts while observing the DISC meter indication for equal offset either side of center.

4. Remove the input signal. The DISC meter should reset at the center position. If not, repeat the procedure.

FM Modulator

1. Connect the test equipment as shown in the figure. Set the MIC GAIN control to the 2 o'clock position, and set the audio generator output for 10 mV at 1 kHz.

2. Adjust VR_{6004} for 5 kHz total deviation on the deviation meter.

3. Reduce the audio generator output level to 1 mV and check the deviation meter for 3.5 kHz total deviation.

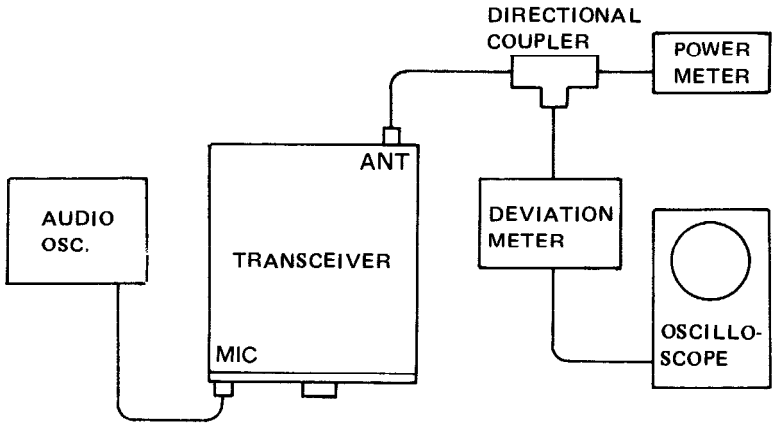
FM VCO

1. Connect the VTVM (set for DC) from the common cathode of varactor D_{6003} to ground (see page 47). Key the transmitter and, with no modulation, adjust T_{6003}, if necessary, for 4 volts on the meter.

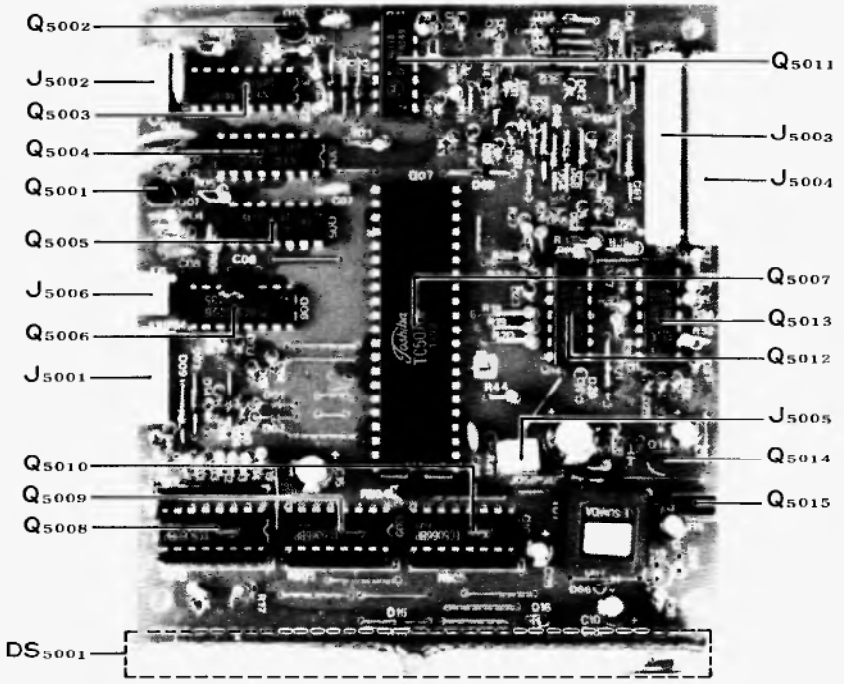
AM/FM Transmit IF

1. Tune the transmitter up in the AM Mode at 29.000 MHz into the dummy load. Set the DRIVE control for 150 mA IC, and adjust T_{6001} for maximum power output.

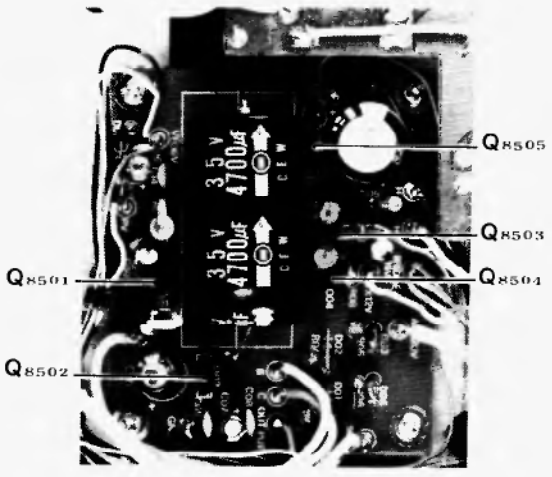
2. Repeat step 1 in the FM mode with 200 mA IC, adjusting T_{6002} for maximum output.



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COUNTER UNIT



RECT. B UNIT

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OPTIONAL CRYSTAL FILTER INSTALLATION

Part(s) required: (one or more of the following)

SSB narrow filter	XF-8.2HSN	(H1102058)
CW filter	XF-8.2HC	(H1102057)
CW filter	XF-455C	(H1102053)
CW narrow filter	XF-8.2HCN	(H1102056)
CW narrow filter	XF-455CN	(H1102054)
AM filter	XF-8.2GA	(H1102055)

1. Disconnect the transceiver from the power source. Remove the two screws attaching the carrying handle, and then the 14 screws attaching the top and bottom covers as shown in Figure 1. Remove the handle and covers.
2. Remove the six screws attaching the IF Unit (located at the left side of the chassis when viewed from the front, Figure 2).
3. Lay the FT-102 on its right side so that, by carefully lifting the edge of the IF Unit, the solder side of the board can be accessed. It may be necessary to disconnect some of the connectors, in which case refer to Figure 5 and take careful note as to where each should be replaced.
4. Referring to Figure 3, install the filters one at a time from the component side of the board, soldering each into place (from the solder side). Make sure to position the filter(s) label(s) facing as shown.
5. Now referring to Table 1 and to Figure 4, locate and remove the jumper wire associated with each filter location into which a new filter was just installed. These jumpers are on the solder side of the board.
6. Reconnect any connectors removed from the IF Unit according to Figure 5, and replace the six screws holding the IF Unit in place.
7. Switch the FT-102 on, and check the CW and/or SSB modes with the NAR switch on and off to ensure that the installation is correct and functioning.
8. Disconnect the power to the transceiver, replace the covers and handle and associated screws, and reconnect the power source. Installation is now complete.

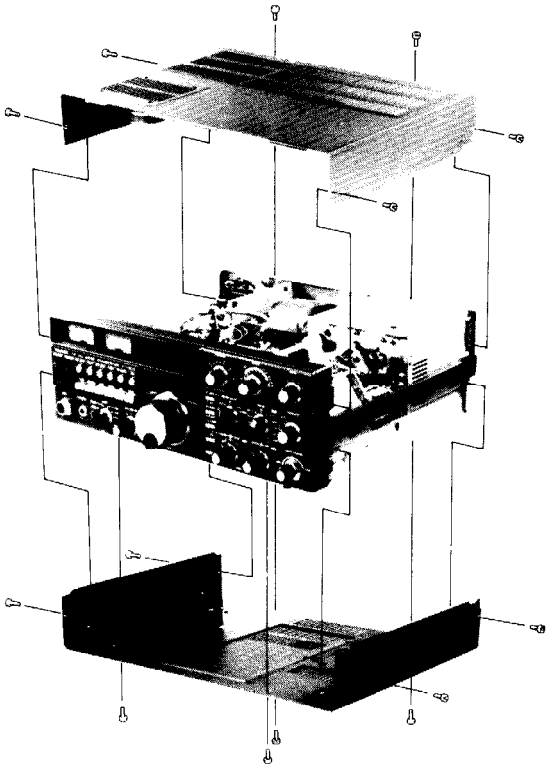


Figure 1

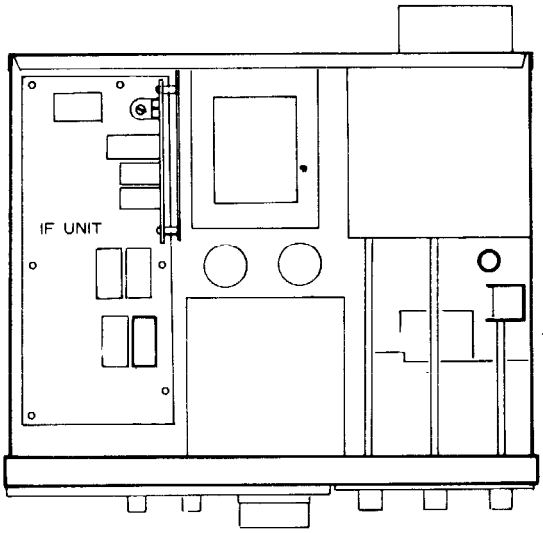


Figure 2

FILTER	LOCATION	REMOVE JUMPERS
AM FILTER XF-8.2GA	XF2002	① and ②
SSB FILTER XF-8.2HSN	XF2004*	③ and ④
CW FILTER XF-8.2HC		
CW FILTER XF-8.2HC or XF-8.2HCN	XF2003	⑤ and ⑥
CW FILTER XF-455C or XF-455CN	XF2005	⑦ and ⑧

* Either a narrow SSB or wide CW filter may be installed here.

