# INSTRUCTION MANUAL

## NOISE METER

## MODEL 1635A

KIKUSUI ELECTRONICS CORPORATION

# 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.

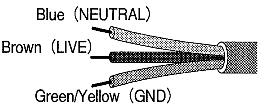
## ☐ AC power cable

The product is porvided 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.

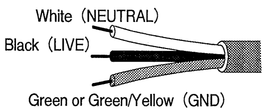
**WARNING**

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

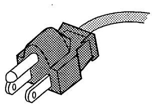
☐ Without a power plug



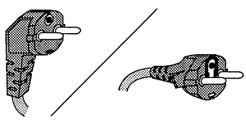

☐ Without a power plug




☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable ______________________________

 Kikusui Part No. Z9-000-027 IB001681 KIKUSUI

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# 1. GENERAL

Model 1635A Noise Meter is designed for measurement of noise level and S/N ratio of tape recorders and other audio equipment. The instrument can be incorporated with up to three aural compensation filters meeting the requirements of DIN, JIS, NAB, CCIR, and CCIR/ARM Standards. The instrument is a high sensitivity AC voltmeter which is capable of indicating the quasi-peak value of DIN and regular mean value by switching. The instrument is compact, light, and consumes less power.

The instrument consists of a preamplifier, an impedance converter with high input impedance, an attenuator, a main amplifier, an indicator circuit, an aural compensation filter circuit, an output circuit and a regulated voltage supply circuit.

The overall measuring range is 3 μV ~ 300 Vrms (-110 ~ +52 dBm, -110 ~ +50 dBv), divided into 15 ranges in 10-dB geometric steps. The instrument can measure an AC voltage of 10 Hz ~ 500 kHz and its scale is evenly graduated in rms equivalent value of sinusoidal wave.

The instrument has an AC output terminal which provides an AC output voltage of 1 Vrms full scale and a DC output voltage which provides a DC voltage of 1 V DC full scale. These voltages can be used for driving an amplifier, a recorder, or other monitoring device.

The instrument has a sensitivity adjustment potentiometer with which the level is adjustable in a continuously variable manner for a range of 0 ~ -10 dB. This provision can be effectively used for measurement of relative level when determining the S/N ratio, etc.

The instrument is incorporated with an over-driven indication function in order to prevent meter indication errors which can result from waveform distortion caused by over-input for the range used when the aural compensation filters are used.

Kikusui standard aural compensation filters are available as follows:

| | |
|---|---|
| o OP-1 DIN NOISE 1967: | DIN 45405 (1967) NOISE |
| o OP-2 DIN AUDIO 1967: | DIN 45405 (1967) AUDIO |
| | JIS C 1502-A,(1977), JIS C 5551-A (1971) |
| o OP-3 JIS-A (1977): | NAB-A (1965), IHF-A-202 (ANSI-S 1.4; 1978), ASA-A |
| | DIN 5045, IEC-A |
| o OP-4 CCIR/ARM: | DOLBY LABORATORIES - B TYPE NOISE REDUCTION |
| | (2 kHz, 0 dB) |
| o OP-5 TUNE 1 kHz: | 1 kHz, 0 dB TUNE FILTER |
| o OP-6 TUNE 400 Hz: | 400 Hz, 0 dB TUNE FILTER |
| o OP-7 CCIR, DIN-NOISE 1978: | CCIR-RECOMMENDATION 468-1 (1974) and 468-2 (1978) |
| | DIN 45405 (1978) NOISE |
| o OP-8 DIN-AUDIO 1978: | DIN 45405 (1978) AUDIO |
| | CCIR-RECOMMENDATION 468-1 (1974) ANNEX |
| | CCIR-RECOMMENDATION 468-2 (1978) ANNEX |

## 2. SPECIFICATIONS

**Instrument name:** Noise meter

**Model number:** 1635A

**Indicating meter:** Scale length approx. 102 mm, dual-color scale
Full scale 1 mA

**Scales:**

RMS scale (black) ..... rms equivalent value of sinusoidal wave
dBm scale (red) ....... with 1 mW, 600Ω reference
dBv scale (red) ....... with 1.0 V, 0 dBv reference

**Input terminal:** BNC receptacle and GND terminal

**Input resistance:** 10 MΩ, all ranges

**Input capacitance:**

30 μV ~ 1 V ranges ........... 40 pF or less
3 V ~ 300 V ranges ......... 30 pF or less

**Maximum allowable input voltage:**

30 μV ~ 1 V ranges ........... 150 V AC rms, ±200 V peak value (Note)
3 V ~ 300 V ranges ........... 300 V AC rms, ±450 V peak value
DC components (all ranges) ... ±400 V

(Note): Frequency not higher than 1 kHz, for 1 minute

Ranges: 15 ranges

RMS scale: 30/100/300 μV

1/3/10/30/100/300 mV

1/3/10/30/100/300 V

dBm and dBv scale: -90/-80/-70/-60/-50/-40/-30/-20/-10/

0/10/20/30/40/50 dB

Accuracy (at 1 kHz):

±3% FS ....... 100 μV ~ 300 V ranges, mean value detection FLAT

±5% FS ....... 30 μV range, mean value detection FLAT

±5% FS ....... All ranges when DIN NOISE, DIN AUDIO or CCIR conpensation filter is used for quasi-peak value detection

Stability:

±0.2% FS or less ....... For ±10% change of line voltage

Temperature coefficient:

0.05%/C° TYP ........... At 1 kHz, mean value detection

0.09%/C° TYP ........... At 1 kHz, peak value detection

Frequency response (1 kHz reference, FLAT, at full scale point):

rms value indication by mean value detection

30 μV range

10 Hz ~ 200 kHz: ±3%

200 kHz ~ 500 kHz: ±10%

100 $\mu$V ~ 300 V ranges

10 Hz ~ 200 kHz: ±3%

200 kHz ~ 500 kHz: ±5%

rms value indication by quasi-peak value detection (by DIN 45405 (1978), CCIR REC 468-1 (1974) and CCIR REC 468-2 (1978))

**All ranges**

**100 Hz ~ 50 kHz: ±5%**

**20 Hz ~ 100 kHz: ±10%**

**10 Hz ~ 20 Hz: ±20%**

**Aural compensation filters which can be incorporated:**

**Up to three (4-point selection including FLAT)**

**Kikusui standard filters (For characteristic curves, refer to Figure 3-5.)**

(1) OP-1 DIN NOISE 1967: DIN 45405 (1967) NOISE

(2) OP-2 DIN AUDIO 1967: DIN 45405 (1967) AUDIO

(3) OP-3 JIS A 1977: JIS C1502-A (1977), JIS C 5551-A (1971), NAB-A (1965), IHF-A-202 (ANSI-S 1.4;1978), ASA-A, IEC-A, DIN 5045

(4) OP-4 CCIR/ARM: 2 kHz 0 dB, DOLBY-B TYPE NOISE REDUCTION SYSTEM

(5) OP-5 TUNE 1 kHz: 1 kHz 0 dB, TUNE FILTER

(6) OP-6 TUNE 400 Hz: 400 Hz 0 dB, TUNE FILTER

(7) OP-7 CCIR, DIN-NOISE 1978: CCIR-RECOMMENDATION 468-1 (1974)
CCIR-RECOMMENDATION 468-2 (1978)
DIN 45405 (1978) NOISE

(8) OP-8 DIN-AUDIO 1978: DIN 45405 (1978) AUDIO
CCIR-RECOMMENDATION 468-1 (1974) ANNEX
CCIR-RECOMMENDATION 468-2 (1978) ANNEX

* For other filters than the above, consult KIKUSUI's representative in your area

Residual noise (mean value detection, FLAT):

5 $\mu$Vrms or less (input shorted, input equivalent, 30 $\mu$V range)

Sensitivity adjustment range: 0 ~ approx. -11 dB (all ranges)

Outputs:

Output terminals:

BNC receptacle and GND terminal

DC output:

Output voltage: +1 V ±3% (all ranges, at "1.0" of the 1.0 scale, 1 kHz)

Output impedance: Approx. 1 kΩ

AC output:

Output voltage: Approx. 1 Vrms (all ranges, at "1.0" of the 1.0 scale)

Output impedance: Approx. 600 Ω

Distortion factor: 2% or less (with mean value detection, FLAT, at 10 mV range, 1 kHz, FS point)

Frequency response: 7 Hz ~ 250 kHz, +1 ~ -3 dB (With mean value detection, FLAT, 10 MΩ registor and 50 pF capacitor connected to the output terminal)

Over-driven operation indication:

Indicator lamp lights or flickers for input signal which causes meter indication error due to waveform distortion when aural compensation filter is used (frequency range 3 Hz ~ 50 kHz).

