INSTRUCTION MANUAL

WOW FLUTTER METER

MODEL 6701

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.

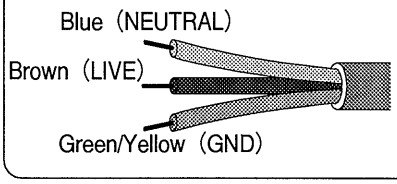
☐ AC power cable

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.

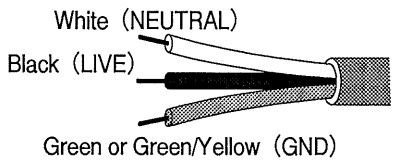
WARNING

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

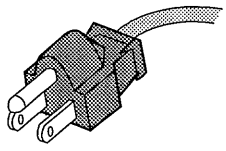
☐ Without a power plug



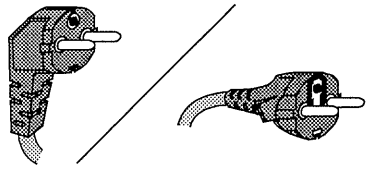
☐ Without a power plug



☐ 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

This instrument measures wow and flutters of various recording/reproducing devices including audio tape recorders, video tape recorders, disc record players, and cine sound recorders. The measurement comply with the following standards:

- o JIS Standard (rms-value measurement)
- o NAB Standard (mean-value measurement)
- o CCIR Standard (peak-value measurement)
- o DIN Standard (peak-value measurement)

The input voltage sensitivity is as high as 100 μV (-80 dBv), allowing direct measurement of the playback head output signal of a tape recorder. The wow and flutter measuring sensitivity also is very high — the instrument has a 0.01% FS range with minimum measuring division of 0.002%.

The instrument employs a highly stable crystal oscillator for providing a reference signal (3 kHz/3.15 kHz). To indicate the tape speed, the instrument employs a 4-digit frequency counter. The gate time of the counter can be referenced to the crystal oscillator output signal or to the AC line frequency (50/60 Hz). Frequency ratio measurement with respect to the reference signal (3 kHz/3.15 kHz) also is possible. Further, the frequency counter can be used for independent frequency measurement for a range of 10 Hz ~ 9999 Hz.

The instrument has output terminals for oscilloscope and pen recorder, for observation and measurement of wow/flutter waveform and period.

Incorporated with the above features, the instrument is widely applicable for wow and flutter measurements in research and development, manufacturing, inspection and maintenance of various types of recording/reproducing devices.

2. SPECIFICATIONS

Model No.:	6701
Measuring center frequency range:	Within 3000 Hz ±150 Hz (JIS, NAB, CCIR) Within 3150 ±150 Hz (DIN)
Input terminals:	5-way type, 19 mm (3/4 in.) spacing, HI, LO, GND terminals
Input impedance:	Within 600 kΩ ±20% (between HI - LO) Approx. 300 kΩ (between HI - GND, LO - GND) Approx. 10 kΩ (between HI - LO, at 0.1 mV range)
Measurable input level range:	0.1 mV ~ 10 Vrms (sinusoidal signal, between HI - LO) in 2 sub-ranges of 0.1 mV Ω 30 mV rms range and 10 mV ~ 10 V rms.
Maximum allowable input level:	Between HI - LO: AC (10 Hz ~ 20 kHz) ..... ±15 Vp-p DC ..... ±50 V Between HI - GND, LO - GND: AC (10 Hz ~ 20 kHz) .... ±15 Vp-p DC ..... ±50 V

Wow/flutter measuring ranges and indication accuracies:

Wow/flutter measuring ranges		0.01%	0.03%	0.1%	0.3%	1%	3%
0.1 mV range	WTD		0.005 ←				→ 3
			±10	±5	±5	±5	±5
	LIN				0.05		3
					±10	±5	±5
10 mV range	WTD	0.002 ←					→ 3
		±10	±5	±5	±5	±5	±5
	LIN		0.005 ←				→ 3
			±5	±5	±5	±5	±5

Top frames: Measuring range (wow/flutter %)

Bottom frames: Indication accuracy (% of full-scale value)

Conditions

Signal source impedance: Not higher than 3 kΩ

Measuring center frequency: 3000 Hz ±50 Hz (JIS, NAB, CCIR) or 3150 Hz ±50 Hz (DIN)

Wow/flutter indication system

Rms value indication in compliance with JIS

Mean value in compliance with NAB

Peak value indication in compliance with CCIR/DIN

Wow/flutter frequency characteristics

Hearing-sense compensation characteristics (WEIGHTED):

In compliance with JIS, NAB, CCIR and DIN standards

Separation characterics (WOW, FLUTTER):

Wow ..... 0.5 Hz ~ 6 Hz

Flutter ..... 6 Hz ~ 200 Hz

Flat response characteristics (LINEAR):

JIS, NAB (4 Hz reference)

Within -3 dB ±1 dB at 0.5 Hz, 200 Hz.

Attenuates with 6 dB/oct or over at frequencies lower than 0.5 Hz.

Attenuates with 15 dB/oct or over at frequencies higher than 200 Hz.

CCIR, DIN (4 Hz reference)

Within -3 dB ±1 dB at 0.3 Hz, 200 Hz.

