INSTRUCTION MANUAL

AC VOLTMETER

MODEL 1832A (1852C)

KIKUSUI ELECTRONICS CORPORATION, JAPAN

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1. GENERAL

Kikusui Model 1832A (1852C) AC Voltmeter is a high-sensitivity dual-pointer instrument which is capable of measuring two voltages at the same time. The meter indication is the mean value of the measured voltage. The instrument can be remote-controlled for measuring range selection, in various sequences which are selectable at the remote control device. When in the manual mode local mode , the instrument can be operated as a conventional AC voltmeter.

When in the manual operation and the black button on the range selector switch is depressed and locked, the ranges of both INPUT 1 and INPUT 2 are selected at the same time in link; when the black button is pulled out and unlocked, the ranges can be set for individual input channels. It also is possible to change the ranges of INPUT 1 and INPUT 2, maintaining a certain level difference between these two input channels.

When in the remote control operation, such functions as skipping of certain ranges also are possible in addition to those available under the manual mode.

This instrument is composed of an impedance converter, voltage attenuator, preamplifier, indicating meter circuit, output circuit, constant voltage circuit, switch circuit, switch drive circuit, and power supply circuit for each of INPUT 1 and INPUT 2 channels, mutually independently. The ground lines of the circuits can be connected to or floated from the chassis ground with the GND-mode switch.

The overall measuring range of Model 1832A Voltmeter is 0.1 mV ~ 300 V rms 《-80 ~ +52 dB》 and that of Model 1852C Voltmeter is 0.1 mV ~ 500 V rms 《-80 ~ +56 dB》. The overall range is divided into 12 ranges in 10-dB steps. The meter scale is graduated in even scale divisions in rms values of sine wave. The measurable frequency range is 10 Hz ~ 500 kHz.

Both 1832A and 1852C have OUTPUT terminals which provide AC output voltages of approximately 1 V rms for the 1832A (or 1.5 V rms for the 1852C) for the meter full-scale. As such AC output voltages available, the instrument can be used also as a monitor or a preamplifier.

The only difference between Model 1832A and Model 1852C is their measuring range. This instruction manual is sritten for the case of Model 1832A, enclosing the items different for Model 1852C in parentheses.

2. SPECIFICATIONS

Instrument name: AC Voltmeter

Model No.: 1832A (1852C)

Items enclosed in parentheses hereunder are for the 1852C.

Indicating meter: Dual pointers, two-color (three-color) scales, 1 mA/FS

Scale graduations: rms value of sine wave, dBm value referenced to 1 mW 600 Ω, dBv value referenced to 1 V as 0 dB.

Input terminals: BNC-type receptacles and GND terminals

Input resistance: 1 MΩ for all ranges

Input capacitance:

1 mV ~ 300 mV ranges (1.5 mV ~ 500 mV ranges) ..... 30 pF or less

1 V ~ 300 V ranges (1.5 V ~ 500 V ranges) ..... 20 pF or less

Maximum allowable input voltages:

1 mV ~ 300 mV ranges (1.5 mV ~ 500 mV ranges)

AC component: 150 V rms or ±200 V p-p

DC component: ±400 V

1 V ~ 300 V ranges (1.5 V ~ 500 V ranges)

AC component: 300 V (500 V) rms or ±450 V (±750 V) p-p

DC component: ±400 V

Ranges: 12 ranges

RMS scale: 1/3/10/30/100/300 mV (1.5/5/15/50/150/500 mV) and 1/3/10/30/100/300 V (1.5/5/15/50/150/500 V)

dB scale: -60/-50/-40/-30/-20/-10 and 0/10/20/30/40/50 dB

Range switching: MANUAL ⟷ REMOTE switching, on instrument panel

Accuracy: ±3% of full scale, at 1 kHz

Stability: 0.5% of full scale or better, against ±10% change of AC line voltage

Ambient temperature and humidity: 5 ~ 35°C (41 ~ 95°F), 85% RH

Temperature coefficient: 0.04%/°C TYP

Frequency characteristics:

10 Hz ~ 500 kHz ..... ±5% with respect to 1 kHz

20 Hz ~ 200 kHz ..... ±3% with respect to 1 kHz

Noise level: 2% or less of full scale, with input terminal shorted

Output terminals: BNC-type receptacles and GND terminals

Output voltage: Approx. 1 V rms (1.5 V rms) for full scale of "1.0" ("1.5") range

Distortion factor: 1.5% or less at full scale, at 1 kHz

Frequency characteristics:

10 Hz ~ 200 kHz $^{+1\ \mathrm{dB}}_{-3\ \mathrm{dB}}$, with input resistance 10 MΩ and input capacitance 30 pF connected to output terminals.

Remote-control connector: 24-pin connector, on the rear panel

Insulation resistance:	100 MΩ or over between power line and chassis, with 500 V DC
Withstanding voltage:	1000 V AC or over between power line and chassis
Power requirements:	100 V, 50/60 Hz, approx. 10 VA
External dimensions:	135W × 164H × 270D mm (5.28W × 6.46H × 10.63D in.)
Maximum dimensions:	140W × 190H × 340D mm (5.51W × 7.48H × 13.39D in.)
Weight:	Approx. 4.5 kg (10 lbs.)
Accessories:	Type 942A Terminal Adaptors ..... 2 Instruction manual 1

