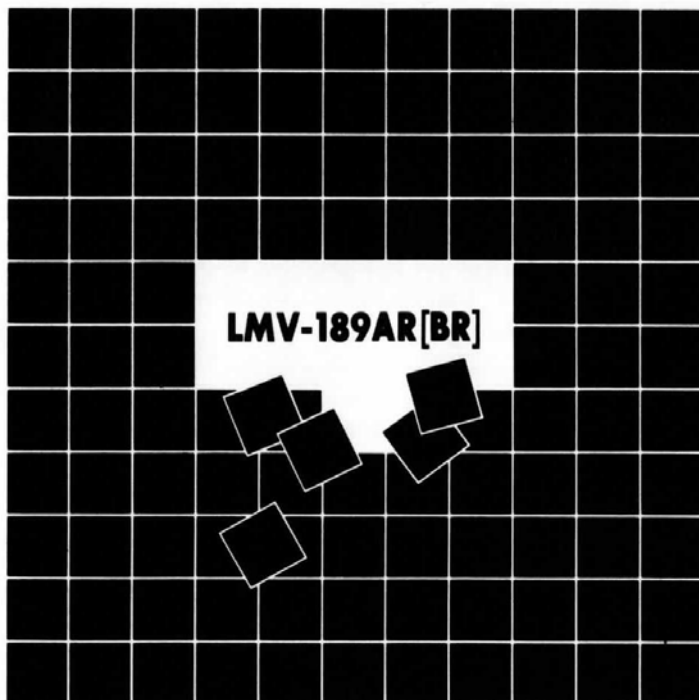


# LEADER

## 2 CHANNEL AC MILLIVOLTMETER

INSTRUCTION MANUAL



LEADER ELECTRONICS CORP.

## FOR SAFETY'S SAKE

Thank you for purchasing our product.

Please observe the following safety precautions when operating this instrument.

### WARNING


- Do not remove any cases or covers.  
The high-voltage section inside this instrument can cause electrical shock.
- Do not operate this instrument and connected units in a volatile or flammable atmosphere.  
An explosive can result.
- Do not insert metal objects (e.g., wire, pin) into the vents.  
Otherwise, you may damage the instrument or suffer electrical shock.
- Connect this instrument to the rated power line voltage.  
Excessive voltage can cause fire.
- Do not touch the high-voltage section with hand directly when measuring it.  
You may suffer electrical shock.
- Do not connect this instrument to equipment whose chassis has electrical potential to ground (i.e., transformerless equipment).  
Otherwise, you may damage the instrument or suffer electrical shock.


### CAUTION

- Use only the fuse of correct type and rating for replacement.  
Before replacing the fuse, be sure to turn the power switch off and disconnect the power cord from the mains.

Cautions on operation appear in the instruction manual. Read the manual carefully to ensure correct operation.

### Explanation of the Terms

 **WARNING** ... The **WARNING** calls attention to abnormal conditions or dangerous practices that could result in personal injury or death.

 **CAUTION** ... The **CAUTION** calls attention to abnormal conditions or dangerous practices that could result in damage to the instrument or other property.

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Note: This instruction manual applies to both LMV-189AR and LMV-189BR, and the information in brackets [ ] refers to the LMV-189BR.

## 1. INTRODUCTION

LMV-189AR [BR] is 2 channel remote controllable AC millivolt-meter with  $30\ \mu\text{V}$  to  $100\text{V}$  [ $50\ \mu\text{V}$  to  $150\text{V}$ ] sensitivity, 5Hz to 1MHz bandwidth and average responding RMS indication meter.

This unit has high sensitivity, high accuracy and good linearity on entire scale.

Each channel has independent circuit and meter has two pointers to read 2 values at one scale. Also, it can be used as high gain broad band amplifier with output terminal.

