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1. INTRODUCTION

1-1 General

This manual describes the procedures for operation of the LAS-5500 Audio System Analyzer.

The Analyzer is made up of seven separate instruments, housed in one case, which may be used in combination or independently as required. It is most useful in overall checking and adjustment of all types of audio equipment especially stereo amplifiers and tape recorders.

1-2 Features

- * The Audio Oscillator has a frequency range from 10Hz to 1MHz, covered in five bands, and with distortion less than 0.05% from 500Hz to 20kHz.
- * The Attenuator has a range from 0 to 101dB at 600Ω input/output impedance, adjustable in 0.1dB steps, and with bandwidth up to 200kHz.
- * The Wow Flutter Meter has a highly sensitive range of 0.03% full scale at weighted or unweighted (flat) conditions.
- * Drift or tape speed can be measured when making wow & flutter reading.
- * The AC Millivoltmeter can measure voltages as low as 30μV and up to 100V; dB scales are provided for measurements referred to dBm (1mW/600Ω) and dBV (1V) for convenience in comparison of signal levels.
- * The Oscilloscope has a 5MHz bandwidth, 10mV/div vertical sensitivity, and 10Hz-100kHz sweep frequency in four steps, with variable fine control. Dummy Load for 2 channels at 8Ω/50W (rating for each channel) Dummy Load for 2 channels at 8Ω/50W (rating for each channel) for stereo output tests.
- * Accessories include a low-capacitance probe for scope use, five connection cables with appropriate clips and plugs.

2. SPECIFICATIONS

2-1 Audio Oscillator

Frequency Range	10Hz-1MHz in 5 decade ranges.
Calibration Accuracy	± 5% below 100Hz. ± 3% above 100Hz.
Output Waveform	Sine Wave
Output Voltage	> 3V rms into 600Ω
Distortion	< 0.05% : 500Hz-20kHz. < 0.1% : 100Hz-100kHz. < 0.5 : 50Hz-500kHz. < 1% : 10Hz-1MHz.
Output Leveling	Within ± 0.3dB (600Ω load).
Output Impedance	600Ω
Output Control	Direct, or through attenuator, (see Sect. 2-2).

2-2 Attenuator

Input/Output Impedance	600Ω; unbalanced.
Attenuation Range	0-101dB in 0.1dB steps.
Accuracy	± 2%.
Frequency Response	± 2% to - 70dB: DC-200kHz ± 2% to -101 db: DC-100kHz
Maximum Input	0.5W maximum (17Vrms, or +27dBm)
Output Load Resistor	600Ω (switchable, in or out).

2-3	AC Millivoltmeter	
	Voltage Range	30 μ V-100Vrms in 12 ranges: 0.3, 1, 3, 10, 30, 100mVrms; 0.3, 1, 3, 10, 30, 100Vrms.
	Decibel Ranges	-90 to +42dB (0db = 0.775V). -90 to +40dB (0dB = 1V).
	Accuracy	\pm 3% of full scale, ref'd to 1kHz.
	Frequency Response	\pm 10%: 5Hz-500kHz. \pm 5%: 10Hz-200kHz. \pm 3%: 20Hz-100kHz.
	Input Impedance	10M Ω / $<$ 65pF, at each range.
	Weighted Filter	According to JIS "A" curve (same as NAB); switchable, in or out.
	Input Connections	UHF-type and pin jacks for Left and Right, switch selectable.
	Measuring Modes	Direct, attenuator output, and W & F (wow flutter).
2-4	Oscilloscope	
	Display Area	8 \times 10div (1div = 6mm).
	Vertical Amplifier	
	Sensitivity	10mV/div.
	Input Control	4 steps: \times 1, \times 10, \times 100, \times 1000; continuous fine adjuster, 10mV-100V/div.
	Bandwidth, -3dB	DC, or 2Hz, to 5MHz.
	Rise Time	70ns.
	Input Impedance	1M Ω /40pF.
	Input Connector	UHF type (SO-239)
	Maximum Input Voltage	600V (DC + AC peak).
	Horizontal Amplifier	
	Sensitivity	Approx. 200mV/div.
	Input Control	200mV to 10V/div coverage.
	Bandwidth, -3dB	DC to 250kHz.
	Input Impedance	100k Ω
	Maximum Input Voltage	100V (DC + AC peak).
	Time Base	
	Sweep Frequency	10Hz-100kHz in 4 ranges, continuous fine adjuster.
	Synchronization	Internal; + polarity only.
2-5	Wow Flutter Meter	
	Measuring Frequencies	JIS, CCIR: 3kHz \pm 10%. DIN: 3.15kHz \pm 10%.
	Input Voltage Range	15mV - 10Vrms (automatic leveling).
	Input Impedance	$>$ 300k Ω
	Drift Measurements	
	Measuring Range	\pm 5%
	Accuracy	within \pm 5% of full scale
	Wow Flutter Measurements	
	Test Ranges	5 ranges: 0.03%, 0.1%, 0.3%, 1%, 3%, at full scale; accuracy, \pm 5% of full scale.
	Frequency Response (within -3 dB \pm 1dB)	
	JIS	0.5 - 200Hz.
	CCIR	0.3 - 200Hz.
	DIN	0.3 - 300Hz.
	Weighted Characteristic	Applicable to JIS, CCIR and DIN standards.
	Indication	
	JIS	Effective value; 95% of input (ref'd to 100%) within 3.5 \pm 1 sec.
	CCIR/DIN	Peak value in accordance with relevant standards.

Indicating Method	Use of % scales of AC millivoltmeter
Test Frequency Source	3kHz \pm 0.03%; output 0.3Vrms; output impedance, approx. 5k Ω ; distortion, < 2%.
To Scope Terminal	
Output Voltage	1Vrms \pm 5% (JIS) 0.7Vrms \pm 5% (DIN, CCIR) } at meter full scale
Output Impedance	2k Ω \pm 20%
2-6 General Data	
Power Supply	100, 115, 200 or 230V, as specified, 50/60Hz; approx. 36 VA, total with all sections in use.
Size (approx.)	150(H) \times 450(W) \times 430(D) mm.
Weight (approx.)	11.5kg(25lbs), including accessories.
Accessories, furnished	Dummy Load, LD-21: Two 8 Ω resistors in one case for Left and Right stereo amplifier output channels; rating, 50W maximum, for each resistor; may be connected in series (16 Ω), or parallel (4 Ω) for 100W maximum; one-channel load condition 1 ea. Low-capacitance probe, LP-16Y 1 ea. Pin-plug/pin-plug cable 2 ea. Banana-plug/clip cable 3 ea. UHF-type adapter for binding post 2 ea.

3. CONTROLES, CONNECTORS, ETC

3.1 Front Panel

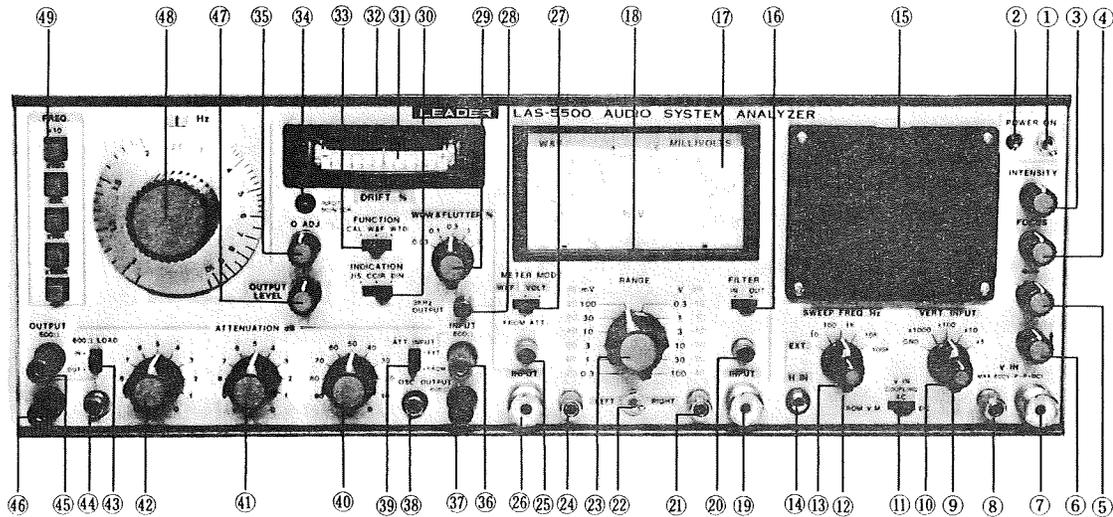


Fig. 3-1 Front Panel

No.	Item	Use
①	POWER switch	Turns on the AC power to all sections in the Analyzer.
②	Pilot lamp	Pilot lamp lights when the power is on.
<u>OSCILLOSCOPE SECTION</u>		
③	INTENSITY control	Adjust the brightness of the CRT spot.
④	FOCUS control	Adjusts the focus (clarity) of the CRT spot.

No.	Item	Use
⑤	HOR. POS. control \longleftrightarrow	Sets the horizontal position of the trace.
⑥	VERT. POS. control \updownarrow	Sets the vertical position of the trace.
⑦	V IN connector	UHF-type: Vertical input connection; for the low-capacitance input probe, LP-16Y, or the banana-plug cable. Maximum input voltage: 600V (DC + AC peak).
⑧	Ground terminal	For ground lead of the input cable.
⑨	VERT. INPUT switch	For setting the input voltage range in four steps, X1, X10, X100, X1000. At GND setting, the amplifier input is shorted to ground see Fig. 3-1-A.

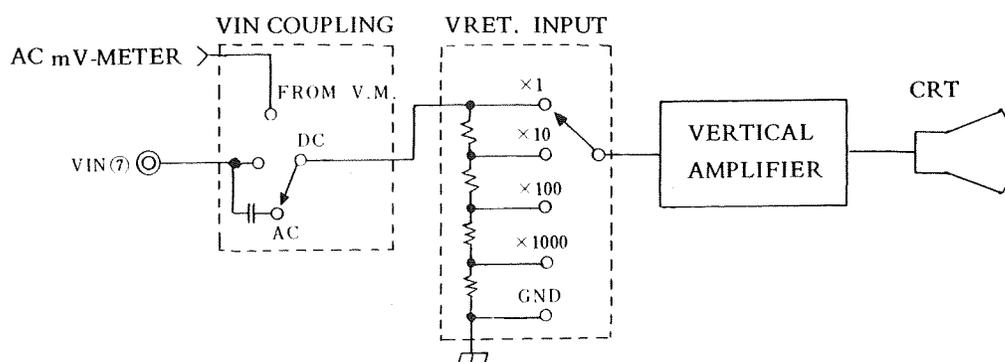


Fig. 3-1-A Vertical input selection circuits

⑩	VARIABLE VERT. control	Small knob: Adjusts the vertical input level between the range steps for the overall input range 10mV/div to 10V/div.
⑪	V IN COUPLING switch	Three positions – 1. FROM V.M: For observation of waveform of the signal under measurement with the AC Millivoltmeter. 2. AC: For AC signals, especially when the superposed DC component is to be blocked. 3. DC: For DC voltage measurement, AC with superposed DC, or very low frequencies.
⑫	SWEEP FREQ. Hz switch	Selects the SWEEP frequency in the 10Hz to 100kHz range; number of waveforms decrease as the sweep frequency is increased. At EXT., the internal sweep is not used and the signal at the H IN connector, ⑬, is used.
⑬	VARIABLE HOR. control	Small knob: Adjusts the width (length) of the horizontal sweep for internal, and for external input at H IN. ⑭
⑭	H IN jack	For connection to an external sweep input signal.
⑮	Graticule	With major divisions spaced at 6mm per division (div.).

