

# **INSTRUCTION MANUAL YO-100**

**YAESU MUSEN CO., LTD.**

TOKYO JAPAN

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YO-100 MONITORSCOPE  
OPERATION MANUAL



GENERAL

The model YO-100 Monitorscope is a measuring equipment for radio amateur use. This instrument consists of a monitor of "on the air" signal and an oscilloscope. A two tone signal generator is built-in for single sideband transmitter adjustment. The main function of the monitorscope is to monitor the transmitted signal on the scope, and it can also be used to observe the signal received with an optional receiver adaptor kit. The cabinet and front panel design of the YO-100 matches that of FT-101B/277B and FT-201 series of amateur SSB equipment.

## SPECIFICATIONS

### VERTICAL AMPLIFIER

Input Impedance - - - - - 500 Killo Ohms  
Sensitivity - - - - - 200 mV <sup>RMS/DIV</sup> ~~P-P/cm~~  
5 mV ~~P-P/cm~~ at 3.18 MHz  
Frequency Response - - - - - 10 Hz to 40 KHz <sup>RMS/DIV</sup>  $\pm 3$  dB  
(Direct 1 - 60 MHz)

### HORIZONTAL AMPLIFIER

Input Impedance - - - - - 500 Killo Ohms  
Sensitivity - - - - - 300 mV <sup>RMS/DIV</sup> ~~P-P/cm~~  
Frequency Response - - - - - 10 Hz to 16 KHz  $\pm 3$  dB  
Sweep Frequency - - - - - 10 Hz to 10 KHz variable

### TONE GENERATOR

Frequency - - - - - 1500 Hz and 1900 Hz approximately  
Output Voltage - - - - - 50 mV nominal

### TRANSMITTER MONITOR

Frequency Coverage - - - - - 1.8 MHz to 60 MHz  
Input Impedance - - - - - 50 to 75 Ohms  
Signal Power Limit - - - - - 10 Watts to 1 Killo Watts

### GENERAL

Power Requirement - - - - - 100/110/117/200/220 or 234 Volts AC  
at 50/60 Hz, 35 Watts  
Size - - - - - 210 (W) x 150 (H) x 290 (D) mm  
Weight - - - - - 6 Kg approximately

## ACCESSORIES

- Coax Cable (1) - - - - - 5D2V both ends with coax plug
- Coax Cable (2) - - - - - RG-58A/U with one end coax and the other end RCA plug
- Shielded Wire (2)
- RCA Plug (2)
- Fuse 3A (3)
- Alignment Tool (1)

## CONTROLS & SWITCHES

Prior to using the monitorscope, it is recommended to understand thoroughly the function of each control and switch described below:

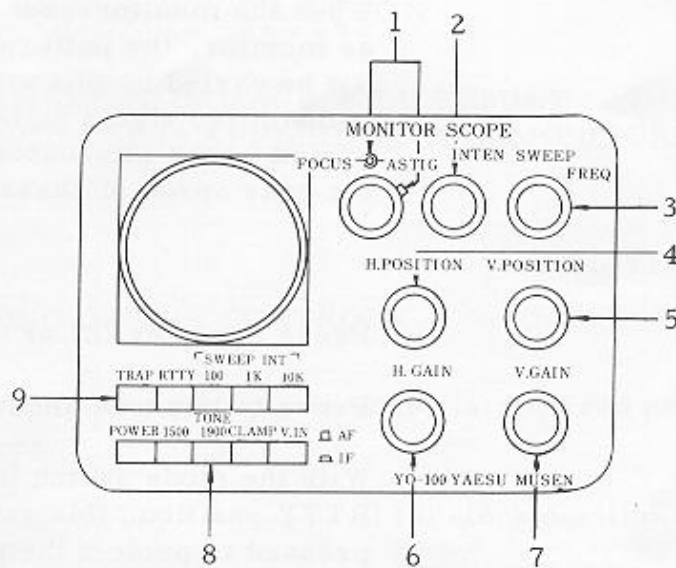


Figure 1

### 1. FOCUS - ASTIG

- These controls are used to adjust the clear and sharp trace. There may be some interaction between these controls and INTENSITY control. Adjust them for the clearest trace.

- 2. INTENSITY - This control varies the brightness of the pattern on the scope screen. Excessive brightness may burn the phosphor on the face of the CRT (Cathode Ray Tube).
- 3. SWEEP FREQ - This control adjusts the sweep frequency for the desired display.
- 4. H. POSITION - This control determines the horizontal position of the displayed pattern.
- 5. V. POSITION - This control determines the vertical position of the displayed pattern.
- 6. H. GAIN - This control is used to vary the gain of the horizontal amplifier.
- 7. V. GAIN - This control is used to vary the gain of the vertical amplifier. When the monitorscope is used as monitor, the pattern height can not be varied by this control. The transmitted signal pattern can be varied by the attenuator located on the rear apron of chassis.
- 8. FUNCTION SWITCHES
  - POWER - Press to power ON or OFF.
  - TONE - Press to two tone generator ON.
  - CLAMP - With the mode switch in TRAP or RTTY position, this switch may be pressed to protect the phosphor from burn-out when the input signal is not present.
  - V. IN - Select the vertical input to audio or to IF signal.
- 9. MODE SWITCHES
  - TRAP - This switch is pressed for trapezoid pattern to check the amplifier linearity.

- RTTY - This switch is pressed for RTTY cross pattern.
- SWEEP INT - This switch is used to change sweep frequency.

### INSTALLATION

The monitorscope may be installed side by side with radio communication equipment for transmitter or receiver signal monitoring. The YO-100 monitorscope is designed to be used in many areas of the world using the power line supply voltage that may differ from the operator's local supply voltage. Therefore, before connecting the AC cord to the power outlet, be sure that the voltage marked on the rear of the monitorscope agrees with the local AC supply voltage.

### CAUTION

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

### INITIAL SETTING OF THE CONTROLS

The following set-up procedure is required prior to operating the monitorscope.

FOCUS-ASTIG . . . . .	12 o'clock position
INTEN . . . . .	3 " "
SWEEP FREQ . . . . .	12 " "
H. POSITION . . . . .	12 " "
V. POSITION . . . . .	12 " "
H. GAIN . . . . .	Fully counter-clockwise
V. GAIN . . . . .	Fully counter-clockwise
MODE . . . . .	SWEEP INT IK depressed

Depress the POWER switch and wait until a bright trace is present on the screen of the scope. Adjust the INTEN control for a proper brightness. Excessive brightness for prolonged period of time may burn the phosphor on the CRT screen.

Adjust the FOCUS-ASTIG controls for a clear and sharp trace. There is an interaction between these controls and INTEN control. Therefore, adjust them for the best focus at the desired brightness.

Adjust the H. POSITION and V. POSITION to bring the spot to the center of screen. Rotate the H. GAIN control and observe that the spot produces a horizontal line in the center of the screen.

## OPERATION

### TRANSMITTER MONITORING

The following instructions are for the transmitter having 50 - 75 ohm coaxial output.

- (1) Connect the RF output of the transmitter (transceiver) or linear amplifier to either coaxial connector marked ANTENNA on the rear of the monitorscope as illustrated in Figure 2. Connect the dummy load or antenna to the other coaxial connector marked ANTENNA.
- (2) Set the TX ATT (Transmitter Attenuator) switch fully clockwise for a minimum coupling.
- (3) Push the POWER switch of the monitorscope and adjust the controls as described in the initial adjustment procedure.
- (4) Turn on the transmitter and adjust the TX ATT, H. GAIN and SWEEP FREQ controls for the desired pattern display.
- (5) Internal tone generator signal may be used for SSB or AM transmitter with the shielded cable. Use either of 1500 KHz and 1900 KHz for signal tone test. In SSB transmission, press down both 1500 KHz and 1900 KHz push buttons for two tone test.
- (6) Refer to the patterns on page 7 for the evaluation of the transmitted signal.