Specified operating temperature range:

5 to 35°C

Power requirements:

100 V, 50/60 Hz AC, approx. 10 VA

(Can be modified by internal connection change to 100 ~ 120 V ±10% or 200 ~ 240 V ±10%)

| | |
|---|---|
| Dimentions: | 134 (W) × 164 (H) × 270 (D) mm<br>(5.28 (W) 6.46 (H) 10.63 (D) in.) |
| (Maximum dimentions): | 140 (W) × 190 (H) × 330 (D) mm<br>(5.51 (W) 7.48 (H) 13.00 (D) in.) |

Weight: Approx. 3.6 kg (40 lb.)

Accessories: Type 942A terminal adaptor ............ 1

Instruction manual .................... 1

# 3. REFERENCES

## 3.1 Dynamic Characteristics of Indicating Meter

DIN, CCIR and JIS Standards specify the dynamic characteristcs of the noise meter pointer. Model 1635A Noise Meter meets all requirements specified in these standards. Exerpts of these requirements are given below for reference.

### 3.1.1 DIN 45405 (1978) Standard (This is all same to CCIR-REC. 468-1 and 468-2)

- o When a continuous sinusoidal voltage is applied, the meter indications shall be the same for both value indication quasi-peak value and rms value indication.

- o Dynamic characteristics

  (a) Single tone-bursts response

  Single bursts of 5 kHz tone are applied to the input at an amplitude such that the steady signal would give a reading of 1/3 to 1 of full scale. The burst should start at the zero-crossing of the 5 kHz tone and should consist of an integral number of full periods. When period T shown in Figure 3-1 is varied as shown in Table 3-1, the requirments shown in Table 3-1 shall be met.

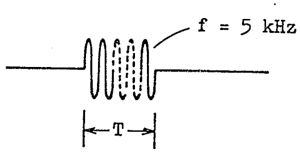


Figure 3-1

Table 3-1

| T (msec) | Maximum indication when 1/3 to 1 F.S are used as 100% or 0 dB | | Tolerance | | | |
|---|---|---|---|---|---|---|
| | | | (%) | | (dB) | |
| 1 | 17% | -15.4 dB | 13.5 | 21.4 | -17.4 | -13.4 |
| 2 | 26.6% | -11.5 dB | 22.4 | 31.6 | -13.0 | -10.0 |
| 5 | 40% | -8.0 dB | 34 | 46 | -9.3 | -6.6 |
| 10 | 48% | -6.4 dB | 41 | 55 | -7.7 | -5.2 |
| 20 | 52% | -5.7 dB | 44 | 60 | -7.1 | -4.4 |
| 50 | 59% | -4.6 dB | 50 | 68 | -6.0 | -3.3 |
| 100 | 68% | -3.3 dB | 58 | 78 | -4.7 | -2.2 |
| 200 | 80% | -1.9 dB | 68 | 92 | -3.3 | -0.7 |
| | 100% | 0 dB | ---- | | ---- | |

(b) When a signal as shown in Figure 3-2 is applied and 1/3 to 1 F.S are used as 100% as was the case of (a), the pointer deflection shall be Table 3-2.

Table 3-2

| Number of bursts / sec | | 2 | | 10 | | 100 | |
|---|---|---|---|---|---|---|---|
| Amplitude referrence | (%) | 48 | | 77 | | 97 | |
| steady signal reading | (dB) | -6.4 | | -2.3 | | -0.25 | |
| Tolerance | (%) | 43 | 53 | 72 | 82 | 94 | 100 |
| | (dB) | -7.3 | -5.5 | -2.9 | -1.7 | -0.5 | -0.0 |

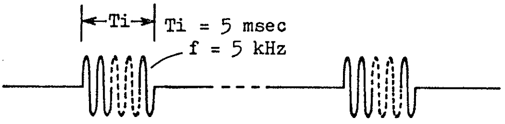


Figure 3-2

o Over load characteristics

Isolated 5 kHz tone-bursts of 0.6 msec duration starting at zero-crossing are applied to the input at an amplitude giving full scale reading using the most sensitive range of the instrument.

The amplitude of the tone-bursts is decreased in steps by a total of 20 dB while the readings are observed to check that decrease by corresponding steps within an overall tolerance of ±1 dB.

The test is repeated for each range.

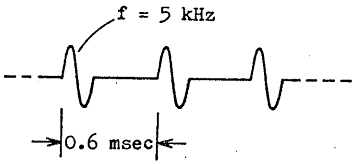


Figure 3-3

o Reversibility error

The difference in reading when the polarity of an asymnetric signal is reversed shall not be greater than 0.5 dB.

1 msec rectangular d.c. pulses with a pulse repetition rate of 100 pulse per second or less are applied to the input in the unweighted mode, at an amplitude giving an indication of 80% of full scale. The polarity of the input signal is reversed and the difference in noted.

### 3.1.2 JIS C 1502 (1977) Standard (rms value indication) refer to section 4.6

Two types of dynamic caracteristics (namely, FAST and SLOW) are specified by this standard. This instrument employs the FAST characteristics. When a signal as shown in Figure 3-4 is applied, the meter indication shall be within $-1\,^{+0.5}_{-1}$ dB (-2 ~ -0.5 dB) of the indication caused when a steady state sinusoidal input of which frequency and amplitude are the same with both of the signal shown in Figure 3-4.

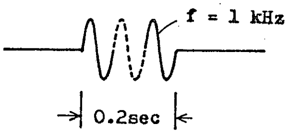


Figure 3-4

## 3.2 Characteristics of Aural Compensation Filters

* Kikusui's standard filters well satisfy the requirements of characteristics mentioned in the following.

a) DIN 45405 (1967) NOISE

Table 3-3

| Frequency (Hz) | Response (dB) | Tolerance (dB) |
|---|---|---|
| ≦ 20 | < -40 | --- |
| ≦ 31.5 | < -38 | --- |
| 63 | -31.6 | ±1.5 |
| 100 | -26.1 | ±1.5 |
| 200 | -17.3 | ±1.5 |
| 400 | - 8.8 | ±1.5 |
| 800 | - 1.9 | ±1.5 |
| 1 K | 0 | ±0.5 |
| 2 K | + 5.3 | ±1.5 |
| 4 K | + 8.2 | ±1.5 |
| 5 K | + 8.4 | ±0.5 |
| 6.3 K | + 8.0 | ±1.5 |
| 7.1 K | + 7.1 | ±1.5 |
| 8 K | + 5.1 | ±2 |
| 9 K | - 0.3 | +3<br>-2 |
| 10 K | - 9.7 | +3<br>-2 |
| ≧ 16 K | < -21 | --- |
| ≧ 20 K | < -23 | --- |
| ≧ 31.5 K | < -30 | --- |

b) DIN 45405 (1967) AUDIO

Table 3-4

| Frequency (Hz) | Response (dB) | Tolerance (dB) |
|---|---|---|
| ≦ 4 | ≦ -20 | ---- |
| 10 | ≦ - 5 | ---- |
| 31.5 ≦ 1K ≦ 20K | 0 | ±0.5 |
| 25 K | ≦ - 3 | ---- |
| ≧ 50 K | ≦ 40 | ---- |

c) JIS C1502 (1977) - A

Table 3-5

| Frequency (Hz) | Response (dB) | Tolerance (dB) |
|---|---|---|
| 31.5 | -39.4 | ±5.0 |
| 40 | -34.6 | ±4.5 |
| 50 | -30.2 | ±4.0 |
| 63 | -26.2 | ±3.5 |
| 80 | -22.5 | ±3.0 |
| 100 | -19.1 | ±2.5 |
| 125 | -16.1 | ±2.0 |
| 160 | -13.4 | ±2.0 |
| 200 | -10.9 | ±2.0 |
| 250 | - 8.6 | ±2.0 |
| 315 | - 6.6 | ±2.0 |
| 400 | - 4.6 | ±2.0 |
| 500 | - 3.2 | ±2.0 |
| 630 | - 1.9 | ±2.0 |
| 800 | - 0.8 | ±2.0 |
| 1 K | 0 | ±2.0 |
| 1.25 K | + 0.6 | ±2.0 |
| 1.6 K | + 1.0 | +2.5<br>-2.0 |
| 2 K | + 1.2 | +3.0<br>-2.5 |
| 2.5 K | + 1.3 | +3.5<br>-3.0 |
| 3.15 K | + 1.2 | +4.0<br>-3.5 |
| 4 K | + 1.0 | +4.5<br>-4.0 |
| 5 K | + 0.5 | +5.0<br>-4.5 |
| 6.3 K | - 0.1 | +5.5<br>-5.0 |
| 8 K | - 1.1 | +6.0<br>-5.5 |

