KENWOOD

STATION MONITOR

SM-230

KENWOOD CORPORATION

© 90/12 11 10 9 8 7 6 5 4 3

B50-7706-10(T)

SAFETY

Symbol in This Manual
⚠ This symbol indicates where applicable cautionary or other imformation is to be found.

Power Source
This equipment operates from a power source that does not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product
This equipment is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the equipment input or output terminals.

Use the Proper Power Cord
Use only the power cord and connector specified for your product.

Use the Proper Fuse
To avoid fire hazard, use a fuse of the correct type.

Do not Operate in Explosive Atmospheres
To avoid explosion, do not operate this product in an explosive atmosphere.

Do not Remove Cover or Panel
To avoid personal injury, do not remove the cover or panel. Refer servicing to qualified personnel.

Voltage Conversion
If the power source is not applied to your product, contact your dealer. To avoid electrical shock, do not perform the voltage conversion.

CONTENTS

1. FEATURES 2
2. SPECIFICATIONS AND ACCESSORIES 3
   2-1. SPECIFICATIONS 3
   2-2. ACCESSORIES 4
3. PRIOR TO USE 5
   3-1. ATTENTION BEFORE USING! 5
   3-2. EXTENDING THE FRONT LEGS 5
4. FRONT AND REAR PANELS 6
   4-1. FRONT PANEL 6
   4-2. REAR PANEL 8
5. DIRECTIONS FOR USE 9
   5-1. BAND SCOPE FUNCTION 9
      5-1-1. Hook-up 9
      5-1-2. Initial Setup 9
      5-1-3. Operation 10
      5-1-4. Operation of Dual Watch Marker 10
      5-1-5. Adjustment of Dual Watch Marker 10
   5-2. OSCILLOSCOPE FUNCTION 10
      5-2-1. Initial Setup 10
      5-2-2. Operation 11
   5-3. MONITOR SCOPE FUNCTION 11
      5-3-1. Hook-up 11
      5-3-2. Initial Setup 12
      5-3-3. Observation of Transmitted Waveforms 12
      5-3-4. Observation of Received Waveforms 13
   5-4. RTTY CROSS-PATTERN FUNCTION 13
      5-4-1. Hook-up 13
      5-4-2. Initial Setup 14
      5-4-3. Operation 14
6. EXPLANATION OF CIRCUITRY 15
   6-1. CIRCUITRY 15
   6-2. UNIT STRUCTURE 15
   6-3. BLOCK DIAGRAM 16
   6-4. CIRCUIT DIAGRAM 17
7. MAINTENANCE AND ADJUSTMENT 21
   7-1. AFTER-SERVICE 21
   7-2. CLEANING AND CARE 21
   7-3. BEFORE DECIDING IT'S A BREAKDOWN 21
   7-4. ADJUSTMENT 22

1. FEATURES

The SM-230 is a station monitor developed as a peripheral to the TS-950 transceiver. Being a multi-function monitor scope incorporating oscilloscope, band scope, monitor scope, RTTY cross pattern observation, and tone generator functions, the unit is ideal as a radio station peripheral (for supplementary operational use, supervision, and equipment calibration).

1. The Band Scope portion enables observation at three selectable scan speeds, over a wide maximum bandwidth of 500 kHz.
   Three bandwidths may be selected: 50 kHz, 200 kHz, and 500 kHz.
2. With the Dual Watch Marker function, even if two waves are received simultaneously, a point appears on the monitor indicating the reception frequency positions, and the signals can be confirmed visually (for use only with the TS-950).
3. The unit is equipped with a dedicated RF I/O terminal which enables observation of signal waveforms over a wide band of frequencies up to 150 MHz.
4. The oscilloscope portion, having a high sensitivity of 10 mV/div and a wideband frequency characteristic of 10 MHz (−3 dB), has considerable capabilities for the observation of all types of wave forms. In addition, it can directly observe IF waveforms received from the TS-950 IF terminal.
5. Because the unit is equipped with a 1,000 Hz/1,575 Hz two tone signal generator, it can be used in transceiver MIC AMP adjustment.
6. The unit uses a large 6-inch-square CTR that is black to match the transceiver.

2. SPECIFICATIONS AND ACCESSORIES

2-1. SPECIFICATIONS

Item		Specifications
CRT		6-inch-square, internal graticule
TRANSMITTED WAVE MONITOR TERMINAL		
Observable frequency		1.8 ~ 150 MHz
Maximum power throughput	1.8 ~ 80 MHz	2 kW_{PEP} (up to 5 min at max ATT)
	30 ~ 150 MHz	100 W_{PEP}
Deflection sensitivity (input, 5 W)	1.8 ~ 80 Hz	More than 1 div
	30 ~ 150 MHz	More than 0.6 div
Attenuator		6-step
TWO-TONE OSCILLATOR PORTION		
Oscillator frequencies		1,000 Hz, 1,575 Hz ± 10%
Output voltage		5 mV (in TWO-TONE mode) ± 20%
Output impedance		600 ohm
BAND SCOPE PORTION ("SLOW" SCAN SPEED)		
Input center frequency		8.830 MHz
Resolution		1 kHz (6 dB bandwidth)
Input sensitivity		More than 1 div per 10 μV rms
Attenuator		0, − 20 dB, and − 40 dB (ATT switch 1, 1/10, and 1/100)
SCAN width		± 25 kHz, ± 100 kHz, ± 250 kHz selectable
Marker precision		± 10% (Marker displayed only in ± 25 kHz range)
OSILLOSCOPE PORTION		
Vertical Unit		
Deflection sensitivity		10 mV/div ~ 10 V/div ± 5%
Frequency characteristics	DC	DC ~ 10 MHz (− 3 dB)
	AC	5 Hz ~ 10 MHz (− 3 dB)
Input impednace		1Mohm ± 2%, Less than 50 pF
Attenuator		1, 1/10, 1/100, and GND (interrange deviation: less than ± 3%)
⚠ Maximum tolerable input voltage		250 V (DC + AC_{peak}) or input voltage 500 Vp-p (below 1 kHz)
Sweep circuit		
Sweep mode		trigger sweep (in absence of signal, auto free run)
Sweep frequency		10 Hz ~ 100 kHz (4 ranges and interrange fine adjust possible)
Sweep linearity		Less than 5%
Triggering		
Trigger sensitivity		Less than 1 div (10 Hz ~ 10 MHz sine wave)
Trigger level		FIX mode
Coupling		AC
Polarity		Rising
Calibration voltage		
Amplitude		0.5 Vp-p ± 3% square wave, + polarity
Frequency		1 kHz ± 5%
X-TUNE PORTION		
Sensitivity		300 mV/8 div ± 20%
Input impedance		50 kohm ± 20% (at 1 kHz)
Frequency characteristic		100 Hz ~ 10 kHz (within − 3 dB)
⚠ Maximum tolerable input voltage		3 V_{rms} [4.5 V (DC + AC_{peak})]

2. SPECIFICATIONS AND ACCESSORIES

Item		Specifications
POWER SOURCE		
Source voltage		AC 100 V, 120 V, 220 V ± 10%, 216 ~ 250 V 50/60 Hz
Power consumption		29 W
DIMENSIONS	Width	266 (266)* mm
	Height	141 (155) mm
	Depth	400 (427) mm
WEIGHT		Approx. 7.5 kg

(*) = Figures in parentheses indicate maximum dimension, including protruding parts.
Circuit and rating are subject to change without notice due to developments in technology.

2-2. ACCESSORIES

Oscilloscope input cord..... 1 cord
IF signal cord..... 1 cord
Dual Watch Marker cord..... 1 cord
X-TUNE cord..... 1 cord
TWO-TONE cord..... 1 cord
Adjustment screwdriver..... 1
Instruction manual..... 1
Warranty..... 1

After unpacking
Shipping container:
Save the boxes and packing in the event your unit needs to be transported for remote operation, maintenance, or service.

3. PRIOR TO USE...

3-1. ATTENTION BEFORE USING!

1) Check the power supply voltage before using. The voltage to be used is indicated on the back panel. Note that use of a different voltage may cause malfunction. Connect the power supply cord after making the necessary check.

2) Avoid using the unit under any of the following conditons:
   1. In places receiving direct sunlight
   2. In hot or humid rooms
   3. Rooms subject to heavy mechanical vibration
   4. Near devices which produce strong magnetic fields or electrical surges.
   5. In areas where explosive gases are either stored or might be generated.

3) Applying power to the Monitor portions' TX terminal in excess of the maximum tolerable power may cause deterioriation of internal parts. Please note that damage of this type is not covered in the warranty.

4) Do not apply voltages to the various input terminals in excess of the respective maximum tolerable voltages specified.

⚠ VERTICAL INPUT: 500 Vp-p, or 250 V (DC + AC_{peak})
X IN: 3 V_{rms} [4.5 V (DC + AC_{peak})]
Y IN: 3 V_{rms} [4.5 V (DC + AC_{peak})]

Do input any signals into IF IN, or ACC3 other than the specified signals. Also, do not apply external voltages to any of the output terminals.

5) Do not raise the brightness any higher than is necessary.

6) Avoid placing objects on top of the unit, or placing the unit in such a way that the ventilation holes in the casing are obstructed. These will raise the internal temperature of the unit and may result in breakdown.

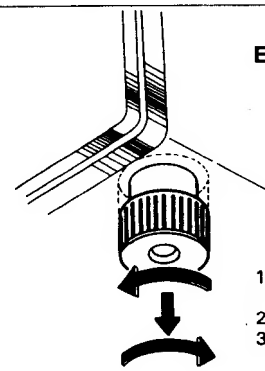
7) Never open the casing, as the inside of the apparatus contains dangerous high-voltage components.