Attenuates with 6 dB/oct or over at frequencies lower than 0.3 Hz.

Attenuates with 15 dB/oct or over at frequencies higher than 200 Hz.

Accuracy of reference level: ±5% or better of full-scale value (between WTD - LIN at 4 Hz)

Tape speed (measuring center frequency indication)

Indication system: 4-digit storage display system, 7-segment LED readout, gate time 1 sec (nominal)

Indication range: 2700 Hz ~ 3500 Hz or wider

Frequency counter

Measuring range: 10 Hz ~ 9999 Hz

Gate time: 1 sec (nominal)

Measuring accuracy: ±(1 count + reference frequency accuracy)

Reference frequency accuracy

Crystal oscillator: 1.26 MHz $\pm 5 \times 10^{-5}$ or better (at 20°C ±10°C)

AC line frequency: Accuracy of the commercial AC line power

Indication system: The same as the item for tape speed.

Input terminals: Terminals for wow/flutter measurement are used in common.

Input level range: 50 mV ~ 10 V rms (sinusoidal signal)

Frequency ratio measurement: 0.003 ~ 3.333 or wider; gate time 1/3, 1/3.15 sec (nominal)

Measuring unit: Hz

* Dimensionless number for frequency ratio measurement.

Internal oscillator (reference signal oscillator for recording)

Oscillating frequency:	3000 Hz or 3150 Hz (automatic selection with INDICATION switch) * 3000 Hz: JIS, NAB, CCIR * 3150 Hz: DIN
Frequency accuracy:	$\pm 5 \times 10^{-5}$ or better (at 20°C ±10°C)
Output voltage:	0.2 V rms or over (open ended)
Distortion factor:	2% or less
Output impedance:	600 Ω ±20% (single-ended)
Output terminals:	5-way type, 19 mm (3/4 in.) spacing

Wow/flutter signal outputs: Outputs for pen recorder and oscilloscope, 5-way terminals, 19 mm (3/4 in.) spacing

Ambient temperature and himidity: 5°C ~ 35°C, 85% RH

Power requirements:	100 V ±10%, 50/60 Hz AC, approx. 38 VA. * Convertible to 110 V, 117 V, 220 V, 230 V or 240 V with internal voltage tap change.
Dimensions:	310 (W) × 150 (H) × 370 (D) mm
(Maximum dimensions):	330 (W) × 160 (H) × 416 (D) mm

Weight (net):	Approx. 8 kg
Accessories	Instruction manual ..... 1 copy
	Shorting bar 1

3. OPERATION METHOD

3.1 Explanation of Front Panel

(Refer to Fig. 3-1)

① POWER ON/OFF: Instrument main power switch. When in the "ON" state, the power is turned on and the power pilot light (green LED) turns on.

② INPUT (A): The signal reproduced by a recording/playback device is applied to this input terminal block for measurement. The terminal block consists of HI, LO and GND terminals. Although the HI and LO terminals are not floated from the ground (GND), keep normally the LO terminal shorted to the GND terminal with the shorting bar (supplied).

When the measured signal level is very low, remove the shorting bar and connect the GND terminal to the ground line of the measured signal source. When the measured signal level is low, note also that a shielded cable should be used for connection to the measured signal source.

* Use a shielded cable which securely guards the signal against noise.

* Although the HI and LO terminals are not floated, short between LO and GND terminals in an appropriate method.

* The GND terminal is connected to the chassis.

③ INPUT SENSITIVITY: PUSH 0.1mV / NORMAL 10mV

Selects the input sensitivity. The depressed and locked state is for 0.1 mV rms and the popped up and released state is for 10 mV rms.

④ PUSH COUNTER ONLY:

Selects the operation mode of the counter. When this switch is depressed and locked, the counter operates as a frequency counter for the input signal.

⑤ WOW/FLUTTER RANGE (%):

Selects the wow/flutter measuring range. The depressed and locked state is for measurement. Six ranges of 0.01%, 0.03%, 0.1%, 0.3%, 1% and 3%, for full-scale values of indicator. Select an appropriate range in accordance with wow/flutter of the measured signal.

⑥ MODE: Selects the wow/flutter measuring mode as follows:

* WEIGHTED: Wow/flutter measurement with hearing-sense compensation, complying with JIS, NAB, CCIR and DIN.

* WOW: Measurement of wow component (0.5 Hz ~ 6 Hz) alone separated from the measured signal.

* FLUTTER: Measurement of flutter component (6 Hz 200 Hz) alone separated from the measured signal.

* LINEAR: Measurement of all wow/flutter components of the measured signal, complying with JIS, NAB, CCIR and DIN.

⑦ INDICATION: Selects the indication system for respective standards as follows:

* JIS: For measurement in compliance with JIS

* NAB: For measurement in compliance with NAB

* CCIR: For measurement in compliance with CCIR

* DIN: For measurement in compliance with DIN

⑧ WOW/FLUTTER % INDICATOR: Indicates directly the wow/flutter, with top scale for "1" and bottom scale for "3" corresponding to setting of the WOW/FLUTTER RANGE (%) selector switch.

