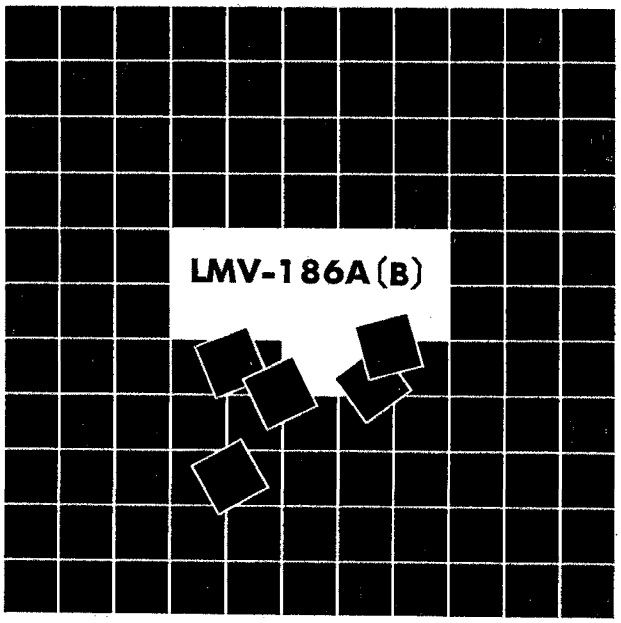
LEADER

2 CHANNEL
AC MILLIVOLTMETER

INSTRUCTION MANUAL



LEADER ELECTRONICS CORP.

CONTENTS

Note: This instruction manual applies to both 186A and 186B and the information in brackets [ ] refers to the 186B.

SECTION 1. GENERAL DESCRIPTION

1.1 Uses

LMV-186A[B]consists of two high sensitivity voltmeters housed in one cabinet. A single meter with two independent pointer movements is used in the measurements.

Voltages can be measured at the same time at two different points in the test circuit or for two separated loads. Switching is provided for measurement or comparison where voltages are within 10dB, such as in stereo circuits.

Identical voltage ranging and amplifiers systems are used in each channel which operate without crosstalk. Decibel scales are provided over the full voltage range, at 0dB = 1 Vrms and 0.775Vrms, which are useful in data plotting and comparison of levels.

The meter scale calibration is in terms of the effective value of a sine wave.

Both voltmeters may also be used as a high gain AC amplifier.

1.2 Specifications

Voltmeter

Measuring voltage range	100μV to 300V [150μV to 500V]
Measuring range	Voltage 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 to 500kHz ± 10% 10Hz to 200kHz ± 5% 20Hz to 100kHz ± 3% (1 kHz ref.)
Input resistance	10 MΩ
Input capacitance	45 pF or less (1mV to 300mV [1.5mV to 500mV]) 25 pF or less (1V to 300V [1.5V to 500V])
Maximum input voltage	AC peak + DC = 600V
Noise	Within 2% of full scale by shorting input
Amplifier	
Output voltage	1V, into open circuit when 1.0V [5.0V] is indicated at full scale of each range
Freqeuncy characteristics	10Hz to 200kHz−3dB (1kHz ref.)
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	100V ±10% 50/60 Hz (can be changed to 120V, 220V, 240V by VOLTAGE SELECT plug.)

		5 VA
Size and weight	. . . . .	150(W) X 200(H) X 250(D)mm, 3.5 kg (exclusive of knobs, rubber feet and handle)
Accessories.	Connection cord (pair-plug to clip cable)	2
	Spare fuse	1
	INSTRUCTION MANUAL	1

