2 CHANNEL

SOLID STATE VOLT METER

VT-150

INSTRUCTION MANUAL

TRIO

CONTENTS

1 FEATURES

The model VT-150 is a 2-channel solid-state voltmeter with an r.m.s. scale. It provides facilities to make an accurate and stable voltage measurement from a minute voltage of 1 mV up to 300 V with frequencies of 10 Hz to 500 kHz.

The model VT-150 has an extremely high-sensitivity. So, it may also be used for measurement of the noise of power source and others, not to speak of general measurements. Further, it may be used as a high-gain amplifier.

FEATURES

** All solid-state circuitry provides minimum warm-up time and small power consumption.

** 2-pointer meter promises more effective uses of a space comparing with those provided by two sets of conventional voltmeter.

** Frequency bandwidth of 10 Hz to 500 kHz and voltage range of 1 mV to 300 V available for various uses.

** Metal-film resistor with a low temperature coefficient and less secular change employed as attenuator resistor.

** Voltage regulator circuit provided in power supply circuit.

** Voltage scale graduated in r.m.s. values of sine wave voltages, dB and dBm scales - easy means provided specifically for measurement of S/N and so on.

** Monitor output terminals provided for connection of an oscilloscope and the likes.

2 SPECIFICATIONS

VOLTMETER

Voltage range	:	1mV full scale to 300V full scale in 12 range (0.001/0.003/0.01/0.03/0.1/0.3/1/3/10 30/100/300)
dB	:	-80 to +50 dB (0 dB = 1V)
dBm	:	-80 to +52 dB (0 dB = 1mW, 600 Ω)
Accuracy	:	±3% of full scale reading (At 1 kHz)
Frequency response (Reference of 1kHz)	:	±10% from 10Hz to 500kHz ± 5% from 20Hz to 250kHz ± 3% from 20Hz to 100kHz
Input impedance	:	1M Ω shunted by 45 PF or less
Change due to power Source voltage variation	:	Within ±0.5% of full scale reading against ±10% variation of power source voltage
Temperature coefficient	:	±0.08%/°C
Operating temperature	:	-10 to +50°C
Rated Max. input voltage	:	DC component ±400V AC component 300Vr.m.s. for 0.3V range or lower 500Vr.m.s. for 1V range or higher
Channel isolation	:	80 dB or more (When each channel operated separately, with range set at 1V and one of channels input terminal short) 50 dB or more (When both channel co-operated, with range set at 1V and one of channels input terminal short)

MONITOR OUTPUT CHARACTERISTIC

Gain	:	Approx. 40 dB
Output voltage	:	Approx. 1V

4 SPECIFICATIONS

Frequency response	: Within ±2 dB from 10Hz to 500kHz (Reference of 1kHz)
Output impedance	: Approx. 600Ω
Distortion facter	: 1% or less at full scale reading (At 1kHz)
S/N	: 40 dB or more at full scale reading
POWER REQUIREMENT	: AC100V, 117V, 230V (±10%) 50/60Hz 5W MAX.
DIMENSIONS	: W140(144) × H200(225) × D235(277)mm Dimensions in ( ) are those which contain all protrusions.
WEIGHT	: 3.7Kg (7.1bs)
ACCESSORIES	: 2 test leads (CA-36) with a dual banana plug. 2 plugs with M type binding post Two 0.5A and 0.2A fuses One instruction manual

3 CIRCUIT DESCRIPTION

See the block diagram and the circuit diagram shown in page 13 .

ATTENUATOR (I)

When the 12- range selector switch is set to any range of 0.001V to 0.3V range, the output voltage of this attenuator becomes equal to the input voltage.

When the switch is set to 1V range, the input voltage is attenuated 60 dB by voltage divider resistors R101 and R103.

The frequency compensating trimmer capacitors is adjusted properly at a frequency of 100kHz.

AMPLIFIER (I)

Amplifier (I) consists of a high-input impedance circuit employing an FET(2SK15-Y). 'It, consisting mainly of Q1(2SK15-Y) and Q5(2SC458(LG)C), forms an amplifier circuit having a gain of 20 dB with a negative feedback of 13 dB provided to insure said gain. Q3(2SA562-Y) is the transistor inserted to compensate the drift of Q1 owing to variation of the temperature. While, Q7(2SC458(LG)C) is an emitter follower which connects the output of this amplifier to the second attenuator. Diodes D1 and D3(1S2075(K)) are those inserted to protect Q1.

