LEADER TEST INSTRUMENTS

LMV-185A〔B〕
2 CHANNEL
AC MILLIVOLTMETER

INSTRUCTION MANUAL

LEADER ELECTRONICS CORP.

CONTENTS

Note: This instruction manual applies to both 185A and 185B, and the information in brackets [ ] refers to the 185B.

1. General

LMV-185A is a two-channel, portable, general purpose, AC voltmeter, which can measure the sinusoidal wave AC voltage between 100μV and 300V (150μV and 500V) within the frequency of 5Hz – 1 MHz.

It responds to the average value of the input signal but is calibrated to indicate the r.m.s. value of a sine wave.

Because each channel has its own indepedant circuit and a 2-pointer type indicator is employed, this voltmeter permits reading of 2-channel indications on the same scale.

2. Features

- Broad-band type: From 5Hz to 1MHz
- High accuracy of ±2%.
- Two measured voltages are indicated on same scale to facilitate comparison between them.
- The use of a double-shaft switch for range switching facilitates single-acting operation as well as interlooking operation with level differences.
- The use of 2-color light-emitting diodes avoids mulfunction in single-acting operation and interlocking operation.
- The use of a new circuit design assures high accuracy, reliability and excellent stability.
- The use of two decibel scales (0 dBV = 1V, 0 dBm = 0.775V) in addition to the voltage scale provides a wide range of applications.
- The output terminal is calibrated to 1 Vrms of full scale to permit use as a waveform monitor or pre-amplifier of low noise and high gain.
- Compact panel arrangement and less space requirement.

3. Specifications

Voltmeter

Measuring voltage range	100μV – 300V [150μV – 500V]
Measuring range	Measuring range 12 ranges 1, 3, 10, 30, 100, 300 mV 1, 3, 10, 30, 100, 300V [1.5, 5, 15, 50, 150, 500mV 1.5, 5, 15, 50, 150, 500V] Decibel range 12 ranges –60, –50, –40, –30, –20, –10dB 0, +10, +20, +30, +40, +50dB (0 dB = 1V, 0 dB = 0.775 V)
Measuring accuracy	±2% of full scale (at 1 kHz or 400 Hz)
Frequency characteristics	5Hz ~ 1MHz ±10% 10Hz ~ 500kHz ± 5% 20Hz ~ 100kHz ± 3% (1 kHz as base)
Input resistance	10 MΩ
Input capacitance	Under 50 PF (1mV – 300mV [1.5mV – 500mV]) Under 35 PF (1V – 300V [1.5V – 500V])
Maximum input voltage	AC peak + DC = 600V
Noise	Within 2% of full scale by shorting input

Amplifier

Output voltage	1 Vrms (no load) when 1.0V [5.0V] is indicated at full scale of each range
Frequency characteristics . . .	10Hz – 300kHz, – 3 dB (1 kHz as base)
Output impedance	600Ω±20%
Distortion factor	Within 1% at full scale (1 kHz)
Operating temperature range .	0 to 40°C
Operating humidity range . . .	Less than 85%
Power Supply	At specified voltage ±10%, 50/60 Hz: Input taps at 100, 120, 200, 240V; approx. 5 VA
Size and weight	132(W) x 150(H) x 250(D)mm, 2.5 Kg (exclusive of buttons, rubber legs and handle)

Accessories . . . . . Terminal adaptor for plug type 2
Furnished connection cord (banana-alligator) . 2

