

**KENWOOD**

WOW FLUTTER METER

**FL-180A**

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**INSTRUCTION MANUAL**

KENWOOD CORPORATION

## WOW FLUTTER METER FL-180A

The FL-180A wow flutter meter measures wow and flutter of various types of sound recording machines, video recording machines and many other rotary machines such as tape recorders, VTR's and turntables in accordance with the JIS (Japan), NAB (U.S.A), CCIR (France) and DIN (Germany) standards.

Before using, please read this instruction manual carefully to insure the maximum performance and trouble-free operation of your FL-180A

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## FEATURES

- Minimum operating input voltage is as low as 0.5 mV, permitting measurements of wow and flutter directly from a small output tape head or PHONO cartridge.
- The FL-180 A has a wide range of measurement range (0.003 to 10%) and is ready for use with professional type recorders and other rotary machines.
- RMS values (JIS), mean values (NAB) and peak values (CCIR/DIN) can be directly read according to international standards.
- Combination of wow and flutter, weighted or unweighted, can be measured on the basis of DIN standards. It is also possible to measure wow and flutter separately.
- High stability crystal oscillators are incorporated to provide 3 kHz and 3.15 kHz as recording signal source.
- Besides measuring wow and flutter, the FL-180 A also indicates the frequency on a 4-digit frequency counter.  
The frequency counter reference time can be used for crystal control and selection of AC power frequency (50/60 Hz).
- The FL-180 A can be switched to operate as a frequency counter.
- Flickering of the monitor lamp allows wow and flutter measurement without adjusting the input level and frequency. If the FL-180 A is used as a frequency counter, the monitor lamp flickers when input frequency exceeds 9.999 kHz (gate time : 1 sec.), indicating overflow of the frequency.  
If input frequency exceeds 55 kHz (gate time : 0.1 sec.), the monitor lamp goes out, indicating that the frequency is out of the measurement range.
- AC and DC voltage output terminals are provided for connecting a frequency analyzer such as oscilloscope, pen recorder, digital memory scope or FFT analyzer to observe waveforms and analyze frequencies. AC voltage is proportional to wow flutter and DC voltage proportional to wow flutter and the speed of revolution.

## SPECIFICATIONS

### Wow flutter meter section

Measuring center frequency :	Within 3 kHz $\pm$ 300 Hz (JIS, NAB, CCIR) Within 3.15 kHz $\pm$ 300 Hz (DIN)
Input level :	0.5 mV $\sim$ 100 mV, 5 mV $\sim$ 30V, two ranges
Input impedance :	300 k $\Omega$ $\pm$ 20%, unbalanced
Wow flutter measurement range :	0.003 $\sim$ 10% (5mV $\sim$ 30V range) 0.01 $\sim$ 10% (0.5mV $\sim$ 100mV range) } 6 ranges
Display system :	RMS value (JIS) Mean value (NAB) Peak value (CCIR, DIN)
Display accuracy :	$\pm$ 5% of full scale (at 4 Hz)
Frequency response :	
Weighted characteristic :	In accordance with JIS, NAB, CCIR/DIN (at 0.2 $\sim$ 200 Hz)
Wow characteristic :	0.5 $\sim$ 6 Hz ( $-3$ dB $\pm$ 1 dB) (JIS/NAB) 0.3 $\sim$ 6 Hz ( $-3$ dB $\pm$ 1 dB) (CCIR/DIN)
Flutter characteristic :	6 $\sim$ 200 Hz ( $-3$ dB $\pm$ 1 dB)
Unweighted characteristic :	0.5 $\sim$ 200 Hz ( $-3$ dB $\pm$ 1 dB) (JIS/NAB) 0.3 $\sim$ 200 Hz ( $-3$ dB $\pm$ 1 dB) (CCIR/DIN)
Roll off :	Less than 0.5 Hz ; more than $-6$ dB/oct (JIS/NAB) More than 200 Hz ; more than $-15$ dB/oct (JIS/NAB) Less than 0.3 Hz ; more than $-6$ dB/oct (CCIR/DIN) More than 200 Hz ; more than $-15$ dB/oct (CCIR/DIN)
Maximum input voltage :	100 V (DC + AC peak)
Input monitor :	Level monitor lamp ON at more than 0.5 mV/5mV of input