ATTENUATOR (II)

Attenuator (II) provides facilities to divide all input voltage into approx. 0.01V for application of its output to the next stage amplifier. In other words this attenuator exerts an attenuation of up to 50 dB to the input voltages on ranges of 0.001 to 0.3V. When the 12 range selector switch is set to 1V range, the input voltage is attenuated 60 dB by the attenuator (I), so that this attenuator is connected to the circuit for 0.001V range.

AMPLIFIER (II)

The Darlington circuit comprising Q9 and Q11 receives the

output of attenuator (II) with a high impedance and delivers its output through transistor Q11 serving as an emitter follower with a low output impedance to the next amplifier stage.

This amplifier provides a gain of approx.38 dB at 1 kHz with a negative feedback of about 22 dB provided to insure said gain.

The amplifier, operating in combination with amplifier (I), forms an amplifier circuit providing an overall gain of 58 dB and an overall negative feedback of 35 dB.

RECTIFIER

The rectifier, consisting of a full-wave rectifier circuit, applies the DC voltage directly in proportion to the mean value of input voltages to the meter to deflect its pointer.

METER

The meter is a 1 mA, 2-pointer DC meter with an internal resistance of 200 Ω. It is provided with 2 magnets within a single case and gives indications equivalent to those of two sets of a voltmeter.

It has a voltage scale graduated in r.m.s. values of sine wave voltages (0 to 10 and 0 to 3) and dB and dBm scales graduated as 10 = 0 dB and 1 mW (600 Ω) = 0 dBm respectively.

POWER SUPPLY

The power supply is of the series regulator tape. It keeps the output voltage to a constant value by regulating the voltage by transistor Q1 (2SD90) under control of transistor Q2 (2SC458 C), which compares the reference voltage provided by diode D2 (wz-120) to the voltage obtained by detecting the output voltage and applies the difference voltage thus obtained to transistor Q1.

It supplies a DC voltage of 23 V as +B supply to the circuit.

4 OPERATING INSTRUCTIONS

1. OPERATING OF CONTROLS ON THE PANEL

This voltmeter is provided with the controls on the panel shown in the table below and external view.

REF. NO.	MARKING ON PANEL	DESCRIPTION
(1)	(NEON LAMP)	Neon lamp which lights when POWER switch is turned to ON.
(2)	POWER	Power ON-OFF switch Throwing this switch in the upper position turns on the set.
(3)	CH 1 & 2	Attenuator having 12 positions to provide an attenuation to the input voltage in 10 dB step. It serves as the voltage range selector switch for CH1 and CH2, when the voltmeter is set for operating CH1 and CH2 co-operated.
(4)	CH 2	Attenuator having 12 positions to provide an attenuation to the input voltage in 10 dB step. It serves as the voltage range selector switch for CH2.
(5)	INPUT 1	CH1 input terminal
(6)	INPUT 2	CH2 input terminal
(7)	GND	Grounding terminal
(8)	GND	Grounding terminal

REF. NO.	MARKING ON PANEL	DESCRIPTION
(9)	CH 2 SELECTOR	In the right- hand position of this switch it allows the CH2 attenuator (4) to select a voltage range for channel 2. In the left-hand position, the switch causes the set to operate CH1 and CH2 simultaneously and allows the CH1 & 2 attenuator (3) to select a voltage range for both CH1 and CH2.
(10)		Mechanical zero adjustment for the pointer provided for channel CH1.
(11)		Mechanical zero adjustment for the pointer provided for channel CH2.
(12)	CH 1 OUTPUT	Monitor output terminal which provided for connecting CH1 signal under measurement to an oscilloscope and others to observe the waveform.
(13)	CH 2 OUTPUT	Monitor output terminal which provided to observe CH2 signal in the same manner as CH1 OUTPUT.
(14)		Power source selector switch for AC 100, 117 or 230 V, 50 or 60 Hz.
(15)		Fuse
(16)		Power cord

2. OPERATING PROCEDURE

(1) Throw the POWER switch to the upper position ON. This causes the neon lamp to light and indicate that the AC power voltage applied to the set. Allow 5 minutes for the set to warm-up.

(2) Connect the test leads to the INPUT terminals.

(3) Set the range selector switch to position 300. Note that the input signal to be measured should be connected to this set only after the range selector switch is set to the position 300 when measuring the AC input voltage superposed on the DC voltage. If you fail to observe the above instructions, a large surge voltage is applied to this set by the DC voltage and the set may be damaged.