4. Block diagram

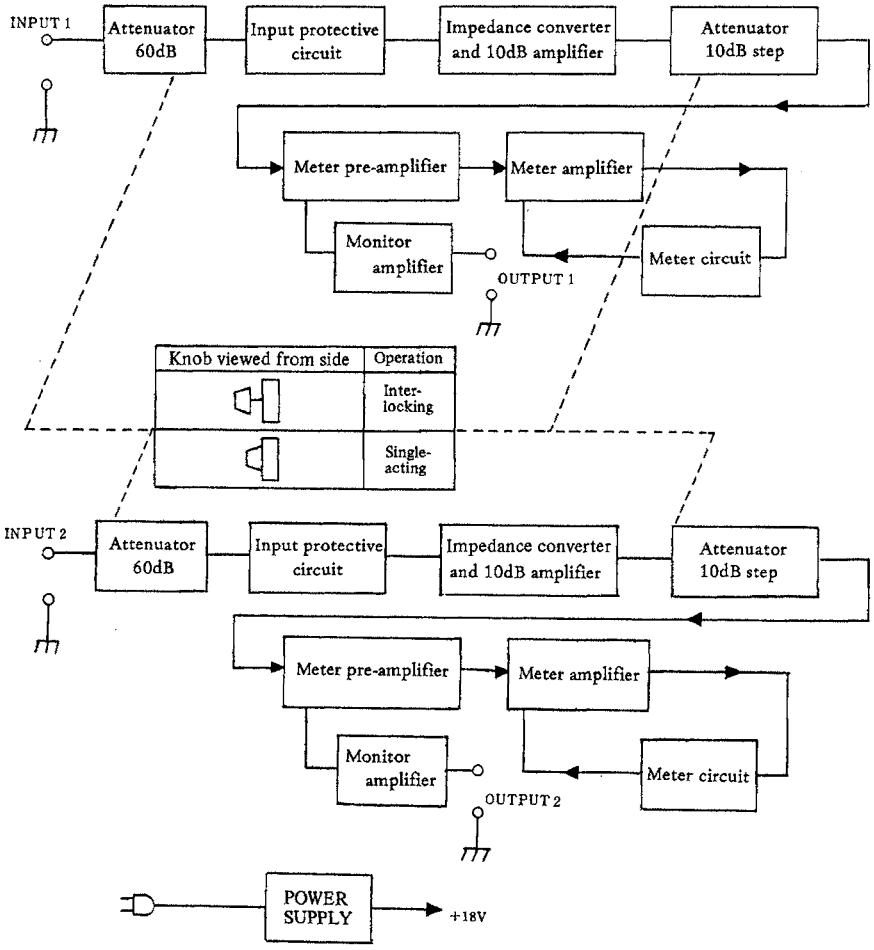


Fig. 1

5. Panel Controls

Explanations of the front and rear panel controls are shown below.

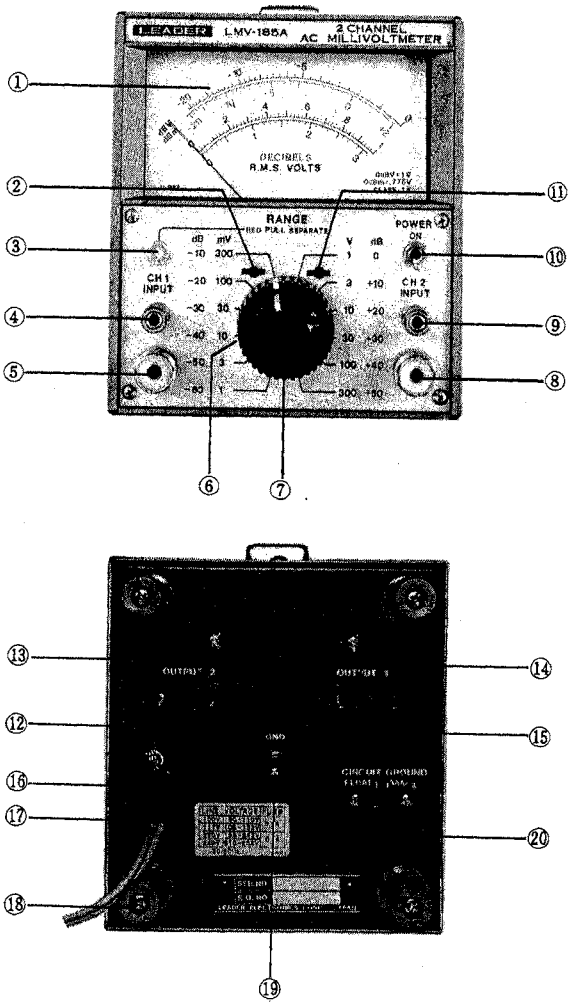
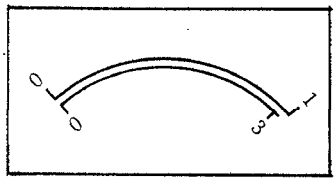


Fig. 2

① METER: With two independent pointer movements, black for INPUT 1 and red for INPUT 2.

