INSTRUCTION MANUAL

WOW FLUTTER METER

MODEL 677D

KIKUSUI ELECTRONICS CORPORATION, JAPAN

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.
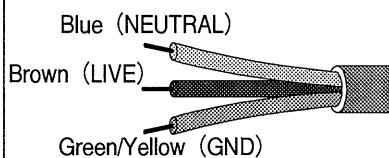
☐ AC power cable

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.
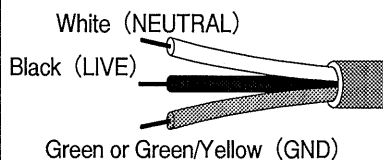
▬▬▬▬▬ WARNING ▬▬▬▬▬

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

☐ Without a power plug

Blue (NEUTRAL)
Brown (LIVE)
Green/Yellow (GND)

☐ Without a power plug

White (NEUTRAL)
Black (LIVE)
Green or Green/Yellow (GND)
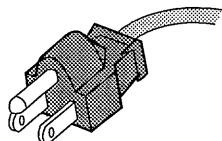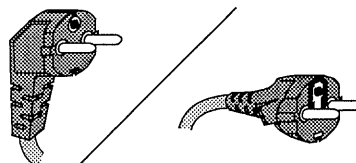
☐ Plugs for USA

☐ 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

TABLE OF CONTENTS

1. GENERAL

Model 677D Wow Flutter Meter measures wows and flutters of various
sound record/playback devices such as audio tape recorders, video
tape recorders, disc record players, and cine sound recorders, etc.
in various measuring systems as follows:

o   Effective value indication as per JIS Standard.

o   Mean value indication as per NAB Standard.

o   Peak value indication as per CCIR Standard.

o   Peak value indication as per DIN Standard.

The tape speed is digitally displayed with a 4-digit frequency
counter. The frequency counter can also be used as an independent
frequency indicator for a range of 10 Hz ~ 999.9 kHz.

The instrument has a SCOPE terminal and a RECORDER terminal which
provide signals for observation, recording, and analysis of waveforms
and periods of wows and flutters.

The instrument provides a very effective means of wow and flutter
measurement for research, manufacturing, inspection and maintenance
of audio and video recording and reproducing devices.

2. SPECIFICATION

Model No.:   677D

Measuring center   Within 3.000 kHz ±150 Hz (JIS, NAB, CCIR)
frequency ranges: 3.150 kHz ±150 Hz (DIN)

Input level range: 5 mV ~ 10 V_{rms} (irrespective of amplitude),
                            (in 2 ranges of 5 mV ~ 10 V_{rms} and 50 mV ~
                            10 V_{rms})

Input impedance: 330 kΩ ±20%, single-ended

Input terminal: 5-way type, distance 19 mm (3/4 in.)

Wow/flutter measuring   0.005 ~ 3% (in 4 ranges of 0 ~ 0.1%,
range: 0 ~ 0.3%, 0 ~ 1%, and 0 ~ 3%)

Wow/flutter   Effective-value indication as per JIS
indication system: Mean value indication as per NAB
                            Peak value indication as per CCIR or DIN

Wow/flutter   Better than ±5% of full scale, for each
indication accuracy: range.

Wow/flutter frequency   (Depend upon frequency characteristics of
characteristics: wow/flutter measuring filter)

   Weighted   Weighted (hearing-sense compensation)
   characteristics: characteristics of JIS, NAB, CCIR, and
                            DIN Standards

   Wow/flutter separa- Wow .... 0.5 ~ 6 Hz
   tion characteristics: Flutter ..... 6 ~ 200 Hz

Flatness characteristics

    JIS, NAB (4 Hz reference)

       -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)

       -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

Tape speed (measuring center frequency)

    Indication system: 4 digits, storage indication system,
                              7-segment LED figures,
                              gate time 1 sec.

    Indication range: 2.700 kHz ~ 3.500 kHz at least

Frequency counter

    Measuring frequency range: 10 Hz ~ 999.9 kHz

    Gate time: 1 sec, 0.1 sec, 0.01 sec (Typ)

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

    Measuring unit: kHz

    Reference frequency: 1.26 MHz, accuracy ±5 x 10^{-5} or better

Indication system: Same with that of Item "Tape speed"

Input level range: 50 mV ~ 10 V_{rms} (irrespective of amplitude)

Internal oscillator (sine wave oscillator for recording)

Oscillating frequency: 3.000 kHz at 3.150 kHz

Frequency accuracy: $\pm 5 \times 10^{-5}$ (at 20°C ±10°C (68°F ±18°F))

Output voltage: 0.2 V_{rms} or over (open terminal)

Distortion factor: Less than 2%

Output impedance: 600 Ω ±20% (single-ended)

Output terminal: 5-way type, distance 19 mm (3/4 in.)