(4) For channel 1 input signal, use the range selector switch (CH1 & 2) as the control while reading the meter indication with the black pointer. For channel 2 input signal, use the range selector switch (CH 2) as the control while reading the meter indication with the red pointer.

(5) When the set is operated with only one channel made effective, any of channel 1 or 2 may be used.
Note, however, that the CH2 SELECTOR switch should be placed in the right-hand position when channel 2 is selected for the operation of the set.

(6) When both channels are needed to be co-operated, use the range selector switch (CH1 & 2) as the control with the CH2 SELECTOR switch placed in the left-hand position.

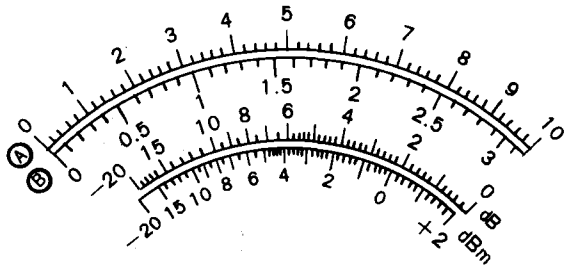
(7) Connect the test leads to the measuring point.

(8) Adjust the range selector switch until the meter deflects over 1/3 of scale.

(9) Read meter indication on an appropriate scale in accordance with the position of the range selector switch employed.

3. READING METER INDICATION

Refer to the scales shown below.



(1) VOLTAGE SCALE

The voltage scale is the black scale calibrated doubly over ranges (A) 0 ~ 10 and (B) 0 ~ 3 with the black graduations and figures.

When the range selector switch is set at position 1 V, full scale graduation 10 of scale (A) 1 ~ 10 corresponds to 1 V. If the switch is in position 300 mV, full scale graduation 3 of scale (B) 1 ~ 3 corresponds to 300 mV.

The above also applies to other ranges of the meter. In other words, the setting of the range selector switch always coinsides with the full scale graduation of meter scale whose range corresponds to the selector switch.

The reason why the meter is provided with two scales having an overlap range is to supplement scale (A) 0 ~ 10, which may offer some difficulties to you when reading the graduations of less than 3, with scale (B) 0 ~ 3 which is an enlarged scale corresponding to the range of scale (A) from 0 to 3. Therefore, read meter indication finely on scale (B) 0 ~ 3 with the range selector switch turned to the next higher range when the meter indication reads on scale (A) 0 ~ 10 falls below 3.

(2) dB SCALE

The dB scale is calibrated over a range of -20 to 0 with the read graduations and figures, of which a voltage ratio of 0 dB is corresponding to graduation 10 of scale (A).

The range selector switch has 12 ranges in 10 dB step, so that it provides an attenuation ratio of 110 dB over an entire ranges from range 1 mV to range 300 V. So, suppose that the reference (0 dB) equals 1 V on the scale (A), a meter indication provides

readings down to -60 dB (1 mV) through switching of voltage range and also further down to -20 dB by this dB scale. Thus, it follows that the meter provides facilities to continuously measure a voltage ratio (1 V ~ 0.1 mV) down to -80 dB. For larger voltage than 1 V, the meter indication provides facilities to measure a voltage ratio (1 V ~ 300 V) up to +50 dB.

(3) dBm SCALE

In general, an average-responding voltmeter has a scale calibrated with respect to the reference level (i.e. 0 dB) which corresponds to a voltage of 0.775 V generated across a 600 Ω resistance load (or a power of 1 mW). For this reason, the power level of the circuit under measurement to the reference level can be measured through the use of this dBm scale, provided that the circuit provides an impedance of pure resistance of 600 Ω.

6 CAUTION ON HANDLING THE SET

(1) In order to make specifically accurate measurement, allow about 5 minutes after switching on for the set to warm up.

(2) Refrain from installing this set in a place where extremely heavy magnetic or electric field prevails.

(3) In case leads other than test leads the supplied with the set is to be used as the input lead, use a lead having a small inter-conductor capacitance between the shielding and conductors.