8) When using the unit, take proper safety precautions by grounding the GND terminal located on the rear panel.

9) When adjusting the SM-230 from the bottom or side panels, be sure to use the provided screwdriver.

3-2. EXTENDING THE FRONT LEGS

The front legs of the SM-230 can be raised to set the machine on a slant. Turn each leg to the left a half-turn and pull down to the desired length, then turn to the right to lock in position. To shorten the legs, turn each leg to the left, push in to the desired length, then turn to the right to lock.



Extending the front legs

1. Rotate the leg one half-turn to the left.
2. Pull the leg out.
3. Rotate the leg one half-turn to the right.
   (The leg will lock in whatever position it has been extended to.)

4. FRONT AND REAR PANELS

4-1. FRONT PANEL

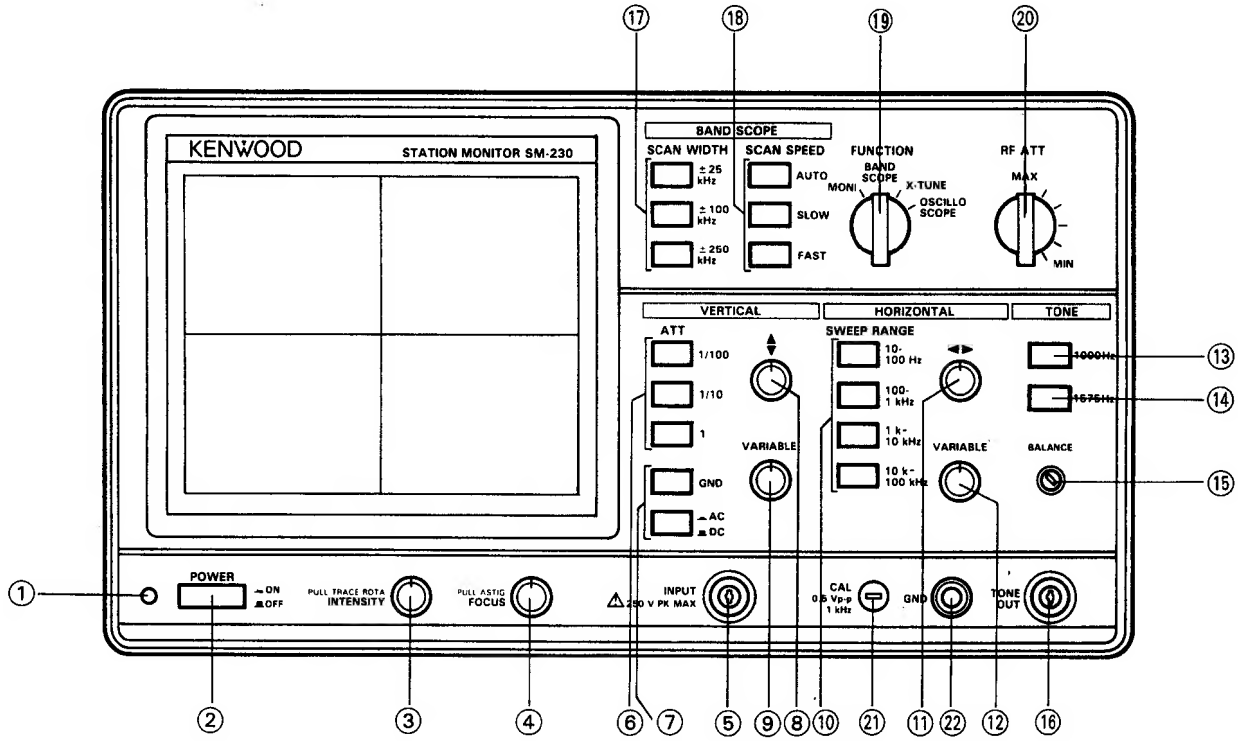


Figure 1

① POWER Indicator
Lights up when the POWER switch is pushed.

② POWER Switch
The ON/OFF switch. Push to switch the unit ON.

③ INTENSITY/PULL TRACE ROTATION Control
INTENSITY : Used to adjust the brightness of the beam trace.
TRACE ROTATION : When the knob is turned in the pulled-out position, it adjusts the inclination of the horizontal trace line. Used to adjust for deviations resulting from the effects of the Earth's magnetic field.

④ FOCUS/PULL ASTIG Control
FOCUS : Used for focal adjustment.
ASTIG : When turned in the pulled-out position, adjusts the convergence of the beam. Used together with FOCUS to obtain crisp, clear-cut waveforms.

⑤ VERTICAL INPUT Jack
The vertical input terminal used in the oscilloscope mode.

⑥ ATT 1/100, 1/10, 1 Switch assembly
Used for adjusting input levels of vertical amplifier in the oscilloscope and bandscope modes. When set to "1," the signals input into INPUT ⑤ are passed directy into the vertical amplifier. When set to "1/10" or "1/100," the signals are attenuated and the amplitude of the waveform on the monitor is reduced to 1/10 or 1/100, respectively. (Displayed as −20 dB or −40 dB when in bandscope mode)

⑦ GND AC/DC Switch
The switch that selects the coupling mode for the vertical input signals in the oscilloscope mode.
GND : The input signals and the vertical amplifier are isolated from each other and the amplifier input is grounded. In this way, the ground potential can be verified.
AC : The input signals are AC-coupled, and DC components are removed.
DC : The input signals are DC-coupled, and observation can be performed with the DC components included.

Note:
When the GND switch is depressed, GND receives priority over AC/DC and the vertical amplifier input is grounded.

4. FRONT AND REAR PANELS

⑧ ▲▼ **Control**
The vertical position adjustment knob. The waveform shifts upwards when the knob is turned clockwise. In the bandscope mode, the trace line shifts to the lower part of the screen. In this mode, it becomes a fine adjustment knob, with a variable range of about ±2 div.
This knob does not operate in the X-TUNE mode.

⑨ **VARIABLE (VERTICAL) Control**
The gain control knob for the vertical amplifier. It is used in conjunction with ATT ⑥ to adjust waveform amplitudes to a suitable size on the monitor. The knob can change the amplitude non-incrementally over a range of more than 10-fold. When this knob is insufficient for satisfactory adjustment of the amplitude, switch the ATT knob.
In the oscilloscope mode, this knob is turned all the way in the "●" direction and calibrated to 10 mV/div. This knob operates in the oscilloscope and bandscope modes.

⑩ **SWEEP RANGE Switch assembly**
The sweep frequency switch. For each indicated frequency, 10 div make up one cycle.
This knob operates in the oscilloscope and monitor modes.

⑪ ◄► **Control**
The horizontal position adjustment knob. It shifts the position of the waveforms laterally. In the bandscope mode, it becomes a fine adjustment knob, with a variable range of about ±2 div. This knob does not operate in the X-TUNE mode.

⑫ **VARIABLE (HORIZONTAL) Control**
The adjustment knob for the sweep frequency. It can be used to change the frequency non-incrementally over a range of more than 10-fold.
In the oscilloscope mode, this knob is turned all the way in the "●" direction and calibrated so that 1 div corresponds to the faster frequency of the indicated SWEEP RANGE. This knob does not operate in the BANDSCOPE and X-TUNE modes.

⑬ **TONE 1000 Hz Switch**
The switch for selecting the 1,000 Hz TONE generator. When it is pushed, this generator will be output via the TONE OUT terminal ⑯.

⑭ **TONE 1575 Hz Switch**
The switch for selecting the 1,575 Hz TONE generator. When it is pushed, this generator will be output via the TONE OUT terminal ⑯.

⑮ **BALANCE Trimmer**
The knob used to adjust the 1,000 Hz and 1,575 Hz oscillation gain balance in the TWO-TONE mode. Adjust it using the adjustment tool.

⑯ **TONE OUT Jack**
The output terminal of the TONE generator.

⑰ **SCAN WIDTH Switch assembly**
The switch used to select the frequency range of the bandscope.

⑱ **SCAN SPEED Switch assembly**
Used to select the scan speed in the bandscope mode. selects the optimal SCAN SPEED for each SCAN WIDTH.

⑲ **FUNCTION Switch**
The switch used to select the operation mode of the station monitor.

MONI	: The mode for observing of waveforms transmitted from the transceiver.
BAND SCOPE	: The mode for observing the frequency band spectrum received by the transceiver.
X-TUNE	: The mode for observing RTTY cross patterns.
OSCILLO SCOPE	: The Single trace 10 MHz oscilloscope mode.

⑳ **RF ATT Switch**
A damper for adjusting the input level of signal waves from the transceiver in the monitor mode. It attenuates in six increments.

㉑ **CAL Terminal**
A voltage terminal for calibration of the oscilloscope. It outputs 1 kHz positive square waves with 0.5 Vp-p.

㉒ **GND Terminal**
The earth terminal.