## 2. FEATURES

- Remote control function is built-in. Range can be changed at hand by optional remote controller.
- To avoid interference, ground circuit is floating from chassis.
- It can be measured microvolt signal with  $300\ \mu\text{V}$  [ $500\ \mu\text{V}$ ] full scale sensitivity.
- $\pm 2\%$  accuracy.
- Broad band as 5Hz to 1MHz ( $\pm 10\%$ )
- Easy to compare two signal levels by 2 pointers on one scale.
- Range switch is constructed for both individual and ganged uses.
- High accuracy, high reliability and high stability with newly designed circuit.
- Two dB scales ( $0\text{dBV} = 1\text{V}$ ,  $0\ \text{dBm} = 0.775\text{V}$ ) are provided beside voltage scale.
- Output level is calibrated at  $1\ \text{V}_{\text{rms}}$  to use it as waveform monitor and high gain pre-amplifier.

### 3. SPECIFICATIONS

■ Voltmeter	
Measurement voltage range:	30 $\mu$ V to 100V [50 $\mu$ V to 150V]
Measurement ranges:	Voltage measurement (12 ranges) 0.3, 1, 3, 10, 30, 100mV 0.3, 1, 3, 10, 30, 100V { 0.5, 1.5, 5, 15, 50, 150mV } { 0.5, 1.5, 5, 15, 50, 150V }
	Decibel measurement (12 ranges) -70, -60, -50, -40, -30, -20, -10, 0, +10, +20, +30, +40 dB (0dBV = 1V, 0dBm = 0.775V)
Measurement accuracy:	Within $\pm 2\%$ of full scale (at 1 kHz or 400Hz)
Frequency response:	5Hz to 1MHz $\pm 10\%$ 10Hz to 500kHz $\pm 5\%$ 20Hz to 100kHz $\pm 2\%$ (1kHz reference)
Input resistance:	10 M $\Omega$
Input capacitance:	Less than 50 pF (0.3mV to 100mV ranges [0.5mV to 150mV ranges]) Less than 30 pF (0.3V to 100V [0.5V to 150V ranges])
Max. input voltage:	0.3mV [0.5mV] to 100mV [150mV] range :AC peak + DC = 60V 0.3V [0.5V] to 100V [150V] range :AC peak + DC = 600V
Input ground terminal:	Selectable between floating and ground connection via a resistor by the switch on the rear panel.

Noise: Within 3% of full scale by shorting input.

Remote control voltage: C MOS level (5V positive logic)

■ Amplifier

Output voltage: 1 Vrms into open circuit  
when 1.0V [5.0V] is indicated  
at full scale of each range

Frequency response: 10Hz to 300kHz-3 dB (1kHz ref.)

Output impedance:  $600\Omega \pm 20\%$

Distortion factor: Less than 1% at full scale (1kHz)  
(without 300  $\mu$ V [500  $\mu$ V] range)

■ Environmental Conditions

Operating Temperature: 0~40°C

Operating Humidity: 30~85%RH(without condensation)

Operating Environment: Indoor use

Operating Altitude: up to 2,000m

Overvoltage Category: II

Pollution degree: 2

Power requirements: AC100,120, 200, 240V $\pm$ 10%(250V max.),  
50/60 Hz (12W max)

Size and weight: 150(W)  $\times$  175(H)  $\times$  250(D)mm  
(excluding knobs, rubber legs and handle), approx. 2.7 kg

Accessories: BNC terminal adapters(LC-1585) . . 2  
BNC-clip cable (3C-2V,75 $\Omega$ ,1m) . . 2  
Fuse . . . . . 1  
Instruction manual . . . . . 1