Table 1

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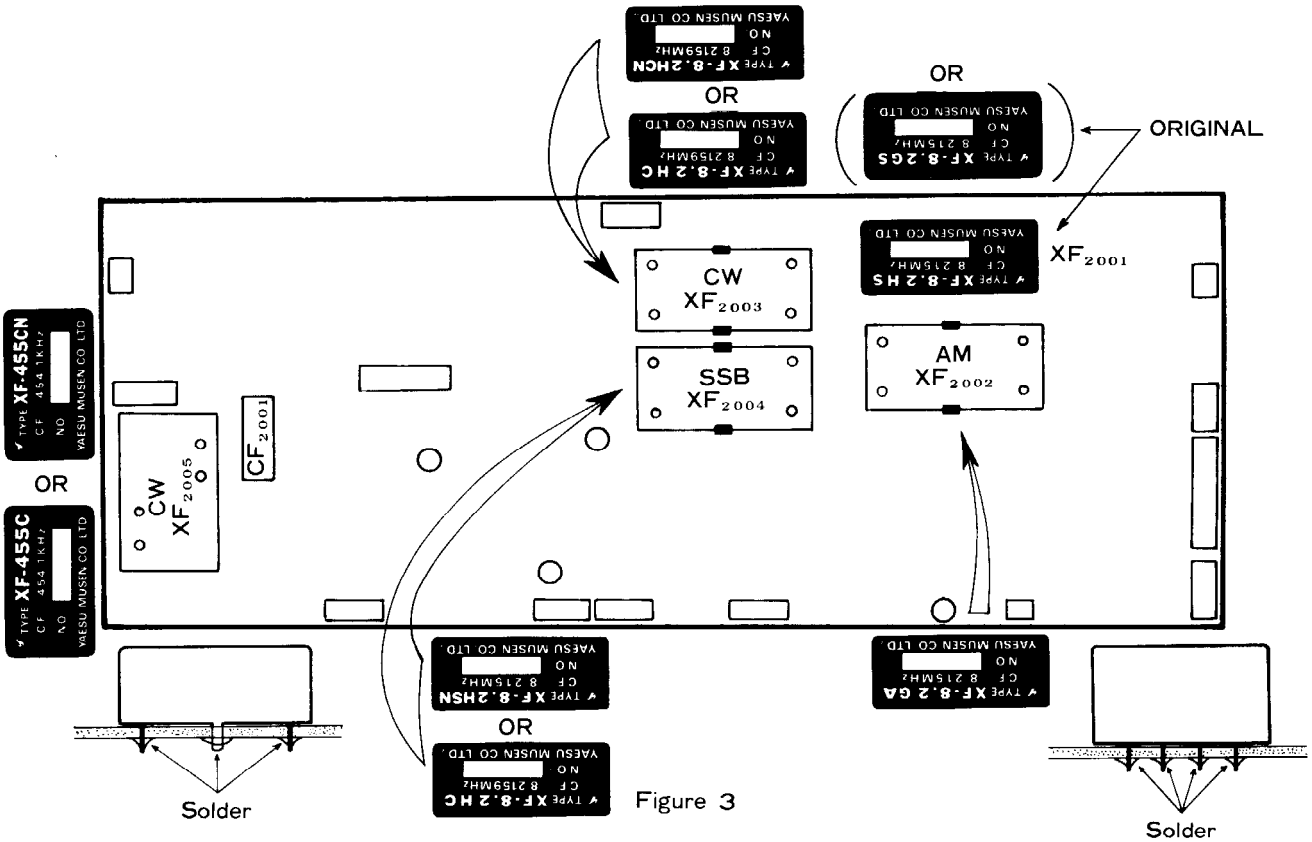


Figure 3

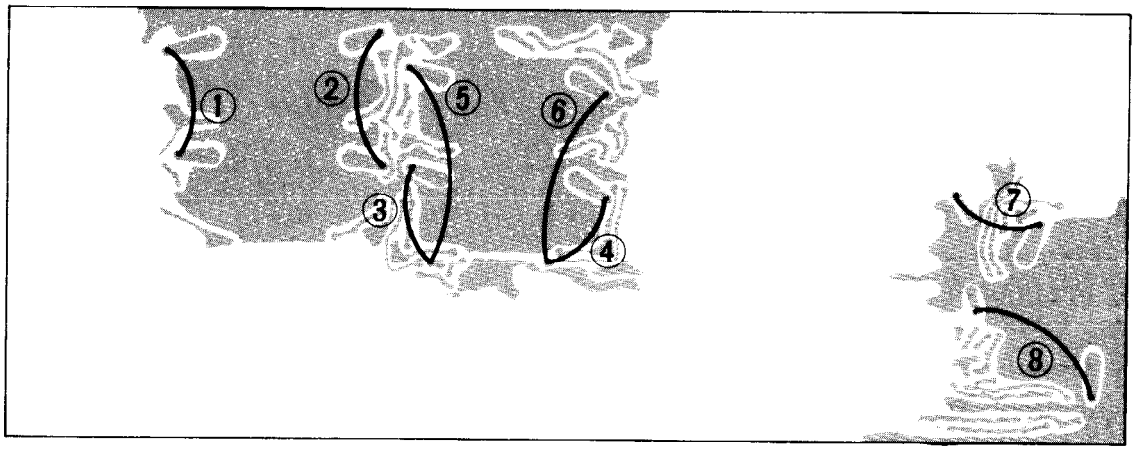


Figure 4

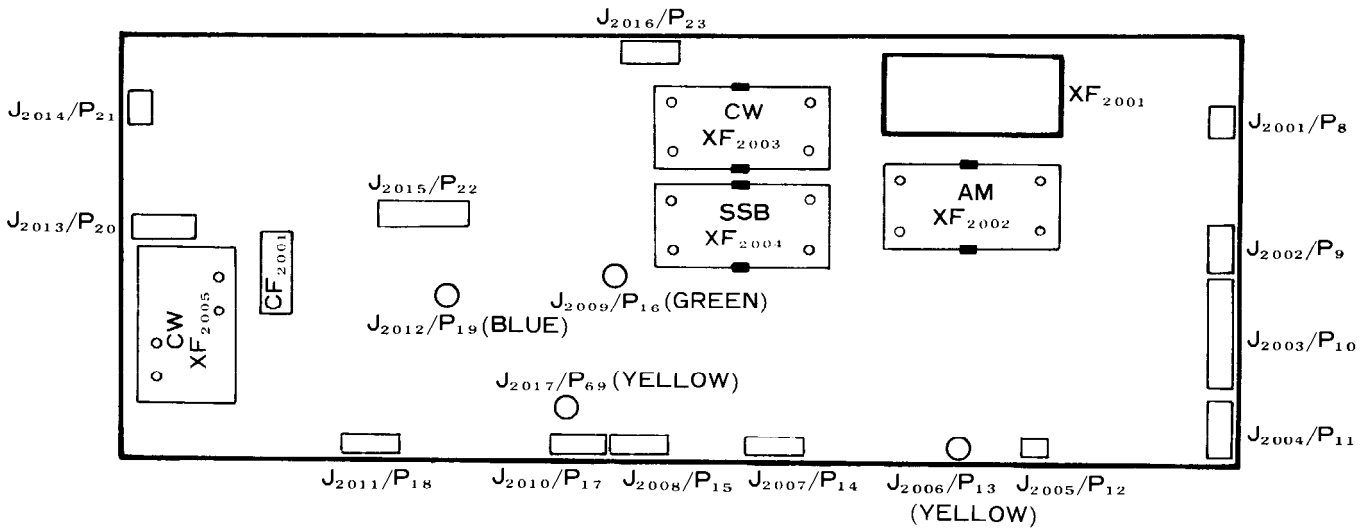


Figure 5

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AM/FM UNIT INSTALLATION

Parts needed: AM/FM kit (D3000184), including one AM/FM Unit (C0023470) and four M3 x 8 screw (U04308001).