Wow/flutter signal   SCOPE terminal and RECORDER terminal;
output terminals: 5-way type, distance 19 mm (3/4 in.)

Operating temperature   5 ~ 35°C (41 ~ 95°F), less than 85% RH
and humidity range:

Power requirements: 100V AC ± 10%, 50/60 Hz, approx. 30 VA
    (Voltage is convertible to 110, 117,
    220, 230 or 240 V with voltage taps
    of internal transformer.)

Dimensions: 200 (W) x 140 (H) x 370 (D) mm
    (7.87(W) x 5.51(H) x 14.57(D) in.)

(Maximum dimensions):   203 (W) x 163 (H) x 412 (D) mm
    (8.00(W) x 6.42(H) x 16.22(D) in.)

Weight: Approx. 7.6 kg (16.8 lb.)

Accessories: Instruction Manual (1 copy)

3. OPERATION INSTRUCTIONS

3.1 Explanation of Front Panel (Refer to Fig. 3-1.)

(1) POWER: ON-OFF switch for main instrument power. When this switch is turned ON, the power is supplied to the instrument and the power pilot lamp (green LED) lights.

(2) INPUT: Input terminal for applying the signal to be measured (from record/playback device). GND terminal is connected to chassis.

Wow/flutter measurement: 3 kHz ±150 Hz

                                     3.15 kHz ±150 Hz

Frequency measurement: 10 Hz - 999.9 kHz

(3) PUSH 5 mV: Input sensitivity selector switch. Popped-up state is for input sensitivity 50 mV_{rms}; depressed and locked state is for input sensitivity 5 mV_{rms}. Maximum allowable input voltage is 10 V_{rms} for both states.

(4) PUSH COUNTER: Frequency counter input selector switch. When this switch is depressed and locked, the instrument operates as a frequency counter and indicates the frequency of the INPUT signal.

(5) GATE TIME (S)   These gate time switches are for setting gate time (S) when used as frequency counter.

GATE TIME (S)	MEASURING UPPER FREQUENCY (kHz)
0.01	999.9
0.1	99.99
1	9.999

(6) RANGE (%):   Wow/flutter measuring range selector
                        switch. Selects 4 ranges of 0.1%,
                        0.3%, 1.0%, and 3.0% for full-scale
                        values. Measurement becomes effective
                        when corresponding button is depressed
                        and locked.

(7) MODE: Wow/flutter measuring mode selector
                        switch for the following modes.
                        Measurement becomes effective when
                        corresponding button is pushed and
                        depressed.

   * WEIGHTED: For wow/flutter measurement with
                        hearing-sense compensation as per
                        JIS, NAB, CCIR, or DIN Standard.

   * WOW: For measurement of wow component
                        (0.5 - 6 Hz) alone separated from
                        the measured signal.

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

   * LINEAR: For measurement of all wow/flutter
                        components of the measured signal
                        as per JIS, NAB, CCIR, or DIN
                        Standard.

(8) INDICATION: Wow/flutter indication system (measuring
                               standard) selector switch. Measurement
                               becomes effective when corresponding
                               button is pushed and depressed.

     * JIS: Wow/flutter are measured as per JIS
                               Standard.

     * NAB: Wow/flutter are measured as per NAB
                               Standard.

     * CCIR: Wow/flutter are measured as per CCIR
                               Standard.

     * DIN: Wow/flutter are measured as per DIN
                               Standard.

(9) WOW/FLUTTER %   Directly indicates the quantity of
     INDICATOR: wow/flutter. Dual scales of "1" and
                              "3" corresponding to RANGE %.

(10) TAPE-SPEED/FREQUENCY   Indicates tape speed or frequency, with
     (kHz):   7-segment LED display of 4 digits.
                              The unit of measure is kHz.
                              Also indicates input level. Normally,
                              where there is no input signal, the
                              digits are OFF (does not light). When
                              the input level is at the required
                              level, digits light indicating that
                              the instrument is ready for measurement.

(11) OVER: Over-range indicator lamp. Lights when
                              input signal frequency is higher than
                              the upper limit (9999).

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3.2 Explanation of Rear Panel (Refer to Fig. 3-2.)

(12) TO SCOPE: This terminal provides a signal for observation of wow/flutter waveform (period) with an oscilloscope. GND terminal is connected to chassis. Output impedance is approximately 10 kΩ.