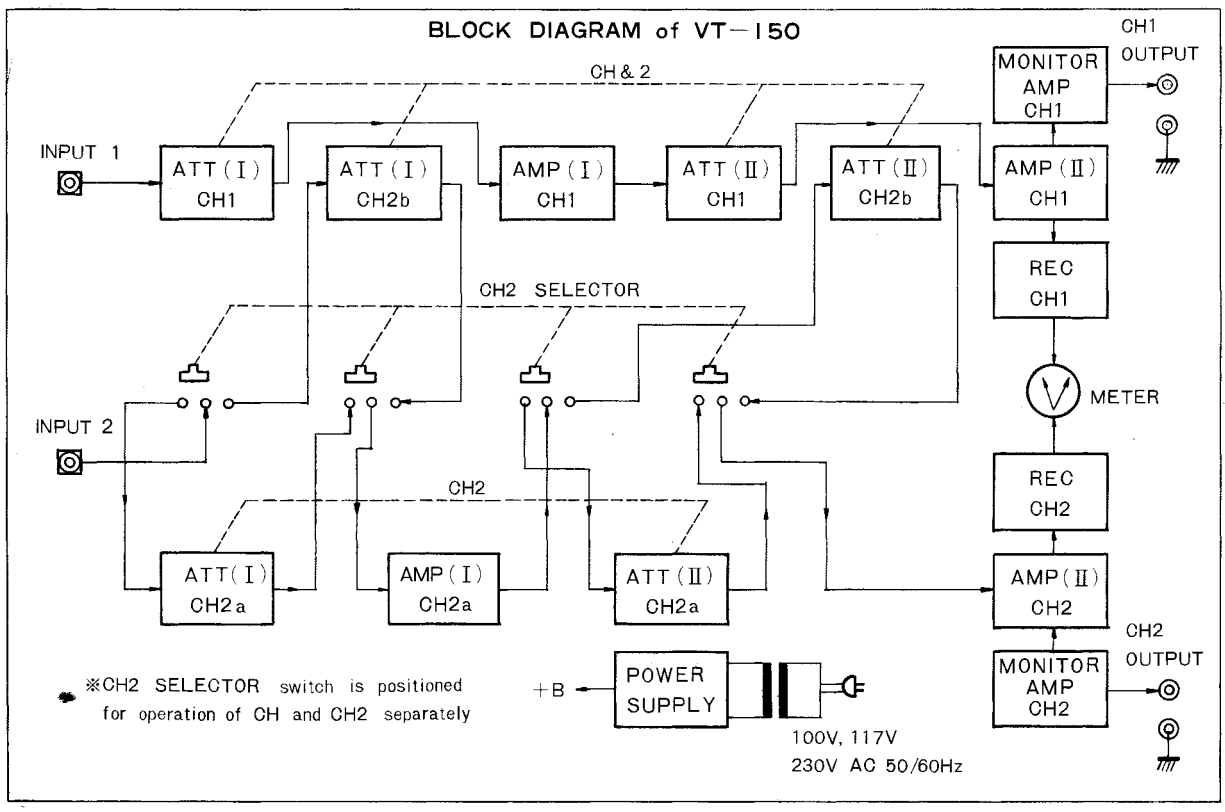
(4) This set is a high sensitivity voltmeter. So, operate the set with sufficient care paid for prevention of the noise of power source and other minute noise.

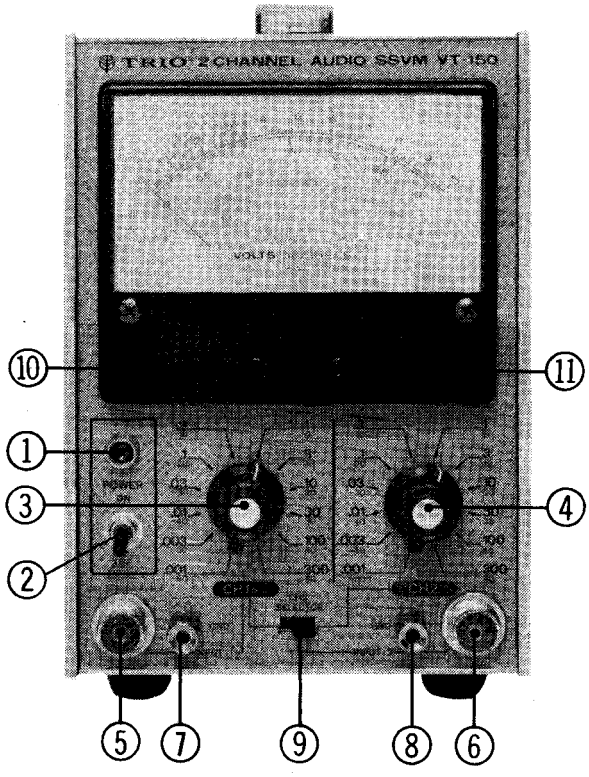
(5) Do not leave the set for many hours in a place where a high temperature or humidity prevails.