4. FRONT AND REAR PANELS

4-2. REAR PANEL

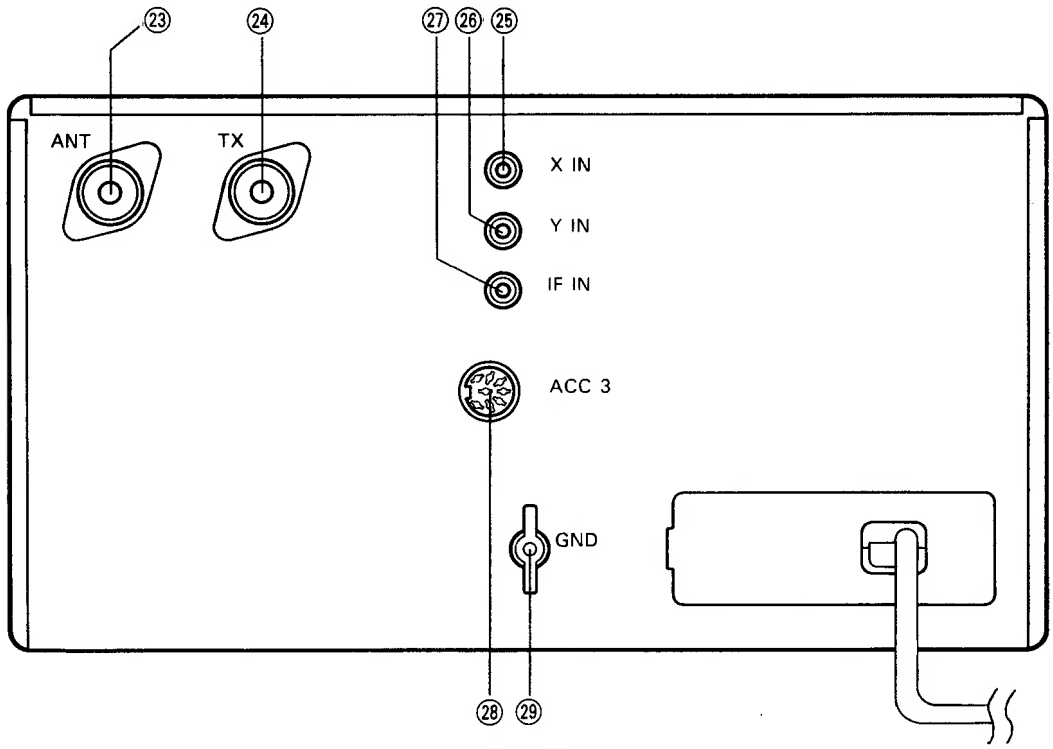


Figure 2

㉓ ANT Jack
Used for hook-up of antenna or dummy load, for observation of transmitted waveforms in the monitor mode.

㉔ TX Jack
Used for hook-up of the transceiver's ANT connector, for observation of transmitted waveforms in the monitor mode.

㉕ X IN Jack
The input terminal for input of the MARK signal during observation of RTTY cross patterns in the X-TUNE mode.

㉖ Y IN Jack
The input terminal for input of the SPACE signal during observation of RTTY cross patterns in the X-TUNE mode.

㉗ IF IN Jack
Used for input of transceiver IF signals when using the bandscope.

㉙ ACC 3 Jack
A terminal which is connected to the TS-950's SCOPE terminal when using the Dual Watch Marker function in the bandscope mode.

PIN NO.	CONTENTS
1	GND
2	Marker ON/OFF
3	Scan width information
4	N.C.
5	Scan width information
6	N.C.
7	Marker position voltage
8	GND

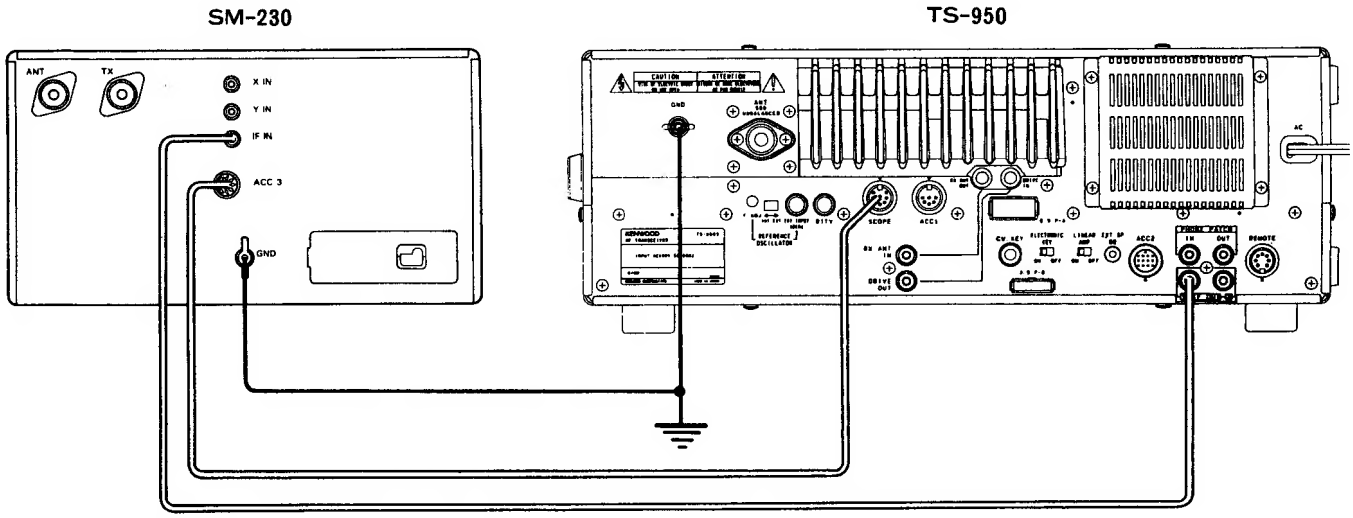
㉙ GND Terminal
The earth terminal. Be sure to connect this with the transceiver GND over the shortest distance possible.

5. DIRECTIONS FOR USE

5-1. BANDSCOPE FUNCTION

5-1-1. Hook-up

Make the connections as shown in Figure 3.



Attention:
Be sure that the transceiver GND and the monitor GND are connected over as short a distance as possible.

Figure 3: Hook-up of the Bandscope

5-1-2. Initial Setup

When using for the first time, observation can be conducted immediately if the controls are set as follows:

Function	BANDSCOPE
▲ ▼	Center
◄ ►	Center
V. VARIABLE	All the way clockwise
FOCUS	Center
INTENSITY	Center

Table 1

Note that when operating in the BANDSCOPE mode, the following controls cease to operate:

GND switch
AC/DC switch
SWEEP RANGE
H. VARIABLE

After setting up precision, the SCAN speed function is set as the following for better viewing:

SCAN SPEED \ Range	±25kHz	±100kHz	±250kHz
AUTO	10Hz	10Hz	10Hz
SLOW	7.7Hz	4.8Hz	3.3Hz
FAST	30Hz	20Hz	15Hz

5. DIRECTIONS FOR USE

5-1-3. Operation

1) The unit is set so that the trace line will come to the lowermost scale line when ▲▼ is set to center. In the situation where the trace line is located off the screen, bring it into view using the ▲▼ control. In the bandscope mode, ▲▼ becomes a fine adjust and, in order to facilitate fine adjustment, it is set to operate in increments of about ±2 div from the center line. This adjustment should be performed at least 30 minutes after the POWER switch is turned on.
2) Set ◄► so that when the CAL MARKER switch of the transceiver is switched to ON the marker signal comes to the center line of the CRT. In the bandscope mode, ◄► becomes a fine adjust and, in order to facilitate fine adjustment, is set to operate in increments of about ±2 div from the center line.
   Because the bandscope is high in precision, and because the internal temperature of the device tends to get relatively high during operation, this adjustment should be performed after the temperature has stabilized and oscillator circuit drift has subsided (about 30 minutes after turning on the power).

Note:
For instructions on how to display the TS-950's marker, refer to the TS-950 Instruction Manual, Section 4-1-1 ("Front Panel" Explanation on "Top Cover").

3) When ◄► has been properly set, turn the CAL marker switch of the TS-950 to OFF to prepare for signal reception. Electric wave distributions such as that in Figure 4 can be observed.
   The waveforms appear on the CRT so that the received signal lies on the center line, waveforms with frequencies higher than that of the received signal appear to the right, and waveforms with frequencies lower than that of the received signal appear to the left. When receiving a high-amplitude signal, spurious noise may be generated. In this case, turn down the gain using V. VARIABLE or V.ATT.
4) Electric wave distributions can be selected having ranges of ±25 kHz, ±100 kHz, or ±250 kHz, centered around the receive frequency. Select the most appropriate one for a given situation.
   The scan speed can be set to AUTO, FAST, or SLOW (AUTO is set so as to provide the optimal scan speed for each scan width). Choose the one which best suits the situation. Note, however, that since setting of the scan speed causes a slip in the frequency, the adjustment described in 2) must be redone.

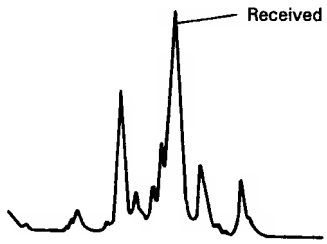


Figure 4. Electric wave distribution observed suring signal reception

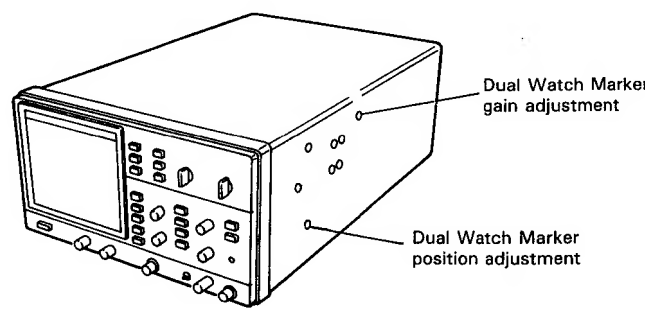
5-1-4. Operation of Dual Watch Marker

The TS-950 includes a function that allows two signals to be received simultaneously. In this case, the frequency indicated on the main display of the TS-950 becomes the center line of the SM-230's display, and the frequency shown on the sub-display is displayed as a trace on the SM-230's CRT screen. Display of the markers is accomplished through brightness modulation of the transmitted signals.

