MODEL 675

WOW FLUTTER METER

OPERATION MANUAL

KIKUSUI ELECTRONICS CORP.

CONTENTS

1. INTRODUCTION

Model 675 wow & flutter meter is an instrument for measuring irregularities in various sound recording and playback equipment (for tape, video tape, record, film, etc.) which require constant speed.

This device can read out speed irregularities in effective value (RMS) and peak value by means of measurements taken in accordance with JIS and CCIR specifications.

Model 675 has also various different measuring modes such as measurements of audibility-compensated value, separation value of wow and flutter components and total value of sperimposed wow and flutter components in accordance with JIS and CCIR specifications. Since this device is provided with an indicator for reading out tape speed and a TO SCOPE terminal for measuring the waveform and period of wow and flutter, it ensures a wide range of applications from study and development to manufacturing and inspection.

Features

1. Model 675 reads out wow and flutter at both RMS value, in accordance with JIS specifications and PEAK value, in accordance with CCIR (DIN) specifications.
2. High sensitivity meter is capable of measuring wow and flutter in input level of minimum 5mV.
3. Application of the input is shown by an indicating lamp, and adjustment of the input level and frequency is unnecessary.
4. Model 675 reads out tape speed as well as wow and flutter.
5. A newly developed discriminator (patent pending) with excellent linearity operates as a complete non-control system in which centering is unnecessary.
6. Wow and flutter can be separately measured.
7. The indicator is provided with a changeable response time device for facilitating measurement.
8. In combination with an oscilloscope, the waveform and period of wow and flutter can be easily observed.
9. Compact size and lightweight.
10. Use of IC and all silicon transistorized circuits ensures high reliability.

2. SPECIFICATIONS

Name of Instrument	Wow & flutter meter
Name of Model	675
Input Terminal	5-way type, 19mm (3/4 inch) interval
Center Frequency Range	Within 3000Hz ± 5%
Input Level	Within 5mV to 5V RMS (regardless of amplitude)
Input Impedance	Approx. 50 kΩ, unbalanced
Measuring Range	Within 0.03 to 3%, in 3-step (0 ~ 0.3%, 0 ~ 1%, 0 ~ 3%)
Indicating System	Effective value indication in accordance with JIS specifications and peak value indication in accordance with CCIR (DIN) specifications
Indicator	Scale length: 85mm, 2-colored scale, 100 μA
Scale	Values of wow and flutter; at effective value (RMS) and peak value (PEAK); dual-range scale of 1.0 and 3.0 respectively; 4-range scale totally

Indicator Error	Within ±10% of max. value
Frequency Characteristics	Audibility compensation characteristic; in accordance with JIS (C5551) and CCIR (DIN) Wow flutter separation characteristic: Wow; 0.5 to 6 Hz Flutter; .6 to 250 Hz Flatness characteristic; +1 dB to -3 dB within a range of 0.5 to 200 Hz (with reference to 4 Hz)
Tape Speed Indicating Range	3000 Hz ± 5% (±150 Hz)
Tape Speed Indicating Error	Within ±0.5% (±15 Hz)
Output Terminal	5-way type; 19mm (3/4 inch) interval
Self Oscillation Frequency	Within 3000 Hz ± 0.5%
Output Impedance	Within 600Ω ± 20% (unbalanced)
Output Voltage	Less than 1.0V (RMS)
Distortion Factor	Less than 1.0%
Regulation	For ±10% variation of line voltage

	Variation of indication: within ±1%	
	Variation of oscillation frequency: within ±0.1%	
Power and Power Consumption	AC .....V,50/60 Hz, approx. 15VA	
Dimensions	200(W) x 150(H) x 280(D) mm	
(Maximum)	200(W) x 159(H) x 304(D) mm	
Weight	Approx. 4 Kg	
Accessories	Fuse 0.5A	2
	Operation manual	1
	Test data	1

3. OPERATION

3.1 Front panel description (See Fig. 3-1)

①	POWER	Pushbutton power switch. When it is pushed and locked power, is turned on and the pilot lamp is lit simultaneously.
②	INPUT	Terminals for connecting input signal from recording and playback equipment. GND terminal is connected to the case.
③	SET· LEVEL & FREQ.	When the input signal level connected to INPUT terminals is more than 5mV and its frequency is within a range of 3 kHz ± 5%, the lamp is lit to indicate that the set is in a ready state.
④	MODE	Pushbuttons for selecting following wow and flutter measuring modes. When they are pushed and locked, a corresponding mode is possible.

	WEIGHTED	Used for measuring audibility-compensated wow and flutter values according to JIS and CCIR (DIN) specifications.
	WOW	Used only for measuring wow component (0.5 ~ 6 Hz) separated from test signal.
	FLUTTER	Used only for measuring flutter component (6 ~ 250 Hz) separated from test signal.
	LINEAR	Used for measuring all components of wow and flutter contained in test signal.
⑤	INDICATION	Pushbuttons for selecting following indication modes of wow and flutter. When they are pushed and locked, a corresponding mode is possible.
	RMS	Used for reading out wow and flutter on meter in effective value (RMS) in accordance with JIS specifications.