1. Place the FT-102 upside down on the work surface, and remove the six screws and the bottom sub-panel as shown in Figure 1.
2. Install the AM/FM Unit using the four screws supplied with the kit, as shown in Figure 2.
3. Remove the plastic covers from the two connectors indicated in Figure 2, and connect them to the AM/FM Unit as shown.
4. Installation is now complete. Operation is described in the FT-102 Instruction Manual. No alignment should be required as the AM/FM Unit was completely aligned at the factory.

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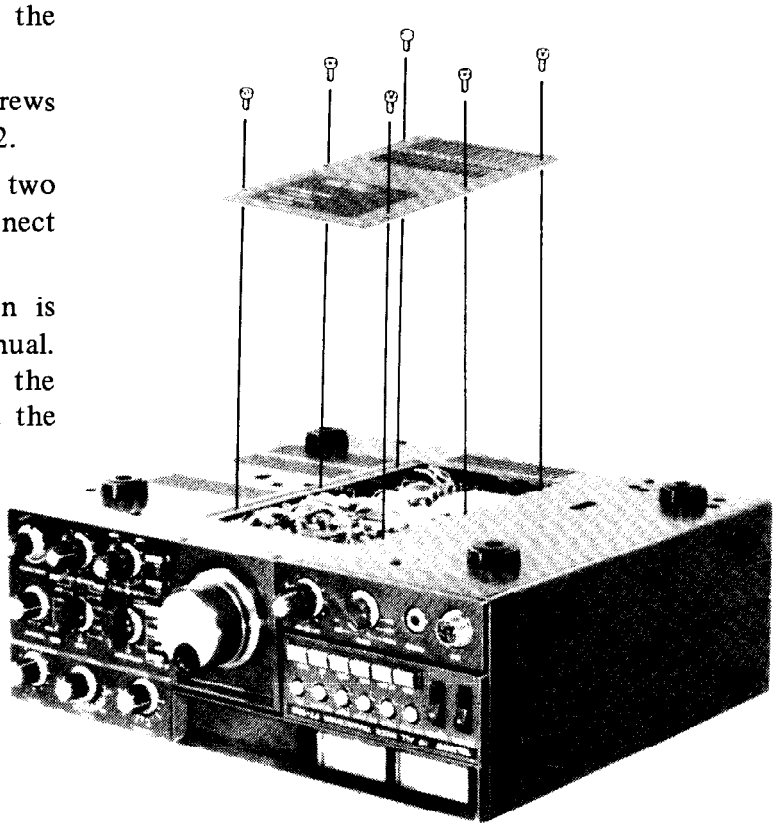


Figure 1

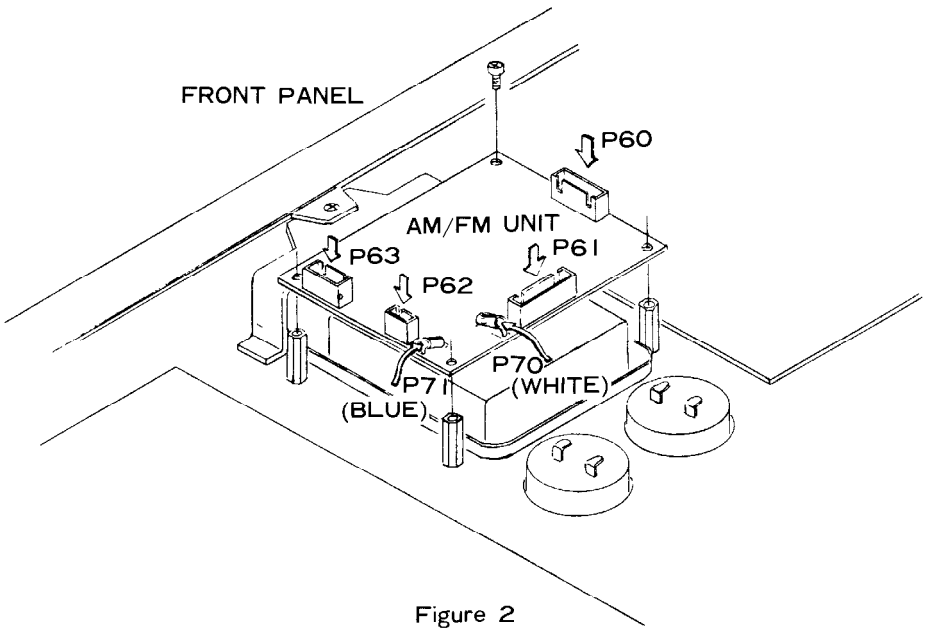
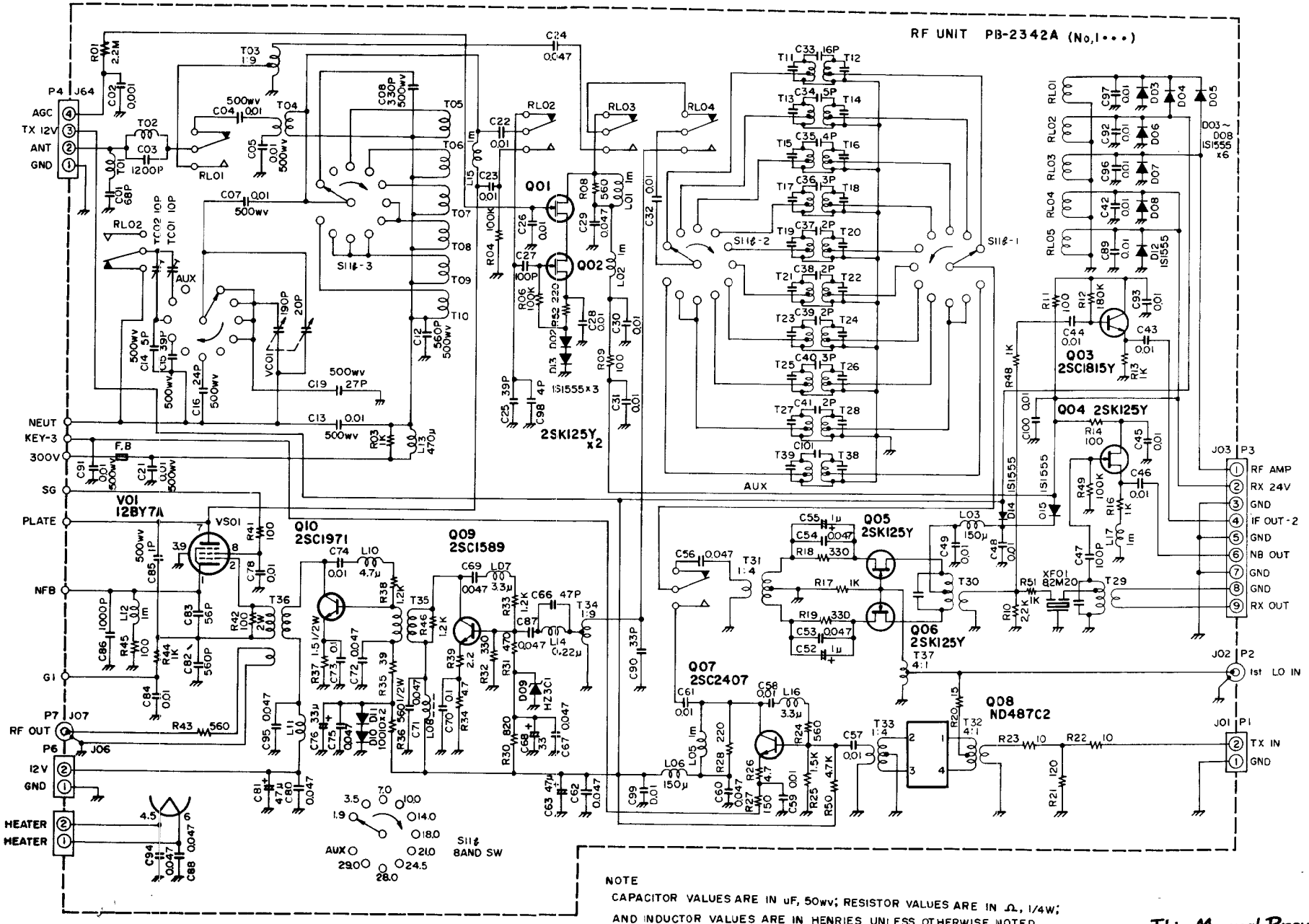
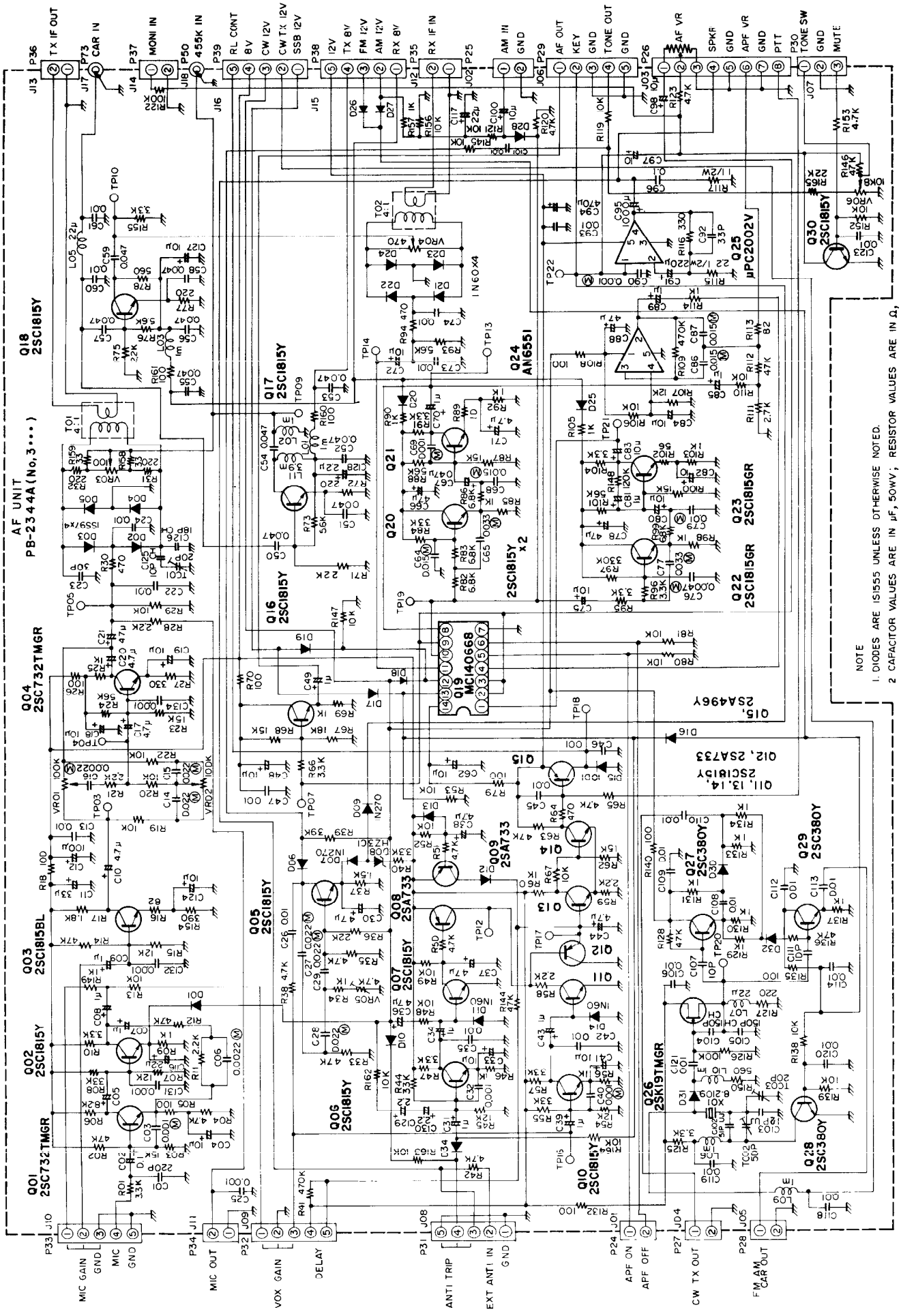