Note:
The Dual Watch Marker is only effective when the scan width of the SM-230 is set at ±25 kHz.

5-1-5. Adjustment of Dual Watch Marker

When a phase difference exists between the frequency variation of the received signal and the Dual Watch Marker variation, the Dual Watch Marker gain adjustment VR must be adjusted. This is done by adjusting the Dual Watch Marker position screw on the side panel of the unit. Adjustment must result in each 1 div on the CRT scale line having the value of 5 kHz.
In case a phase difference exists between the position of signal reception and the Dual Watch Marker position, the same adjustment screw is adjusted for alignment.
In doing so, first make the adjustment discussed in 2) of 5-1-3 for setting the transceiver's main and sub frequencies to the same value. Then adjust the unit so that the marker trace comes to the center line of the CRT.



5-2. OSCILLOSCOPE FUNCTION

The oscilloscope portion of the SM-230 is designed to offer the exact same level of quality and precision found in dedicated oscilloscope units. It has a wide-band frequency characteristic of DC ~10 MHz (−3 dB) and a high sensitivity of 10 mV/div, making it comparable in performance to units currently used in transceiver R&D.

5-2-1. Initial Setup

When using for the first time, observation can be conducted immediately if the controls are set as follows:

Function	OSCILLOSCOPE
V. ATT	1/100 range
▲▼	Center
V. VARIABLE	All the way clockwise
SWEEP RANGE	1 kHz ~ 10 kHz range
◄►	Center
H. VARIABLE	All the way clockwise
FOCUS	Center
INTENSITY	Center

Table 2

5. DIRECTIONS FOR USE

5-2-2. Operation

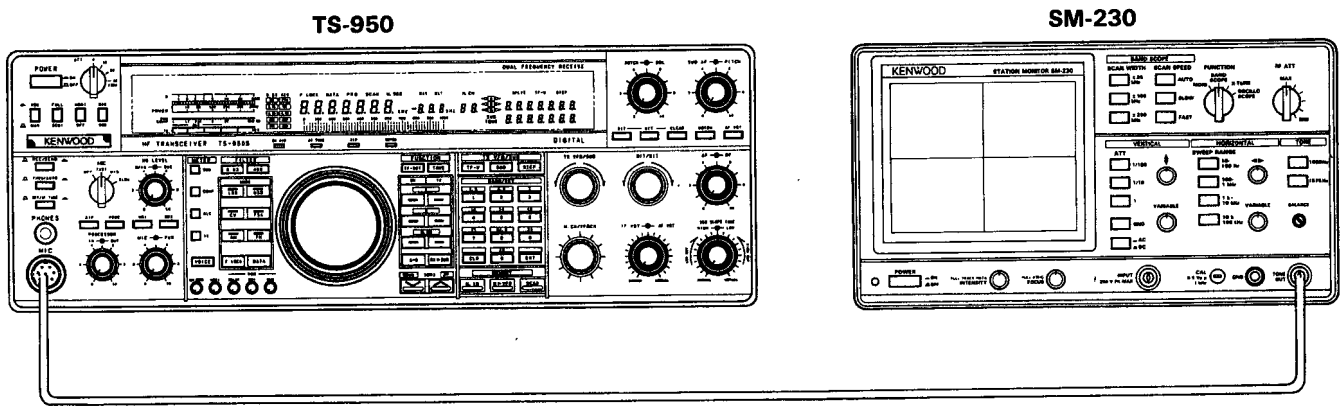
1) The trace line should appear at the center of the CRT screen. If it doesn't, adjust it as necessary with the ▲▼ knob. Next, adjust the INTENSITY and FOCUS knobs to give a clear, easily-viewable trace.
2) Apply an input signal to the INPUT terminal and adjust the ATT and SWEEP RANGE to bring the waveform to the appropriate size.

Note:
Since the TRIGGER unit uses a FIX circuit, there is no need for the usual complex trigger manipulations. Due to use of the FIX circuit, however, synchronization may become impossible to achieve for wave forms which, for example, differ radically in duty ratio.

5-3. MONITOR SCOPE FUNCTION

5-3-1. Hook-up

Caution:
If the SM-230 is placed near a linear amp or other device that tends to emit flux easily, the beam may exhibit some rocking.



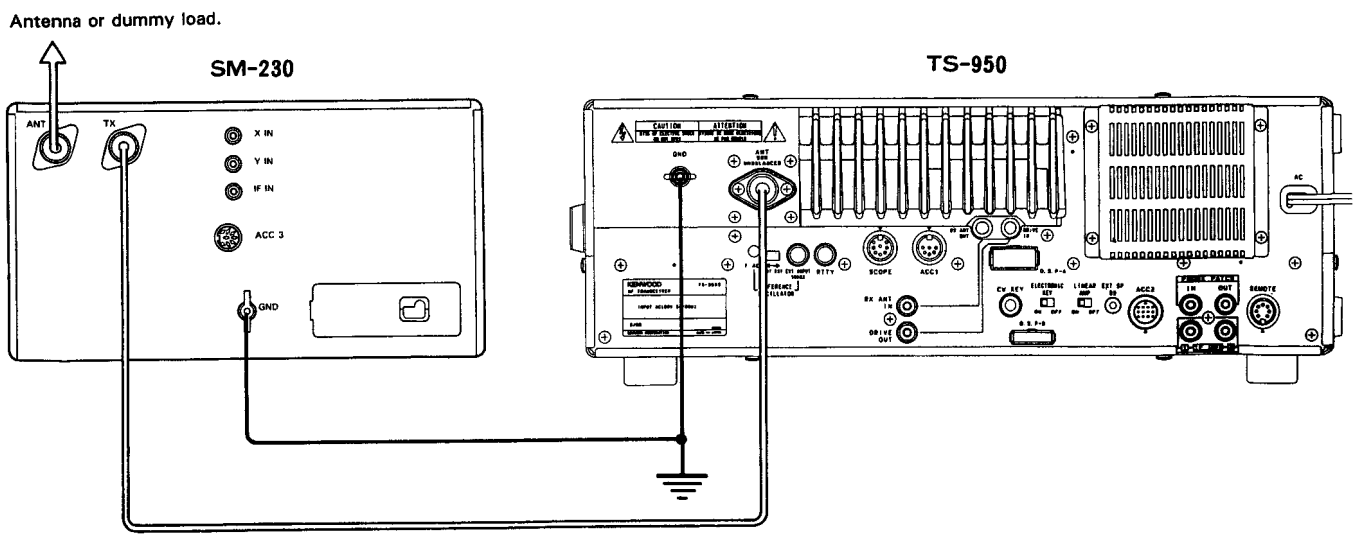


Figure 5. Hook-up of transmitting monitor

Attention:
Be sure that the transceiver GND and the monitor GND are connected over as short a distance as possible.

5. DIRECTIONS FOR USE

5-3-2. Initial Setup

When using for the first time, observation can be conducted immediately if the controls are set as follows:

Function	MONI
RF ATT	MAX
▲▼	Center
◄►	Center
SWEEP RANGE	10 ~ 100 Hz
H. VARIABLE	Center
FOCUS	Center
INTENSITY	Center

Table 3

Note that when operating in the MONITOR mode, the following controls do not operate:

V. ATT
V. VARI.
GND switch
AC/DC switch

5-3-3. Observation of Transmitted Waveforms

Set the controls of the SM-230 as shown in Table 1. Adjust the transciever to the best possible settings for transmission and hook up the microphone. If the unit is set to transmit and sounds are spoken into the microphone, wave forms will appear on the SM-230's CRT.
If the waveforms do not appear, adjust the ◄► and ▲▼ knobs so that the waveforms come to the center of the CRT. Next, adjust the INTENSITY of the trace as needed and adjust the FOCUS so as to produce an easily-viewed image. Adjust the RF ATT, SWEEP RANGE, and H. VARI to bring the waveform to the appropriate size.

Figure 6 shows the waveform that results if the transciever is placed in the SSB mode, the SM-230's TONE generator output is input into the transceiver's MIC terminal, and a SINGLE TONE modulation is applied. (Refer to Table 3 for the knob settings, and set the TONE switch to either 1,000 Hz or 1,575 Hz.)
Figure 7 is the waveform that results when both the 1,000 Hz and 1,575 Hz of the TONE SW are both set to ON. In this case, waveforms such as Figure 10 (A) may occur, that lack the constrictions. This indicates that the balance has deteriorated slightly, due to factors such as the value of the transciever's IF crystal filter or the frequency characteristic of the MIC AMP.
Adjust the TWO-TONE balance knob to obtain a normal waveform as shown in Figure 10 (B). Perform the adjustment in either the LSB or USB mode, whichever one is used more frequently.
The amplitude of the TWO-TONE signal can be adjusted using the TWO-TONE output voltage adjustment knob located on the side panel of the SM-230.
Figure 9 shows representative waveforms that result from speaking into a microphone connected up to the transceiver.
Figure 9 shows waveforms resulting from hooking a key up to the receiver and keying in the CW mode.