1.3 Block Diagram

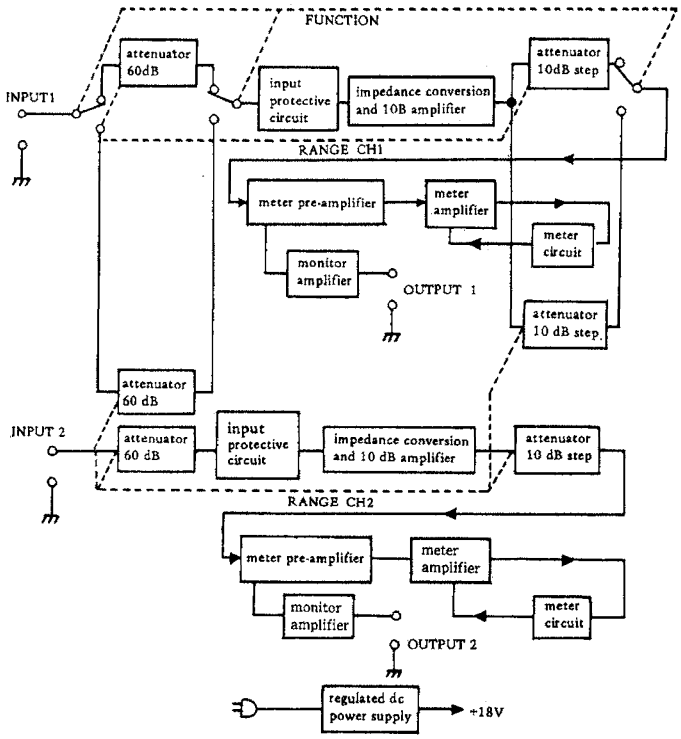
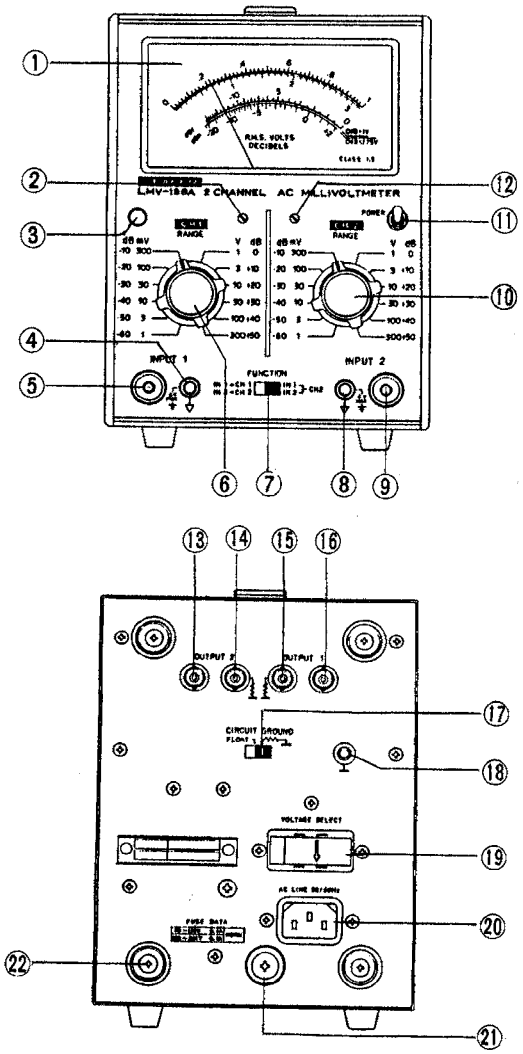


Fig. 1

1.4 Panel Controls

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



① METER: With two independent pointer movements, black for INPUT 1 and red for INPUT 2. Scale calibration at 0-1Vrms [0-5Vrms] and 0-3Vrms [0-1.5Vrms], referred to the average value of a sine wave, and two decibel scales for 0dB = 1V and 0.775V respectively.

②⑫ Mechanical zero adjustment screw

Turn POWER Switch ⑪ 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.

④⑧ "INPUT"

These are the ground terminals for voltage measurement. When the CIRCUIT GROUND switch ⑰ on the rear panel is set to ⏚, the ground terminal of each channel is connected to the frame through a 47Ω resistor as shown in Fig. 2. When the switch is set to FLOAT, the ground terminal of each channel is completely floating as shown in Fig. 3.