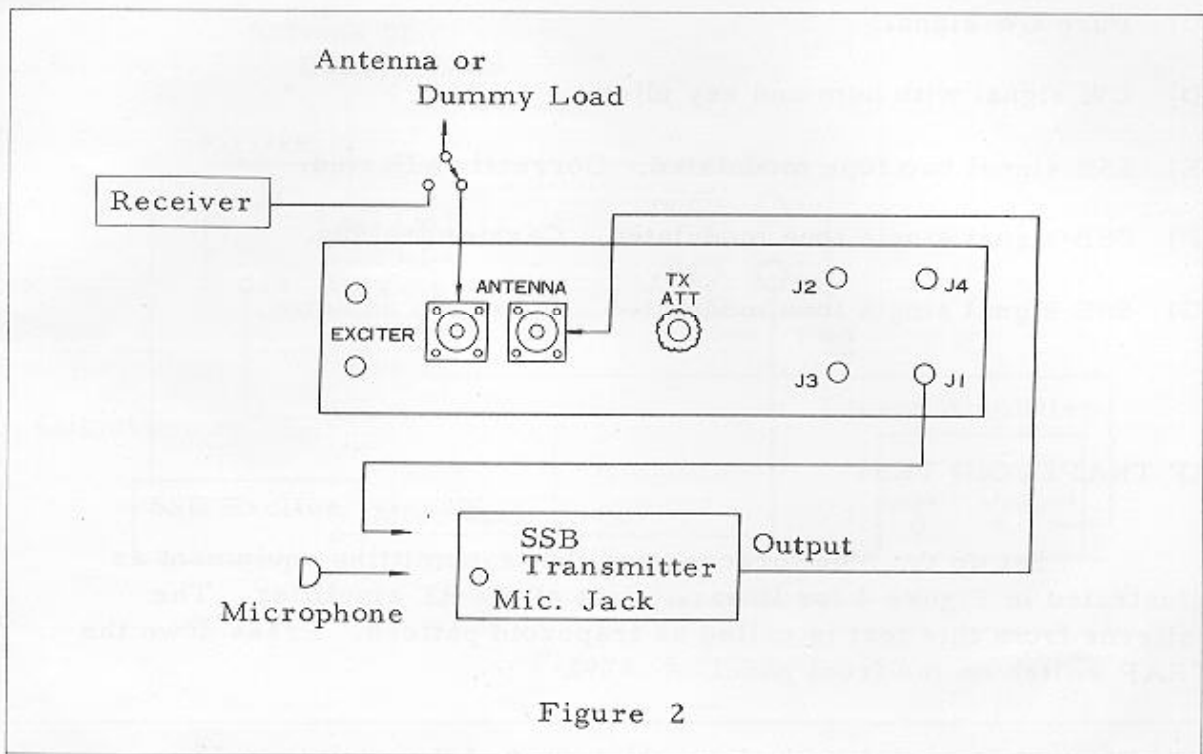


Figure 2

The followings are typical transmitted signal patterns displayed on the monitorscope screen when it is connected as Figure 2.

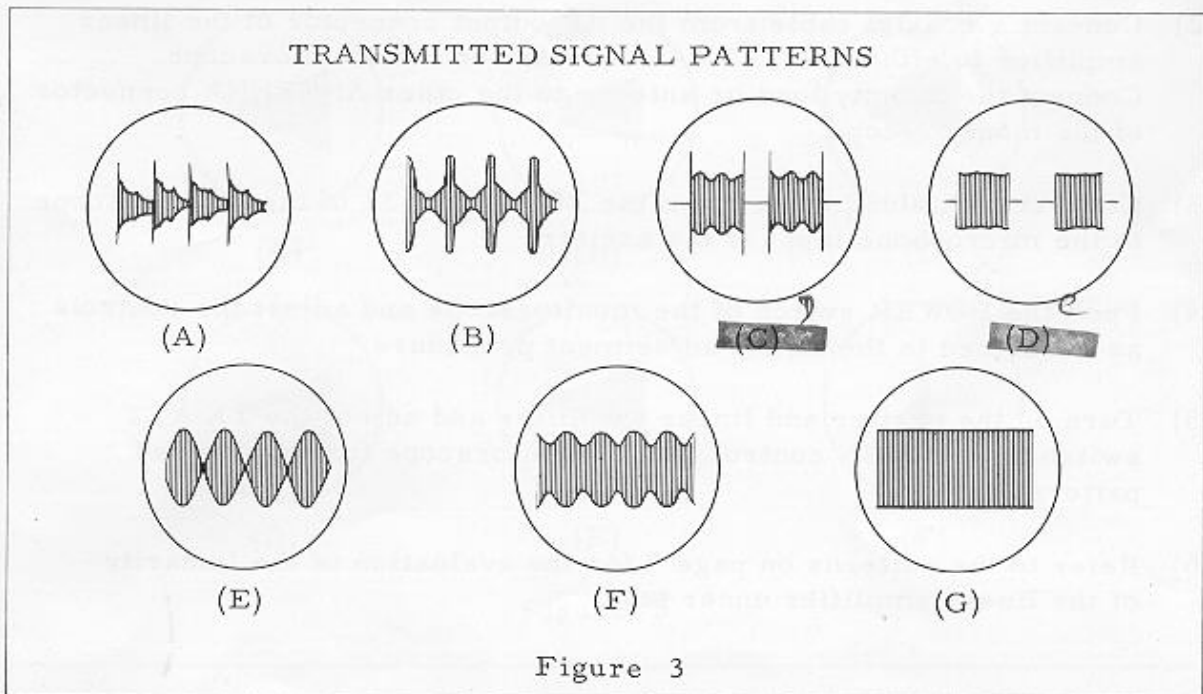


Figure 3

- (A) SSB signal voice modulated. Correctly adjusted.
- (B) SSB signal voice modulated. Excessive mic gain or insufficient loading. Flat topping is seen.