No.	Item	Use
<u>AC MILLIVOLT METER</u>		
①6	FILTER switch	Connect a JIS "A" weighting filter in the internal measuring circuit for special applications at IN; normally set at OUT.
①7	Meter	With scales graduated in volts, dB (decibel), and in % (for wow flutter readings).
①8	Mechanical zero adjuster	For setting the pointer at 0 on the left end of the scales for V and %. Adjustment is made with the AC power at off.
①9	INPUT connector	UHF-type: For voltage measurement only; used for the RIGHT channel output signal when the switch, ②2, is set at RIGHT.
②0	INPUT jack	For pin-plug connection; same purpose as connector ①9 (paralleled connections).
②1	Ground terminal	For ground lead connection.
②2	LEFT-RIGHT switch	Selects the signal to be measured from the Left or Right input connector.
②3	RANGE switch	Selects the range of the AC Millivoltmeter for scale on the meter, ①7
②4	Ground terminal	For ground lead connection.
②5	INPUT jack	For pin-plug Voltage measurement at LEFT setting of the METER MODE switch, ②7, and at the W & F setting; see Fig. 3-1-A.
②6	INPUT connector	UHF-type
②7	METER MODE switch	<p>Three positions –</p> <ol style="list-style-type: none"> 1. W & F: For wow flutter measurements 2. VOLT: For measurement of voltage from external sources at the INPUT connectors. 3. FROM ATT: For voltage measurement at the output of the attenuator, when used.
<u>WOW FLUTTER METER</u>		
②8	3kHz OUTPUT jack	A 3kHz signal with high accuracy is available for the standard recording signal used in wow flutter and drift tests; output is approximately 0.3Vrms.
②9	WOW FLUTTER % switch	Select the full scale range of the AC Millivoltmeter used in wow flutter measurements.
31	DRIFT % meter	Indicates the drift in speed, -5% to +5% range, of a tape (disc) recorder, referred to the 3kHz (JIS, CCIR), 3.15kHz (DIN) input.

No.	Item	Use
③①	INDICATION switch	Three positions for measurements in accordance with the different standards of JIS, CCIR, and DIN.
③②	Mechanical zero adjuster	For setting the DRIFT meter pointer at center 0 on the scale; accessible through a hole at top of the case (AC power must be at off).
③③	FUNCTION switch	Three positions – 1. W & F: Overall wow flutter response. 2. WTD: Weighted response. 3. CAL: Setting when calibrating the DRIFT % meter to the 0 mark with use of the 3kHz test signal, ②⑧
③④	INPUT MONITOR lamp	Indicates when the test input voltage (>15mV) and frequency (3kHz ± 10% at JIS/CCIR, and 3.15kHz ± 10% at DIN) are proper for the measurements.
③⑤	0 ADJuster	For setting the electrical 0 center on the DRIFT % meter when the FUNCTION switch, ③③, is set at CAL.
<u>ATTENUATOR SECTION</u>		
③⑥ ③⑦	INPUT 600Ω terminals	For input connections when the attenuator is used as a separate unit; the black terminal is for ground. NOTE: The ATT INPUT switch, ③⑨, must be set at EXT.
③⑧	OSC OUTPUT 600Ω jack	Output from the audio generator is available at this jack. The output voltage is controlled with the OUTPUT LEVEL control, ④⑦
③⑨	ATT. INPUT switch	Two positions – 1. EXT.: Use of the attenuator as a separate unit. 2. FROM: For attenuating the output voltage (level) of the audio generator.
④① ④②	ATTENUATION dB switches	For attenuating the signal voltage from the audio generator, or an external source, in the 0 – 101 dB range.
④③	600Ω LOAD switch	At IN, a 600Ω load is connected across the output of the attenuator; at OUT, this load is removed from the circuit.
④④ ④⑤ ④⑥	Pin jack terminals	These connector (internally connected in parallel) are for the output of the attenuated signal. The black terminal is for ground.
<u>AUDIO OSCILLATOR SECTION</u>		
④⑦	OUTPUT LEVEL control	Adjusts the signal output level from the generator.
④⑧	Hz dial	For setting the generator frequency; calibrated from 1 to 10.

No.	Item	Use												
④9	FREQ. switches	Frequency range multipliers –												
		<table border="1"> <thead> <tr> <th>Setting</th> <th>Frequency Range</th> </tr> </thead> <tbody> <tr> <td>X10</td> <td>10 – 100Hz</td> </tr> <tr> <td>X100</td> <td>100 – 1000Hz</td> </tr> <tr> <td>X1K</td> <td>1 – 10kHz</td> </tr> <tr> <td>X10k</td> <td>10 – 100 kHz</td> </tr> <tr> <td>X100k</td> <td>100 – 1000kHz (1MHz)</td> </tr> </tbody> </table>	Setting	Frequency Range	X10	10 – 100Hz	X100	100 – 1000Hz	X1K	1 – 10kHz	X10k	10 – 100 kHz	X100k	100 – 1000kHz (1MHz)
Setting	Frequency Range													
X10	10 – 100Hz													
X100	100 – 1000Hz													
X1K	1 – 10kHz													
X10k	10 – 100 kHz													
X100k	100 – 1000kHz (1MHz)													

**DUMMY LOAD
IN PROTECTIVE COVER Fig. 3-2**

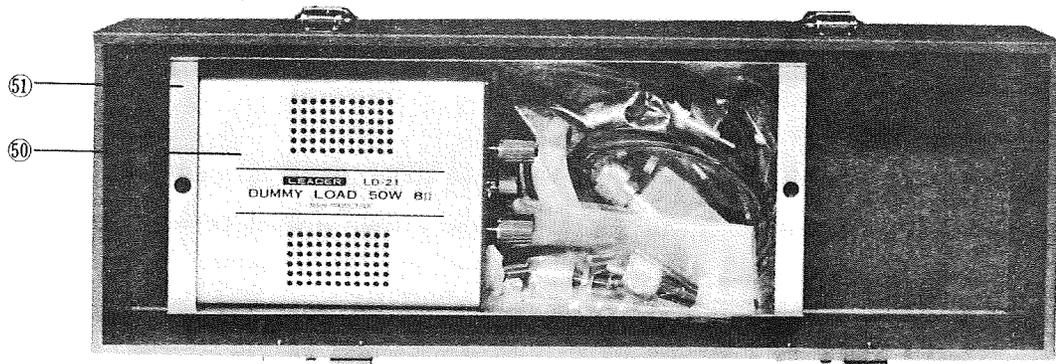


Fig. 3-2 Protective cover items.

No.	Item	Use
⑤0	DUMMY LOAD unit, LD-21	Refer to Accessories in SECT. 2.6 on General Data for description.
⑤1	Cable Compartment See Fig. 3-2	The cover is fastened with two captive latches. For removal, pull out the black tops.

At Rear of Case, Fig. 3-3

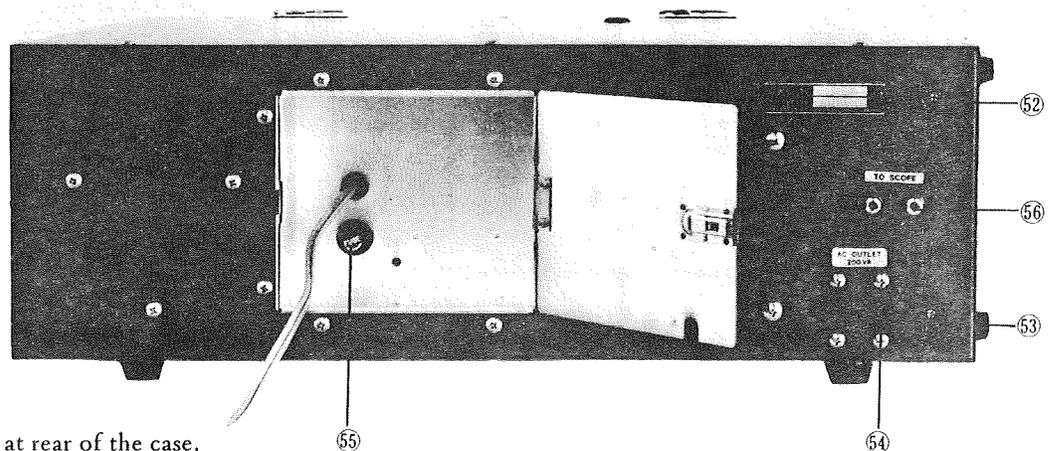


Fig. 3-3 Items at rear of the case.

No.	Item	Use						
52	Plastic feet	Used when the instrument is operated in the upright position.						
53	Rubber feet							
54	AC outlets	Unswitched: For supplying AC power to other equipment, such as a soldering iron, and the set under test. Total power must not exceed 200VA.						
55	FUSE holder	For the AC input fuse; ratings —						
		<table border="0"> <tr> <td>Line Voltage</td> <td>Fuse</td> </tr> <tr> <td>100, 115V</td> <td>1 A</td> </tr> <tr> <td>200, 230V</td> <td>0.5A</td> </tr> </table>	Line Voltage	Fuse	100, 115V	1 A	200, 230V	0.5A
Line Voltage	Fuse							
100, 115V	1 A							
200, 230V	0.5A							
56	TO SCOPE	These terminals are used when monitoring the Wow & Flutter characteristics on an oscilloscope.						

4. OPERATION

4-1 Precautions Before Use

- (1) The AC line input voltage for operation should be within $\pm 10\%$ of the specified value for the Analyzer.
- (2) When the audio oscillator output is connected to a circuit in which DC voltage is present, always connect a suitable blocking capacitor in series with the "hot" lead. This is to protect the internal circuit parts.
- (3) The maximum input to the attenuator section is 0.5W, or 17Vrms (+27dBm). Higher inputs will cause damage to the resistors in circuit.
- (4) The pointer in the meter of the AC millivoltmeter should be set at 0 at left end of V and % scales. If not, turn off the AC power and adjust the zero adjuster screw ⑱
- (5) The maximum input to the AC millivoltmeter and oscilloscope is 600V (DC + AC-peak). Higher voltages will damage the internal circuit parts.

4-2 Preliminary Notes

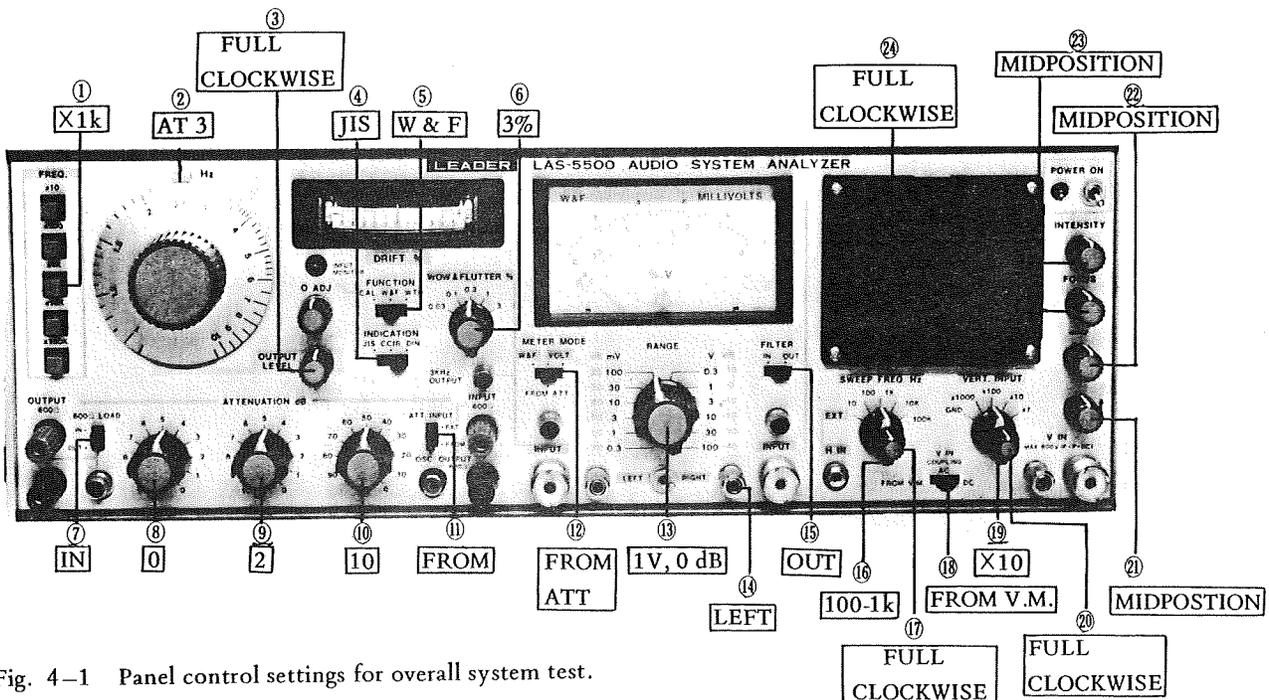


Fig. 4-1 Panel control settings for overall system test.