3. OPERATION METHOD

3.1 Explanation of Front and Rear Panels

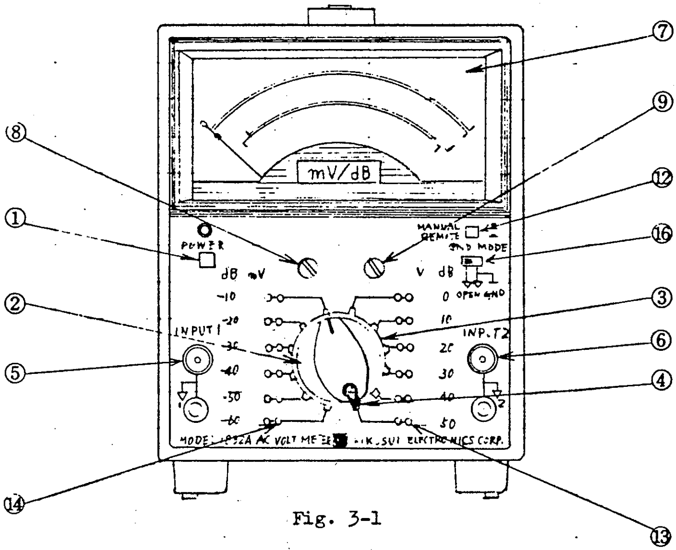


Fig. 3-1

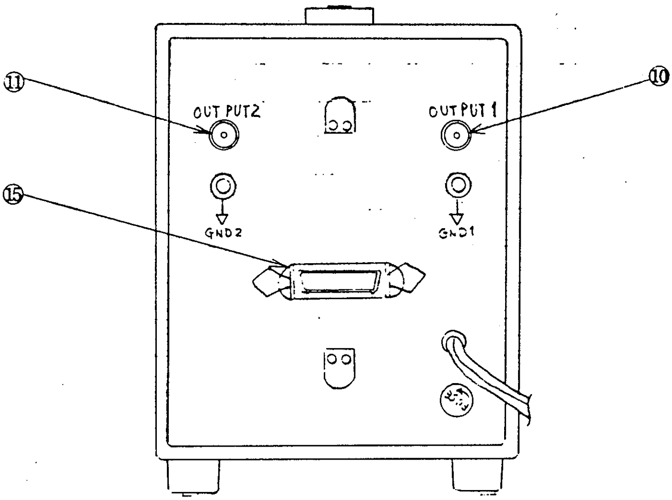


Fig. 3-2

① POWER switch:

Pushbutton switch for AC main power. Depressed and locked state is for ON; pushed again and popped up state is for OFF. The indicating meter may fluctuate irregularly for some 15 seconds after turning-ON the power. This is only transiential and not an abnormal sign of the instrument.

② INPUT 1 range switch:

③ INPUT 2 range switch:

Located concentrically in the center of front panel, the inner arrow-shape knob for INPUT 1 and the outer round knob for INPUT 2. Have 12 ranges covering 1 mV ~ 300 V (1.5 mV ~ 500 V) as turned clockwise. Left-hand figures are for mV; right-hand figures for V. Blue figures are for dB.

④ Range switch LOCK button:

Red button on inner range switch. When depressed and locked, ranges of INPUT 1 and INPUT 2 can be switched in gang. When releases, ranges can be switched individually.

5 INPUT 1 terminals:

6 INPUT 2 terminals:

Accept voltages to be measured. Consist of BNC-type receptacles and GND terminals. Connections can be conveniently made with BNC-type.

Connection can be made also with a banana plug for to the center conductor of the receptacle. When "Kikusui 942A Terminal Adaptor" is inserted, connection can be made with a banana plug, spade lug, alligator clip, 2-mm (0.079 in.) tip or a wire of smaller than 2 mm (0.079 in.) as is the case for the GND terminal.

The outer conductor of the receptacle and the GND terminal are connected to or floated from the meter panel and chassis with the GND-mode switch.

7 Indicating meter:

The indicating meter is a dual-pointer type -- the black pointer for INPUT 1 and the red pointer for INPUT 2. It has four scales as follows:

1) "1.0" scale ("1.5" scale)

For 1/10/100 mV and 1/10/100 V (1.5/15/150 mV and 1.5/15/150 V) ranges. The "1.0" scale when set at 1 mV range denotes 1 mV; when set at 100 V range, it denotes 100 V. (The "1.5" scale when set at 1.5 mV range denotes 1.5 mV; when set at 150 V range, it denotes 150 V.)

2) "3" scale ("50" scale)

For 3/30/300 mV and 3/30/300 V (5/50/500 mV and 5/50/500 V) ranges. The scale values denote in a similar fashion as those of the "1.0" ("1.5") scale.

3) "dBv" scale

Indicates in terms of dBv value referenced to 1 V. The same scale is used for the 12 ranges of -60 to +50 dBv.

4) "dBm" scale

Indicates in terms of "dBm" value referenced to 1 mW, 600 Ω. The same scale is used for the 12 ranges of -60 to +50 dBm.

(8), (9) Zero adjustments:

(8) is marked black and is for mechanical zero adjustment of the INPUT 1 pointer black . (9) is marked red and is for mechanical zero adjustment of the INPUT 2 pointer red .

(10), (11) OUTPUT terminals:

Provide output signals of the instrument -- (10) for INPUT 1 channel output signal and (11) for INPUT 2 channel output signal. These terminals are located on the rear panel and are used for monitoring the signals or for employing the instrument as an amplifier.

The black terminals are at the ground potential.

Connections can be made, as is the case for Kikusui type 942A Terminal Adaptor, with a banana plug, spade plug, alligator clip, 2-mm (0.079 in.) chip, or leadwire of a conductor diameter of 2 mm (0.079 in.) or less. Connections can be made most conveniently with standard dipole banana plugs connected to a coaxial cable.

(12) Range switch mode selector switch:

Selects the range switch mode between MANUAL and REMOTE. The popped up state of the button is for MANUAL local , and the ranges can be selected with switches 2, 3 and 4 on the instrument front panel.

The depressed and locked state of the button is for REMOTE. The LED lamps 13 and 14 turn ON and range switching can be controlled with a remote control device connected to terminal 15.

When in the MANUAL mode, the remote control is ineffective; when in the REMOTE mode, ranges cannot be switched with switches 2, 3 and 4 on the instrument front panel.

13, 14 Range lamps:

These lamps indicate range positions when in the REMOTE operation. The outer green LED lamps 13 are for INPUT 1, the inner red LED lamps 14 are for INPUT 2.

These lamps do not turn ON when in the MANUAL operation or, even when in the REMOTE operation unless the remote control device is connected.

15 REMOTE connector:

A 24-pin connector for REMOTE range switching operation. Use a mating 24-pin connector for external connections. For pin numbers and other details, refer to Section 3.2.

⑯ ⚠ GND-mode switch:

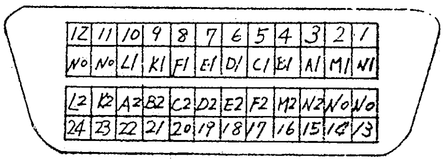
The INPUT 1 circuit and INPUT 2 circuit are mutually independent and their ground circuits are floated from the chassis, casing and panel. With this GND-mode switch, the ground circuits of the channels can be connected to or floated from the chassis ground.

When this switch is thrown to the GND position, the outer conductor of the BNC receptacles (which are ground lines of the input circuits) and the ground terminals (ground "$\triangledown_1$" of INPUT 1 and ground "$\triangledown_2$" of INPUT 2) are connected to the case ground " $\perp$ " with respective resistors of which resistances are sufficiently low as compared with the input resistances.

When this switch is thrown to the OPEN position, the ground "$\triangledown_1$" of INPUT 1 and the ground "$\triangledown_2$" of INPUT 2 are floated from the case ground " $\perp$ " and, therefore, the instrument can be used as two mutually independent voltmeters.

3.2 Remote Control Section

The layout of pins of the REMOTE terminal mounted on the instrument rear panel is shown in Fig. 3-3.