### Frequency counter section

Measuring frequency range :	0.01 $\sim$ 55.00 kHz (gate time : 0.1 s) 0.010 $\sim$ 9.999 kHz (gate time : 1 s)
Input level :	100 mV <sub>rms</sub> $\sim$ 30 V <sub>rms</sub>
Input impedance :	300 k $\Omega$ $\pm$ 20% (unbalanced)
Counting capacity :	Decimal system, 4-digit LED memory display
Reference time :	
Reference time frequency :	10.080 MHz (built-in crystal) AC power frequency (AC line power)
Reference time frequency accuracy :	$\pm 5 \times 10^{-5}$ (0 $\sim$ 40 $^{\circ}$ C) (built-in crystal) Refer to AC power supply accuracy. (AC line power)
Gate time :	1 s, 0.1 s

Measurement accuracy :  $\pm$  (1 digit + reference time accuracy)  
 Maximum input voltage : 100 V (DC + AC peak)  
 Input monitor : Level monitor lamp goes on at 100 mV input or more.  
 (Flickers if input frequency exceeds "9.999 kHz" with the GATE TIME button released. Turns off if input frequency exceeds 55.00 kHz beyond the measurement range with the GATE TIME button depressed.)

### Output terminals

#### Recording output signal

Signal frequency : 3 kHz, 3.15 kHz  
 Accuracy :  $\pm 5 \times 10^{-5}$   
 Output voltage :  $0.2 V_{rms} \pm 20\%$  (open output)  
 Output impedance :  $600 \Omega \pm 20\%$  (unbalanced)  
 Distortion factor : Less than 1% (600  $\Omega$  terminated)

#### Drift output terminal (DRIFT)

Output voltage : Approx. DC  $\pm 1 V$ , for each  $\pm 1\%$  of frequency drift  
 Output impedance :  $600 \Omega \pm 20\%$  (unbalanced)

#### Scope output terminal (TO SCOPE)

Output voltage : Approx. 3  $V_{rms}$  of full scale  
 Output impedance :  $600 \Omega \pm 20\%$  (unbalanced)

#### Recorder output terminal (RECORDER)

Output voltage : Approx. DC 1 V of full scale  
 Output impedance :  $600 \Omega \pm 20\%$  (unbalanced)

### Power requirements

Voltage : AC 100/120/220  $\pm 10\%$ , 216 V ~ 250 V, 50/60 Hz  
 Power consumption : Approx. 14 W

### Operating temperature

0 ~ 40  $^{\circ}C$

### Dimensions

( ) dimensions include protrusion from basic outline dimensions.  
 Width 260 mm  
 Height 150 mm (171)  
 Depth 305 mm (360)

### Weight

Approx. 5.2 kg

### Accessories

Connecting cord with plugs and clips  
 (CA-36) ..... 1 piece  
 AC cord ..... 1 piece  
 Instruction manual ..... 1 copy  
 Replacement fuse  
 (0.5 A) ..... 2 pieces  
 (0.3 A) ..... 2 pieces

\*Circuit and rating are subject to change without notice due to developments in technology.

