INSTRUCTION MANUAL

MODEL 677A

WOW & FLUTTER METER

KIKUSUI ELECTRONICS CORPORATION

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1. GENERAL

Kikushi Model 677A Wow & Flutter Meter is designed to measure variations in the running speed of various sound record/playback devices such as audio tape recorders, video tape recorders, disc record players, and cine sound recorders. Measurement can be made also in conformity with the JIS Standard, NAB Standard, and CCIR (DIN) Standard.

The measuring sensitivity is very high and covers a range of 0.005 - 1% being divided into three sub-ranges. Measurement can be made under the weighted mode as per the JIS, NAB, or CCIR (DIN) Standards, under the state that wow and flutter are mutually separated, and under the state that wow and flutter are mutually superimposed.

The tape speed is digitally measured with a frequency counter and is indicated with a 4-digit readout. Due to the above features, the 677A is very convenient for research, development, manufacturing, inspection, and maintenance of record/playback devices.

The 677A has output terminals for an oscilloscope and a recorder in order to facilitate analysis of wow and flutter by displaying or recording the waveform on such instruments.

FEATURES

1. The value of wow and flutter is measurable as per various standards and the measured value is directly readable.

JIS Standard:	R.m.s. value indication
NAB Standard:	Mean value indication
CCIR (DIN) Standard:	Peak value indication

2. The measuring sensitivity is high. The minimum input level is as low as 5 mV.

3. Lighting of the input pilot LED indicates correct application of the input signal. No adjustment is required for input level and frequency.
   (LED : Light Emitting Diode)

4. The measuring center frequency range is as wide as 3000 Hz ± 10%.

5. The wow and flutter measuring sensitivity is high. The minimum measurable level is as low as 0.005%.

6. Tape speed is displayed with the 4-digit display of the digital frequency counter, eliminating human reading errors.

7. Wow and flutter can be measured mutually separately.

8. An output terminal for an oscilloscope is provided for observation of wow and flutter waveform and period.

9. An output terminal for a recorder also is provided for recording of tape speed (drift), and wow and flutter.

10. The frequency accuracy of the internal oscillator is as high as 3000 Hz ± 0.05% (+1.5%). Temperature drift of the oscillation frequency is virtually zero.

11. IC's and silicon transistors are employed throughout the circuits, resulting in high reliability, compactness and lightweight.

12. The digital frequency counter which usually is used to measure the tape speed can also be used, by pressing the corresponding selector button, to measure input signal frequency for a range of 10 - 9999 Hz.

2. SPECIFICATIONS

Name:	Wow & Flutter Meter
Model:	677A
Input terminals:	5-way, 19 mm (3/4 in.) intervals
Measuring center frequency range:	3000 Hz ±10% (±300 Hz)
Input level range:	5 mV - 10 V rms (irrespective of amplitude)
Input sensitivity selection:	5 mV - 10 V rms 50 mV - 10 V rms } 2 ranges
Input impedance:	Approx. 50 kΩ (single-ended)
Measuring ranges:	0.005 - 1% (in three subranges of 0 - 0.1%, 0 - 0.3%, and 0 - 1%)
Indication systems:	Rms value indication as per JIS Standard. Mean value indication as per NAB Standard. Peak value indication as per CCIR (DIN) Standard.
Indicating meter accuracy:	Better than ±5% of F.S.
Frequency characteristics	
Weighted characteristics:	As per JIS (C5551), NAB, and CCIR (DIN)
Flat characteristics:	0.5 - 200 Hz, +1 dB ~ -3 dB (4 Hz as reference)
Wow and flutter separation characteristics:	Wow 0.5 - 6 Hz, flutter 6 - 200 Hz

Tape speed indication:	Decimal display with memory, 4 digits
Frequency measuring range:	10 Hz - 9999 Hz
Gate time:	1 sec.
Measuring accuracy:	±1 count ± reference time accuracy
Measuring unit:	Hz
Reference frequency:	100 kHz, accuracy $\pm 5 \times 10^{-5}$
Counter input terminals:	5-way, 19 mm (3/4 in.) intervals
Input level range:	50 mV - 10 V rms (irrespective of amplitude)
Input impedance:	Approx. 100 kΩ (single-ended)
Internal oscillator	
Output terminals:	5-way, 19 mm (3/4 in.) intervals
Frequency:	3000 Hz ±0.05% (±1.5 Hz)
Output impedance:	600 Ω ±20% (single-ended)
Output voltage:	1.0 V rms or over (open terminal)
Distortion factor:	Less than 1.0%
Oscilloscope terminals:	5-way, 19 mm (3/4 in.) intervals
Output level:	Approx. 3 Vp-p (open terminal), for F.S. indication in JIS or NAB Approx. 4 Vp-p (open terminal), for F.S. indication in CCIR
Output impedance:	Approx. 50 kΩ (single-ended)
Recorder terminals:	5-way, 19 mm (3/4 in.) intervals
Output level:	±0.027 V/deviation (Hz) (open terminal)
Output impedance:	Approx. 50 kΩ (single-ended)

Stability:	(for ±10% variation of nominal ____V AC line voltage)
Variation in wow and flutter indication:	Within ±1% of F.S.
Variation in tape speed indication:	Within ±0.05% (at 3000 Hz)
Variation in oscillation frequency:	3000 Hz ±0.04%
Power requirements:	____V AC, 50/60 Hz, approx. 23 VA
Dimensions:	200 (W) × 140 (H) × 380 (D) mm
(Maximum dimensions):	(200 (W) × 160 (H) × 410 (D) mm)
Weight:	Approx. 6.5 kg
Accessories:	
	Instruction manual 1

3. OPERATION PROCEDURE

3.1 EXPLANATION OF FRONT PANEL (See Fig. 3-1.)

(1) POWER: When this switch is pressed and locked, the power of the Meter is turned on and the display tubes of the counter light. The power is turned off when the button is pressed again.

(2) INPUT: Input terminals for the signal from record/ playback device to be tested. The GND terminal is electrically connected to chassis and housing. Also when the Meter is used as a counter for frequency measurement, the signal to be measured is applied to these terminals.

(3) SENSITIVITY PUSH 5 mV: Input sensitivity selector switch. The unpushed state is for 50 mV rms, and the pushed and locked state is for 5 mV rms of sensitivity. The maximum input voltage, for both states, is 10 V rms.

