FL-180

WOW FLUTTER METER

INSTRUCTION MANUAL

WOW FLUTTER METER FL-180

The FL-180 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-180.

CONTENTS

FEATURES

- Minimum operating input voltage is as lows as 0.5 mV, permitting measurements of wow and flutter directly from a small output tape head or PHONO cartridge.
- The FL-180 has a wide range of measurement range (0.003 to 10%) and is ready for use with professional type tape 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 also indicates the speed of revolution 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 can be switched to operate as a frequency counter.
- Adoption of monitor lamp allows measurements of wow and flutter without adjusting input level and input frequency. The monitor lamp flickers when the input frequency of the frequency counter exceeds "9999 Hz", indicating an overflow of frequency.
- 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 ±300 Hz (JIS, NAB, CCIR)
	Within 3.15 kHz ±300 Hz (DIN)
Input level:	0.5 mV ~ 100 mV, 5 mV ~ 30V, two ranges
Input impedance:	300 kΩ ±20% , unbalanced
Wow flutter measurement range:	0.003 ~ 10% (5 mV ~ 30V range) 0.01 ~ 10% (0.5 mV ~ 100 mV range) } 6 ranges
Display system:	RMS value (JIS)
	Mean value (NAB)
	Peak value (CCIR, DIN)
Display accuracy:	±5% of full scale (at 4 Hz)
Frequency response:	
Weighted characteristic:	In accordance with JIS, NAB, CCIR/DIN (at 0.2 ~ 200 Hz)
Wow characteristic:	0.5 ~ 6 Hz (−3 dB ±1 dB) (JIS/NAB)
	0.3 ~ 6 Hz (−3 dB ±1 dB) (CCIR/DIN)
Flutter characteristic:	6 ~ 200 Hz (−3 dB ±1 dB)
Unweighted characteristic:	0.5 ~ 200 Hz (−3 dB ±1 dB) (JIS/NAB)
	0.3 ~ 200 Hz (−3 dB ±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:	100V (DC + AC peak)
Input monitor:	Level monitor lamp ON at more than 0.5 mV/5 mV of input

Frequency counter section

Measuring frequency range:	10 ~ 9999 Hz
Input level:	100 mVrms ~ 30Vrms
Input impedance:	300 kΩ ±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:	$\pm 5 \times 10^{-5}$ (0~40°C) (built-in crystal)
	Refer to AC power supply accuracy. (AC line power)
Gate time:	1 sec.
Measurement accuracy:	± (1 digit + reference time accuracy)
Maximum input voltage:	100V (DC + AC peak)
Input monitor:	Level monitor lamp ON at more than 100 mV of input (flickers at more than "9999 Hz")

Output terminals

Recording output signal

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

Drift output terminal (DRIFT)

Output voltage:	Approx. DC±1V, for each ±1% of frequency drift
Output impedance:	600Ω ±20% (unbalanced)

Scope output terminal (TO SCOPE)

Output voltage:	Approx. 3Vrms of full scale
Output impedance:	600Ω ±20% (unbalanced)

Recorder output terminal (RECORDER)

Output voltage:	Approx. DC 1V of full scale
Output impedance:	600Ω ±20% (unbalanced)

Power requirements

Voltage:	AC 100/120/220/240V ±10%, 50/60 Hz
Power consumption:	Approx. 14W
Operating temperature:	0 ~ 40°C
Dimensions:	Width 260 mm Height 150 mm Depth 318 mm
Weight:	Approx. 5.3 kg
Accessories:	Connecting cord with plugs and clips (CA-36) .... 1 piece AC cord .... 1 piece Instruction manual .... 1 copy Replacement fuse (0.5A) .... 2 pieces (0.3A) .... 2 pieces

