

METER CALIBRATOR
MODEL 6920B
SERIAL NUMBER PREFIX 6D

January, 1967
HP Part No. 06920-90001

SECTION I GENERAL INFORMATION

1-1 DESCRIPTION

1-2 The Model 6920B is a feedback-regulated power source particularly suited for calibration of meters. Ten continuously variable output ranges are provided, ranging from 1 volt to 1000 volts and from 100 μ A to 5A full output. All ranges provide either dc or ac at the power-line frequency; however, the 100 μ A range is not calibrated in ac. Power output capability is from 2.5 watts in the 10A range to 10 watts in the 10, 100, and 1000 volt ranges. The ac output, while having the same waveform as the input power line, is controlled to have the correct average value. The 3 digit output dial is calibrated in terms of the RMS value of a sine wave.

1-3 The 6920B is particularly useful for production-line checking of meters for accuracy and for sticking movements. In addition, the wide range of outputs allows convenient checking of multi-meters in the laboratory. Compact construction, through the use of all semiconductor circuitry, allows for easy portability.

1-4 Built-in current and voltage limiting circuits protect the 6920B from short circuit loads in voltage ranges and open-circuit loads in current ranges.

1-5 OPTIONAL EQUIPMENT

1-6 A 0.1 ohm shunt is available to extend the voltage capabilities downward to include 1mV full output, when used in conjunction with the current

ranges of the 6920B. When the shunt is used, the source impedance is 0.1 ohm.

1-7 INSTRUMENT IDENTIFICATION

1-8 This manual applies only to the Model 6920B. Change sheets will be supplied which include any differences between your instrument and this manual.

1-9 COOLING SYSTEM

1-10 This instrument is convection cooled and requires no maintenance except for occasional dusting. Adequate space should be provided around the unit to allow free circulation of cooling air.

1-11 POWER CABLE

1-12 A 5-foot three conductor power cable is supplied with the instrument terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturers' Association (NEMA). NEMA recommends that the instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground pin.

1-13 To preserve the protection feature when operating the instrument from a two-prong outlet, use a three-prong to two-prong adaptor and connect the green pigtail on the adaptor to ground.

Table 1-1. Specifications

<p>INPUT: 105-125Vac, single phase, 58-62Hz.</p> <p>OUTPUT: AC or DC</p> <table style="margin-left: 20px;"> <tr> <td>.01</td> <td>- 1V</td> <td>to 5A</td> </tr> <tr> <td>.1V</td> <td>- 10V</td> <td>to 1A</td> </tr> <tr> <td>1V</td> <td>- 100V</td> <td>to 100mA</td> </tr> <tr> <td>10V</td> <td>- 1000V</td> <td>to 10mA</td> </tr> <tr> <td>1μA</td> <td>- 100μA*</td> <td>to 500V</td> </tr> <tr> <td>10μA</td> <td>- 1mA</td> <td>to 500V</td> </tr> <tr> <td>100μA</td> <td>- 10mA</td> <td>to 500V</td> </tr> <tr> <td>1mA</td> <td>- 100mA</td> <td>to 50V</td> </tr> <tr> <td>10mA</td> <td>- 1A</td> <td>to 5V</td> </tr> <tr> <td>100mA</td> <td>- 5A</td> <td>to .5V</td> </tr> </table> <p>*dc only</p> <p>TOTAL OUTPUT DISTORTION: Equal to the input waveshape distortion plus 3%.</p> <p>LINE REGULATION: The accuracy specifications will be met with line voltages from 105 to 125Vac.</p> <p>OUTPUT IMPEDANCE: DC - 1 volt range: Less than 0,0005 ohms, Other ranges: Accuracy specification is met with any load within the listed output capability.</p> <p>AC - 1 volt range: Less than 0,001 ohms, 100μA range: Greater than 500 megohms.</p>	.01	- 1V	to 5A	.1V	- 10V	to 1A	1V	- 100V	to 100mA	10V	- 1000V	to 10mA	1 μ A	- 100 μ A*	to 500V	10 μ A	- 1mA	to 500V	100 μ A	- 10mA	to 500V	1mA	- 100mA	to 50V	10mA	- 1A	to 5V	100mA	- 5A	to .5V	<p>Other ranges: Accuracy specification is met with any load within the listed output capability.</p> <p>On 10Vac range - minimum load resistance 5 ohms 100Vac range - minimum load resistance 500 ohms 1000Vac range - minimum load resistance 50K ohms</p> <p>Power factor of load 0.9 to 1.0 in ac ranges.</p> <p>OPERATING TEMPERATURE: 0$^{\circ}$ to 50$^{\circ}$C. Accuracy specification met at 25 \pm 10$^{\circ}$C after 1 hour warm-up in static environment.</p> <p>DC ACCURACY: 0.2% of output \pm1 digit.</p> <p>AC ACCURACY: 0.4% of output \pm1 digit.</p> <p>OVERLOAD PROTECTION: May be shorted in voltage ranges and open-circuited in current ranges without damage.</p> <p>GROUNDING: In voltage ranges, the negative terminal is grounded. In current ranges, both terminals are off-ground; load must be floating.</p>
.01	- 1V	to 5A																													
.1V	- 10V	to 1A																													
1V	- 100V	to 100mA																													
10V	- 1000V	to 10mA																													
1 μ A	- 100 μ A*	to 500V																													
10 μ A	- 1mA	to 500V																													
100 μ A	- 10mA	to 500V																													
1mA	- 100mA	to 50V																													
10mA	- 1A	to 5V																													
100mA	- 5A	to .5V																													