(4) SET LEVEL: When the signal being fed to the input terminal is not less than 5 mV or 50 mV (according to the state of the input selector switch), this green LED lights to indicate that the signal is in the measurable state.

(5) PUSH COUNTER: When this button is pressed and locked, the Meter operates as a frequency counter and indicates the frequency of the signal being applied through the INPUT terminal.

(6) COUNTER INPUT LEVEL: When the level of the signal being applied to the INPUT terminal is not less than 50 mV rms, this green LED lights to indicate that the Meter is ready to operate as a frequency counter.

(7) INDICATION: Push-button switches to select indication modes (measuring standards) as mentioned below. When the required button is pressed and locked, indication is made as per the selected standard.

- o JIS: Wow and flutter are measured as per JIS (Japanese Industrial Standard).
- o NAB: Wow and flutter are measured as per NAB Standard.
- o CCIR: Wow and flutter are measured as per CCIR Standard.

(8) MODE: Push-button switches to select the below-mentioned modes of wow and flutter measurement. When the required switch is pressed and locked, measurement is made in the corresponding mode.

- o WEIGHTED: Wow and flutter are measured in the weighted mode (with hearing sense compensation) as per JIS, NAB, and CCIR (DIN) Standards.
- o WOW: Wow component alone (0.5 - 6 Hz) of the input signal is separately measured.
- o FLUTTER: Flutter component alone (6 - 200 Hz) of the input signal is separately measured.
- o LINEAR: All components of wow and flutter are inclusively measured as per JIS, NAB, and CCIR (DIN) Standards.

(9) WOW & FLUTTER (%): These pushbutton switches select wow and flutter measuring ranges for 0.1%, 0.3%, or 1.0% as the maximum indication value. An appropriate button should be pressed according to the level of wow and flutter to be measured.

(10) WOW % INDICATOR: Wow and flutter indicating meter with double scales (the upper scale is for 1.0 and the lower scale for 0.3). Reading corresponds with setting of the WOW & FLUTTER (%) selector switches. The same indication system is applicable to all standards (JIS, NAB, and CCIR).

(11) FREQUENCY (Hz) TAPE SPEED: A 4-digit decimal readout which displays the tape speed or the frequency (in Hz) of the input signal when the Meter is used as a frequency counter.

(12) STAND: This stand may be erected to adjust the observation angle of the front panel of the Meter.

3.2 EXPLANATION OF REAR PANEL (See Fig. 3-2.)

(13) TO SCOPE: This terminal provides a wow and flutter signal which can be displayed on an oscilloscope for waveform observation and period measurement. The GND terminal is connected to the chassis. The output impedance is approximately 50 kΩ.

(14) TO RECORDER: This terminal is for recording of drift (tape speed), or wow and flutter, using a recorder. The GND terminal is connected to the chassis. The output impedance is approximately 50 kΩ.

(15) DRIFT DC - 200 Hz SWITCH: This switch selects recording of either drift (tape speed), or wow and flutter. The DRIFT position is for the former and the DC-200Hz position is for the latter.

(16) 3 kHz OUTPUT: This terminal provides a 3 kHz output used as a recording signal. The GND terminal is connected to the chassis.

(17) FUSE: AC line fuse holder. The fuse is a regular tubular glass fuse (1 A).

(18) POWER CORD: AC line power cord. (To be connected to an outlet of nominal ____V, 50/60 Hz AC.)