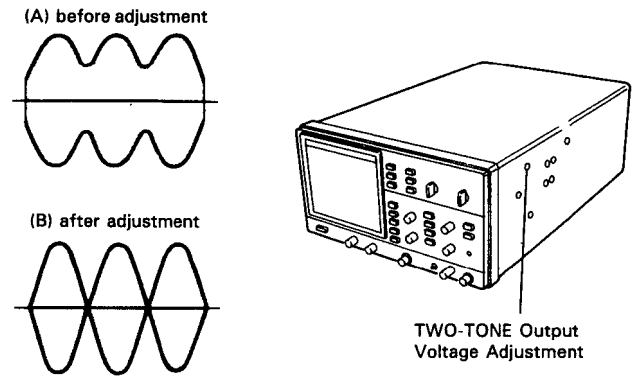
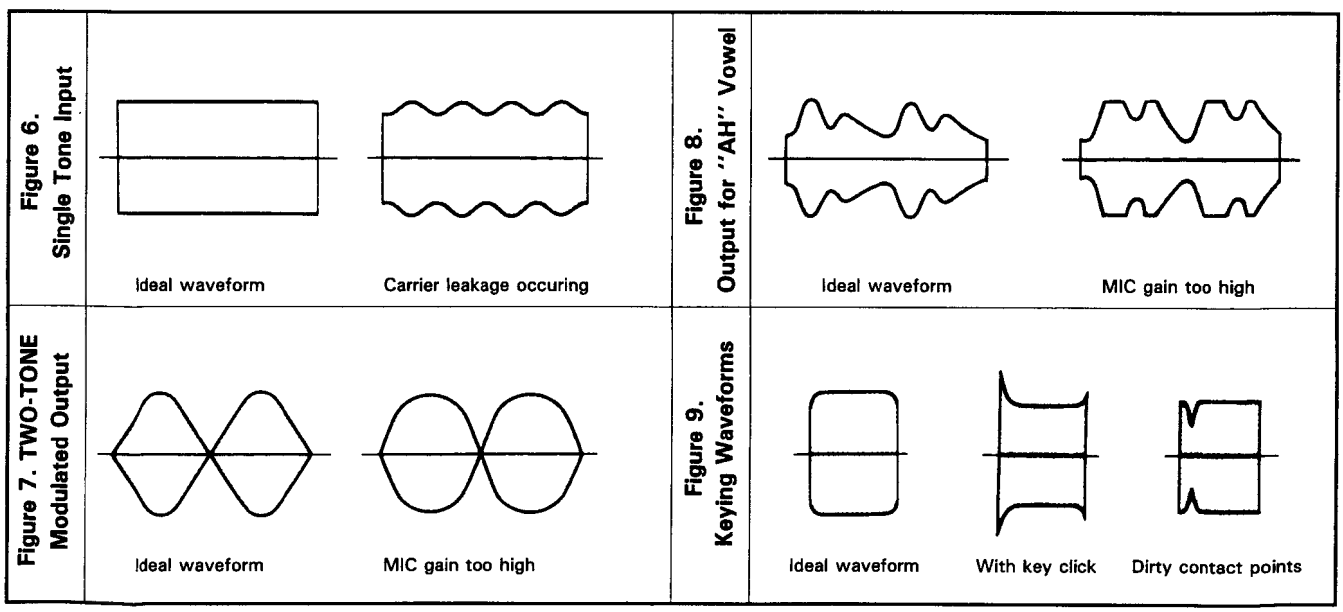


Figure 10. Two-Tone Generator Wavforms



5. DIRECTIONS FOR USE

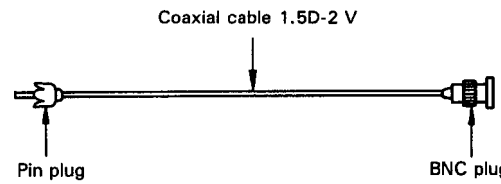
Caution:
When inputting 2 kW_{PEP} transmission signals, RF ATT should be turned to maximum and transmission time should be limited to less than 5 minutes.
In the case of high-amplitude inputs, signals should be input after setting RF ATT to maximum, and care should be taken that the input does not exceed an amplitude of 8 div on the screen.
Internal parts of the unit may undergo deterioration power is applied in excess of the rated values. Take particular care as damage of this type is not covered under the warranty.

5-3-4. Observation of Received Waveforms
When observing waves received by the partner station, the connecting cord should be hooked up between the IF terminal of the TS-950 and the V. INPUT terminal of the SM-230. The controls should be set as in Table 3, with the following changes:

FUNCTION	→	OSCILLOSCOPE
V. ATT	→	1

Next, the V. VARI, SWEEP RANGE, and SWEEP VARI knobs should be adjusted to make the wave forms easy to view (see Section 5-2).

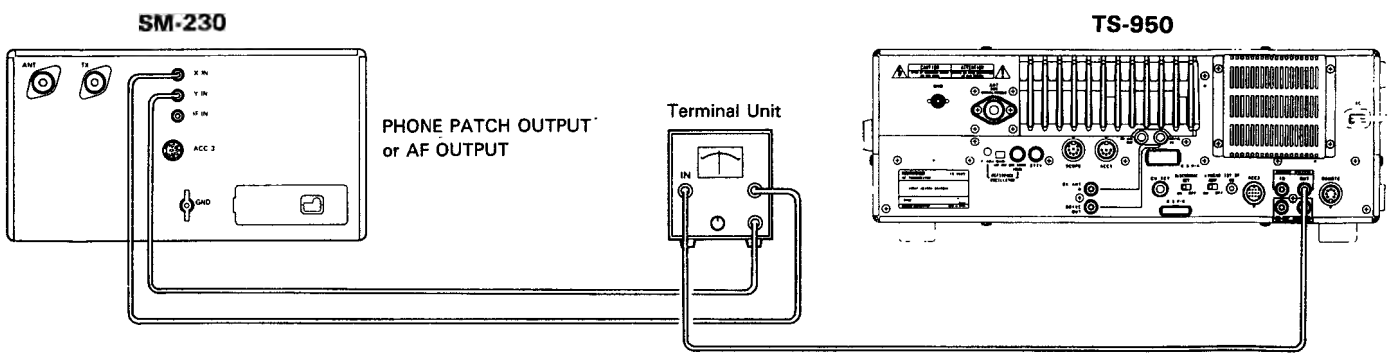
Attention:
It will be necessary to make a patch cord as shown in the diagram below.



5-4. RTTY CROSS-PATTERN FUNCTION

RTTY reception can be tuned easily by observation of the cross-patterns.

5-4-1. Hook-up
Make the hook-ups as shown in Figure 11.



Attention:
The balance adjustment of the Terminal Unit should be made so that the SPACE signal and MARK signal of the demodulator output are at the same level.

Figure 11. RTTY Cross-Pattern Hook-Up

5. DIRECTIONS FOR USE

5-4-2. Initial Setup

Manipulate the oscilliscope so as to bring the trace line up on the screen, then adjust the TRACE ROTATION so that the trace coincides with the horizontal scale line.
When using for the first time, observation can be conducted immediately if the controls are set as follows:

Function	X-TUNE
FOCUS	Center
INTENSITY	Center
TRACE ROTATION	Optimal position

Note that in the X-TUNE mode, the following do not function:

V. ATT
V. VARIABLE
▲
▼
GND switch
AC/DC switch
SWEEP RANGE
H. VARIABLE
◄►

Bring the spot to the center of the CTR using the mark position adjustment knob and the space position adjustment knob located on the side panel.

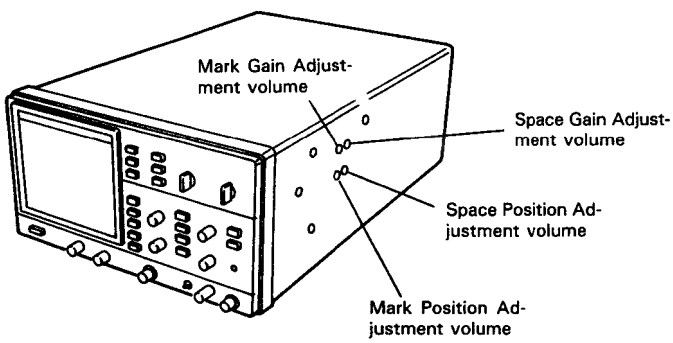


Figure 12

5-4-3. Operation

Receive the RTTY signal and bring the cross-pattern on the CRT to the appropriate size using the mark gain adjustment and space gain adjustment volumes located on the side panel of the SM-230.
The position may change slightly when the gain adjustment is made. If it does, adjust once again using the position adjustment volume.
If proper tuning is obtained, a pattern similar to Figure 13a will result. Figure 13b shows the type of pattern that results when tuning is slightly off. Figure 13c shows the type of pattern that results when the Q value of the terminal unit filter is low.