As viewed from the back; 1 ~ 24 are pin numbers. NO = Normal Open

Fig. 3-3

Pins No's. 1 ~ 10 are for INPUT 1 and No's. 15 ~ 24 are for INPUT 2.

Relationships between pins and ranges are as follows: The "L" voltage approx. -15 V is constantly delivered between L1 and L2 and the "H" voltage 0 V between K1 and K2. The range switch operation is performed using these "H" and "L" voltages. A truth table of relationships between pins and ranges is shown in Table 3-1.

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Table 3-1

Range \ Pin	A1 (A2)	B1 (B2)	C1 (C2)	D1 (D2)	E1 (E2)	F1 (F2)	M1 (M2)	N1 (N2)	K1 (K2)	L1 (L2)
1 (1.5) mV	H	L - 0	L - 0	L - 0	L - 0	L - 0	L	H - 0	H	L
3 (5) mV	L - 0	H	L - 0	L - 0	L - 0	L - 0	L	H - 0	H	L
10 (15) mV	L - 0	L - 0	H	L - 0	L - 0	L - 0	L	H - 0	H	L
30 (50) mV	L - 0	L - 0	L - 0	H	L - 0	L - 0	L	H - 0	H	L
100 (150) mV	L - 0	L - 0	L - 0	L - 0	H	L - 0	L	H - 0	H	L
300 (500) mV	L - 0	L - 0	L - 0	L - 0	L - 0	H	L	H - 0	H	L
1 (1.5) V	H	L - 0	L - 0	L - 0	L - 0	L - 0	H - 0	L	H	L
3 (5) V	L - 0	H	L - 0	L - 0	L - 0	L - 0	H - 0	L	H	L
10 (15) V	L - 0	L - 0	H	L - 0	L - 0	L - 0	H - 0	L	H	L
30 (50) V	L - 0	L - 0	L - 0	H	L - 0	L - 0	H - 0	L	H	L
100 (150) V	L - 0	L - 0	L - 0	L - 0	H	L - 0	H - 0	L	H	L
300 (500) V	L - 0	L - 0	L - 0	L - 0	L - 0	H	H - 0	L	H	L

Notes: Numerals 1 and 2 which follow the alphabet letters denote INPUT 1 and INPUT 2, respectively. The term "-O" which is used as "L-O" and "H-O" means that the pin is not required to be connected to L1, L2, K1, or K2.

K1, K2, L1, and L2 are for supplying powers to the REMOTE connector pins. Do not use them as power sources for other purposes.

Relationship between pin connections and ranges is shown in Fig. 3-4.

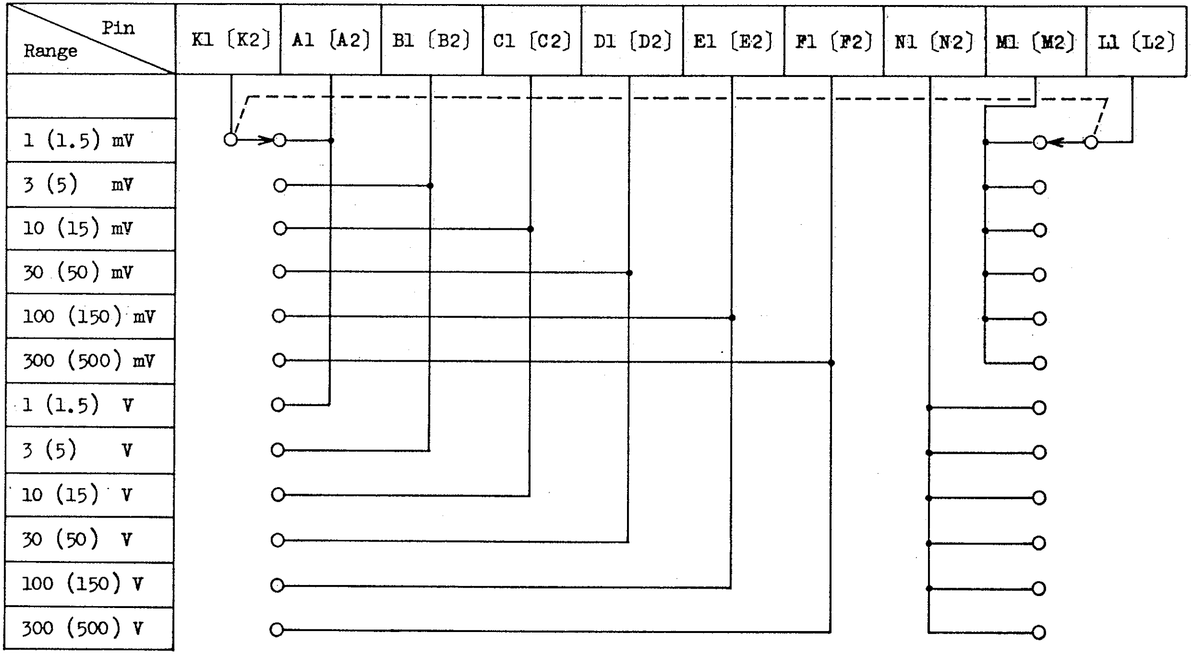


Fig.3-4

3.3 Preparations for Measurement

1) Ensure that the POWER switch is OFF.

2) Check that the pointers are indicating the zero scale position. If they are not, adjust them correctly to the zero position by means of the mechanical ZERO adjustments. If the instrument power has been ON, allow more than 5 minutes of settling time after turning OFF the instrument power and, then, perform mechanical zero adjustment.

3) Connect the power cord of the instrument to an AC line outlet of 100 V or other voltage to which the instrument has been set , 50 or 60 Hz.

4) If the REMOTE operation is required, connect the remote control device to the REMOTE connector on the instrument rear panel.

5) Set the RANGE switc hes in the 300 V (500 V) positions.

6) Turn-ON the POWER switch. The power is supplied to the instrument and the power pilot lamp above the POWER switch turns ON. For some 15 minutes after turning-ON the power, the pointers may fluctuate irregularly. The same may happen also when the power is turned OFF. These are only transiential and not an abnormal sign of the instrument.

7) When the pointers are stabilized, the instrument is ready for measurement.

3.4 AC Voltage Measurement

1) When the measured voltage level is very low or the signal source impedance is high, in order to prevent induction noise, use a shielded cable or a coaxial cable. When the measured signal level is high, the frequency is low and the output impedance is low, measurement can be done most conveniently by using the Kikusui Type 942A Terminal Adaptor supplied .

   Note: For measurement at the 1 mV (1.5 mV) range, it is recommended to use a shielded cable or a coaxial cable in order to prevent radiation noise caused by the indicating meter.

2) At first, set the range switch at the highest range in order to prevent overvoltage input. Lower the range observing the meter deflection.