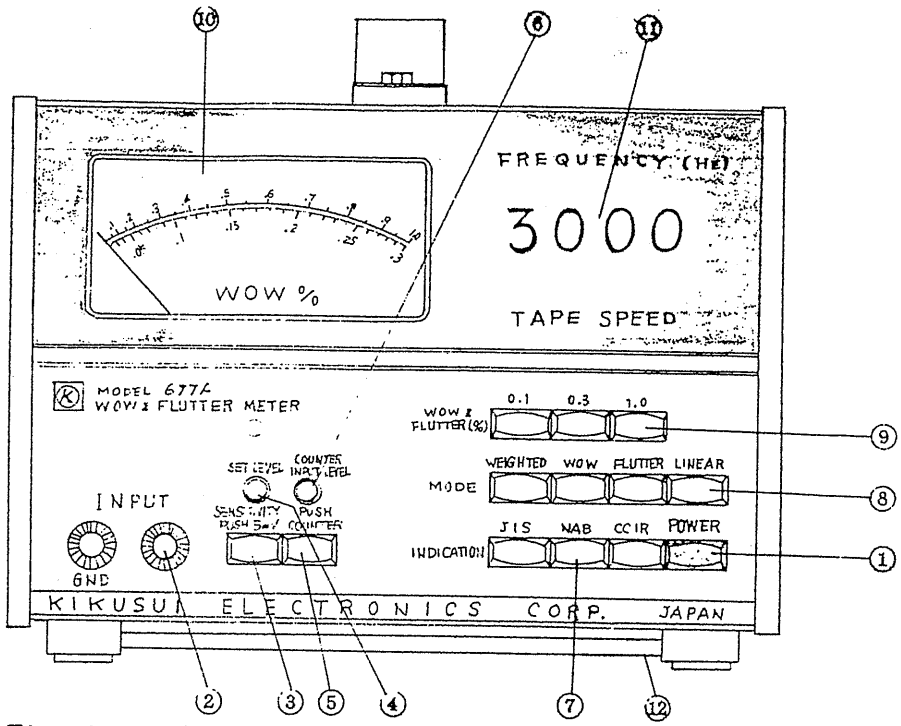


Fig. 3-1 Front panel layout

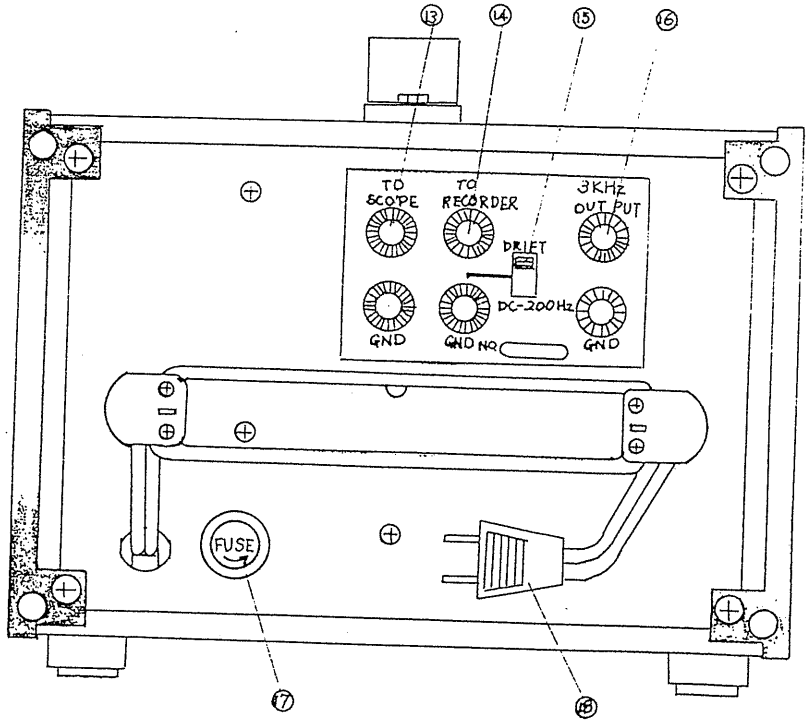


Fig. 3-2 Rear panel layout

3.3 OPERATION PROCEDURE

3.3.1 Set the POWER switch in the OFF state, connect the power cord to an AC line outlet (100 V), and set other panel switches as below:

MODE:	WEIGHTED or LINEAR state, normally.
INDICATION:	JIS, NAB, or CCIR, as required.
WOW & FLUTTER (%):	1.0
SENSITIVITY PUSH 5 mV:	Unpushed state
PUSH COUNTER:	Unpushed state

3.3.2 In the case an initial recording is required, connect the 3 kHz OUTPUT terminal (on the rear panel) to the input of the tape recorder to be tested. In the other case that recording has already been made, connect the playback output terminal of the tape recorder to the INPUT connector.

3.3.3 Press the POWER switch to turn on the power. When this is done, nixie tubes light. In the case the initial recording is required, make recording for the period required for measurment. The output of the 3 kHz OUTPUT terminal (on the rear panel) is constantly kept supplied irrespective of setting of the other switches.

3.3.4 Apply the reproduced signal of the tape recorder (the signal to be measured) to the INPUT connector of the Wow & Flutter Meter. If the signal level is not less than 50 mV, the SET LEVEL green LED lights to indicate that the measurement is ready to be made. If the signal level is low, press the SENSITIVITY PUSH 5 mV button to raise the input sensitivity from 50 mV to 5 mV. Under this state, even if the lamp is lighted, measurement cannot be successfully made unless the TAPE SPEED meter is indicating a speed of 3000 Hz ±10% (±300 Hz).

3.3.5 The measurement is ready to be made if the SET LEVEL green LED is lighted and the TAPE SPEED is within a range of 2700 Hz to 3300 Hz. Change the WOW & FLUTTER (%) selector buttons in the order of "1.0", "0.3", and "0.1" in accordance with the magnitude of the wow and flutter component of the measured signal. In parallel with the measurement of the wow and flutter component, the tape speed can be directly read on the frequency counter (in Hz) irrespective of setting of the other panel switches.

3.3.6 The value of wow and flutter can be directly read on the same meter scale for all of JIS, NAB, and CCIR Standards.

3.3.7 To measure the wow component alone, press the WOW button of the MODE selector; to measure the flutter component alone, press the FLUTTER button. In these cases, measurements are made irrespective of JIS, NAB, and CCIR Standards. Indication systems alone are separated between wow and flutter.

3.3.8 The waveform and period of wow and flutter can be displayed and measured by connecting the output signal of the TO SCOPE terminal to an oscilloscope. To record drift (tape speed), connect the signal of the TO RECORDER terminal to a recorder and throw the DRIFT/DC-200Hz switch to the DRIFT position. For recording of wow and flutter, throw the switch to the DC-200Hz position. The signal of the TO RECORDER terminal actually is the output of a frequency discriminator and this signal is constantly supplied irrespective of setting of the panel switches. The signal varies in the negative polarity as the tape speed drifts into a faster speed. The signal of the TO SCOPE terminal corresponds to setting of the MODE selector and WOW & FLUTTER (%) selector switches.

3.3.9 To operate the Wow & Flutter Meter as a frequency counter, press the PUSH COUNTER button and connect the signal to be measured to the INPUT terminal. (The measurable input signal level range is 50 mV to 10 V rms.)

3.3.10 When the Meter is operated as a frequency counter, the readout indicates the frequency of the input signal irrespective of setting of the panel switches.

3.4 MEASURING EXAMPLES

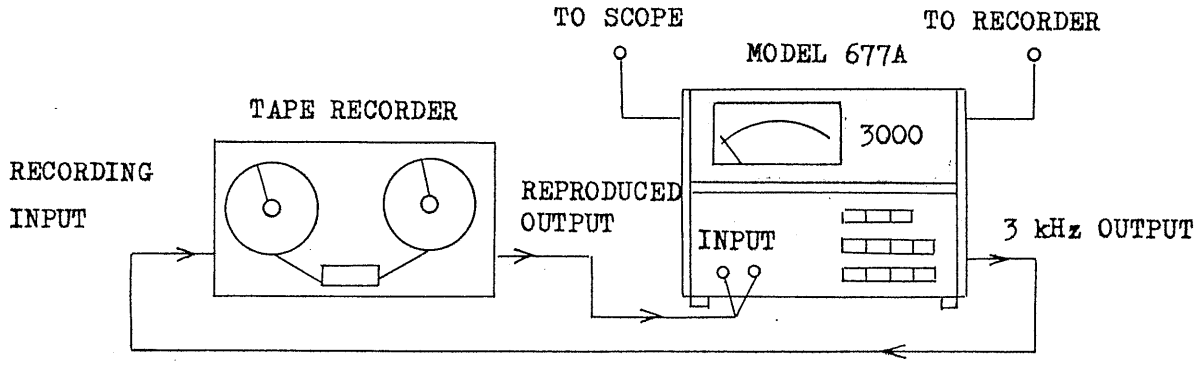


Fig. 3-3 A measuring setup for wow and flutter of a tape recorder

3.4.1 Measuring Methods

(1) Simultaneous record/playback measurement: Measurement is made while recording and playback are being simultaneously performed (for devices which can perform simultaneous record/playback operation).