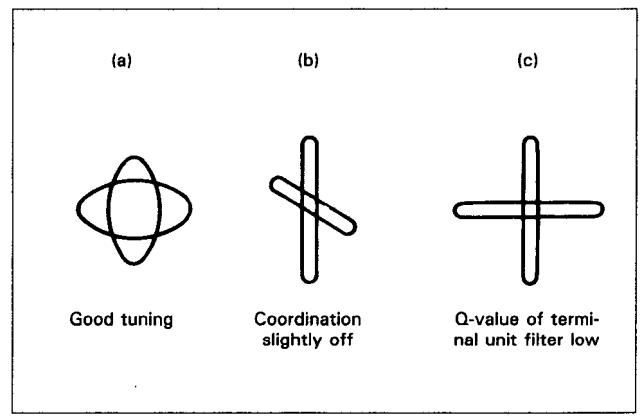


Figure 13. RTTY Cross-Pattern

6. EXPLANATION OF CIRCUITRY

6-1. EXPLANATION OF CIRCUITRY

6-1-1. Oscilloscope Portion

Signals input via the BNC pass through the AC-DC converter circuit (which is composed of relays), GND select circuit, attenuator circuit, and source follower, and are then input into the preamp. This preamp consists of a "feed forward" control configuration in which high-frequency components are amplified by transistors and low-frequency components are amplified by op amps. The resulting output is split into two signal paths for distribution to the final amp and the trigger sweep circuit. The final amp, which consists of differential amplification circuits, directs the resulting output into the Y-deflection plate of the CRT.

Signals entering the trigger sweep circuit are passed to a clamping circuit and Schmitt circuit for waveform shaping and divided into two paths. One is input as a clock signal for the sweep gate flip-flop, and the other is sent into an "auto" circuit. This auto circuit detects the presence or absence of an input signal and supplies the SET signal for the triggered sweep and the auto free-run sweep.

The trigger sweep circuit consists of components which include a sweep gate flip-flop, constant-current circuit, comparator, and hold-off circuit; it generates a sawtooth sweep voltage. The constant-current circuit determines the inclination of the sawtooth wave, that is, the sweep interval; and the comparator determines the amplitude of the wave, that is, the length of the beam trace. The hold-off circuit determines the hold-off interval. The output of this hold-off circuit is sent into the SET input of the sweep gate flip-flop as an "end-of-sweep" signal.

The output of the trigger sweep circuit is input into the final amp which is composed of differential amplification circuits. The resulting amp output is directed into the X-deflection plate of the CRT.

6-1-2. Bandscope Portion

IF signals, input from the transceiver after being first appropriately attenuated by an IF attenuator, are tuned to the 8.83 MHz band by the tuning coil and input into the mixer. The sawtooth wave output explained in the "Oscilloscope" section is divided into two paths. One goes to the horizontal final amp; the other goes to the bandwidth-selecting attenuator (composed of analog switches), where the sawtooth amplitude is attenuated.

The attentuated sawtooth waveform is input as a bias voltage into the variable capacitor in the LC oscillation circuit to change the oscillation frequency by a scan signal width. This controlled oscillation frequency signal is mixed with the previously-mentioned input signal (IF signal). Then, the mixer output is amplified by a log amp, rectified, and then input into the vertical amplifier.

6-1-3. Monitor Portion

RF signals input via the transceiver are passed through signal-pickup resistors and condensers and into the RF attenuator. Here, the signals are further attenuated by condensers and divided into two paths. One is input into the Y-deflection plate of the CRT, and the other is passed through a detector circuit and input into the trigger sweep circuit.

The RF input is equipped with a surge absorber.

6-1-4. X-TUNE Portion

MARK signals and SPACE signals input from the RTTY demodulator are condenser-coupled, and are then input into an amplifier which is composed of op amps. The unit is configured with analog switches in such a way that the resulting output is directed to the final amp only during operation in the X-TUNE mode.

6-1-5. TWO-TONE Portion

This portion is constructed using a Wien Bridge oscillator circuit and is temperature compensated. It thereby produces high-stability signals.

6-1-6. Power Supply Circuitry

The stabilized power source outputs voltages of +5 V, ±10 V, and +140 V. The circuitry, constructed entirely of op amps and control transistors, creates the +140 V output from an unregulated 170 V, the ±10 V from an unregulated 13 V, and the +5 V from the regulated +10 V. For the ±10 V and +140 V outputs, bleeder resistors are connected between the emitter and collector of the transistors to reduce the power consumption of the control transistors.

The high voltage circuit consists of components which include a transformer, a high-voltage block using a voltage doubler rectifier connection, oscillating transistors, and control op amps; it therefore provides extremely high stability. In this case, it produces an output of 1.8 V.

6-2. UNIT STRUCTURE

The main units making up the SM-230 include the vertical power supply unit, the horizontal unit, and the panel unit.

6-2-1. Vertical Power Supply Unit (X73-1870-00)

This unit includes the AC-DC converter circuit used by the oscilloscope, the GND selector circuit, the attenuator circuit, the vertical preamp, and the power supply circuit.

6-2-2. Horizontal Unit (X74-1510-00)

This unit includes the trigger sweep circuit, the vertical final amp, the horizontal final amp, the X-TUNE amp, the band scope oscillator circuit, the log amp, and the TWO-TONE oscillator circuit.

6-2-3. Panel Unit (X69-1160-00)

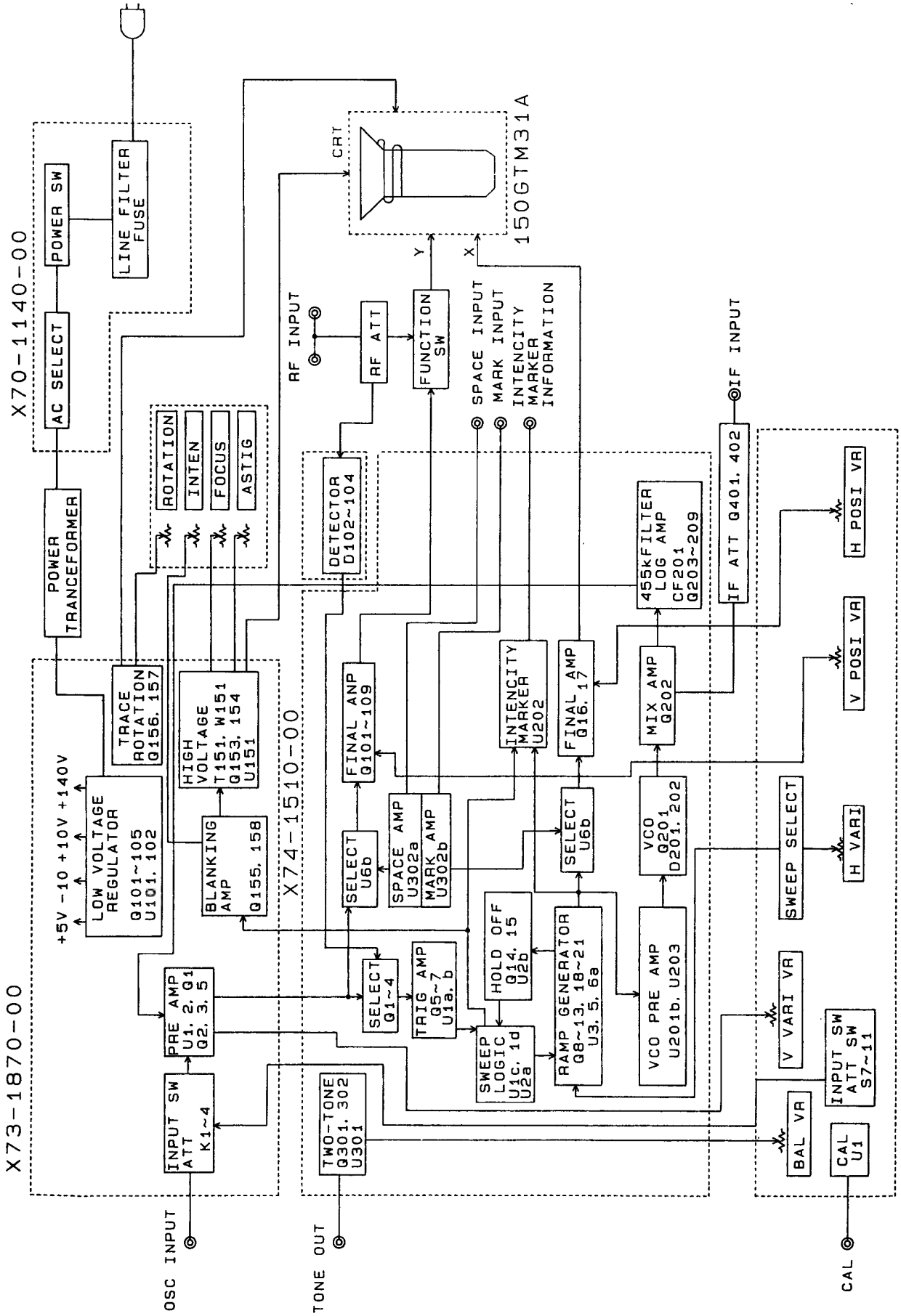
This is the unit to which the panel switches are directly attached, and it transmits information from the switches directly to the vertical power supply unit and horizontal unit. It also includes the CAL circuit.

6-2-4. Monitor Input Unit (X69-1160-00)

This unit includes the RF pickup resistors, condenser, detector, and surge absorber.

