

INSTRUCTION MANUAL

AUTOMATIC DISTORTION METER

MODEL 630

KIKUSUI ELECTRONICS CORPORATION

79.3.16 792639

# Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.

(Revision should be applied to items indicated by a check mark )

Input voltage

The input voltage of this product is \_\_\_\_\_ VAC,  
and the voltage range is \_\_\_\_\_ to \_\_\_\_\_ VAC. Use the product within this range only.

Input fuse

The rating of this product's input fuse is \_\_\_\_\_ A, \_\_\_\_\_ VAC, and \_\_\_\_\_.

### WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

AC power cable

The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

### WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.



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## 1. GENERAL

Model 630 Automatic Distortion Meter is capable of measuring the voltage level of a signal of 20 Hz ~ 100 kHz and the harmonic distortion factor of a signal of 400 Hz or 1 kHz with two meters at the same time. The measurements are rapid and accurate.

This instrument requires no full-scale calibration for distortion measurement and is capable of measuring a signal of which level varies and, therefore, the instrument can be very conveniently used as a distortion meter on a production line.

The instrument employs in its fundamental wave elimination circuit for distortion measurement a sharp high pass filter and, therefore, it can successfully measure the distortion factor even when the measured signal frequency varies by wow and flutters as is the case of the signal of a tape recorder, or a disc record player, or other instrument.

## 2. SPECIFICATIONS

Instrument: Automatic Distortion Meter

Model No.: Model 630

### Distortion measuring section

Input impedance: 100 k $\Omega$   $\pm$ 10%, single-ended, 40 pF or less

Measured signal frequency: 400 Hz  $\pm$ 5%,  
1 kHz  $\pm$ 5%, and

Overall measurable range: 0.03% ~ 30%

Measuring range: 7 ranges  
0.1%, 0.3%, 1%, 3%, 10%, 30% full scale,  
and CAL

Measurable input voltage: 30 mVrms ~ 100 Vrms  
With input level appropriateness  
indicator lamp

Measuring accuracy:  $\pm$ 5% of full scale or better  
( $\pm$ 10% of full scale or better for 0.1% range)

Fundamental wave elimination characteristics:

HPF system

-76 dB or less at  $\pm 5\%$  of 400 Hz or 1 kHz

-70 dB or less at  $\pm 10\%$  of 400 Hz or 1 kHz

Monitor output voltage: Approx. 0.5 Vrms at full scale

Output impedance approx. 10 k $\Omega$

AGC range: Approx. 15 dB

+5  
-10 dB with respect to full scale of LEVEL  
meter

AC voltage measuring section

Input impedance: 100 k $\Omega$   $\pm 10\%$ , single-ended, 40 pF or less

Measuring ranges: 7 ranges

0.1 V, 0.3 V, 1 V, 3 V, 10 V, 30 V, 100 V  
full scale

Measuring accuracy:  $\pm 3\%$  of full scale or better (at 1 kHz)

Frequency response: 20 Hz ~ 100 kHz,  $\pm 3\%$  with respect 1 kHz

Noise: 2% or less (input shorted)

Ambient temperature range: 5 $^{\circ}$  ~ 35 $^{\circ}$ C

Relative humidity: 85% max.

Power requirements: 100 V, 115 V, 215 V, 230 V  $\pm 10\%$ , 50/60Hz AC,  
Approx. 8 VA  
(Voltage selectable at rear panel)

Insulation and withstanding voltage:

