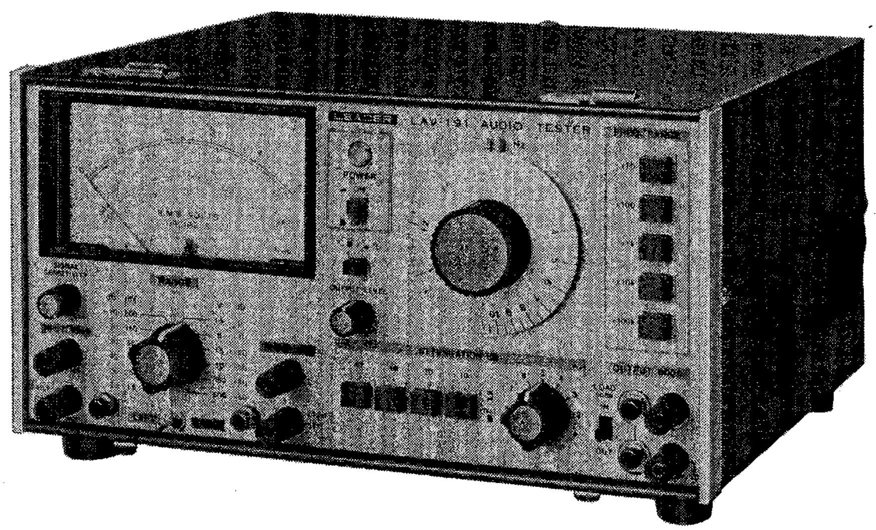
LEADER TEST INSTRUMENTS

MODEL LAV-191

AUDIO TESTER

INSTRUCTION MANUAL



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LEADER ELECTRONICS CORP.

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1. DESCRIPTION

The LAV-191 is a combination of a wideband audio generator and a wide-range AC millivoltmeter.

This instrument is specially useful in testing and servicing audio circuits, monaural and stereo, for frequency response and gain characteristics. The generator frequency range is 10Hz to 1MHz and the output is controllable from 0 to −120dB in 1dB steps into a 600Ω load.

The AC millivoltmeter covers a voltage range from 150μV to 500Vrms in the 10Hz to 1MHz range. In addition to the direct input, two switchable input – LEFT and RIGHT – are provided for stereo circuit measurements. A separate decibel scales, at 0dB = 0.775Vrms and 0 dB = 1 Vrms can be used when comparing signal levels.

2. SPECIFICATIONS

Audio Generator Section

Frequency Range — 10Hz – 1MHz in five decade ranges.

Calibration Accuracy — ± (3%+1Hz).

Output Characteristics

Sine Wave

- Voltage: over 3Vrms into 600Ω
- Responce: Flat within ±0.5dB.
- Distortion, maximum:
  - 500Hz ~ 20kHz 0.05%
  - 50Hz ~ 200kHz 0.4%
  - 20Hz ~ 500kHz 0.8%
  - 10Hz ~ 1MHz 1.5%

Impedance — 600Ω Internal load and external load change-over system.

Control — Variable: 0 to over 3Vrms.

Attenuator: 120dB in 1dB steps at 600Ω; 40dB×2, 20dB, 10dB, 1dB × 10 accuracy within ± 1.5%.

Frequency Characteristics:

Accuracy	dB range	Frequency
± 0.5dB	0 - 60	to 500kHz
	60 - 120	to 150kHz
± 2 dB	0 - 60	to 1 MHz
± 6dB	60 - 120	to 500kHz
± 10dB	60 - 120	to 1 MHz