(13) TO RECORDER: This terminal provides a signal for recording of drift (tape speed) and wow/flutter waveform. GND terminal is connected to chassis. Output impedance is approximately 10 kΩ.

(14) INT OSC OUT   This terminal provides the output of
       3 kHz/3.15 kHz: the sine wave oscillator for recording. Frequency is 3 kHz when other standard than DIN is selected or it is 3.15 kHz when DIN is selected. GND terminal is connected to chassis.

(15) FUSE: Tubular glass fuse of 1 A (slow blow type) in AC power line.

(16) POWER CORD: Connect to AC power line receptacle (100 V, 50/60 Hz AC).

3.3 Explanation of Side Panel (Refer to Fig. 3-3.)

This panel indicates the components which are to be adjusted for instrument calibration. The panel can be readily removed simply by removing the screws at both ends. When the panel is removed, components (semi-fixed potentiometers) are accessible in the positions corresponding to indications on the panel.
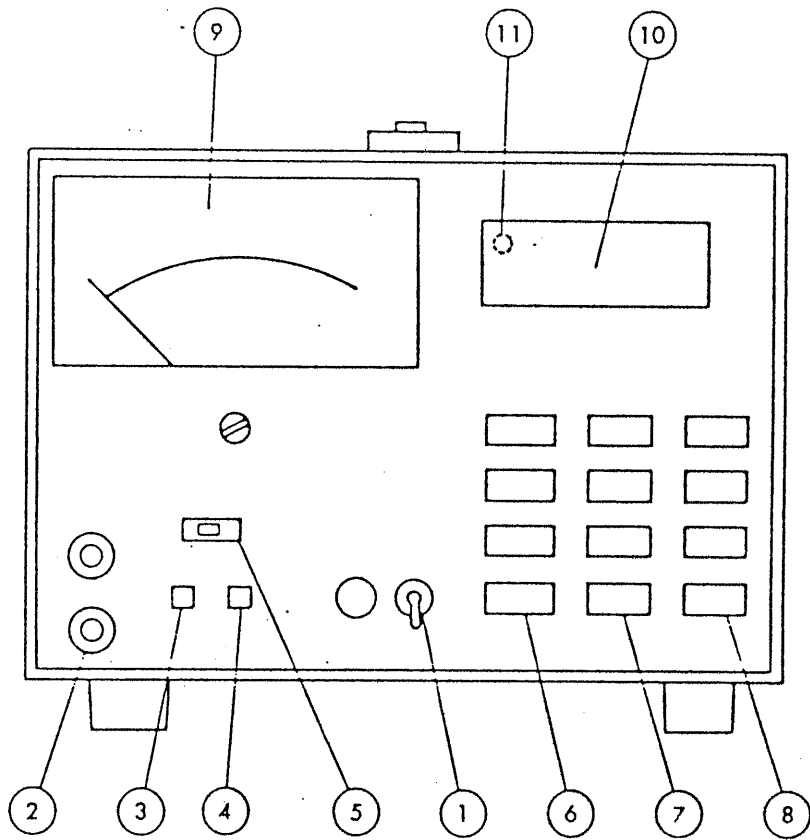
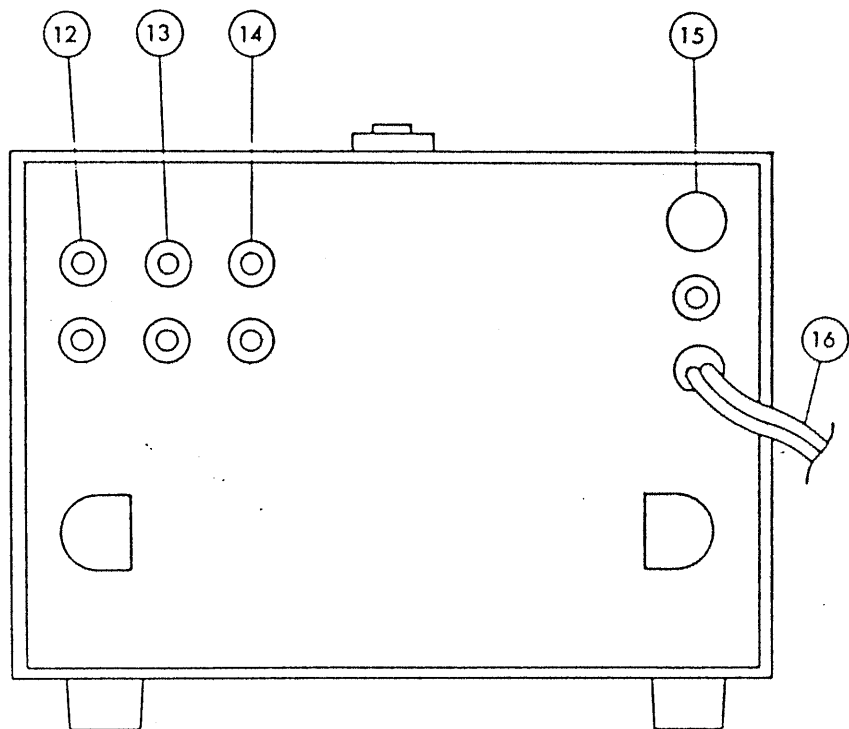Fig. 3-1 Layout of components on front panel