3) Use the 1.0 or 3 (15 or 5) scale as required. The scale factors are as shown in Table 3-2.

Table 3-2

Range		Scale	Scale factor	Unit of measure	Gain dB
1 (1.5) mV	-60 dB	1.0 (15)	× 1 (× 0.1)	mV	60
3 (5) mV	-50 dB	3 (50)	× 1 (× 0.1)	mV	50
10 (15) mV	-40 dB	1.0 (15)	× 10 (× 1)	mV	40
30 (50) mV	-30 dB	3 (50)	× 10 (× 1)	mV	30
100 (150) mV	-20 dB	1.0 (15)	× 100 (× 10)	mV	20
300 (500) mV	-10 dB	3 (50)	× 100 (× 10)	mV	10
1 (1.5) V	0 dB	1.0 (15)	× 1 (× 0.1)	V	0
3 (5) V	10 dB	3 (50)	× 1 (× 0.1)	V	-10
10 (15) V	20 dB	1.0 (15)	× 10 (× 1)	V	-20
30 (50) V	30 dB	3 (50)	× 10 (× 1)	V	-30
100 (150) V	40 dB	1.0 (15)	× 100 (× 10)	V	-40
300 (500) V	50 dB	3 (50)	× 100 (× 10)	V	-50

4) To measure the signal in terms of dBm referenced to 1 mV, 600 Ω, use the common dB scale for all ranges and proceed as follows: The "0" position in the center of the dBm scale indicates the level of each range name. To know the level of the measured signal, add the meter reading to the level dBm of the range name.

Example 1: Assume that the range name is "30 dBm 30 V. (50 V) " and the dBm scale reading is 2. The measured signal level in this case is calculated as follows:

$$2 + 20 = 32 \text{ dBm}$$

Example 2: Assume that the range name is "-20 dBm 100 mV (150 mV) " and the dBm scale reading is 1. The measured signal level in this case is calculated as follows:

$$1 + (-20) = 1 - 20 = -19 \text{ dBm}$$

5) To measure the signal in terms of dBv referenced to 1 V, use the common dB scale for all ranges and proceed as follows: From the 1.0 (10) point of the "1.0" ("15") scale, extend an assumed pointer line to the dBv scale. The position where the assumed pointer line crosses the dBv scale is the "0" level for the range name. The signal level can be known by adding the level dBv of the range name to the scale reading.

Example: Assume that the range name is "-10 dBv , 100 mV (150 mV) " and the dBv scale reading is -20. The measured signal level in this case is calculated as follows:

$$-20 + (-10) = -20 - 10 = -30 \text{ dBv}$$

Meter reading is more accurate in a section closer to the full scale. With the above example, for instance, it is possible that, when the range switch is turned counterclockwise to the "-30 dBv, 30 mV (50 mV)" position, the dBv scale might read -2 and the level be calculated as follows:

$$-2 + (-30) = -2 - 30 = -32 \text{ dBv}$$

3.5 AC Current Measurement

An AC current can be measured by feeding the current I to be measured in a resistor of known resistance R and determining with this voltmeter the voltage drop E developed across the resistor, and using Ohm's law $I = E/R$. When measuring an AC current, take heed of the fact that the "-" side of the input terminal of this instrument is connected to the ground.

Example: Measure the heater current of a vacuum tube nominal 6.3 V, 0.3 A.

Assume that a non-inductive resistor of 0.1 Ω is used as the standard resistor R and the voltage drop across the resistor is determined to be 29 mV with this voltmeter with a measuring setup as shown in Fig. 3-5. The current is calculated using Ohm's law as follows:

$$I = \frac{29 \times 10^{-3}}{0.1} \text{ A} = 290 \times 10^{-3} \text{ A} = 290 \text{ mA}$$

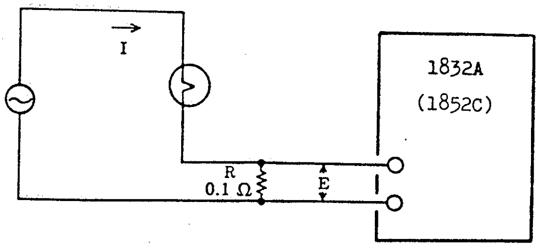


Fig. 3-5

3.6 How to Use the Amplifier

By measuring the voltage E developed across a certain impedance X , the apparent power VA in the impedance can be calculated as $VA = E^2/X$.

If the impedance X is a non-inductive resistance R , the power P consumed is calculated as $P = E^2/R$.

Since this instrument has a dBm scale, when R = 600 Ω, the power can be directly read in terms of dB. Further, by using the decibel charts of Figs. 3-6 and 3-7, the power can be known in terms of dB even when the load resistance is not 600 Ω but any other value within a range of 1 Ω ~ 10 kΩ.

3.7 Errors Caused by Waveform

This instrument is a "mean-value indicating meter" and its pointer deflects in proportion to the mean value of its input voltage, while its scale is calibrated with the rms value of sinusoidal wave. Therefore, errors can be caused by waveform distortions of the input signal. The relationship of waveform distortions vs. meter indications is shown in Table 3-3.

Table 3-3

Input signal	Rms value	Meter indication
Fundamental wave of 100% amplitude	100%	100%
100% fundamental wave + 10% 2nd hormonic	100.5%	100%
100% fundamental wave + 20% 2nd harmonic	102%	100 ~ 102%
100% fundamental wave + 50% 2nd harmonic	112%	100 ~ 110%
100% fundamental wave + 10% 3rd harmonic	100.3%	95 ~ 104%
100% fundamental wave + 20% 3rd harmonic	102%	94 ~ 108%
100% fundamental wave + 50% 3rd harmonic	112%	90 ~ 116%

3.8 Decibel Charts

1) Decibel (dB)

Decibels indicate the ratio between two powers P_1 and P_2 with the natural logarithm as follows:

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

When the impedances of the circuits where P_1 and P_2 exist are equal, decibels are used also to represent ratios in voltage or current as follows:

$$dB = 20 \log_{10} \frac{E_2}{E_1}$$

$$dB = 20 \log_{10} \frac{I_2}{I_1}$$

Though originally were for ratios in power, decibels have become to be used, since quite long ago, also for representing ratios in voltage and current.

Assume that the input voltage of an amplifier is 10 mV and the output voltage is 10 V. The gain of this amplifier is 10 V/100 mV = 1000 times. In dB value, the gain is expressed as follows:

$$\text{Gain} = 20 \log_{10} \frac{10\ \text{V}}{10\ \text{mV}} = 60\ (\text{dB})$$

The output voltage of an RF signal generator may be given in terms of dB with respect to 1 μV. An output signal voltage of 10 mV, for example, is expressed as follows:

$$10\ \text{mV} = 20 \log_{10} \frac{10\ \text{mV}}{1\ \mu\text{V}} = 80\ (\text{dB})$$

For such decibel representations, their reference levels 0 dB levels should be indicated. For the above example, indication should be as 10 mV = 80 dB (1 μV = 0 dB) where the note enclosed in the parentheses indicates the reference level.