Square Wave

- Output: Over 3 Vp-p into 600Ω
- Rise Time 200 ns.
- Sag 5% at 50Hz

Output Impedance — 600Ω ± 10%

SYNC Signal Terminal — Input Impedance: Approx 10 kΩ

Control range: ± 1 %/V

AC Millivoltmeter Section

Voltage Range	1.5mV (0.15mV min.) to 500Vrms full scale in 12 ranges.
Decibel Range	–80 to +55dB (0dB = 0.775V) –80 to +54 dB (0 dB = 1V) in 12 ranges.
Accuracy	Within ±2% of full scale.
Frequency Range	20Hz-100kHz within ±2% ref: 1kHz. 10Hz-1MHz within ±10%
Input Impedance	10MΩ; less than 50pF: 1.5-500mV range less than 35pF: 1.5-500V range
Input Selection	LEFT and RIGHT, switchable.
Amplifier Output Voltage	Approx. 1V rms at full scale
Output Terminal	RCA pin jack
Distortion	Less than 2% at 1kHz, full scale
Output Frequency Responce	10Hz–500kHz, –3dB (Connected input resistor 10MΩ and capacitor 50pFto output terminal)

Power Supply	100, 117, 200, 234V 50/60Hz; approx. 8VA.
Size and Weight	215(H) x 300(W) x 160(D) mm; 4kg.
Accessories, supplied -	
Lead, clip to pin plug	2 ea.
Lead, spade tip to pin plug	2 ea.
Option, on separate order:	Carrying case with strap.

3. CONTROLS AND CONNECTORS

3.1. AC Millivoltmeter Section, see Fig. 3-1.

① Meter: With scales calibrated for Volts, rms, and decibels.

② Mechanical zero adjuster for the meter.

③ SIGNAL SENSITIVITY: When the knob is set at the position of CAL, this unit can be used as AC millivoltmeter calibrated at the value of the range used in the same manner as that of ordinary AC millivoltmeter. When the knob is set at other than CAL, this unit is to set the level of incoming signal at 0dB and compare signal against standard signal in making measurement of SN ratio, etc.

④ RANGE switch: Selects the input voltage and dB level ranges.

⑤ ⑩ INPUT terminal (red): For the high potential side. ⑤ LEFT, ⑩ RIGHT.

⑥ ⑪ INPUT terminal (black): For the low potential side; this is "floated" from the chassis with a 0.22μF capacitor, ⑥ LEFT, ⑪ RIGHT.

⑦ Input jack for LEFT signal of stereo input.

⑧ INPUT SELECTOR switch: Selects the LEFT or RIGHT signal of stereo input.

⑨ Input jack for RIGHT signal of stereo input.

3.2 AF Signal Generator Section, see Fig. 3-1.

⑫ ATTENUATION dB switches: For attenuating the AF output signal; range is 0 to 110dB.

⑬ Attenuator switch: Adjusts the AF output signal in 1dB steps.

⑭ OUTPUT IMPEDANCE switch: Selects the output load impedance; 600Ω.

⑮ OUTPUT jack: For use with the pin plug lead.

⑯ Ground terminal (chassis connection).

⑰ OUTPUT terminal: For the AF output signal (connected in parallel with pin jack (17

⑱ FREQ. RANGE switches: Five pushbuttons for selecting the range of the output frequency.

⑲ Frequency dial, Hz: Calibrated from 1 to 10Hz; actual output frequency depends on the range setting.

⑳ OUTPUT LEVEL control: For continous adjustment of output.

㉑ Switch for output waveform selection, sine or square, as marked.

㉒ Pilot lamp: Indicates when the AC power is on.

㉓ POWER switch: Push on the AC power.

3.3 Rear Connections, see Fig. 3-2.

㉔ SYNC terminals: For connection to an external frequency control source; black terminal is for ground.

㉕ Shorting-link: Normally connected across the SYNC terminals when the synchronizing input signal is not used.

㉖ Number plate.

㉗ Amplifier output terminal

Approx. 1V rms output voltage will be available from this terminal when meter indication is full scall.

By using output from this terminal, monitering of the waveform under test on oscilloscope is available.

㉘ Puts in the accessory cable and others.

㉙ Fuseholder for the AC line.

㉚ AC inlet.

㉛ AC receptacle: Outlet for direct power connection to auxiliary equipment, independent power switch and line fuse; indicated current rating not to be exceeded.
Note: AC 100V 6A or AC 250V 2A max.