	PEAK	Used for reading out wow and flutter on indicator in peak value in accordance with CCIR specifications.
⑥	TIME CONSTANT	To select a time constant on wow and flutter indicator. Push and lock button which corresponds to time desired.
	NORM	Used for measurement in accordance with JIS and CCIR specifications.
	RMS FAST, PEAK SLOW	Used for reading out RMS value in fast response time on indicator, or peak value in slow response time.
⑦	METER RANGE	Pushbuttons for selecting measuring range of wow and flutter. When they are pushed and locked, a range of 0.3, 1 or 3% can be optionally obtained. Since these percentages are values indicated on the full scale, an optional range should be selected according to intensity of wow and flutter.

⑧	WOW % Indicator	Meter which guages wow and flutter. The upper dual-range black scale is for effective value (RMS) and the lower dual-range red scale is for peak value (PEAK). The divisions of 1.0 and 3.0 shown on the full scales correspond to the meter ranges.
⑨	TAPE SPEED Indicator	The center frequency of test signals is indicated by this meter. Since tape speed is proportional to playback frequency, it is identified directly on meter. The frequency range is within 3 kHz ± 5% (150 Hz).
⑩	3 kHz OUTPUT	Terminals for picking up 3 kHz output signal as standard recording source signal. GND terminal has been connected to the case.
⑪	STAND	If meter position is too low for reading filt stand in upright position.

3.2 Rear panel description (See Fig. 3-2)

⑫	TO SCOPE	The waveform and period of wow and flutter can be observed by connecting an oscilloscope to this terminal. The black terminal is previously connected to the case. The output impedance is approx. 50kΩ.
⑬	FUSE	A glass-tube fuse of 0.5A is set in fuse holder used for AC line.
⑭	Power Cord	Connected to 50/60 Hz AC outlet.