50 M $\Omega$  or over with 500 V DC

1000 V AC, 1 minute

Dimensions: 310 (W)  $\times$  150 (H)  $\times$  320 (D) mm

(Maximum dimensions) 330 (W)  $\times$  165 (H)  $\times$  370 (D) mm

Weight: Approx. 6 kg

Accessories: AC power cord ..... 1  
Instruction manual ..... 1

### 3. OPERATING METHOD

#### 3.1 Explanation of Front Panel

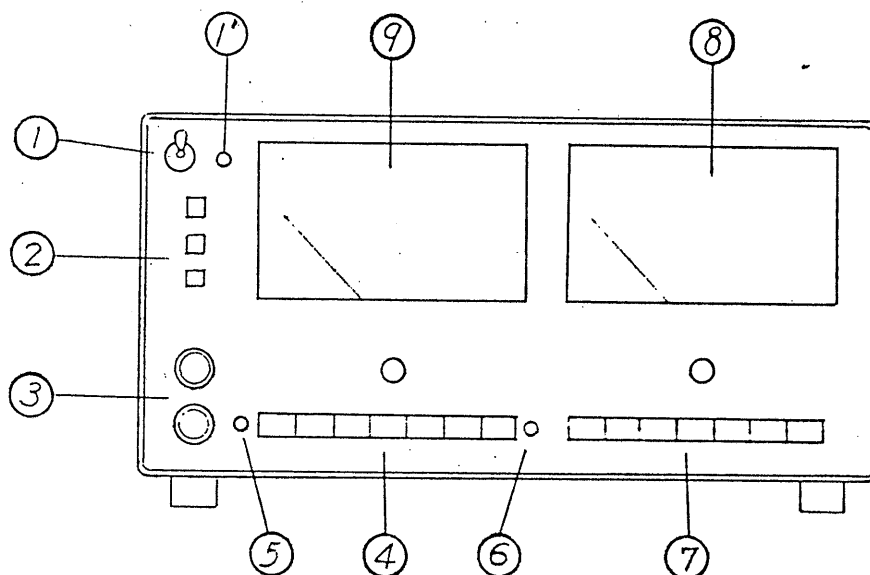


Figure 3-1. Front panel

- ① POWER                      Instrument power ON/OFF switch. When power is ON, green LED power lamp ① lights.
- ② FUNCTION                    Selects one of the four measuring functions as follows:
- o LEVEL ONLY                To measure the level of AC voltage signal connected to INPUT terminal ③.
  - o 400Hz                      To measure total harmonics distortion factor of 400 Hz signal connected to INPUT terminal ③. Signal level is measured at the same time.



o 1kHz

To measure total harmonics distortion factor of 1 kHz signal connected to INPUT terminal

③. Signal level is measured at the same time.

③ INPUT

Terminals for connecting the input signal.

Input impedance 100 k $\Omega$   $\pm$ 10%, single-ended.

GND terminal (black) is connected to the case.

④ INPUT RANGE

An appropriate one of the buttons with respect to the input signal level should be pressed.

For distortion measurement, a range should be

so selected that the LEVEL meter pointer is

within -10 dB ~ 0 dB (red mark of dB scale)

with respect to full scale. Even when the

meter pointer is deflected overscale due to

AM modulation or other cause, the distortion

measurement is not affected so far as the

input appropriateness indicator lamp ⑥ does

not light.

- ⑤ DISTORTION INPUT UNDER These lamps do not light when the signal level in the distortion factor measurement is within the measurable range as above.
- ⑥ DISTORTION INPUT OVER If the input signal level is lower by -10 dB or less from full scale, the DISTORTION INPUT UNDER lamp ⑤ lights requesting to raise the input signal level; if input signal level is higher by +5 dB or more from the full scale the DISTORTION INPUT OVER lamp ⑥ lights requesting to lower the input signal level.
- ⑦ DISTORTION RANGE Push-buttons for range selection for distortion measurement. The CAL button is for instrument calibration.
- ⑧ DISTORTION METER Indicates the distortion factor in % or dB. The meter is calibrated for mean-value-response r.m.s.-value-scale.
- ⑨ LEVEL METER Indicates the signal level in V or dB. The meter is calibrated for mean-value-response r.m.s.-value-scale.