㉜ Power voltage selection switch.

㉝ Cord winder.

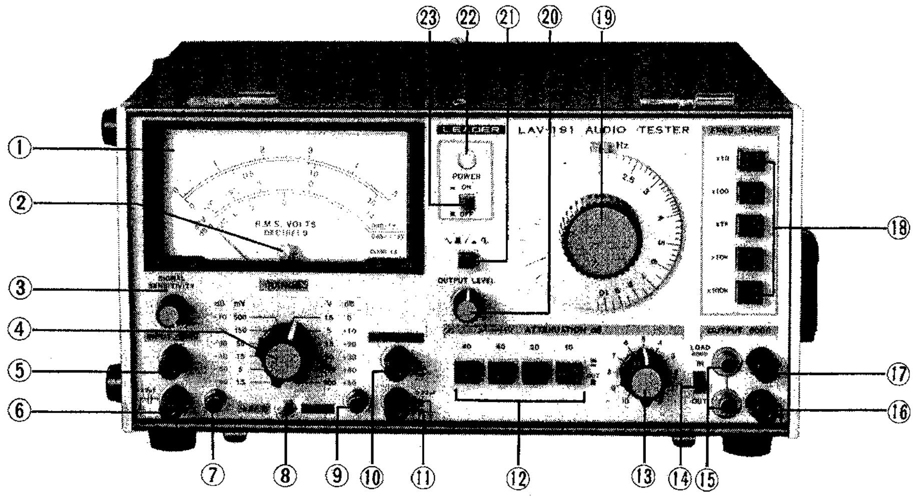


Fig. 3-1 Front panel controls and connectors.

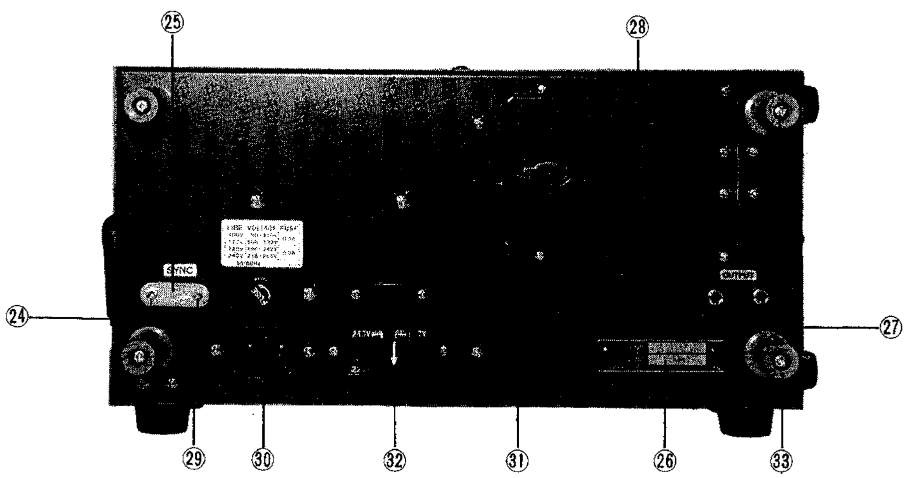


Fig. 3–2 Rear panel controls.

4. OPERATION

4.1 Initial Checks

Check the 0 pointer setting on the meter. If not zeroed at the left end of the scale, adjust the zero-set screw on the panel below the meter. (See Fig. 3-1.)

4.2 AF Signal Generator

4.2.1 PRECAUTIONS

1. The output should not be connected to a circuit in which voltage over 12Vrms, is present to prevent damage to the attenuator system. If D C voltage is present, connect it through a capacitor to eliminate D C voltage.

2. Output connection leads should be as short as possible. Long leads are liable to pick up noise when used at low output levels.
Using a shielded cable at the output will affect the output at high frequencies into high impedance loads due to the shunt capacitance effect.