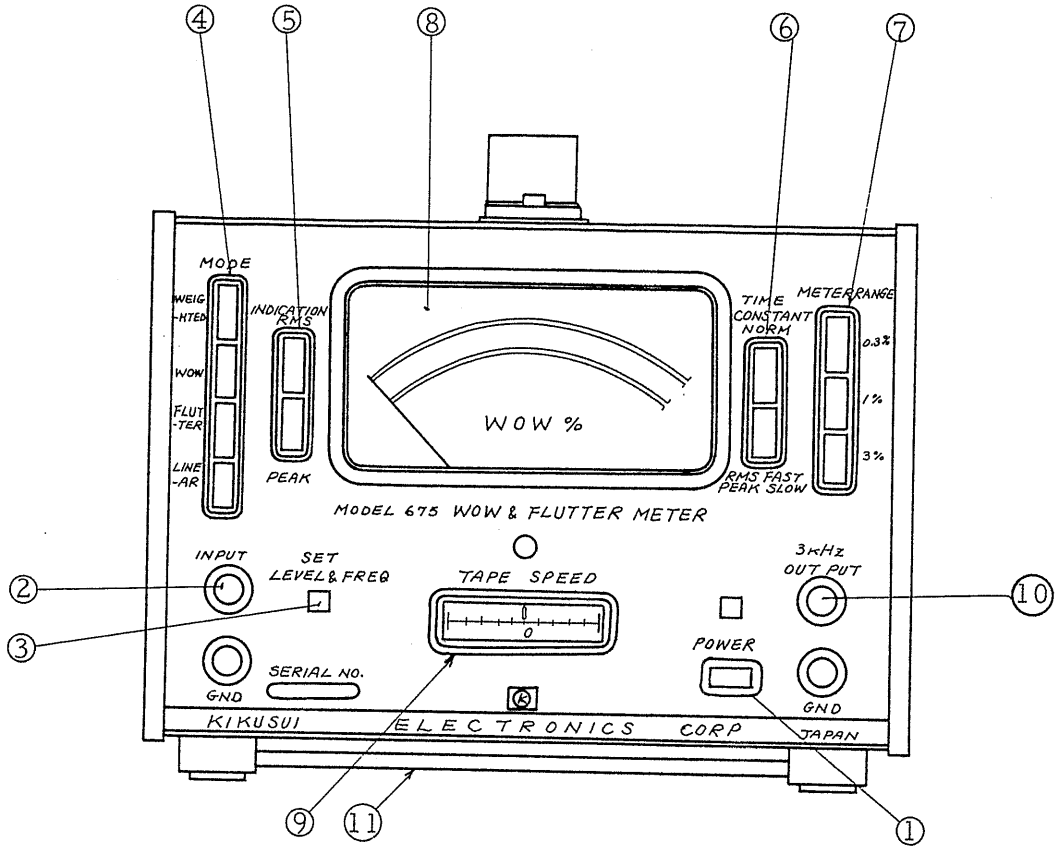


Fig. 3-1 Front Panel

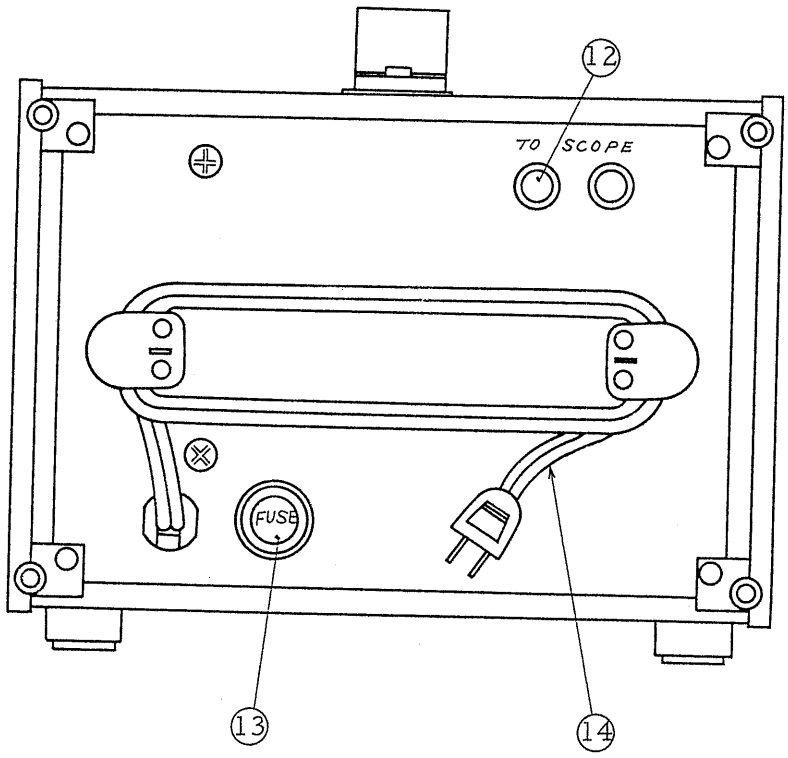


Fig. 3-2 Rear Panel

3.3 First-time Operation

1) Press POWER button off.

After connecting the power cord to AC power outlet, set each pushbutton as follows:

MODE:	normally, at WEIGHTED or LINEAR
TIME CONSTANT:	normally, at NORM
INDICATION:	at RMS or PEAK
METER RANGE:	at 3%

2) When previous recording is necessary, connect 3 kHz OUTPUT terminals to the input side of the test recorder.

When the recorded tape is used, connect the output cord of the reproducer to INPUT terminals.

3) Press POWER button on and the pilot lamp above POWER will light.

Previous recording, when necessary, should be of a specified time length.

Since the output at 3 kHz OUTPUT can be obtained regardless of setting of other pushbuttons, recording can be readily performed.

4) When the output from the reproducer is more than 5mV and its frequency is within a range of 3 kHz ± 5%, SET LEVEL & FREQ lamp lights to indicate that the set is in a state of readiness.

When the lamp doesn't light, the input level is so low or its frequency so deviated that measurement is impossible.

5) Wow and flutter can be read out by the above-mentioned procedures. Select a meter range of 3, 1 or 0.3% according to the amount of wow and flutter.
Tape speed can be read out on TAPE SPEED indicator regardless of setting of other pushbuttons.

6) When measuring only the wow, set MODE pushbutton at WOW. When measuring only the flutter, set MODE pushbutton at FLUTTER.

7) When selecting METER RANGE according to the amount of wow and flutter, set each pushbutton for measurement in accordance with JIS or CCIR specifications as follows;

For JIS specifications: at WEIGHTED, RMS, NORM

For CCIR specifications: at WEIGHTED, PEAK, NORM

8) To change over the response time of the wow & flutter indicator, proceed in the following manner:
When reading out RMS value in a fast response time on the indicator, or reading out PEAK value in a slower response time, switch TIME CONSTANT pushbutton from NORM to RMS FAST, PEAK SLOW.

9) To observe the waveform and period of wow and flutter in the above-mentioned measurement, connect TO SCOPE terminal on the rear panel to an oscilloscope.
When MODE pushbuttons are change over, a corresponding output can be obtained at TO SCOPE terminals.

3.4 Sample of Measurement

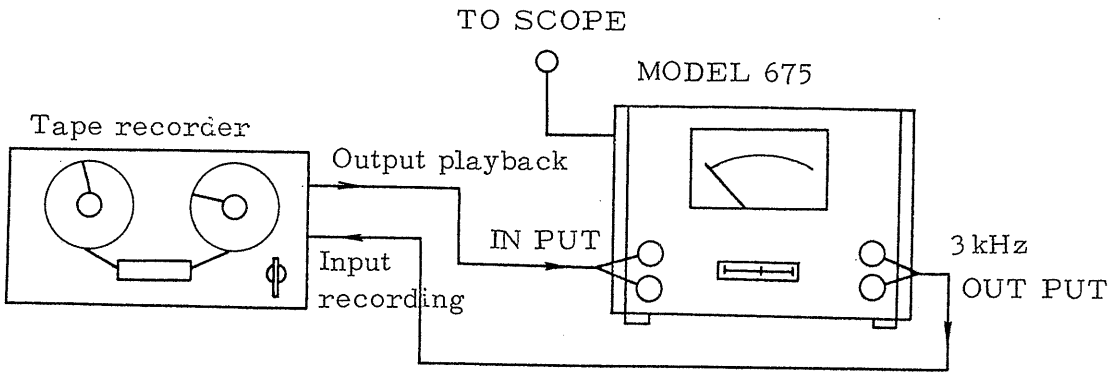


Fig. 3-3 Wiring diagram of wow and flutter measurement in tape recorder

1) The wiring diagram shown in Fig. 3-3 is applicable to all of the following measuring methods:

simultaneous playback measuring; measuring playback signal while recording (in machine which permits simultaneous recording and playback performance);

two-step playback measuring; measuring playback signal after rewinding the recorded tape;

two-set playback measuring; measuring playback on recorder other than machine on which tape was originally recorded.