d) CCIR RECOMMENDATION 468-1 (1974), 468-2 (1978), DIN 45405 (1978) NOISE

Table 3-6

| Frequency (Hz) | Response (dB) | Tolerance (dB) |
|---|---|---|
| 31.5 | -29.9 | ±2.0 |
| 63 | -23.9 | ±1.4 |
| 100 | -19.8 | ±1.0 |
| 200 | -13.8 | ±0.85 |
| 400 | - 7.8 | ±0.7 |
| 800 | - 1.9 | ±0.55 |
| 1 K | 0 | ±0.5 |
| 2 K | + 5.6 | ±0.5 |
| 3.15 K | + 9.0 | ±0.5 |
| 4 K | +10.5 | ±0.5 |
| 5 K | +11.7 | ±0.5 |
| 6.3 K | +12.2 | 0 |
| 7.1 K | +12.0 | ±0.2 |
| 8 K | +11.4 | ±0.4 |
| 9 K | +10.1 | ±0.6 |
| 10 K | + 8.1 | ±0.8 |
| 12.5 K | 0 | ±1.2 |
| 14 K | - 5.3 | ±1.4 |
| 16 K | -11.7 | ±1.65 |
| 20 K | -22.2 | ±2.0 |
| 31.5 K | -42.7 | +2.8<br>- ∞ |

e) DIN 45405 (1978) AUDIO , CCIR RECOMMENDATION 468-1 (ANNEX), 468-2 (ANNEX)

Table 3-7

| Frequency (Hz) | Response (dB) |
|---|---|
| 22.4 > | More decrease by 12 dB/octave |
| 22.4 31.5 | +0.5<br>-6 |
| 31.5 16 k | ±0.5 |
| 16 k 22.4 k | +0.5<br>-6 |
| 22.4 < | More decrease by 18 dB/octave |

f) CCIR/ARM

The CCIR/ARM Standard is for the aural compensation filters for Dolby B type noise reduction system. As compared with that of the CCIR Standard of (d), the characteristics of the CCIR/ARM Standard are such that the characteristics of the former are shifted so that the response becomes 0 dB at 2 kHz (overall characteristics are shifted by -5.6 dB).

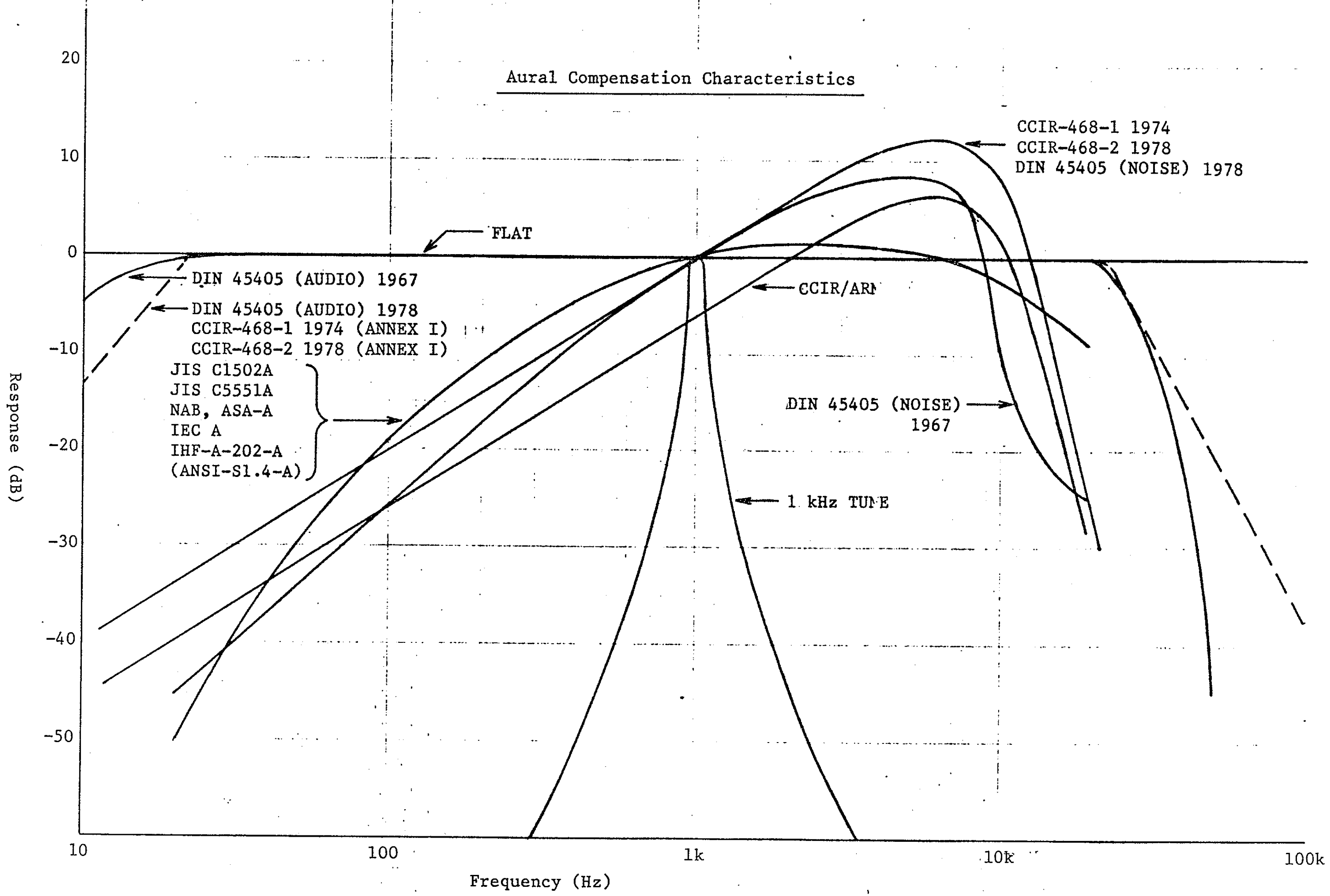


Figure 3-5

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## 4. OPERATION METHODS

### 4.1 Explanation of Panels

o Explanation of front panel:

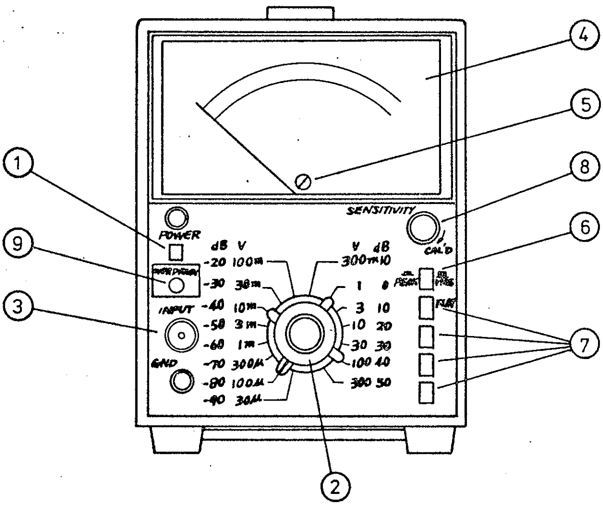


Figure 4-1

① POWER SWITCH:

For ON-OFF control of the instrument power. The depressed and locked state is ON and the green LED lamp lights. As you press the switch again, the power is turned OFF.

Approximately 10 seconds after turning ON the switch, the meter pointer may deflect irregulary. This is only transiential and is not an abnormal indication.

② Range swtich:

The range switch in the center of front panel is for selecting the measuring range. The black letters indicate the full scale voltage values and the red letters indicate the dB values. The range value increases as you turn the switch clockwise. Be careful not to apply an overvoltage to the input circuits. Start with a high range and gradually turn to lower ranges, observing the indicating meter deflection.

③ INPUT terminals:

Signal to be measured are applied to these terminals consisting of the BNC receptacle and GND terminal.