4.2.2 CONTROL ADJUSTMENTS

1. Set the POWER switch at ON. Allow about 30 seconds for warm-up.
2. Frequency setting:
The output frequency is set with the frequency dial and the FREQ. RANGE switches.

FREQ. RANGE SETTING (Multiplier)	OUTPUT FREQUENCY RANGE
×10	10 – 100Hz
×100	100 – 1000Hz (1kHz)
×1K	1 – 10kHz
×10K	10 – 100kHz
×100K	100 – 1000kHz (1MHz)

3. Connections
   a. Ground lead to the black OUTPUT terminal.
   b. "Hot" lead to the red OUTPUT terminal, or pin plug to the pin jack (both outputs are in parallel).
   c. Output leads to the input of the test circuit.
4. Output Level Setting:

The OUTPUT LEVEL control is normally used to set the reference output level. The attenuators - pushbuttons and the rotary switch - are set as required. The signal attenuation is the sum of the markings on the attenuators. The marking on the attenuator is referred to the 600Ω load.

Example: Pushbuttons at 20 and 10
Rotary switch at 6
Total attenuation = 20 + 10 + 6 = 36dB

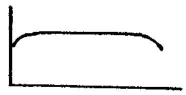
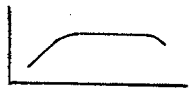
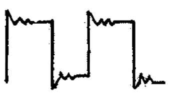
4.2.3 Square Wave Output

Square wave signals are useful in the rough determination of response characteristics of amplifiers at high and low frequency.

The interconnections are identical with those for sine wave operation, see Fig. 4-1.

The scope for waveform observation should have fast rise time characteristics.

The chart given below shows the waveforms at the amplifier output for different responses.

Waveshape	Amplifier Response	Condition
RECTANGULAR 	 FLAT	SATISFACTORY
DROOPING 	 DEFICIENT LOW FREQUENCIES	LOW PRIMARY INDUCTANCE IN OUTPUT TRANSFORMER: INCORRECT VALUES OF THE COUPLING ELEMENTS
PEAKED 	 DEFICIENT HIGH FREQUENCIES	HIGH LEAKAGE INDUCTANCE IN OUTPUT TRANSFORMER OR HIGH DISTRIBUTED CAPACITANCE IN CIRCUIT
RIPPLE 	 RINGING AT HIGH FREQUENCY	MALADJUSTMENT IN THE NEGATIVE FEEDBACK CIRCUIT; INCORRECT CONSTANTS; INSTABILITY

For an amplifier with good characteristics, the response will be flat up to about the 11th harmonic of the input fundamental. As an example. If a 1kHz square wave is reproduced without distortion, the amplifier response is flat to about 11kHz.

NOTES:
1. Output voltage settings are initially made with the OUTPUT LEVEL adjustments and the waveform switch set at the sine wave position.
   The indicated value on the scope will be equal to the peak-to-peak output voltages.
   The waveform selector switch is then set at the square wave position. Disregard the voltmeter reading.
   If in doubt, check the p-p output voltage with a calibrated scope.
2. It is advisable to check the input waveform on a scope before application.
3. Connection from the SYNC output terminal to the scope sync input will make adjustments easier when displaying waveforms.

The low frequency response will start to fall off at about 1/11 of the fundamental when there is a sag, or droop, in the displayed waveform.

4.2.4 Use of SYNC Connections

A. General

The sync connections, on the rear panel, can be used in several applications as described below.

The "input" or "output" impedance is approximately 10kΩ.

B. Output Frequency Control

The oscillator frequency can be synchronized with an accurate source over a range of ±1% per rms volt input, see Fig. 4-1.

For example, when the oscillator is set at some point between 990 and 1010Hz, and a signal of exactly 1000Hz is applied, the oscillator will automatically lock in at 1000Hz. Thus, high accuracy can be achieved with the use of a precision frequency standard.

In another application, a distorted waveform can be "purified", or filtered, by passing it through the oscillator.