1) Model 185A



2) Model 185B

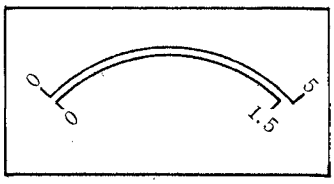


Fig. 3

②⑪ Mechanical zero adjustment screw

Turn POWER Switch ⑩ to off. Set the voltage calibration to 0 by adjusting the mechanical zero adjustment screw with a screwdriver.

③ Pilot lamp: Indicates when the AC power is on.

④⑨ "INPUT" (metallic terminal)

This is the ground terminal when measuring voltage.

⑤⑧ "INPUT" (plug, U.H.F. type)

This is the terminal for applying voltage to be measured. Type M and type UHF connectors and twin-type banana plugs can be used because 4 and 5, 8 and 9 are 19mm apart. Individual banana plugs may also be used with 4 and 5, 8 and 9 separately.

⑥⑦ RANGE Knob

This is the knob for selecting a full scale range on the indicator. At each position where the knob comes to rest, the voltage value is shown in black scale while the absolute level in reference to 0 dB is shown in red scale.

When the knob ⑦ is pushed, the lamp ③ turns green, and the knobs ⑥ and ⑦ are interlocked. When the knob ⑦ is pulled, the lamp turns red, and the knobs ⑥ and ⑦ can be operated individually.

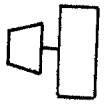
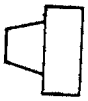
Knob viewed from side	Operation	Color of lamp
	Single-acting	Red
	Interlocking	Green

Fig. 4

⑩ POWER switch: For turning on the AC power.

⑫⑮ "OUTPUT" (Red Terminal)

This is the output terminal when the instrument is used as an amplifier. When the meter indicates full scale at each stop position of the range switches ⑥ and ⑦ , 1 Vrms of voltage can be obtained. Output to "INPUT 1" is "OUTPUT 1", and output to "INPUT 2" is "OUTPUT 2."

⑬⑭ "OUTPUT" (Black Terminal)

When the instrument is used as an amplifier, this output terminal is grounded.

⑯ Fuse

Protects instrument against over load and short circuits. Fuse is removable by counter-clockwise rotation.

⑰ Power supply cord

Connects units to power source.

⑱ Cord winder

Provides convinient power cord strage.

⑲ GND (metal) terminal

This is permanently connected to the frame.

When the CIRCUIT GROUND switch ⑳ is set to FLOAT, this terminal is used to connect the equipment frame with the frame ground of the device to be measured.

⑳ [CIRCUIT GROUND] switch

When this switch is set to  , the ground terminal of each channel is connected to the frame through a 47Ω resistor as shown in Fig. 5. When the switch is set to FLOAT, the ground terminal of each channel is floating as shown in Fig. 6.

6. Preliminary Notes

6-1 The line voltage used for this instrument should be ±10% of the rated value.

6-2 Mechanical zero adjustment of the indicator

If the pointer of the scale is not at 0 when power is off, set to 0 by adjusting the mechanical zero adjustment screw with an insulated screwdriver.

6-3 Excessive input voltage

The maximum input voltage of this instrument is AC peak + DC = 600V. Do not apply a voltage greater than this value. If a larger input is applied to the input terminals, circuit parts may be damaged or destroyed.

6-4 Input waveform

This instrument gives indications according to the mean value of the input waveform, and the calibration is done in effective values of sine waves. Therefore, distortion of the input voltage waveform may result in incorrect readings.

6-5 Induction noise

When the measured voltage is very small, or when the impedance of the source of the measured voltage is relatively high, an incorrect indication may result due to the induction of external noises. If this occurs, use shielded cables to reduce or eliminate noise pick-up.

7. Operation

7-1 Preparation

1. Before connecting this instrument to the power source, check to see that the pointer of the scale is at 0. If it is off 0, set it to 0 by adjusting the zero adjustment screw.
2. Connect the power plug to the power source of the correct voltage.
3. Select FLOAT — —⏚ switch on the rear panel.
   FLOAT - - - - GROUND terminal on the front panel is isolated from chassis.
   —⏚ - - - GROUND terminal on the front panel is connected by 47Ω to chassis. (See paragraph 7-3)
4. Set the range switch to 300V [500V] in advance.
5. Set the power switch at ON, whereupon the pilot lamp will glow. During the first five seconds or so, there will be a random swing of the pointers; this is normal.
6. After about ten seconds, the voltmeter is ready for use.