⑨ TAPE SPEED/ FREQUENCY (Hz): Indicates the tape speed or input signal frequency, with 4-digit 7-segment-LEDs.

Also has a function as a input signal pilot. When no input signal is applied, the display goes off. When the input signal is within the measurable range, the display turns on. Note, however, that it may turn on even when the input signal level is lower than the specified minimum measurable level.

⑩ OVER: When the input signal frequency is higher than 9999 Hz, this light flickers to indicate that the frequency is higher than the displayable limit.

⑪ Hz: Indicates the measuring unit "Hz" for frequency counter ⑨. This light turns on when the FREQ button of COUNTER MODE selector switch ⑬ is pressed.

(12) RATIO: Indicates that the frequency counter (9) is operating for ratio measurement. This light turns on when the RATIO (A/B) button of COUNTER MODE selector switch (13) is pressed.

(13) COUNTER MODE: Selects the operation mode of the counter in accordance with measuring mode as mentioned in the following. (reference gate time selecting switch)

* FREQ 50 Hz EXT (LINE): The reference gate time signal is based on the AC line frequency (50 Hz area).

* FREQ 60 Hz EXT (LINE): The reference gate time is based on the AC line frequency (60 Hz area).

* FREQ INT (CRYSTAL): The reference gate time is based on the internal crystal oscillator output.

* RATIO (A/B) INT (CRYSTAL): The reference gate time is based on the internal crystal oscillator output. The counter (9) displays ratio A/B between input signal frequency (A) of INPUT (2) and output signal frequency (B) of INT OSC OUTPUT (16).

(14) OUTPUT TO RECORDER: Provides an output signal for recording with a strip-chart recorder or other device for obtaining permanent record of drift (of tape speed) and wow/flutter. The GND terminal is connected to the chassis. The output impedance is approximately 10 kΩ.

(15) OUTPUT TO SCOPE: Provides an output signal for an oscilloscope for observation of wow/flutter waveform and period. The GND terminal is connected to the chassis. The output impedance is approximately 10 kΩ.

(16) OUTPUT (B) (3kHz/3.15kHz) INT OSC: Provides the internal crystal oscillator output signal for recording. The signal frequency is 3 kHz when other standard than DIN is selected with INDICATION selector (7) or it is 3.15 kHz when DIN is selected. The GND terminal is connected to the chassis. The output impedance is 600 Ω (nominal).

3.2 Explanation of Rear Panel

(Refer to Fig. 3-2)

⑰ GND terminal: For grounding the chassis (casing). Connect this terminal to a good earth ground whenever practicable, to prevent electric shock hazards.

⑱ FUSE: Fuse holder of the AC power line. Use a slow-blow fuse of a glass tube type (6.4 mm dia. x 30 mm). The current rating depends on the AC line voltage as follows:

* 100 V, 110 V, 117 V ..... 1 A
* 220 V, 230 V, 240 V ..... 0.5 A

⑲ Power cord: Connect to an AC line power outlet (100 V ±10%, 50/60 Hz).

* By changing the internal transformer taps, six types of AC line voltages are available as follows:

  100 V, 110 V, 117 V
  220 V, 230 V, 240 V

3.3 Explanation of Side Panel

Remove this panel to gain access to semi-fixed resistors for calibrating the instrument. The instrument can be calibrated without removing the main unit cover.