Fig. 3-2 Layout of components on rear panel

INSTRUMENT REAR

CALIBRATION

RANGE (%) — 0.3 1.0 3.0

MODE — WOW FLUTTER LINEAR

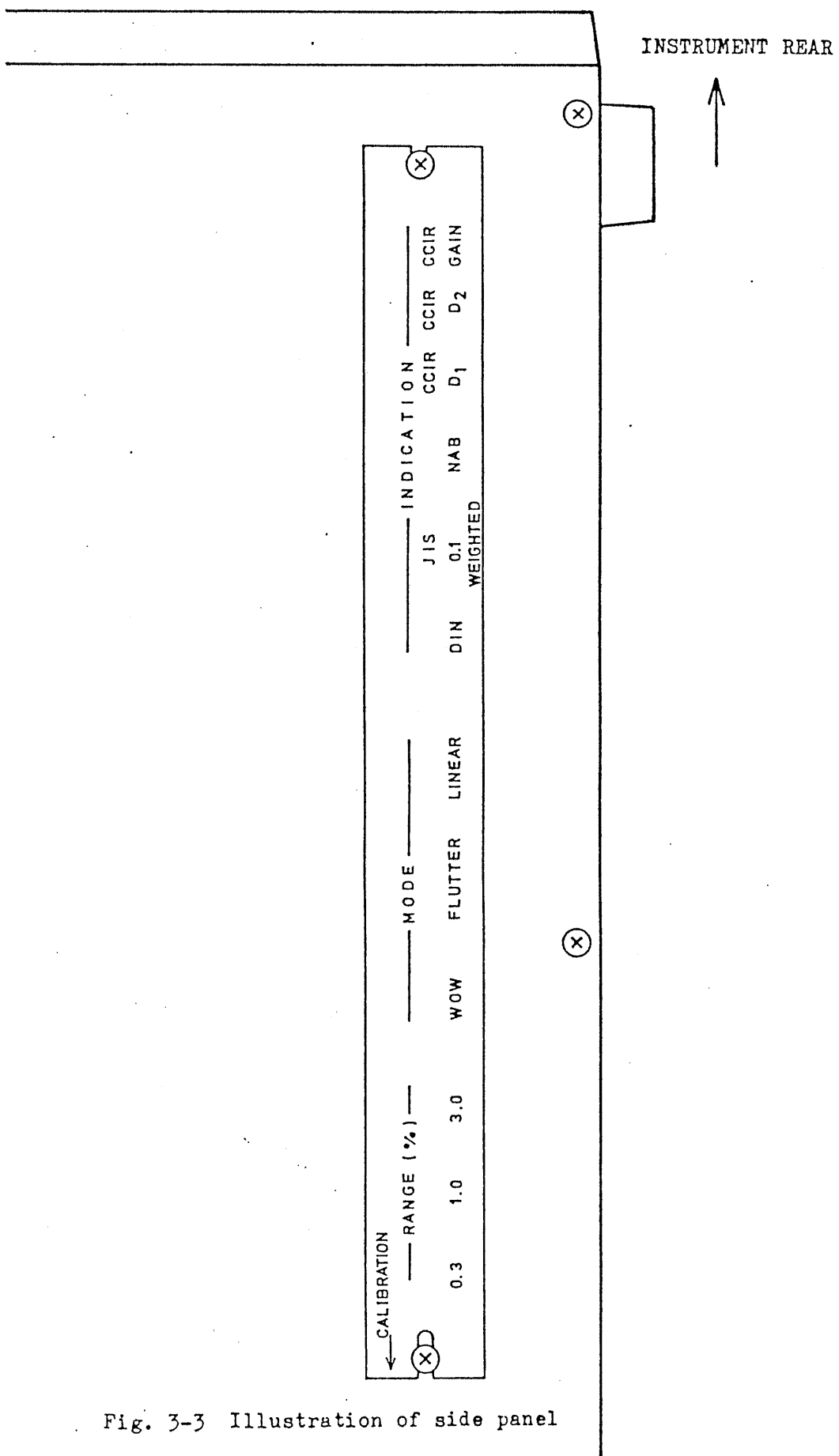INDICATION — DIN JIS NAB CCIR D_1 CCIR D_2 CCIR GAIN

0.1 WEIGHTED

Fig. 3-3 Illustration of side panel

3.4 Operation Procedure

3.4.1 Turn-OFF the POWER switch. Connect POWER cord to an AC
line receptacle. Set panel switches as follows:

PUSH 5 mV:	Popped-up state
PUSH COUNTER:	Popped-up state
RANGE (%):	3.0
MODE:	Normally, WEIGHTED or LINEAR
INDICATION:	JIS, NAB, CCIR, or DIN, as required.

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

3.4.3 If the tested object is a tape recorder and recording is
required before testing or if the object is required to
be tested recording and reproducing at the same time,
connect the INT OSC OUT 3kHZ/3.15kHz terminal on the rear
panel of the 677D to the input of the tested object.

* Either 3 kHz or 3.15 kHz should be used in accordance
with the industrial standard applied. Refer to 3.5
"Notes in Operation."

Apply to the INPUT of 677D the measured signal produced by
the tested object.

3.4.4 If the level of the signal applied to the INPUT is 50 mV_{rms}
or higher, the TAPE SPEED/FREQUENCY (kHz) display unit
digitally indicates the input signal frequency, indicating
that the 677D is in the measuring status. If the input
signal level is lower than 50 mV_{rms}, depress the PUSH 5mV
button so that the input sensitivity is increased and the
required input signal level effectively becomes 5 mV_{rms}
or higher.

* In the above case, even if the TAPE SPEED/FREQUENCY
  (kHz) display unit is indicating a certain value,
  measurement is not reliable unless the indicated value
  is 3 kHz ±150 Hz (for JIS, NAB, or CCIR) or 3.15 kHz
  ±150 Hz (for DIN).

3.4.5 If the 677D is in the status of Par. 3.4.4 above, the
       instrument is in the measuring status. Observing the
       indicator, increase the instrument sensitivity by varying
       the RANGE % selector from 3.0 to 1.0 and 0.3 until the
       indicator pointer is deflected maximum without deflected
       over the full scale.

       * The tape speed can be directly read on the TAPE
         SPEED/FREQUENCY (kHz) display unit (in terms of kHz),
         irrespective of setting of control buttons (except
         PUSH COUNTER button) on the panel. The frequency