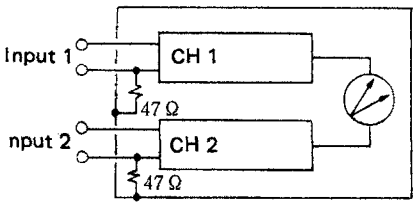


Fig. 2

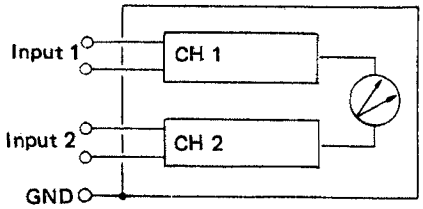


Fig. 3

⑤⑨ "INPUT"

This is the terminal for applying voltage to be measured. 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.

⑥ RANGE CH 1 switch: With 12 positions for selecting the full scale range of INPUT 1.

⑦ FUNCTION switch:

a. IN1-CH1 / IN2-CH2 (left) For separate voltage measurements of INPUT 1 and INPUT 2 with RANGE CH1 and RANGE CH2 switches.

b. IN1, IN2 ┐├ CH2 (right) RANGE CH2 switch is used in common for INPUT 1 and INPUT 2 for measurements in the same voltage range.

⑩ RANGE CH 2 switch: with 12 positions for selecting the full scale range under following conditions –

a. For INPUT 2 at FUNCTION switch setting IN1-CH1 / IN2-CH2

b. For INPUT 1 and INPUT 2 in common at FUNCTION switch setting IN1, IN2 ┐├ CH2.

⑪ PWR switch: For turning on the AC power.

⑬⑯ "OUTPUT" (Red Terminal)

This is the output terminal when the instrument is used as an amplifier. When the meter indicates full scale at each position of the range switches ⑥ and ⑩ , 1 Vrms can be obtained. Output to "INPUT 1" is "OUTPUT 1", and output to INPUT 2" is "OUTPUT 2."

⑭⑮ "OUTPUT" (Black Terminal)

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

⑰ 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. 2. When the switch is set to FLOAT, the ground terminal of each channel is floating as shown in Fig. 3.

⑱ GND (metal) terminal

This is permanently connected to the frame.

When the CIRCUIT GROUND switch ⑰ is set to FLOAT, this terminal is used to connect the equipment frame with the frame ground of the device to be measured.

⑲ "VOLTAGE SELECT" (Voltages Selector)

100V, 117V, 220V or 240V is available.

⑳ "AC LINE 50/60Hz"

Connect the attached power cord to supply the rated line voltage.

㉑ Fuse

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

㉒ Cord winder

Provides convinient power cord storage.

SECTION 2 OPERATION

2.1 Preliminary Notes on Operation

A. 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 components may be damaged or destroyed.

B. When the input cables are used, the capacitance, approximately 50pF, will be in shunt across the test circuit. This must be taken into account, especially at high frequencies. Use of short separated leads may be necessary to reduce the shunt capacitance.

When measurements of low voltages in high impedance circuits, noise may be picked up and error will be introduced. If shielded cables are used, keep the length as short as possible.

C. The AC line voltage should be kept within ±10% of the rated value for stability and long trouble free operation.

D. During the standby condition when the AC power has been turned on but the instrument is not in use, always set the range switches at a high range. This will prevent noise pickup and also will protect the meter movements.

E. The voltage and dB indications are referred to the average value of a sine wave. Any departure from the sine wave will result in error, the amount depending on the harmonic content in the input waveform.

2.2 Preparation

1. Before turning on the AC power, check the mechanical zero of the two meter pointers.

If it is off 0, set it to 0 by adjusting the zero adjustment screw.

2. Control settings:

   AC switch at off.

   RANGE switches, CH1 and CH2, at highest range.

   FUNCTION switch at IN1-CH1 / IN2-CH2 (left side).

3. Connections:

   AC plug to AC mains.

   Cable plugs to INPUT 1 and INPUT 2.

   Cable clips to the test circuits.