### 3.2 Explanation of Rear Panel

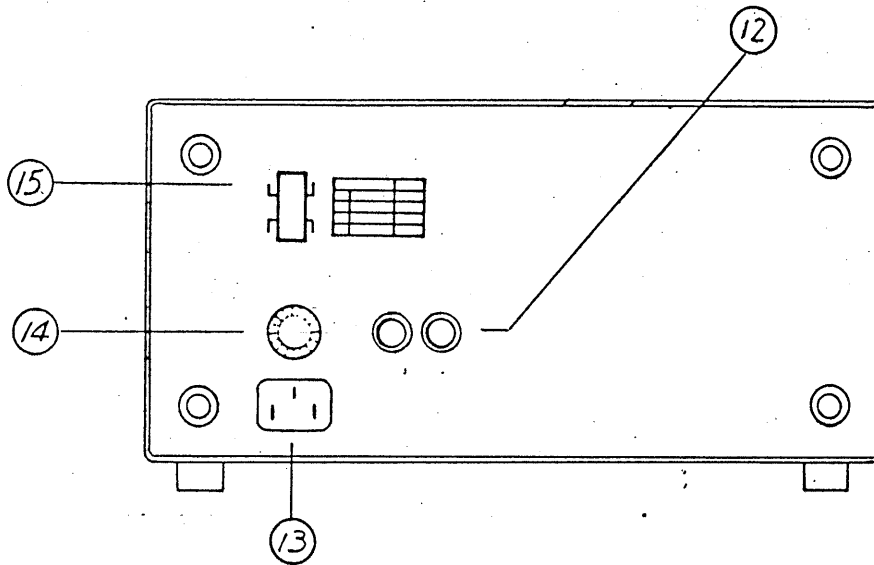


Figure 3-2. Rear panel

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- ⑫ MONITOR OUTPUT Provides an output signal for monitoring the input signal waveform and level measurement and spectrum analysis of distortion components using oscilloscope, spectrum analyzer or other instrument.

The output voltage is proportional to meter deflection (aprox. 0.5 Vrms at meter full scale), output impedance approx. 10 k $\Omega$ , frequency response -3 dB at 30 kHz, and LPF characteristics of 18 dB/OCT.

Note: The IO monitor terminal (white terminal) is connected to the case through a 10-ohm resistor (1/2 watt). Do not use this terminal mixedly with other ground terminals.

- ⑬ AC POWER CONNECTOR This instrument operates on an AC power of
  - ⑭ FUSE nominal 100, 115, 215 or 230 V. The voltage
  - ⑮ AC VOLTAGE is selectable with the AC voltage selector
  - SELECTOR SOCKET socket ⑮. A fuse corresponding to the
- AC voltage must be used.

Table 3-1. AC voltage selection and fuse

Line voltage		Fuse
A	90 V ~ 110 V	0.5 A
B	104 V ~ 126 V	
C	194 V ~ 236 V	0.2 A
D	207 V ~ 253 V	

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### 3.3 Preparations for Measurement

3.3.1 Check that the AC voltage selector socket at the rear of the instrument conforms with the line voltage.

3.3.2 Set the POWER switch at an upper left on the front panel in the OFF state, connect the power cord between instrument rear connector and AC line outlet.

3.3.3 Paying attention to range switch setting so that the meter pointer is not deflected over the scale, turn ON the POWER switch. The meter pointer may deflect at random approximately 10 seconds after the switch is turned ON but this is not an abnormal indication.

3.3.4 When the meter pointer is stabilized, the instrument is ready for use.

### 3.4 Measurements

#### 3.4.1 Distortion Measurements

FUNCTION (2) ..... 400Hz or 1kHz  
INPUT RANGE (4) ..... 100V  
DISTORTION RANGE (7) ..... 30%

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Apply to the INPUT terminal, set the INPUT RANGE switch in conformity with the input signal, and lower the INPUT RANGE switch to an appropriate range that the LEVEL meter pointer indicates between -10 dB ~ 0 dB (red mark of dB scale).

Next, gradually lower the DISTORTION RANGE switch to 10%, 3%, 1% and so forth to read with an appropriate range the distortion in % or dB.

#### 3.4.2 AC Voltage Measurement

FUNCTION ② ..... LEVEL ONLY  
INPUT RANGE ④ ..... 100V

Apply the signal to be measured to the INPUT terminal.

So set the INPUT RANGE switch that the LEVEL meter pointer deflects maximum on the scale, and read the value in V or dB.

#### 3.5 Notes in Use

3.5.1 The ambient conditions for this instrument are temperature 5°C ~ 35°C, and relative humidity 85% maximum. Do not use the instrument under direct sunlight or close to a heat source, or in a highly humid atmosphere. Avoid, whenever possible, the use in adverse environments such as in corrosive gas, dust, chemicals, mechanical vibration, magnetic field, etc.

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### 3.5.2 Mechanical zero adjustment of meter:

No adjustment is required if the meter pointer is indicating the zero scale position when the power is OFF. If the pointer is not indicating the zero position, adjust it to the zero position with the mechanical zero adjustment screw at a lower part of the meter.

- 3.5.3 The maximum allowable input voltages of this instrument are 30 V AC at the 0.1V range and 100 V AC at the other ranges. Pay attention so that no voltages higher than these are applied to the input circuit.