#### 4. BLOCK DIAGRAM

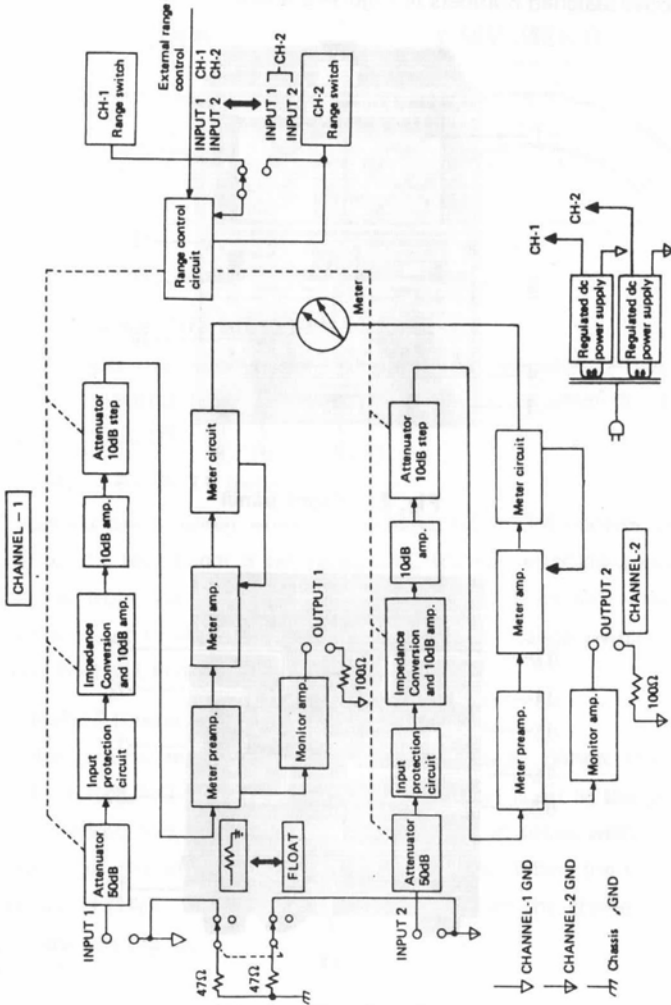


Fig. 1 Block diagram

## 5. PANEL DESCRIPTION

The front and rear panel functions are described in reference to their respective assigned numbers in Figures 2 and 3.

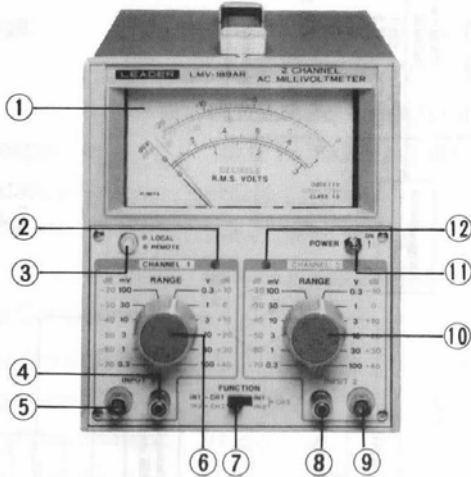


Fig. 2 Front panel

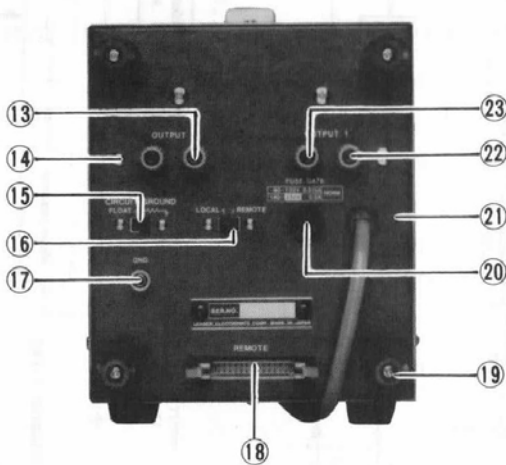


Fig. 3 Rear panel

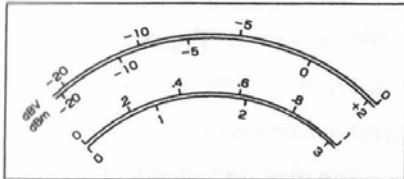


## Front Panel

### ① Meter:

Has the voltage and dB scales.

#### LMV-189A R



#### LMV-189B R

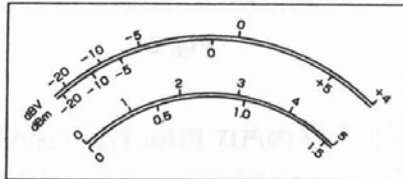


Fig. 4

### ② ⑫ Mechanical zero adjustment screw:

Is to adjust the zero position of the meter indicator. Adjust the screw, if necessary, by a minus type screw driver when the power switch ⑪ is off.

### ③ LOCAL – REMOTE indication lamp:

Is turned on in green when the LOCAL-REMOTE control switch ⑮ on the rear panel is set to LOCAL (range switching operation by the front panel control) and is turned on in red when the switch is set to REMOTE (external control of range switching by the LPC-1801 Program Controller).