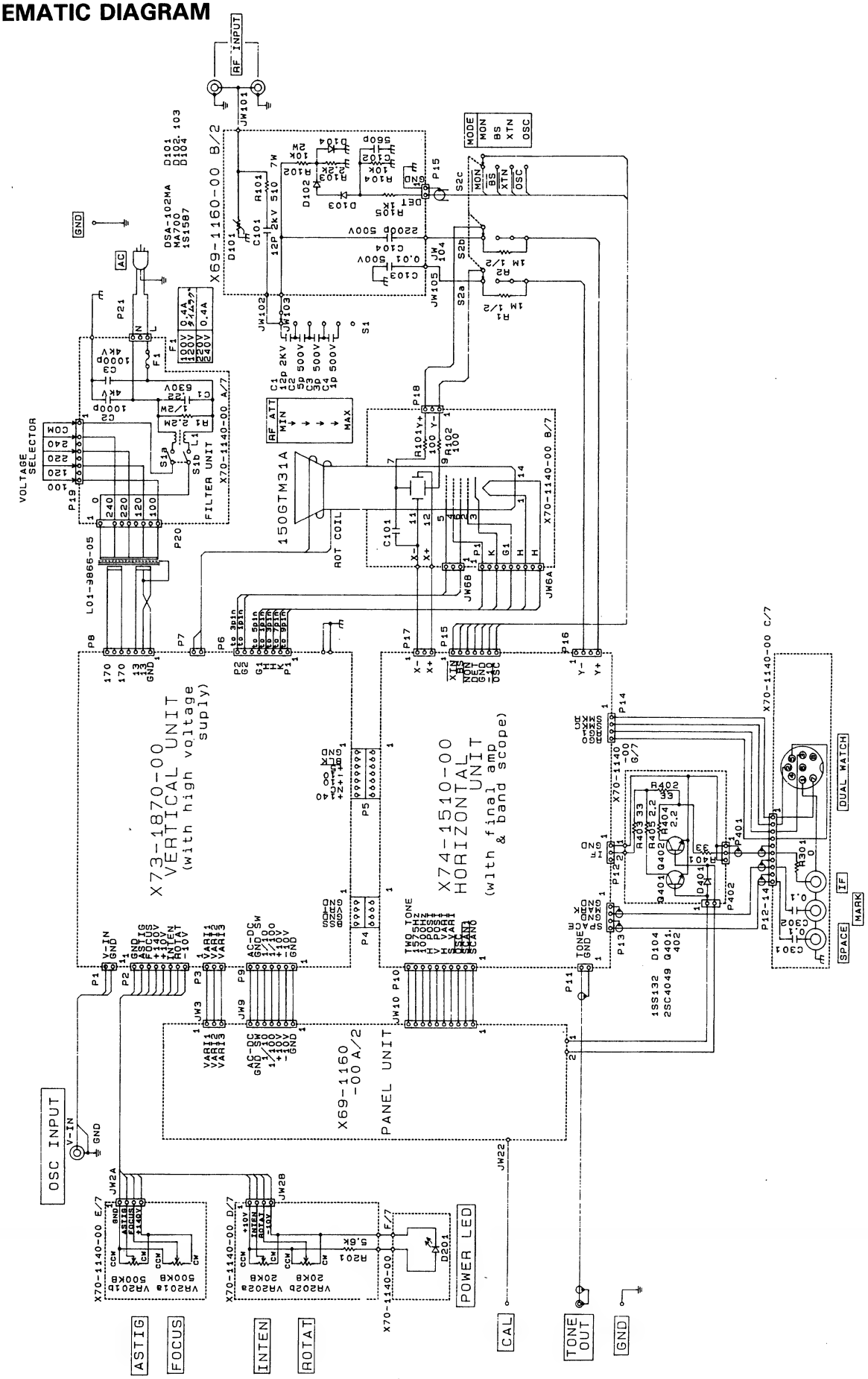
6. EXPLANATION OF CIRCUITRY

6-3. BLOCK DIAGRAM



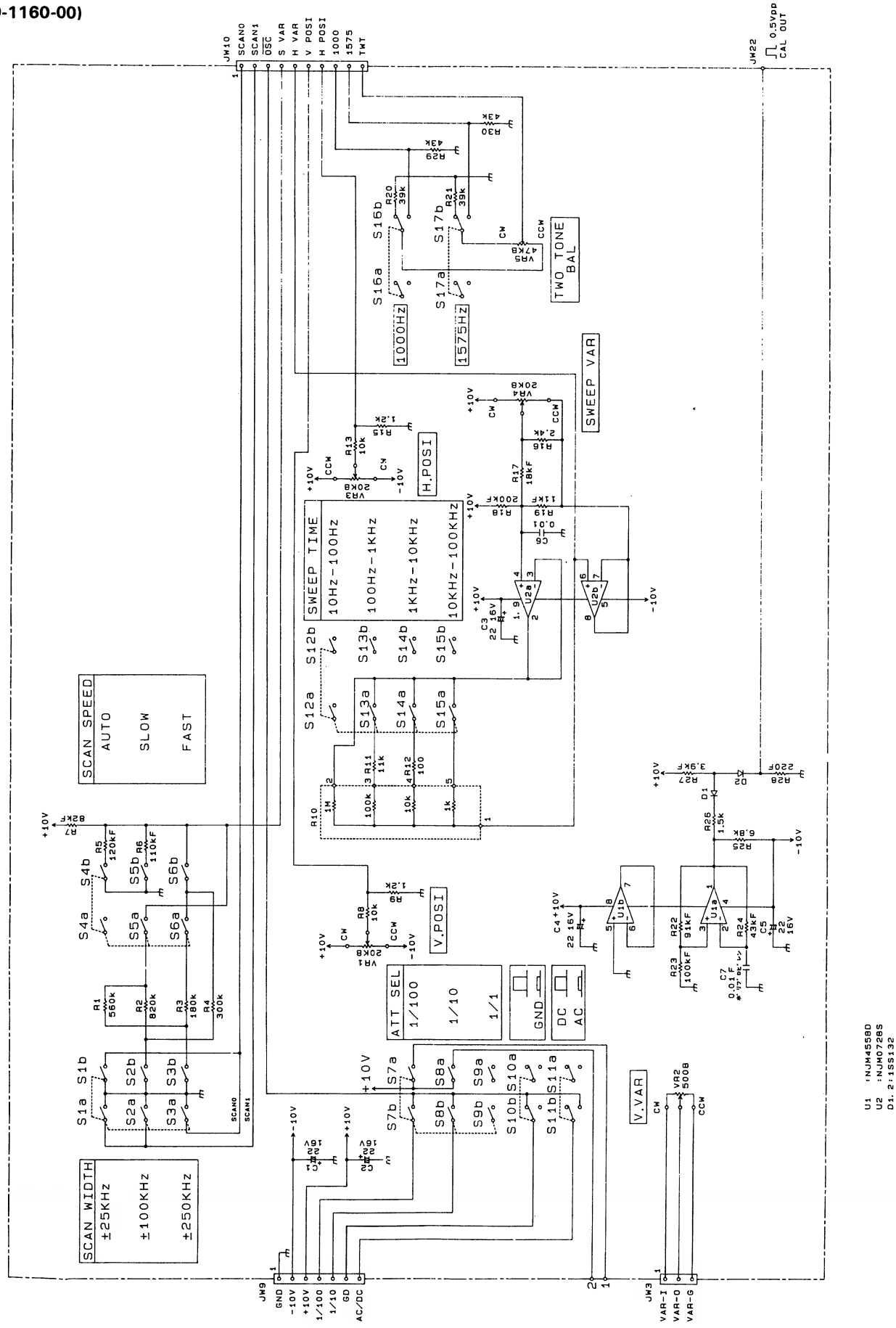
6. EXPLANATION OF CIRCUITRY

6-4. SCHEMATIC DIAGRAM



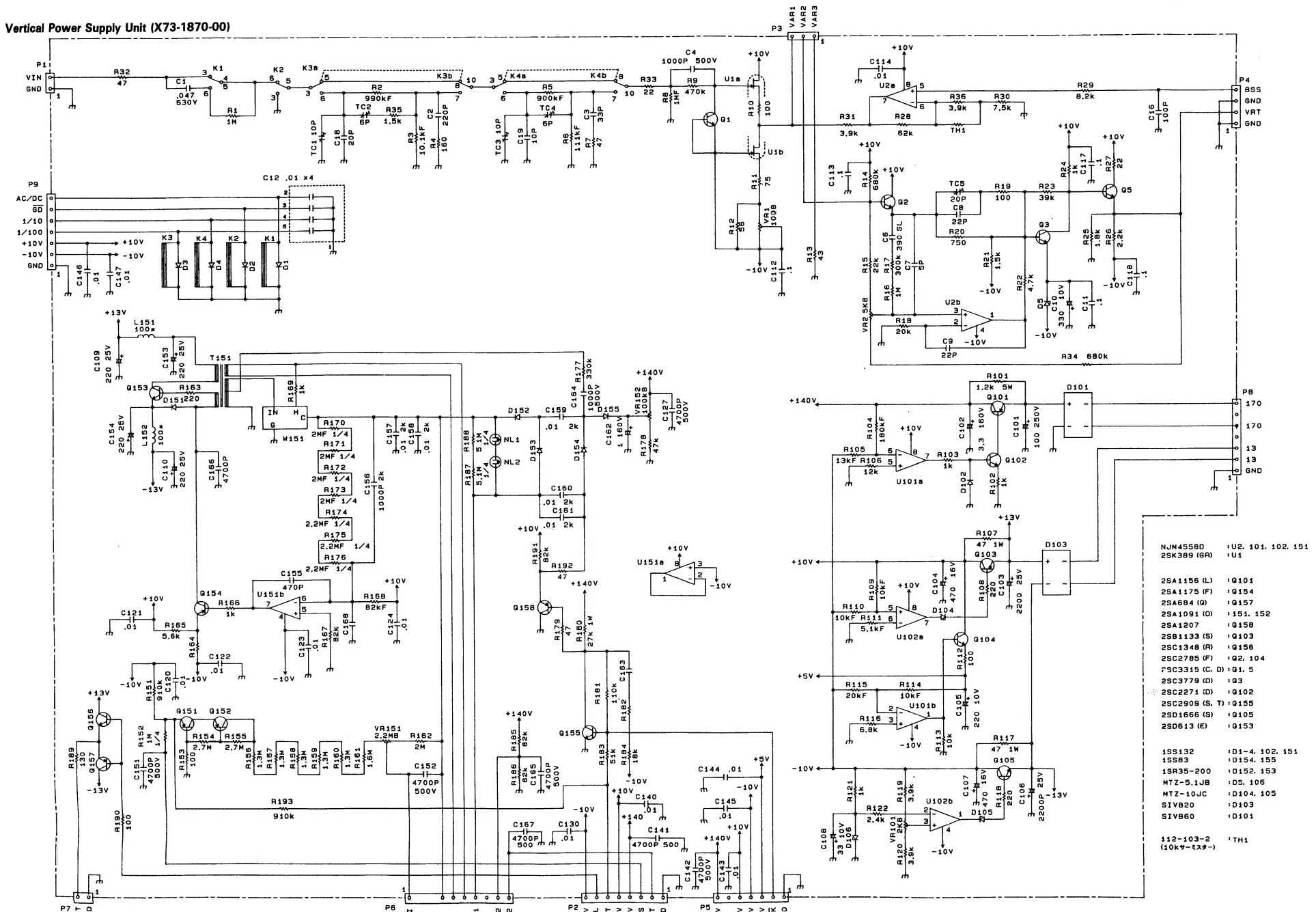
6. EXPLANATION OF CIRCUITRY

Panel Unit
(X69-1160-00)

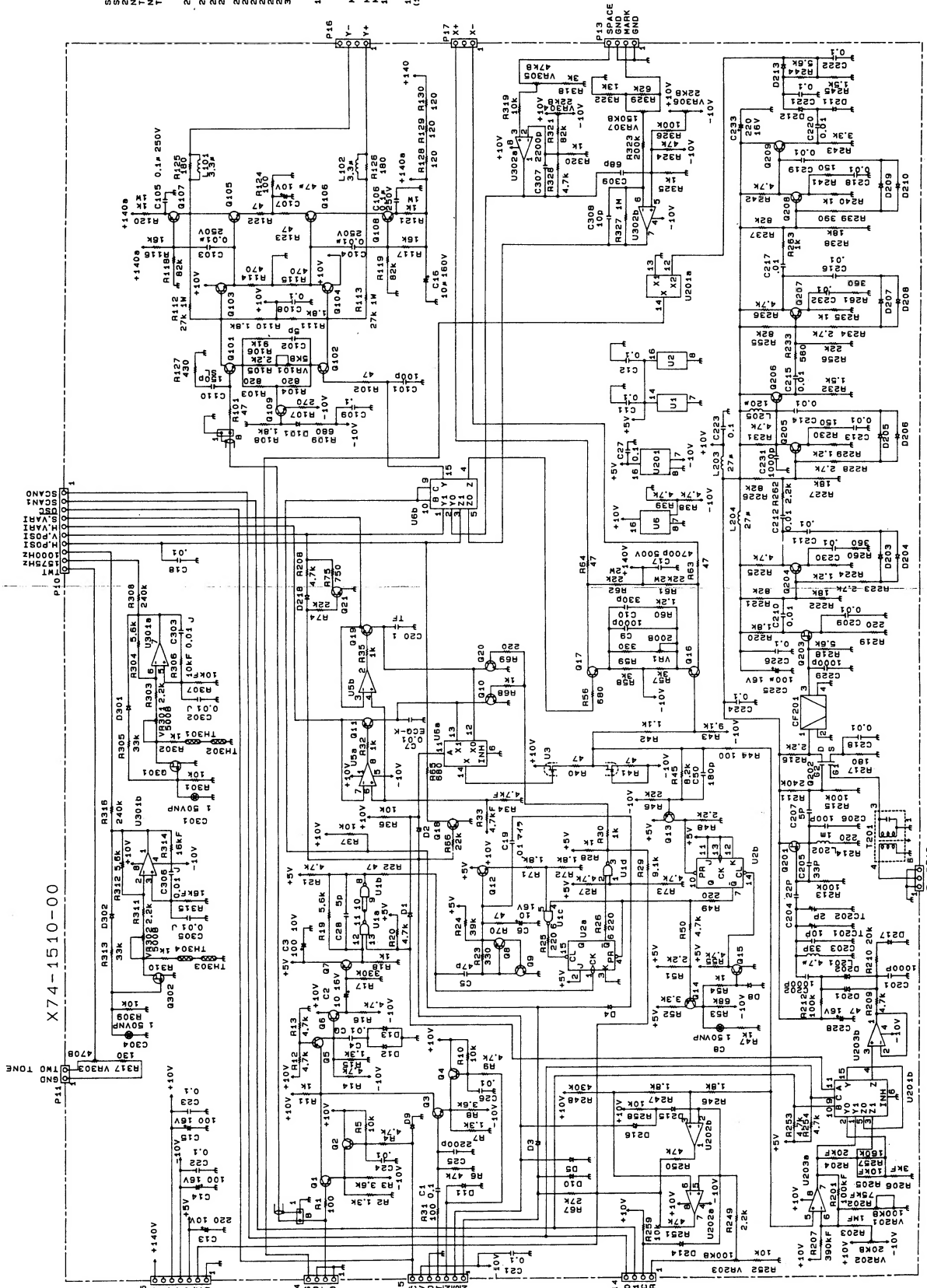


6. EXPLANATION OF CIRCUITRY

Vertical Power Supply Unit (X73-1870-00)



6. EXPLANATION OF CIRCUITRY



Vertical Unit (X74-1510-00)

7. MAINTENANCE AND ADJUSTMENT

7-1. AFTER-SERVICE

1. Warranty - Fill in the designated information on the warranty form (e.g., place and date of purchase), confirm the contents of the warranty, and put the warranty form in a safe place.
2. Warranty period - The warranty period lasts for 1 year from the date of purchase. If the unit should malfunction under conditions of normal use during this period, please bring the unit, together with your warranty form, back to the place of purchase or to a KENWOOD service center. The unit will be prepared according to the specifications on the warranty.
3. For repairs required after expiration of the warranty period, please contact the place of purchase or a KENWOOD service center. If function can be restored by repair the unit will be repaired at a charge, as requested by the customer.
4. Concerning after-service, please do not hesitate to contact the place of purchase or a KENWOOD service center regarding any points that are unclear.

7-2. CLEANING AND CARE

If the front panel or casing become soiled, wipe it with a dry silicone cloth or other other soft cloth.

Attention:
Do not use paint thinners, benzene, alcohol, or other solvents as they may cause discoloration or deformation.

7-3. BEFORE DECIDING IT'S A BREAKDOWN...

The symptoms listed in the following chart may NOT be indicative of malfunction. Try correcting them as described in the chart below and, if trouble persists, please contact a KENWOOD service center.