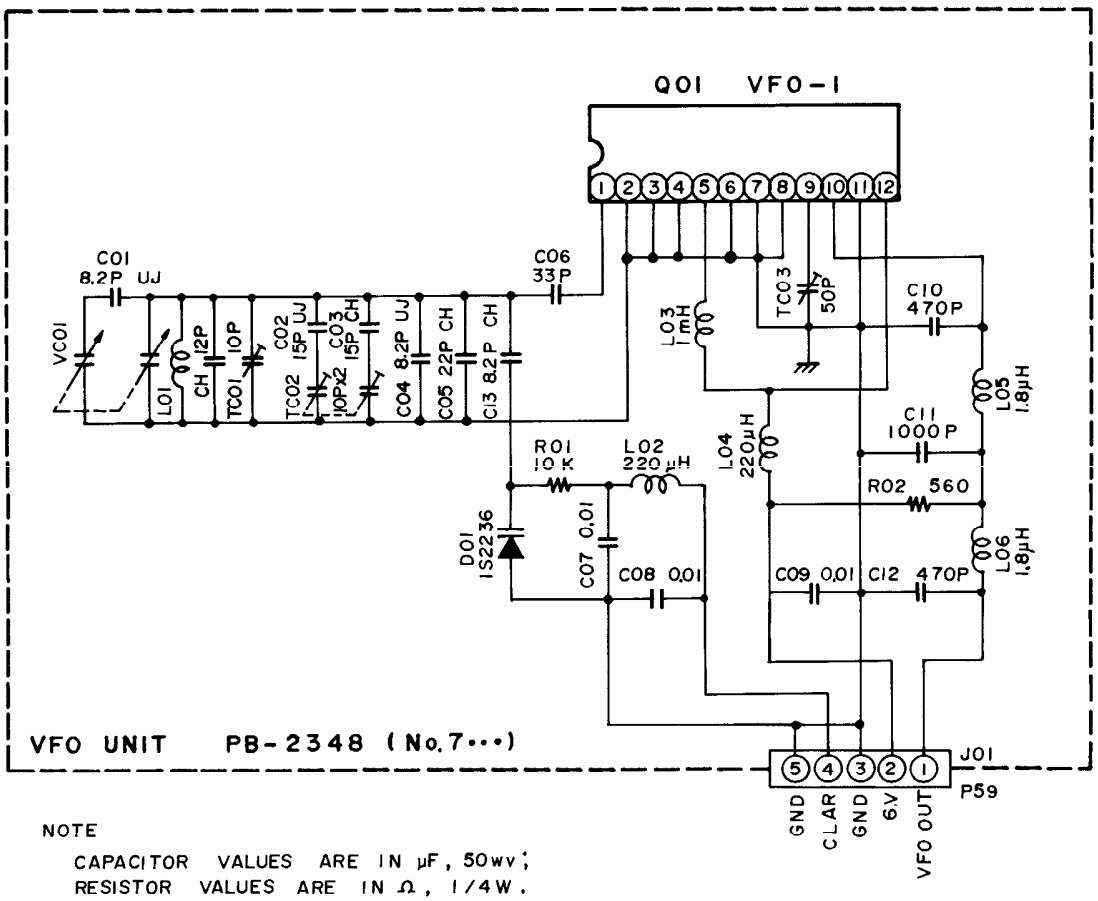
Figure 2



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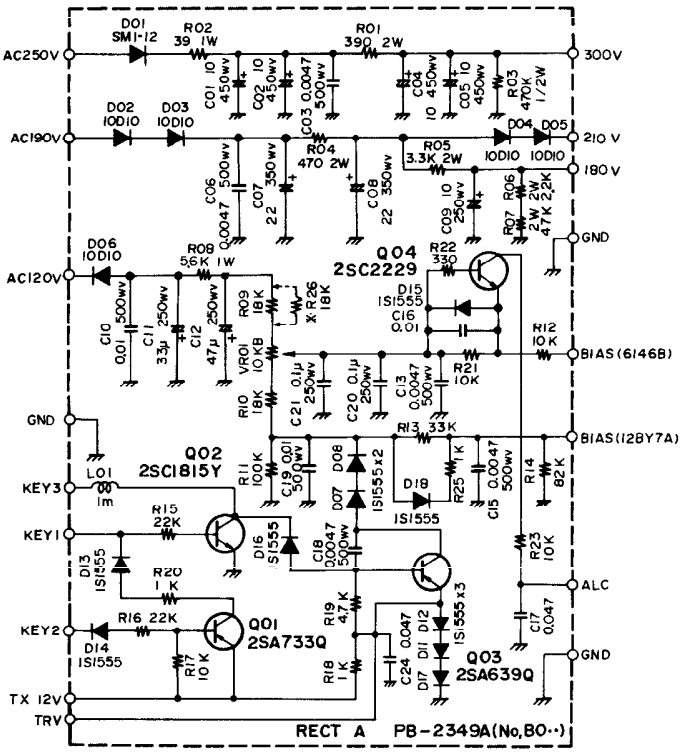