         indication range is 2.700 kHz ~ 3.500 kHz at least.

3.4.6 To measure the wow component alone, depress the WOW button
       for MODE setting. To measure the flutter component alone,
       depress the FLUTTER button.

       * In this case, measurement is made irrespective of
         standards selected by the INDICATION buttons.

3.4.7 To observe the waveform and period of the wow/flutter
       measuring signal, connect an oscilloscope to the TO SCOPE
       terminal of the 677D.

       * An output corresponding to the MODE and RANGE %
         selectors is provided. To record drift (tape speed),
         connect a recorder to the TO RECORDER terminal. If
         a high speed oscillograph is used, drift and wow/
         flutter can be recorded at the same time.

* The signal is not affected by setting of the
RANGE %, MODE, and INDICATION selector buttons on
the panel. The signal polarity is "-" (negative)
for "+" (positive) direction deviation of tape speed.

3.4.8 To operate the 677D as a frequency counter, depress the
PUSH COUNTER button and apply to the INPUT terminal the
signal to be measured. If the applied signal level is
not lower than 50 mV_{rms}, the digital display unit indicates
the input signal frequency.

* When the 677D is set as a frequency counter, the
function of the PUSH $5mV_{rms}$ and other buttons on the
panel are idle and the instrument does not operate
as a wow/flutter meter.

* If the input signal frequency is higher than the upper
limit (9999), the OVER lamp lights.

GATE TIME (S)	MEASURING UPPER FREQUENCY (kHz)
0.01	999.9
0.1	99.99
1	9.999

3.5 Notes in Operation

3.5.1 The indicated value substantially differs by the standard
applied (setting of the INDICATION and MODE selectors).
Since no standards are available on separate measurement
of wow and flutter, use the MODE selector (WOW and
FLUTTER buttons) for laboratory analysis, etc.

3.5.2 If the input signal level and frequency is not within
the specified ranges of the 677D, the TAPE SPEED/FREQUENCY
(kHz) display unit does not light (refer to Par. 3.4.4,
3.4.8). However, if the level is sufficiently high, the
display unit indicates a certain value even when the
frequency is not within the specified range. Therefore,
for wow/flutter measurement, ensure that the center
frequency range is within the specified range.