2) dBm, dBv

Term "dBm" stands for "dB (mW)" and is used to represent power ratios referenced to 1 mW as 0 dB. This term often is used implying that the impedances of the circuits where the powers occur are 600 ohms. To be more accurate, the expression for such cases should be as "dB (mW 600Ω)".

Thus, when powers and impedances are given, ratios in voltage and current also can be expressed with dB as in power. Term "dBm" is used being referenced to the following physical quantities.

0 dBm = 1 mW or 0.775 V or 1.291 mA.

The term "dBv" represents a voltage ratio referenced to 1 V as 0 dB. This term is frequently used in autio engineering, as it provides a convenient means of ratio calculation.

Since the "dBm" scales of this instrument is graduated with dBm and dBv values defined as above, the meter reading should be converted when measurement is to be done in terms of a dBm or dBv value which is referenced to a value other than the above 0 dB value 1 mW, 600 Ω; or 1 V . Due to the nature of the logarithm, conversion calculation can be accomplished through simple addition or subtraction. The decibel charts of Figs. 3-6 and 3-7 are used for this purpose.

3) How to Use the Decibel Charts

Fig. 3-6 shows a chart for converting ratios in power, voltage or current into decibel values. Different scales are used according to whether the ratio of two powers (or equivalents) or that of two voltages or currents is to be calculated.

Example 1: What is 5 mW in dB value reference to 1 mW?

Since the ratio is in power, use the left-hand side scale. Calculate 5mW/1mW = 5 and find the dB value to be 7, following the dotted line.

Example 2: What are 50 mW and 500 mW in dB values referenced to 1 mW?

When the ratio is smaller than 0.1 or larger than 10, find figures in Fig. 3-6 and add the figures found.

50 mW = 5 mW   10 = 7 + 10 = 17 dB

500 mW = 5 mW   100 = 7 + 20 = 27 dB

Table 3-4

Ratio		Decibel	
		Powernratio	Voltage or current ratio
10,000	$= 1 \times 10^4$	40 dB	80 dB
1,000	$= 1 \times 10^3$	30 dB	60 dB
100	$= 1 \times 10^2$	20 dB	40 dB
10	$= 1 \times 10^1$	10 dB	20 dB
1	$= 1 \times 10^0$	0 dB	0 dB
0.1	$= 1 \times 10^{-1}$	-10 dB	-20 dB
0.01	$= 1 \times 10^{-2}$	-20 dB	-40 dB
0.001	$= 1 \times 10^{-3}$	-30 dB	-60 dB
0.0001	$= 1 \times 10^{-4}$	-40 dB	-80 dB

Example 3: What is 15 mV in dB(v) value?

Since referenced to 1 V, calculate at first as 15mV/1V = 0.015 and, next, calculate using the voltage and current scale as follows:

$$0.015 = 1.5 \times 0.01 = 3.5 + (-40) = -36.5 \text{ dB(v)}$$

Or, in the reverse of the above, calculate as follows:

$$1\text{V}/15\text{mV} = 66.7$$

$$66.7 = 6.67 \times 10 \rightarrow 16.5 + 20 = 36.5 \text{ dB(v)}$$

4) Decibel Addition Chart

To convert the dBm reading into a power value,use the chart of Fig. 3-7.

Example 1: Assume that the meter reading is -4.8 dBm as measured across an 8-ohm speaker voice coil. Calculate the power (apparent power, to be more accurate) fed to the coil.

Using the chart of Fig. 3-7, find the value of +18.8 for 8 ohms as indicated with the dotted line. Add this value to the meter reading to know the power expressed in terms of dB (mW, 8Ω).

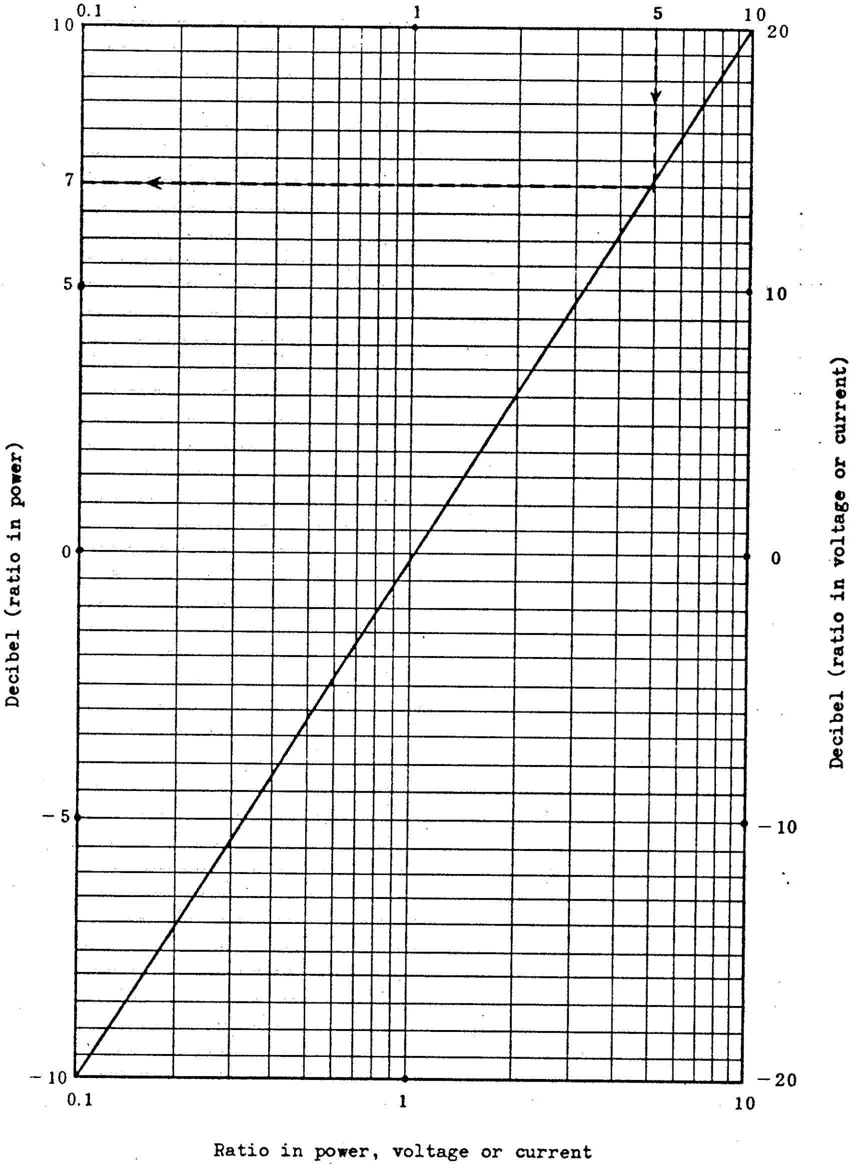
dB (mW, 8Ω) = -4.8 + 18.8 = +14

To convert 14 dB (mW, 8Ω) into a power value, use Fig. 3-6 and find the value to be 25 mW.