SECTION II INSTALLATION

2-1 INCOMING INSPECTION

2-2 The instrument should be unpacked and inspected both mechanically and electrically upon receipt. Observe packing method and retain packing materials until unit has been inspected. Mechanical inspection involves checking for signs of physical damage such as scratched panel surfaces, broken knobs, etc. If damage is present, file a claim with the carrier. The electrical inspection involves checking the instrument against its specifications. Section V includes a performance check which is an in-cabinet check to verify proper instrument operation. It is recommended as an incoming inspection test. Refer to the warranty page if there is any electrical malfunction.

2-3 INSTALLATION

2-4 The meter calibrator is a portable instrument requiring no permanent installation. It is only necessary to connect the power cable supplied with the instrument to the power input and the instrument is ready for operation.

2-5 This instrument is air cooled. Sufficient space to permit free flow of cooling air around the instrument should be considered when installing. It should not be used in an area where the temperature exceeds 50°C (122°F). For rated accuracy, the temperature should be between 15°C and 35°C (59°F to 95°F).

2-6 POWER REQUIREMENTS

2-7 The 6920A operates on 115 volts 60Hz. The average input current with the output fully loaded

is 1 ampere.

2-8 REPACKAGING FOR SHIPMENT

2-9 The following list is a general guide for repackaging an instrument for shipment. If you have any questions, contact your authorized Harrison Laboratories sales office.

a. Use the original container designed for the instrument. If a new container is required, a foam pack and container can be ordered from Harrison Laboratories. The stock number is given in the table of replaceable parts under "Miscellaneous."

b. Wrap the instrument in heavy paper or plastic before placing it in the shipping carton.

c. Use plenty of packing material around all sides of the instrument and protect the panel with cardboard strips.

d. Use heavy cardboard carton or wooden box to house the instrument and use heavy tape or metal bands to seal the container.

e. Mark the packing box with "Fragile--Delicate Instrument," etc.

NOTE

If the instrument is to be shipped to Harrison Laboratories for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. In any correspondence, be sure to identify the instrument by model number and serial number.

SECTION III OPERATION

3-1 INTRODUCTION

3-2 The 6920B is ready to use as received from the factory. For maximum accuracy, allow one hour after turning on to allow the internal temperature to stabilize.

3-3 Figure 3-1 describes the operating controls and indicators.

3-4 OPERATING CONTROLS

3-5 OUTPUT SWITCH

3-6 This disconnects the output terminals when it is in the center "OFF" position. It should be "OFF" when changing loads, changing the range or function switch setting and when turning on the instrument. This insures that any voltage transients which may occur at these times do not damage the load or the operator.

3-7 When all other settings are made and the load connected, the output switch can be tipped to either the "ON TEST" or the "ON HOLD" position. In either case power is now being fed into the load. The switch will return to "OFF" from the "ON TEST" position as soon as figure pressure is removed. It will remain in the "ON HOLD" position until manually returned to "OFF."

3-8 Always return the output switch to "OFF" before removing the load. This is particularly important in the current ranges where dangerous voltages will exist if the load is removed with the output still "ON."

3-9 This switch is also used to reset the over-voltage protection circuit. See Paragraph 3-28.

3-10 OUTPUT TERMINALS

3-11 The device to be calibrated is connected to the output terminals. In dc the Red (HI) terminal is positive (conventional current flow out of the red terminal).