Connection to these terminals is done with BNC type plug.

It also is possible to insert the accessory "Type 942A Terminal Adaptor" and connect the signal to the adaptor with a banana plug, spade lug, alligator clip, 2-mm tip, or a conductor of 2-mm diameter or less.

The outer conductor of receptacle and the GND terminal are connected to the instrument panel and conductors inside the casing.

④ Indicating Meter:

The indicating meter has four types of scales from outside to inside, as follows:

1: "1 SCALE"

For 100 μV, 1/10/100 mV, and 1/10/100 V ranges

2: "3 SCALE"

For 30/300 μV, 3/30/300 and 3/30/300 V ranges

3: "dB V SCALE"

Graduated in dBv value with 1.0 V as reference. The same scale is used for all of 15 ranges from -90 to 50 dB.

4: "dBm SCALE"

Graduated in dBm value with 1 mW, 600 Ω as reference. The same is used for all of 15 ranges from -90 to 50 dB.

⑤ Zero Adjustment of Indicating Meter:

For mechanical zero adjustment of the indicating meter. The adjustment should be done when 5 minute or more has elapsed after turning off the instrument power and the meter pointer has been settled.

⑥ Detection System Selector Switch:

The depressed and locked state is for DIN Standard and CCIR-RECOMMENDATION peak value detection. The indicating meter is calibrated to indicate rms value for sinusoidal wave.

The pop up state to which the switch is reset when it is pressed again is for mean-value detection as for general voltmeter. The meter is calibrated to indicate the rms value for sinusoidal wave.

The relationship between filter and PEAK or rms (AVE) value is as shown in Table 4-1.

Table 4-1

| Filter \ Mode | PEAK | rms (AVE) |
|---|---|---|
| DIN NOISE, AUDIO 45405 (1967) | o | o * |
| DIN NOISE, AUDIO 45405 (1978) | o | |
| JIS A | | o * |
| JIS B | | o * |
| CCIR-REC 468-1 (1974)<br>468-2 (1978) | o | |
| CCIR/ARM | | o |
| TUNE | | o |
| FLAT | | o |

*: refer to section 4.6

⑦ Aural compensation selector switch:

This switch is for aural compensation filters, for four points including FLAT. The FLAT is unique to this instrument and has the frequency response characteristics of the specification, without using any filter.

For the remaining three points, up to three aural compensation filters can be selected and built in. When filters of DIN or JIS Standard are required, the customer is requested to specify the matter when ordering the instrument because such filters have effects on the dynamic characteristics of the indicating meter.

(8) Sensitivity adjustment knob:

This knob is for continuously-variable adjustment of the instrument by 0 ~ -10 dB or over. This adjustment is convenient when comparing relative levels of signals for S/N measurement, etc.

The extremely clockwise position (where the potentiometer is locked generating a click sound) is the calibrated position and the value can be directly read on the indicating meter for the range selected by the RANGE switch.

As you turn the knob counterclockwise, the gain is reduced to down to -10dB or over.

(9) Over-driven state indicator lamp:

When an aural compensation filter is used, even though the input voltage is as large as causing waveform distortions for the range, it is possible that the meter pointer does not largely deflect due to the characteristics of the filter. In such a case, this warning lamp (red LED) lights (flickers if the measuring frequency is low) to indicate that the meter indication involves errors caused by waveform distortion.

(Note: Frequency range 3 Hz ~ 50 kHz)

o Expranation of Rear Panel

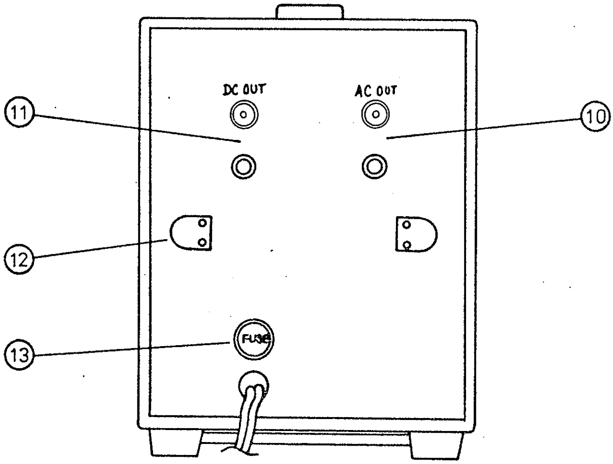


Figure 4-2

⑩ AC OUT terminals:

These terminals provide an AC output when this instrument is used as a monitor or an amplifier. Connection to these terminals is done with BNC type plug.

It also is possible to insert the accessory "Type 942A Terminal Adaptor," with banana plug, spade lug, alligator clip, 2-mm tip, or wires of 2-mm diameter or less.

⑪ DC OUT terminals:

These terminals provide a DC voltage when this instrument is used to drive an ink-writing recorder. The connection method is the same with that for the AC OUT terminals of ⑩.

⑫ Cord holder:

Used to hold the power cord when the instrument is transported or stored.

⑬ Fuse holder:

Holds the fuse connected in the primary circuit of the power transformer. To replace the fuse, remove it by turning the cap in the arrowhead direction (counter-clockwise.)

4.2 Preparations for Measurement

1) Turn OFF the power switch.

2) Check that the indicating meter pointer is indicating precisely the zero scale position. If it has been shifted, adjust it to the zero scale position with mechanical meter

zero adjustment. If the instrument power has been ON, turn OFF the power and allow 5 minutes or more to let the pointer perfectly settled and, then, perform zero adjustment.

3) Connect the power cord to an AC line outlet of the correct voltage (100 ~ 120 V ±10% or 200 ~ 240 V ±10% to which the instrument has been modified), 50 or 60 Hz.

4) Set the RANGE switch in the 300 V position.

5) Turn the SENSITIVITY adjustment knob to the extremely clockwise position where the potentiometer is locked generating a click sound.

6) Turn ON the POWER switch. The instrument power is turned ON and the green power pilot lamp lights.

   For approximately 10 seconds after turning ON the POWER switch, the meter pointer may deflect irregularly. The same may happen when the POWER switch is turned OFF. These are only transiential and not abnormal indications.

7) When the meter pointer is stabilized, the instrument is ready for measurement.

4.3 AC Voltage Measurement

1) When the measured signal level is low or the signal source impedance is large or the signal frequency is high, use a coaxial cable or a pair of stranded wires. When the measured signal voltage is low and the signal source impedance is small and the signal frequency is low, the use of the Type 942A Terminal Adaptor is convenient.

Note: At 30 $\mu$V ~ 1 mV ranges, the use of a shielded wire or a coaxial cable is recommended in order to prevent coupling by radiation from the indicating meter.

If a regular coaxial cable (such as 3C2V) is used, noise may be introduced due to movement or bending of the cable. Use of a low-noise cable is recommended especially when measurement is done at a high sensitivity.

2) In order to prevent applying an overvoltage to the instrument input circuit, set at first the RANGE switch at the highest range and then gradually lower the ranges observing the indicating meter deflection.

3) When measurement is done using an aural compensation filter, it is possible that the measured signal is greatly attenuated by the filter and the meter hardly deflects in spite of that

the measured signal up to the input side of the filter is as large as causing an overvoltage for the range being used. In order to alert you to this type of measurement errors caused by waveform distortions, an over-driven indicator lamp (LED) is provided. When this lamp has turned on (flickers if the measured signal frequency is low), lower the measuring range (turn clockwise the RANGE switch) or lower the input level of the measured signal.

4) The indicating meter scales are of a "1.0, 3" type and the scale factors are as shown in Table 4-2.

Table 4-2

| Range | Scale | Multiplication factor | Unit | Gain |
|---|---|---|---|---|
| 30 μV -90 dB | 3 | × 10 | μV | 90 dB |
| 100 μV -80 dB | 1.0 | × 100 | μV | 80 dB |
| 300 μV -70 dB | 3 | × 100 | μV | 70 dB |
| 1 mV -60 dB | 1.0 | × 1 | mV | 60 dB |
| 3 mV - 50 dB | 3 | × 1 | mV | 50 dB |
| 10 mV -40 dB | 1.0 | × 10 | mV | 40 dB |
| 30 mV -30 dB | 3 | × 10 | mV | 30 dB |
| 100 mV -20 dB | 1.0 | × 100 | mV | 20 dB |
| 300 mV -10 dB | 3 | × 100 | mV | 10 dB |
| 1 V 0 dB | 1.0 | × 1 | V | 0 dB |
| 3 V 10 dB | 3 | × 1 | V | -10 dB |
| 10 V 20 dB | 1.0 | × 10 | V | -20 dB |
| 30 V 30 dB | 3 | × 10 | V | -30 dB |
| 100 V 40 dB | 1.0 | × 100 | V | -40 dB |
| 300 V 50 dB | 3 | × 100 | V | -50 dB |

5) When measuring the input signal in dBm value with reference to 1 mW 600 Ω, use the dBm scale which is common for all ranges and determine the value as follows: The "0" point on the dBm scale represent the level indicated by the RANGE switch. The level of the input signal can be known by adding the scale reading to the level selected by the RANGE switch.