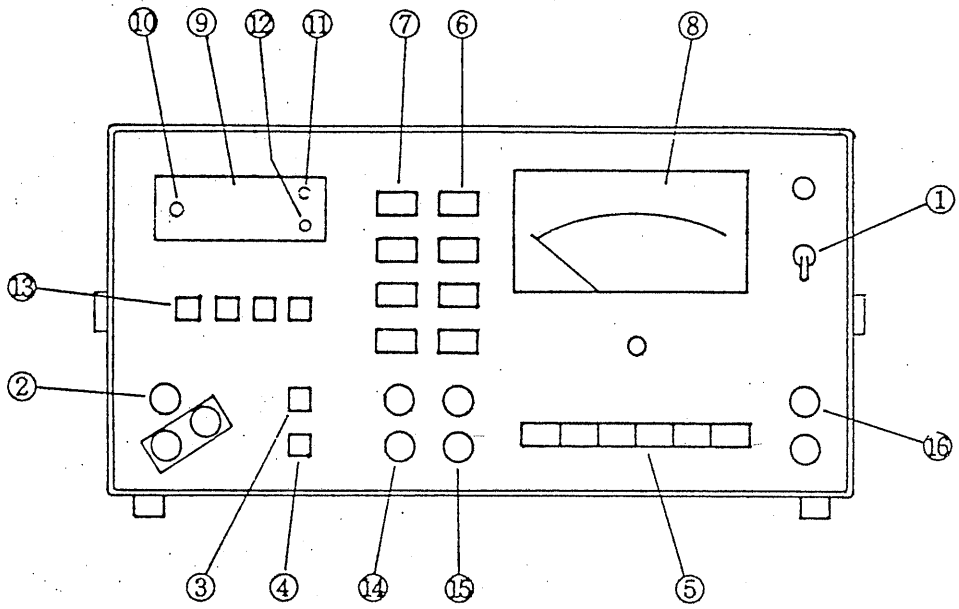

Fig. 3-1 Layout of components on front panel

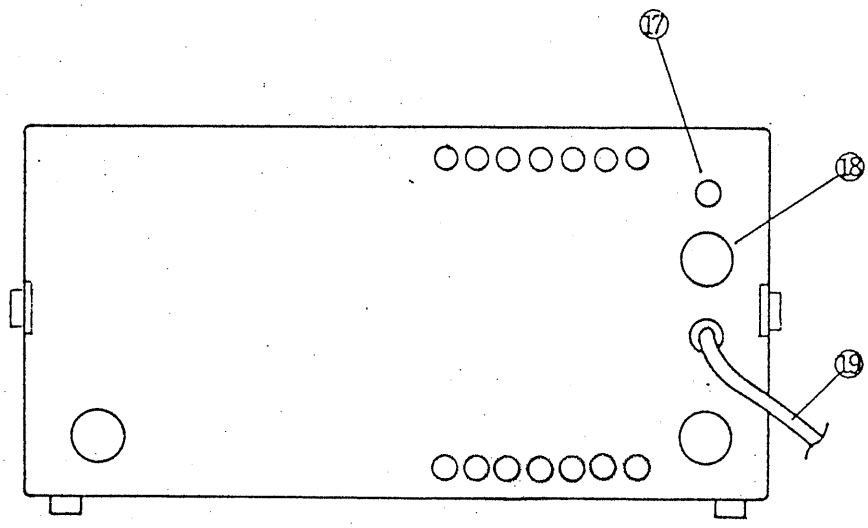

Fig. 3-2 Layout of components on rear panel

3.4 Operating Procedure

3.4.1 Set the POWER switch in the OFF state and connect the power cord to an AC line outlet. Set the pushbutton switches on the panel as follows:

INPUT SENSITIVITY:	NORMAL 10 mV
PUSH COUNTER ONLY:	Popped up state
WOW FLUTTER RANGE (%):	3
MODE:	WEIGHTED or LINEAR, normally
COUNTER MODE:	FREQ INT (CRYSTAL)

3.4.2 Turn-on the POWER switch. The power pilot light (green LED) will turn-on.

3.4.3 When the measured object is a tape recorder or other similar device on which a signal is required to be recorded before measurement or when measurement is to be performed by recording and reproducing at the same time, connect the input terminal of the measured device to the "OUTPUT (B) INT OSC" terminal.

* Either the 3 kHz or 3.15 kHz signal for recording can be selected by means of the INDICATION button on the front panel. (For frequency selection refer to Item 3.5.7).

Next, apply to the INPUT (A) terminal the signal reproduced from the recorder or other device to be tested.

3.4.4 Provided that the level of the signal applied to the INPUT (A) terminal is 10 mV rms or over (of sinusoidal signal), the TAPE SPEED/FREQUENCY (Hz) display unit turns-on and indicates the frequency of the input signal as a sign that the instrument is ready for measurement.

When the input signal lever is lower than 10 mV rms, set the INPUT SENSITIVITY switch in the PUSH 0.1 mV state so that the input sensitivity is raised to 0.1 mV rms (of sinusoidal signal).

* Note that the TAPE SPEED/FREQUENCY (Hz) display may turn on even when the input level is lower than the specified minimum level (10mV or 0.1 mV).

* Even when the TAPE SPEED/FREQUENCY (Hz) display is turned-on under the above condition, the instrument does not indicate the correct wow/flutter unless the frequency is 3 kHz $\pm$150 Hz (JIS, NAB, CCIR) or 3.15 kHz $\pm$150 Hz (DIN).

3.4.5 Under the measuring state of the above and observing the indicating meter, raise the sensitivity by changing the WOW FLUTTER RANGE (%) switch in the order from "3", "1" to "0.1" until the meter pointer deflect the maximum amount without overscale. When this is done, the wow/flutter rate can be directly read on the meter -- on the scale corresponding to the selected WOW FLUTTER RANGE (%) button.

3.4.6 To measure the wow component alone, press the WOW button of the MODE selector switch; to measure the flutter component alone, press the FLUTTER button.

* This measurement has no relation with standards selected by the INDICATION SWITCH.

3.4.7 To observe and measure the wow/flutter waveform and period in the above measurement, connect an oscilloscope to the TO SCOPE terminal.

* The output available at the terminal is corresponding to the setting of the MODE selector and WOW FLUTTER RANGE (%) switch.

To record the drift of tape speed, connect an ink-writing recorder to the TO RECORDER terminal. By using a fast response recorder, the drift and wow/flutter can be recorded at the same time.

* The output is independent of settings of the MODE, INDICATION, and WOW FLUTTER RANGE (%) switches. As the tape speed increases (varies in the "+" direction), the signal decreases (varies in the "-" direction).

3.4.8 Tape speed (2700 Hz ~ 3500 Hz or wider) is indicated by TAPE SPEED/FREQUENCY (Hz).

The readout is independent of the control knob on panel except the selector switch of COUNTER MODE, PUSH COUNTER ONLY.

3.4.9 Other methods of tape speed measurement

* By selecting the reference gate time of frequency counter.