3.5.3 When the input signal (the output signal of the record/
playback device tested) is sufficiently high (more than
50 mV_{rms}), measurement should be made without depressing
the PUSH 5 mV button. The wow/flutter indicator does
not deflect over the full scale and noise-resistant stable
measurement can be done.

3.5.4　The output frequency of the INT OSC OUT 3kHz/3.15kHz
　　　　vary by setting of the INDICATION selector as follows:

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

　　　　The output also varies slightly between 3kHz setting and
　　　　3.15kHz setting.

3.5.5　Regarding the RANGE %, MODE, and INDICATION selectors,
　　　　do not depress two or more buttons at the same time.
　　　　If two or more buttons are depressed, no reliable measurement
　　　　can be expected.

3.5.6　The specified environmental conditions are ambient temperature
　　　　$5 \sim 35^{\circ}C$ ($41 \sim 95^{\circ}F$) and relative humidity less than 85%.
　　　　Do not use the 677D under direct sunlight or near a heat
　　　　source.　Note that adverse environmental conditions (gas,
　　　　dust, vibration, chemicals) shorten the life expectancy of
　　　　the instrument.

4. OPERATING PRINCIPLE

4.1 Definitions of Wow/Flutter

Speed variation of an object in motion can be expressed in terms of percentage (%) as follows:

$$\frac{v - v_0}{v_0} \times 100 \ (\%)$$

where, v_0: average speed

v : instantaneous speed

This concept is applicable to measurement of relative speed change. Assume that a relative speed change (change of relative speed between head and tape) of a tape recorder is to be measured. Since speed and frequency are linearly proportional, speed change can be handled as frequency change. Therefore, relative speed change of the tape recorder can be expressed in terms of percentage as follows:

$$\frac{f - f_0}{f_0} \times 100 \ (\%)$$

where, f_0: center frequency

f : instantaneous frequency

Therefore, wow and flutter can be defined as variation in reproduced signal frequency due to variation of relative speed between signal detector and signal recording media of a tape recorder in operation. Slower frequency variations are called "wow" and faster frequency variations are called "flutter." Very slow variations are called "drift" and are distingwished from wow and flutter.

To put it in another way, wow and flutter causes such
effect that center frequency f_0 is frequency modulated with
the deviation of $f - f_0$. The factor of wow/flutter is
corresponding to the depth of frequency modulation.
Frequency variations are referred to as "drift", "wow", and
"flutter", as the variation speed becomes faster.

4.2 Operating Principle

Referring to the definition in Sub-section 4.1, wow/flutter
can be measured by demodulating (discriminating) the frequency-
modulated signal and determining the demodulated signal
amplitude. A basic block diagram of the 677D is shown in
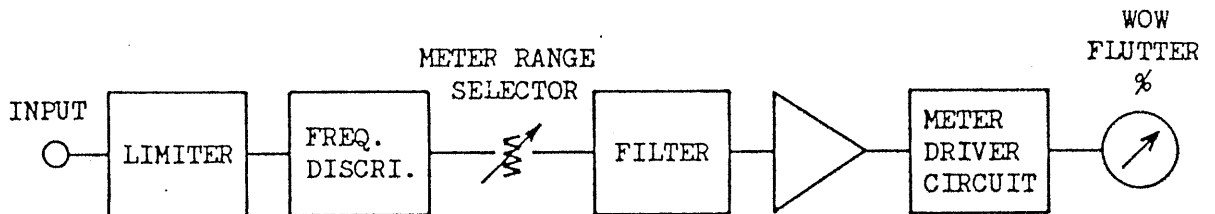Fig. 4-1. The concept diagram of wow/flutter meter is shown
in Fig. 4-1.

Fig. 4-1.

The input signal is fed through the limiter to the frequency
discriminator for frequency-demodulation. The demodulated
signal is fed through the meter range selector to the filter.
The filter attached "weight" to the signal in accordance with
frequency change speed, in either one of the four modes of
WEIGHTED, WOW, FLUTTER, and LINEAR.

    * WEIGHTED: Attaches weight to signal as specified by
                  JIS, NAB, CCIR, or DIN in order to compensate
                  for the sense of hearing of human being.

* WOW, FLUTTER: Separates into wow and flutter, with
6 Hz as the discriminating point between
the two.

* LINEAR: Passes all components of wow and flutter.
Characteristics are specified as is the
case for WEIGHTED.

The signal weighted by the filter is amplified and fed to the
meter driver circuit (indicator circuit) which drives the
indicating meter. The indicator circuit provides the required
characteristics for respective standards (JIS: effective
value, NAB: mean value, CCIR/DIN: peak value) and it also
controls dynamic characteristics of the indicating meter.