4. 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.

   After about ten seconds, the voltmeter is ready for use.

5. **Select a proper setting of the CIRCUIT GROUND switch ⑰ on the rear panel. When it is set to -⏚, the input ground terminal is connected to the frame through a 47Ω resistor; when it is set to FLOAT, the input terminal is floating from the frame.**

   For the detailed method of measurement, refer Section 2.9.

2.3 Voltage Measurements

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－186A

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
300 mV	0－3	100	10 mV
100 mV	0－1	100	2 mV
30 mV	0－3	10	1 mV
10 mV	0－1	10	0.2 mV
3 mV	0－3	1	0.1 mV
1 mV	0－1	1	0.02 mV

Table 1

LMV－186B

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

2.4 Inputs at Different Voltage Levels

1. Set the FUNCTION switch at $\frac{\text{IN1-CH1}}{\text{IN2-CH2}}$ (left side).
2. Set the two RANGE switches as required.

   The voltages are the scale readings multiplied by the proper multiplier, see Sect. 2.3.

2.5 Inputs in the Same Voltage Range

When measuring or comparing voltages, such as in stereo circuits, at identical settings of RANGE CH1 and RANGE CH2 switches —

1. Set the FUNCTION switch at $\left.\begin{matrix}\text{IN1}\\ \text{IN2}\end{matrix}\right\}$ CH2 (right side).
2. Use the RANGE CH2 switch for the voltage measurement. This switch will now be common and control the same voltage ranges of both inputs. (The RANGE CH1 switch is not used.)

   The black and red pointers respectively indicate the voltages of INPUT 1 and INPUT 2.

2.6 One-channel Operation

The instrument can be used for voltage measurement of one input an in the conventional voltmeter. This is done by setting the FUNCTION switch at $\frac{\text{IN1-CH1}}{\text{IN2-CH2}}$ (left side).

In this instance, the RANGE switch of the channel not in use is set at the highest range.

2.7 Level Measurement in dB (decibels)

1. Voltage levels in dB for INPUT 1 and INPUT 2 are determined in the same manner at both settings of the FUNCTION switch as described for voltage measurements.
2. The two scales below the voltage scales on the dial are used. These are calibrated for 0dB = 1V rms and 0dB = 0.775Vrms.

   The actual level is the algebraic sum of the switch marking and the meter reading.

Examples:

a. Switch setting +20dB
Meter reading − 4dB
Level +20 + (-4) = 16dB.

b. Switch setting − 30dB
Meter reading − 1dB
Level − 30 + (−1) = −31dB.

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

RANGE SETTING	LMV—186A		LMV—186B	
	dBm	dBV	dBm	dBV
+50	+30:to+52	+30:to+50	+30:to+56	+30:to+54
+40	+20:to+42	+20:to+40	+20:to+46	+20:to+44
+30	+10:to+32	+10:to+30	+10:to+36	+10:to+34
+20	0:to+22	0:to+20	0:to+26	0:to+24
+10	−10:to+12	−10:to+10	−10:to+16	−10:to+14
0	−20:to+ 2	−20:to+ 0	−20:to+ 6	−20:to+ 4
−10	−30:to− 8	−30:to−10	−30:to− 4	−30:to− 6
−20	−40:to−18	−40:to−20	−40:to−14	−40:to−16
−30	−50:to−28	−50:to−30	−50:to−24	−50:to−26
−40	−60:to−38	−60:to−40	−60:to−34	−60:to−36
−50	−70:to−48	−70:to−50	−70:to−44	−70:to−46
−60	−80:to−58	−80:to−60	−80:to−54	−80:to−56

Table 3

2.8 Amplifier Output

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-amplifer.

Range setting (dB)	−60	−50	−40	−30	−20	−10	0	10	20	30	40	50
Degree of 186A amplification (dB)	60	50	30	30	20	10	0	−10	−20	−30	−40	−50
Degree of 186B amplification (dB)	56	46	36	26	16	6	−4	−14	−24	−34	−44	−54

2.9 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 of a 2-channel millivoltmeter 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.