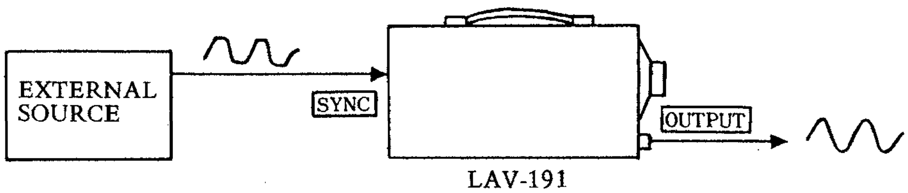


Fig. 4-1 Use of the SYNC terminals.

C. SYNC Output Application

The sync output voltage, approximately 2.5Vrms, should be sufficient to synchronize or trigger the sweep in a scope or to operate a frequency counter. This voltage is not affected by the setting of the OUTPUT LEVEL control.

4.3 AC Millivoltmeter

4.3.1. PRECAUTIONS

1. Maximum input voltages: To prevent damage to the input circuit, application of excessive voltages must be avoided.
   AC peak + DC = 600V
2. Low voltage measurements: When measuring voltages in the millivolt ranges, the RANGE switch should be set at a high range and lowered as required.
   If the input leads are at the open, or "free" condition, the meter pointer may go off scale; always set the RANGE switch at a high range. Due to the high input impedance, stray voltage picked up cause this effect.
3. The RANGE switch should be set where the readings can be taken above 1/3 of full scale length (except on the lowest range). This will result in higher accuracy of the readout.

4.3.2 PREPARATION

1. Set the RANGE switch at 500V and turn on the POWER switch.
2. When the power is turned on (or off), the meter pointer may fluctuate; this is a normal condition.
   The millivoltmeter is ready for use as soon as the pointer comes to rest.
3. Connect the input leads to the terminals, black for the low potential and the red for the "high" side.
   When stereo outputs are under measurement, connect the signal inputs to the LEFT and RIGHT pin jack respectively; set the INPUT SELECTOR switch as required.

4.3.3 VOLTAGE MEASUREMENTS

1. Connect the input lead tips to the test point or the output of the test circuit.
2. The RANGE switch should be set where the readings can be taken above 1/3 of full scale. This will result in higher accuracy of the readout.
3. The voltage range at the different settings of the RANGE switch is given in the following table.

RANGE SWITCH	VOLTAGE RANGE, V or mV	SCALE	SCALE MULTIPLIER	V or mV, PER DIV.
500	0 – 500	0 – 5	100	10
150	0 – 150	0 – 1.5	100	5
50	0 – 50	0 – 5	10	1
15	0 – 15	0 – 1.5	10	0.5
5	0 – 5	0 – 5	1	0.1
1.5	0 – 1.5	0 – 1.5	1	0.05

4.3.4 dB (DECIBEL) MEASUREMENTS

The dB scale is calibrated with reference to 0dB = 0.775Vrms (1mW) into 600Ω.
The dB range at the different settings of the RANGE switch is given in the following table.

RANGE SETTING	dBm	dBV
+50	+30 ~ +56	+30 ~ +54
+40	+20 ~ +46	+20 ~ +44
+30	+10 ~ +36	+10 ~ +34
+20	0 ~ +26	0 ~ +24
+10	-10 ~ +16	-10 ~ +14
0	-20 ~ + 6	-20 ~ + 4
-10	-30 ~ - 4	-30 ~ - 6
-20	-40 ~ -14	-40 ~ -16
-30	-50 ~ -24	-50 ~ -26
-40	-60 ~ -34	-60 ~ -36
-50	-70 ~ -44	-70 ~ -46
-60	-80 ~ -54	-80 ~ -56

* The dB range is the algebraic sum of the RANGE marking and the scale reading.