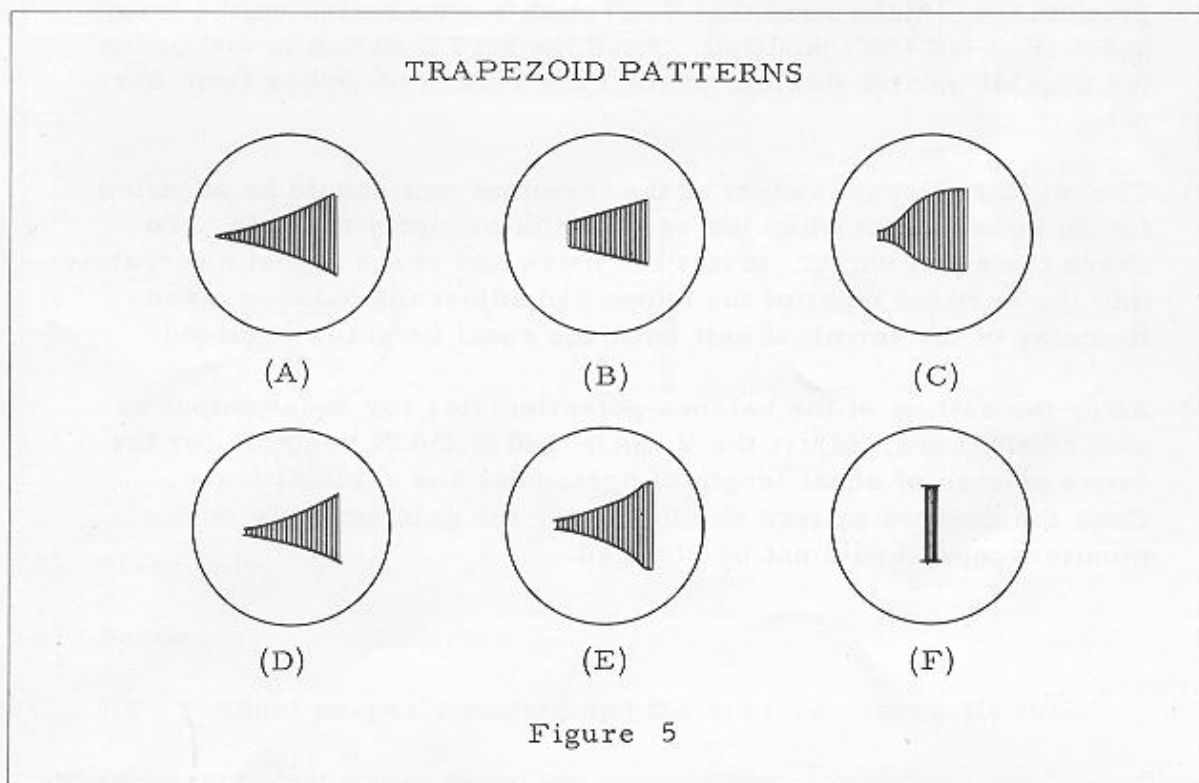
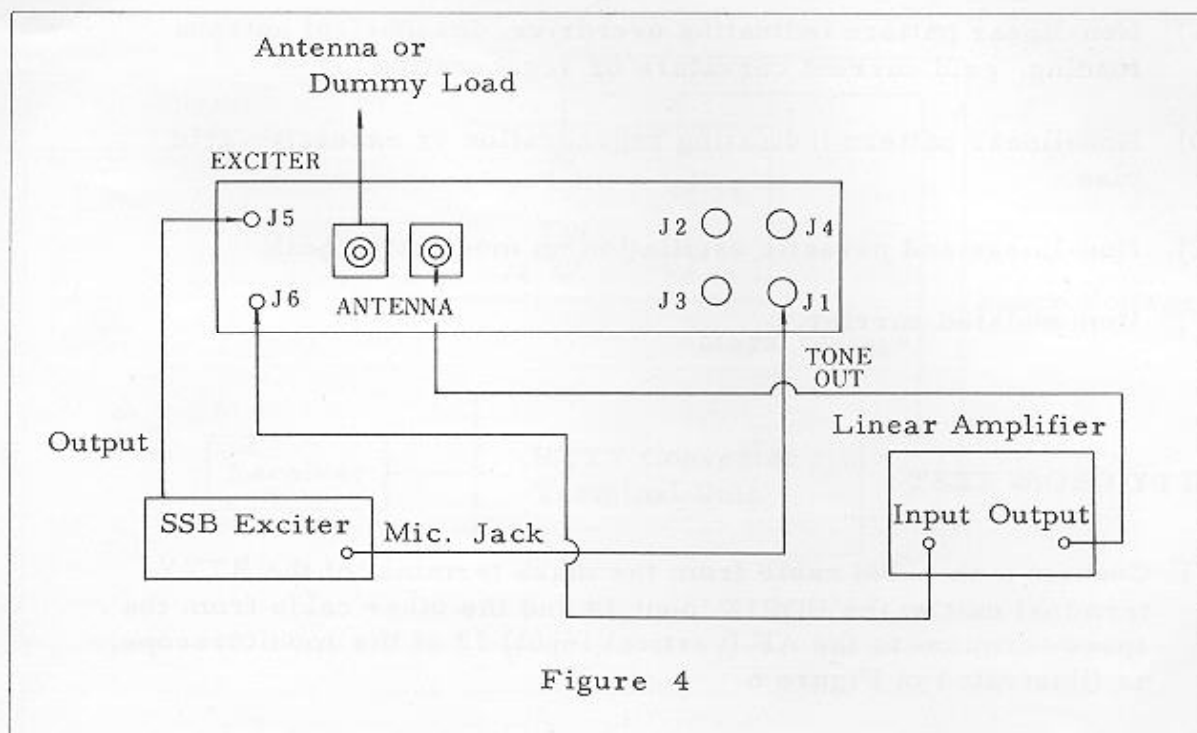
- (C) Pure CW signal.
- (D) CW signal with hum and key click.
- (E) SSB signal two tone modulated. Correctly adjusted.
- (F) SSB signal single tone modulated. Carrier leaking.
- (G) SSB signal single tone modulated. Correctly adjusted.

#### RF TRAPEZOID TEST

Set up the monitorscope and the transmitting equipment as illustrated in Figure 4 for linearity test of the RF amplifier. The patterns from this test is called as trapezoid pattern. Press down the TRAP switch on the front panel.

- (1) Connect a coaxial cable from the output of the exciter to J5 connector marked EXCITER and connect the other connector J6 to the input of the linear amplifier under test with a coaxial cable.
- (2) Connect a coaxial cable from the RF output connector of the linear amplifier to either ANTENNA connector on the monitorscope. Connect the dummy load or antenna to the other ANTENNA connector of the monitorscope.
- (3) Connect a shielded cable from the TONE OUT J1 of the monitorscope to the microphone input of the exciter.
- (4) Push the POWER switch of the monitorscope and adjust the controls as described in the initial adjustment procedure.
- (5) Turn on the exciter and linear amplifier and adjust the TX ATT switch and H. GAIN control of the monitorscope for the desired pattern display.
- (6) Refer to the patterns on page 9 for the evaluation of the linearity of the linear amplifier under test.

NOTE : To avoid the burn-out of the screen phosphor when there is no output from the transmitter, the CLAMP switch may be pressed to deflect the bright spot off the side of the screen.



(A) Good linearity.

(B) Modulation less than 100% and good linearity.

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- (C) Non-linear pattern indicating overdrive, insufficient antenna loading, grid current curvature or regeneration.
- (D) Non-linear pattern indicating regeneration or excessive grid bias.
- (E) Non-linear and parastic oscillation on modulation peak.
- (F) Unmodulated carrier.

#### RTTY CROSS TEST

- (1) Connect a shielded cable from the mark terminal of the RTTY terminal unit to the HORIZ input J4 and the other cable from the space terminal to the AF (vertical input) J2 of the monitorscope, as illustrated in Figure 6.
- (2) Set the front panel controls as described in the initial adjustment procedures. Make sure that V. IN push button switch on the front panel is at out (AF) position. Push the RTTY switch in and press the CLAMP switch down to protect the screen phosphor from burn-out.
- (3) The mark and space output of the terminal unit should be adjusted for an equal output when the receiver is properly tuned in. To check the equal output, insert the mark and space signal alternately into the vertical input of the scope and adjust the balance potentiometer of the terminal unit until the equal height is obtained.
- (4) After the setting of the balance potentiometer for equal output as described above, adjust the V. GAIN and H. GAIN controls for the cross pattern of equal length of horizontal and vertical trace. Once the desired pattern has been set, the gain controls on the monitorscope should not be changed.