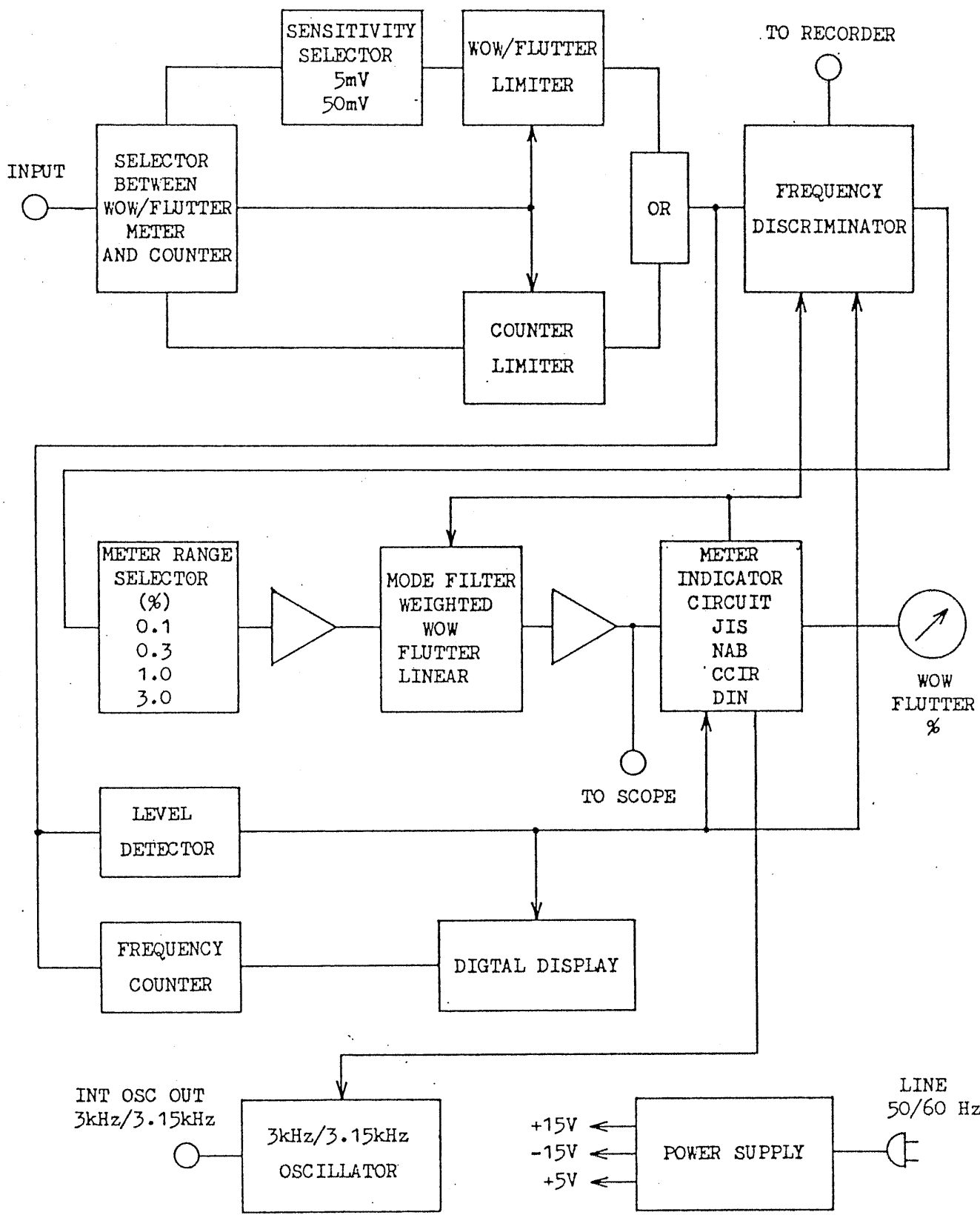A block diagram of the 677D is shown in Fig. 4-2.

Fig. 4-2 Block diagram of the 677D

5. MAINTENANCE

5.1 Calibration

The 677D has been designed for long period reliable operation. To ensure reliability and accuracy, the instrument should recommendably be calibrated every six months.

5.2 Notes in Calibration

5.2.1 Before turning-on the instrument power, check mechanical zero of the indicating meter. If it has been shift, adjust it correctly.