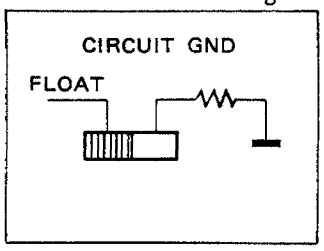
A switch is provided on the rear panel of the instrument, and two floating conditions are switchable as shown in Figure 4.

When Switched to ⏚ :

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

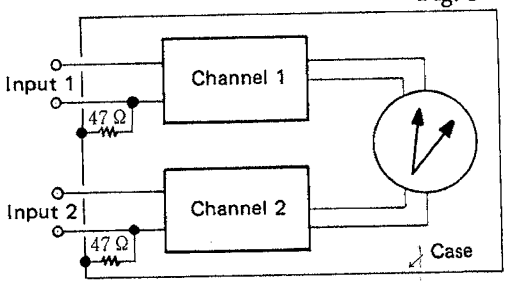
When making measurements, care must be taken not to apply voltages over 7Vrms between the ground terminal and the case ground by making wrong connections with opposite polarity.

Fig. 4



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 is 4Ω and the output is over 11W.

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 ham etc.

Fig. 6

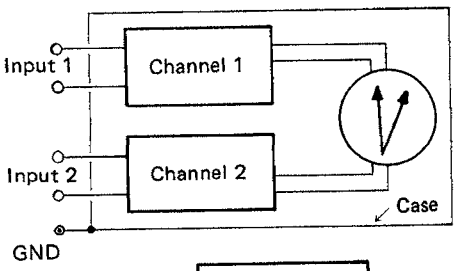
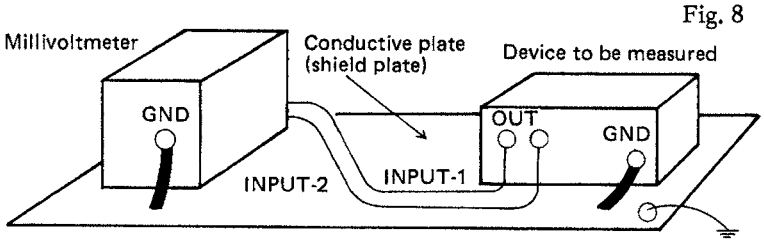


Fig. 7

Ensuring Stable Measurements:

Special care is necessary to eliminate unfavorable effects of external noises such as ham 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



SECTION 3 CIRCUIT DESCRIPTION

LMV-186A and LMV-186B 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. 60 dB attenuator

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

2. Input protective circuit

   The input protective circuit consists of Q101, Q102, Q201, and Q202, and protects FET Q103 and Q203 from excessively large input voltages.

3. Impedance conversion circuit +10 dB amplifier

   This circuit consists of Q103, Q203 (FET), Q104 and Q204, 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 Q105, Q106, Q205 and Q206, and amplifies small signals into large signals.

6. Meter amplifier and meter circuit

   It consists of Q109, Q110, Q111, Q209, Q210, Q211, D104, D105, D204, D205 and meter.

   The rectifier circuits of D104, D105, D204 and D205 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 D106, D107, D108 and D109 rectifier circuits and D110, Q112 and Q113 stabilization circuits. With D110 Zener diode as the reference voltage, it supplies +18V stabilized voltage to the impedance conversion circuit, meter pre-amplifier, meter amplifier and monitor amplifier.

SECTION 4 MAINTENANCE

4-1 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 fuse. After fuse is changed, be sure to investigate the cause. Take appropriate steps before power is turned back on.

4.2 How to remove the cover

Remove the cover as shown below.