14 dB (mW, 8Ω) → 25 mW

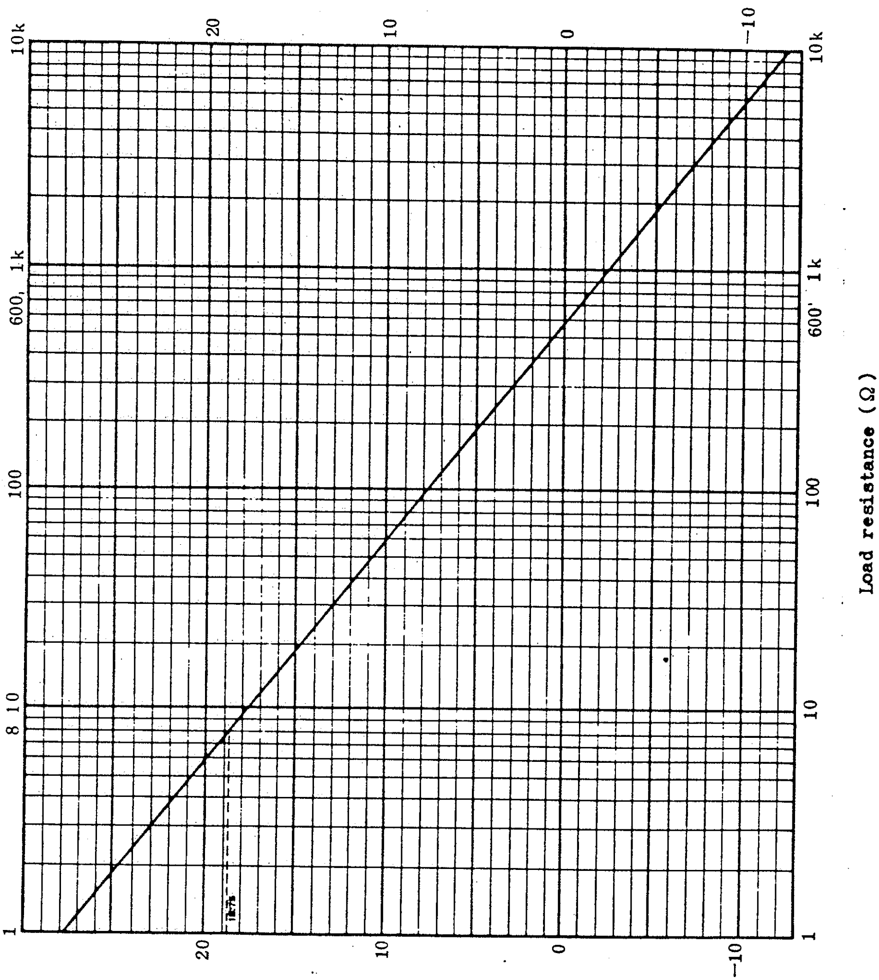
Example 2: What voltage is required to be applied to a 10 kΩ resistor to obtain a power of 1 W?

As 1 W is 1000 mW and is equivalent to 30 dB(mW), the answer can be known by calculating the voltage for 30 dB (mW, 10kΩ). Referring to Fig. 3-7, the addition calculation of 600 Ω → 10 kΩ results in -12.2 and, therefore, the meter should indicate 30 - (-12.2) = 42.2 on the dB (mW, 600Ω) scale. The voltage which causes meter indication of 42.2 - 40 = 2.2 dBm on the 40 dBm range (0 ~ 100 V 0 ~ 150 V) is the answer and this voltage can be found to be 42.2 dBm = 100 V.



Decibel conversion chart

Fig. 3-6



Added value (dB)

Decibel addition chart

Fig. 3-7

4. OPERATING PRINCIPLE

The 1832A (1852C) AC Voltmeter consists of an input section, meter drive circuit, output section, switch circuit, switch drive circuit, remote range indicator section, remote control circuit, and power supply for each of INPUT 1 and INPUT 2 channels.

When the GND-mode switch is the GND position, the ground line of each circuit is connected through a resistor to the ground line of power supply and chassis. Thus, the ground lines of INPUT 1 and INPUT 2 are mutually isolated and also floated from the ground of chassis and casing through resistors. If the GND-mode switch is the OPEN position, the ground line of each circuit is floated from the ground line of power supply and chassis.

The parts numbers not enclosed in the parentheses are for INPUT 1 and those enclosed in the parentheses are for INPUT 2.