### 3.5.4 Waveform errors:

This instrument is an average-value-indicating voltmeter which indicates a value proportional to the average value of the measured AC voltage, but its scale is calibrated in rms value. Therefore, the meter may not indicate the correct rms value if the measured signal is distorted. The effects of distortions on the measured value is shown in Table 3-2. As can be seen in this table, errors are very small when the harmonic level is less than 10%.

Table 3-2. Waveform errors

Measured voltage	rms value	Meter reading
Fundamental wave of amplitude 100%	100%	100%
100% fundamental wave + 10% 2nd harmonic wave	100.5%	100%
100% fundamental wave + 20% 2nd harmonic wave	102%	100 ~ 102%
100% fundamental wave + 50% 2nd harmonic wave	112%	100 ~ 110%
100% fundamental wave + 10% 3rd harmonic wave	100.5%	95 ~ 104%
100% fundamental wave + 20% 3rd harmonic wave	102%	94 ~ 108%
100% fundamental wave + 50% 3rd harmonic wave	112%	90 ~ 116%

3.5.5 The distortion factor in the specification is defined as per TOTAL DISTORTION FACTOR of IEC Standards as follows:

$$\text{Distortion factor} = \frac{(\text{Distortion wave in rms}) - (\text{Fundamental wave in rms})}{\text{Distortion wave in rms}} \times 100 (\%)$$

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3.5.6 When induction noise is large, make the input signal cable as short as possible and use a shielded cable for the input cable. Also pay attention to grounding of the instrument and to the noises caused by the AC power line and other sources.

#### 4. OPERATING PRINCIPLE

A block diagram of this instrument is shown in Figure 4-1.