Example 1:

Assume that meter reading on the dBm scale with the "30 dB (30 V)" range was 2. The signal level in this case is calculated as follows:

$$2 + 30 = 32 \text{ dBm}$$

Example 2:

Assume that meter reading on the dBm scale with the "-20 dB (100 mV)" range was 1. The signal level in this case is calculated as follows:

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

6) To measure the input signal in dBv value referenced to 1.0 V, use the dBv scale in common for all ranges and determine the value in a similar manner as in the case of dBm value measurement.

Example 1:

Assume that the meter reading on the dBv scale with the "30 dB (30 V)" range was -2. The signal level in this case is calculated as follows:

$$-2 + 30 = 28 \text{ dBv}$$

Example 2:

Assume that the meter reading on the dBv scale with the "-20 dB (100 mV)" range was -5 dBv. The signal level in this case is calculated as follows:

$$-5 + (-20) = -5 - 20 = -25 \text{ dBv}$$

## 4.4 AC Current Measurement

An AC current can be measured by feeding the current (I) in a non-inductive resistor of known resistance (R), measuring the voltage (E) developed across the resistor and calculating the current using equation $I = E/R$. When using the instrument for this purpose, note that the "-" input terminal is connected to the instrument chassis and casing.

Example:

Assume a case of determining the heater current of a vacuum tube (nominal 6.3 V, 0.3 A). Assume that the current was fed in a non-inductive resistor of 0.1 Ω with a measuring setup as shown in Figure 4-3 and the indicating meter reading was 29 mV. The heater current in this case is determined as follows:

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

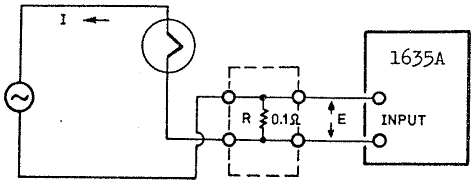


Figure 4-3

## 4.5 Use as an Output Meter

By determining the voltage (E) developed across a certain impedance (X), the apparent power (VA) in the impedance (X) can be known as $VA = E^2/X$. If the impedance (X) is of a pure resistor (R), the power (P) consumed in the resistor (R) is calculated as $P = P^2/R$. As this instrument has a dBm scale, if the resistance is 600 Ω, the power can be directly read in dB value.

Using the decibel conversion charts of Figures 4-4 and 4-5, even when the resistance is any value within 1 Ω ~ 10 kΩ, the power can be known in dB value by adding the value found in the chart.

## 4.6 Waveform Errors (at rms MODE)

This instrument is a "mean value indication type" voltmeter which indicates a value proportional to the mean value of the input signal. However, the indicating meter scales are graduated for rms values of sinusoidal wave. Therefore, if the input signal waveform is distorted, errors are introduced and the meter does not accurately indicate the rms value.
The relationship of waveform distortions VS, meter indications is shown in Table 4-3.

Table 4-3

| Input signal | RMS Value | Meter indication | Meter indication errors |
|---|---|---|---|
| Fundamental wave of 100% amplitude | 100% | 100% | 0% (0 dB) |
| 100% fundamental wave +10% 2nd hormonis | 100.5% | 100% | -0.5% (-0.044 dB) |
| 100% fundamental wave +20% 2nd hormonis | 102% | 100 ~ 102% | 0 ~ -2% (0 ~ -0.175 dB) |
| 100% fundamental wave +50% 2nd hormonis | 112% | 100 ~ 110% | -1.8 ~ -10.7% (-0.158 ~ -0.98 dB) |
| 100% fundamental wave +10% 3rd hormonis | 100.3% | 95 ~ 104% | -5.3 ~ +3.7% (-0.47 ~ +0.32 dB) |
| 100% fundamental wave +20% 3rd hormonis | 102% | 94 ~ 108% | -7.8 ~ +5.9% (-0.71 ~ +0.48 dB) |
| 100% fundamental wave +50% 3rd hormonis | 112% | 90 ~ 116% | -19.6 ~ +3.6% (-1.89 ~ +0.31 dB) |

## 4.7 How to Use the Decibel Conversion Charts

### 1) Decibel

The term "bel" (B) is used as a standard unit for expressing the ratio between two power levels in terms of the natural logarithm with 10 as base. The term "decibel" (dB) is one-tenth of bel and is defined as follows:

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

Thus, the term dB indicates the relative level of power P2 with respect to power $P_1$, in terms of 10 times of the natural logarithm of the ratio of the two powers.

If the impedances of the circuits where powers $P_1$ and $P_2$ exist are the same, the power ratio may be expressed solely with the voltage or current as follows:

$$dB = 20 \log_{10} \frac{E_2}{E_1} \quad \text{or} \quad 20 \log_{10} \frac{I_2}{I_1}$$

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

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 HF 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

The term "dBm" stands for "dB (mW)" and is used to represent a power ratio 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. The 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 audio 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 Figures 4-4 and 4-5 are used for this purpose.

3) How to Use the Decibel Charts

Figure 4-4 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 their 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 5 mW/1 mW = 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, use Table 4-4 and add the values found.

$$50 \text{ mW} = 5 \text{ mW} \times 10 \rightarrow 7 + 10 = 17 \text{ dB}$$

$$500 \text{ mW} = 5 \text{ mW} \times 100 \rightarrow 7 + 20 = 27 \text{ dB}$$

Table 4-4

| Ratio | | Decibel: Power ratio | Decibel: 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:**

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

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

1V/15mV = 66.7

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

-36.5 dB(v)

4) Decibel Addition Chart

The convert the dBm reading into a power value, use the chart of Figure 4-5.

Example 1: Assume that the meter reading was -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 Figure 4-5, 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).

$$dB\ (mW,\ 8\Omega) = -4.8 + 18.8 = +14$$

To convert 14 dB (mW, 8Ω) into a power value, use Figure 4-4 and find the value to be 25 mW.

$$14\ dB\ (mW,\ 8\Omega) \rightarrow 25\ mW$$

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 equivalent to 30 dB(mW), the answer can be known by calculating the voltage for 30 dB (mW, 10 kΩ). Referring to Figure 4-5 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 ) is the answer and this voltage can be found to be 42.2 dBm = 100 V.