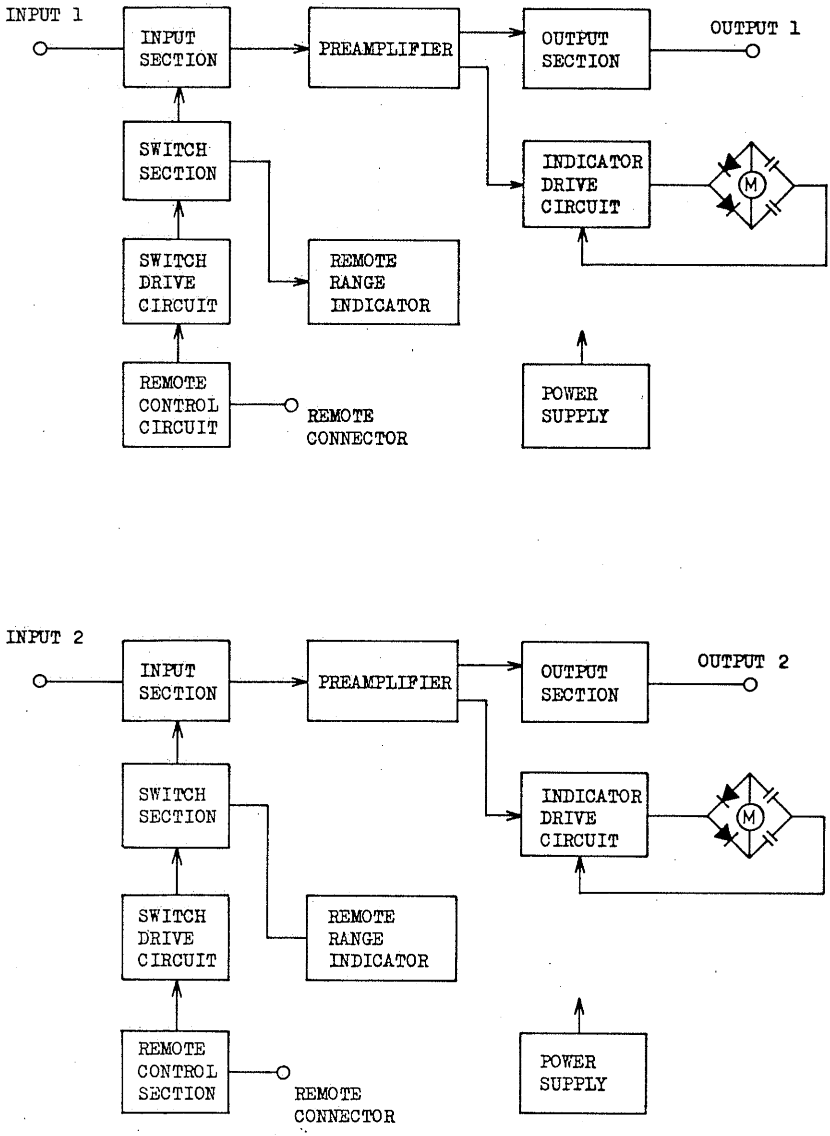

INPUT 1
INPUT SECTION
PREAMPLIFIER
OUTPUT SECTION
OUTPUT 1
SWITCH SECTION
INDICATOR DRIVE CIRCUIT
M
SWITCH DRIVE CIRCUIT
REMOTE RANGE INDICATOR
REMOTE CONTROL CIRCUIT
REMOTE CONNECTOR
POWER SUPPLY
INPUT 2
INPUT SECTION
PREAMPLIFIER
OUTPUT SECTION
OUTPUT 2
SWITCH SECTION
INDICATOR DRIVE CIRCUIT
M
SWITCH DRIVE CIRCUIT
REMOTE RANGE INDICATOR
REMOTE CONTROL SECTION
REMOTE CONNECTOR
POWER SUPPLY

Fig. 4-1

4.1 Input Section

The input section consists of a pre-stage attenuator 0/60 dB , an impedance converter,and a post-stage attenuator six 10-dB steps: 0/10/20/30/40/50 dB as shown in Fig. 4-2

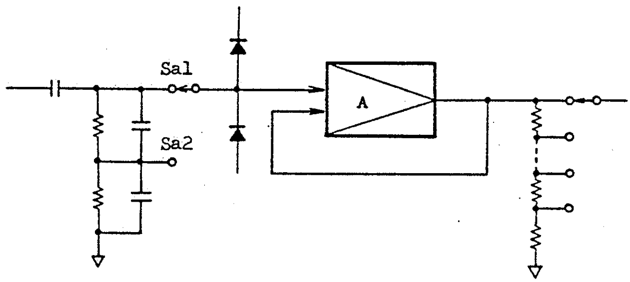


Fig. 4-2

When the RANGE switch is in one of the 1 mV ~ 300 mV (1.5 mV ~ 500 mV) positions, the input signal is fed to Sa1; when it is one of the 1 ~ 300 V (1.5 ~ 500 V) positions, the signal is fed to Sa2. The attenuated signal is fed to the impedance converter which provide a high input impedance and a low output impedance. To provide the high input impedance, the impedance converter employs FET transistors Q101 Q201 and Q102 Q202 for its initial stage. The output signal of the impedance converter is fed to the post-stage attenuator.

The post-stage attenuator divides the signal to a level of approximately 1 mV (1.5 mV).

Diodes CR101 and CR102 [CR201 and CR202] are provided in order to protect the attenuator against overvoltage input.

4.2 Preamplifier

The preamplifier is a negative feedback amplifier consisting of three transistors. It amplifies the low level signal received from the post-stage attenuator.

4.3 Meter Drive Circuit

The meter drive circuit has transistors Q505 and Q506 [Q605 and Q606]. A feedback current flows from the collector of Q506 [Q606] to the emitter of Q505 [Q605] through rectifying diodes CR501 and CR502 [CR601 and CR602]. Due to this current feedback, the diodes are driven with almost constant currents and their non-linearity is compensated for and, consequently, the meter deflection becomes linear. This principle is shown in Fig. 4-3. For the positive half-cycles of the amplifier output voltage, the current flows in the direction of a → b → c → d as indicated with the solid line; for the negative half-cycles, the current flows in the direction of d → b → c → a. The meter is driven with the mean value of these currents.

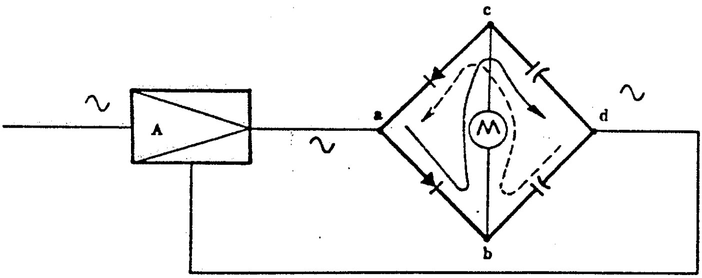


Fig. 4-3

4.4 Output Section

This section amplifies with its transistor Q504 Q604 the collector voltage of transistor Q502 Q602 of the preamplifier. The output terminal of this section provides a voltage of approximately 1 V (approximately 1.5 V) corresponding to the full scale of the "1.0" (15) scale.

4.5 Switch Section

This section has reed relays for switching of the pre-stage attenuator 0/60 dB and FET switches for switching of the post-stage attenuator 0/10/20/30/40/50 dB .

4.6 Switch Drive Circuit

This circuit has twelve transistors Q701 ~ Q712 , a rotary switch on the front panel, and a remote control switch circuit for remote range change operation .

4.7 Remote Range Indicator Section

This circuit has red LED lamps for INPUT 1 and green LED lamps for INPUT 2, which indicate on the instrument front panel the ranges selected in the remote range switching mode.

4.8 Remote Connector

This connector is mounted on the instrument rear panel, for connection between this instrument and the remote controlling device for range switching.

4.9 Power Supply

Each of the INPUT 1 and INPUT 2 channels has its own power supply which provides regulated supply voltages of +25 V, +11 V, and -15 V.

The +25 V supply voltage is produced by generating a reference voltage with zener diode CR504 [CR604], error-voltage-amplifying the supply voltage with transistor Q508 [Q608] and incorporating a series control circuit with transistor Q507 [Q607].