3-12 In all voltage ranges the Black (LO) terminal is connected to the chassis and to earth ground through the three-wire power cord.

NOTE

In all current ranges the black terminal is connected to a point in the circuit which is as much as 1 volt off ground potential, depending on the output dial setting. Do not shunt the LO terminal to earth ground with the device being calibrated. Inaccurate results may be obtained or the load could be damaged. There should be no problem of this kind with non-electronic or battery-powered current meters. If line-operated instruments are to be calibrated, see Paragraph 3-29.

3-13 FUNCTION SWITCH

CAUTION

Do not turn FUNCTION SELECTOR when OUTPUT SWITCH is on.

3-14 The Function Switch is the input line switch for the meter calibrator. In the "OFF" position, input power is off. In "ac", alternating current will be delivered to the output terminals, while in "dc", direct current is available.

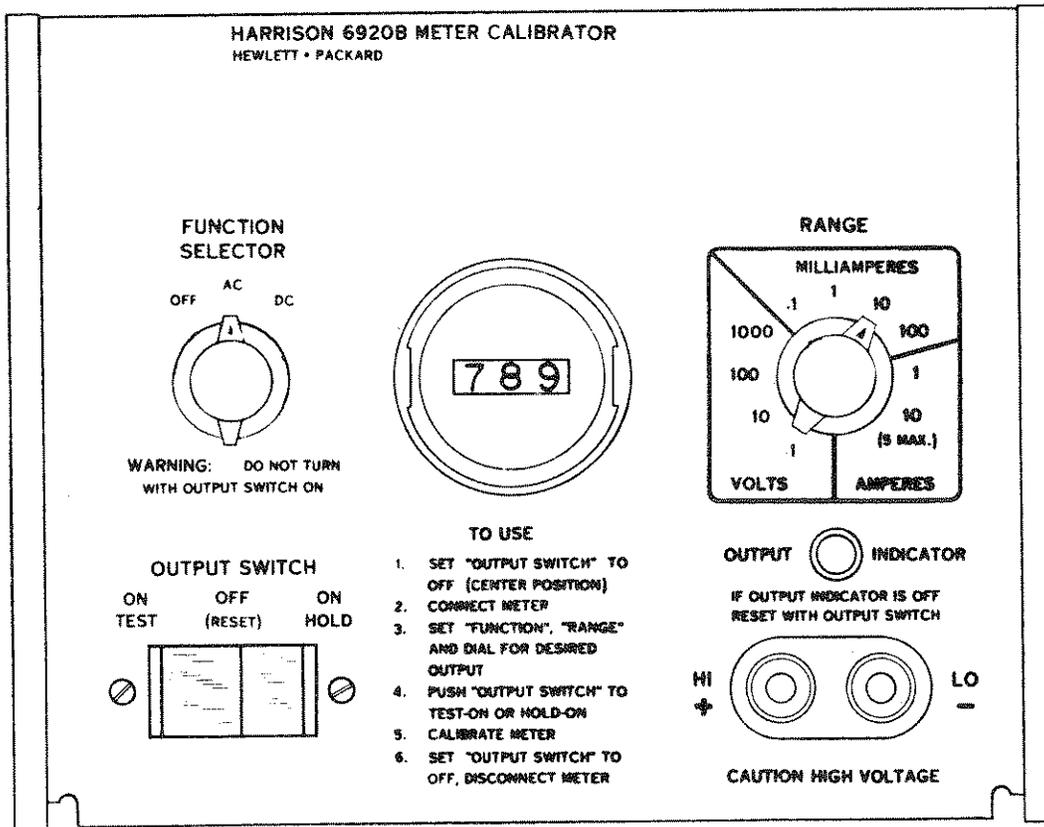
3-15 RANGE SWITCH

3-16 The range switch selects the current or voltage range appropriate to the meter being tested. The range indicated by the switch is the output dial fully clockwise, to (1)000.

3-17 OUTPUT DIAL

3-18 The three-digit, ten turn output dial allows continuous adjustment of the calibrator output within any range.

3-19 To determine the correct decimal point placement, consider the decimal point to be immediately to the left of the left-hand digit, then multiply this number by the range switch setting. For example: 123 on the 10mA range is $.123 \times 10\text{mA} = 1.23\text{mA}$.



1. **Function Selector:** Provides line power to meter calibrator when in "AC" or "DC" position. Selects AC or DC at the output terminals.

2. **Power Indicator:** Lights when instrument is turned on and AC source provided. Not lit if fuse is blown or missing.