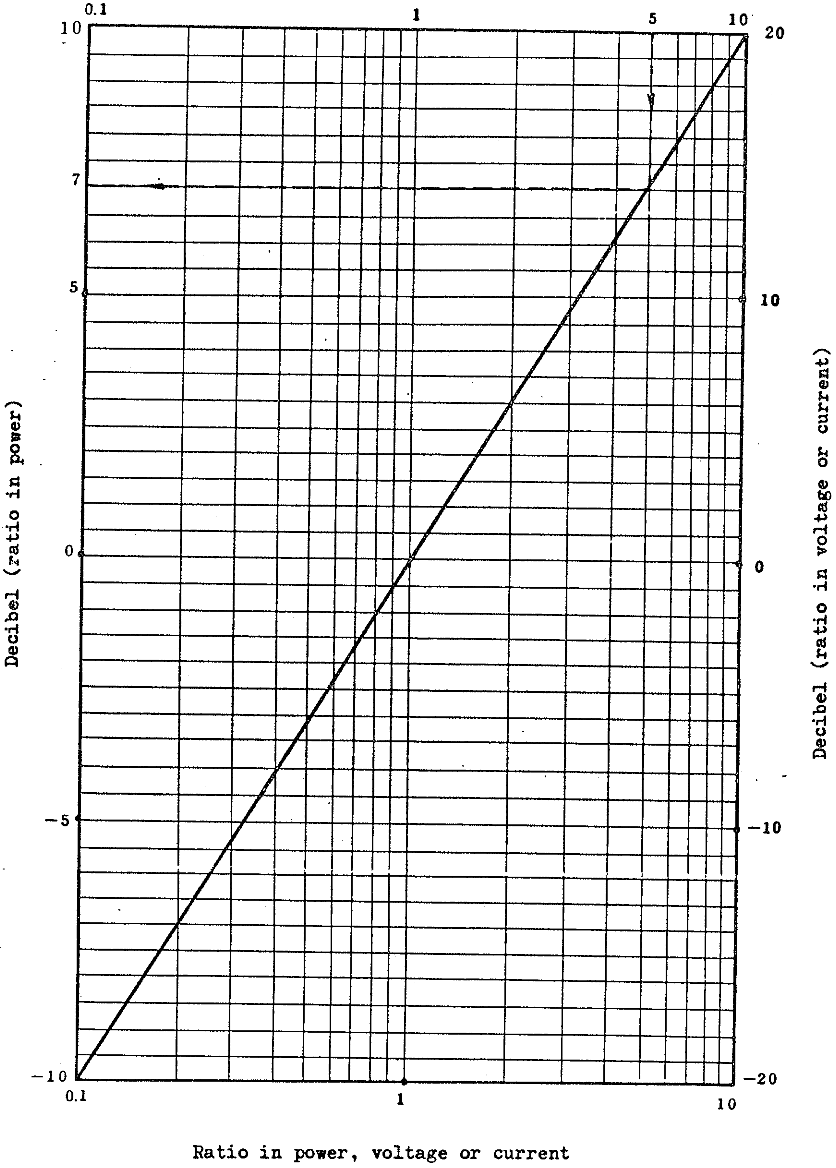


Figure 4-4. Decibel conversion chart

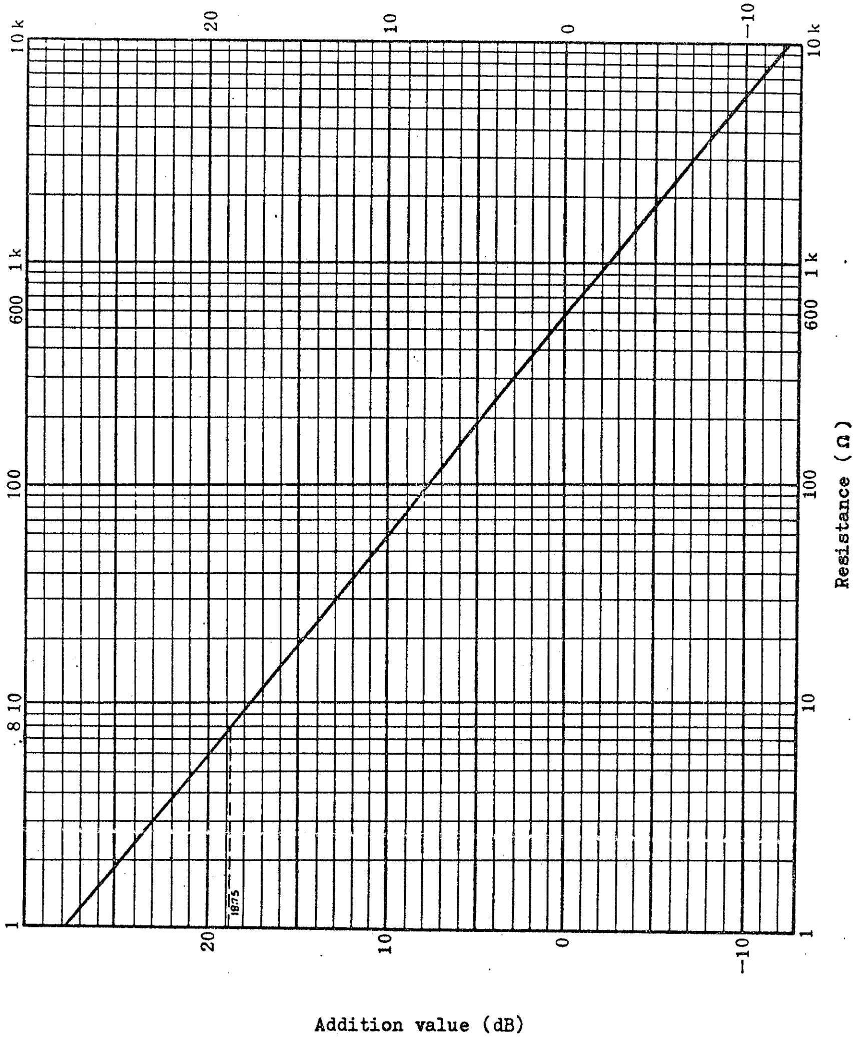


Figure 4-5. Decibel Addition Chart

# 5. OPERATING PRINCIPLE

## 5.1 Instrument Construction

This instrument consists of an input circuit (preamplifier, pre-stage attenuator, impedance converter), post-stage attenuator, aural compensation filter circuit, main amplifier, mean value detection indicating meter drive circuit, peak value detection indicating meter drive circuit, AC output circuit, DC output circuit, overvoltage input detection circuit, power supply circuit, and aural compensation filter power supply circuit.

## 5.2 Input Circuit

o 30 μV ~ 1 mV ranges:

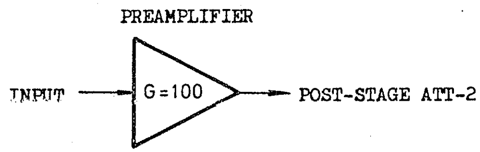


Figure 5-2

The input signal is amplified by a factor of 100 and, then, sent to the post-stage attenuator.

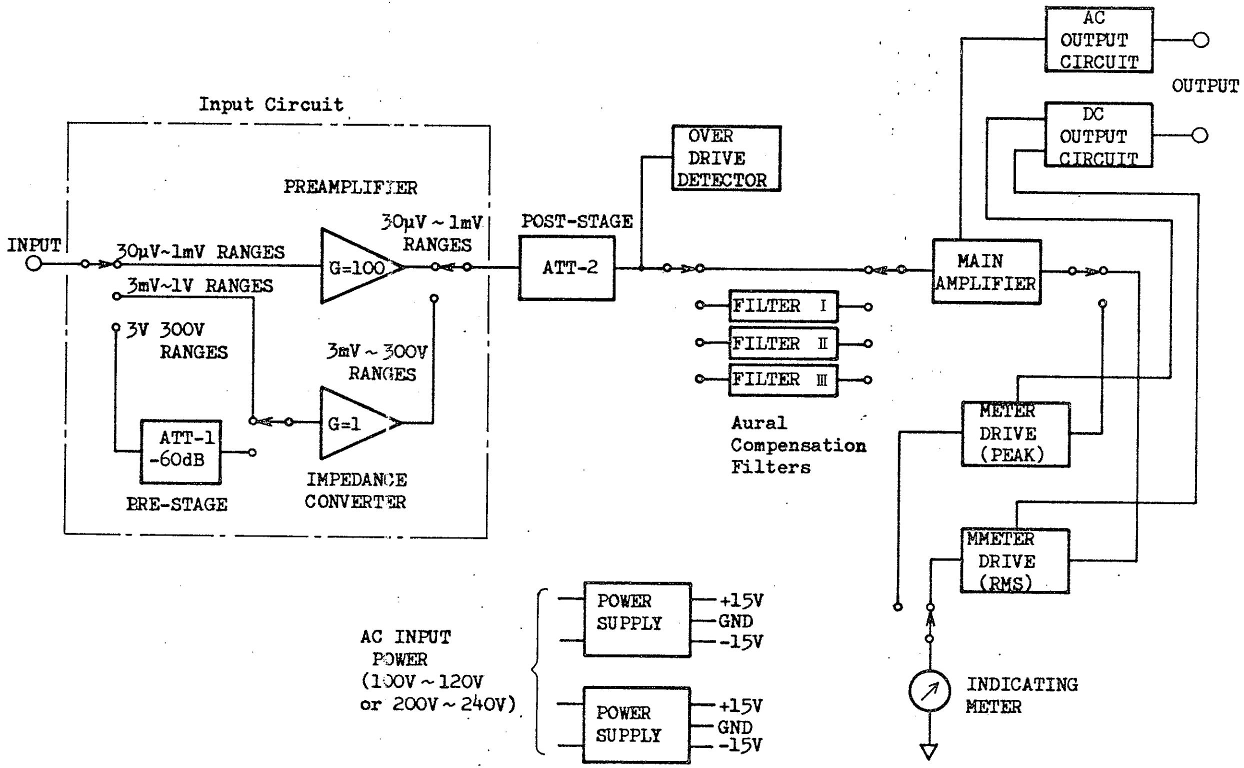


Figure 5-1 Block Diagram

o 3 mV ~ 1 V ranges:

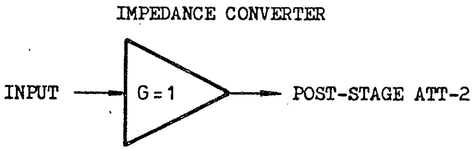


Figure 5-3

The input signal is fed via the impedance converter to the post-stage attenuator.

o 3 V ~ 300 V ranges:

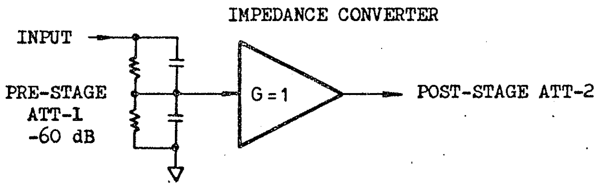


Figure 5-4

The input signal is fed via the 60 dB pre-stage attenuator and the impedance converter to the post-stage attenuator.