In operating the Analyzer, especially for the first time, it is advised that the user becomes familiar with the controls, connections, etc. Although a large number of these items on the panel, in actual practice only a limited number is used.

Number in (0) are used to indicate the switches, etc., with reference to Fig. 4-1.

4-2-1 Preparation

- (1) Remove the front cover by loosening the two clasps and sliding the cover sideways. Lift the tilt stand located at the bottom side.
- (2) Set the POWER switch at off (down).
Connect the AC cord plug to the AC input.
- (3) Open the rear compartment lid and take out the AC cord.
Lead the cord through the cut-out (on lid) and close the lid.

4-2-2 Overall System Test

In this test, procedures will be given to acquaint the user with the functions in the Analyzer, i.e., from signal generation to voltage and scope indications.

Referring to Fig. 4-1, set the controls, etc., in the order as shown in the CHART.

CHART FOR OVERALL SYSTEM TEST

STEP	SWITCH OR CONTROL	SETTING	ITEM IN FIG. 4-1
1	FREQ pushbutton	X1k	④9
2	Frequency dial	3	④8
3	Output Level	Full clockwise	④7
4	Indication	JIS	③1
5	Function	W & F	③3
6	Wow Flutter	3%	②9
7	600Ω Load	IN	④3
8	Attenuation, dB: 0.1 step	0	④2
9	" : 1 step	2	④1
10	" : 10 step	10	④0
11	" : Input	FROM	③9
12	Meter Mode	FROM ATT	②8
13	Range	1V, 0 dB	②3
14	Left-Right	LEFT	②2
15	Filter	OUT	①6
16	Sweep Freq. Hz	100 – 1k	①2
17	Variable	Full clockwise	①3
18	V In Coupling	FROM V.M.	①1
19	Vert. Input	X10	①9
20	Variable	Full clockwise	①0
21	 positioning	Midposition	①6
22	 positioning	Midposition	①5
23	Focus	Midposition	①4
24	Intensity	Full clockwise	①3
25	Power	ON	①1

On the scope screen, a sine waveform should appear (if in "loop" form, adjust the VARIABLE control of SWEEP FREQ switch). Adjust the INTENSITY control for suitable trace brightness and the FOCUS control for clarity in the display.

The AC Millivoltmeter, hereinafter called "mV-meter", should read near 0dB on the scale.

The above tests indicate that the audio generator, attenuator, mV-meter, and the scope are in proper operation.

For the DRIFT % meter test –

Make connections between the OSC OUTPUT ③⑧ to the mV-meter INPUT ②⑤, using the pin-plug cable.

Set the METER MODE switch ②⑦ at W & F. The INPUT MONITOR lamp (green) will light and the meter ①⑦ will read 0 within a short time.

Rotate the frequency dial towards the lower frequency; the DRIFT % meter ③⑩ should swing in the – (minus) direction. Raising the frequency should swing the meter in the + (plus) direction.

After this test, remove the pin-plug cable connections.

Use of the Aduo Oscillator

Refer to Fig. 4-2 for the control functions.

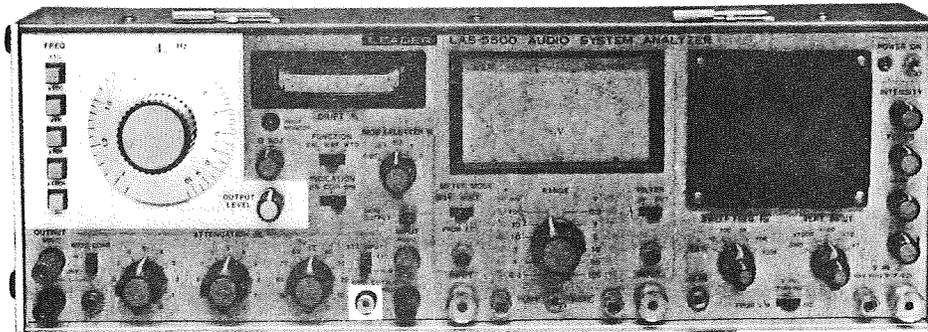


Fig. 4-2 Audio generator section

(1) Frequency setting:

Set the FREQ. switch ④⑨ at the range to be used.

Rotate and set the frequency dial ④⑧ at the described point.

(2) Output voltage (level) setting:

a. Switch positions:

ATT. INPUT ③⑨	FROM
600Ω LOAD ④③	IN
Attenuator, ④⑩, ④①, ④②	0
METER MODE ②⑦	FROM ATT. (midposition)
LEFT-RIGHT ②②	LEFT
FILTER ①⑥	OUT
RANGE ②③	At the desired range.

a. Adjust the OUTPUT LEVEL control ④⑦ so that the mV-meter reads the desired voltage.

Note: With this control, the minimum output can be set to approximately 10mV. For lower voltages, use the attenuator switches, see below.

(3) Output switching

a. The oscillator output, with the source impedance at 600Ω, is available at the OSC OUTPUT ③⑧ terminals, pin-jack or the binding posts.

- b. When using the attenuator, set the ATT. INPUT switch ③⑨ at FROM. Under this condition, the attenuated output with attenuator control, is obtained at the OUTPUT ④④, ④⑤, or ④⑥, using the pin-plug or banana-plug cable. (Black is for ground.)

4-4 Use of the Attenuator

4-4-1 As an Independent Unit.

Refer to Fig. 4-3 for controls and connections.

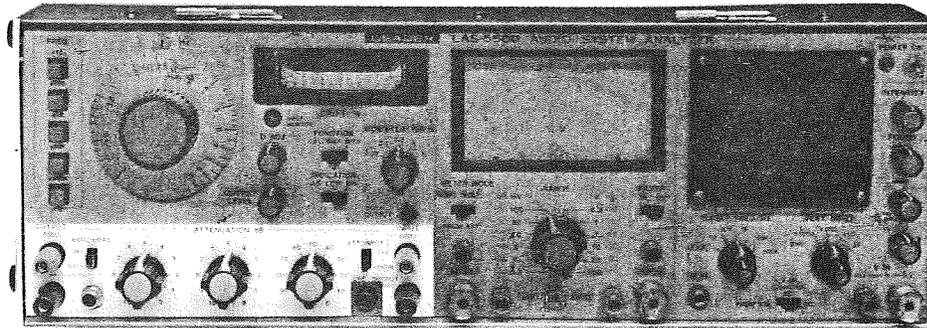


Fig. 4-3 Attenuator section

- (1) Set the ATT. INPUT switch ③⑨ at EXT.
- (2) Connections:
Input signal to INPUT 600Ω ③⑥ and ③⑦ terminals.
Attenuated output from the OUTPUT terminals ④④, ④⑥, or pin-jack ④⑤, to the load circuit.
- (3) Set the attenuator switches for the desired attenuation.
the overall range is 0 to 101dB in steps of 0.1 dB.

Notes: In this mode, separate the input and output leads as far apart as possible. This prevents leakage between the input and the output. Unless this is done, accuracy will be degraded; this effect is especially evident when high attenuation is applied. To avoid this condition, it is highly recommended that short shielded cables, preferably coaxial, are used for input/output connections.

4-4-2 Use of the 600Ω Load

The input/output impedance of the attenuator is 600Ω.

For proper attenuation characteristic, the load impedance must be 600Ω.

However, when testing audio amplifiers, etc., the input impedance of the test input circuit may be high and the attenuated signal voltage will vary greatly with the attenuator settings due to mismatched conditions. In this event, it is necessary to set the 600Ω LOAD switch ④③ at IN.

When the load impedance is 600Ω, set the switch at OUT.

When 600Ω matching pads are used, the insertion loss in dB must be taken into account.

4-5 Use of the AC Millivoltmeter

The panel controls are shown in Fig. 4-4.

The scales are used in measurement of voltage in V, dB levels in dBm and dBV, and for wow flutter values in % (see Sect. 4-7)

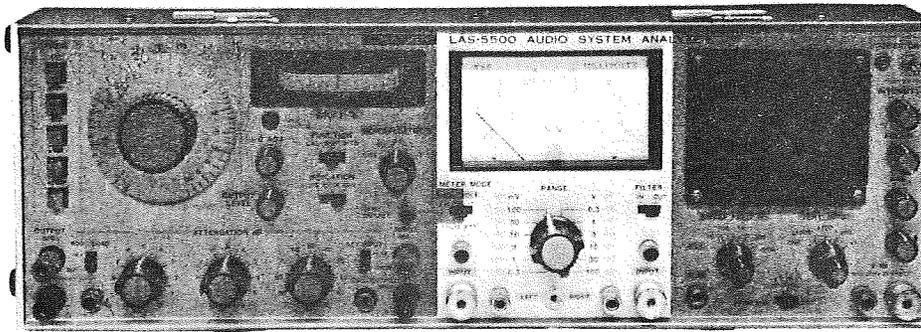


Fig. 4-4 AC millivoltmeter section

In use the AC Millivoltmeter, hereinafter called "mV-meter" for short, the METER MODE switch (27) is set at VOLT or FROM ATT, dependent upon desired measurement conditions.

4-5-1 AC Voltage Measurements

(1) Switch settings:

RANGE (23) 100V

METER MODE (27) VOLT

LEFT-RIGHT (22) Dependent upon INPUT connections

FILTER (16) OUT (see Sect. 4-5-3)

(2) INPUT connections:

Two types of connections are possible at the LEFT or RIGHT inputs –

- a. Pin-plug cable to pin jack (25) and (20), or
- b. For leads, the accessory terminal adapter plugged in the connector (26) and (19) respectively, and use of the adjacent ground terminal.

(3) For the voltage measurement, connect the cable clips, or test lead prods at the test point.

(4) Set the RANGE switch so that a reading is obtained above at least 30% of full scale. This will insure accuracy of the readings. The voltage ranges are shown in Table 4-1.