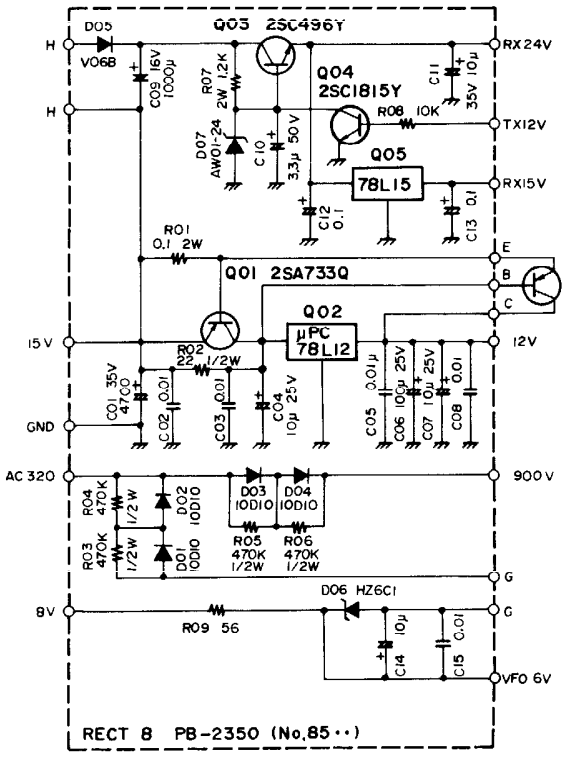
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NOTE

CAPACITOR VALUES ARE IN μF, 50wv;
RESISTOR VALUES ARE IN Ω, 1/4W.

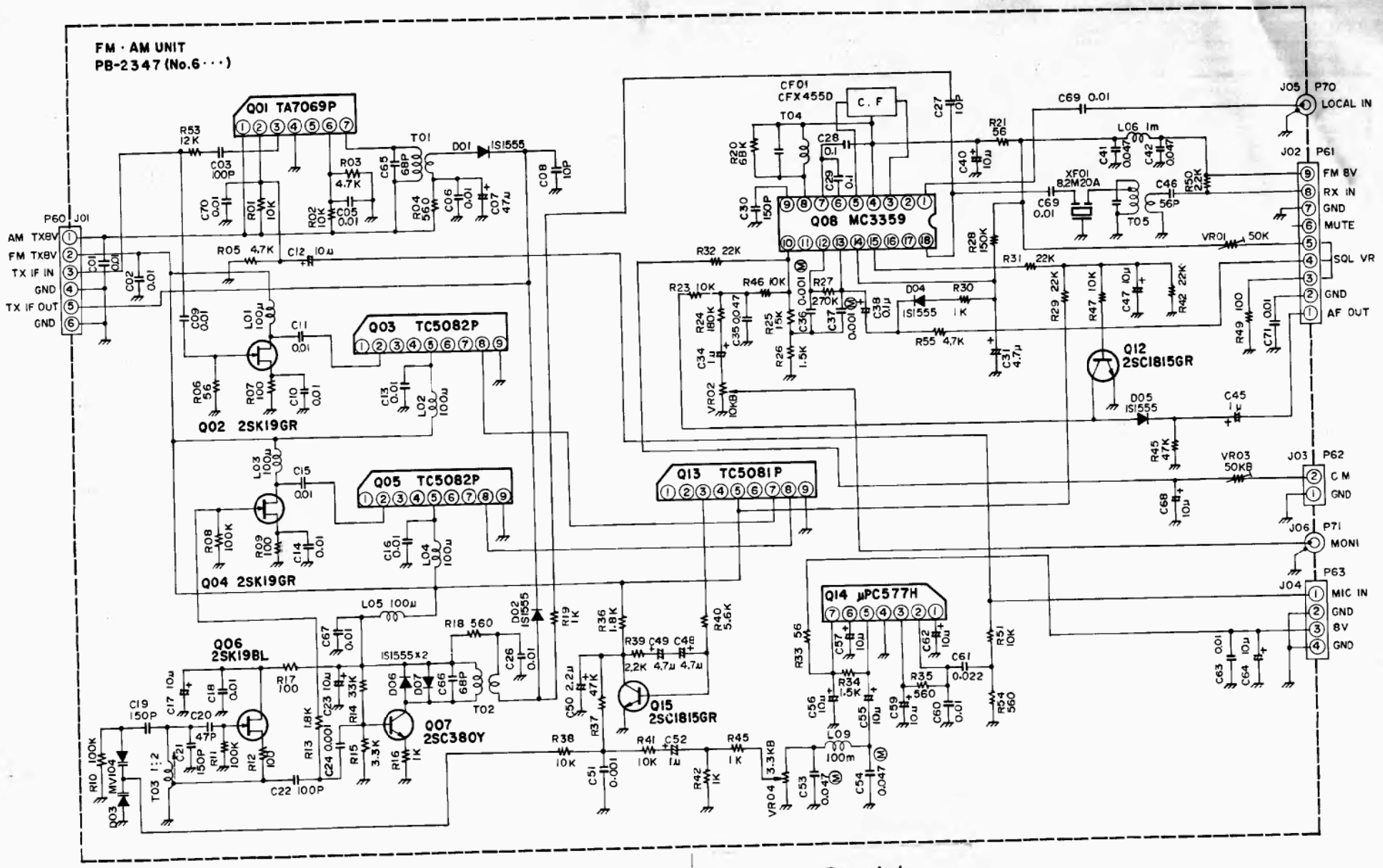




NOTE

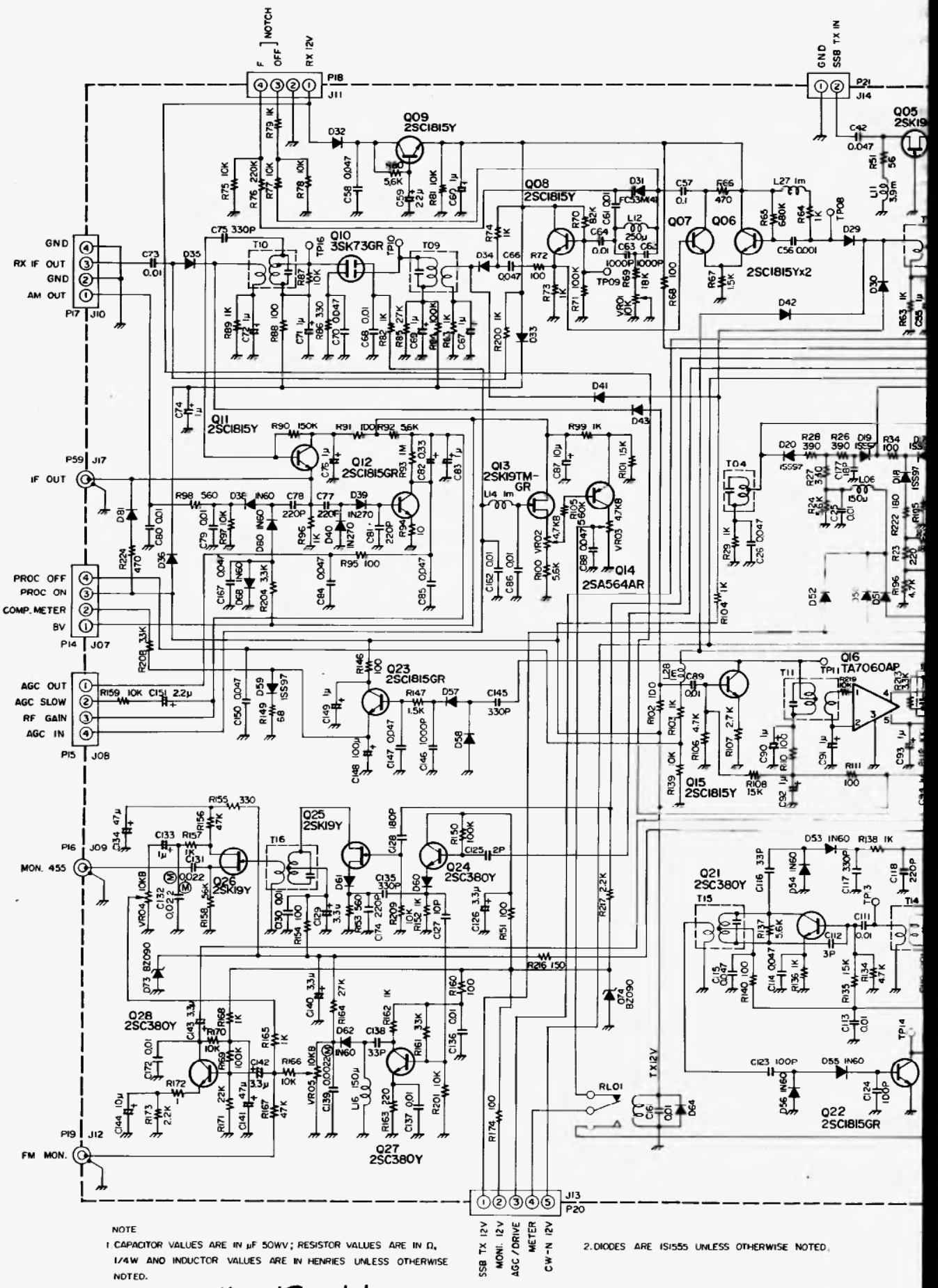
CAPACITOR VALUES ARE IN μF, 50wv; RESISTOR VALUES ARE IN Ω, 1/4W; AND INDUCTOR VALUES ARE IN HENRIES UNLESS OTHERWISE NOTED.