(1) Set the COUNTER MODE switch in the RATIO (A/B) state. In this case the reference gate time is referenced to the internal crystal oscillator and the tape speed is indicated in terms of ratio A/B between input signal frequency (A) and OUTPUT (B) terminal signal frequency (B).

* The frequency of the OUTPUT (B) terminal signal is automatically set as selected by the INDICATION switch. (The frequency is at the center frequency of the selected Standard.) For details, refer to Item 3.5 "Notes in Operation."

With the 7-segment LED display, the decimal point is displayed at the most-significant column, the LED light for RATIO indication turns-on, and if the input signal frequency is

the same with the OUTPUT (B) frequency, the display indicates as "1.000". This indication signifies that the frequency ratio is "1.000". Thus, the degree of tape speed variation can be indicated in simple terms of ratio. The ratio indication range is 0.85 ~ 1.15 or wider.

* As the measuring Standard differs (selection of INDICATION button differs), indication may differ even for the same tape speed. Ensure that the correct Standard and correct Standard Test Tape are used.

(2) Set the COUNTER MODE switch at FREQ "50Hz" or "60Hz". With this setting, the counter operates as a conventional frequency counter. The gate time in this case is referenced to the AC line frequency. In such a case that the measured frequency is affected by AC line frequency variation, this method may be used since it enable measurement eliminating the effects cause by AC line frequency variation. Select the "50Hz" or "60Hz" in conformity with the AC line frequency.

3.4.10 To use the counter as a conventional frequency counter, depress the PUSH COUNTER ONLY button and apply the signal to be measured to the INPUT (A) terminal. Provided that the applied signal level is 50 mV rms or over (of sinusoidal signal), the digital counter unit turns-on and indicates the input signal frequency.

* In this case, the operations of other pushbutton switches than the COUNTER MODE button switch have no effect on the frequency measurement and the instrument's function as a wow/flutter meter remains idle.

* When the input signal frequency is higher than 9999 Hz, the OVER light turns-on in order to indicate that the signal frequency is higher than the measurable limit.

3.4.11 The COUNTER MODE switch selects four modes. The FREQ INT (CRYSTAL) mode is used in general. The RATIO (A/B) mode is for frequency ratio measurement as mentioned in Item 3.4.9-(1). The ratio indication range in this case is 0.003 ~ 3.333. The FREQ "50Hz" and "60Hz" modes are for frequency measurement as mentioned in Item 3.4.9-(2).

3.5 Notes in Operation

3.5.1 In wow/flutter measurement, the indicated value differs according to the settings of the INDICATION selector switch (applied Standard) and of the MODE selector switch. No Standards are available for independent measurement of wow and flutter (settings in the WOW and FLUTTER positions). Use these modes for analysis study.

3.5.2 If the level and frequency of the input signal applied to the INPUT (A) terminal are not within the specified ranges of this instrument, the TAPE SPEED/FREQUENCY (Hz) digital display unit does not turn-on. However, if the input signal level is sufficiently high, the digital display unit turns-on even if the input signal frequency is not within the specified frequency range of the instrument. For wow/flutter measurement, ensure the center frequency specified by the Standard applied for the measurement.

3.5.3 When the reproduced signal level (input signal) is sufficiently large (10 mV rms or over), set the INPUT SENSITIVITY selector switch in the NORMAL 10 mV position. With this setting, stable measurement can be done as the wow/flutter meter does not deflects over the full scale and the measurement is less affected by noise.

3.5.4 If the input signal is not sinusoidal (if the signal includes higher orders of harmonics at large rates even when the fundamental component is a sine wave), the instrument may not operate in spite of that the signal level is within the input signal level. This is especially true when the input signal is a square wave of an abnormal duty ratio. Measurement is successful if the effective-value level of the signal is within the operating input level range of the instrument.

3.5.5 The input impedance between HI and LO of the INPUT (A) terminal normally is within 600 kΩ ±20%. When the INPUT SENSITIVITY selector switch is set in the PUSH 0.1 mV position, the input impedance becomes approximately 10 kΩ. When the instrument operated as a frequency counter (when the PUSH COUNTER ONLY button is depressed), the impedance is within 600kΩ ±20% irrespective of setting of the INPUT SENSITIVITY selector switch.

3.5.6 The OVER light of the frequency counter operates up to approximately 15 kHz. When the frequency is higher than this, this light goes off as well as the digital display goes off. Note that this state is the same with that no input is being applied. Using a signal of 10 Hz or lower, ensure that the digital display unit flickers.

3.5.7 The signal frequency of the OUTPUT (B) (3kHz/3.15kHz) INT OSC terminal differs according to setting of the INDICATION selector switch as follows:

* 3 kHz ..... JIS, NAB, and CCIR
* 3.15 kHz ..... DIN

The output signal level also slightly differs between 3 kHz and 3.15 kHz.

3.5.8 Do not press at the same time two or more buttons of the WOW FLUTTER RANGE (%), MODE, INDICATION, and COUNTER MODE selector switches. If two or more switches are depressed at the same time, no correct measurement can be expected.

3.5.9 Note that, since the wow/flutter measuring sensitivity and input sensitivity of this instrument are very high, the wow/flutter measuring range and indicating meter errors vary by settings of controls on the front panel and by the input signal level. (Refer to Section 2 "SPECIFICATIONS").