## PANEL CONTROLS AND THEIR FUNCTIONS

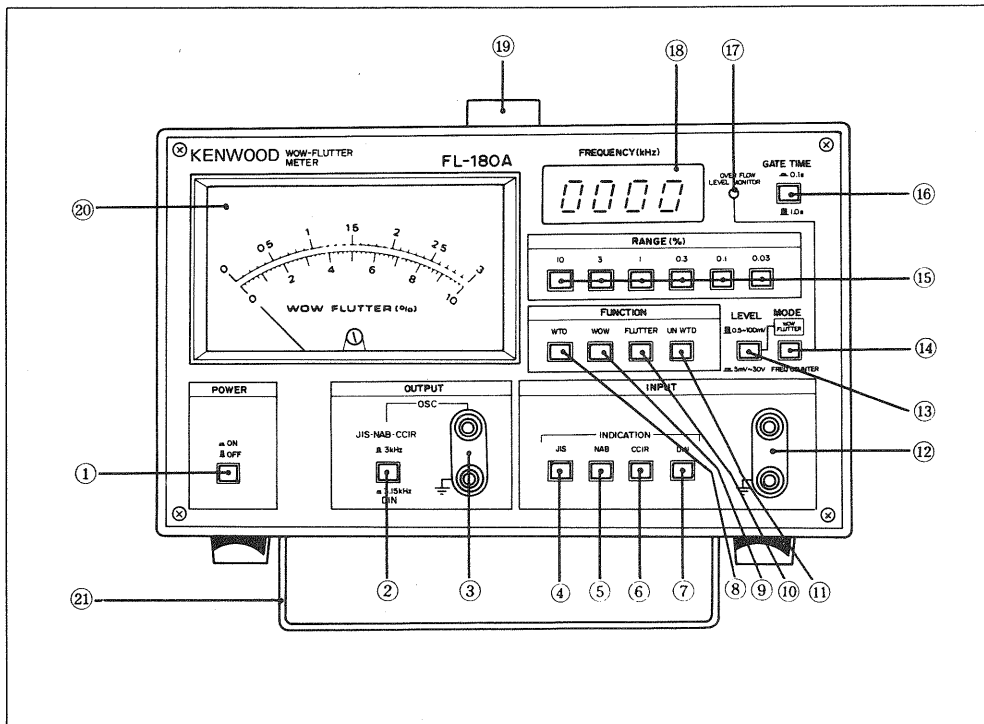





Fig. 1 Front panel

### Front Panel

#### ① POWER

Power switch. Press (  ) the pushbutton switch and the 4-digit frequency display LED ⑱ indicates "0000" (no input). The FL-180 A is ready for operation.

#### ② OSC (JIS, NAB, CCIR/DIN)

Recording signal select switch. Press (  ) the pushbutton switch and 3.15 kHz signal (DIN) is available at the OSC OUTPUT ③. By releasing (  ) the switch, 3.0 kHz (JIS, NAB, CCIR) signal is obtained at the OSC OUTPUT ③.

#### Note :

When measuring wow and flutter of each standard, this switch should set to the appropriate standard.

#### ③ OSC OUTPUT

Recording signal output terminal. A sine wave signal of the frequency selected by the recording signal select switch ② is outputted. The output voltage is 200 mVrms, output impedance is 600 ohm and distortion factor is 1%. Select the desired standard when measuring wow and flutter of a tape recorder, etc.

#### ④ INDICATION (JIS)

Standard select switch for measuring wow and flutter. Press the pushbutton switch and the meter ⑳ will indicate RMS value of JIS standard.

**⑤ INDICATION (NAB)**

Press the pushbutton switch and the meter ⑳ will indicate a mean value of NAB standard.

**⑥ INDICATION (CCIR)**

Press the pushbutton switch and the meter ⑳ will indicate a peak value of CCIR standard.

**⑦ INDICATION (DIN)**

Press the pushbutton switch and the meter ⑳ will indicate a peak value of DIN standard.

**⑧ FUNCTION (WTD)**

This switch is used to select the frequency component contained in wow and flutter to be measured. By pressing the pushbutton switch, weighted wow and flutter of each standard are measured.

**⑨ FUNCTION (WOW)**

By pressing the pushbutton switch, wow with frequency component of 0.5~6 Hz (0.3~6 Hz) (-3dB) can be measured. [ ( ) for CCIR/DIN ]

**⑩ FUNCTION (FLUTTER)**

By pressing the pushbutton switch, flutter with frequency component of 6~200 Hz (-3dB) can be measured.

**⑪ FUNCTION (UNWTD)**

By pressing the pushbutton switch, wow and flutter on 0.5~200 Hz (0.3~200Hz) band can be measured. [ ( ) for CCIR/DIN ]

**⑫ INPUT**

Input terminal for measuring wow flutter and frequency.

The input impedance is 300k $\Omega$ , and the maximum input voltage is 100V (DC + AC peak).