7-2 Measurement of AC Voltage

1. The switches, RANGE CH1 and RANGE CH2, should be set at the position where the voltages can be read along the upper portion of the scales, at least 30% of full scale. Higher accuracy will be achieved under this condition.

2. The two pointers, black and red respectively, are used for INPUT 1 – RANGE CH1 and INPUT 2 – RANGE CH2.
3. The proper multiplier must be applied to the voltage scale readings at each range.
   The voltage range settings and multipliers are given in the charts below.

LMV– 185A

RANGE	SCALE	MULTIPLIER	VOLT/DIV
300V	0 – 3	100	10 V
100V	0 – 1	100	2 V
30V	0 – 3	10	1 V
10V	0 – 1	10	0.2 V
3V	0 – 3	1	0.1 V
1V	0 – 1	1	0.02V
300mV	0 – 3	100	10 mV
100mV	0 – 1	100	2 mV
30mV	0 – 3	10	1 mV
10mV	0 – 1	10	0.2 mV
3mV	0 – 3	1	0.1 mV
1mV	0 – 1	1	0.02mV

Table 1

LMV – 185B

RANGE	SCALE	MULTIPLIER	VOLT/DIV
500 V	0 –5	100	10 V
150 V	0 –1.5	100	5 V
50 V	0 –5	10	1 V
15 V	0 –1.5	10	0.5 V
5 V	0 –5	1	0.1 V
1.5V	0 –1.5	1	0.05V
500 mV	0 –5	100	10 mV
150 mV	0 – 1.5	100	5 mV
50 mV	0 –5	10	1 mV
15 mV	0 – 1.5	10	0.5 mV
5 mV	0 –5	1	0.1 mV
1.5mV	0 – 1.5	1	0.05mV

Table 2

7-3. Floating of Input Terminal

The ground terminal of each channel INPUT is independently floating from the case ground. This floating function is useful to avoid the following problems:

When the ground terminals are common, undesireable current will flow in the circuit to be measured through the common ground terminals, and it may result in erroneous meter readings. This effect occurs not only in measurements of very small voltages but also of high current circuit voltages such as power amplifier load test.

A switch is provided on the rear panel of the instrument, and two floating conditions are switchable as shown in Figure 4.

When Switched to ⏚ :

The ground terminal of each INPUT is connected through a 47Ω resistor to the case ground as shown in Figure 5.

When making measurements, care must be taken not to apply voltages over 7Vrms between the ground terminal and the case ground by making wrong connections with opposite polarity.

Note particularly the polarity in making the power amplifier measurements, when the load is 8Ω and the output is over 6W, and when the load is4Ω and the output is over 11W.

Fig. 4

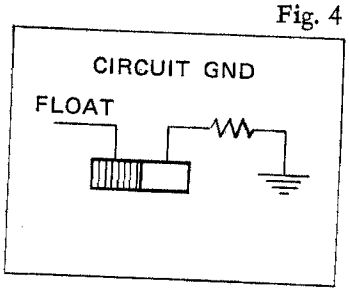
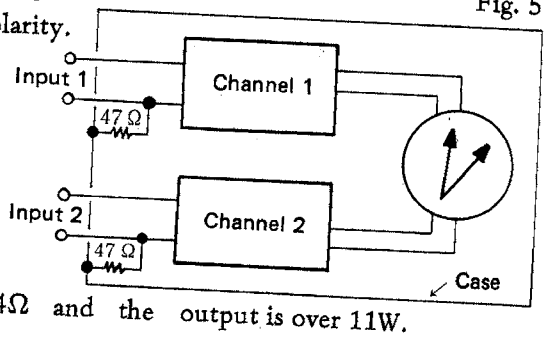


Fig. 5



When Switched to FLOAT:

Because the ground terminal of each channel is completely insulated from the case ground as shown in Figure 6, a short thick lead (woven wires of about 30 cm long) should be connected between the GND terminal of the instrument on the rear panel and the frame ground of the device to be measured. Otherwise, wrong meter reading will result in due to external noises such as hum etc.