(2) Separate record/playback measurement: First, recording is made and the recorded tape is rewound. Next, measurement is made playing back the recorded tape.

(3) Different recorder measurement: Measurement is made by playing back the tape which has been recorded with another tape recorder.

Measurement in all of the above three methods can be made with a measuring setup as shown in Fig. 3-3.

3.4.2 Excerpt of JIS C 5551 " Test Method for Magnetic Sound Recording and Reproducing Equipment "

Reproduce the signal from the wow/flutter test tape wound on a reel of the maximum size usable on the tape recorder to be tested. Measure the reproduced signal using a wow/flutter meter which has a weighted circuit (hearing sense compensation circuit) of the characteristics as shown in Fig. 3-4 and which can indicate the wow/flutter component in rms value. Determine the measured value in percentage.

Measurement shall be made for three times at each of the start, middle, and end sections of the tape wound on the reel.
The largest one of the three shall be determined as the wow/flutter characteristics of the tested tape recorder. Measurment for each section must be made for a period not less than 10 sec.

3.5 PRECAUTIONS

3.5.1 Note that, in wow and flutter measurement, the indication largely varies according to the applied standard. Also note that the indication largely varies according to JIS, NAB, and CCIR Standards, and to whether a weighted circuit is employed or not.

3.5.2 For the separate measurement of WOW or FLUTTER, there are no standards or recommendations to be based upon.

3.5.3 The reproduced output which is applied to the INPUT terminal must have a sufficient level to light the SET LEVEL LED. This LED lights so far as the input signal has a sufficient level, even when the signal is not within 3 kHz ±10%. Ensure that the indication of the TAPE SPEED readout is within a range of 2700 to 3300 Hz.

3.5.4 Do not apply a signal from a circuit where a DC or other signal is superimposed, to the INPUT, 3 kHz OUTPUT, TO SCOPE, or TO RECORDER terminal.

3.5.5 Do not simultaneously press two or more buttons of each of selectors for MODE, INDICATION, and WOW & FLUTTER. If this precaution is ignored, measurement will be unsuccessful.

3.5.6 When the reproduced signal level is sufficiently high (more than 50 mV), measurement should be made without pressing the SENSITIVITY PUSH 5 mV button. Under this state, the wow/flutter indicating meter is less subjected to overscale deflection and stable measurement being less affected by noise can be made.

3.5.7 If the pointer of the indicating meter is not pointing the zero scale position under the state the power is turned off, adjust the pointer to the zero position by inserting a screwdriver through the adjusting hole drilled in the panel.

4. OPERATING PRINCIPLE

The operating principle of the Model 677A Wow & Flutter Meter is shown in the block diagram of Fig. 4-1.