### ④ ⑧ INPUT (metal terminal):

Is the ground terminal of the applied voltage. When the CIRCUIT GROUND switch ⑮ on the rear panel is set to the ground side marked  $\sim$ , the terminal is connected in series with a 47- $\Omega$  resistor to the unit frame as shown in Fig. 5. When the switch is set to FLOAT, the terminal is floating from the frame ground as shown in Fig. 6.

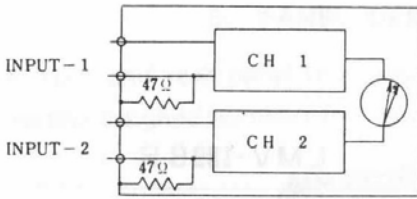


Fig. 5

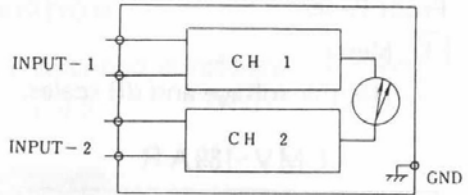


Fig. 6

⑤ ⑨ INPUT (BNC type connector):

Is the input connector to apply measurement voltage. By using an attachment terminal adapter, the connector can be used to connect a banana tip plug.

⑥ ⑩ RANGE switch:

Is used for selecting full scale value. At each stop position, the voltage values of the full scale are indicated in black, and the absolute levels of 0 dB calibration are shown in dB.

⑦ FUNCTION switch:

For selecting the meter function.

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.

⑪ POWER switch:

Is used to turn on and off the power.

## Rear Panel

### ⑬⑳ OUTPUT (gray terminal):

Is the ground terminal for the output terminal ⑭ or ㉒. It is connected in series with a 100-Ω resistor to the input ground terminal in floating position.


### ⑭㉒ OUTPUT (red terminal)

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 ⑩, 1 V<sub>rms</sub> of voltage can be obtained. Output to "INPUT 1" is "OUTPUT 1", and output to "INPUT 2" is "OUTPUT 2."

"1" calibration in the case of 189AR

"5" calibration in the case of 189BR

### ⑮ CIRCUIT GROUND switch:

When set to , each ground terminal is connected in series with a 47-Ω resistor to the unit frame as shown in Fig. 5.

When set to FLOAT, each ground terminal is floating from the unit frame as shown in Fig. 6.

### ⑯ LOCAL – REMOTE switch

When set to LOCAL, range switching is controlled on the front panel. The LOCAL-REMOTE indication lamp ③ is lit in green. When set to REMOTE, remote control of range switching is available by using a remote control box such as a separately available LPC-1801 Program Controller.

The LOCAL-REMOTE indication lamp ③ is lit in red when the switch is set to REMOTE.

### ⑰ GND terminal (metal terminal):

Is connected to the frame of a device to be tested when the CIRCUIT GROUND switch ⑮ is set to FLOAT.

⑱ REMOTE input connector:

Is the remote control input connector for external range selection operation.

⑲ Cord winder legs

⑳ Fuse

㉑ Power cord

## 6. OPERATION

### 6.1 Notes on Operation

(1) Power voltage rating

The power voltage supplied to the LMV-189AR[BR] should be within  $\pm 10\%$  of the nominal voltage selected.

(2) Mechanical zero adjuster of indicator

When the meter pointer or pointers are off 0, while the power is turned off, adjust one or both of the mechanical zero adjustment screws using a minus types screw driver.

(3) Excess input voltage

The maximum allowable voltage of the LMV-189AR[BR] is AC peak + DC = 600 V. Therefore, do not apply a higher input voltage.

Application of an excess voltage may result in damages and burning of circuit components.

(4) Input waveform

The LMV-189AR[BR] indicates mean values of input signal waveforms and the scale is calibrated in the terms of effective value of sine wave. Therefore, when the input voltage waveform is distorted, the meter indication may be erroneous.

(5) Induction noise

When the measurement voltage level is very small or the measurement voltage source impedance is relatively high, indication error may be introduced by externally induced noise such as from a power transformer. In such cases, use a shield cable with BNC type connector instead of using a cable with banana tip plug or BNC connector terminal adapter which has unshielded portion of conductor.