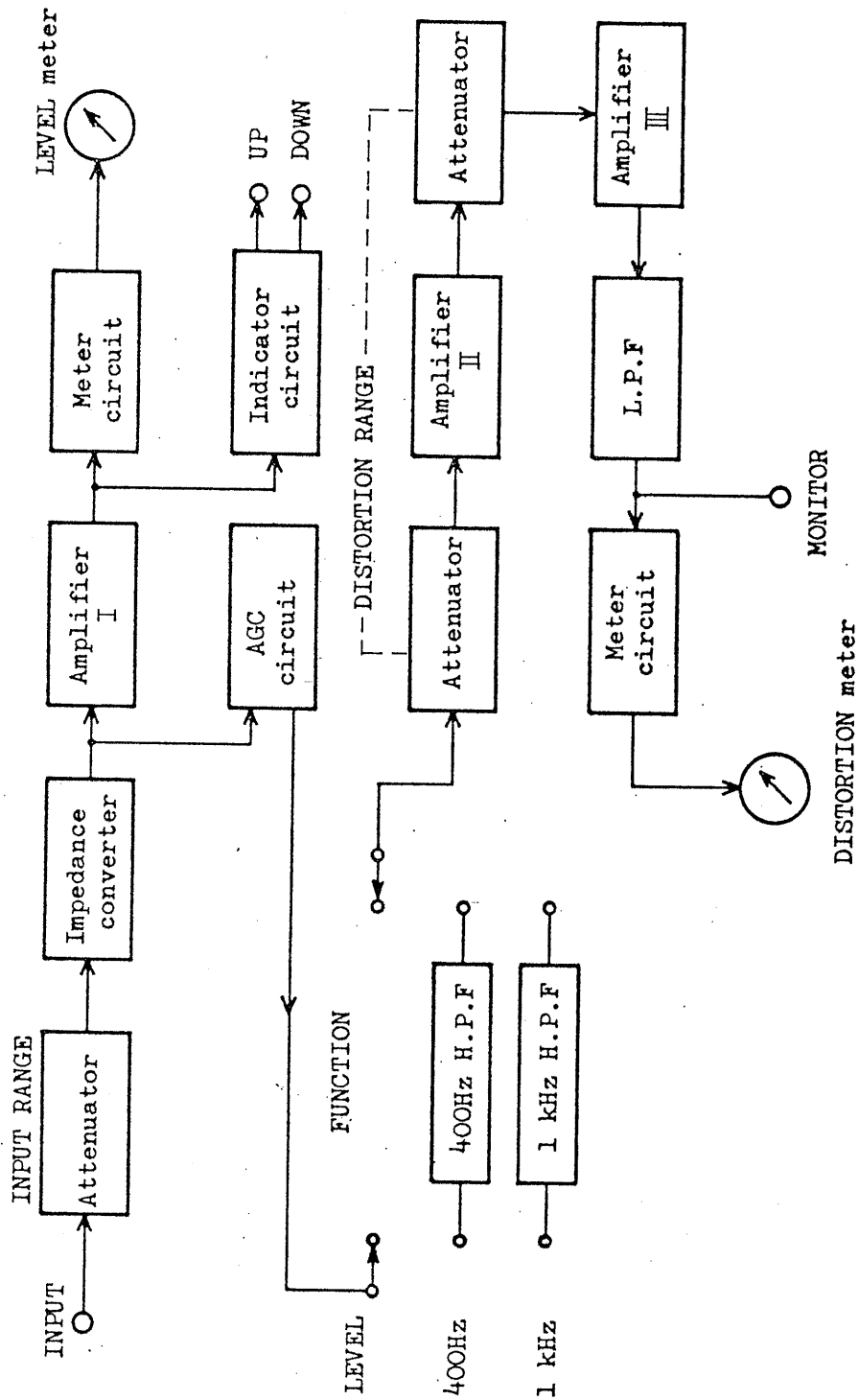


Figure 4-1. Block diagram

### Input Circuit

- o The input signal is applied to the impedance converter through the 100-k $\Omega$  attenuator. The 100-k $\Omega$  attenuator reduces the input signal in 10-dB steps for a total range of 0 dB to -60 dB.
- o The output signal of the impedance converter is branched off and fed to the LEVEL indicator circuit and DISTORTION indicator circuit.

### LEVEL Indicator Circuit

- o The LEVEL indicator circuit constantly indicates the signal level irrespective of FUNCTION switch setting.
- o The appropriate level indicator circuit performs AC-DC conversion on the signal and judges with its comparator whether the signal level is suitable for distortion measurement or not.
- o The meter is a 1-mA full scale type.

### DISTORTION Indication Circuit

- o The output signal of impedance converter is fed to the AGC circuit.

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- o The AGC circuit maintains the amplifier output at a constant voltage by converting the amplifier output into a DC voltage, amplifying the differential voltage with respect to the reference voltage, and feeding the resultant current to the diode so that the resistance of CdS varies to compensate for input voltage change.

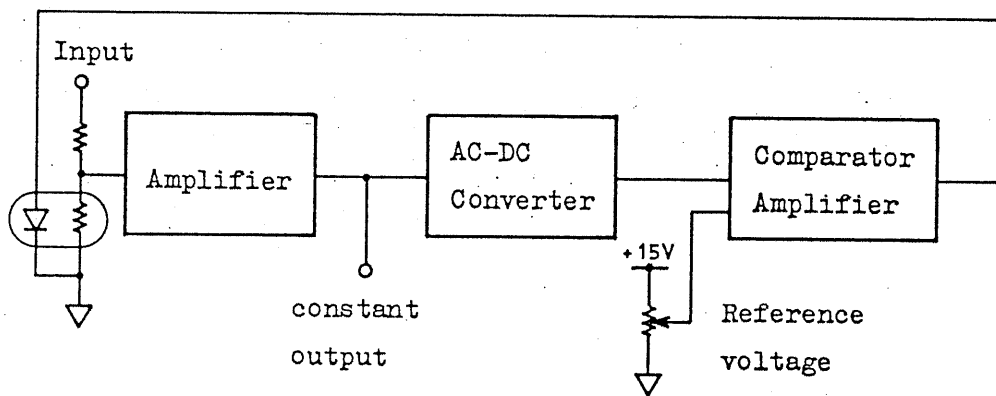


Figure 4-2. AGC Circuit

- o The signal of which voltage is maintained constant is fed through a distortion measurement filter if 400Hz, 1KHz or EXT is selected.
- o The signal which has passed through the distortion measurement filter is attenuated by the 600-ohm attenuator and is fed through amplifier II (approx. 37 dB), 600-ohm attenuator, and amplifier III (approx. 37 dB) to the LPF (low pass filter).
- o The cut-off characteristics of the LPF is -3 dB at 30 kHz, -18 dB/OCT.
- o The meter is a 1-mA full scale type.