3.5.10 Note that, since the oscillating frequency of the internal reference signal oscillator of this instrument is 1.26 MHz and the display elements of the frequency counter are driven in a time-sharing system, the instrument may radiate waves though very slightly. An MW radio receiver or an FM radio receiver placed very close (within 10 cm) to this instrument may be affected.

3.5.11 The ambient temperature and humidity conditions of this instrument are 5 ~ 35°C and 85% RH. Do not use the instrument under direct sunlight, near a heat source, or in a highly humid atmosphere. When the instrument has been moved from a cold place to a warm place, allow a sufficient stabilization period after turning-on the instrument power. The storing ambient temperature range is approximately -10°C to +60°C. Note also that adverse environmental conditions (gases, dust, vibration, chemicals, etc.) will shorten the instrument life.

4. OPERATING PRINCIPLE

4.1 Definitions of Wow and Flutter

The rate of variation in speed of an object in motion can be expressed in terms of percentage as follows:

$$\frac{v - v_o}{v_o} \times 100\ (\%)$$

where, v_o: Average velocity

v : Instantaneous velocity

This concept can be applied for measurement of relative speed variation of the recording medium a record/playback device (such as the tape of a tape recorder). Since the reproduced signal frequency is a function of the tape speed, the rate of relative speed change of a record/playback device can be expressed in terms of the rate of frequency change in percentage as follows:

$$\frac{f - f_o}{f_o} \times 100\ (\%)$$

where, f_o: Center frequency

f : Instantaneous frequency

Thus, wow and flutter can be defined as "frequency variation caused by variation in relative velocity between recording medium and detecting head of a record/playback device when in the recording or reproducing operation. Slower frequency variation is called "wow" and faster variation is called "flutter." Very slow variation (gradual variation) is called "drift" and it is not included in the categories of wow and flutter as used here.

In other words, wow and flutter are the same in effects with that center frequency f_o has been frequency-modulated with the deviation of $f - f_o$. The rate of wow and flutter denotes the degree of frequency modulation. The terms wow, flutter and drift are used to distinguish the changing speeds.

4.2 Measuring Principle

The rate of wow and flutter difined in Item 4.1 can be known by demodulating the frequency-modulated signal. The basic construction of this wow and flutter meter, which employs the above principle, is as shown with a basic block diagram in Fig. 4-1.

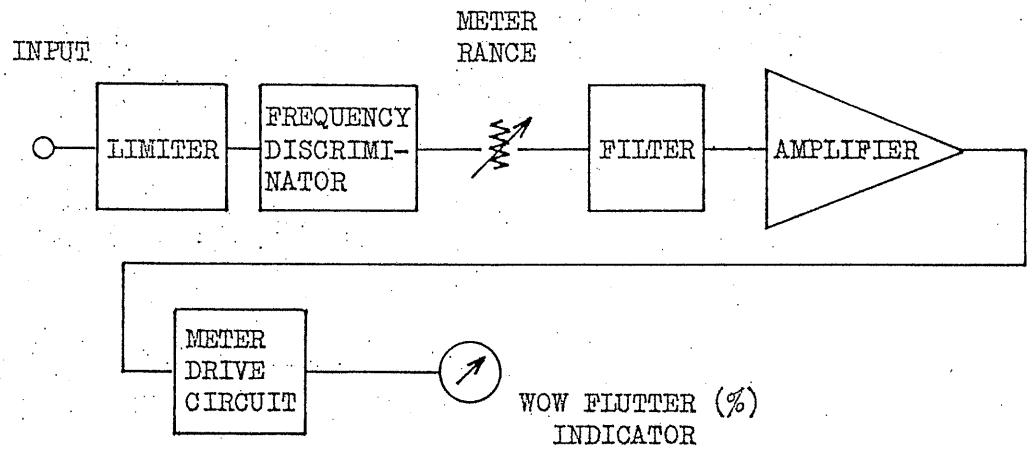

Fig. 4-1 Basic block diagram of Wow and Flutter Meter

The input signal is fed through the limiter circuit to the frequency discriminator for demodulation. The demodulator output signal is fed through the meter range selector circuit to the filter circuit which conditions the signal in accordance with the speed of frequency change as defined in Item 4.1. The conditioned modes are four types of WEIGHTED, WOW, FLUTTER, and LINEAR.

* The WEIGHTED mode is for hearing-sense compensation in compliance with JIS, NAB, CCIR and DIN. The signal is weighted in accordance with the effects of wow and flutter on the hearing sense of human being.

* The WOW and FLUTTER modes are for separating the wow and flutter with 6 Hz as the boundary frequency between the two components.

* The LINEAR mode is for passing the total components of wow and flutter. The Standards are available as is the case for the WEIGHTED mode.

The signal weighted as above is amplified with the amplified with the amplifier and fed to the indicating meter through the meter drive circuit (indicating meter circuit). The indicating meter circuit provides indicating systems corresponding to the applied Standard (JIS = effective value, NAB = mean value, CCIR/DIN = peak value). This circuit also controls the dynamic characteristics of the indicating meter. A full block diagram of the instrument is shown in Fig. 4-2.