(6) Caution under high field strength

A meter indication of the unit may be interfered by a high field strength. Please use the unit the place where the high field strength is not interfered.

## 6.2 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) Connect AC plug to AC mains.


- (3) Select LOCAL – REMOTE switch on the rear panel.

LOCAL — Range selecting with RANGE switch on the front panel.

REMOTE — Range selecting with remote control.

- (4) 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  $47\Omega$  to chassis.

- (5) RANGE switches, CH1 and CH2, at highest range.

- (6) Set the power switch at ON, whereupon the indication lamp will glow.

During the first five seconds or so, there will be a random swing of the pointers; this is normal.

- (7) After about ten seconds, the voltmeter is ready for use.

### 6.3 Measurement of AC Voltage

- (1) The meter will indicate presence of voltages when a connection is made to the "INPUT" connector and the voltage to be measured is applied.
- (2) If the reading is less than 30% of full scale, turn the "RANGE" switch counterclockwise, and reduce the voltage range gradually. Read the indicated value when the pointer is more than 30% of the full scale and less than full scale.
- (3) There are two maximum voltage calibrations, "1" and "3" ["1.5" and "5"], on the scale. Tables 1 and 2 show the positions of "RANGE" switch vs. the calibration of the voltages used.

LMV-189AR

Range	Scale	Multiplier	V per Div.
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

Table 1

## LMV-189BR

Range	Scale	Multiplier	V per Div.
150V	0 – 1.5	100	5V
50V	0 – 5	10	1V
15V	0 – 1.5	10	0.5V
5V	0 – 5	1	0.1V
1.5V	0 – 1.5	1	0.05V
0.5V	0 – 5	0.1	0.01V
150mV	0 – 1.5	100	5mV
50mV	0 – 5	10	1mV
15mV	0 – 1.5	10	0.5mV
5mV	0 – 5	1	0.1mV
1.5mV	0 – 1.5	1	0.05mV
0.5mV	0 – 5	0.1	0.01mV

Table 2

#### 6.4 Floating Function of Input Terminal

Each of the ground side input terminals is floating from the frame ground respectively.

On a 2 channel millivoltmeter, if the two ground side input terminals are common, a common path will be formed between two circuits to be tested through the common ground, thus extra current flows and erroneous indication appears on the meter. This trouble occurs not only in measurement of very small level of signals but also in voltage measurement of high current circuit such as of power amplifier loading test.

The floating function eliminates the above mentioned trouble.

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.

The CIRCUIT GROUND switch as shown in Fig. 7 is provided on the rear panel and two types of floating conditions are available by switching.

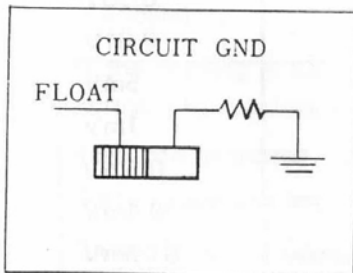


Fig. 7

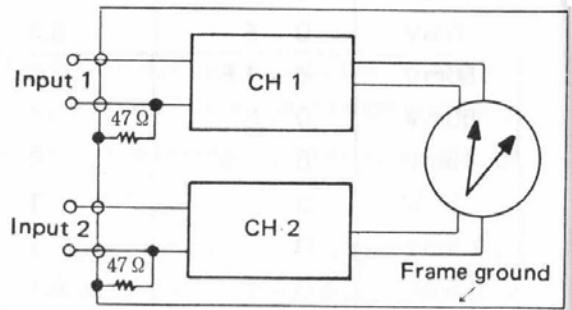


Fig. 8

When the switch is set to  $\text{---}\ \Omega\ \text{---}\ \text{---}$  :