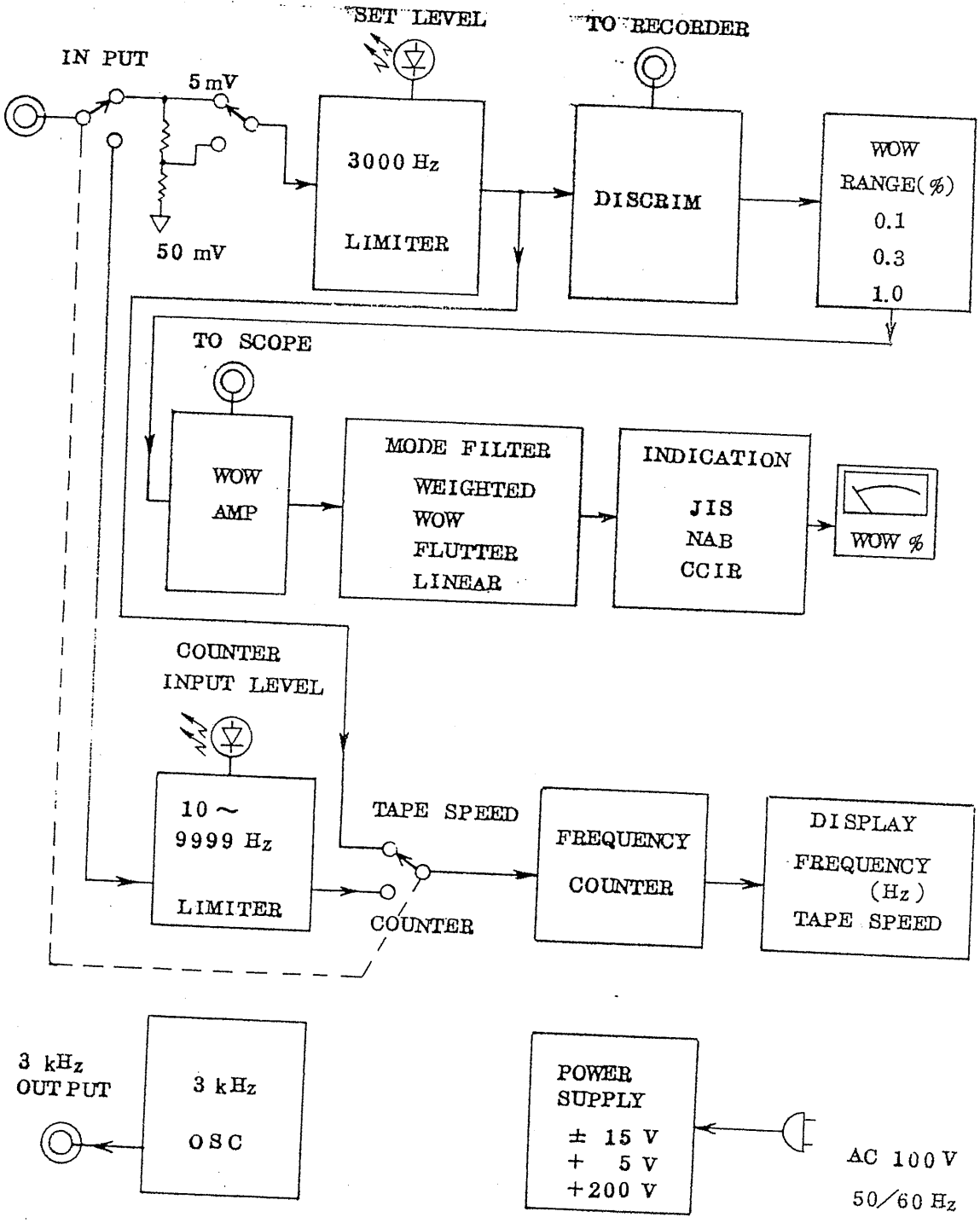


Fig. 4-1 Block diagram of Model 677A WoW & Flutter Meter

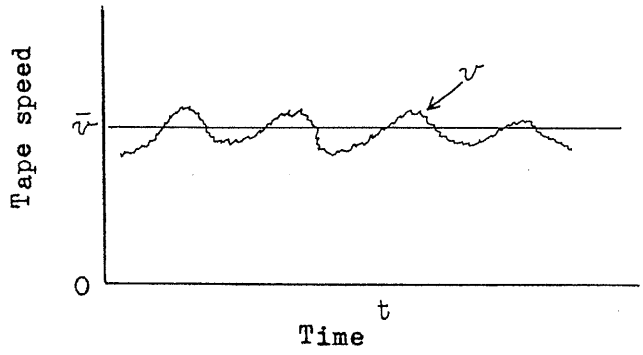


Fig. 4-2 Definition of wow and flutter

The ordinate of Fig. 4-2 represents the tape speed; and the abscissa the time. Denoting the average tape speed by $\bar{v}$, the wow/flutter is given as follows:

$$\text{Wow/flutter} = \frac{v - \bar{v}}{\bar{v}} \times 100\ (\%)$$

When the tape on which a signal has been recorded with an ideal tape recorder having almost no wow/flutter is reproduced by the tape recorder to be tested, the wow/flutter can be given with the below equation since the instantaneous frequency of the reproduced signal is proportional to the tape speed.

$$\text{Wow/flutter} = \frac{f - f_o}{f_o} \times 100\ (\%)$$

where, f_o: Center frequency (constant frequency of test tape)

f: Instantaneous value of reproduced frequency (measured frequency)

Wow/flutter actually is measured employing the latter equation. In fact, the signal reproduced by the tested tape recorder is frequency-modulated by wow and flutter with respect to the center frequency (f_o). The wow/flutter factor actually is measured as a depth of frequency modulation. Thus, the basic operating principle of the wow/flutter meter is identical with that of the demodulator of an FM receiver.

Wow and flutter are caused by departures of the actual tape speed from the absolutely uniform ideal tape speed. Slower variations are called "wow," and faster variations "flutter." Very slow variations are called "drift" and are distinguished from wow and flutter.

Referring to Fig. 4-1, the output signal (frequency-modulated signal) of the tape recorder to be tested is fed through the INPUT terminal to the limiter. The limiter eliminates the amplitude-modulated component of the signal lest it should adversely affect the wow/flutter measurement.

The constant-amplitude output of the limiter is fed to the frequency discriminator. The limiter output is also fed to the frequency counter circuit to indicate the frequency (tape speed) with the digital readout. The frequency-demodulated output of the discriminator is voltage-divided with the wow/flutter range selector, is amplified, and is applied to the mode selector which has filters of the required characteristics. The WEIGHTED filters are for hearing sense compensation as per JIS, NAB, and CCIR Standards. The WOW filter and FLUTTER filter, having responses as illustrated in Fig. 4-3, are used to separate the wow component from the flutter component with 6 Hz as the separating frequency. The LINEAR filter passes all wow and flutter components.

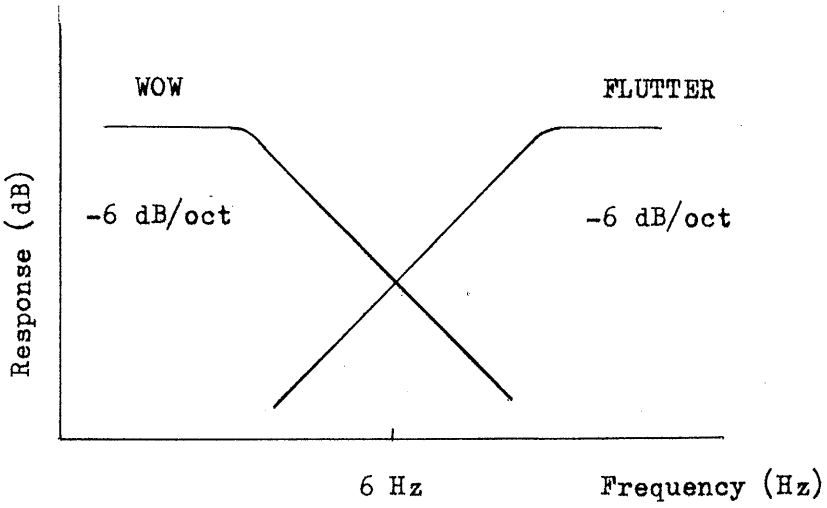


Fig. 4-3

The wow/flutter signal which has passed the required filter is amplified and drives the wow/flutter indicating meter in the selected indication system (JIS, NAB, or CCIR).

The TO SCOPE terminal provides the wow/flutter signal to be displayed on an oscilloscope for waveform observation. The TO RECORDER terminal provides the wow/flutter and drift (tape speed) signal to be recorded with an external recorder. The signal voltage varies in the negative polarity as the tape speed increases.

When a test tape (standard tape) on which the standard signal has been correctly recorded is available, wow/flutter measurement can be readily made by playing back this tape with the tape recorder to be tested. However, when no such test tape is available, the signal must at first be recorded on a tape and the recorded tape must then be played back. To provide the reference signal (3 kHz) for this purpose, a reference oscillator is incorporated in the Wow & Flutter Meter. This oscillator is a tuning-fork type, provides excellent frequency accuracy and stability, and its operation is independent from all other circuits of the Wow & Flutter Meter.

5. MAINTENANCE

5.1 ACCESS TO INTERNAL COMPONENTS

5.1.1 To Gain Access to the Chassis

Ensure that the power is turned off. Remove the four clamping-screws of the four studs at the four corners of the rear panel, and slowly pull backwards both side panels, top panel, and bottom panel.

5.1.2 Layout of Components

The layout of the major components of the Wow & Flutter Meter is as shown in Fig. 5-1. Fourteen printed circuit boards as mentioned below are used in the Meter.