2) Quotation from JIS C5551 Tape Recorder Test Method

Play back the wow & flutter testing tape on the largest real which fits test tape recorder.

Measure this output in percentage by means of a RMS value indication wow and flutter meter in which is integrated an audibility compensation circuit having the characteristics shown in Fig. 3-4.

Measure the tape three times each at the start, center and end of the real.

Average the three values measured in each position.

The wow and flutter of the test set is indicated by the highest of these averages.

3.5 Caution

1) When wow and flutter are measured, values indicated depend on applied specifications.

Set TIME CONSTANT pushbutton at NORM.

WHEN RMS FAST, PEAK SLOW pushbutton is set, measurement does not conform with JIS and CCIR specifications.

2) Be sure to increase the output level of the reproducer connected to INPUT terminals until SET LEVEL FREQ lamp lights.
The signal frequency is probably deviated.
In such a case, measurement is impossible.

3) Never directly connect INPUT, 3 kHz OUTPUT or TO SCOPE to DC source or a circuit where the test signal is superimposed on another signal.

4) Do not press simultaneously two or more panel pushbuttons of the same mode during measurement.
Proper measurement will be rendered impossible.

5) When the indicating pointer does not center on value zero of the scale in a power-off state, adjust for zero using screw-driver through the panel hole.

4. PLINCIPLE OF OPERATION

Fig. 4-1 is the block diagram which shows operational principle Model 675 WOW & FLUTTER METER.