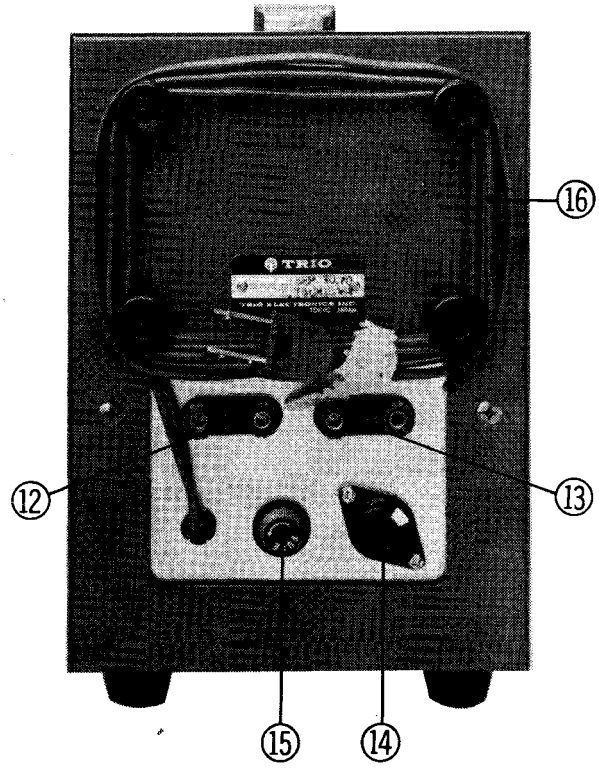
(6) This set is provided with one 0.5A (250 V) and 0.2A (250 V) fuses. Use the 0.5A (250 V) fuse when the set is to be operated from a 100 or 117 V AC. For the AC 230 V operation, use the 0.2A (250 V) fuse.

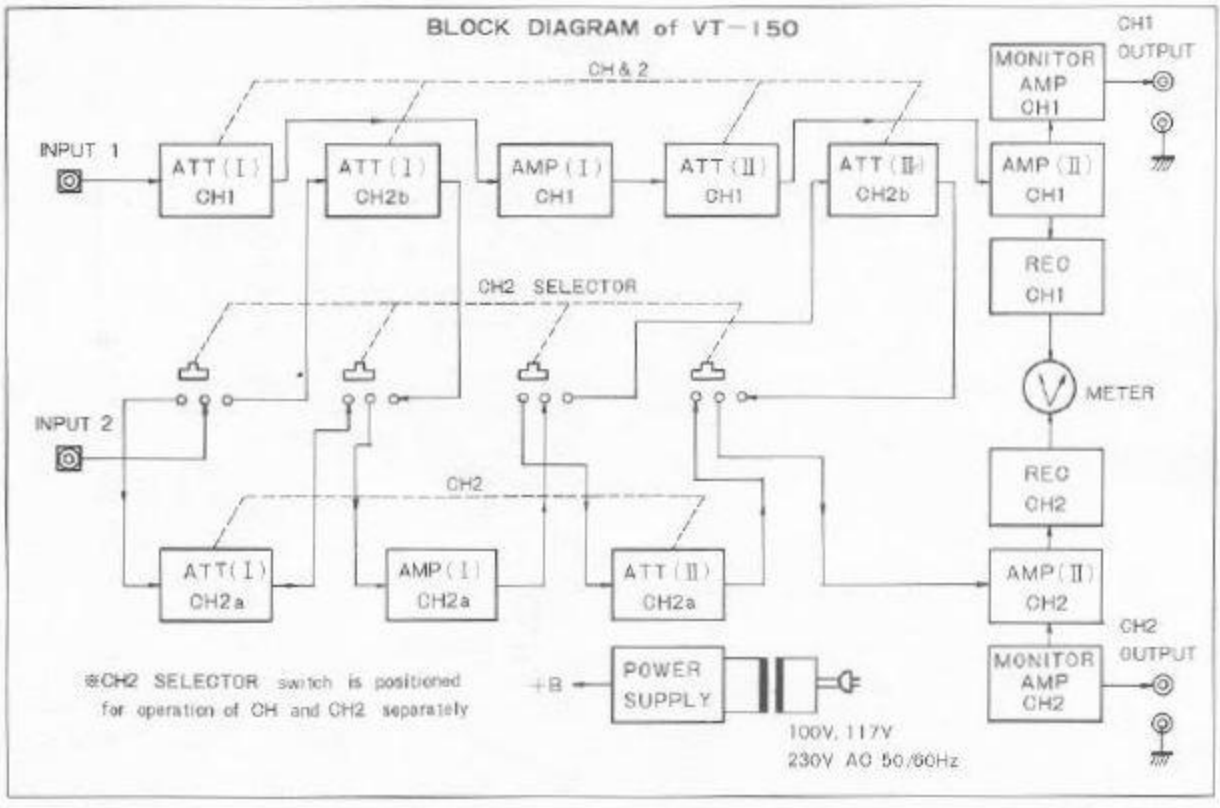
power Connection is for AC230V operation, in this circuit diagram