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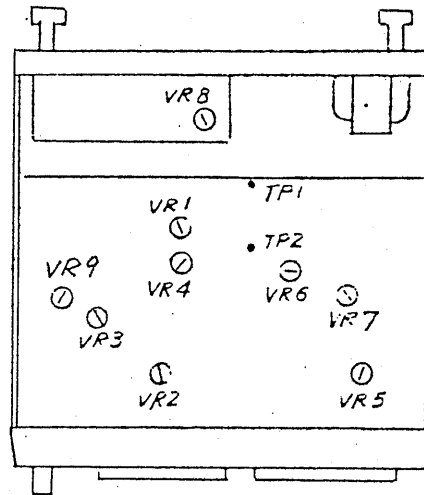
## 5. MAINTENANCE

### 5.1 Inspection of Internal Components

Remove the top and bottom covers after removing the eight screws at both sides of the top and bottom covers and two screws of the bottom cover.

Note: Note that adjustments should be done with the bottom cover installed.

### 5.2 Layout of Internal Components



Front panel

Figure 5-1. Layout of adjusting potentiometers  
(Top view)

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### 5.3 Adjustment and Repair

The instrument is required to be adjusted and calibrated when it has become incapable of satisfying the specifications or when it has been repaired. Before starting calibration, perform mechanical zero adjustment of the indicating meter and allow more than 15 minutes of stabilization period after turning ON the instrument power.

#### 5.3.1 Adjustments of Constant Voltage Circuits

Measured point	Setting range	Adjusting potentiometer
TP1 - GND	DC + 14.9 V ~ + 15.1 V DC	VR 1
TP2 - GND	DC - 14.8 V ~ - 15.2 V DC	Confirm

#### 5.3.2 Adjustment of LEVEL Meter

Set the switches as follows:

FUNCTION ..... LEVEL ONLY  
INPUT RANGE ..... 0.1V  
DISTORTION RANGE ..... CAL

Apply to the INPUT terminal a calibration signal of 1 kHz, 0.1 Vrms (sinusoidal wave of low distortion), and so adjust VR2 that the meter pointer indicates accurately the full scale.

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Next, vary the calibration signal frequency for a range of 20 Hz ~ 100 kHz and check that the level change is within  $\pm 3\%$  with respect to that at the reference frequency of 1 kHz.

### 5.3.3 Adjustment of DISTORTION Meter.

- o Adjustment for 400Hz

FUNCTION	.....	400Hz
INPUT RANGE	.....	1V (0 dB)
DISTORTION RANGE	.....	CAL

Apply to the INPUT terminal a sinusoidal wave signal of 400 Hz ( $f_0$ ), 1 Vrms, distortion factor 0.01% or less from a low distortion signal generator. Raise the frequency to 800 Hz ( $2 f_0$ ) and so adjust VR5 that the DISTORTION meter indicates 0 dB. Further, raise the frequency to 1.2 kHz ( $3 f_0$ ) and check that the meter indication is within  $\pm 0.5$  dB. Next, return the frequency to 400 Hz, and set the INPUT RANGE to 0.1V and check that the indication is 0.015% (-76 dB) or less.

- o Adjustment for 1kHz

FUNCTION	.....	1kHz
INPUT RANGE	.....	1V (0 dB)
DISTORTION RANGE	.....	CAL

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Apply to the INPUT terminal a sinusoidal wave of 1 kHz, 1 Vrms and distortion factor 0.01% or less from a low distortion signal generator. Raise the frequency to 2 kHz and so adjust VR8 that the DISTORTION meter indicate 0 dB. Further, raise the frequency to 3 kHz and check that the meter indication within  $\pm 0.5$  dB. Next, return the frequency to 1 kHz and check that the indication is 0.015% (-76 dB) or less.

#### 5.3.4 Repair of AGC circuit

When the AGC circuit has failed and repaired, the circuit must be adjusted.

FUNCTION .....	400Hz
INPUT RANGE .....	0.1V
DISTORTION RANGE .....	CAL

Apply to the INPUT terminal a sinusoidal wave of 800 Hz, 0.1 Vrms from a signal generator and so adjust VR4 that the DISTORTION meter indicates the full scale.

Varying the signal generator output for a range of -10 dB ~ +5 dB, read the DISTORTION meter indication. If the meter indication is within  $\pm 0.1$  dB, no adjustment is required.



If the meter indication is not within the above tolerance, make adjustment as follows:

Reduce the signal generator output until the INPUT meter indication is reduced to -10 dB. Adjust VR3 to a point immediately before the DISTORTION meter indication starts reducing. Next, increase the signal generator output by +5 dB from 1 Vrms, and so adjust VR10 that the DISTORTION meter indication is within  $\pm 0.1$  dB.

Also adjust the appropriate input level indicator lamps with VR6 and VR7.

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