## 5.3 Post-stage Attenuator (ATT-2)

Attenuates the signal voltage in 10-dB equal ratio (0/10/20/30/40/50 dB) as shown in Figure 5-5.

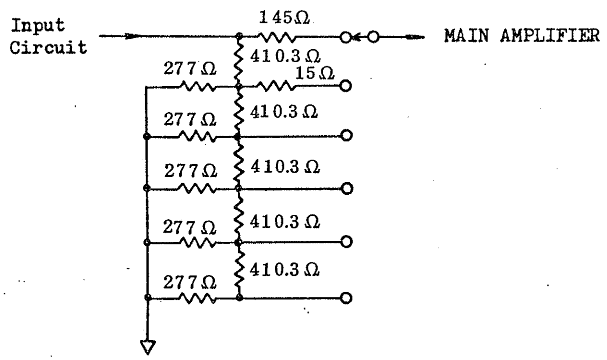


Figure 5-5

## 5.4 Aural Compensation Filter Circuit

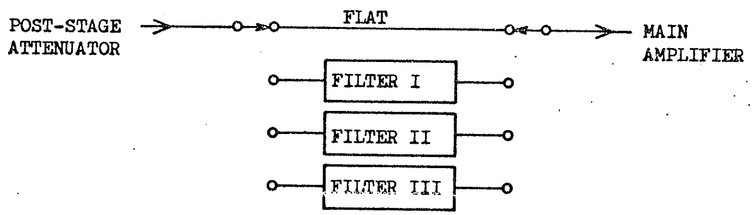


Figure 5-6

This circuit selects one of the four circuits, namely FILTERS I ~ III and FLAT.

For FILTERS I ~ III, any combinations of Kikusui's standard filters are possible. For other filters, please contact Kikusui's representative in your area.

### 5.5 Main Amplifier

The main amplifier amplifies the signal which is applied through the post-stage attenuator and filter circuit. The amplifier is a negative feedback amplifier with three transistors (Q111 ~ Q113) and having a gain of approximately 30 dB. The gain of the negative feedback amplifier is continuously variable for approximately 10 dB with the sensitivity adjustment potentiometer. The output of the amplifier is fed to the indicating meter drive circuit and output circuit.

### 5.6 Mean Value Detection Indicating Meter Drive Circuit

This circuit is composed of transistors Q115 and Q116 and IC MC101. A feedback current is fed from the collector of transistor Q116 via a rectifying diode to the emitter. Due to this feedback current, the diode is driven in an almost constant current mode, thereby improving the non-linearity of the diode and enabling the indicating meter scale graduated linear.

### 5.7 Peak Value Detection Indicating Meter Drive Circuit

This circuit is a quasi-peak-value detecting indicating meter drive circuit meeting the requirements of DIN and CCIR. The circuit consists of transistors Q202 Q203 and IC's MC204 MC209. MC204 MC206 follow the negative peak value of the input signal waveform, the output MC206 is rectified by CR209 and CR210 and smoothed by capacitors C211 ~ C213 to meet the meter drive characteristics specified by DIN Standard.

5.8 AC Output Circuit

This circuit receives the collector voltage signal of transistor Q113 of the main amplifier and amplifies the signal with transistor Q114, and provides the amplified signal with an output impedance of 600 ohms. The output terminal of this circuit provides a voltage of approximately 1 V when the indicating meter is full scale.

5.9 DC Output Circuit

This circuit detects with its MC210 the output of MC101 or MC209 of each of the indicating meter drive circuits, conditions the output impedance, and delivers the resultant output signal to the rear panel of the instrument.

Diodes CR211 and CR212 protect the DC output circuit. Even when a signal is applied by mistake to the output terminal, the signal is clamped by these diodes.

## 5.10 Overvoltage Input Detection Circuit

This circuit comprises a comparator consisting of IC's MC201 and MC202, an OR circuit consisting of diodes CR203 and CR204, and a multivibrator consisting of CMOS IC MC203 which provides a time constant for flickering the lamp.

Transistor Q201 for driving the over-driven state indicator lamp (LED CR401).

## 5.11 Power Supply

This circuit provides +15 V and -15 V regulated supply voltages. The +15 V supply is provided by IC (MC 102). The -15 V supply is provided by IC (MC103) with reference to the +15 V supply. The -15 V supply is regulated. Transistors Q117 and Q118 are Darlington-connected and Transistors Q119 and Q120 of the +15 V supply operate as current boost transistors for the -15 V supply.

## 5.12 Power Supply for Aural Compensation Filter Circuit

This circuit provides +15 V and -15 V regulated supply voltages the +15 V supply is provided by IC (MC211). The -15 V supply is provided by the regulated power supply circuit consisting of Q206 and Q207, which is connected for tracking to the +15 V supply as reference. Transistor Q205 is a current boost transistor for the +15 V supply.

# 6. MAINTENANCE

## 6.1 To Gain Access to Internal Adjustments

To gain access to the internal components, remove the top casing after undoing the two screws on the top of the casing and other two screws at each of the right and left sides of the casing and remove the bottom casing after undoing the four screws at the bottom of the casing. (Refer to Figures 6-1 and 6-2.)

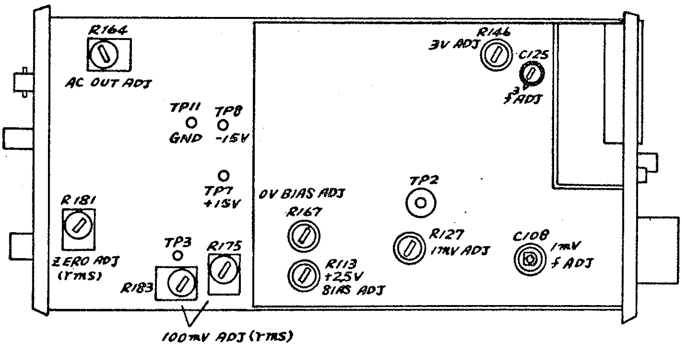


Figure 6-1

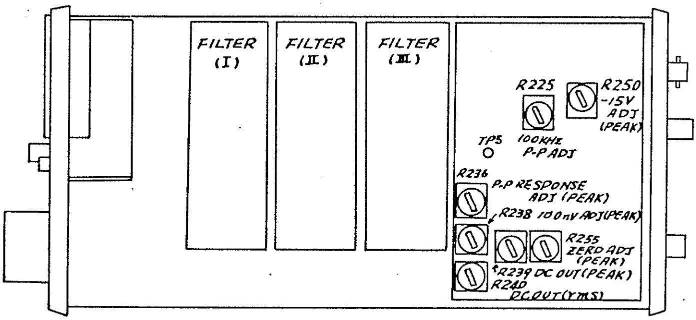


Figure 6-2

## 6.2 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 in the due order explained in the following. (Refer to Figures 6-1 and 6-2).