4.3.5 Use of SIGNAL SENSITIVITY (S/N MEASUREMENTS)

A. This SIGNAL SENSITIVITY shall be used with its knob ③ usually set at the position of CAL.

B. By utilizing this knob, measurement of SN ratio, level measurement against standard signal (e.g. measurement of crosstalk characteristics), etc. can be easily performed. An example of SN ratio measurement by means of this instrument is now described as follow:

C. Example of SN ratio measurement

An amplifier (A) of which maximum output is 2V is now assumed to be measured by this instrument for its SN ratio at the maximum output.

Arrange wiring between this instrument and the amplifier as shown in the drawing, set the millivolt meter at 5V range and set the output of amplifier (A) at 2V based on indicated value on the meter. (At this time, gain of (A) is set at maximum.)

Next, rotate the knob of SIGNAL SENSITIVITY counterclockwise to its extreme end (at this time the meter indicates 0.6V.) and set the range at 1.5V (0dB range) one step lower.

Next, adust the indicator needle of dBV or dBm scale to 0dB by means of SIGNAL SENSITIVITY knob. At this point, change-over the switch shown in the drawing to N side.

Rotate the range change-over switch ④ counterclockwise to cause the meter needle to sway.

If the meter indicates –3dB in the –50dB range when the scale of dBm range is set at 0dB and the switch is set at N side, its SN ratio will be 53dB by the following formula: (0) – (–50) – (–3) = 53

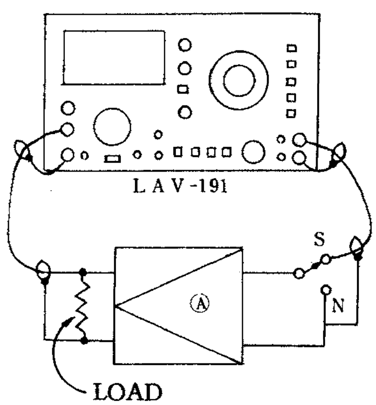


Fig. 4-2

4.4 Typical Applications

4.4.1 USE OF THE ATTENUATORS

The output impedance of the attenuator system is designed to match the 600Ω load. The correct attenuation, or sum of the marked settings, holds only for the 600Ω condition.

When other load impedances are used, there will be a mismatch in which the actual voltage attenuation depends on the load.

For example, when working into an open circuit, or a high impedance, the output voltage will be 6dB above the 600Ω condition. Thus, this value must be subtracted from the marked settings.

In other words, if the voltage is initially set at 1V, say at 0dB, into 600Ω, then at open circuit, the voltage will be 2V, or 6dB higher. Under this condition, the attenuation will be −6dB and must be accounted for.

The table below shows the number of dB for voltage to be subtracted from the settings at different load impedances.

NUMBER OF dB TO BE SUBTRACTED	LOAD IN OHMS
0	600
1.9	1000
3.7	2000
5.0	5000
5.5	30k
5.9	60k
6.0	∞ (open)

Example:		
	Attenuator setting	35dB
	Load impedance	2000Ω
	Actual attenuation	35 − 3.7 = 31.3 dB

If in doubt, the output voltage at each attenuation step can be measured with the voltmeter.

4.4.2. INPUT/OUTPUT CHARACTERISTIC

Generator settings:

Frequency at 400 or 1000Hz.

Attenuators at 0dB (pushbuttons at out and rotary switch at 0).

Connect the voltmeter to the OUTPUT.

Adjust the OUTPUT LEVEL control for the meter reading at, say 1V and do not touch the control during the measurements. Remove the connection.

Set the pushbutton for 60dB attenuation.

Connections:

Generator output to the amplifier input.

Voltmeter input across the load at the amplifier output, see Fig. 4-3.