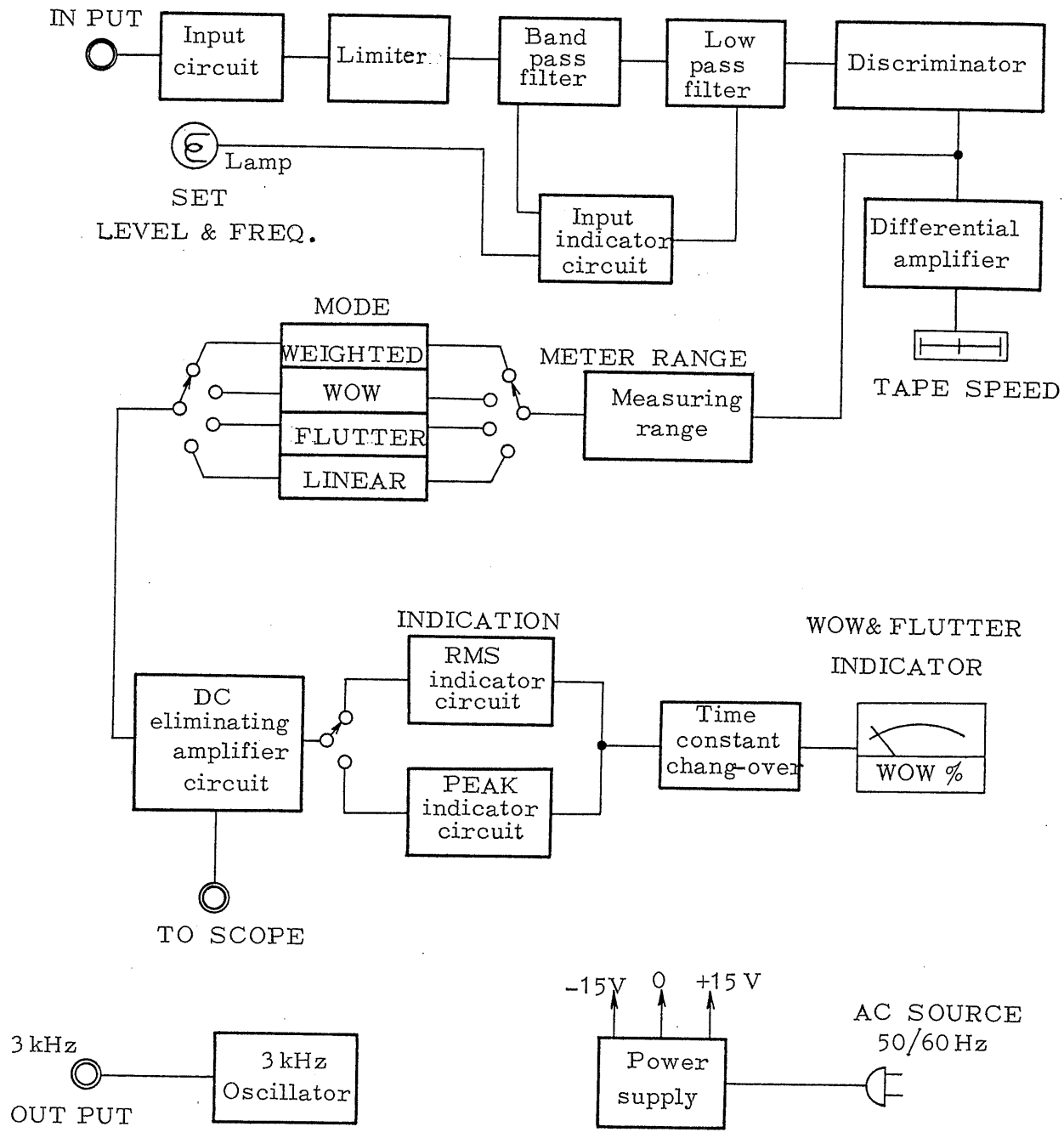


Fig. 4-1 Block diagram of Model 675 wow & flutter meter

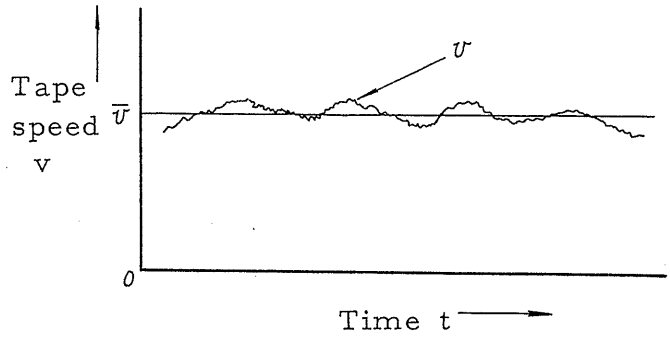


Fig. 4-2 Definition of wow & flutter

In Fig. 4-2, the longitudinal axis is expressed as instantaneous value v of tape speed and the transversal axis as time t.

Wow and flutter are defined as follows:

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

Where, $\bar{v}$ = average speed

The test tape recorder then plays back the tape on which constant frequency fo has been recorded on an ideal recorder which is almost free from wow and flutter.

Since instantaneous frequency f of the output is proportional to tape speed, the definition of wow and flutter can be converted as follows:

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

Namely, the output of the recorder has waveforms in which center

frequency f is frequency-modulated, and the wow and flutter are then modulation degree.

Therefore, wow and flutter can be measured by detecting the degree of modulation as with demodulation of FM signal by means of FM receiver.

In Fig. 4-1, the frequency-modulation output of the test recorder is applied to the limiter through INPUT terminals to eliminate level fluctuation (amplitude-modulation component caused by the test recorder), and to allow proper measurement of wow and flutter.

The wow and flutter signal, its amplitude regulated by the limiter, is applied to a discriminator circuit composed of a band pass filter, low pass filter and discriminator (patent pending) -- the total circuit having excellent linearity.

Wow and flutter detected here actuates TAPE SPEED indicator through the differential amplifier.

The detected output is also divided in the measuring range circuit, and applied to a group of mode filters.

WEIGHT position is used for audibility compensation.

In WOW and FLUTTER positions, wow and flutter circuits separated at cross-over frequency of 6 Hz are connected.

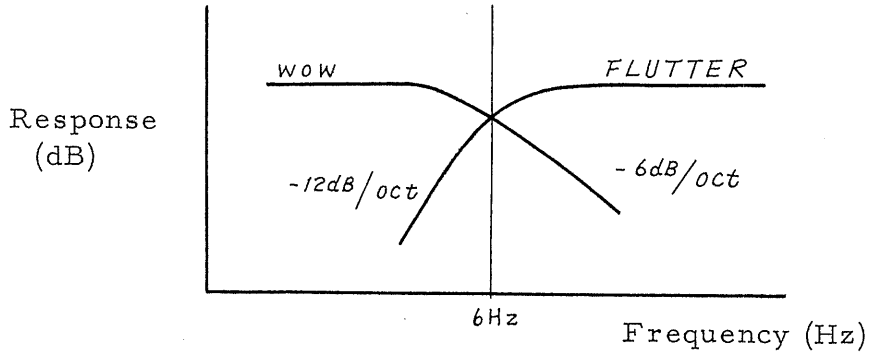


Fig. 4-3

In LINEAR position, all components of wow and flutter pass through this circuit.

After passing through these filters, the wow and flutter signals are applied to the DC eliminating amplifier circuit to actuate the wow & flutter indicator in RMS or PEAK indication mode as preset.

TO SCOPE terminals are provided for observing the waveform of wow and flutter on the CRT of an oscilloscope.

As described above, it is advisable to use the standard tape recorded properly for measurement.

However, when such a tape is not available, it is necessary to record and play back the 3 kHz signal by means of the test recorder for application to the wow & flutter meter.

Therefore, an oscillator of 3 kHz is built in to Model 675.

This oscillator is completely isolated from the other circuits.

5. MAINTENANCE

5.1 Internal Inspection

Remove the screws and feet at four places shown in Fig. 5-1. Pull back side plates, top plate and bottom plate showly for internal check.