TABLE 4-1 VOLTAGE MEASUREMENT RANGES

RANGE	SCALE	MULTIPLIER	V PER DIVISION
100V	0 – 1	100	2V
30V	0 – 3	10	1V
10V	0 – 1	10	0.2V
3V	0 – 3	1	0.1V
1V	0 – 1	1	0.02V
0.3V	0 – 3	0.1	0.01V
100mV	0 – 1	100	2mV
30mV	0 – 3	10	1mV
10mV	0 – 1	10	0.2mV
3mV	0 – 3	1	0.1mV
1mV	0 – 1	1	0.02mV
0.3mV	0 – 3	0.1	0.01mV

4-5-2 Measurement of Signal Levels in Decibels

- a. Two dB (decibel) scales are provided for dB referred to dBm where 0dBm = 1mW into a 600Ω load, and dBV where 0dBV = 1V regardless of the load impedance.
- b. Measurements are made in the same manner as in use of the mV-meter outlined in the previous section, 4-5-1.
- c. The measuring ranges depend on the setting of the RANGE switch and are given in TABLE 4-2.

TABLE 4-2 dBm AND dBV RANGES

RANGE	dBm ★		dBV ★★	
+40	+20	+42	+20	+40
+30	+10	+32	+10	+30
+20	0	+22	0	+20
+10	-10	+12	-10	+10
0	-20	+2	-20	0
-10	-30	-8	-30	-10
-20	-40	-18	-40	-20
-30	-50	-28	-50	-30
-40	-60	-38	-60	-40
-50	-70	-48	-70	-50
-60	-80	-58	-80	-60
-70	-90	-68	-90	-70

★ 0dBm = 1mW into 600Ω
★★ 0dBV = 1V reference

4-5-3 Use of the FILTER Circuit

The FILTER switch (16) is normally set at OUT.

It is set at IN when measuring the S/N (signal-to-noise ratio) in audio amplifiers, etc. The constants in the filter circuit have been selected to meet with the JIS (Japanese Industrial Standards) "A" Curve. The frequency weighting is in accordance with the hearing characteristics of the human ear.

4-5-4 LEFT-RIGHT Switch Operation

This switch is used to select the input signal to the mV-meter from a stereo source connected to the respective INPUT connectors, see Fig. 405.

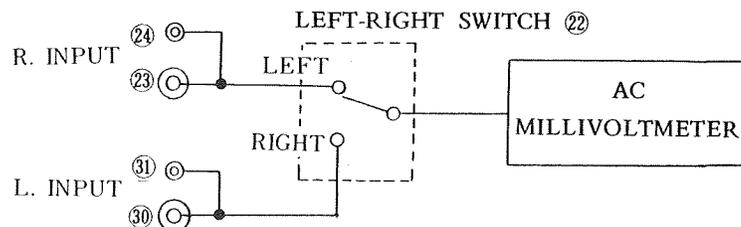


Fig. 4-5 LEFT-RIGHT input switching.

The switching will enable rapid comparison and/or measurements of two signal voltages, or levels in dB, when measuring separation, cross-talk, and other characteristics.

4-5-5 Attenuator Output Checking

The signal level, or voltage, at the attenuator output can be checked without external connections. This permits measurements of the attenuated signal as follows:

- a. From the audio generator with the ATT. INPUT switch ③⑨ at FROM.
- b. From an external source with the ATT. INPUT switch at EXT.

The mV-meter ranges are selected as described for voltage and dB measurements, refer to sec. 4-5-1 and 4-5-2.

4-6 Use of the Oscilloscope

The panel controls are shown in Fig. 4-6.

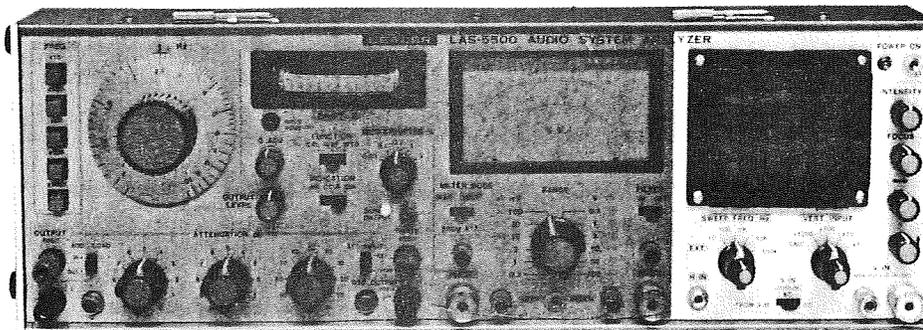


Fig. 4-6 Oscilloscope panel controls.

4-6-1 Preparation

(1) Control and switch settings:

INTENSITY ③	conditions.	For suitable spot brightness, compatible with ambient light conditions.
FOCUS ④		For clear trace display
SWEEP FREQ. Hz ⑬		100 – 1k
VERT. INPUT ⑨		GND
V IN COUPLING ⑪		DC
↔ position ⑤		For trace at midscreen
↑ positioning ⑥		For trace on the center horizontal line

Readjust the positioning controls to center the trace on the screen.

4-6-2 Waveform Observation

- a. The scope is provided with two input circuits, namely – from the V IN connector ⑦ at the AC and DC settings of the V IN COUPLING switch and from the mV-meter output at the FROM V.M. setting (this enables observation of the LEFT and RIGHT inputs during voltage measurements).
- b. Adjustments:
 - (1) VERT. INPUT switch from $\times 1000$ – – $\times 1$ as required to adjust the trace amplitude.
 - (2) SWEEP FREQ. switch and VARIABLE control to adjust the number of wave “cycles”.

4-6-3 Vertical Input (amplitude) Calibration

The trace amplitudes can be calibrated in terms of peak-to-peak voltage, V_{p-p} , when required for quantitative measurements. This is done with use of the audio oscillator and the mV-meter. (NOTE: calibration is not required when only the general waveform observation is used.)

(1) Set the switches as follows'

- a. Audio oscillator – Frequency at 1kHz
- b. Attenuator –
 - ATTENUATION 30dB
 - ATT. INPUT FROM OSC
- c. AC mV-meter –
 - METER MODE FROM ATT
 - RANGE 30mV
 - FILTER OUT
- d. Scope –
 - VERT. INPUT X1
 - SWEEP FREQ. Hz 100 – 1k
 - V IN COUPLING AC

(2) Connections:

Connect one of the accessory cables between the V IN connector ⑦ and the attenuator OUTPUT ④⑤, or ④④ and ④⑥

Note: If the LP-16Y Low-Cap probe is used, set the handle switch at the 1:1 condition.

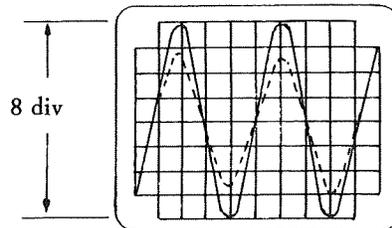
(3) Adjustments:

- a. Audio oscillator –

Set OUTPUT LEVEL control so that the mV-meter reads 28mV.

- b. Set VARIABLE of VERT. INPUT so that the trace height is 8div.

Do not touch this control after the calibration. Use the vertical positioning control to “center” the trace if necessary, see figure below.



- c. When the wave-form is displayed double or triple, or flickeringly.

The wave-form is synchronized or stopped by VARIABLE adjuster ⑬

- d. By the above manipulation, the vertical sensitivity is calibrated to 10mVp-p as to the amplitude per one division.

Without turning VARIABLE-adjuster ⑩, setting of VERT.

INPUT adjuster ⑨ into X10 X100 and X1000, the sensitivity is 10mVp-p/div, or as follows:

VERT. INPUT setting	Sensitivity, per div.
X1	10 mVp-p
X10	100mVp-p
X100	1Vp-p
X1000	10Vp-p

Note: By setting the trace height with the VARIABLE adjuster at the 4 div. height, the sensitivity is 20mVp-p/div, or as follows:

<u>VERT. INPUT setting</u>	<u>Sensitivity, per div.</u>
×1	20mVp-p
×10	200mVp-p
×100	2Vp-p
×1000	20Vp-p

- (4) Remove the V INPUT connections from the attenuator output terminals.

4-6-4 AC Voltage Measurements

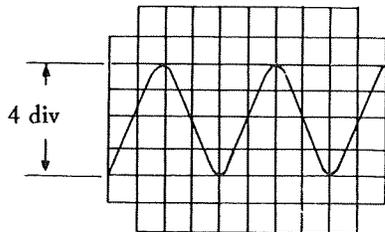
- (1) After the vertical sensitivity calibration process given in Sect. 4-6-3., connect the LP-16Y probe cable, or accessory cable between the V IN connector and the test point.

Note: The VARIABLE control on the VERT. INPUT switch must not be touched – this is important.

- (2) Adjust the SWEEP FREQ. and VARIABLE control to display two or three “cycles” of the input waveform.
- (3) Using the positioning controls, adjust the trace height to be between the horizontal lines, using the top or lower line for reference.

- (4) The AC voltage, Vp-p or mVp-p, is calculated from the relation –
- $$\text{Volts, p-p} = (\text{Trace height in div}) \times (\text{Sensitivity in V or mVp-p per div}) \times (\text{VERT. INPUT setting}).$$

Example, see figure –



Trace height = 4div.
 Sensitivity = 20mVp-p/div.
 VERT. INPUT = ×1, . . . ×1000

The measured voltage in this example will be -

<u>VERT. INPUT setting</u>	<u>Measured Voltage</u>
×1	80mVp-p
×10	800mVp-p
×100	8Vp-p
×1000	80Vp-p

- (5) For sine wave signals, the effective, or rms, values are calculated from the relation –

$$\text{Volts, effective} = \frac{\text{Peak to peak voltage}}{2.82}$$

where the figure, 2.83 is the factor, $2\sqrt{2}$

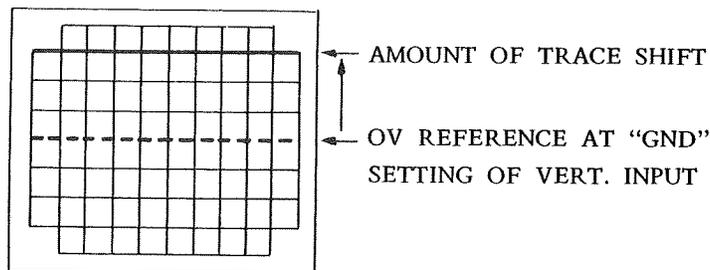
For example, $2\text{Vp-p} = 0.707\text{Vrms}$.

4-6-5 DC Voltage Measurements

DC voltages can be measured with the scope when it has been calibrated for the AC peak-to-peak voltage condition.

- (1) Connections:
 LP-16Y probe cable to the V IN connector.

- (2) Set the V IN COUPLING switch at DC.
Notes: a. Since the input is DC, no waveform will be displayed, only the horizontal trace will appear on the screen.
b. The voltage is determined by the shift of the horizontal trace line when the input is applied.
- (3) Set the VERT. INPUT switch at GND.
- (4) With the vertical positioning control, set the trace line on the middle horizontal line for 0V reference.
- (5) Connect the probe tip and ground clip at the test point.
Note: Set the probe multiplier at 1:1
- (6) Adjust the VERT. INPUT switch and note the trace line position on the scale, see figure.



The DC voltage is calculated from the relation –

$$V_{DC} = (\text{Trace shift in div}) \times (\text{Sensitivity in V or mV per div}) \times (\text{VERT. INPUT setting}).$$

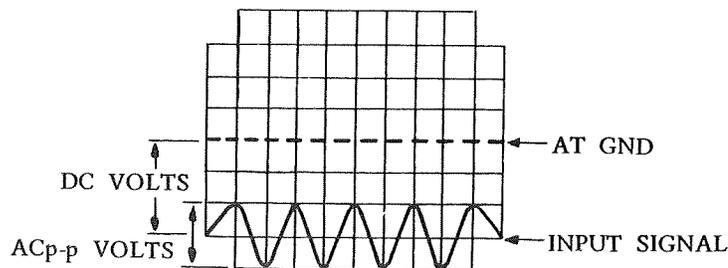
Example: In the above figure, the shift is 3div.