3. **Output Dial:** Allows calibrated adjustment of output over the range selected.

4. **Range Switch:** Selects the voltage or current available with the output dial at its maximum setting - (1)000.

5. **Output Indicator:** Lit when power is being delivered at output terminals. Extinguished if over voltage protection circuit trips or output

switch is off.

6. **Output Terminals:** Connector for meter being calibrated. LO (-) terminal is connected to chassis ground in all voltage ranges. In current ranges the ground is inside the circuit and neither terminal should be grounded (see Paragraph 3-29).

7. **Output Switch:** Open-circuits output terminals when in Off (reset) position. In this position the over-voltage protection circuit is also reset. In either "On" position power is delivered to the output. "On Test" will return "Off" as soon as finger pressure is removed. "On Lock" will remain on until manually returned to "Off."

NOTE

Although the output dial can be mechanically positioned to or near 000, it is not calibrated below 010.

calibrator is delivering power to the output terminals. The light is out if the output switch is in the "OFF" position. It also will be off when the over-voltage protection circuit is activated, which will occur if the load is removed in any of the current ranges.

3-20 OUTPUT INDICATOR

3-21 The output indicator is lit when the meter

3-22 If the output light is not on and output power is desired, move the output switch to the "OFF (RESET)" position. Check the load to be sure that it is within the voltage capabilities of the 6920B, then return the output switch to "ON."

TABLE 3-1

Range	Maximum Output	Meter Resistance
1 volt DC	5 amperes	---
10 volts DC	1 ampere	---
100 volts DC	100ma	---
1000 volts DC	10ma	---
100 μ a DC	500 volts	---
1ma DC	500 volts	---
10ma DC	500 volts	---
100ma DC	50 volts	---
1 ampere DC	5 volts	---
10 amperes DC	5 amperes/0.5 volts	---
1 volt AC	5 amperes	---
10 volts AC	1 ampere	5 ohms minimum
100 volts AC	100ma	500 ohms minimum
1000 volts AC	10ma	50K ohms minimum
100 μ a AC	Not Calibrated	---
1ma AC	500 volts	---
10ma AC	500 volts	---
100ma AC	50 volts	---
1 ampere AC	5 volts	---
10 amperes AC	5 amperes/0.5 volts	---

3-23 GENERAL OPERATING PROCEDURE

3-24 A brief procedure for using the Model 6920B meter calibrator, printed on the front panel, is also shown in Figure 3-1.

3-25 OVERLOAD

3-26 The load should be within the current capability of the voltage range with which it is being used. If excessive current is drawn the output voltage will begin to fall, approaching zero for large overloads. Table 3-1 lists the output capabilities of the 6920B in the various ranges.

NOTE

In the 1 volt, 5 amp range, it is very important to minimize the length of load leads and check the method of connection to the output terminals. Contact and lead resistance amounting to only 0.1 ohm would drop 0.5

volt at 5 amperes, leaving only 0.5 volt available at the load.

3-27 In current ranges, it should be recalled that an open circuit is the maximum load condition and that a short circuit is minimum load. When testing current meters, the OUTPUT switch should be returned to "OFF" before removing the meter under test. If this is not done, the output voltage will momentarily exceed the full voltage capability of the current range in use, to as much as 1500 volts in the lowest three current ranges.

3-28 If a current meter is inadvertently removed with the output "ON", an over-voltage protection circuit will turn the error amplifier off - preventing further high-voltage operation. When this occurs, the OUTPUT INDICATOR light ceases to glow brightly and becomes very dim, indicating to the operator that the protection circuit has tripped. The protection circuit can also be activated when changing ranges or turning on the meter calibrator

with the output switch "ON." The over-voltage protection is reset when the OUTPUT switch is placed in the "OFF (RESET)" position.

NOTE

When the over-voltage protection is energized, the output may be as high as 20% of the range switch setting in dc operation or 30% of range setting in ac, regardless of the setting of the output dial. To avoid the possibility of overloading a meter, always return the output switch "OFF" before changing ranges.

3-29 GROUNDING

3-30 With panel meters, multimeters, battery operated instruments and clip-on current meters which have no connection with earth ground, no grounding difficulties should be encountered in either the voltage or current ranges.

3-31 When calibrating line-operated meters which may have resistance and capacitance to earth ground and may generate currents between earth ground and the negative lead, some precautions are necessary in grounding. In voltage ranges the best procedure is to break any connection with earth ground in the meter being tested (as shown in Figure 3-2), the ground connection being made through the negative terminal of the 6920B.