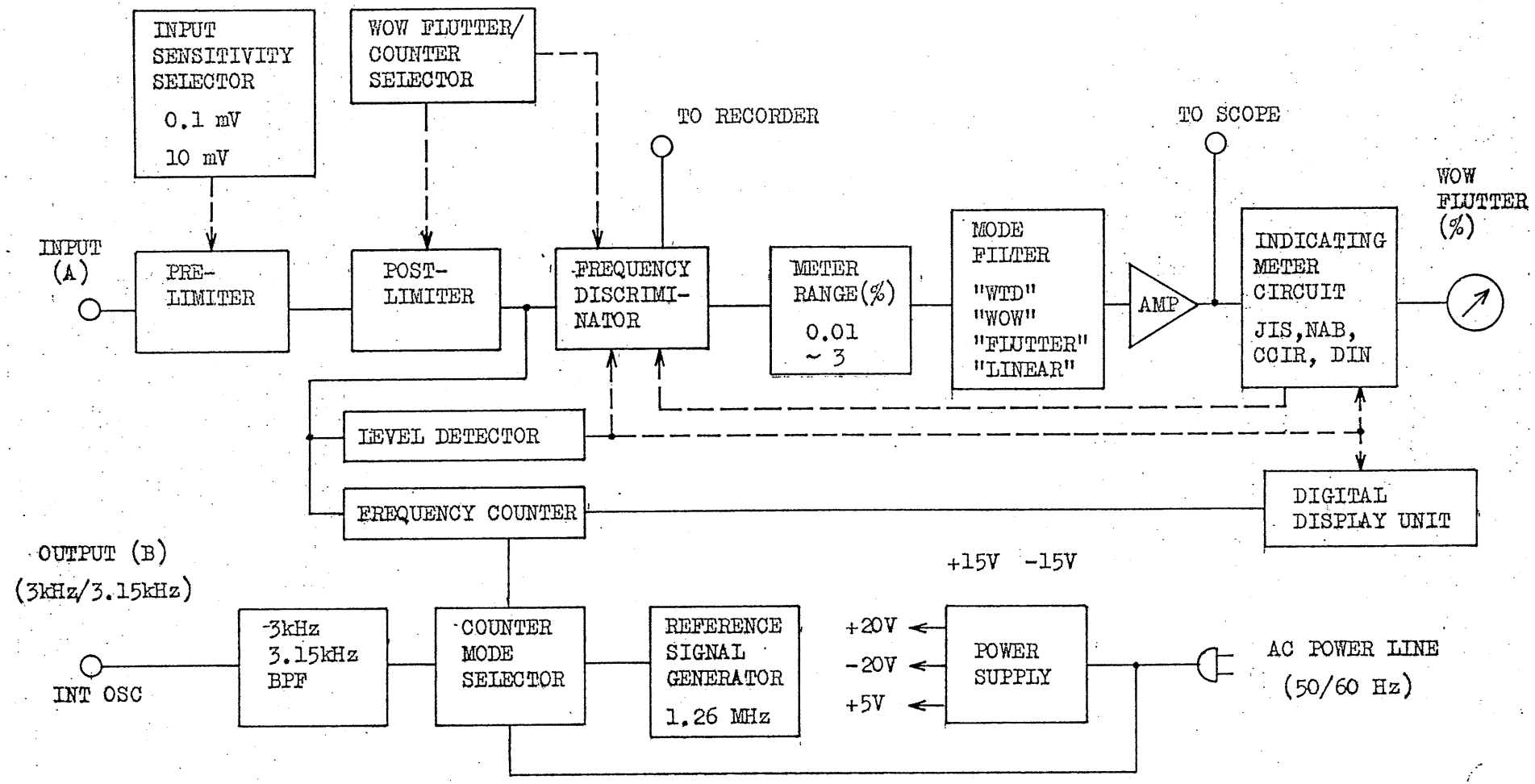

Fig. 4-2 Block diagram of Model 6701 Wow and Flutter Meter

5. MAINTENANCE

5.1 Calibration

The instrument has been designed for accurate and reliable operation for a long time. However, it is most recommendable to calibrate the instrument at every six (6) months in order to maintain its reliability and expecially its accuracy.

5.2 Notes in Calibration

5.2.1 Before turning-on the instrument power, check the mechanical zero of the meter and adjust it as if required.

5.2.2 Allow more than 5 minutes of stabilization period after turning-on the instrument power.

5.2.3 Allow sufficient statilization periods also for other devices which are used for calibration.

5.2.4 Calibrate the instrument in an ambient temperature of $20^{\circ}C \pm 10^{\circ}C$.

5.3 Calibration Procedure

Remove the calibration panel from the right-hand side of the instrument (by removing the two clamping-screws at both sides).

The semi-fixed potentiometers inside the instrument are identified with the marks on the panel.

* It is possible that some semi-fixed potentiometer are missing despite their marks exist on the panel. The missing potentiometers signify that they are not required to be adjusted for calibration.

* For calibration, follow in the due order the procedure mentioned in the following and set the center frequency of the wow/flutter calibrator frequency at 3 kHz and the output voltage at approximately 1 V rms unless specified otherwise.