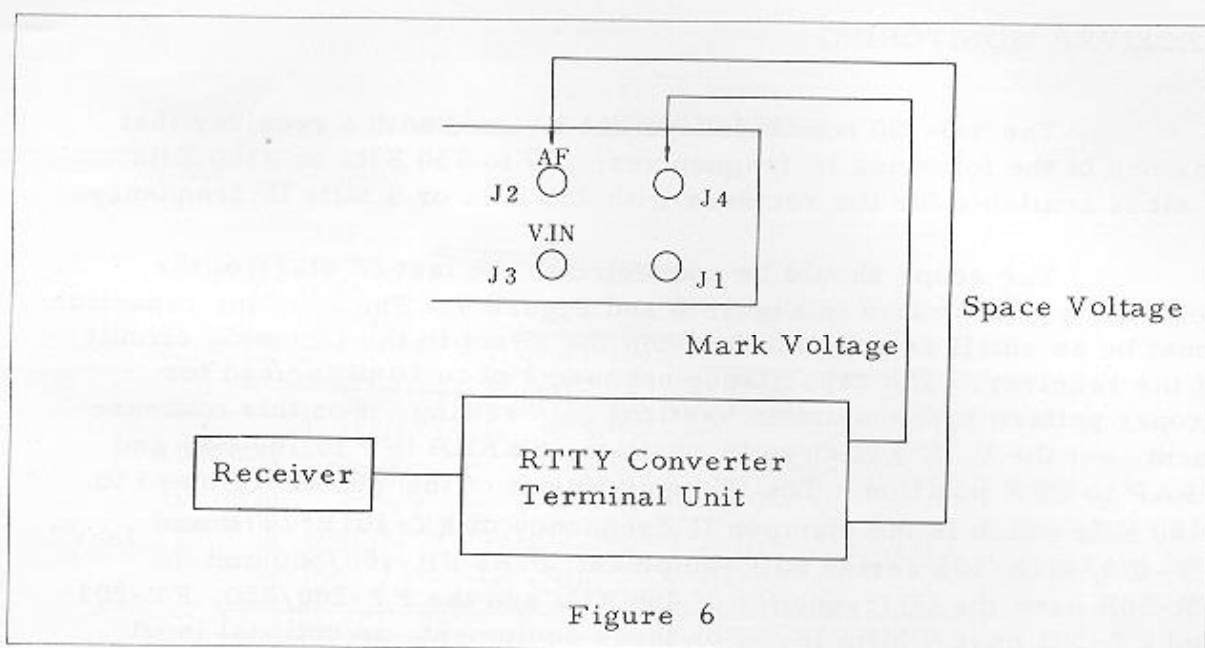


Figure 6

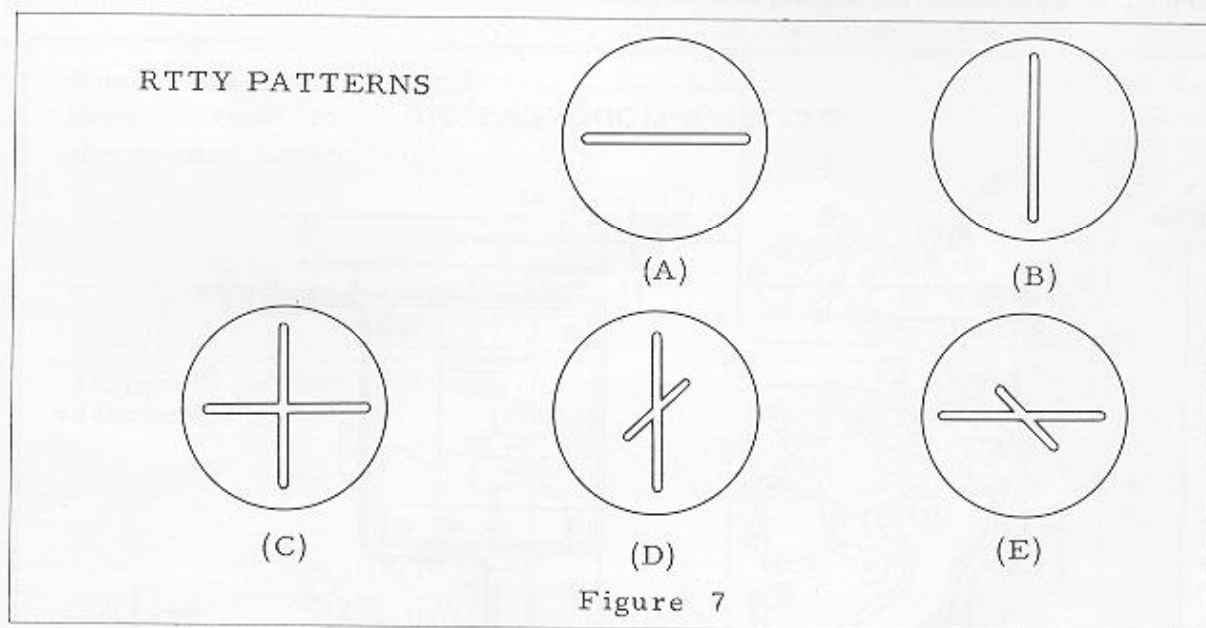


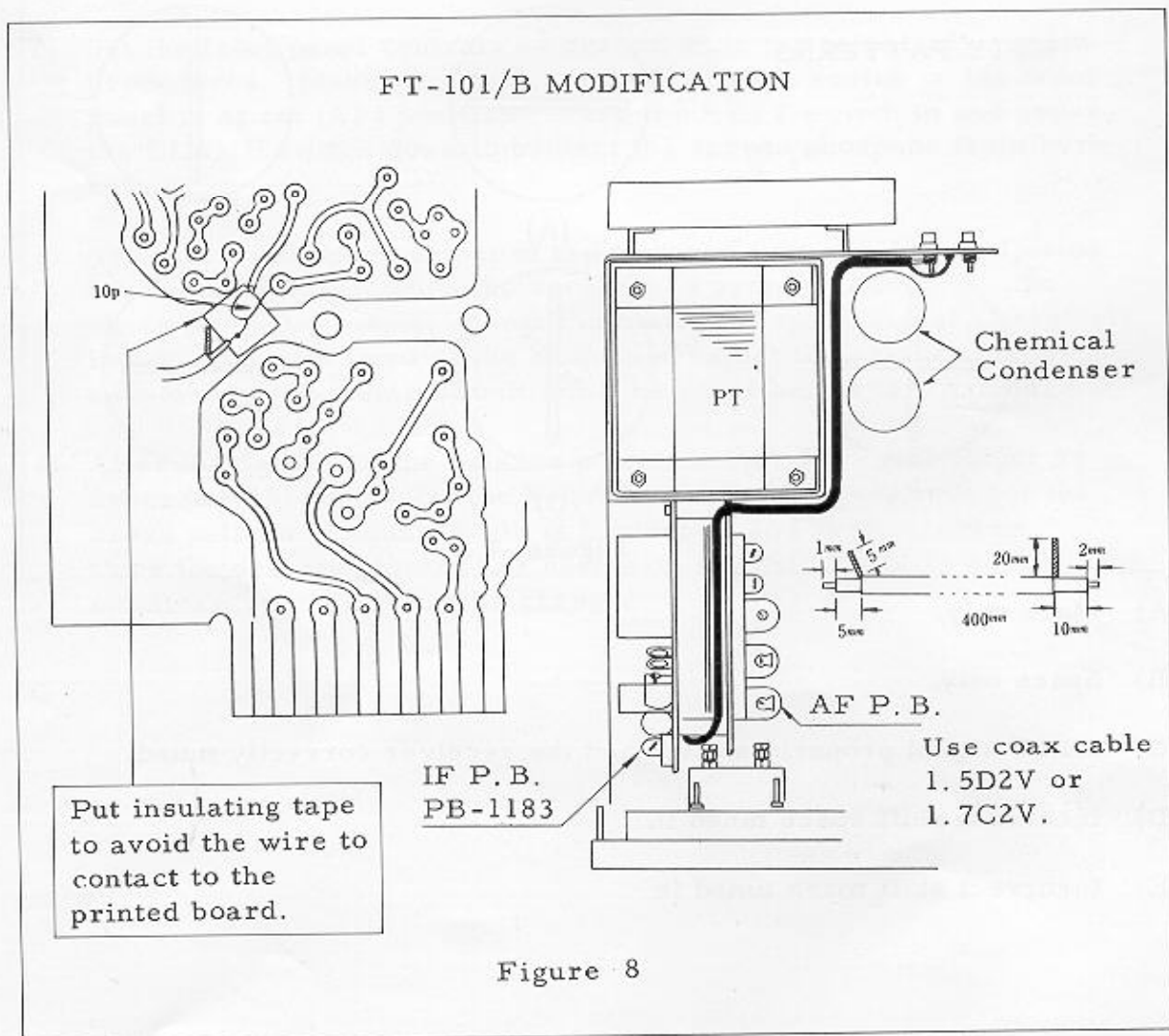
Figure 7

- (A) Mark only.
- (B) Space only.
- (C) RTTY signal properly shifted and the receiver correctly tuned.
- (D) Incorrect shift space tuned in.
- (E) Incorrect shift mark tuned in.