PANEL CONTROLS AND THEIR FUNCTIONS

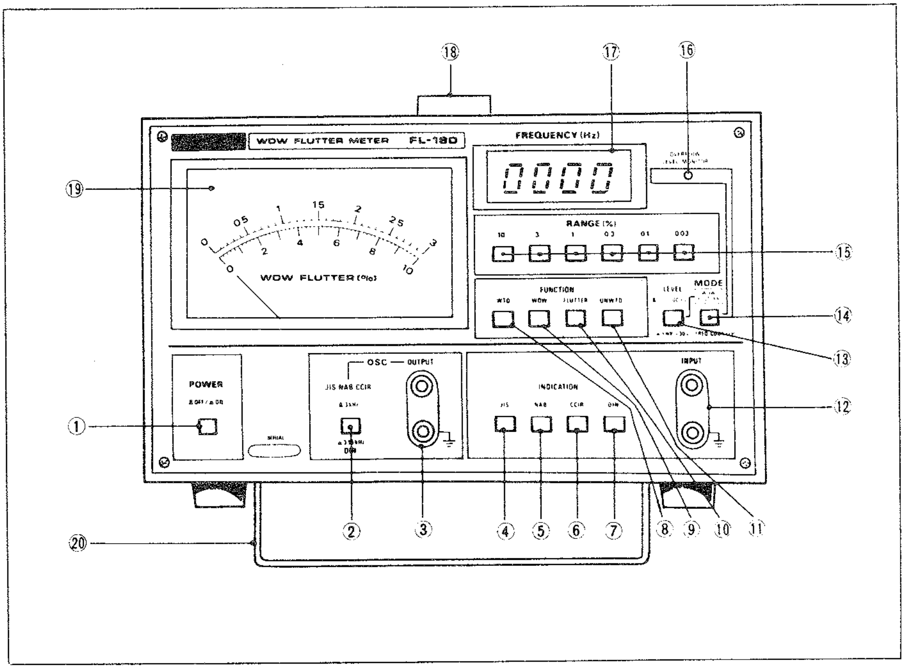

Fig. 1 Front panel

Front Panel

① POWER
Power switch. Press (■) the pushbutton switch and the 4-digit frequency display LED ⑰ indicates "0000" (no input). The FL-180 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 be 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 swtich for measuring wow and flutter. Press the pushbutton switch and the meter ⑲ will indicate RMS value of JIS standard.

⑤ INDICATION (NAB)
Press the pushbutton switch and the meter ⑲ will indicate a mean value of NAB standard.

⑥ INDICATION (CCIR)
Press the pushbutton switch and the meter ⑲ will indicate a peak value of CCIR standard.

⑦ INDICATION (DIN)
Press the pushbutton switch and the meter ⑲ 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) (−3 dB) can be measured. [( ) for CCIR/DIN]

⑩ FUNCTION (FLUTTER)
By pressing the pushbutton switch, flutter with frequency component of 6 ~ 200 Hz (−3 dB) can be measured.

⑪ FUNCTION (UNWTD)
By pressing the pushbutton switch, wow and flutter on 0.5 ~ 200 Hz (0.3 ~ 200 Hz) band can be measured. [( ) for CCIR/DIN]

⑫ INPUT
Input terminal for measuring wow flutter and frequency.
The input impedance is 300 kΩ, 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 5 mV 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 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.

16 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) ±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 the input frequency is more than 9999 Hz, indicating an overflow frequency.

Note:

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

17 FREQUENCY

The 4-digit, red LED display indicates the frequency of wow flutter being measured. The maximum reading is "9999".

18 Carrying Grip

Use this grip when carrying the FL-180.

19 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.