If the sensitivity is 10mV/div and the VERT. INPUT setting is $\times 100$, the DC voltage is 3V.

The polarity depends on the direction of the trace shift, “+” if upward and “–” if downward.

4-6-6 Superposed DC on AC Voltage

- (1) The test procedure is practically identical with that given in Sect. 4-6-5 for DC voltage measurement. The only difference is that there will be two sets of voltage, DC and AC (p-p) to be measured. Initially, the DC reference line is set with the VERT. INPUT switch at GND.
- (2) Next the VERT. INPUT switch is adjusted so that the AC component will be displayed on the screen, see figure.



- (3) For an example, referring to the above figure, assume that the sensitivity is 20mVp-p/div and the VERT. INPUT is set at $\times 100$.

Then for the DC voltage –

$$20\text{mV} \times 3\text{div} \times 100 = 6000\text{mV}, \text{ or } 6\text{V}, \text{ and}$$

for the AC voltage –

$$20\text{mV} \times 2\text{div} \times 100 = 4000\text{mV}, \text{ or } 4\text{V}$$

- (4) When the DC voltage is very high in comparison with the AC voltage, separate measurements must be made for the DC and AC conditions.

4-6-7 External Horizontal Input

When the SWEEP FREQ. switch ⑫ is set at EXT., the internal sweep (timing) circuit is not used, leaving only the horizontal amplifier in operation. This enables the connection of an external sweep source to the input for Lissajous pattern display, X-Y operation, etc.

The horizontal input is connected to the H IN pin jack ⑭ with the pin-plug cable.

4-6-8 Use of the LP-16Y Probe

- a. The characteristics of the low-capacitance probe furnished with the Analyzer are as follows:

Maximum input voltage	250Vrms, or 600VDC.
* At X1 setting:	
Input resistance	1MΩ, or the scope input resistance
Input capacitance	250pF, when the scope input capacitance is 50pF.
Bandwidth	DC – 5MHz
* At X10 setting:	
Input resistance	10MΩ, when the scope input resistance is 1MΩ.
Input capacitance	Less than 25pF.
Capacitance compensation	For scope input with 20–40pF input capacitance.
Multiplying accuracy	±2%
Bandwidth	DC – 40MHz.

- b. As shown in Fig. 4-7, the probe is composed of a retractable tip, a handle switch, and ground clip lead.

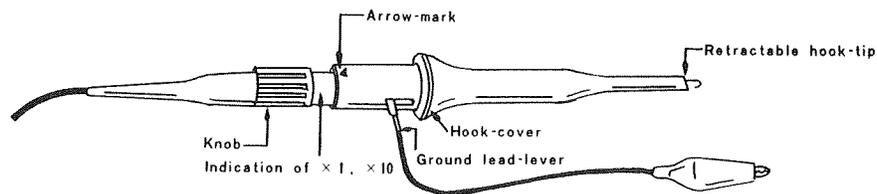


Fig. 4-7 LP-16Y probe structure.

- Retractable tip: The hook-type tip can be exposed by pulling back the protective cover.
- X1, X10 switch: The changeover is done by holding the cover and rotating the handle part to set the range at the white index mark.
- Ground clip lead: This clip must be securely connected to the ground of the test circuit.

- c. Measuring conditions –

(1) X1 setting:

This is for direct measurement of the input to the scope V INPUT connector. Due to the relatively high input capacitance in the connecting cable, this setting is suitable for checking audio circuits where the impedance is low, and the cable shunting effect is not a problem.

(2) X10 setting:

At this setting, the capacitance shunting effect is low, less than 25pF, and may be used for most circuit checking. It should be noted that the input voltage to the scope will be reduced by 1/10 and must be taken into account, especially when the scope has been calibrated.

4-7 Wow Flutter and Drift Measurements

4-7-1 General

The wow flutter measuring section in the Analyzer is shown in Fig. 4-8.

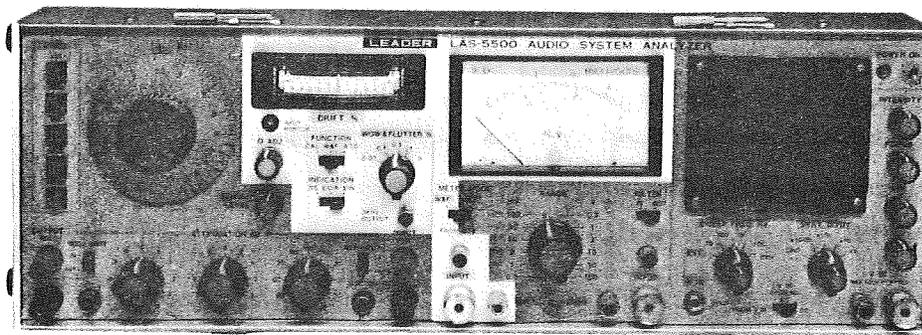


Fig. 4-8 Wow flutter measuring section.

The circuit characteristics are applicable to the JIS (Japanese Industrial Standards), CCIR (Europe) and DIN (West Germany) standards as follows:

STANDARDS	JIS	CCIR	DIN
Center Frequency	3kHz	3kHz	3.15kHz
Indicated Value	Effective	Peak	Peak
Response	0.5-200Hz	0.3-200Hz	0.3-300Hz
Weighted Characteristic	JIS C-5551 (same as used for CCIR, DIN)		

4-7-2 preparation

Switch Setting		Adjust, or Connect
1. FUNCTION	③③ CAL.	Conditions for DRIFT meter ③① calibration using the 0 ADJ control ③⑤ - a. At 3kHz (JIS/CCIR): Set the control for 0 (center indication). b. At 3.15kHz (DIN): Set the control for +5% indication.
2. METER MODE	②⑦ W & F	Cable between INPUT ②⑤ or ②⑥ of mV-meter and tape recorder output circuit.
3. WOW FLUTTER %	②⑨ 3%	
4. FUNCTION	③③ W & F, or WTD	Dependent upon the measured characteristic.
5. INDICATION	③① JIS, CCIR, or DIN	Dependent upon the measuring standard.

4-7-3 Measurements

- (1) A test tape of 3kHz (JIS, CCIR) or 3.15kHz (DIN) is played back from the tape recorder.
The input voltage should be in the 15mV-10V range and the frequency within $\pm 10\%$. Under this condition, the INPUT MONITOR lamp will light.
Note: If the lamp does not light, check the input voltage and/or the recorded tape frequency.
- (2) Note the readings on the % scales (same graduations as for voltage).
Adjust the WOW FLUTTER switch until a reading is obtained reasonable high on the scale, except for values in the 0.03% range.

- (3) The DRIFT % meter will indicate the tape speed in terms of percent, – or +, relative to the input frequency.

Measurements should be made on the tape reel, or cassette, at the start, middle and near end of the tape winding. The value of drift is determined by the maximum value read on the meter.

4-7.4 Standard Frequency Tape Recording

As mentioned previously, the standard tapes used in measurements are 3kHz for JIS and CCIR, and 3.15kHz for DIN.

A standard tape for JIS/CCIR can be recorded with use of the accurate internal 3kHz source. Connect a pin-plug cable from the 3kHz OUTPUT jack ⑳ to a high grade tape deck for recording. Needless to mention, the recorder must have wow flutter characteristics of less than 0.01% at constant speed for accuracy in measured results.

4-8 Use of the Dummy Load, LD-21

4-8-1 Connections

The LD-21 is designed to match two (stereo) output circuits at 8Ω each.

Each load resistor is capable of handling up to 50W.

In the unit, four terminals are provided, two for each resistor. The terminals are “floating” the center metal terminal is the case ground connection.

4-8-2 Changing the Load Impedances

The unit can be used for 1-channel loading with the terminals connected as shown in Fig. 4-10. The maximum power rating is 100W for 4Ω parallel and 50W for 16Ω series.

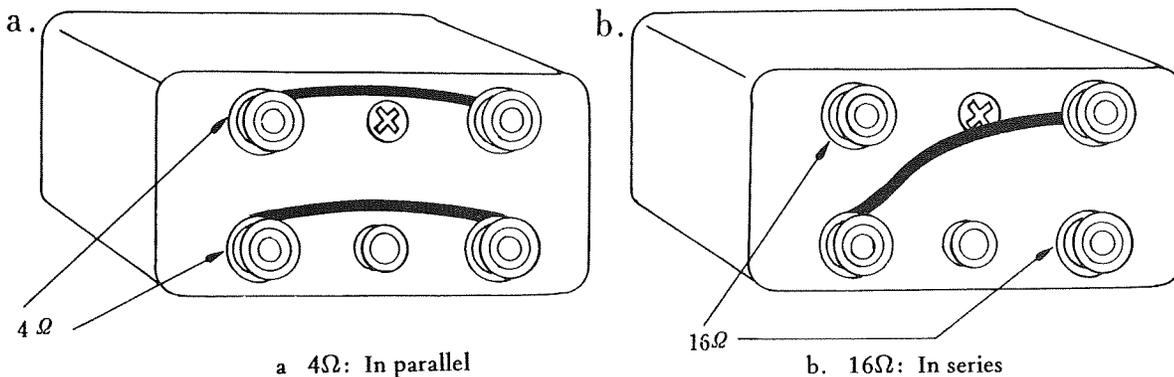


Fig. 4-10 Connections for 1-channel loading: LD-21

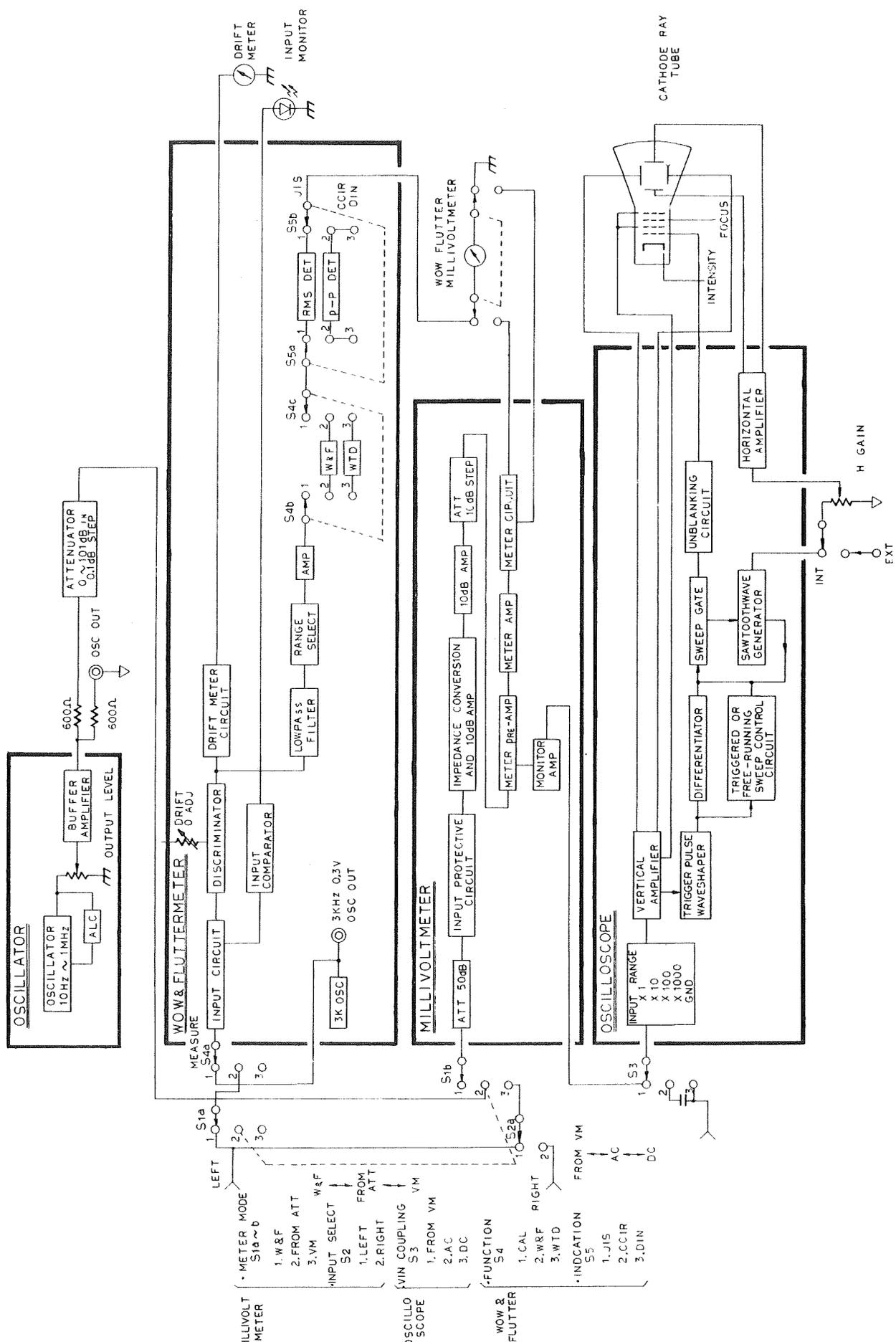
4-9 AC Outlets

Two AC outlets are provided at the rear of the case.