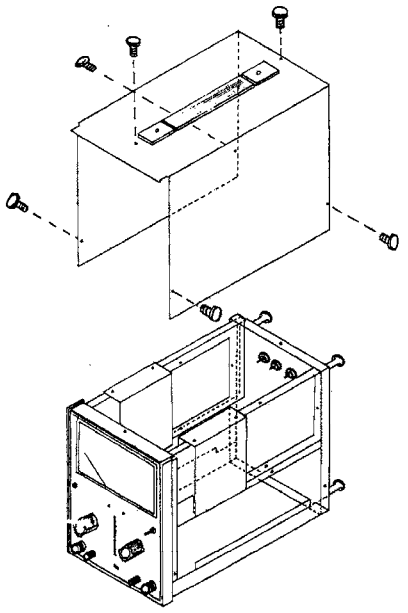


Fig. 9

4.3 Adjustment and correction

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

1. Adjustment of stabilization power

Connect a DC voltmeter to the +18V line of the printed circuit, and adjust VR105, VR204(Vcc18V ADJ) of **Figure 10** to get +18V.

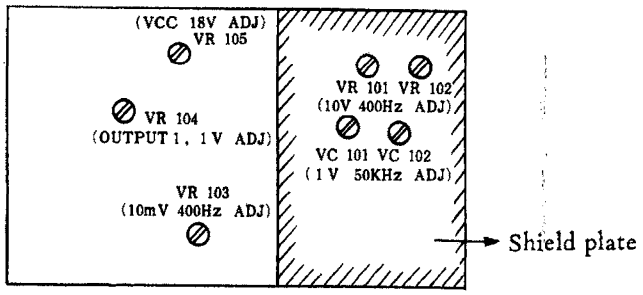


Fig. 10 (a) when viewed from the side panel of INPUT 1

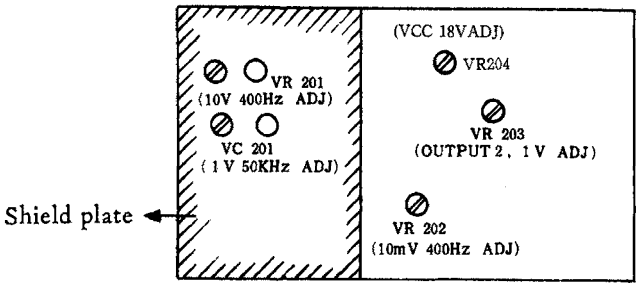


Fig. 10 (b) When viewed from the side panel of INPUT 2

2. Procedure for 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 VR103, VR202 (10mV 400 Hz ADJ) of **Figure 10** to full scale.

4) Next, set the voltmeter range at 10 V.

5) Set the output voltage of the calibrator to 10V, turn the "FUNCTION" switch to $\begin{matrix}\text{IN1-CH1}\\ \text{IN2-CH2}\end{matrix}$ position, and adjust VR101 and VR201 (10V 400Hz ADJ) to full scale.
Next, turn the switch to $\left.\begin{matrix}\text{CH1}\\ \text{CH2}\end{matrix}\right\}$ CH2 position and adjust VR102 in the same way.

6) Next, set the voltmeter range at 1V.