Fig. 6

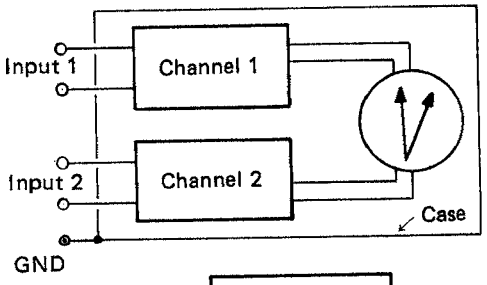
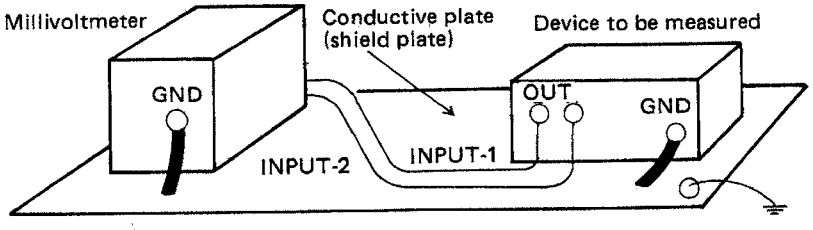


Fig. 7

Ensuring Stable Measurements:

Special care is necessary to eliminate unfavorable effects of external noises such as hum when high sensitivity measurements are to be made. More accurate and stable measurements are available when a millivoltmeter and the device to be measured are connected as shown in Figure 8.

Fig. 8



Note: When measure a BTL amplifier of car stereo, it can not make accurate measurement, even FLOATING mode. Because ground line has same signal as hot line.
Also, when monitor the output signal by oscilloscope, it may be different from input signal.
In this case please contact our sales office.

7-4 How to use Decibel Range

The indicator has the following two red dB calibrations:

0 dB = 0.775 V (1mW 600Ω ..... dBm)

0 dB = 1V ..... dBV)

Table 3 shows each dB range vs dBm and dBV.

Decibel values can be read by adding range dB values to indicated values of the pointer.

Example 1		Example 2	
Scale	+ 1 dB	Scale	− 4 dBV
Range	+ 20 dB	Range	− 30 dB
Level	+ 21 dBm	Level	− 34 dBV

The dB ranges at different settings of the RANGE switches are given in the chart which follows.

RANGE SETTING	LMV – 185A		LMV – 185B	
	dBm	dBV	dBm	dBV
+50	+30~+52	+30~+50	+30~+56	+30~+54
+40	+20~+42	+20~+40	+20~+46	+20~+44
+30	+10~+32	+10~+30	+10~+36	+10~+34
+20	0~+22	0~+20	0~+26	0~+24
+10	−10~+12	−10~+10	−10~+16	−10~+14
0	−20~+ 2	−20~+ 0	−20~+ 6	−20~+ 4
−10	−30~− 8	−30~−10	−30~− 4	−30~− 6
−20	−40~−18	−40~−20	−40~−14	−40~−16
−30	−50~−28	−50~−30	−50~−24	−50~−26
−40	−60~−38	−60~−40	−60~−34	−60~−36
−50	−70~−48	−70~−50	−70~−44	−70~−46
−60	−80~−58	−80~−60	−80~−54	−80~−56

Table 3

7-5 Use of "OUTPUT" terminal

When the indicator show "1" ["5"] at full scale, the "OUTPUT" terminal can obtain an output of 1Vrms no matter where the RANGE switch is positioned. An oscilloscope can be used as a monitor of measured signal waveforms, or as a pre-amplifier by connection to the "OUTPUT" terminal. Table 4 shows the degrees of amplification when the instrument is used as a pre-amplifier.

Notes: The following troubles will occur if a low load impedance is connected to the terminal.

Resistance ..... Output voltage is lowered. Low frequency characteristics deteriorate.

Capacitance ..... As load capacitance increases, high frequency characteristics deteriorate.