**⑬ LEVEL**

Input sensitivity select switch for measuring wow and flutter. Press (■) the pushbutton switch and wow flutter can be measured with more than 5mV input voltage. Release (■) the switch to measure wow and flutter with more than 0.5 mV input.

**⑭ MODE**

This switch is used to select the mode of measurement ; wow flutter or frequency.

Press the pushbutton switch and the FL-180 A functions as a frequency counter covering 10~9999 Hz. Release the switch to measure wow and flutter.

**⑮ RANGE**

This switch is used to select the wow flutter measurement range. It selects a maximum of 6 ranges, 0.03%, 0.1%, 0.3%, 1%, 3%, and 10% full scale.

⑩ **GATE TIME**

This pushbutton is used to select the gate time.

Press this pushbutton (button engaged) to set the gate time to 0.1 second and the measurement range to 00.01 to 55.00 kHz.

Press it again (button released) to set the gate time to 1 second and the measurement range to 0.010 to 9.999 kHz.

⑪ **OVERFLOW/LEVEL MONITOR**

During measurement of wow flutter, the monitor lamp will light when an input signal of specified level (selected by LEVEL ⑬) and frequency (3 kHz, 3.15 kHz)  $\pm 300$  Hz is present.

During measurement of frequency, this lamp will also light when a signal of specified input level (more than 100 mV) is present.

The lamp flickers when input frequency exceeds 9.999 kHz with the GATE TIME button released (gate time : 1 second), indicating overflow of the frequency.

It goes out when input frequency exceeds 55.00 kHz with the GATE TIME button depressed (gate time : 0.1 second), indicating that the frequency is out of the measurement range.

**Note :**

The lamp flickers momentarily at the time of power ON. This is normal and is not an indication of trouble.

⑫ **FREQUENCY**

The 4-digit red LED indicates the frequency during wow flutter or frequency measurement.

⑬ **Carrying Grip**

Use this grip when carrying the FL-180 A

⑭ **Meter**

This meter indicates wow flutter for direct reading. It provides two full scale readings of "10" and "3" which correspond to each position of the RANGE switch ⑮.

If the meter is not zeroed mechanically, adjust it with a standard screwdriver.

⑯ **Stand**

This stand can be locked by pulling in the "arrow" direction (see Fig. 2).

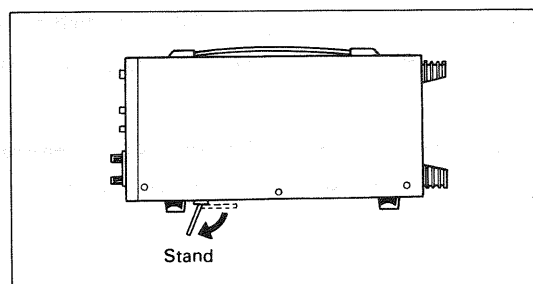


Fig. 2 Use of auxillary foot



## Rear Panel

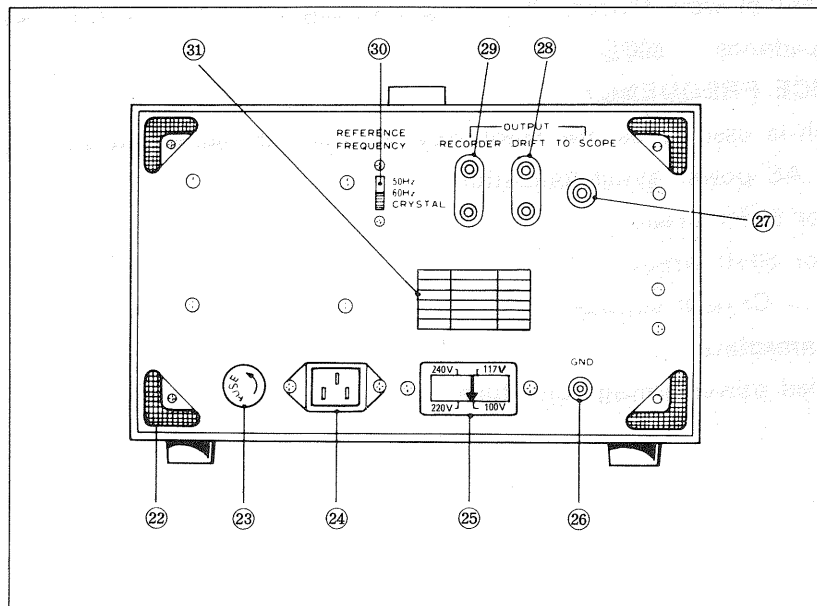


Fig. 3 Rear panel

### ②② Cord Reel

This cord reel is used to store the power cord for carrying convenience.