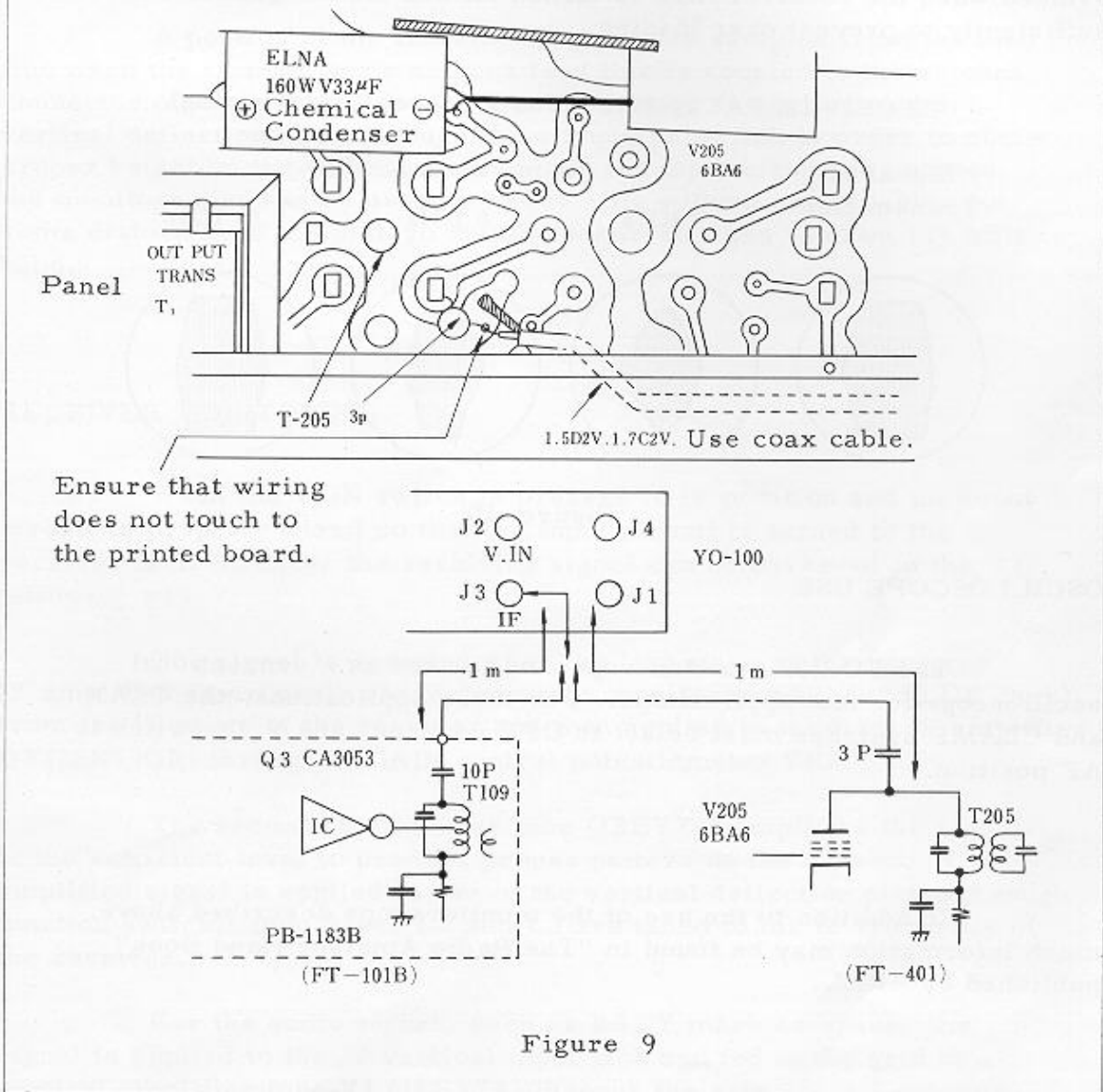
## RECEIVER MONITORING

The YO-100 monitorscope can be used with a receiver that has one of the following IF frequencies: 50 to 150 KHz or 3180 KHz. A kit is available for the receiver with 455 KHz or 9 MHz IF frequency.

The scope should be connected to the last IF stage of the receiver as illustrated in Figure 8 and Figure 9. The coupling capacitor must be as small as possible to avoid the effect to the IF tuning circuit of the receiver. The capacitance between 1 pf to 10 pf is used for proper pattern with maximum vertical gain setting. For this measurement, set the V.IN switch to IF position, SWEEP INT to 100 Hz, and TRAP to OFF position. The IF input circuit of the YO-100 is tuned to 3180 KHz which is the common IF frequency of FT-101B/277B and FT-400/401B/505 series SSB equipment. The FR-400/500 and FR-50B have the IF frequency of 455 KHz and the FT-200/250, FT-201 and FT-501 have 9 MHz IF. For these equipment, an optional input circuit is available through your dealer.



FT-400/401/B MODIFICATION



The received pattern may not be identical to the transmitted pattern, as the received signal passes through a sharp filter in the receiver IF section and also is affected by the receiver AGC section. The bandwidth of the receiver IF filter affects the display of the actual transmitted signal. The IF bandwidth is required 10 times of the actual modulated signal in order to prevent the distortion. This means that a 3 KHz filter can only produce 300 Hz signal without distortion. Therefore, attention must be paid, as the flat topping SSB signal may be

displayed as if it were acceptable on the RF envelope patten. Please refer to Figure 10.

With the AGC ON, the leading portion of the waveform may be displayed with higher amplitude than normal. This problem can be avoided when the receiver AGC is turned off and the RF gain is reduced sufficiently to prevent over loading.

#### RECEIVER PATTERNS (1000 - Severe Flat Topping)

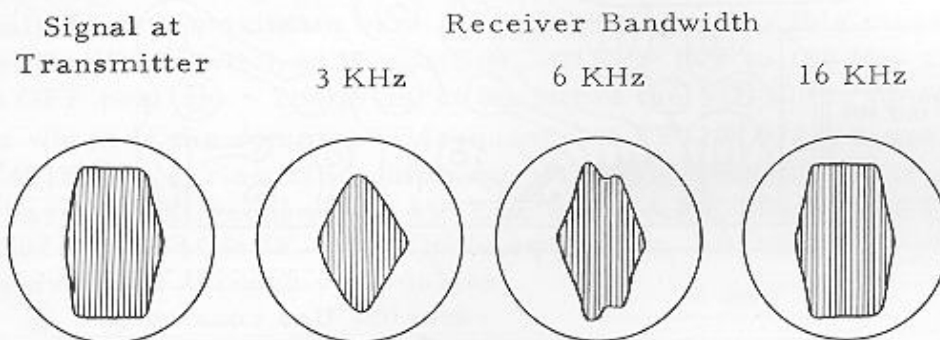


Figure 10

#### OSCILLOSCOPE USE

The YO-100 monitorscope can be used as a conventional oscilloscope for test applications. For these applications, the TRAP and CLAMP switches must be set to OFF position, and V. IN switch to AF position.

In addition to the use of the monitorscope described above, much information may be found in "The Radio Amateur Hand Book" published by ARRL.

#### CIRCUIT DESCRIPTION

The block diagram may be helpful to understand the performance of the monitorscope. Please refer to the block diagram on page 20.

## TRANSMITTER MONITORING

When the transmitter signals are connected to a 50 to 72 ohm transmission line which is terminated with matched load, ten to several Killo Watts signals can be monitored on the scope.

A portion of the transmitter power is sampled from the feed line when the transmitter's antenna feed line is coupled to the antenna connector of the monitorscope. The RF voltage is applied to the vertical deflection plate through the attenuator switch in order to obtain proper height on the CRT screen. Since the input circuit is untuned, the monitorscope can be used up to 100 MHz without any trouble, but some distortion of the pattern may be observed when used on 144 MHz band.

## RECEIVER MONITORING

When the V. IN switch is pressed to IF position and the input circuit is properly wired so that the input circuit is turned to the receiver IF frequency, the receiving signal can be observed in the following way.

The signal is sampled when the last stage of the receiver IF amplifier is properly connected to the monitorscope input J3 (IF Jack) from the IF stage of the receiver and then applied to the first IF amplifier Q1 (2SK19GR) through V. GAIN control potentiometer VR2.

The second IF amplifier tube (12BY7A) amplifies the signal to the sufficient level to produce proper pattern on the screen. The amplified signal is applied to one of the vertical deflection plates through function switch. Inductance L2 and L3 are tuned to the IF frequency of the receiver.

For the audio signal, such as RTTY mark or space, the signal is applied to the J2 vertical input jack and fed to the grid of a vertical amplifier tube V1 (12BY7A) through the gain control potentiometer VR1. The V1 works in configuration of resistance coupled amplifier and amplifies the signal to the sufficient level to produce proper pattern on the screen. The cathode circuit of V1 and V2 is opened by the function switch S1e when it is not in use.



## HORIZONTAL CIRCUIT

The voltage applied to the horizontal deflection plate is selected by the mode switch. When the TRAP (trapezoid) switch is pressed, the input signal from J5 and J6 is rectified by V5 (6AL5) and applied to the grid of V3a (12AT7) through the H.GAIN control VR8. The amplified signal by V3a is then fed to the horizontal deflection plate through C20. With the RTTY switch pressed position, the input signal from J4 is directly fed to the grid of V3a through H.GAIN control.

The SWEEP INT switch selects the frequency of internal sweep oscillator. The sweep frequency is varied from 10 Hz to 10 KHz with the switches marked 100, 1K, 10K (Hz) and the potentiometer marked SWEEP FREQ on the front panel. Q201 - Q205 generate sawtooth signal for the deflection plate.

## CLAMP CIRCUIT

When no output from the transceiver is present in the set-up for a trapezoid test, the CRT surface may burn by the sharp spot with high brightness. The clamp circuit is used to deflect off the spot from the screen when no signal is present. With the TRAP or RTTY switch ON position, the cathode circuit of V3b is connected to the ground and the V3b draws plate current when the CLAMP switch is pressed down.