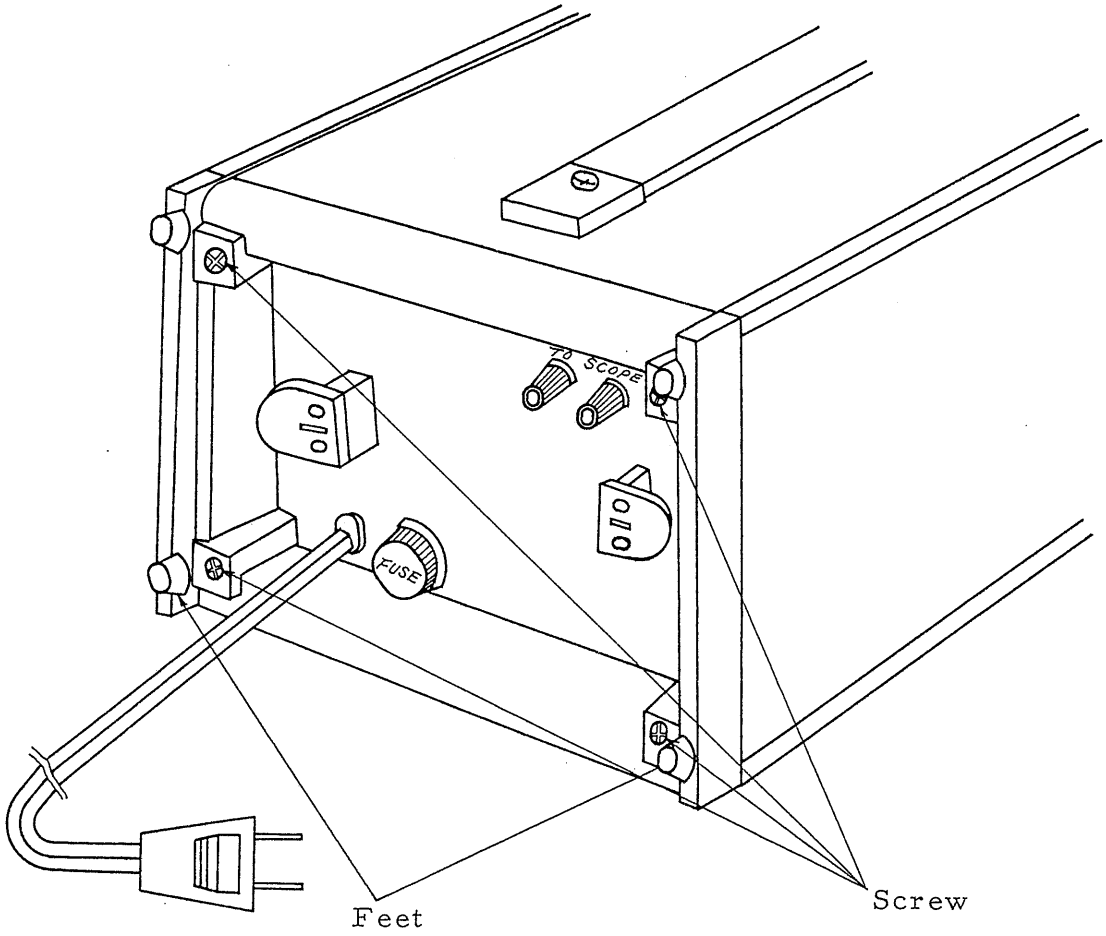
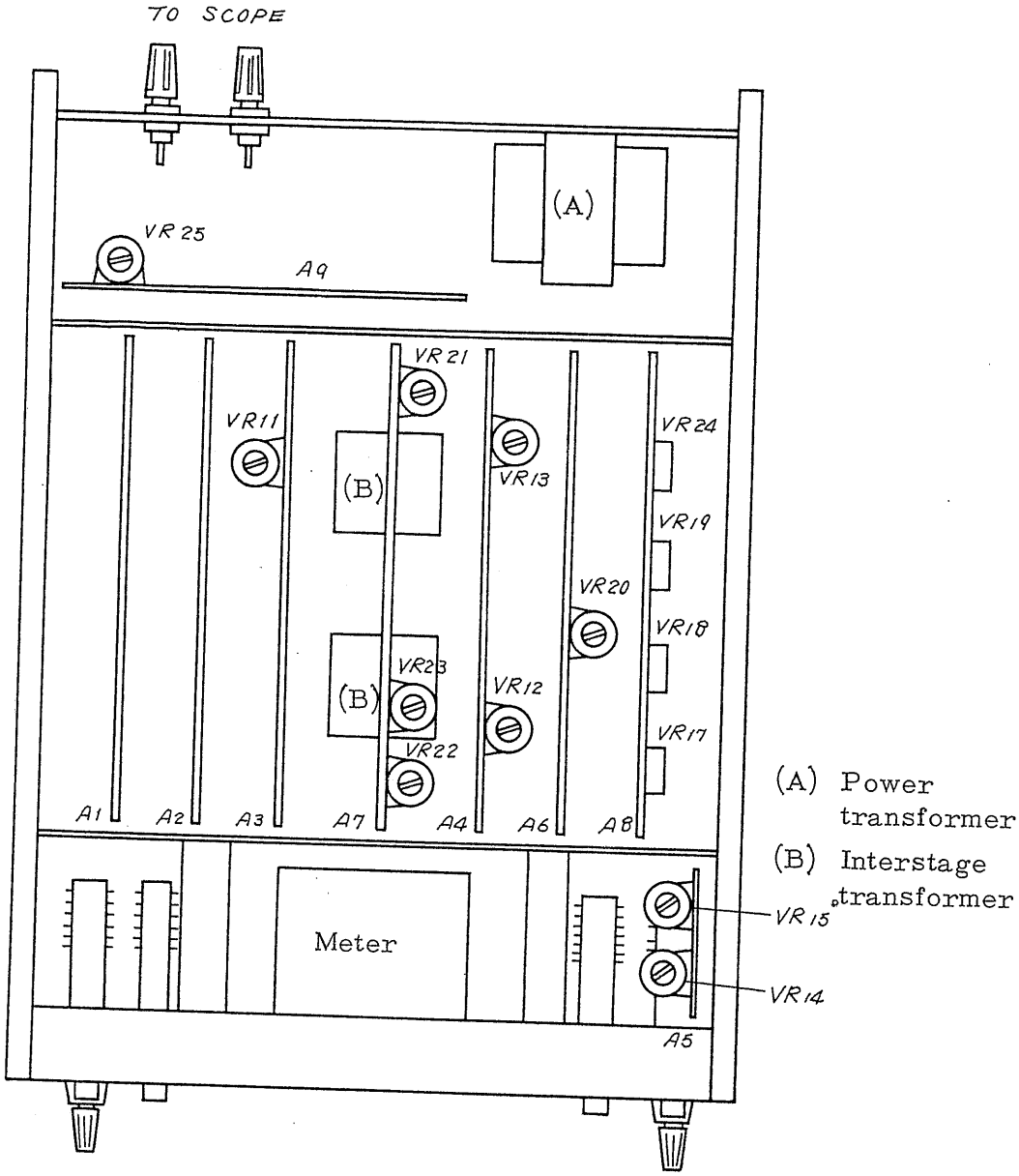