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

5.2.3 Fully stabilize the calibrating equipment also.

5.2.4 Ambient temperature should be 20°C ±10°C (68°F ±18°F).

5.3 Calibration Procedure

Remove the calibration panel on the right-hand side of the instrument, by sliding it after loosening its two clamping-screws. Potentiometers for calibration are accessible in positions corresponding to indications on the panel.

* Calibration must be carried out in the below-mentioned order. Set the wow/flutter calibrator at center frequency 3 kHz and output voltage about 1 V_{rms}, unless specified otherwise.

5.3.1 Calibration of Meter Sensitivity and Range (%)

(1) Depress the following switches on the front panel:

  * RANGE % 0.1
  * MODE .... WEIGHTED
  * INDICATION .... JIS

(2) Apply to the 677D a signal frequency-modulated with a wow/flutter frequency of 4 Hz, 0.100%$_{rms}$ of FM rate, from the calibrator.

(3) So adjust the JIS (0.1% WEIGHTED) potentiometer of INDICATION that the meter pointer deflects to "1" scale position of the "0 ~ 1" scale.

(4) Depress the "0.3" button of RANGE % selector on the front panel.

(5) Set the FM rate of the calibrator at 0.300%$_{rms}$. So adjust the RANGE (%) 0.3 potentiometer that the meter pointer deflects to "3" scale position of the "0 ~ 3" scale.

(6) In a similar manner as above, adjust the RANGE (%) 1.0 and 3.0 potentiometers.

5.3.2 Level Adjustment of Mode Filter

(1) Depress front panel buttons as follows:

  * RANGE (%) 0.1
  * MODE .... LINEAR
  * INDICATION .... JIS

(2) Set the calibrator as described in Par. 5.3.1, Item (2).

(3) So adjust the MODE – LINEAR potentiometer that the meter pointer deflected to "1" position of the "0 – 1" scale.

(4) Depress the WOW button of MODE selector on the front panel.

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

(6) So adjust the WOW potentiometer that the meter pointer deflects to "1" position of the "0 – 1" scale.

(7) Depress the FLUTTER button of MODE selector on the front panel.

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

(9) So adjust the FLUTTER potentiometer that the meter pointer deflects to "1" position of the "0 – 1" scale.

5.3.3 Adjustment of INDICATION – NAB

* Adjustment for JIS has been completed by the above procedure.

(1) Depress buttons on the front panel as follows:

* RANGE (%) 0.1
* MODE .... LINEAR
* INDICATION .... NAB

(2) Set the calibrator as described in Par. 5.3.1, Item (2), except the wow/flutter frequency which must set at 40 Hz in this case.

(3) So adjust the INDICATION - NAB potentiometer that the meter pointer deflects to "1" position of the "0 - 1" scale.

5.3.4 Adjustment of INDICATION - CCIR

(1) Depress buttons on the front panel as follows:

* RANGE (%) 0.1
* MODE   .... WEIGHTED
* INDICATION   .... CCIR

(2) Set the calibrator as described in Par. 5.3.1, Item (2), except the FM rate which must be set at 0.100% peak in this case.

(3) So adjust the INDICATION - CCIR GAIN potentiometer that the meter pointer deflects to "1" position of the "0 - 1" scale.

(4) Depress the "1.0" button of RANGE (%) selector on the front panel.

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

(6) So adjust the CCIR - D1 and D2 potentiometers that the meter deflects maximum "1 ± 0.04" and minimum "0.41 ±0.04 of the "0 - 1" scale.

* D1 potentiometer: Adjustment of maximum deflection
* D2 potentiometer: Adjustment of minimum deflection

(7) Vary the pulse width of the calibrator signal to 60 msec, 30 msec and 10 msec, and check that the maximum indicated values 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

(8) If the values are do not meet the above requirements, repeat the procedure starting by Item (6) above.

(9) When the above adjustment has been made, repeat the procedure of Item (1) in order to check that the meter pointer indicates "1" position of the "0 ~ 1" scale.

(10) Repeat the procedure of (1) through (9) for 2 or 3 times.

5.3.5 Adjustment of INDICATION - DIN

(1) Depress buttons on the front panel as follows:

* RANGE (%) 0.1
* MODE .... WEIGHTED
* INDICATION .... DIN

(2) Set the calibrator as described in Par. 5.3.1, Item (2), except the center frequency which must be set 3.15 kHz and the FM rate which must be set at 0.100% peak in this case.

(3) So adjust the INDICATION - DIN potentiometer that the meter pointer is deflected to "1" position of the "0 ~ 1" scale.

   * If the center frequency of the calibrator is 3 kHz only, adjust the pointer to "0.952" position.

* Dynamic characteristics have already been adjusted in Par. 5.3.4, Items (4) through (10) and need not be repeated here.