The plate current causes voltage drop across VR4-R20 which varies the horizontal deflection plate voltage and the spot moves to one side of the screen. When the transmitted signal is present, the RF voltage is impressed to the cathode of V5b (6AL5). This voltage is rectified by the V5b and its negative voltage is passed to the grid of V3b (12AT7) to stop conducting, which returns its plate voltage and the voltage of the horizontal deflection plate, causing the pattern to return to the normal displaying surface.

## TWO TONE GENERATOR

The Q101 and Q102 (2SC373) generate 1900 Hz tone signal and Q103 and Q104 (2SC373) generate 1500 Hz tone signal. The function switches marked 1900 and 1500 turn on two generator circuits independently or simultaneously. When the both switches are pressed down, two generators oscillate simultaneously and VR102 potentiometer is used

to obtain same amplitude output. The VR104 is used for output level adjustment. The VR101 and VR103 are used to set the oscillating condition to produce pure sine wave.

#### POWER SUPPLY

The primary winding of power transformer is split into two windings for the purpose of operating the monitorscope at the different line voltage area. Otherwise specified, the transformer is wired for 100 Volts operation. The secondary of the power transformer has five windings to deliver four different DC voltages and also AC heater supply for the tubes. A separate winding is used for CRT (Cathode Ray Tube) which requires high voltage insulation. The D401 and D402 (HG3) provide -1200 Volts for the CRT in full wave voltage doubler circuit. Four sets of 10D10, D301 - D304, provide +600 Volts in a full wave voltage doubler and return lead of the winding provides +300 Volts. The D403 - D406 (1S1941) are bridge-connected providing +30 Volts for the transistors.

TOP VIEW

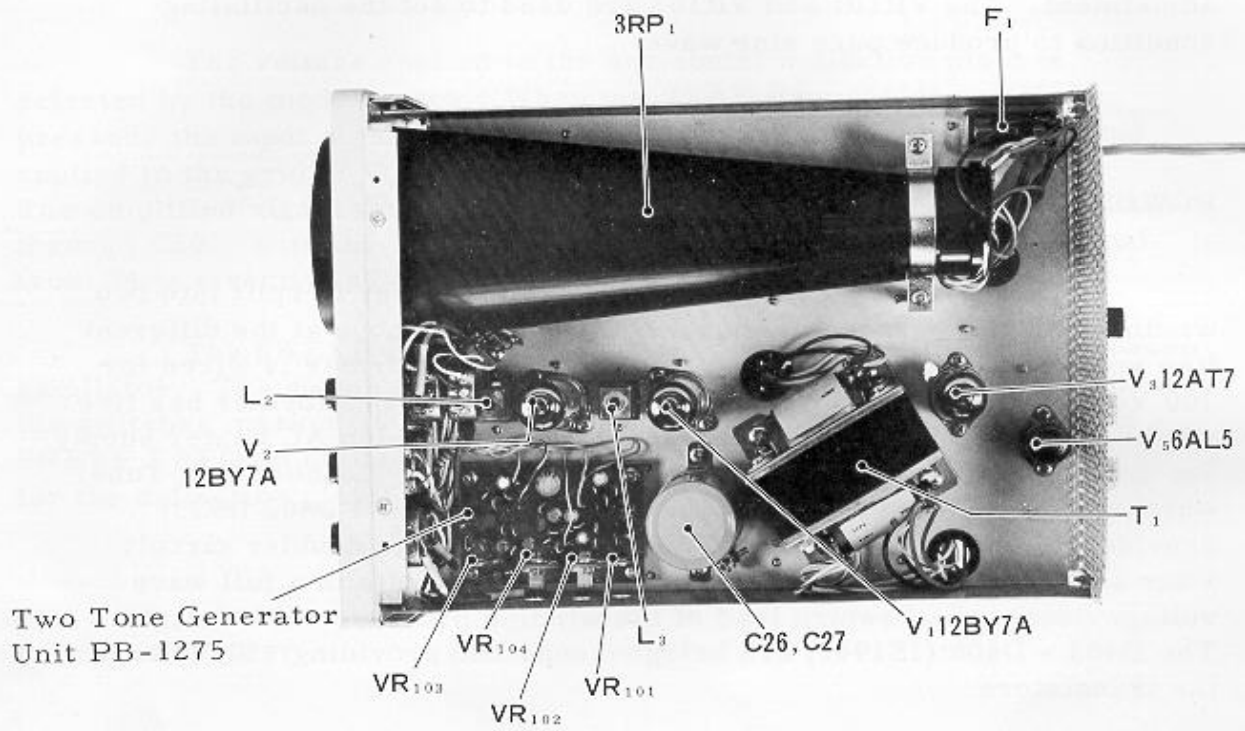


Figure 11

BOTTOM VIEW

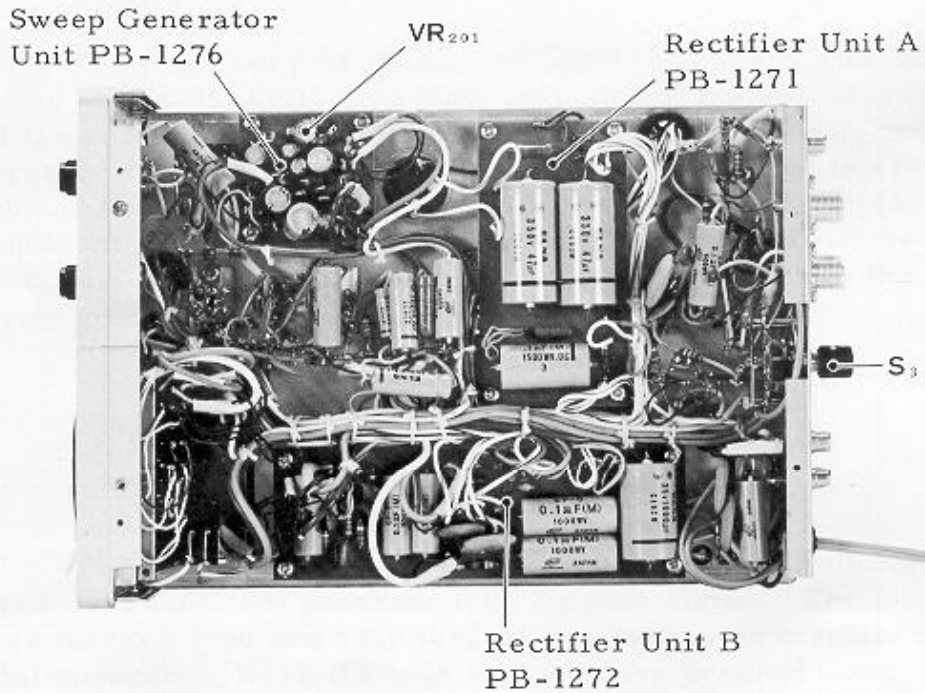


Figure 12

## VOLTAGE MEASUREMENTS

### AC Voltage

Pin No. Tube	1	2	3	4	5	6	7	8	9	10	11	12
V 1 12BY7A	2	0	E	AC 6.3	AC 6.3	E	150	100	E			
V 2 12BY7A	23	0	E	AC 6.3	AC 6.3	E	280	280	E			
V 3 12A T 7	320	0	5	AC 6.3	AC 6.3	290	0	0	E			
V 4 3RP1A	H	-1.2K	-1.2K	-800	-	290	290	290	290	310	-	H
V 5 6AL5	0	0	AC 6.3	E	0.25	E	-2.5					