Range setting (dB)	−60	−50	−40	−30	−20	−10	0	10	20	30	40	50
Degree of 185A amplification (dB)	60	50	30	30	20	10	0	−10	−20	−30	−40	−50
Degree of 185B amplification (dB)	56	46	36	26	16	6	−4	−14	−24	−34	−44	−54

Table 4

7-6 Measurement of alternating current

When AC voltage is V, alternating current is I and resistance is R, there is a relationship as follows:

$$I = V/R$$

Current can be determined out by measuring the voltages at both ends of the resistance based on the above relationship.

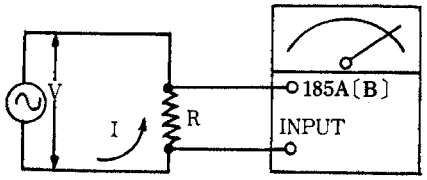


Fig. 9

Note: The "INPUT" terminal of this instrument is grounded at one end.

8. Functional description

LMV-185A and LMV-185B are similar as far as functions are concerned. They consist of a 60 dB attenuator, input protective circuit, impedance conversion circuit, 10 dB step attenuator, meter pre-amplifier, meter amplifier, meter circuit, monitor amplifier and regurated power circuit.

1. 60dB attenuator

   Controls input voltage so that the impedance conversion circuit will work normally. The attenuation is 0 dB in the 1 mV – 300 mV [1.5mV – 500 mV] range, and 60 dB in higher rangers.

2. Input protective circuit

   The input protective circuit consists of Q101, Q102, Q105 and Q106 and protects FET Q107 and Q103 from excessively large input voltages.

3. Impedance conversion circuit +10 dB amplifier

   This circuit consists of Q103, Q107 (FET), Q104 and Q108, and converts high input impedance into low impedance, and has +10 dB gain.

4. 10 dB step attenuator

   In conjunction with the 60 dB attenuator, it selects proper values to be measured.

5. Meter pre-amplifier

   It consists of Q201, Q203, Q208 and Q210, and amplifies small signals into large signals.

6. Meter amplifier and meter circuit

   It consists of Q205, Q206, Q207, Q212, Q213, Q214, D202, D203, D205, D206 and meter.

   The rectifier circuits of D202, D203, D205 and D206 and the meter are in the feedback circuit of the amplifier, thus the indications of the meter are in proportion to the input voltage.

7. Monitor amplifier

   1 Vrms output is obtained at the "OUTPUT" terminal when the meter indicates full scale after a signal is taken out of a part of the meter preamplifier and amplified.

8. Regurated power circuit

This circuit consists of D207, D208, D209, D210, D211, D212, D213 and D214 rectifier circuits and IC201 and IC202 stabilization circuits. It supplies + 18V stabilized voltage to the impedance conversion circuit, meter pre-amplifier, meter amplifier and monitor amplifier.

9. Maintenance

9-1 Changing fuses

A fuse can be removed by turning the fuse holder on the rear side in the direction of the arrow. Use 0.1A fuses. After fuses are changed, be sure to investigate the cause. Take appropriate steps before power is turned back on.

9.2 How to remove the cover

Remove the cover as shown below.

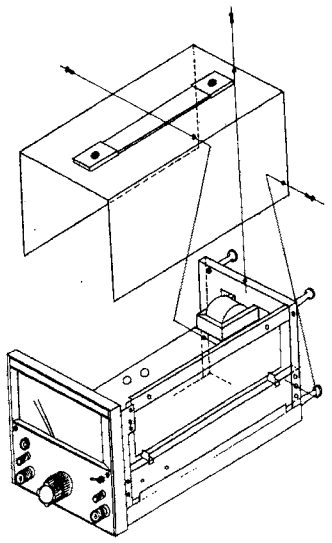


Fig. 10

9.3 Changing the voltage to the correct power source voltage

The power transformer is on the rear side when the case is opened. The terminals numbered 1, 2, 3* and 1, 2, 3* are primary ones. When changing the voltage of the applied power source, change wiring as shown in Figure 11.

*1, 2, 3 for each primary winding; there are two primary windings.