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NOTE
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AND INDUCTOR VALUES ARE IN HENRIES UNLESS OTHERWISE NOTED.

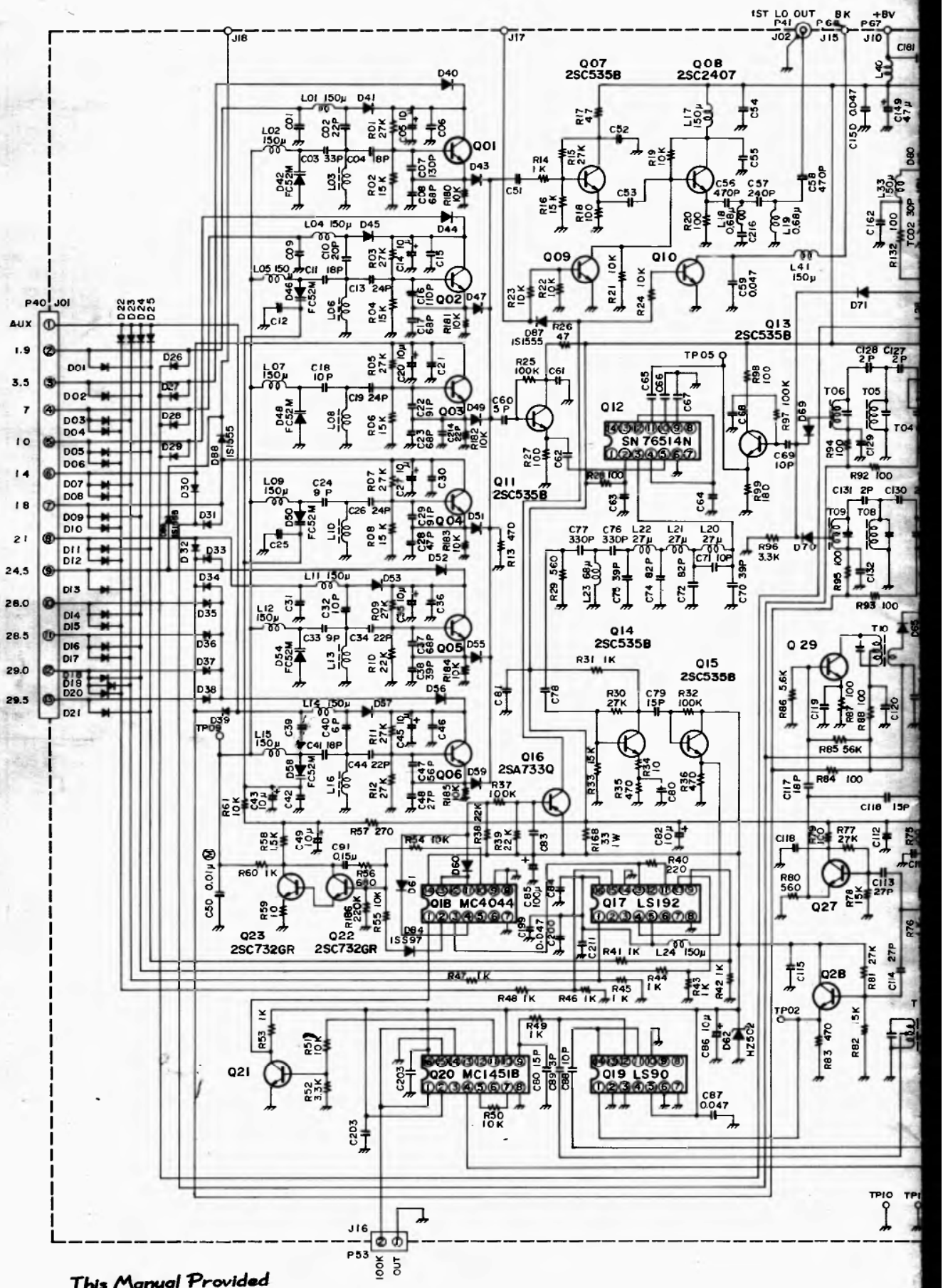
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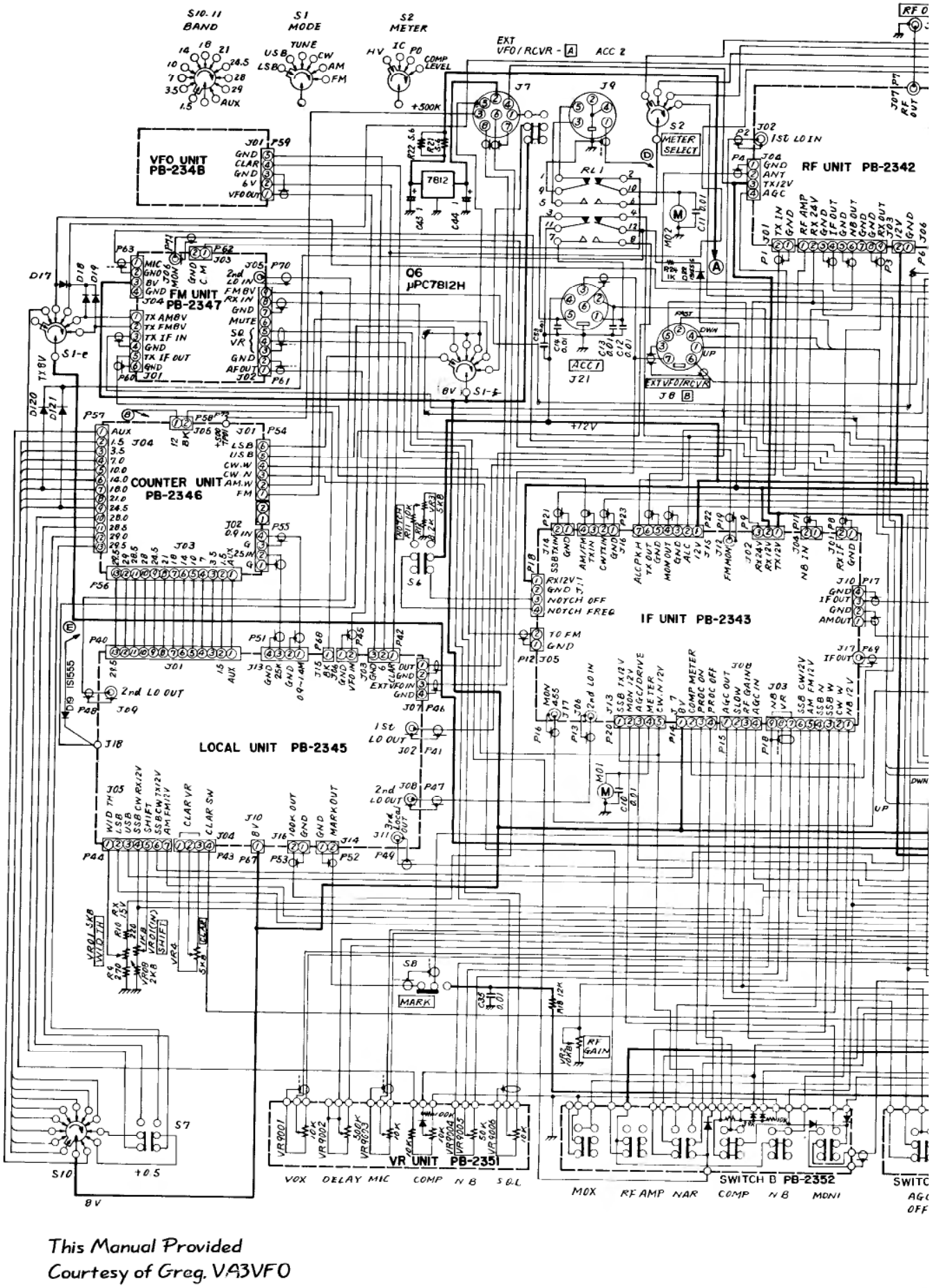