### ②③ Fuse Holder

A 0.3 A fuse is used for operating the FL-180 A on 220 V or 240 V AC power. For operation on 100 V or 120 V, it should be replaced with a 0.5 A fuse.

#### Note :

Never use a fuse with different current rating.

### ②④ Power Connector

AC power connector. Use the supplied AC cord.

### ②⑤ Power Selector Switch

Set this switch to the correct power voltage.

### ②⑥ GND Terminal

Ground terminal.

#### Note :

Before using, the FL-180 A must be properly earthed. Improper earthing can result in electrical shocks.

### ②⑦ TO SCOPE

AC voltage proportional to wow flutter is available at this terminal. The output voltage is about 3V full scale and the output impedance is about  $600\Omega$ . Used for observing waveforms or analyzing frequencies.

### ②⑧ DRIFT

Drift output terminal. The frequency drift is about  $DC \pm 1V$  for  $\pm 1\%$  and the output impedance is about  $600\Omega$ . The output voltage is proportional to the speed of revolution of equipment under test.

**②⑨ RECORDER**

This terminal provides DC voltage proportional to meter reading during measurement of wow flutter. The output voltage is about 1V full scale and the output impedance is 600  $\Omega$ .

**③⑩ REFERENCE FREQUENCY**

This switch is used to set the frequency counter reference time for crystal control or AC power synchronization.

50 Hz — For 50 Hz areas

60 Hz — For 60 Hz areas

CRYSTAL — Crystal control

**③⑪ Voltage Nameplate**

Use specified power voltage and fuse.

## PRECAUTIONS

1. Do not expose the FL-180A to direct sunlight. Note that excessive temperature rise results in unstable performance or damages transistors and IC's.
2. Avoid using the FL-180A in locations with high temperature and humidity.
3. Use the FL-180A in vibration-free locations. Vibration can cause misoperation.
4. AC power fluctuation should be within  $\pm 10\%$  of the rated voltage (MAX. 250V). Power frequency is 50/60 Hz.
5. Before the power is turned ON, check the mechanical zero point of the meter.
6. The FL-180A should be used under temperatures of 0 to 40  $^{\circ}\text{C}$ .
7. In measuring wow flutter, confirm the applicable standard and condition.
8. The maximum input voltage is 100V (DC + AC peak). Do not apply a voltage in excess of this limit. Never connect external voltage to the output terminals.
9. To prevent electrical shocks, be sure to connect the GND terminal (see ②⑥ on the rear panel) to an appropriate earth point.
10. When measuring wow flutter, the FL-180A must be placed uprightly ; otherwise, accurate measurements cannot be obtained.

## OPERATIONS

### Preparation for Operation

1. Set the power selector switch to the correct voltage observing the "arrow" mark on the plug.
2. Set the control knobs as follows :  
RANGE : 1%  
FUNCTION : WTD  
INDICATION : As desired  
LEVEL, MODE, OSC : As desired.
3. Connect the power cord to the AC outlet and press the AC power switch ①. The frequency display ⑱ will light to indicate "0000".  
The FL-180A is now ready for operation.

#### Note :

When the power is ON, the LED lamp (OVERFLOW/LEVEL MONITOR) ⑰ will flicker and the meter deflects off the scale.

This is normal and is not an indication that the meter is defective.