Figure 13

## RESISTANCE CHART

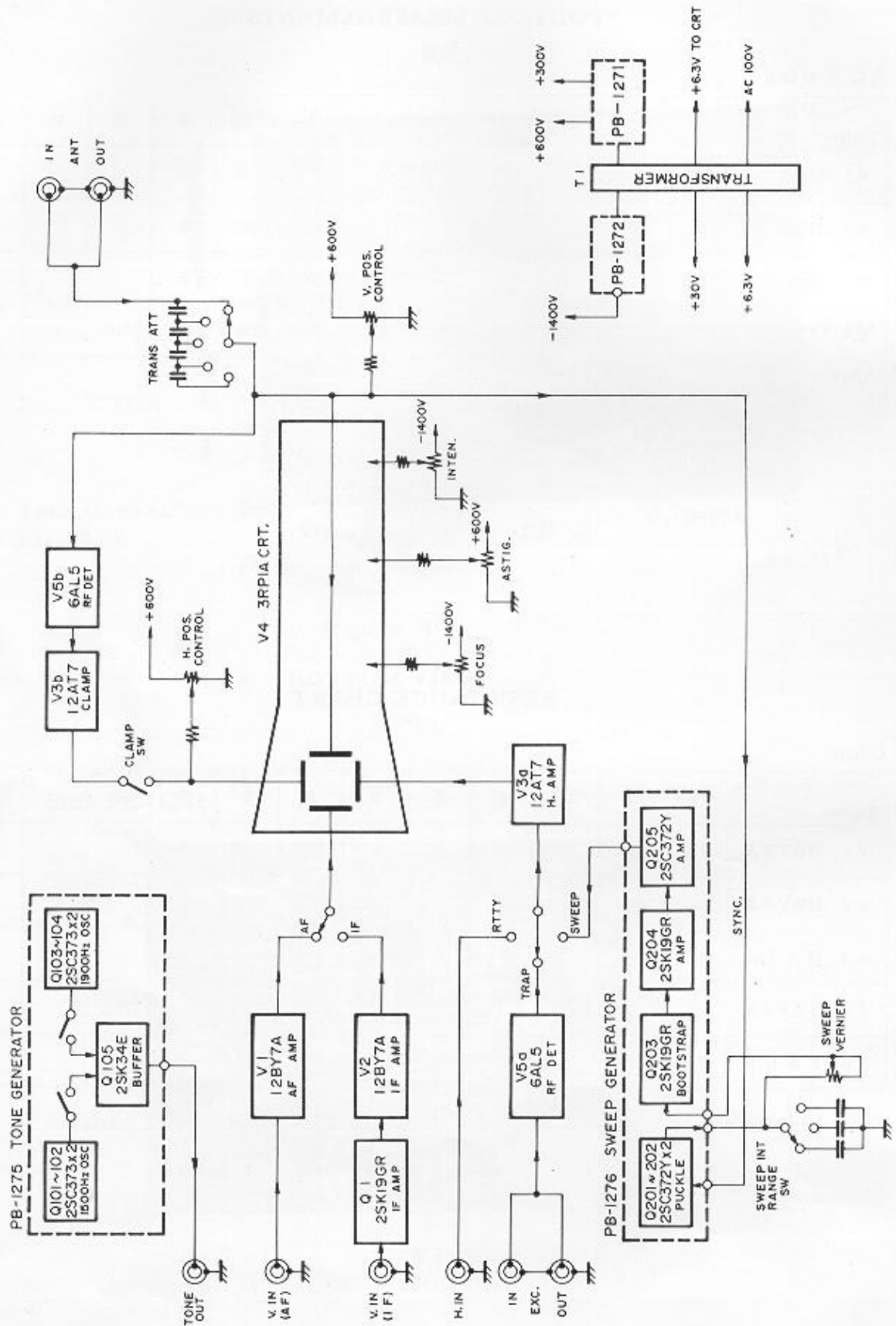
### Ohm

Pin No. Tube	1	2	3	4	5	6	7	8	9	10	11	12
V 1 12BY7A	180	*180K	E	0	0	E	34K	110K	E			
V 2 12BY7A	~	*45K	E	0	0	E	20K	65K	E			
V 3 12A T 7	100K	*200K	1.8K	0	0	600K	9M	~	E			
V 4 3RP1A	~	5M	5M	3.5M	-	600K	3.5M	170K	1.2M	320K	-	~
V 5 6AL5	7K	700	0	E	48K	E	5M					

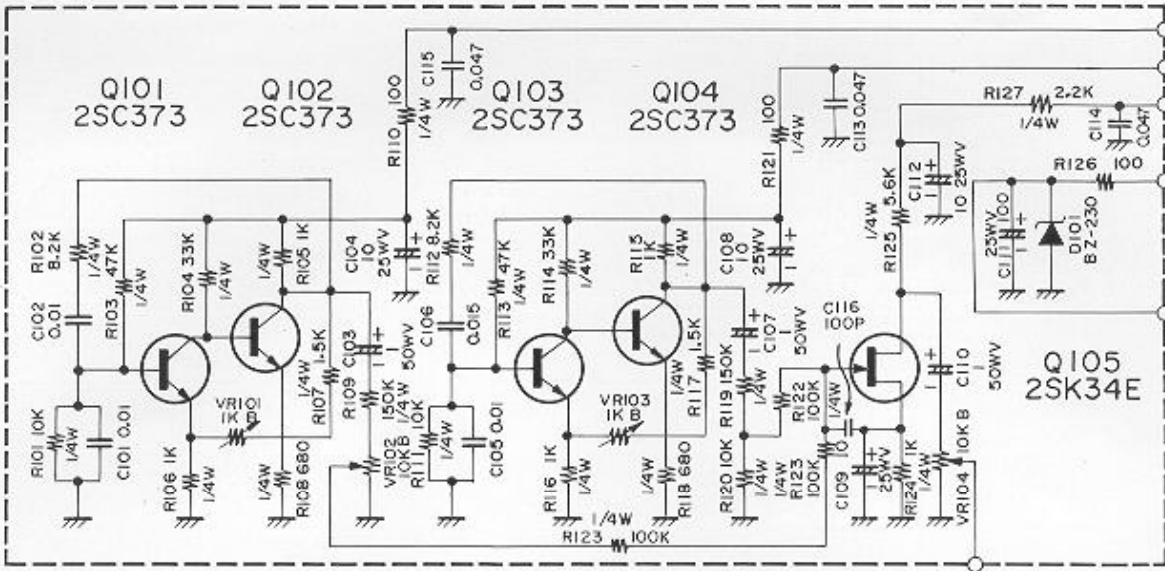
Value \* varies with the setting of potentiometer on the front panel.

Figure 14

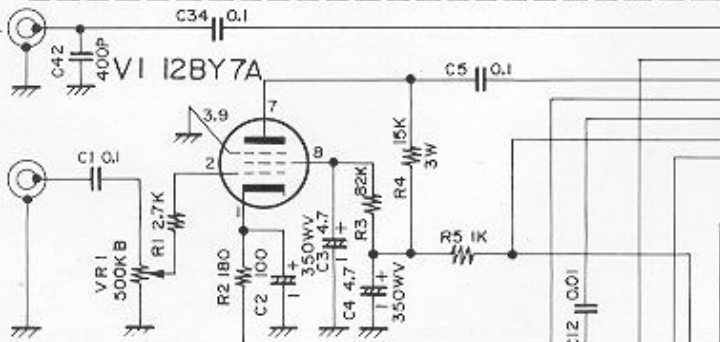
# YO-100 BLOCK DIAGRAM



PB-1275



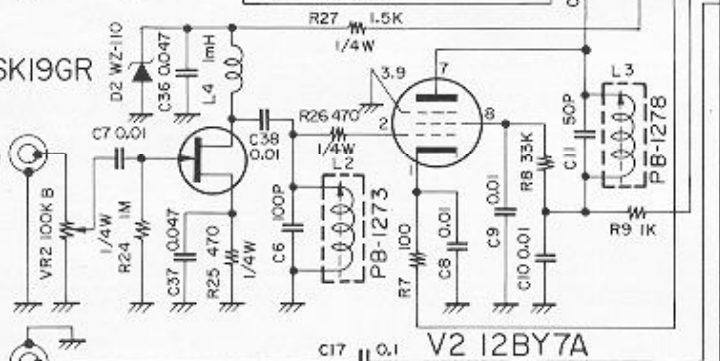
J1 TONE OUT



V1 12BY7A

Q1 2SK19GR

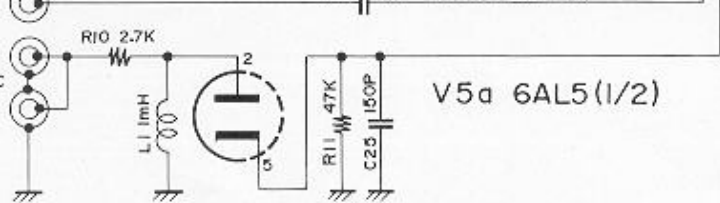
J3 IN (IF)