NOTE

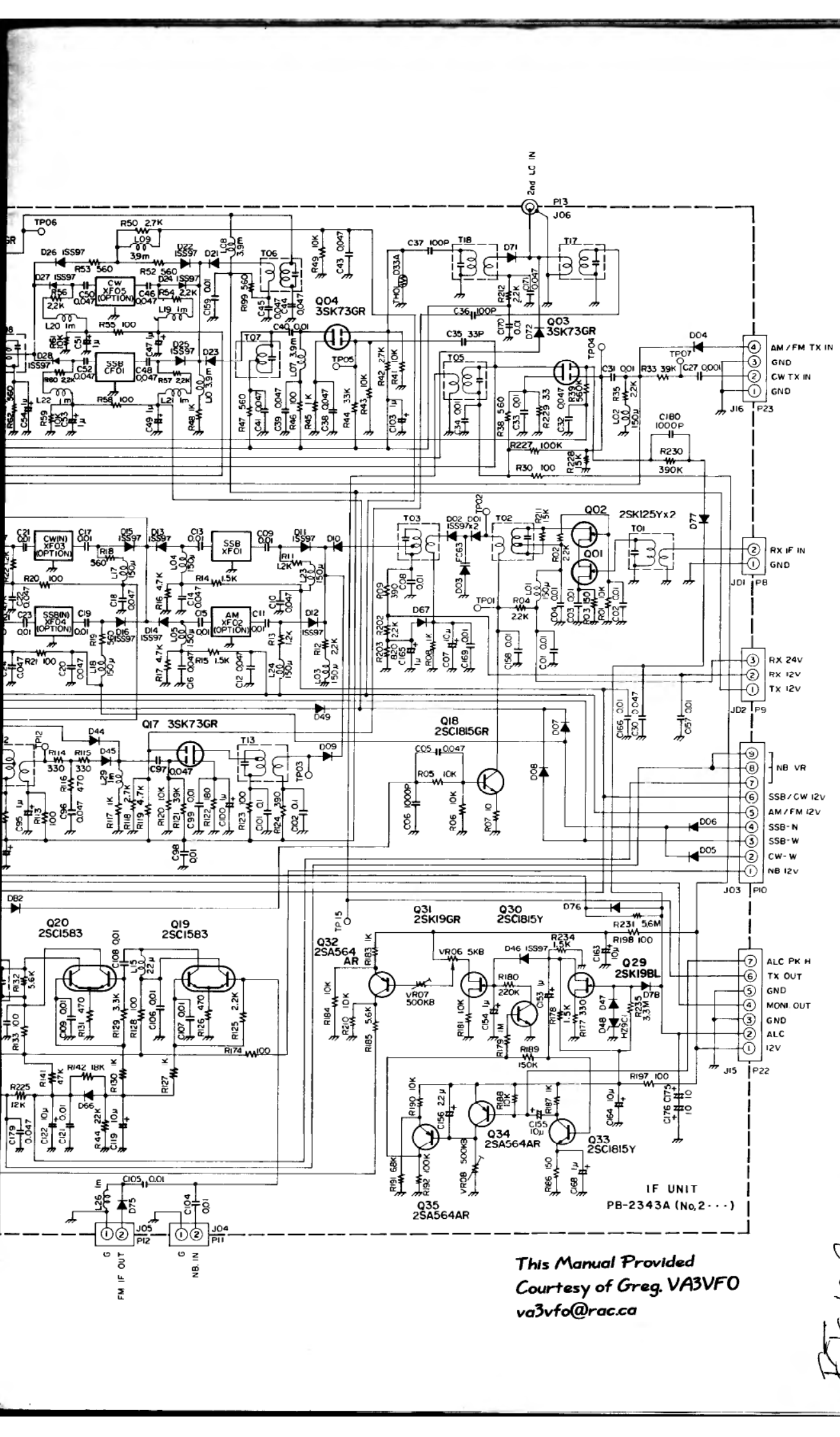
1. CAPACITOR VALUES ARE IN μF 50WV; RESISTOR VALUES ARE IN Ω, 1/4W AND INDUCTOR VALUES ARE IN HENRIES UNLESS OTHERWISE NOTED.
2. DIODES ARE 1S1555 UNLESS OTHERWISE NOTED.