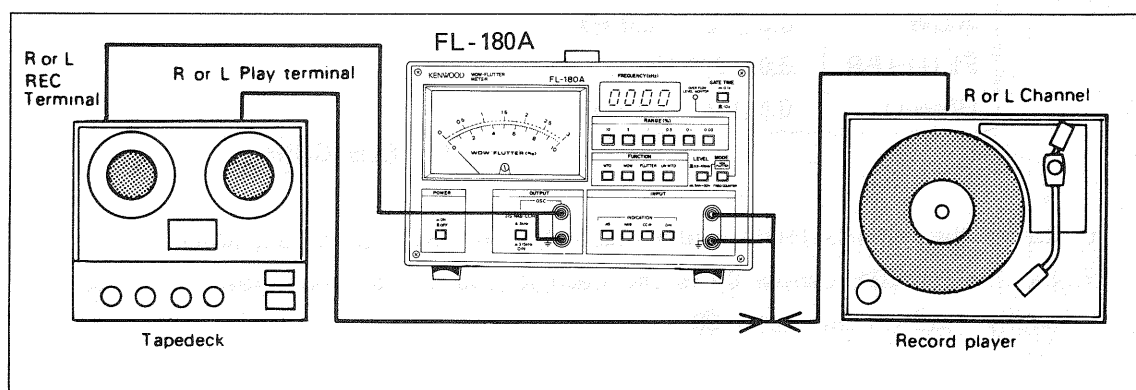


Fig. 4 Connecting the FL-180A

### Operating Procedures :

#### Operation of wow flutter meter

1. Connect the FL-180A to the equipment to be tested, such as tape recorder or turntable.
2. In testing tape recorder, use a wow flutter test tape, or record and play the signal of the OSC output terminal ③. In testing turntable, use a wow flutter test record.

#### Note :

To measure wow flutter according to JIS, NAB or CCIR standard, use a tape or record containing 3 kHz of center frequency (3.15 kHz for DIN).

3. Plug an AC power cord to AC outlet. Push the pushbutton switch ①. and the 4-digit frequency display ⑱ indicates "0000". The FL-180A is ready for operation.

- Set the MODE switch ⑭ to WOW FLUTTER. Next, set the LEVEL switch ⑬ to "5 mV~30V" and check that the MONITOR lamp ⑰ lights. If the input voltage is too small and the lamp does not light, set the LEVEL switch to "0.5 mV~100 mV".

**Note :**

When the MONITOR lamp is OFF, the wow flutter cannot be measured accurately.

Then, confirm that the frequency display ⑱ is indicating 3 kHz (3.15 kHz for DIN)  $\pm$  300 Hz.

**Note :**

If the input voltage is large, the MONITOR lamp will light with frequencies other than 3 (3.15) kHz.

- Select the FUNCTION switch ( ⑧ ~ ⑪ ) for the desired frequency component. The relationship between functions and frequency components is as follows :

Function	Frequency component (band)
WTD	Weighted frequency response of each standard (0.2~200 Hz)
WOW	0.5 (0.3) ~6.0 Hz
FLUTTER	6.0~200 Hz
UNWTD	0.5 (0.3) ~200 Hz

\* ( ) for DIN/CCIR

- Select the INDICATION switch according to the type of standard.
- Set the RANGE switch ⑲ to the desired position so that wow flutter can be easily read on the meter ⑳