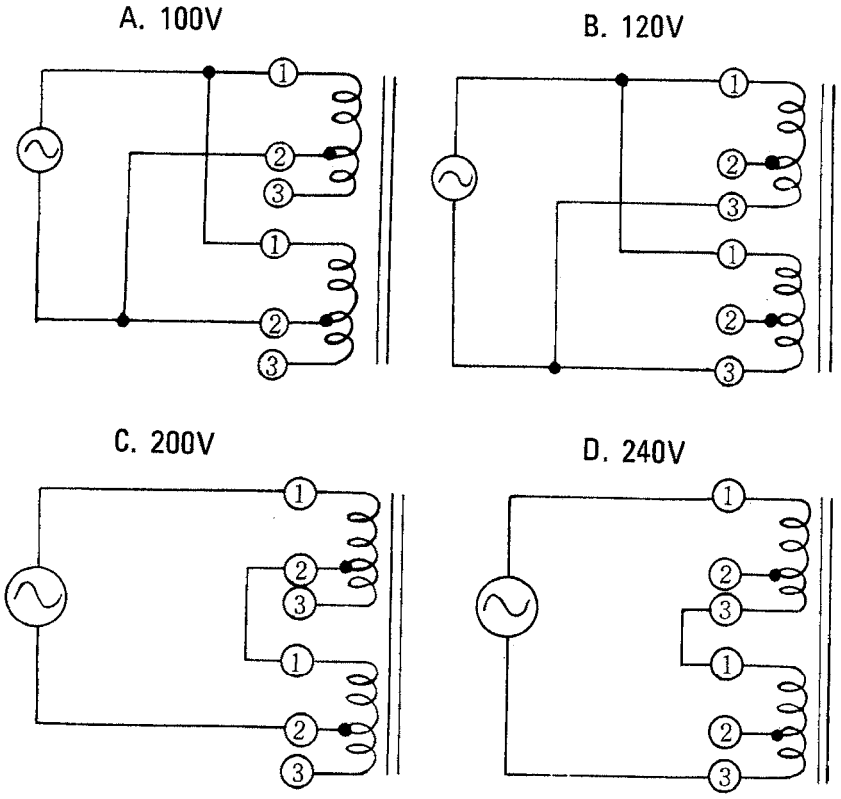
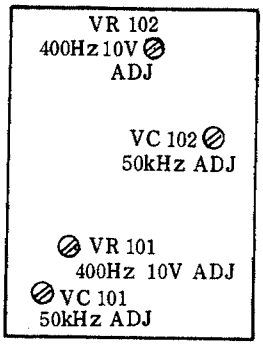


Fig. 11

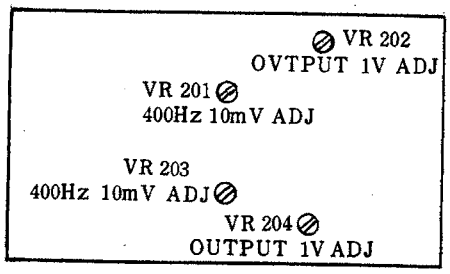
9.4 Adjustment and correction

If specifications are not met after repairs are made, make adjustments or corrections as follows:



When viewed from above the shielding plate

Fig. 12(a)