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1ST LO OUT
BK
+8V
P41
P66
P67
J02
J15
J10
J18
J17
Q07
2SC5358
Q08
2SC2407
Q01
Q02
Q03
Q04
Q05
Q06
Q09
Q10
Q11
2SC5358
Q12
SN 76514N
Q13
2SC5358
Q14
2SC5358
Q15
2SC5358
Q16
2SA733Q
Q17 LS192
Q18 MC4044
Q19 LS90
Q20 MC14518
Q21
Q22
2SC732GR
Q23
2SC732GR
Q27
Q28
Q 29
P40 J01
AUX
1.9
3.5
7
10
14
18
21
24.5
28.0
28.5
29.0
29.5
J16
P53
100K
OUT
TP05
TP09
TP02
TP10
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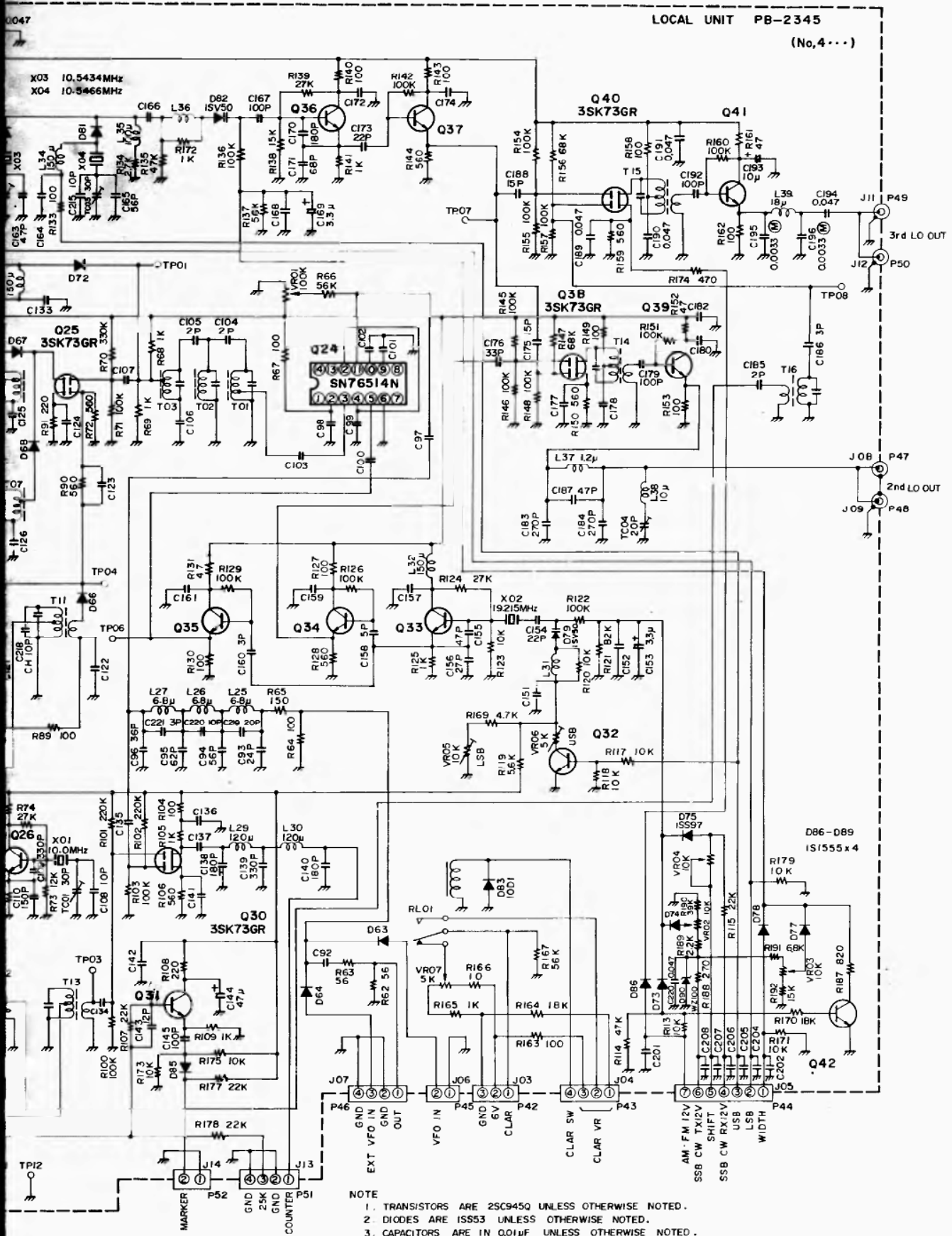
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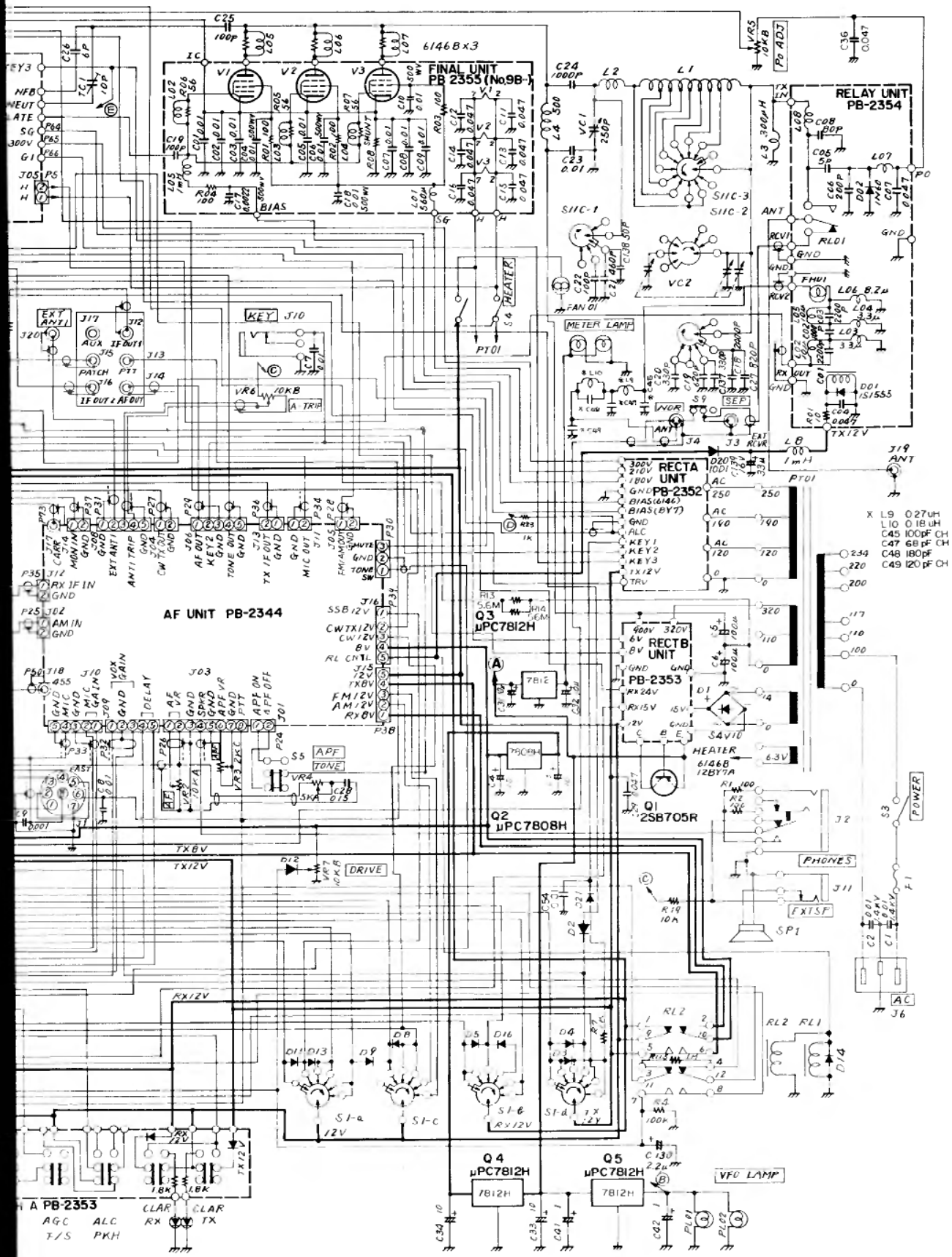
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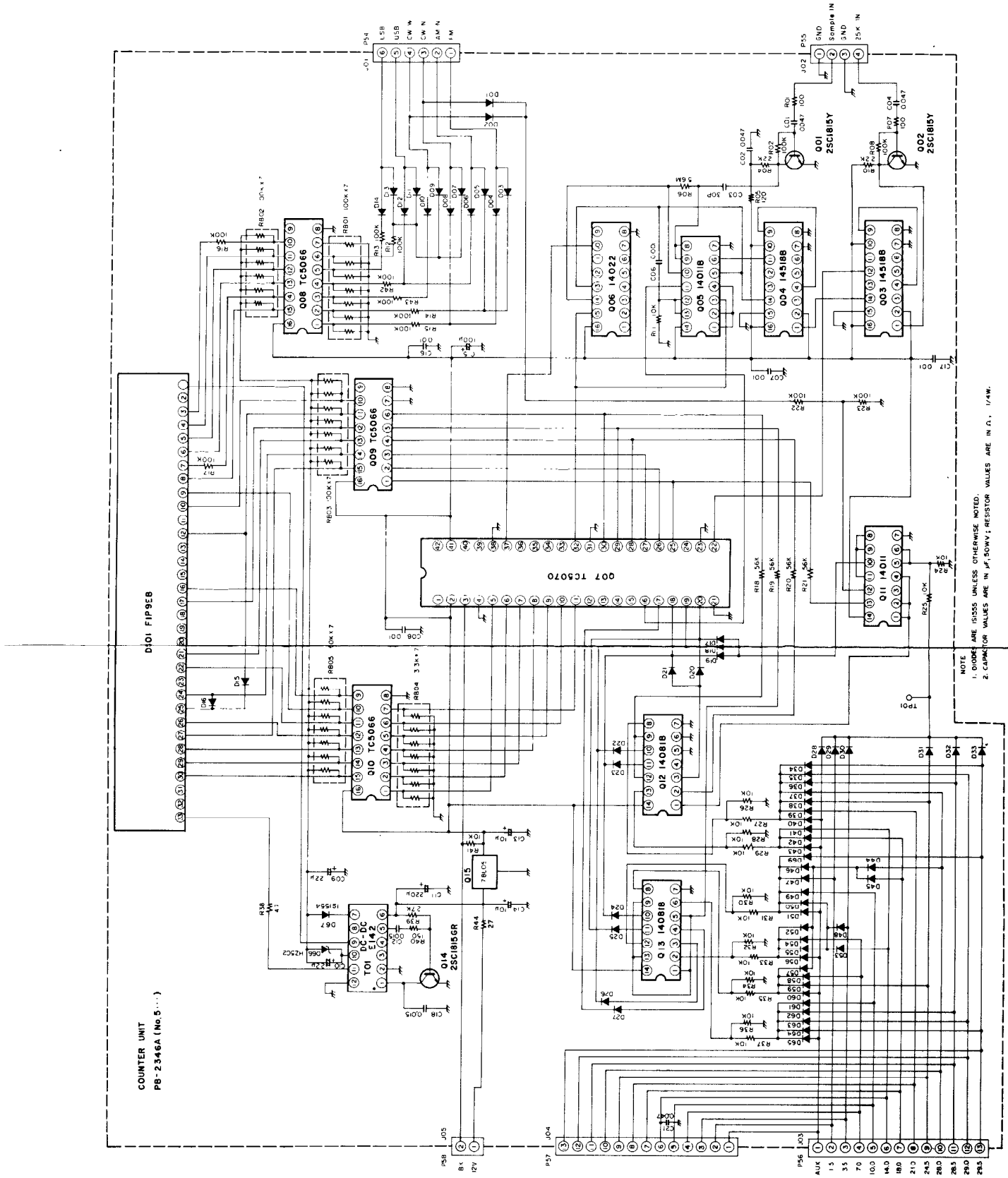


NOTE
1. TRANSISTORS ARE 2SC945Q UNLESS OTHERWISE NOTED.
2. DIODES ARE 1SS53 UNLESS OTHERWISE NOTED.
3. CAPACITORS ARE IN 0.01μF UNLESS OTHERWISE NOTED.
4. CAPACITOR VALUES ARE IN μF, 50WV; RESISTOR VALUES ARE IN Ω, 1/4W; AND INDUCTOR VALUES ARE IN HENRIES UNLES OTHERWISE NOTED.

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X L9 0.27uH
L10 0.18uH
C45 100pF CH
C47 68 pF CH
C48 180pF
C49 120 pF CH



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