**Output Terminals on Rear Panel :**

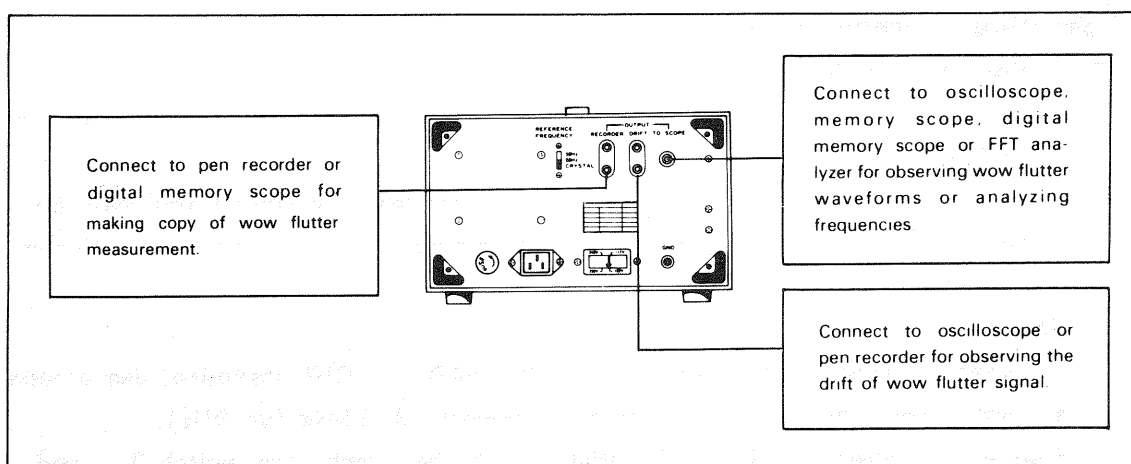


Fig 5 Out put terminal on rear panel

## Operation of frequency counter

1. Set the MODE switch ⑭ to **FREQ · COUNTER** and connect a signal to be measured to the input terminal ⑫. The LEVEL MONITOR lamp ⑰ will light if the input signal is more than 100mV, indicating that the FL-180A is operating as a frequency counter. The frequency is indicated in "Hz".

### Note :

If input frequency exceeds 9.999 kHz with the GATE TIME button released (gate time : 1 second), the OVERFLOW lamp ⑯ flickers, indicating overflow. Note that 10 kHz and over digits are not displayed. (Example : If 13.256 kHz is input, "3.256" is displayed.)

If input frequency exceeds 55.00 kHz with the GATE TIME button depressed (gate time : 0.1 second), the OVERFLOW lamp ⑯ goes out, indicating the frequency is out of the measurement range.

2. Select the position the REFERENCE FREQUENCY switch on the rear panel to set the reference time (time gate) for crystal control or AC power frequency synchronization.

Fig. 6 shows the connections of the FL-180A and the oscillator.

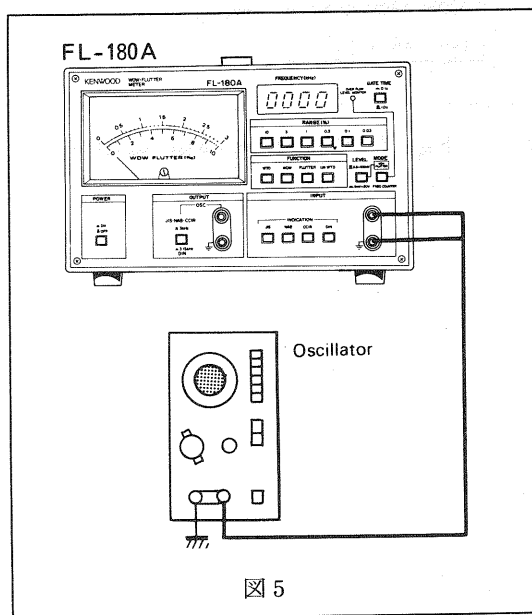


Fig. 6 Connection of the FL-180A and the oscillator

## MAINTENANCE

### Power voltage selection : (Fig. 7)

When operating the FL-180 A on 100V, 120V or 220V, set the voltage selector switch on the rear panel to the correct position.

For operation on 100V or 120V, take out the fuse (0.3A) in the fuse holder on the rear panel, and replace it with a 0.5A fuse.

#### Note :

When changing the power voltage, be sure to remove the power cord from the AC outlet.

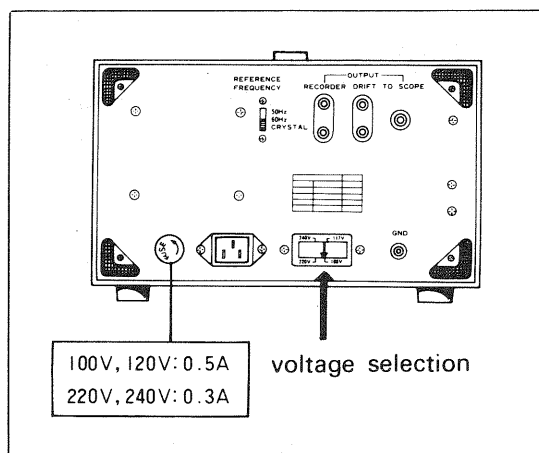


Fig. 7 Power voltage selection

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