Problem	Cause	Remedy
Even when POWER switch is turned on, LED does not light up, and nothing appears on CRT.	1. Unit is not securely plugged into the AC outlet. 2. Fuse is burnt out.	1. Plug cord securely into outlet. 2. Call service center for fuse replacement.
POWER LED is lit up, but nothing appears on CRT.	1. INTENSITY knob is turned too far down. 2. ▲▼ knob is turned all the way to one extreme.	1. Turn INTENSITY knob clockwise. 2. Turn ▲▼ knob to center.
Beam trace is out of focus, OR beam trace is tilted.	1. FOCUS or ASTIG adjustment is off. 2 TRACE ROTATION adjustment is off.	1. Adjust FOCUS or ASTIG knobs as needed. 2. Adjust TRACE ROTATION knob as needed.

7. MAINTENANCE AND ADJUSTMENT

7-4. ADJUSTMENT

The items below are pre-adjusted, but the adjustment may slip with the passage of time or other factors. A simple adjustment procedure is described below.

- **DC BALANCE Adjustment**

After turning V. VARI, the trace line or the centerline of the waveform may shift up or down. This shifting can be eliminated by readjusting the DC Balance.

First of all, turn V. ATT, GND, and V.VARI as far as possible in the counterclockwise direction, and adjust ▲▼ so as to bring the trace line to the center of the CRT. Begin turning the V. GAIN knob in the clockwise direction and, if the trace line shifts, bring it back to center by using a screwdriver to gently adjust the DC BALANCE screw located on the underside of the unit.

If this procedure is repeated 2-3 times, the DC BALANCE adjustment will be achieved, and the trace line will not shift even if V. GAIN is turned.

Note:
Perform this adjustment about 15 minutes after the machine is switched ON.

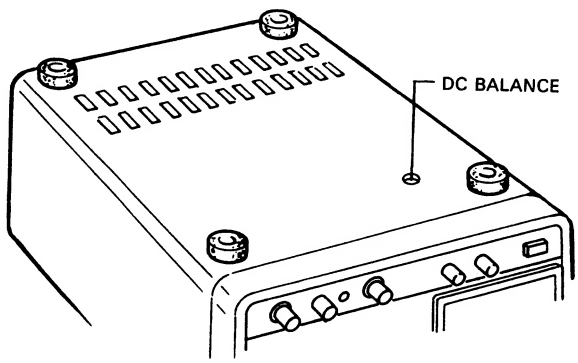


Figure 14. Adjustment hole on the bottom panel

Adjustment of certain side-panel knobs may be required, depending on usage conditions. These adjustments are explained in the respective "Operation" sections.