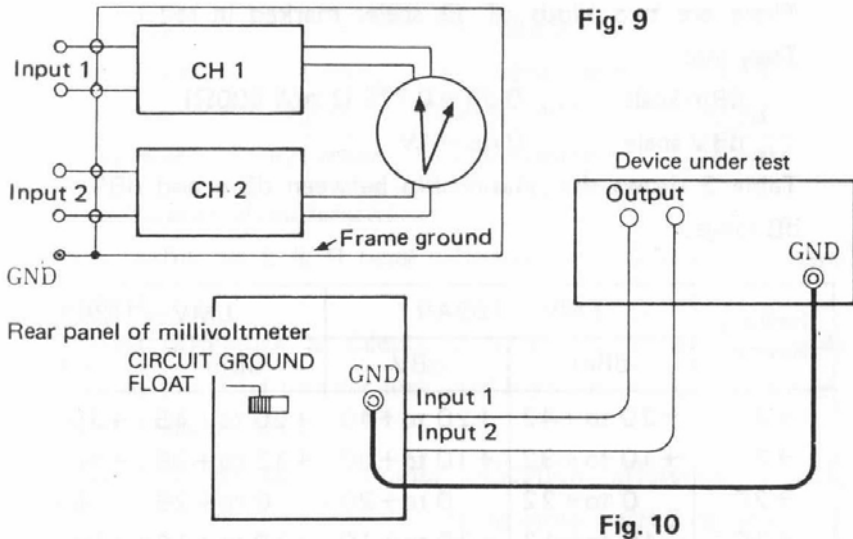
The ground terminal of each channel is connected to the frame ground through a  $47\text{-}\Omega$  resistor as shown in Fig. 8. Care must be taken not to apply a voltage of more than 7 Vrms between the ground terminal and frame ground by an accident of wrong connection of reverse polarity in measurement. Special attention should be paid on the polarity in power amplifier measurements where the load is  $8\ \Omega$  and the power is more than 6 W or the load is  $4\ \Omega$  and the power is more than 11 W.

When the switch is set to FLOAT:

The ground terminal of each channel is completely isolated from the frame ground as shown in Fig. 9. Therefore, connect the GND terminal on the rear panel and the frame of a device to be tested by a thick short (braided wires of about 30 cm) cable as shown in



Fig. 10. If this cable is not connected, erroneous indication may be caused by external noise, such as hum.



Stable measurement method:

Elimination of external noise such as hum is difficult, particularly in high sensitivity measurement. A recommended method to obtain accurate and stable measurement result is to place the millivoltmeter and a device under test on a metal plate and connect them as shown in Fig. 11.

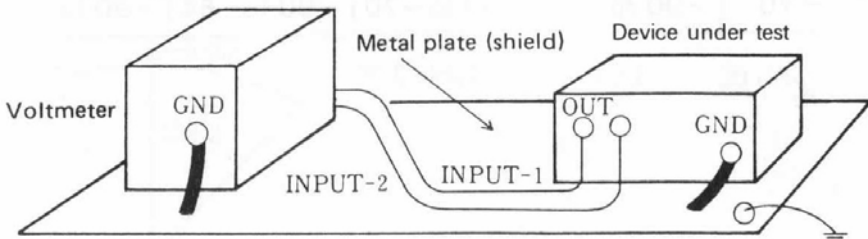


Fig. 11

## 6.5 How to use Decibel Range

### (1) Decibel measurement

There are two kinds of dB scales marked in red on the meter.

They are:

dBm scale . . . . 0 dB = 0.775 (1 mW 600Ω)

dBV scale . . . . 0 dB = 1V

Table 3 shows the relationship between dBm and dBV for each dB range.

Setting Range	LMV - 189AR		LMV - 189BR	
	dBm	dBV	dBm	dBV
+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
-70	-90 to -68	-90 to -70	-90 to -64	-90 to -66

Table 3

Decibel value reading is expressed in the sum of range dB value and indication value of the pointer.

Example 1:

Indication value	+ 1 dBm
Range value	<u>+20 dB</u>
Level reading	+21 dBm

Example 2:

Indication value	– 4 dBV
Range value	<u>–30 dB</u>
Level reading	–34 dBV

(2) Level difference measurement

This is useful for L & R level difference measurement of stereo amplifiers.

The level difference is calculated from the following formula:

(A) When the CH-1 pointer indicates a smaller value than that the CH-2 pointer does:

$$\text{Level difference} = | (\text{meter indication difference}) + (\text{CH 1 range value} - \text{CH 2 range value}) |$$

(B) When the CH 2 pointer indicates a smaller value than that the CH-1 pointer does:

$$\text{Level difference} = | (\text{meter indication difference}) + (\text{CH 2 range value} - \text{CH 1 range value}) |$$

Measurement example:

Apply the L-signal to CH 1 and the R-signal to CH 2.