20 Stand

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

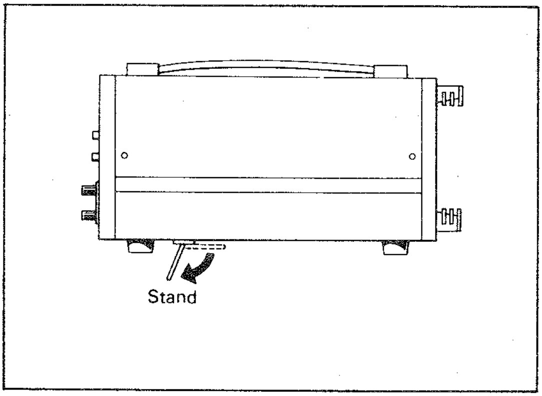

Fig. 2 Use of auxiliary foot

Rear Panel

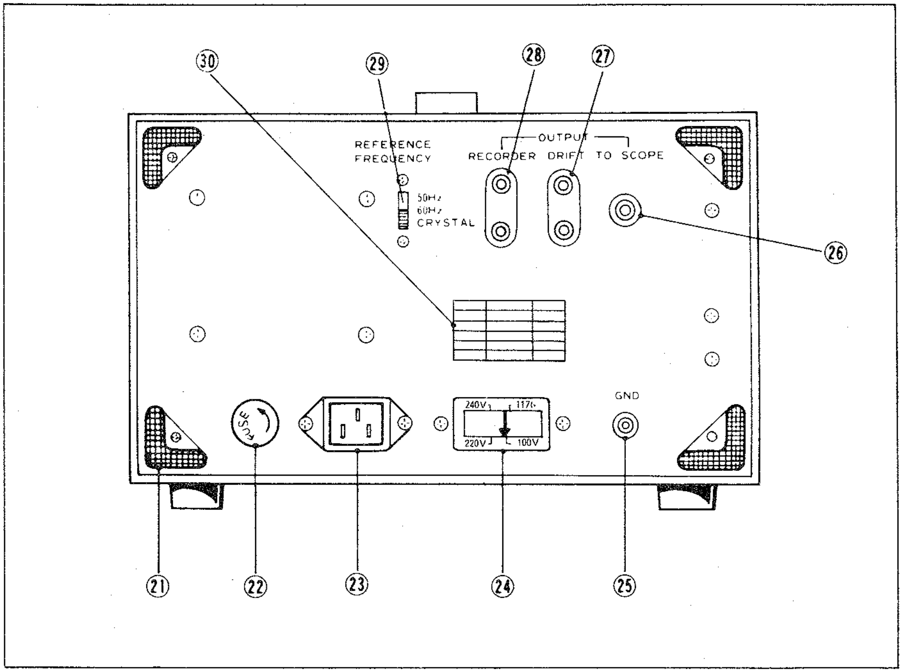

Fig. 3 Rear panel

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

22 Fuse Holder
A 0.3A fuse is used for operating the FL-180 on 220V or 240V AC power. For operation on 100V or 120V, it should be replaced with a 0.5A fuse.
Note:
Never use a fuse with different current rating.

23 Power Connector
AC power connector. Use the supplied AC cord.

24 Power Selector Switch
Set this switch to the correct power voltage.

25 GND Terminal
Ground terminal.
Note:
Before using, the FL-180 must be properly earthed. Improper earthing can result in electrical shocks.

26 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 600Ω. Used for observing waveforms or analyzing frequencies.

27 DRIFT

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

28 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 600Ω.

29 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

30 Voltage Nameplate

Use specified power voltage and fuse.

PRECAUTIONS

1. Do not expose the FL-180 to direct sunlight. Note that excessive temperature rise results in unstable performance or damages transistors and IC's.
2. Avoid using the FL-180 in locations with high temperature and humidity.
3. Use the FL-180 in vibration-free locations. Vibration can cause misoperation.
4. AC power fluctuation should be within $\pm$10% of the rated voltage. Power frequency is 50/60 Hz.
5. Before the power is turned ON, check the mechanical zero point of the meter.
6. The FL-180 should be used under temperatures of 0 to 40°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 ㉕ on the rear panel) to an appropriate earth point.
10. When measuring wow flutter, the FL-180 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. The FL-180 is factory set to operate on AC 240V.
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 switch ① . The frequency display ⑰ will light to indicate "0000".
   The FL-180 is now ready for operation.
   Note:
   When the power is ON, the LED lamp (OVERFLOW/LEVEL MONITOR) ⑯ will flicker and the meter deflects off the scale.
   This is normal and is not an indication that the meter is defective.

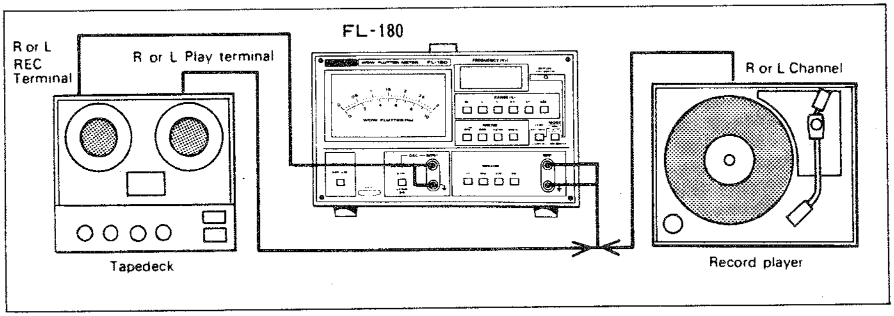

Fig. 4 Connecting the FL-180

Operating Procedures:

Operation of wow flutter meter

1. Connect the FL-180 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 ⑰ indicates "0000". The FL-180 is ready for operation.