A1: Limiter for wow/flutter measurement

A2: Frequency discriminator

A3: Wow/flutter signal amplifier

A4: Mode filters, meter circuit

A5: Indication system selector switches

A6: 3 kHz oscillator

A7: Input range selector

A8: Power supply (±15 V)

A9: Output for recorder (for drift measurement)

A10: Mother board

A11: Digital readout circuit

A12: Counter circuit

A13: Limiter for frequency counter

A14: Power supply (+5 V, +200 V)

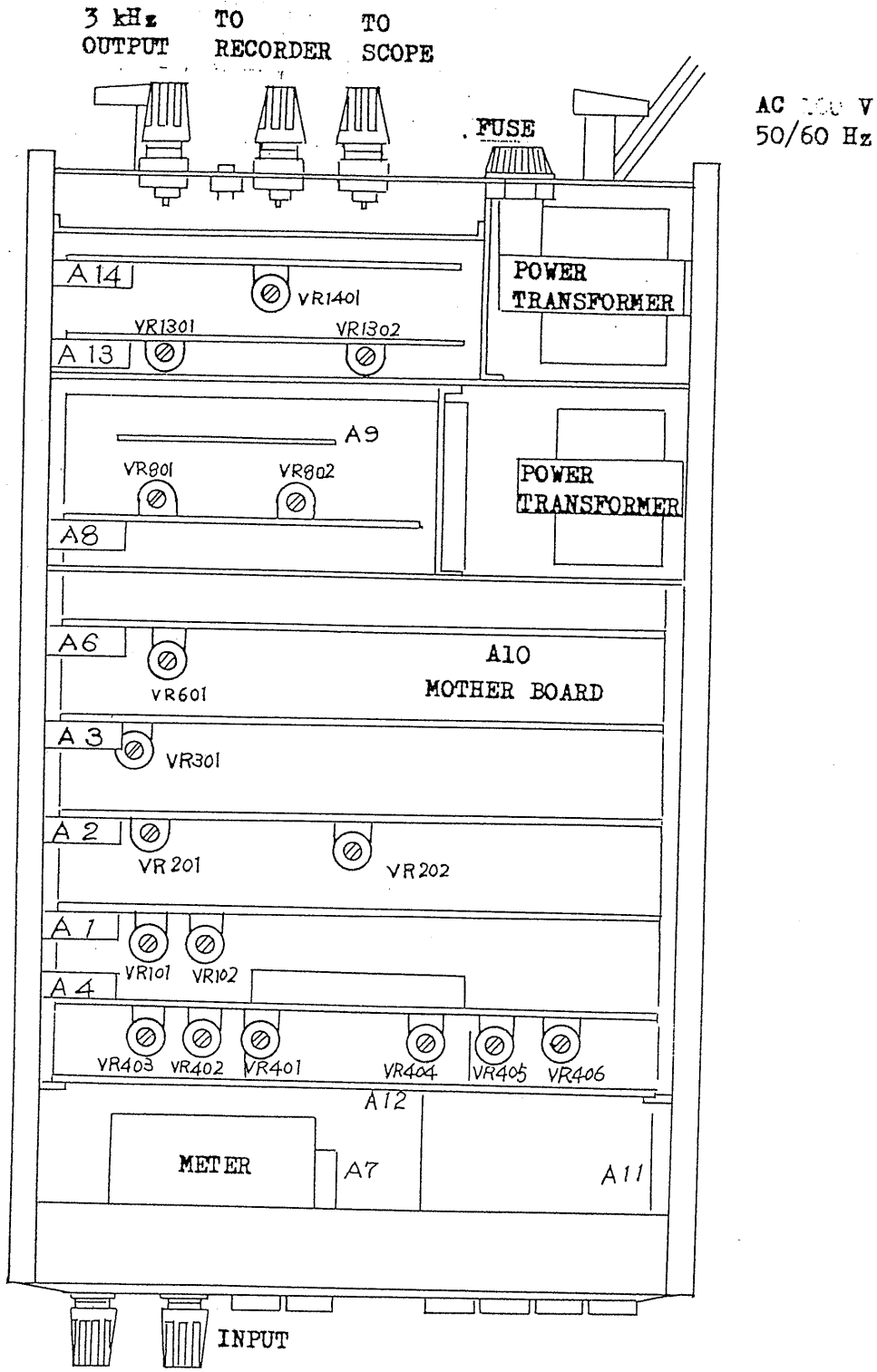


Fig. 5-1 Layout of components (top view)

5.2 ADJUSTMENT AND CALIBRATION

The Model 677A Wow & Flutter Meter has been properly adjusted and accurately calibrated at the factory prior to shipment and, therefore, does not require adjustment or calibration by the user. However, adjustment and calibration will be necessary when periodical servicing or troubleshooting is made or when a certain defective component is replaced. Such adjustment and calibration procedures will be described in this section.

5.2.1 Precautions for Adjustment and Calibration

(a) Allow more than 5 minutes of stabilization period after turning on the power of the Meter.

(b) Allow sufficient stabilization periods for calibrating instruments also.

(c) Refer to Fig. 5-1 and the schematic diagrams.

5.2.2 Instruments Required for Adjustment and Calibration

Instruments	Performance	Remarks
Wow/flutter calibrator	Center frequency: 3 kHz Wow/flutter: 0 - 1% Wow/flutter frequency: 0.2 - 200 Hz	KIKUSUI MODEL 601
Audio signal generator	20 Hz - 100 kHz	KIKUSUI MODEL 417A
AC voltmeter	0.1 mV - 300 V	KIKUSUI MODEL 164D
Frequency counter	0.1 Hz - 1 MHz	
DC voltmeter	0 - 100 V	KIKUSUI MODEL 155A

5.2.3 Adjustment of Regulated Voltage Circuit

Connect a DC voltmeter to each of between test point TP801 of printed board A8 and chassis and between test point TP802 and chassis, and adjust VR801 and VR802 so that the voltages are made +15 V and -15 V, respectively.

5.2.4 Adjustment of 3 kHz Oscillator

The oscillation frequency does not appreciably vary by aging and, therefore, no frequency adjustment is required. For output voltage adjustment, connect an AC voltmeter to the 3 kHz OUTPUT terminal (on the rear panel) and adjust VR601 (on printed board A6) so that the voltage is made 1.5 V rms.