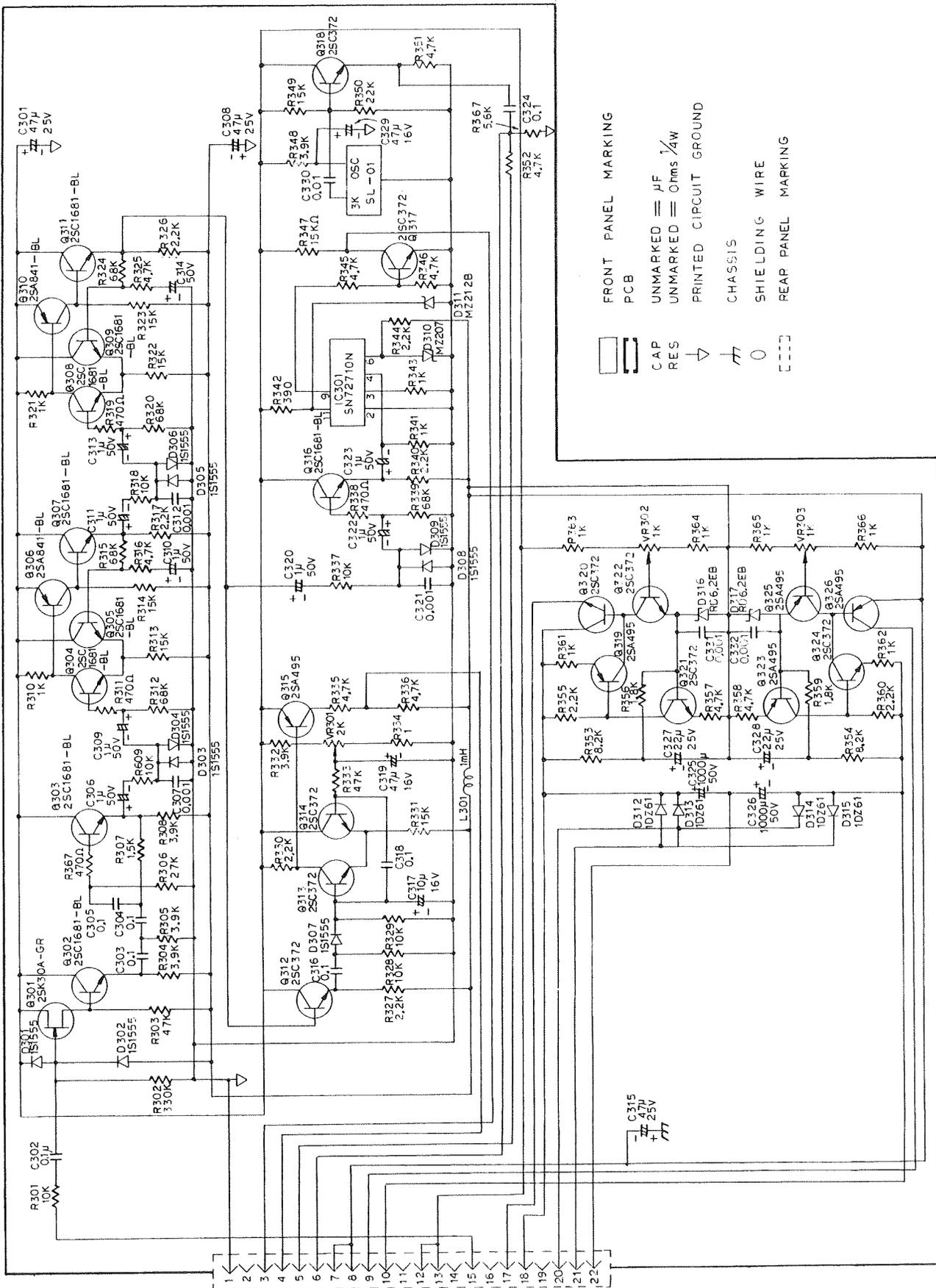
AC power is available directly from the AC line through the AC cord.

Note that both outlets are unswitched, and also not fused.

Warning !! The maximum total power supplied to the external equipment must be less than 200VA.



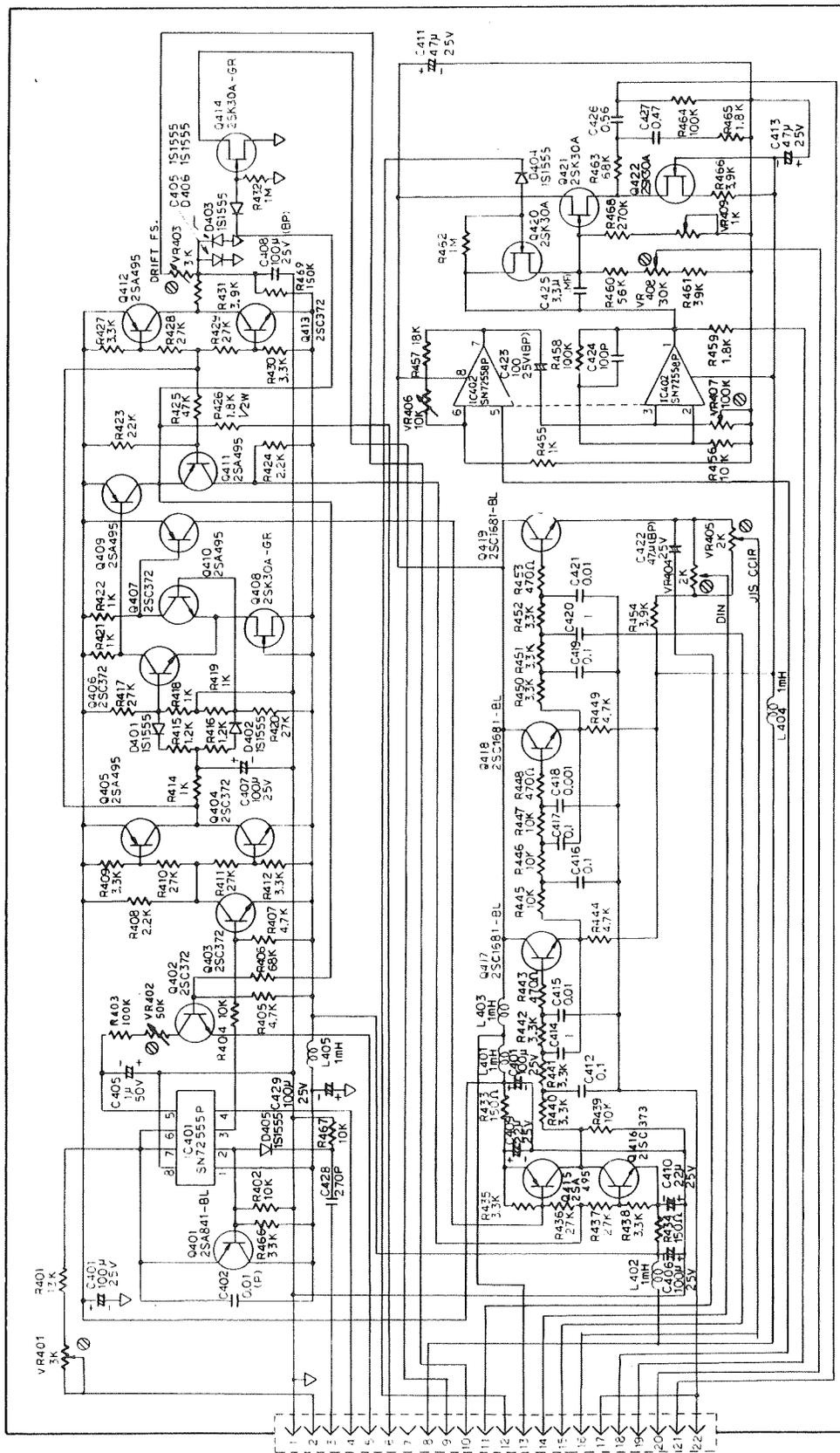
SCHEMATIC	MOD P1	LAS-5500	0-984 (1/10)	B
				LEADER ELECTRONICS CORP.



T-11320

- FRONT PANEL MARKING
- PCB
 - CAP UNMARKED = μ F
 - RES UNMARKED = Ohms $\frac{1}{4}$ W
 - PRINTED CIRCUIT GROUND
 - CHASSIS
 - SHIELDING WIRE
 - REAR PANEL MARKING

SCHEMATIC	Model LAS-5500	0-2E4A(2/10)
WOW & FLUTTER METER	INPUT AMP & POWER SUPPLY	LEADER ELECTRONICS CORP.