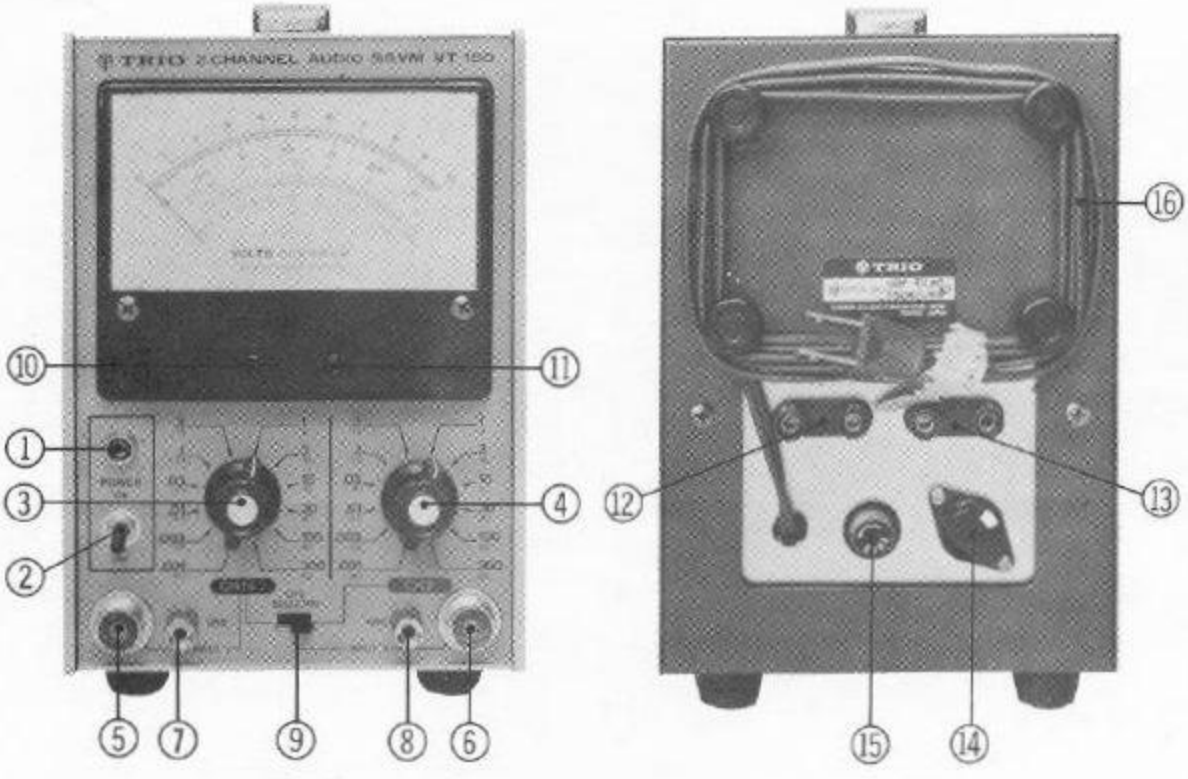
Note: Resistor with no specified value are those of 1/4W and 5%. Also, the circuit elements may be changed without notice owing to a technical innovation.