5.2.5 Adjustment and Calibration of Wow/Flutter Indicating Meter

(1) Set the panel switches as below.

MODE:	WEIGHTED
INDICATION:	JIS
SENSITIVITY PUSH 5 mV:	Unpushed state
WOW & FLUTTER (%):	0.1
POWER:	ON

(2) To the INPUT terminal, connect a wow/flutter calibrator which has been set as below.

(a)	Output:	Voltage approx. 1 V, center frequency 3000 Hz
(b)	Wow/flutter:	0.1% rms, sine wave
(c)	Wow/flutter frequency:	4 Hz

(3) If the meter pointer is not correctly deflected to the full scale position, make adjustment with VR301 of printed board A3.

(4) Set the MODE selector alone among the front panel selectors as below.

MODE: LINEAR

(5) Adjust VR403 (on printed board A4) so that the meter indicates the full scale position.

(6) Press the WOW button of the MODE selector.

(7) Set the wow/flutter frequency of the calibrator alone at 2 Hz.

(8) Adjust VR401 so that the meter indicates the full scale position.

(9) Press the FLUTTER button of the MODE selector.

(10) Set the wow/flutter frequency of the calibrator alone at 40 Hz.

(11) Adjust VR402 so that the meter indicates the full scale position.

(12) Press the WEIGHTED button of the MODE selector and the NAB button of the INDICATION selector.

(13) Set the wow/flutter frequency of the calibrator alone at 4 Hz.

(14) Adjust VR406 so that the meter indicates the full scale position.

(15) Set the calibrator as below.

(a) Output: Voltage approx. 1 V, center frequency 3000 Hz

(b) Wow/flutter: 0.1% peak, sine wave

(c) Wow/flutter frequency: 4 Hz

(16) Set the INDICATION selector alone among the panel selectors as below.

INDICATION: CCIR

(17) Adjust VR405 so that the meter indicates the full scale position.

5.2.6 Adjustment of Dynamic Characteristics of Wow & Flutter Indicating Meter

No adjustment is required for the JIS and NAB Standards because the dynamic characteristics do not vary substantially. For the CCIR Standard, make adjustment as below.

(1) Set the panel selectors as below.

MODE:	WEIGHTED
INDICATION:	CCIR
SENSITIVITY PUSH 5 mV:	Unpushed state
WOW & FLUTTER (%):	0.1
POWER:	ON

(2) To the INPUT terminal, connect the wow/flutter calibrator which has been set as below.

(a)	Output:	Voltage approx. 1 V, frequency 3000 Hz
(b)	Wow/flutter:	3% rms
(c)	Function:	Pulse
(d)	Wow/flutter frequency range:	1 Hz (irrespective of dial)
(e)	Pulse width:	100 msec.

(3) Turn clockwise the MODULATION control of the calibrator so that the maximum deflection conforms with the full scale position of the meter.

(4) Check for that the minimum deflection (center indication between one full scale and the other full scale) is (40 ±10)% or within a range of .3 to .5 of the scale.

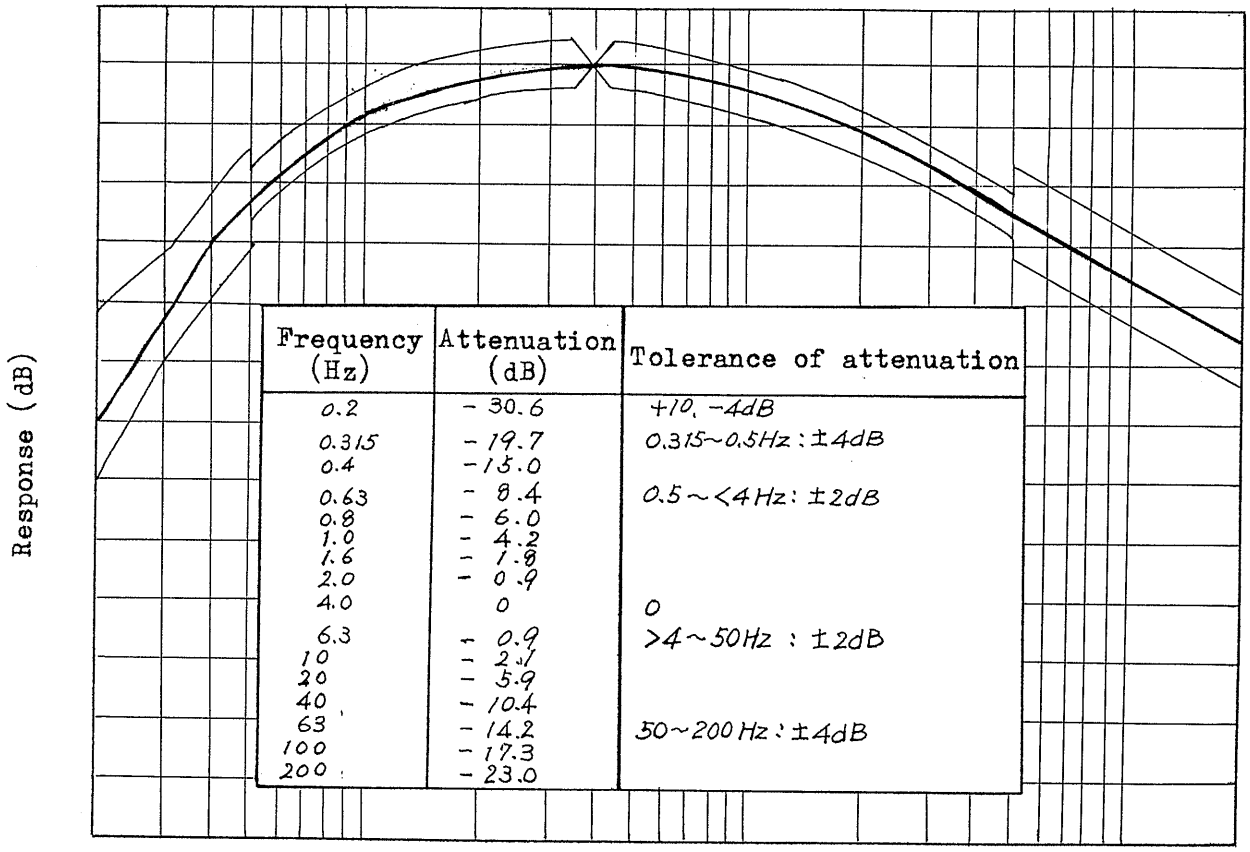
(5) Change the pulse width of the calibrator to 60 msec., 30 msec., and 10 msec., and check for that the maximum indications are within the below ranges.