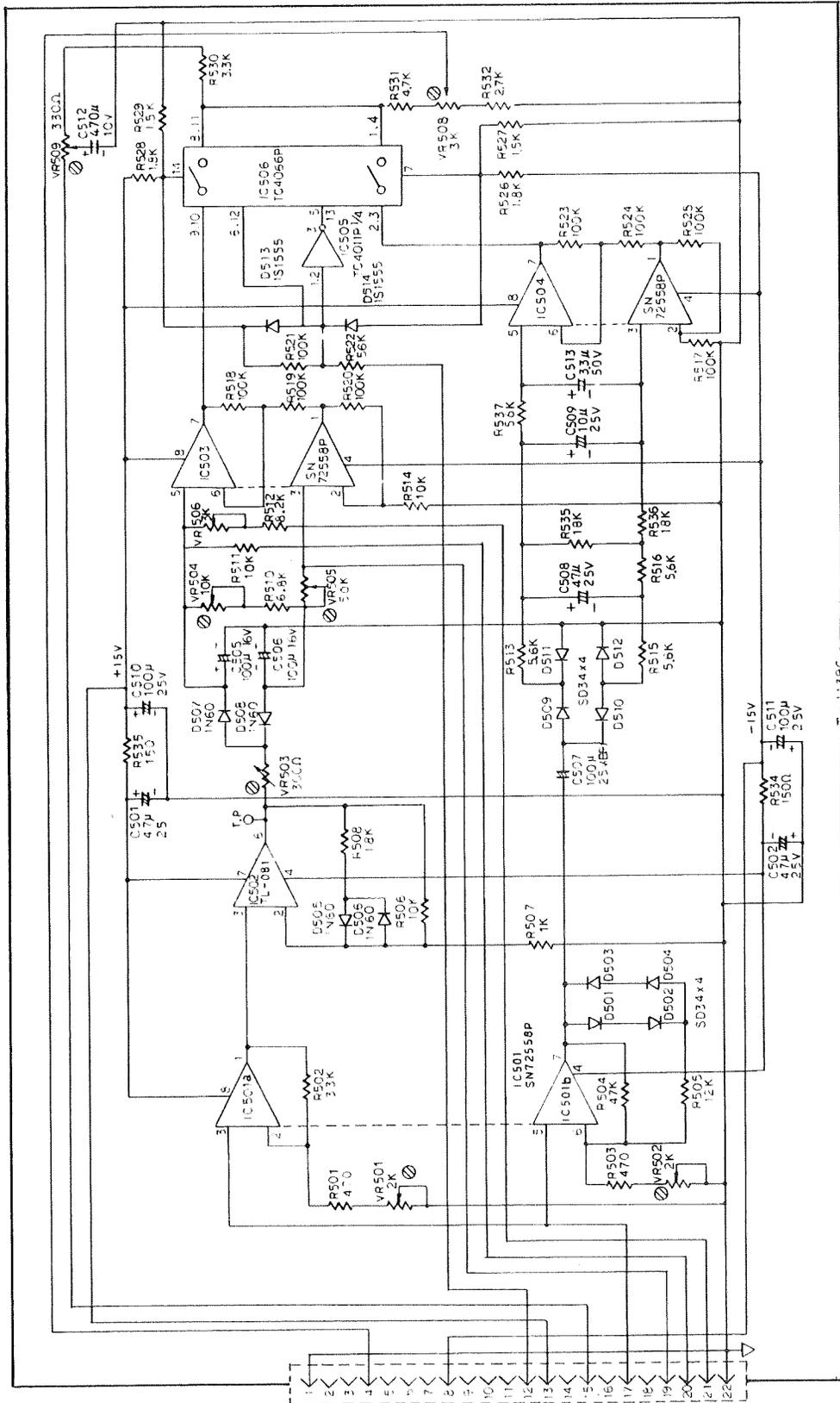


- NOTES
- REAR PANEL MARKING
 - FRONT PANEL MARKING
 - PCB
 - CAP
 - PES

- ▽ PRINTED CIRCUIT GROUND
- ▭ CHASSIS
- SHIELDING WIRE

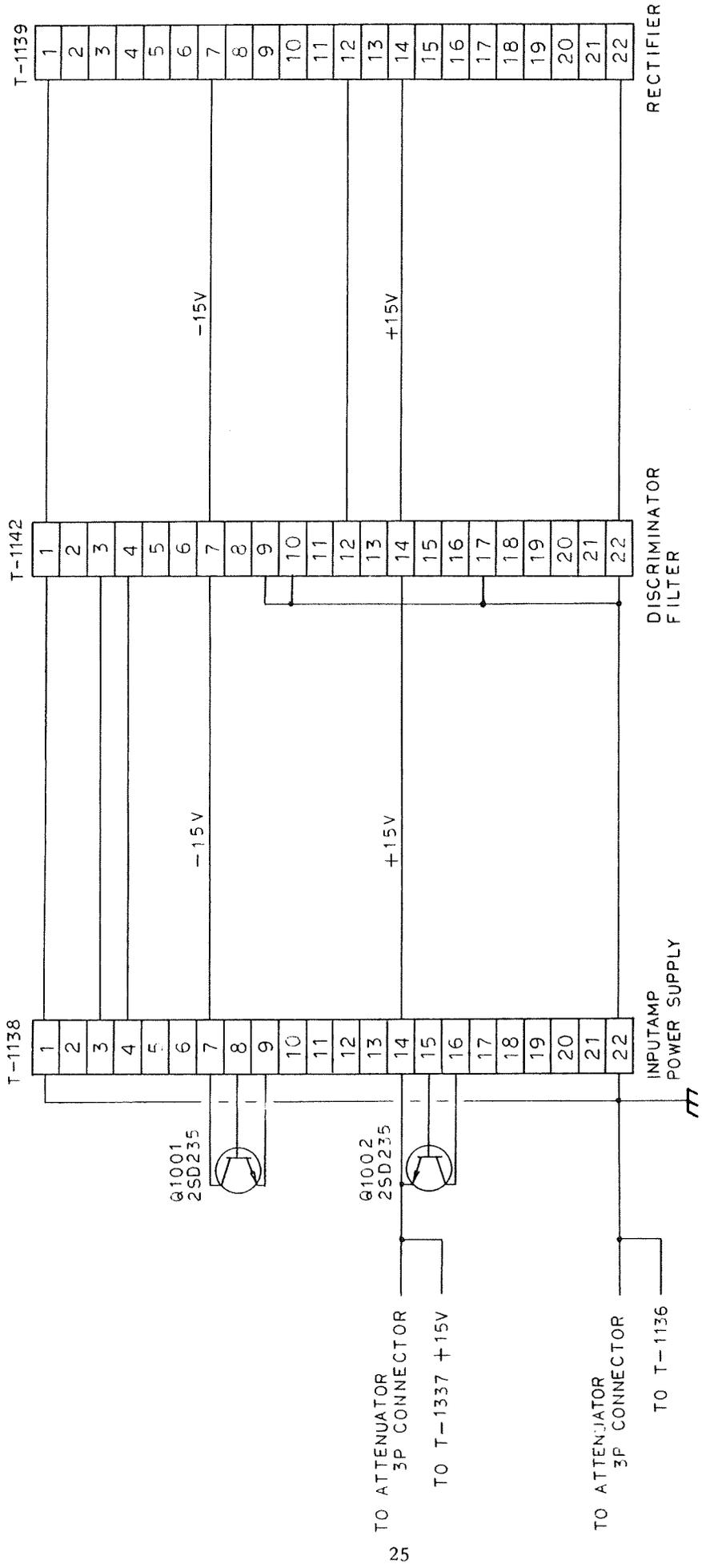
UNMARKED = HF P = PF
 UNMARKED = 0hms 1/4W