Fig. 5-1

Caution: Remove the feet on rear plate.
Use handle to make front panel incline.
Top plate will then come off.



A_1 : LIMITER	A_2 : BAND PASS FILTER	A_3 : DISCRIMINATOR
A_4 : TAPE SPEED	A_5 : METER RANGE	A_6 : METER AMP.
A_7 : METERING CIRCUIT	A_8 : 3 kHz OSCILLATOR	A_9 : POWER SUPPLY

Caution: Only the semi-fixed resistors, which are necessary for calibration, are shown. Their symbol numbers are identical with those in the circuit diagram.

Fig. 5-2 Illustration of component arrangement

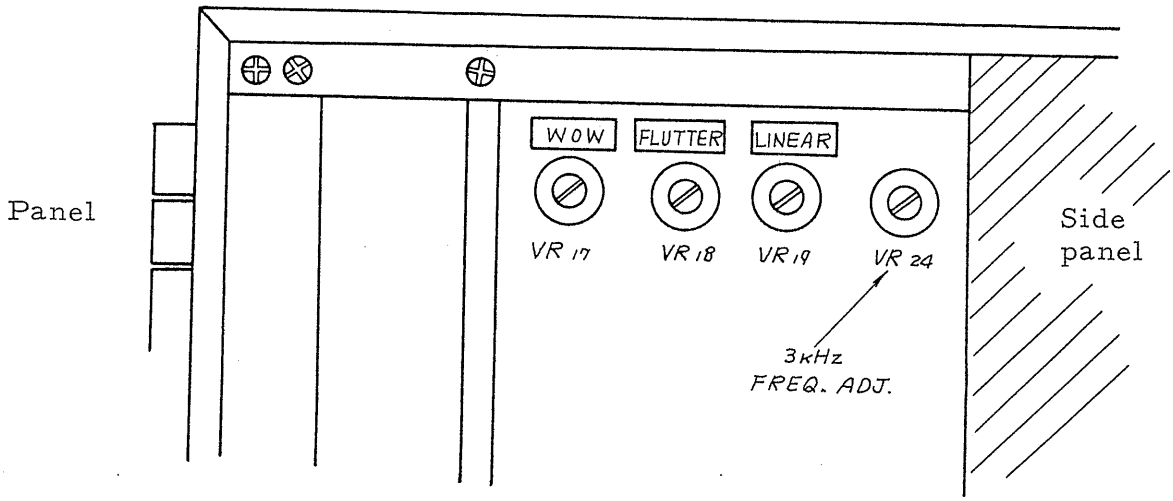


Fig. 5-3

5.2 Adjustment and Calibration

When Model 675 does not meet specifications after a long time of use or repairing, adjust it as follows:

1) Adjustment of Voltage Regulator Circuit

Connect DC voltmeters between connector No. 8 and GND in printed circuit board A9, and between connector No. 10 and GND.

Turn VOLTAGE ADJ VR25 until the meters read out +15V and -15V respectively.

2) Adjustment of 3 kHz oscillator

Connect a frequency counter to 3 kHz OUTPUT terminals.

Turn FREQ ADJ VR24 until the counter reads out 3 kHz.

3) Adjustment of TAPE SPEED meter

Adjust zero point with VR12 and sensitivity with VR13.

4) Zero adjustment of discriminator

Apply input signal of 3 kHz and approx imately 1 volt to INPUT.

Turn DISCRI ZERO VR11 until TAPE SPEED meter reads out zero.

5) Adjustment of MODE Filters

Connect the output of the wow & flutter calibrator to INPUT.