4. Set the MODE switch ⑭ to WOW FLUTTER. Next, set the LEVEL switch ⑬ to "5 mV ~ 30V" and check that the MONITOR lamp ⑯ 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 ⑰ is indicating 3 kHz (3.15 kHz for DIN) ±300 Hz.

   Note:

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

5. 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

6. Select the INDICATION switch according to the type of standard.
7. Set the RANGE switch ⑮ to the desired position so that wow flutter can be easily read on the meter ⑲

Output Terminals on Rear Panel:

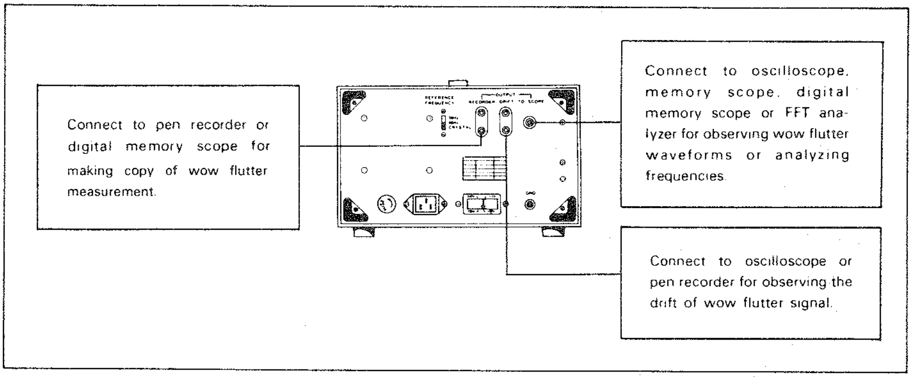

Fig. 5 Out put terminal on rear panel

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 ⑯ will light if the input signal is more than 100 mV, indicating that the FL-180 is operating as a frequency counter. The frequency is indicated in "Hz"

   Note:

   When the input frequency is more than 9999 Hz, the OVERFLOW lamp ⑯ flickers. In this case, the frequency on 10 kHz order is not indicated, for example, 13256 Hz is indicated as "3256".
2. Select the position of 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-180 and the oscillator.

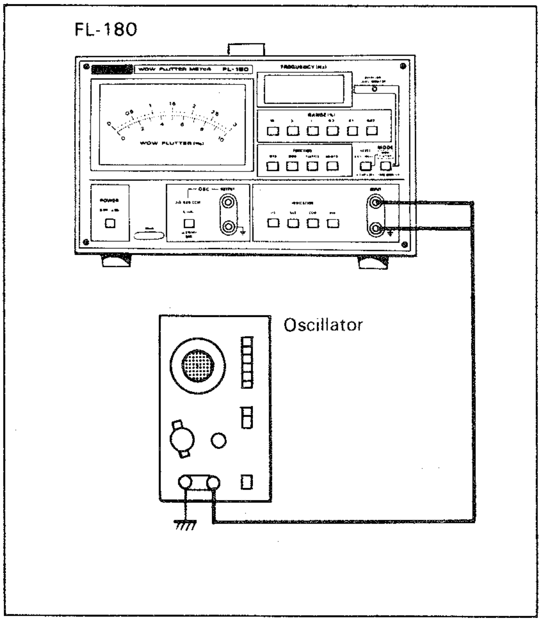

Fig. 6 Connection of the FL-180 and the oscillator

MAINTENANCE AND ADJUSTMENT

Maintenance

Removing the case (Fig. 7):

1. Remove the 2 screws on top of the case, 4 screws on side and 4 screws on bottom using a Phillips type screwdriver.
2. Remove the upper case by pulling upward and the lower case by pulling downward.