SCHEMATIC	Model L.A.S-5500	DISCRIMINATOR & FILTER	LEADER ELECTRONICS CORP.
WOW & FLUTTER	METER		

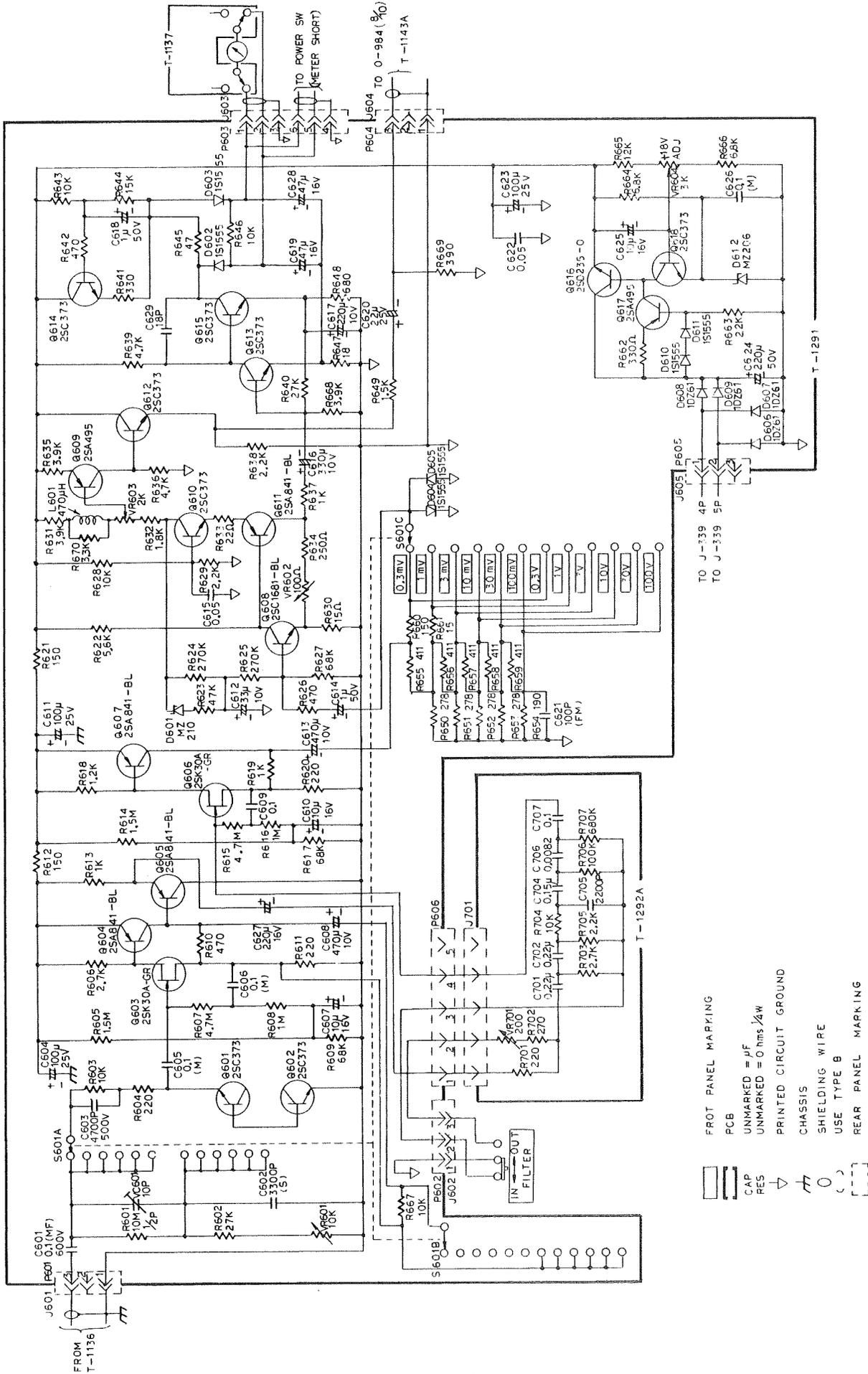


T - 1139C

WOW & FLUTTER METER	Model LAS-5500	0 - 934B (1/2) JA
RECTIFIER		LEADER ELECTRONICS CORP.
SCHEMATIC		

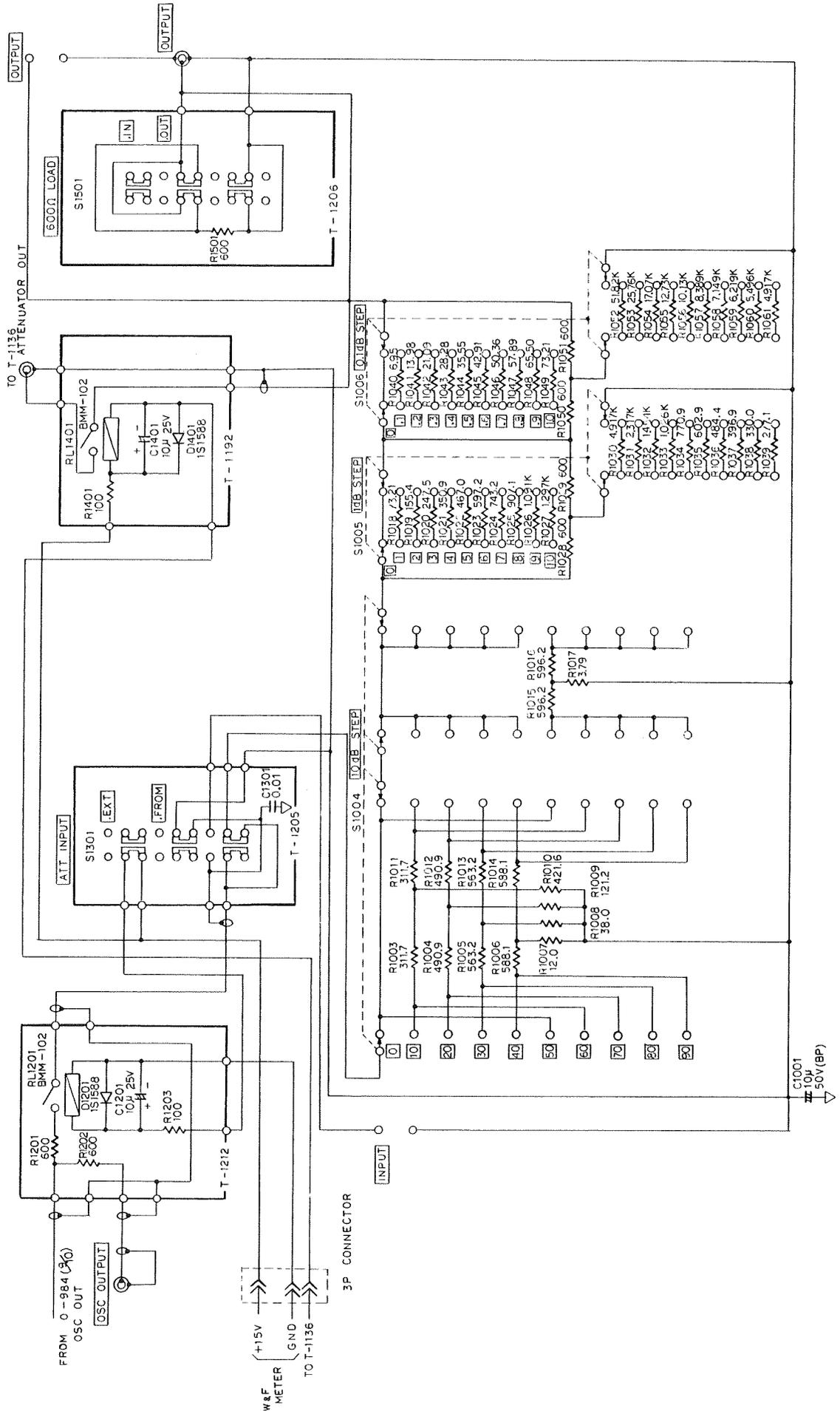


SCHEMATIC	Model LAS -5500	0 - 984 (5/10)
	WOW & FLUTTER METER	LEADER ELECTRONICS CORP.

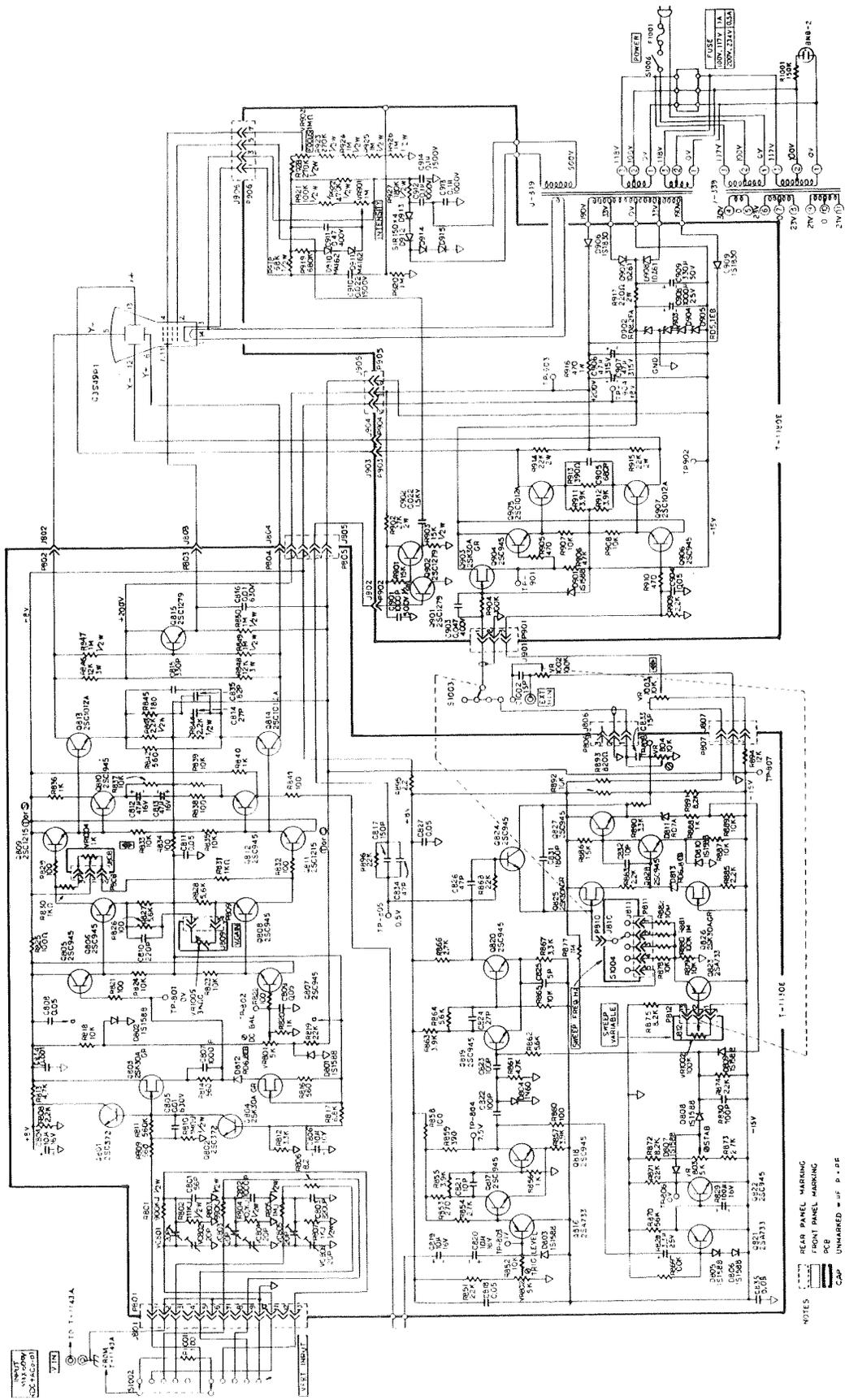


- FRONT PANEL MARKING
- PCB
- UNMARKED = μ F
- UNMARKED = 0.1ms/4W
- PRINTED CIRCUIT GROUND
- CHASSIS
- SHIELDING WIRE
- USE TYPE B
- REAR PANEL MARKING

SCHEMATIC	Model LAS-1100	O-984 (6/10)
AC MILLIVOLT	METER	LEADER ELECTRONICS CORP.

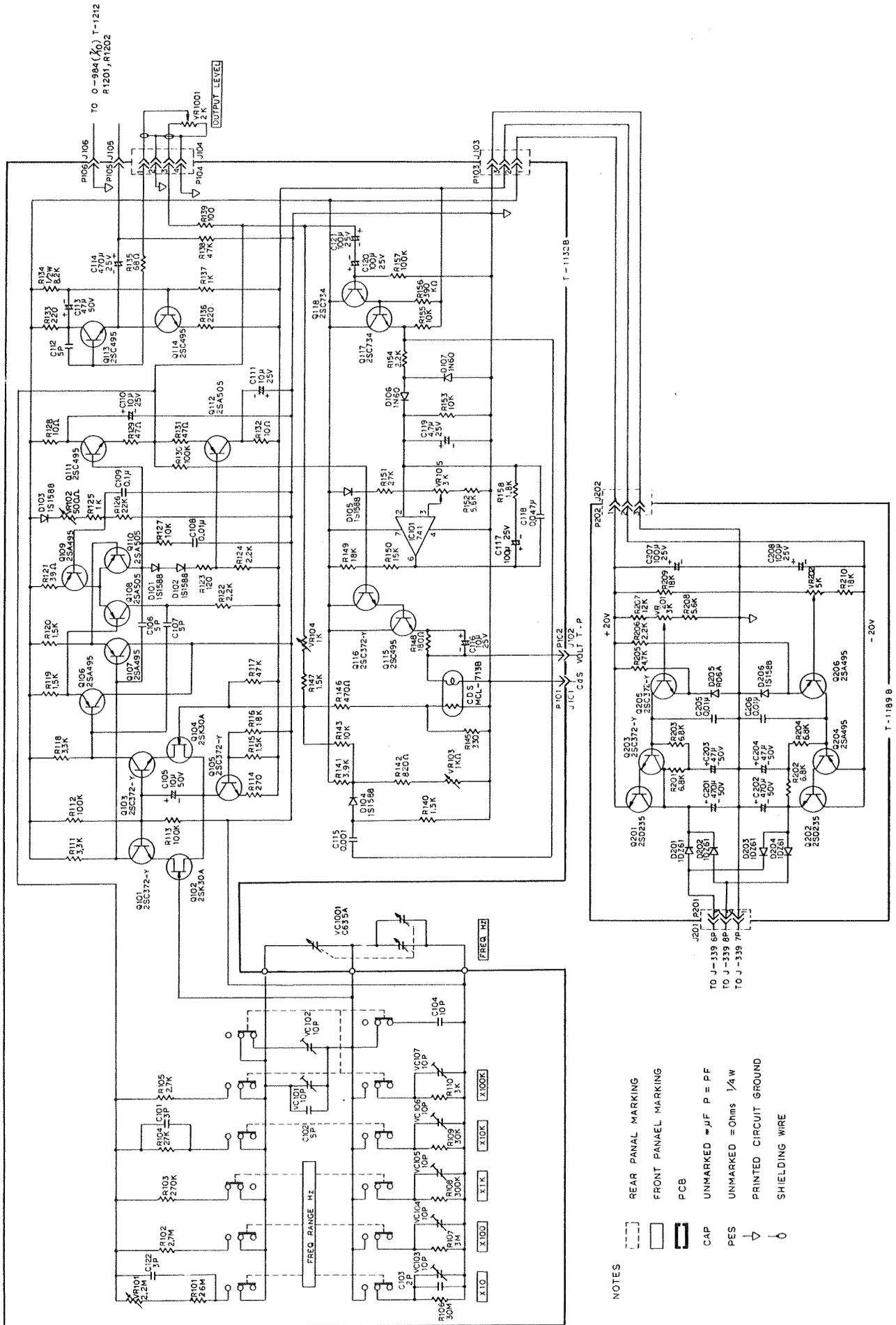


SCHEMATIC	MODEL LAS-5500	0-984 (7/10)
ATTENUATOR BLOCK		LEADER ELECTRONICS CORP.



SCHEMATIC Model LAS-5500 0-984 (810A) LEADER ELECTRONICS CORP.

- NOTES
- REAR PANEL MARKING
 - FRONT PANEL MARKING
 - PCB
 - UNMARKED = 0.1% 1/4W
 - PEE UNMARKED = 0.1% 1/4W
 - PRINTED CIRCUIT BOARD
 - CHASSIS
 - SHIELDING WIRE
 - () USE TYPE B



- NOTES
- REAR PANNEL MARKING
 - FRONT PANNEL MARKING
 - PCB
 - UNMARKED = JIF P = PF
 - UNMARKED = Ohms 1/4 W
 - PRINTED CIRCUIT GROUND
 - SHIELDING WIRE