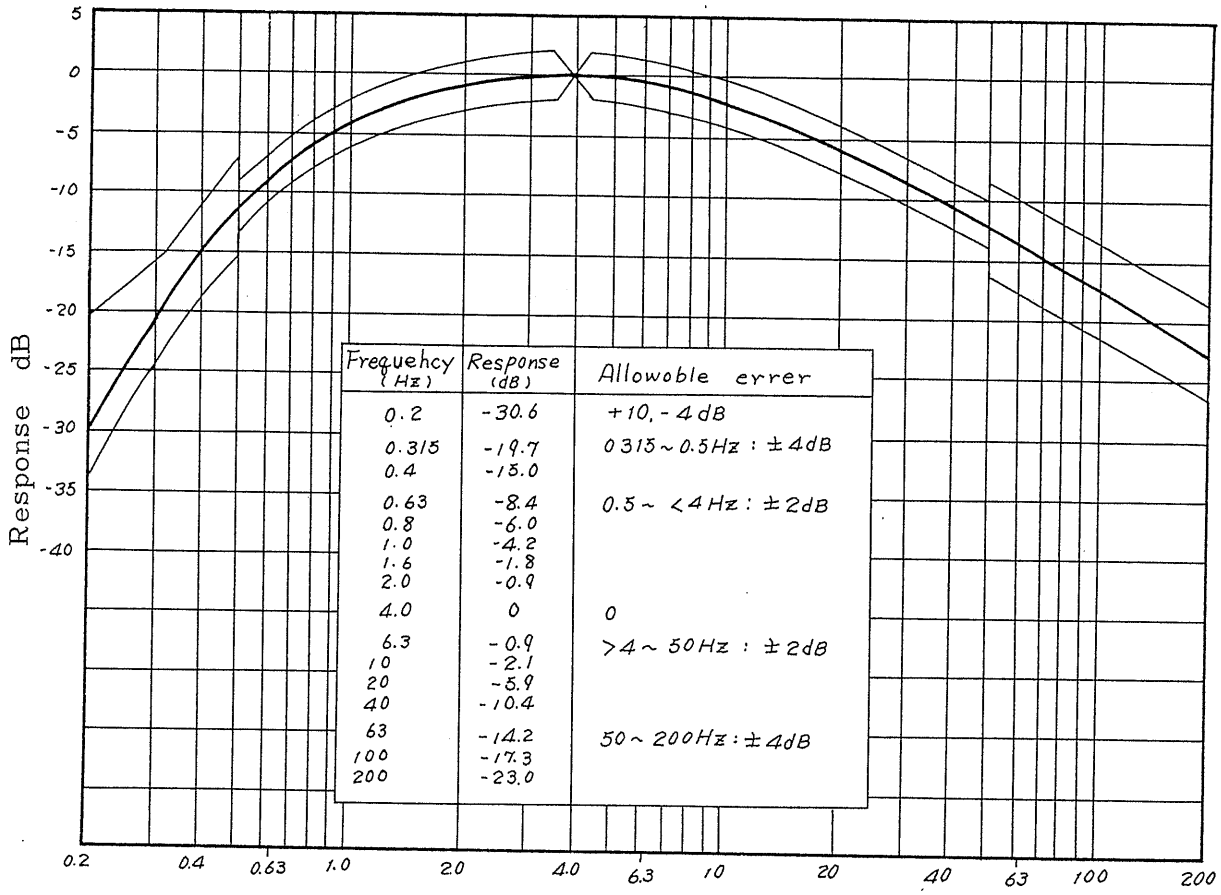
Turn WOW VR17, FLUTTER VR18 and LINEAR VRL until their filter's sensitivity matches that of WEIGHTED filter.

6) Calibration of Wow and Flutter

Connect the output of the wow & flutter calibrator to INPUT terminals.

- o After setting METER RANGE at 0.3%, calibrate sensitivity with VR20.
- o Changing the output of the calibrator, calibrate METER RANGE with VR14 for 3% and with VR15 for 1%.
- o Calibrate the sensitivity of RMS with VR21.
- o Calibrate the sensitivity of PEAK with VR22.
- o Calibrate the dynamic characteristics of PEAK with VR23.

Fig. 3-4 Frequency-response curve of weighting network



Frequency (Hz)	Response (dB)	Allowable error
0.2	-30.6	+10, -4 dB
0.315	-19.7	0.315 ~ 0.5 Hz : ±4 dB
0.4	-15.0	
0.63	-8.4	0.5 ~ <4 Hz : ±2 dB
0.8	-6.0	
1.0	-4.2	
1.6	-1.8	
2.0	-0.9	
4.0	0	0
6.3	-0.9	>4 ~ 50 Hz : ±2 dB
10	-2.1	
20	-5.9	
40	-10.4	
63	-14.2	50 ~ 200 Hz : ±4 dB
100	-17.3	
200	-23.0	

Dynamic Characteristics of Indicator (in accordance with CCIR specifications)

Calibrate a meter over the full scale by using frequency modulation waves (center frequency 3 kHz) p-p-deviated with 4 Hz sinewaves. Next, applying frequency modulation waves deviated with one-way-directional pulses of 1 Hz repetition frequency and 100 ms pulse width, adjust the pulse height until the same full scale is obtained.

When pulse width A is changed, the meter should read B% as shown in the following table.

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

When the pulses of 1 Hz repetition frequency and 100 ms pulse width are applied to the meter, return time should be such that the meter reads out 40 ± 10% for a period from one pulse to next pulse.

(Quoted from CCIR recommendation 409-1.)