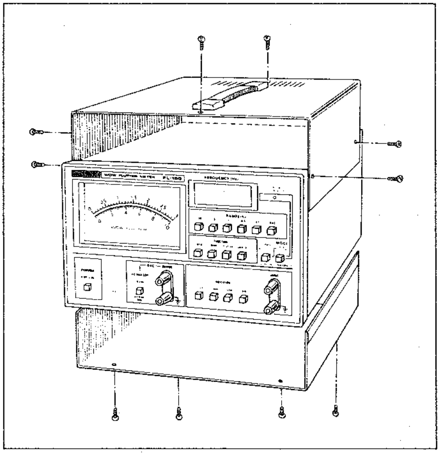

Fig. 7 Removing the case

Power voltage selection: (Fig. 8)

When operating the FL-180 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.

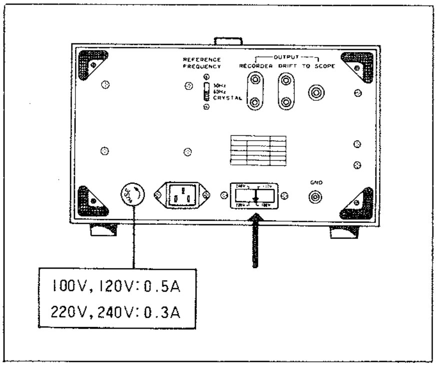

Fig. 8 Power voltage selection

Adjustment

Adjustment of offset balance:

When the offset balance of the output terminals on the rear panel is deviated, it should be adjusted as follows:

1. Turn on the power to set the FL-180 in operation. Ascertain that the LEVEL MONITOR lamp is OFF and the frequency display is indicating "0000" Hz.
2. Connect a tester, digital multimeter or oscilloscope to each output terminal and measure DC voltage.
3. Adjust the following volume controls to obtain DC 0V on each output terminal.

Other adjustments

For adjustments requiring test instruments other than oscilloscope and multimeter, contact your nearest TRIO's agency.

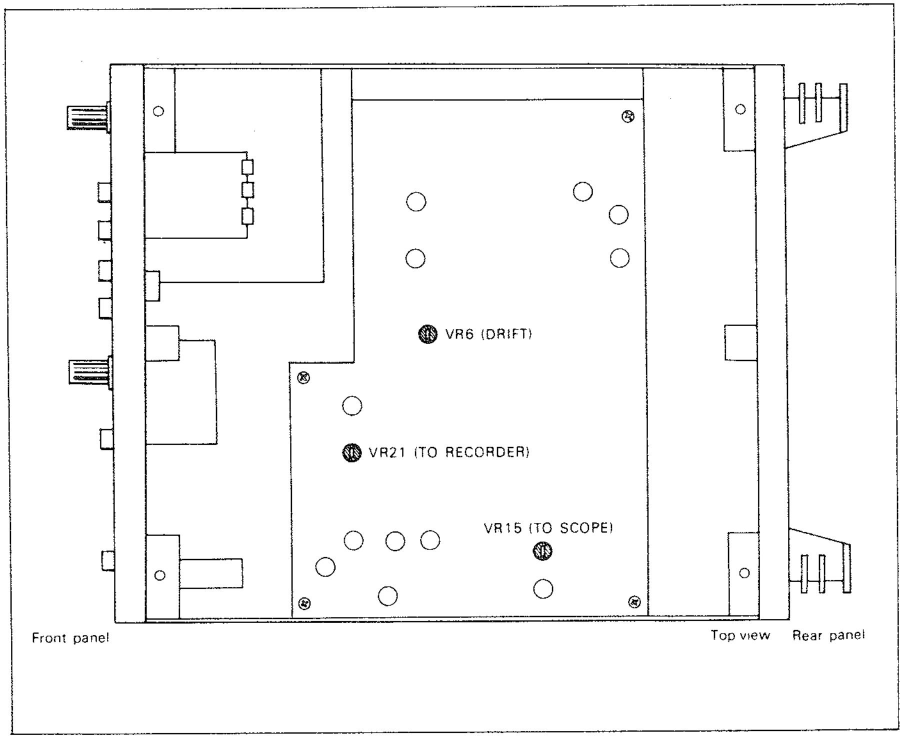

Fig. 9 Location of adjustment

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