5.3.1 Indication Calibration for JIS

(1) Set the panel switches as follows:

COUNTER MODE:	FREQ INT (CRYSTAL)
INPUT SENSITIVITY:	NORMAL 10 mV
PUSH COUNTER ONLY:	Popped-up state
INDICATION:	JIS
MODE:	LINEAR
WOW FLUTTER RANGE (%):	0.1

(2) From a calibrator, apply a signal sinusoidal frequency-modulated wow/flutter signal of 4 Hz for 0.100% rms.

(3) So adjust the JIS potentiometer that the meter pointer indicates the "1" position of the "0 ~ 1" scale.

* The JIS calibration is complete with this procedure.

(4) Varying the degree of FM (frequency modulation) of the calibrator signal in conformity with the WOW FLUTTER RANGE (%) switch of instrument, check the meter indication (full scale).

(5) Check that the meter indication is within ±5% FS for the 0.01% range and ±2.5% for other ranges.

(6) After the above check is over, return the WOW FLUTTER RANGE (%) switch to the 0.1% range position.

5.3.2 Level Adjustment of MODE Filter

(1) Set the MODE switch of the panel in the WEIGHTED state.

(2) Set the calibrator as explained in Item 5.3.1 (2).

(3) So adjust the WTD control that the meter pointer indicates the "1" position of the "0 ~ 1" scale.

(4) Set the MODE switch of the panel in the WOW state.

(5) Set the wow/flutter frequency of the calibrator alone at 1 Hz.

(6) Check that the meter pointer is within 0.95 ~ 1.05 of the "0 ~ 1" scale.

(7) Set the MODE switch of the panel in the FLUTTER state.

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

(9) Check that the meter pointer is within 0.95 ~ 1.05 of the "1 ~ 0" scale.

(10) Return the MODE switch of the panel to the LINEAR state.

5.3.3 Indication Calibration for NAB

* Calibration for JIS is complete by the above procedure.

(1) Set the INDICATION switch of the panel in the NAB state.

(2) Set the calibrator as explained in Item 5.3.1 (2). Set, however, the wow/flutter frequency at 40 Hz.

(3) So adjust the NAB control that the meter pointer indicates the "1" position of the "0 ~ 1" scale.

5.3.4 Indication Calibration for CCIR

(1) Set the panel switches as follows:

INDICATION: CCIR

MODE: LINEAR

(2) Set the calibrator as explained in Item 5.3.1 (2). Set, however, the rate of FM at 0.100% peak and the wow/flutter frequency at 40 Hz.

(3) So adjust the CCIR, GAIN control that the meter pointer indicates the "1" position on the "0 ~ 1" scale.

(4) Set the MODE switch of the panel in the WEIGHTED state and the WOW FLUTTER RANGE (%) switch in the "1" position.

(5) Set wow flutter signal of the calibrator at frequency 1 Hz, FM rate 2% peak-peak, waveform square pulse, and pulse width 100 msec.

(6) In the above case of Item (5), so set the frequency deviation that the frequency changes in the positive (+) direction as the puse signal is applied.

(7) So adjust the CCIR, (-) D1, D2 controls that the maximum deflection of the meter pointer becomes "1 ±0.04" and the minimum deflection "0.41 ±0.04" on the "0 ~ 1" scale.

* Adjust the maximum deflection with D1 .

* Adjust the minimum deflection with D2 .

* The frequency discriminator of this instrument varies in the negative (-) direction as the frequency varies in the positive (+) direction. In the above case, therefore, adjust the (-) sides of the D1, D2 controls. If the frequency variation is in the negative (-) direction, adjust the (+) sides of the D1, D2 controls.

(8) Varying the pulse width of the calibrator signal to 60 msec, 30 msec and 10 msec, check that the maximum meter indications on the "0 ~ 1" scale are as follows:

* 60 msec ..... 0.9 ±0.06
* 30 msec ..... 0.62 ±0.06
* 10 msec ..... 0.21 ±0.03

(9) If the indications are not within the above tolerances, re-adjust the instrument starting by Item (7).

(10) Set the frequency deviation of Item (5) in the negative (-) direction.

(11) Adjust the CCIR, (+) D1, D2 controls as explained in Items (7) ~ (9).

(12) When the above adjustment has been done, return the procedure to Item (1) and check that the meter pointer deflection is within "1 $\pm$0.025" on the "0 ~ 1" scale.

(13) Repeat the procedure of (1) through (12) for 2 or 3 times.

5.3.5 Indication Calibration for DIN

(1) Set the panel switches as follows:

INDICATION:	DIN
MODE:	LINEAR
WOW FLUTTER RANGE (%):	0.1

(2) Set the calibrator as explained in Item 5.3.1 (2). Set, however, the center frequency at 3.15 kHz, FM rate at 0.100% peak and wow/flutter frequency at 40 Hz.

(3) So adjust the DIN control that the meter pointer indicates the "1" position on the "0 ~ 1" scale.

* Only when the center frequency of the calibrator is 3 kHz, adjust the meter pointer at 0.952 of the "0 ~ 1" scale.

* The dynamic characteristics have already been adjust in Item 5.3.4 and they are not required to be adjusted here.