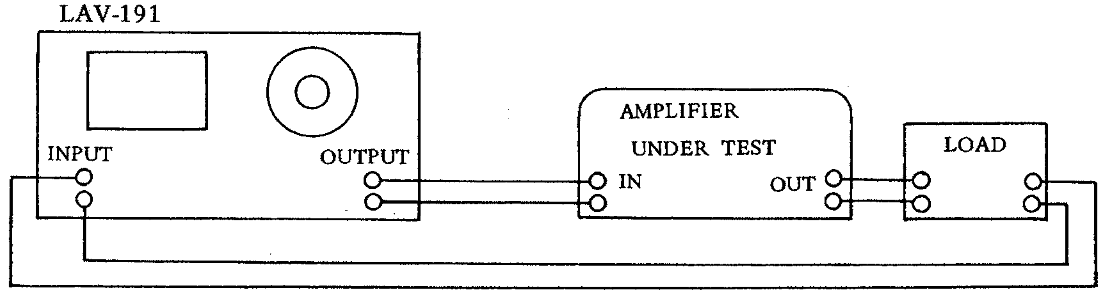


Fig. 4-3. Amplifier measurement

Adjustments:

Note the voltmeter reading as the attenuation is lowered (increase in the input voltage).

The "overload" point will be reached when any increase in the input voltage will produce no further increase in the output. Normally the "undistorted" output is taken at some point on the linear portion of the plotted input/output curve.

The output power at this point is calculated from the relation -

$$P_{output} = \frac{(\text{VOLTS})^2}{\text{LOAD IN }\Omega} \text{ watts.}$$

4.4.3 FREQUENCY RESPONSE

Using the same connections shown in Fig. 4-3, a frequency run is made on the amplifier.

The method most commonly used - constant input VS. output level (voltage) - will be described.

The input to the amplifier is set at a voltage well below the overload point.

The generator frequency is varied over the desired range and the amplifier output voltage is plotted against the frequency. The generator output is flat for practical purposes and generally there will be no need to adjust the output at each test frequency.

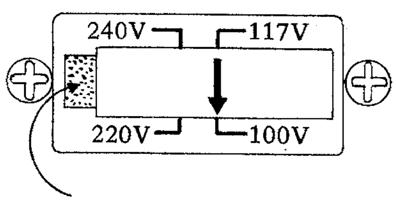
When plotting the response in dB, it will be convenient to initially set the generator output so that the voltmeter reading is 0dB at 400 or 1000Hz. Then by varying the frequency and noting the dB scale reading, the relative response VS. frequency can be plotted on a semi-log paper.

5. MAINTENANCE

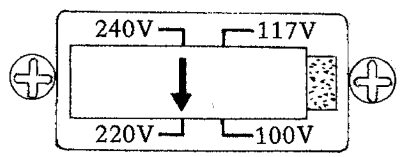
5.1 Power voltage

Voltage of power supplied to this Audio Tester is indicated by the switch fixing plate on the rear panel.

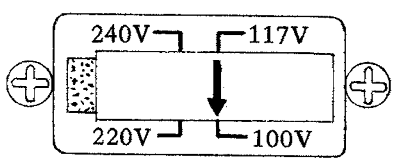
To set desired power line voltage, insert the voltage switching plug with guide plate into its socket so that the arrow marked on the plug is directed to one of power line voltages marked on the socket as shown in the following figure.