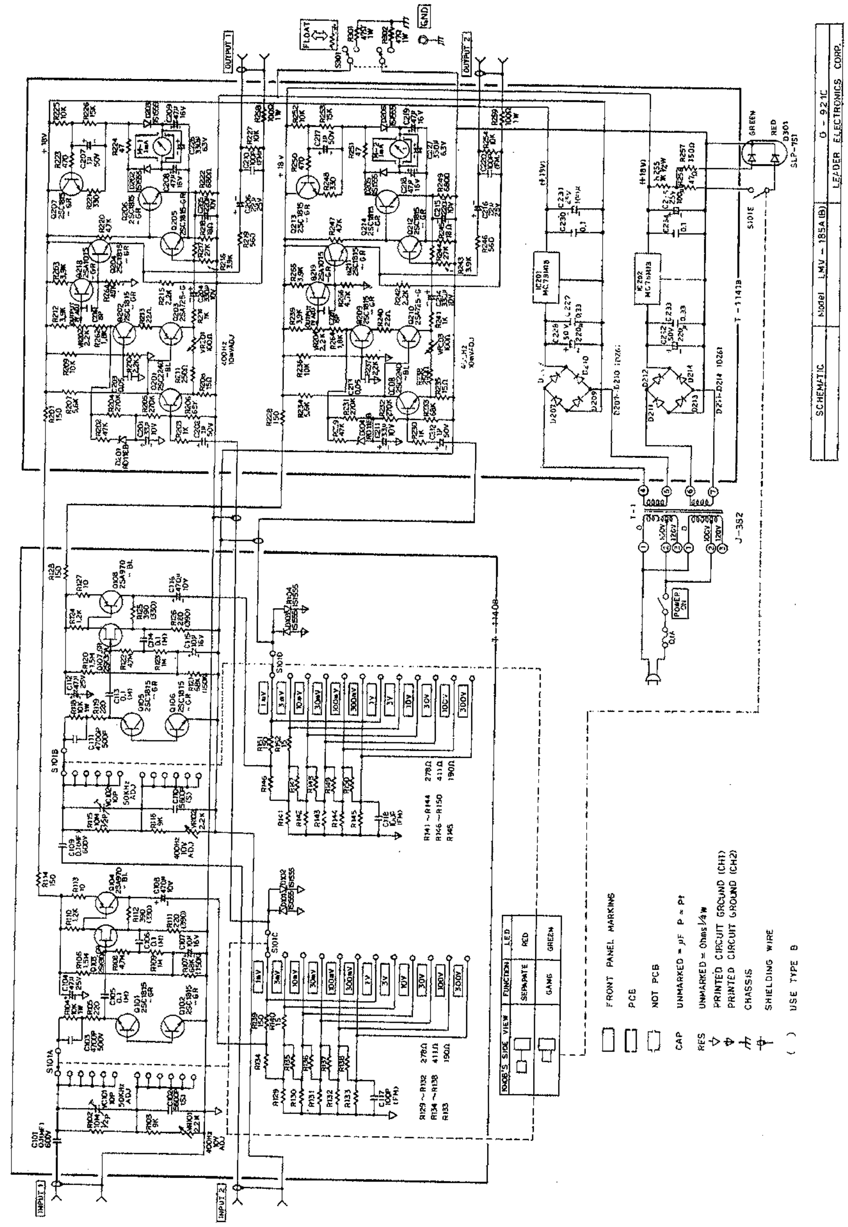
When viewed from the right side

FIg. 12(b)

1. Procedure of correcting indicated values
   1) Connect a voltmeter calibrator to the INPUT.
   2) Set the voltmeter range at 10mV.
   3) Set the output voltage of the calibrator to 10mV, and adjust VR201, VR203 (10mV 400 Hz ADJ) of Figure 12(b) to full scale.
   4) Next, set the voltmeter range at 10 V.
   5) Set the output voltage of the calibrator to 10V, and adjust VR 101 and VR 102 (10V 400Hz ADJ) shown in Fig. 12(a) to full scale.
   6) Next, set the voltmeter range at 1V.
   7) Change the signal source from the calibrator to an oscillator of good frequency characteristics. Set the frequency of the oscillator to 500Hz, and set the output voltage so that the instructed value is 1V full scale.
   8) Next, switch the signal frequency from 500Hz to 50kHz, and adjust VC 101 and VC 102 (1V 50kHz ADJ) shown in Fig. 12(a) in such a way that the frequency characteristics will become flat. If this adjustment is not performed exactly, conduct calibration from the beginning again.
2. Adjustment of output voltage terminals

   After the above adjustment is finished, set the voltmeter range at 1V. next, apply a 1kHz signals to attain full scale, and adjust VR202, VR204 (OUT 1V ADJ) of FIgure 12(b) so that the output terminal voltage is 1Vrms.

Note: In the case of the 185B, adjust each set voltage by a multiplier of 1.5. For instance, 10mV should be changed to 15mV.


SCHEMATIC
Model LMV-185A(B)
LEADER ELECTRONICS CORP.
O-921C
FRONT PANEL MARKING
PCB
NOT PCB
CAP UNMARKED = μF P = Pf
RES UNMARKED = Ohms 1/4W
PRINTED CIRCUIT GROUND (CH1)
PRINTED CIRCUIT GROUND (CH2)
CHASSIS
SHIELDING WIRE
( ) USE TYPE B