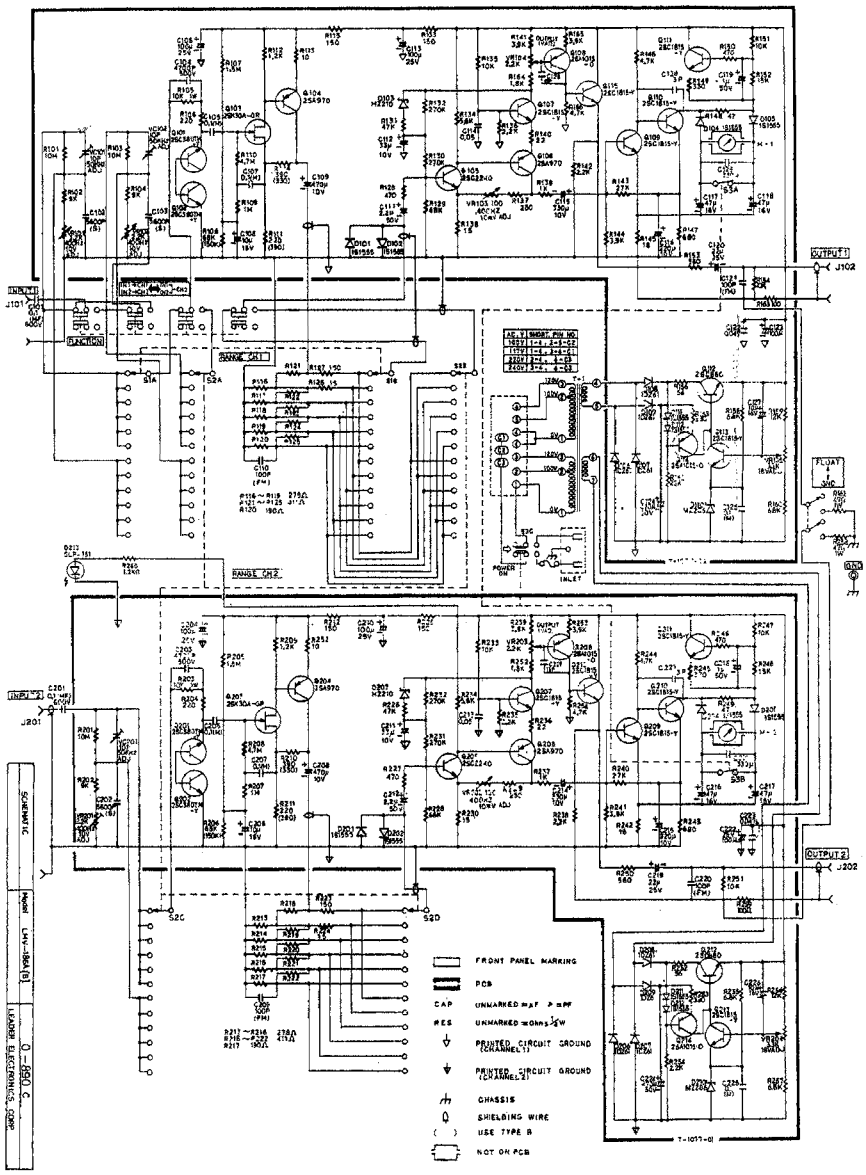
7) Change the signal source from the calibrator to an oscillator of good frequency characteristics. Set the frequency of the oscillator to 500Hz, and set the output voltage so that the instructed value is 1V full scale.

8) Next, turn the "FUNCTION" switch to $\begin{matrix}\text{IN1-CH1}\\ \text{IN2-CH2}\end{matrix}$ position, change the signal frequency from 500Hz to 50kHz, and adjust VC101 (1V 50kHz ADJ) shown in **Fig. 10** so that the frequency characteristic becomes flat. Turn the switch to $\left.\begin{matrix}\text{IN1}\\ \text{IN2}\end{matrix}\right\}$ CH position and adjust VC102. Adjust VC201 on the INPUT 2 side in the same way. If this adjustment is not correct, repeat the correction procedure from the beginning.

3. 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 VR104, VR203 (OUT 1V ADJ) of **Figure 10** so that the output terminal voltage is 1Vrms.

Note: In the case of the 186B, adjust each set voltage by a multiplier of 1.5. For instance, 10mV should be changed to 15mV.


INPUT 1
J101
FUNCTION
RANGE CH1
OUTPUT 1
J102
FLOAT
INPUT 2
J201
RANGE CH2
OUTPUT 2
J202
FRONT PANEL MARKING
PCB
CAP UNMARKED =μF P =PF
RES UNMARKED =ohms 1/2W
PRINTED CIRCUIT GROUND (CHANNEL 1)
PRINTED CIRCUIT GROUND (CHANNEL 2)
CHASSIS
SHIELDING WIRE
USE TYPE B
NOT ON PCB
SCHEMATIC
POWER
LEADER ELECTRONICS CORP.
0 — 660 C