Assume the meter indications and measurement ranges are as shown below.

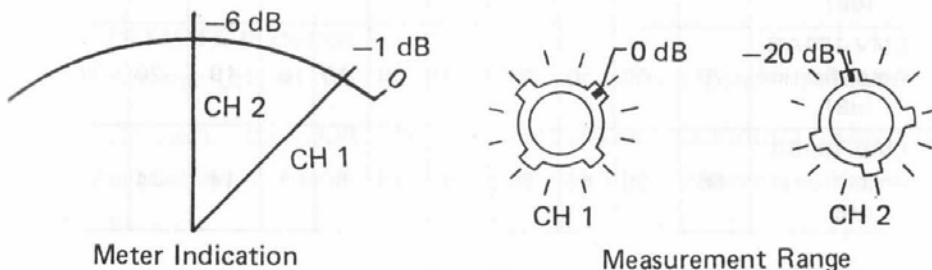


Fig. 12

	Meter Indication	Measurement Range
CH 1	-1 dB	0 dB
CH 2	-6 dB	-20 dB

Table 4

As the CH 2 pointer indication is smaller than that of CH 1, (meter indication difference) =  $(-1) - (-6) = 5$  dB.

And, the CH 2 range is 2 steps below of that of CH 1, thus referring to CH 2

(CH 2 range value - CH 1 range value) = +20 dB.

Accordingly,

Level difference =  $| (5) + (20) | = 25$  dB

### 6.6 Use of OUTPUT Terminal

The output signal calibrated to 1 V<sub>rms</sub> is available from the OUTPUT terminal when the meter pointer indicates full scale regardless the range switch setting.

The LMV-189AR[BR] can be used as a preamplifier or measurement signal waveform source for monitoring on an oscilloscope when connected with the latter.

The amplifications of the LMV-189AR[BR] when used as a preamplifier are as shown in Table 5.

Setting Range (dB)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40
LMV-189AR Amplification (dB)	70	60	50	40	30	20	10	0	-10	-20	-30	-40
LMV-189BR Amplification (dB)	66	56	46	36	26	16	6	-4	-14	-24	-34	-44

Table 5

Note: The load impedance connected to the OUTPUT terminal should be 10 kΩ or higher and 100 pF or lower.

If the load impedance is low, the following troubles occur:

Resistance component . . . . Output voltage drops.

Low band frequency characteristic deteriorates.

Capacitance component . . . As the load capacitance increases, high band frequency characteristic deteriorates.

### 6.7 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.

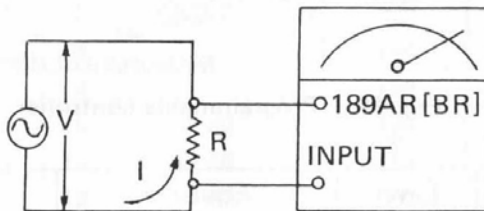


Fig. 13

### 6.8 REMOTE (External Control)

- (1) Set the LOCAL-REMOTE switch on the rear panel to REMOTE.
- (2) Connect the LPC-1801 Programmable Controller which is separately available to the control input connector on the rear panel.

(3) The LPC-1801 has the following specifications:

Number of selections: Max. 8 (5 programs in the base).

The remaining 3 can be added by installing extra DIP switches.

Selection method: Independent presetting for CH 1 and CH 2 by the DIP switches.

(4) LPC-1801 programmable controller for LMV-189AR [BR] is shown in Fig. 14.