Table 6-1

| Test point | Voltage with respect to GND |
|---|---|
| TP7 +15 $V_1$ supply | 14 ~ 15.5 V |
| TP8 -15 $V_1$ supply | -14 ~ -15.5 V |
| TP1 +13 V supply | 11 ~ 15 V |
| TP9 +15 $V_2$ supply | 14 ~ 15.5 V |
| TP10 -15 $V_2$ supply | -14 ~ -15.5 V |

1) Mechanical zero adjustment of indicating meter:

So adjust the mechanical zero adjustment screw (⑤ in Figure 4-1) that the meter pointer indicates accurately the zero scale position. If the instrument power has been ON, turn OFF the power and allow 5 minutes or over to let the meter pointer settle and, then, perform mechanical zero adjustment.

2) Bias adjustment:

So adjust potentiometer R167 of the mean value indicating meter drive circuit that the voltage between test point TP3 and ground becomes zero volt. Also, so adjust potentiometer R113 of the preamplifier of input circuit that the voltage between test point TP2 and ground becomes +2.5 V. (For this adjustment, short the input terminals and set the range at 30 V.)

3) Electrical zero adjustment of indicating meter:

Set the RANGE switch ( ② in Figure 4-1) at 300 V range, short the input terminals, set the detection system selector switch (⑥ in Figure 4-1) in the rms state, and set the aural compensation selector switch (⑦ of Figure 4-1) in the FLAT state. Under these conditions, so adjust potentiometer R181 that the pointer of the indicating meter (④ of Figure 4-1) accurately indicates the zero scale position.

Next, set the detection system selector switch in the PEAK state and adjust the meter pointer accurately to the zero scale position by adjusting potentiometer R255 in a similar manner as done for rms.

4) Sensitivity adjustment and output adjustment:

Set the RANGE switch in the ±100 mV range, set the detection system selector switch in the rms state, and set the aural compensation selector switch in the FLAT position, apply to the input terminal a calibration signal of 100 mV 400 Hz or 1 kHz and so adjust potentiometers R174 and R183 of the indicating meter drive circuit that the meter pointer indicates accurately the full scale position, so adjust potentiometer R164 that the voltage of the AC output terminal becomes 1 V, and so adjust potentiometer R240 that the signal of the DC output terminal becomes 1 V.

Next, set the detection system selector switch in the PEAK state, apply a calibration signal of approximately 100 mV 100 kHz and, observing the waveform of TP5, so adjust potentiometer R225 that the peak value of the return waveform is correctly adjusted.

Next, apply a calibration signal of accurately 100 mV 400 Hz or 1 kHz and so adjust potentiometer R238 that the indication becomes full scale. Under this state, so adjust potentiometer R239 that the signal of the DC output terminal becomes 1 V.

5) Preamplifier:

Set the RANGE switch at 1 mV, set the detection system selector switch in the rms state, and set the aural compensation selector switch for FLAT. Apply to the input terminal a calibration signal of 1 mV 400 Hz or 1 kHz and so adjust potentiometer R127 of the preamplifier that the meter indicates accurately full scale. Next, change the calibration signal frequency to 400 kHz and so adjust the trimmer capacitor C108 that the meter indicates full scale. Repeat a few times the adjustments at 400 Hz and 400 kHz so that the adjustments become complete.

6) Adjustment of pre-stage attenuator:

Set the RANGE switch at the 3 V range. Apply to the input terminal a calibration signal of 3 V 400 Hz or 1 kHz and so adjust potentiometer R146 of the attenuator that the meter indicates full scale. Next, change the frequency of the calibration signal to 40 kHz and so adjust trimmer capacitor C125 that the meter indicates full scale.

7) Calibration of aural compensation filter:

Calibration of aural compensation filters requires a high-grade sophisticated calibration facility and technique. The filters should be factory-adjusted. Please contact Kikusui's representative in your area.

8) Adjustment of dynamic characteristics of meter:

The meter is required to be adjusted meeting the requirements of DIN and JIS Standards, requiring special facility and technique. Please contact Kikusui's representative in your area.

## 6.3 Troubleshooting

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

Circuit voltages without input signal for the instrument are shown in Tables 6-2 through 6-9. (The voltages are with respect to the ground and as measured with a 11-MΩ input resistance Kikusui Volt Ohm Meter 107C. The values may differ slightly from set to set.)

Pins of transistors and IC's, as viewed from the bottom, are shown in Figure 6-3.

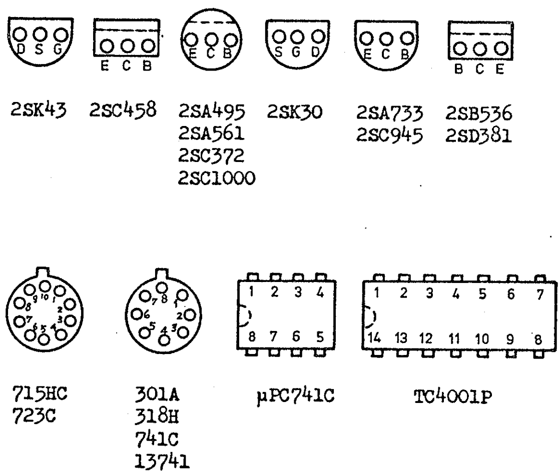


Figure 6-3 Pins of transistors and IC's

(bottom view)

1) Preamplifier

Table 6-1

| Transistor | Emittor or source | Collector or drain |
|---|---|---|
| Q101 2SC458 | 4 V | 7 V |
| Q102 2SK43 | 0.4 ~ 0.9 V | 4 V |
| Q103 2SC458 | 6.5 V | 12 V |
| Q104 2SA495 | 6.5 V | -11 V |
| Q105 2SC372 | -15 V | 0 V |
| Q106 2SC372 | 3 V | 14 V |
| Q107 2SA561 | 3 V | -15 V |
| Q108 2SC372 | 12.5 V | 15 V |

2) Impedance converter

Table 6-2

| Transistor | Emitter or source | Collector or drain |
|---|---|---|
| Q109 2SK30A | 0.25 V | 15 V |
| Q110 2SC372 | -0.4 V | 14 V |

3) Main amplifier and AC output

Table 6-3

| Transistor | Emitter | Collector |
|---|---|---|
| Q111 2SC1000 | 0.6 V | 6 V |
| Q112 2SA495 | 6.5 V | 3.3 V |
| Q113 2SC372 | 6.6 V | 7.5 V |
| Q114 2SA495 | 8.2 V | 6.4 V |

4) Mean value detection indicating meter drive circuit

Table 6-4

| Transistor | Emitter | Collector |
|---|---|---|
| Q115 2SA495 | -0.04 V | -11 V |
| Q116 2SC372 | -12 V | 0.1 V |

MC101 No.6 pin (with input 0 V) Approx. 0 V

5) Peak value detection indicating meter drive circuit

Table 6-5

| Transistor | Emitter | Collector |
|---|---|---|
| Q202 2SC372 | 0.4 V | 10 V |
| Q203 2SA495 | 10.7 V | 2.2 V |
| Q204 2SA495 | approx. 0 V | -15 V |

MC209 No.6 pin (with input 0 V) Approx. 0 V

6) Overvoltage input detection circuit

Table 6-6

| IC | Pin No. | Voltage |
|---|---|---|
| MC201 301A | 6 | Approx. 0 V |
| MC202 301A | 6 | Approx. 0 V |
| MC203 TC4001P | 4 | Approx. 0 V |

7) Power supply (Refer to Table 6-1)

Table 6-7

| IC | Pin No. | Voltage |
|---|---|---|
| MC102 723C | 4 | 6.8 ~ 7.8 V |
| MC103 741C | 2 | Approx. 0 V |

8) Power supply for aural compensation filter

Table 6-8

| Transistor | Emitter | Collector |
|---|---|---|
| Q205 2SC381 | 14.5 V | 19.5 V |
| Q206 2SA495 | 0 V | -15.6 V |
| Q207 2SB536 | 15 V | 21 V |

MC 211 No.4 pin 7 V

## 6.4 AC Line Voltage Modification

The primary winding of the power transformer has taps for 100 V system and 200 V system. To modify the AC line voltage of the instrument, change the connection to the required tap.

To change from the 100 V system to the 200 V system, disconnect No. 1 wire (normally, brown wire is used) and connect No. 2 wire (normally, red wire is used) on the rear panel of the instrument. The color coding for the wires is shown in Table 6-10. However, as wires of different colors may be used, be sure to check the tap wire numbers when modifying the line voltage.

Table 6-9

| AC line voltage | Tap wire number | Wire color |
|---|---|---|
| 0 V | 0 | black |
| 100 ~ 120 V ±10% | 1 | brown |
| 200 ~ 240 V ±10% | 2 | red |