J4 H. IN

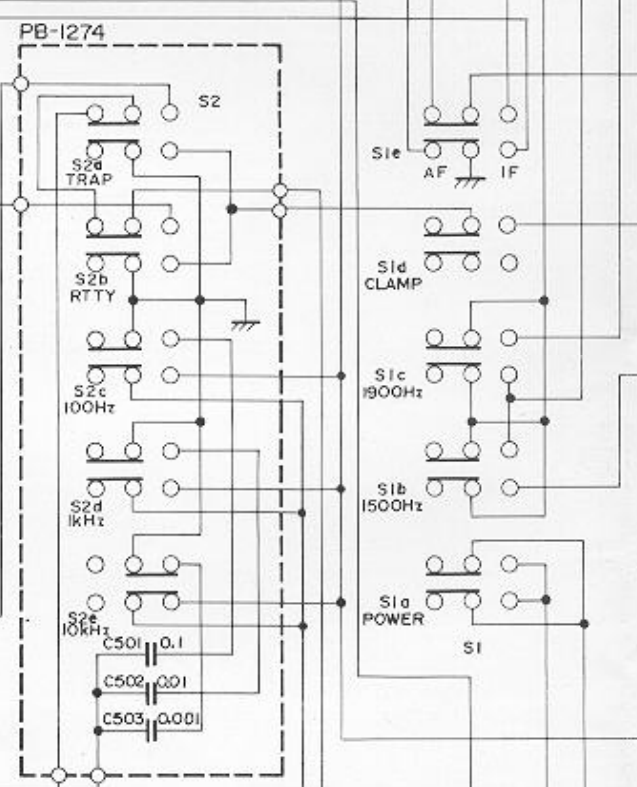
J5 EXC

J6

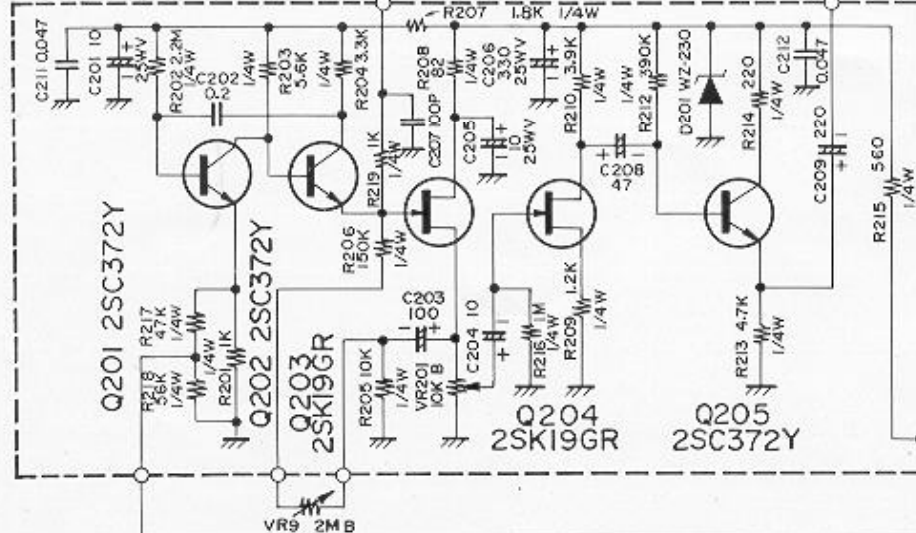


V2 12BY7A

V5a 6AL5 (1/2)



PB-1276



Q201 2SC372Y

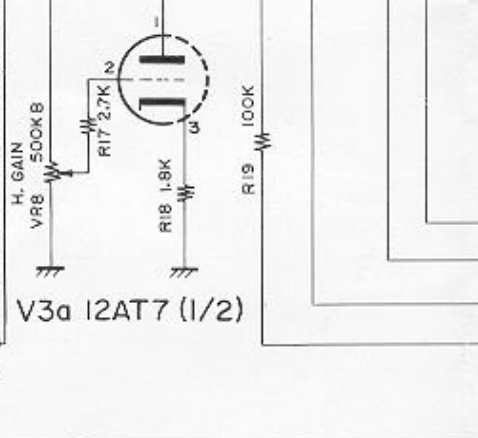
Q202 2SC372Y

Q203 2SK19GR

Q204 2SK19GR

Q205 2SC372Y

V3a 12AT7 (1/2)



C20 0.1

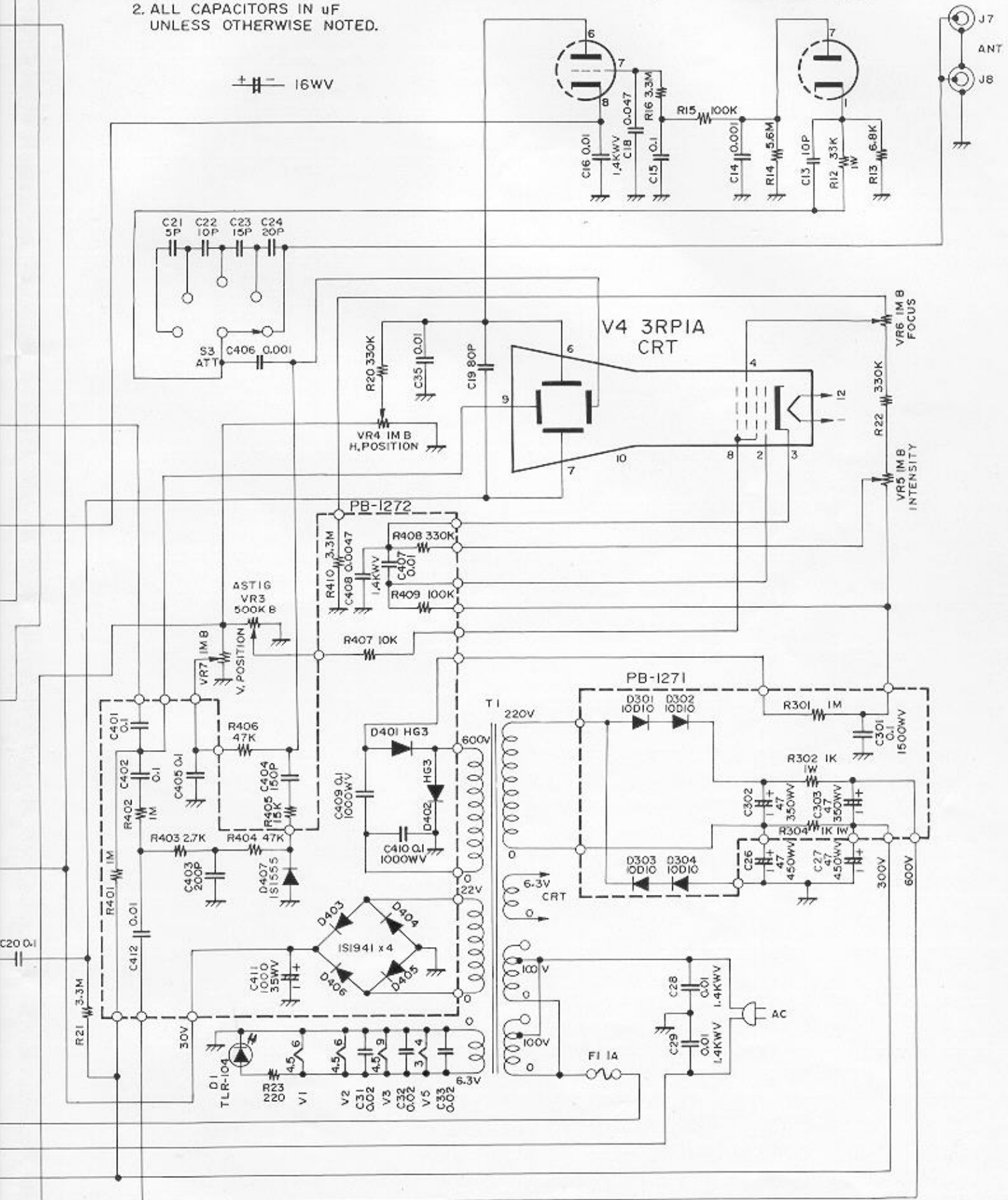
NOTE:

1. ALL RESISTORS IN  $\Omega$  1/2W  $\pm 10\%$  UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN  $\mu F$  UNLESS OTHERWISE NOTED.

$\pm$  16WV

V3b 12AT7 (1/2)

V5b 6AL5 (1/2)



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CIRCUIT DIAGRAM

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