BLOCK DIAGRAM of VT-150
CH1 OUTPUT
MONITOR AMP CH1
CH & 2
INPUT 1
ATT (I) CH1
ATT (I) CH2b
AMP (I) CH1
ATT (II) CH1
ATT (III) CH2b
AMP (II) CH1
REC CH1
CH2 SELECTOR
METER
INPUT 2
REC CH2
CH2
ATT (I) CH2a
AMP (I) CH2a
ATT (II) CH2a
AMP (II) CH2
CH2 OUTPUT
MONITOR AMP CH2
※CH2 SELECTOR switch is positioned for operation of CH and CH2 separately
+B
POWER SUPPLY
100V, 117V
230V AC 50/60Hz


TRIO 2 CHANNEL AUDIO SCOPE VT-150
TRIO
10
11
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3
4
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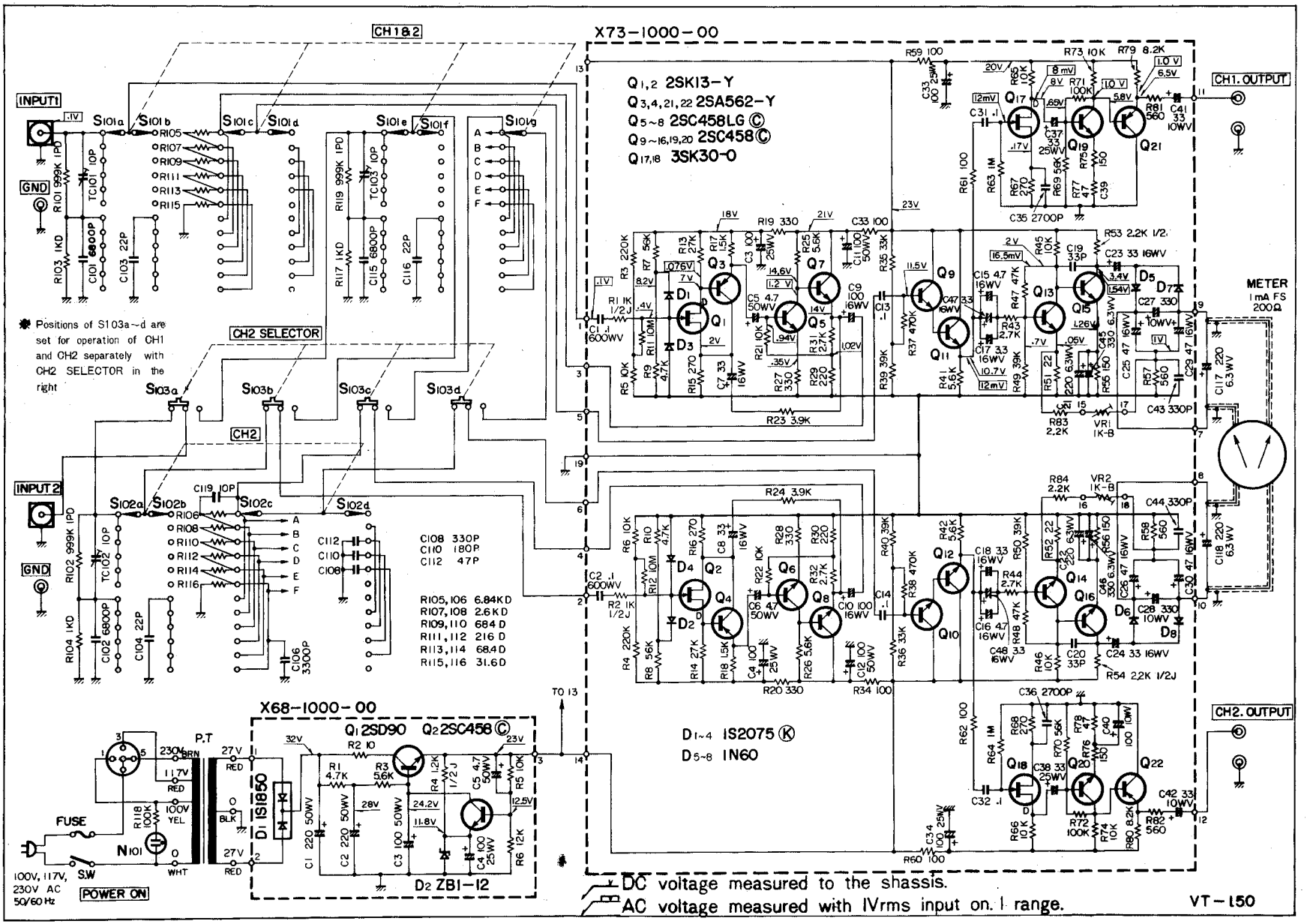
16
12
13
15
14



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