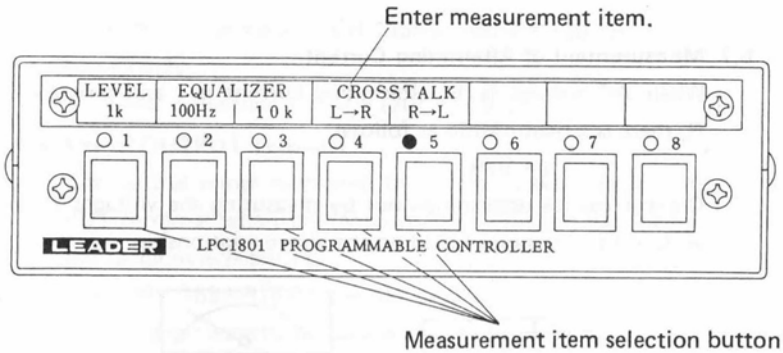


Fig. 14 Programmable controller

Measurement Item	Level	Equalizer		Crosstalk	
	1 kHz	100 Hz	10 kHz	L→R 1 kHz	R→L 1 kHz
CH 1 (L)	0 dB	-10 dB	-20 dB	0 dB	-60 dB
CH 2 (R)	0 dB	-10 dB	-20 dB	-60 dB	0 dB

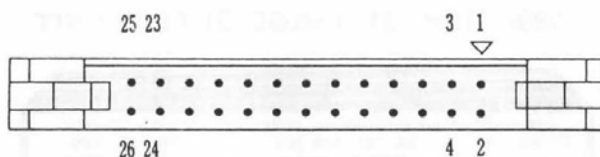
Table 6. Preset range

(A) set the ranges as shown in Table 6 using the DIP switches in the controller unit.

(B) Pushing one of the measurement item selection buttons results in causing the LMV-189AR[BR] to select the range corresponding to the button for which the program was assigned on the LPC-1801.

(C) When a controller other than the LPC-1801 is used, refer to Fig. 15 and Table 7 for range selection. The control voltage and drive current are specified as follows:

	LO	HI
TTL (CMOS) level true logic	0 to 0.4 V	4 to 5 V
Drive current	0 mA	1.2mA



View from the rear side

CHANNEL-1			
	1	2	GND
+18 V	3	4	
-60 dB	5	6	
-40 dB	7	8	-50 dB
-20 dB	9	10	-30 dB
0 dB	11	12	-10 dB
+ 5 V	13	14	+ 5 V
0 dB	15	16	-10 dB
-20 dB	17	18	-30 dB
-40 dB	19	20	-50 dB
-60 dB	21	22	
+18 V	23	24	
	25	26	GND
CHANNEL-2			

Setting range (dB)	Control terminal to input control signal (dB)	
+40	-60	-50
+30	-60	-40
+20	-60	-30
+10	-60	-20
0	-60	-10
-10	-60	0
-20		-50
-30		-40
-40		-30
-50		-20
-60		-10
-70		0

Concent the source of +5V and the control terminal.

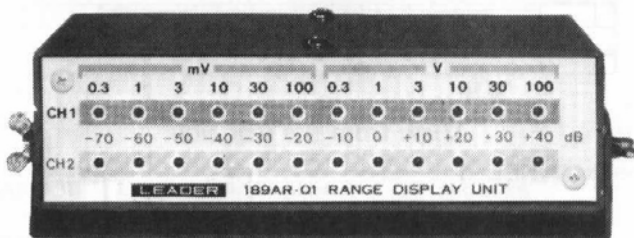
Fig. 15 Remote terminal

Table 7

Note: To use a TTL drive remote controller without LPC-1801;

- (a) Position the LOCAL – REMOTE switch to REMOTE, then connect the controller to REMOTE connector.
  - (b) Do not operate the LOCAL-REMOTE switch on the rear panel while the remote cable is being kept connected to the REMOTE connector.
- If a range indication is required while REMOTE is in use, 189AR[BR]-01 range display unit should be connected between remote control cables.

### 189AR[BR]-01 RANGE DISPLAY UNIT



## 7. MAINTENANCE

 CAUTION

### 7.1 Fuse Replacement

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

Fuse Data

Rated Voltage	Operating Voltage Range( $\pm 10\%$ )	Fuse Rating Normal	Leader Part Number
100V 117V	90 to 110V 105 to 129V	0.315A	436 3140 006
220V 240V	198 to 242V 216 to 250V	0.2A	436 3130 003



## **7.2 Calibration**

The LMV-189AR[BR] is designed to provide stable performance when used properly.

If the instrument requires adjustment or calibration after extended use, be sure to contact your nearest Leader agent.