The +11 V supply voltage employs the reference voltage.

The -15 V supply voltage is produced with reference to the +25 V supply voltage, through error-voltage-amplification with transistor Q510 [Q610] and series regulation with transistor Q511 [Q611].

This -15 V supply is used for remote-controlled range switching. Note that the supply is designed on an assumption that switching is done with mechanical devices such as rotary switches or pushbutton switches and the supply power is not consumed by external circuits. When switching the ranges with electrical devices such as relays or solid-state switching circuits, provide supply powers externally and mutually independently for INPUT 1 and INPUT 2.

5. MAINTENANCE

5.1 Locations of Adjusting Potentiometers

Locations of adjusting potentiometers are shown in Fig. 5-1. To gain access to these potentiometers, remove the top casing cover after removing the two screws on top and four screws on sides and remove the bottom casing cover after removing the four screws at the buttom.

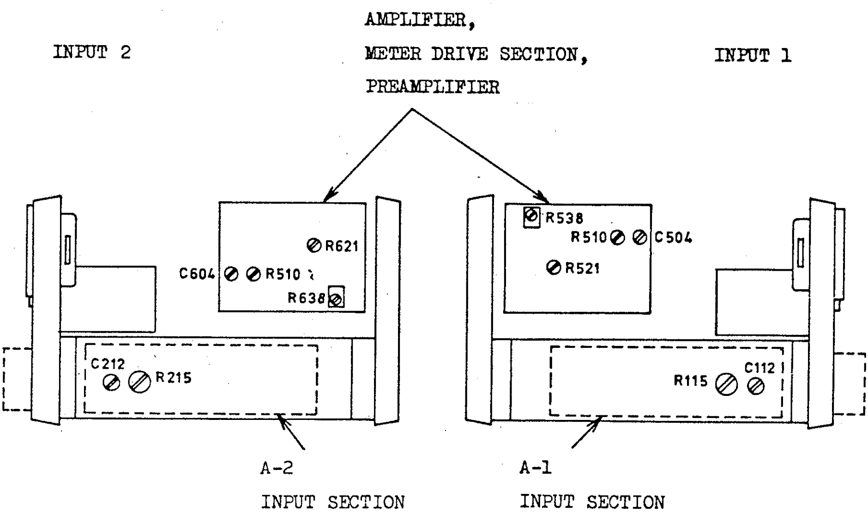


Fig. 5-1

5.2 Adjustment and Calibration

When the instrument has become not satisfying its specification after a long time of use or a repair, adjust and calibrate the instrument as explained in this section.

1) Check of regulated voltage circuit:

Connect a DC voltmeter between ground and emitter of transistor Q507 [Q607] of the power supply and so adjust potentiometer R538 [R638] that the voltmeter reads +25 V. Also check that the voltage between ground and emitter of transistor Q511 [Q611] is approximately -15 V.

2) Calibration at low and high frequency ranges preamplifier :

At first, perform mechanical zero adjustment of the indicating meter as explained in Item 3.3 2) .

Set the range switch in the 30 mV (50 mV) position, apply to the input terminal a calibrating signal of 30 mV (50 mV) of 1 kHz of sine wave of low waveform distortion, and so adjust the potentiometer R510 [R610] of the printed circuit board A-5 A-6 that the meter pointer indicates accurately the full-scale position.

Next, change the calibrating signal frequency to 500 kHz and so adjust the trimmer capacitor C504 [C604] that the pointer indicates accurately the full-scale position.

3) Adjustment of pre-stage attenuator:

Set the range switch in the 1 V (1.5 V) position, apply to the input terminal a calibrating signal of 1 V (1.5 V) 1 kHz, and so adjust the potentiometer R115 [R215] of the attenuator that the meter pointer indicates accurately the full-scale position.

Next, change the calibrating signal to 100 kHz and so adjust the trimmer capacitor C112 [C212] that the meter pointer indicates accurately the full-scale position.

Repeat alternately the adjustments at 1 kHz and 100 kHz for several times so that the instrument satisfies both frequency requirements at the same time.

4) Adjustment of output amplifier:

Set the range switch in the 1 V (1.5 V) position, apply to the input terminal a calibrating signal of 1 V (1.5 V) 1 kHz, and so adjust potentiometer R521 [R621] that the voltage measured at the output terminal becomes 1 V (1.5 V).

Perform the above adjustments of 2) ~ 4) for both INPUT 1 channel ((black pointer)) and INPUT 2 channel ((red pointer)).

5.3 Troubleshooting

The instrument is manufactured under stringent quality control and inspection programs and normally is free of troubles. Should any failure be caused notwithstanding, check the instrument circuit voltages to locate the cause of the trouble.

Circuit voltages without any input signal being applied to the instrument are shown in Tables 5-1, 5-2, and 5-3. The voltages are with respect to the ground and are as measured with an 11-MΩ input impedance VTVM -- Kikusui Series 107.

1) Impedance converter (printed boards A-1, A-2):

Table 5-1

Parts No.	Transistor	Emitter - source (V)	Base - gate (V)	Collector - drain (V)
Q101 Q201	2SK30A	6.7		20.0
Q102 Q202	2SC372	6.0	6.6	25

2) Preamplifier, meter drive section, and output section
(printed boards A-5, A-6)

Table 5-2

Parts No.	Transistor	Emitter (V)	Base (V)	Collector (V)
Q501 Q601	2SC1000			3.8
Q502 Q602	2SC372	5.5	6.0	11.5
Q503 Q603	2SA495	4.5	3.8	2.5
Q504 Q604	2SC372	10.8	11.4	20.2
Q505 Q605	2SC372			5.5
Q506 Q606	2SC372	4.8	5.5	11.2

3) Power supplies (printed boards A-5, A-6)

Table 5-3

Parts No.	Transistor or diode	Emitter - cathode (V)	Base - anode (V)	Collector (V)
Q507 Q607	2SD381	25.0	25.7	36
Q508 Q608	2SC372	11	11.6	25.7
Q509 Q609	2SC372	31.5	25.0	25.0
Q510 Q610	2SA495	0	-0.7	-15.7
Q511 Q611	2SB536	-15	-15.7	-28.5
CR504 CR604	RD11A	11	0	

5.4 AC Line Voltage Modification

The primary winding of the power transformer has taps for 110 V, 117 V, 220 V, 230 V, and 240 V in addition to that for 110 V. To modify the AC line voltage of the instrument, remove the transformer cover and change the connection to the required tap. The color codes of the transformer tap wires are shown in Table 5-4.

Table 5-4

Tap wire color	Tap wire number	Voltage (V)
Grey	1	0
Brown	2	100
Red	9	110
Orange	10	117
Yellow	11	220
Green	12	230
Blue	13	240