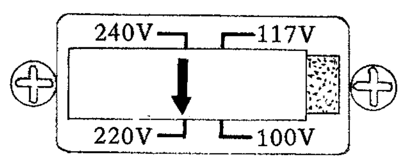
For 100V



For 220V



For 117V

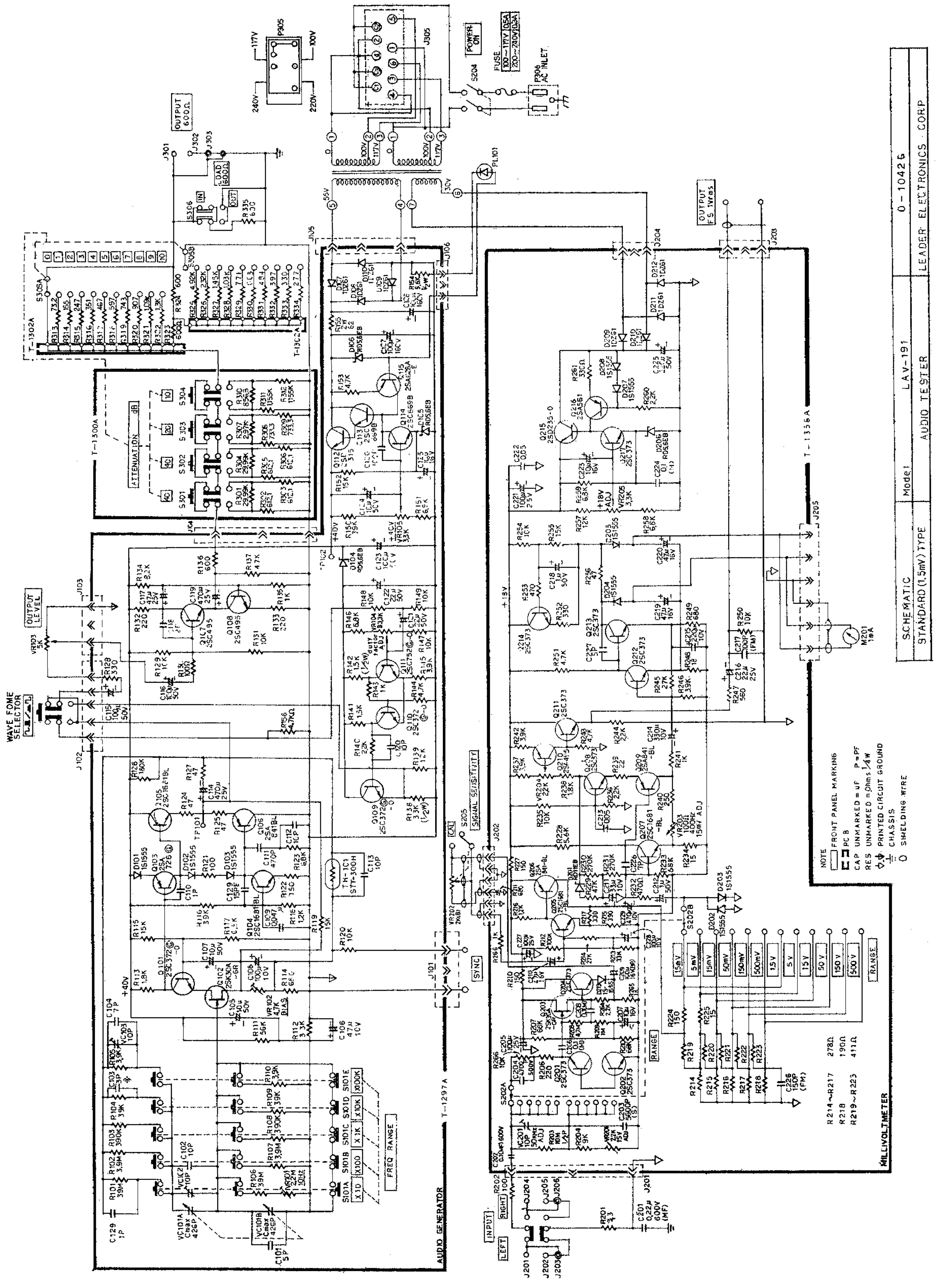


For 240V

5.2 Fuse

Fuses of this Tester are rated as shown in the Table. If a fuse is broken off, find its cause. Replace the fuse after safety was confirmed.

Power voltage	Fuse rating
100, 117V	0.5 A
220, 240V	0.3 A


SCHEMATIC
STANDARD (1.5mV) TYPE
Model
LAV-191
AUDIO TESTER
0-10426
LEADER ELECTRONICS CORP
AUDIO GENERATOR
MILLIVOLTMETER
ATTENUATION dB
FREQ RANGE
WAVE FORM SELECTOR
OUTPUT LEVEL
OUTPUT 600Ω
SIGNAL SENSITIVITY
RANGE
INPUT
LEFT
RIGHT
SYNC
POWER ON
AC INLET