60 msec.:	.84 - .96
30 msec.:	.56 - .68
10 msec.:	.18 - .24

(6) If the indication is not within the above ranges, adjust VR404 on printed board A4.

(7) When the above adjustment has been made, the full scale will be slightly affected. So, return to the procedure of Paragraph 5.2.5 (15). Repeat the procedure for a few times.

5.3 WEIGHTED CURVES (JIS, NAB, AND CCIR), AND DYNAMIC CHARACTERISTICS RECOMMENDED BY CCIR



Frequency (Hz)	Attenuation (dB)	Tolerance of attenuation
0.2	- 30.6	+10, -4dB
0.315	- 19.7	0.315~0.5Hz : ±4dB
0.4	- 15.0	
0.63	- 8.4	0.5~<4Hz : ±2dB
0.8	- 6.0	
1.0	- 4.2	
1.6	- 1.8	
2.0	- 0.9	
4.0	0	0
6.3	- 0.9	>4~50Hz : ±2dB
10	- 2.7	
20	- 5.9	
40	- 10.4	
63	- 14.2	50~200Hz : ±4dB
100	- 17.3	
200	- 23.0	

Fig. 3-4 Weighted compensation curves for wow/flutter measurement

Dynamic Characteristics of Indicator as per CCIR Recommendation

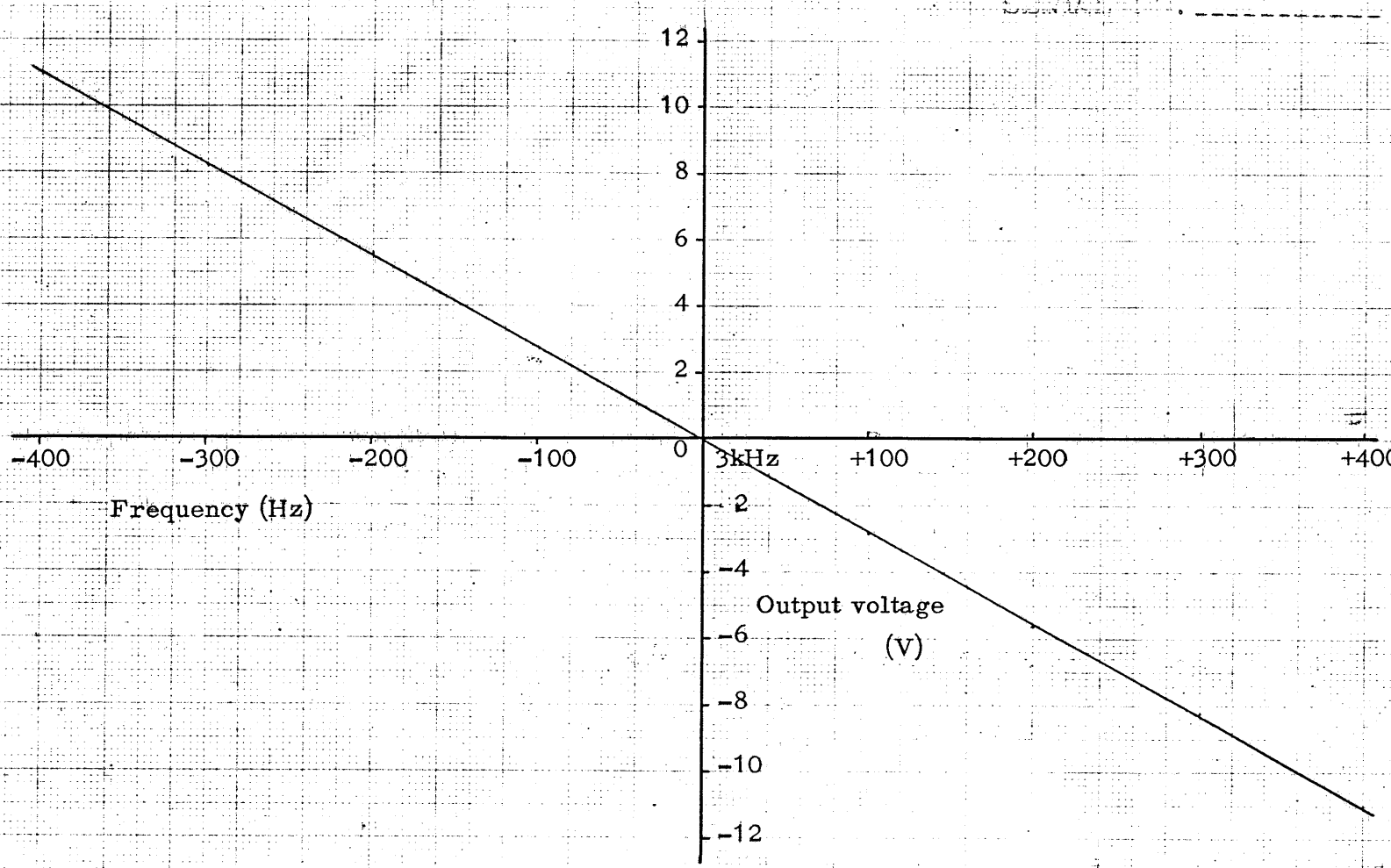
The meter shall be calibrated for its full scale with a frequency-modulated signal (center frequency 3 kHz and peak-to-peak modulated with a sine wave of 4 Hz). Next, apply another frequency-modulated signal (modulated with the rectangular pulses of the unidirectional polarity, pulse repetition frequency 1 Hz, and pulse width 100 msec.), and adjust the pulse height so that the same full scale is obtained. When the pulse width (A) is applied, the meter indication must be B% as shown in the below table.

A (msec.)	10	30	60	100
B (%)	21±3	62±6	90±6	100±4

The return time must be such that, when a pulse signal of repetition frequency 1 Hz and of pulse width 100 msec. is applied, the meter indicates (40±10)% between two adjoining pulses.

CCIR RECOMMENDATION 409-1

DISCRIMINATOR CHARACTERISTICS
(TYPICAL VALUE)



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