3-32 Line operated current meters, with the exception of clip-on models, require special care in grounding to avoid inaccurate measurements. Two quick tests, illustrated in Figure 3-3, will show where problems exist.

a. Remove any connection between the low or (-) meter terminal and ground. Ground the (+) or high terminal. The meter should read zero within the desired accuracy.

b. Again with the (-) or LO meter terminal ungrounded, connect the (+), high, terminal to a +1 volt source, with respect to ground, ac for ac meters, dc for dc meters. The 1 volt range of the 6920B works well for this. To avoid possible damage to the meter, bring the voltage up slowly from zero until 1 volt is reached. If the meter still reads zero within the desired accuracy limits, no problem will be encountered in calibration if the LO (-) terminal is left ungrounded.

3-33 The above tests are accurate as long as the full-current voltage drop across the meter is small compared with 1 volt. Any guard shields present in the meter should be connected to the (-), LO, terminal but not to ground.

3-34 If the tests in 3-32 show that problems do exist, Figure 3-4 shows a way of curing the problem. A (+1) amplifier such as the DY-2460A Solid State dc amplifier with DY-2461A-M4 plus-one gain plug-in is used to isolate the low-side terminal of the meter from the LO (-) terminal of the 6920B.

GROUNDING CONSIDERATIONS

I. VOLTAGE RANGES

CAUTION:
DO NOT GROUND EITHER OUTPUT TERMINAL OF THE CALIBRATOR UNDER ANY CIRCUMSTANCES.

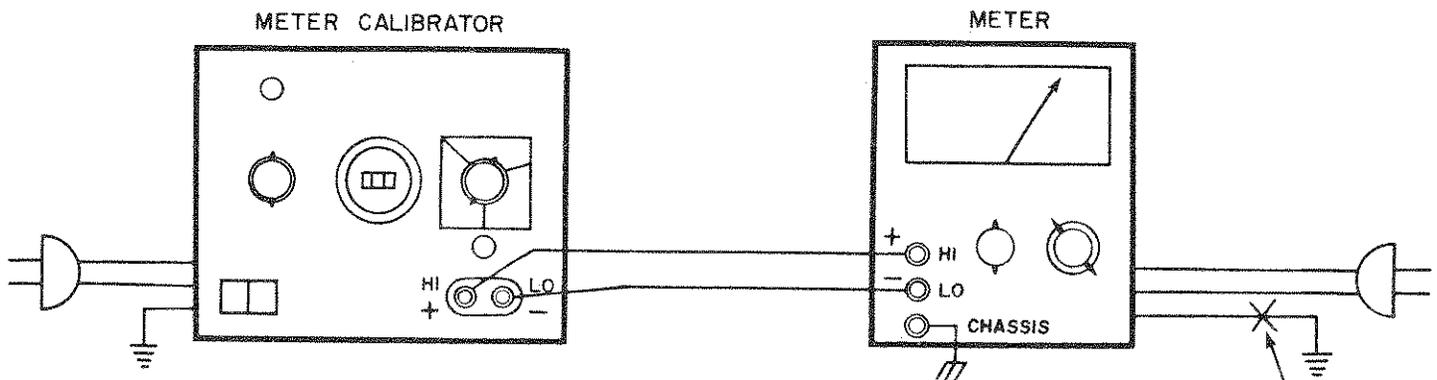
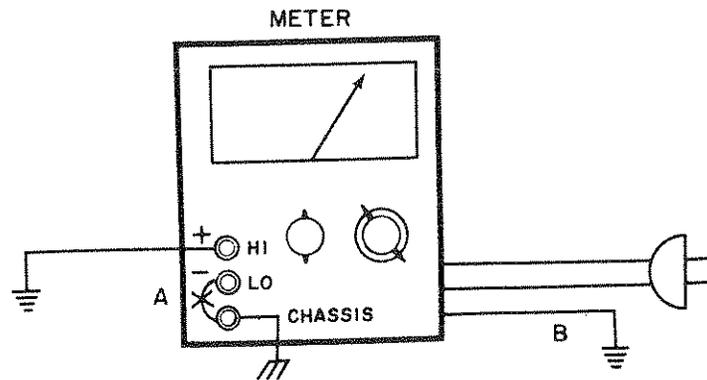


FIG. 3-2

BREAK GROUND LEAD HERE.
CONNECT LO TERMINAL TO
CHASSIS GROUND, IF POSSIBLE.

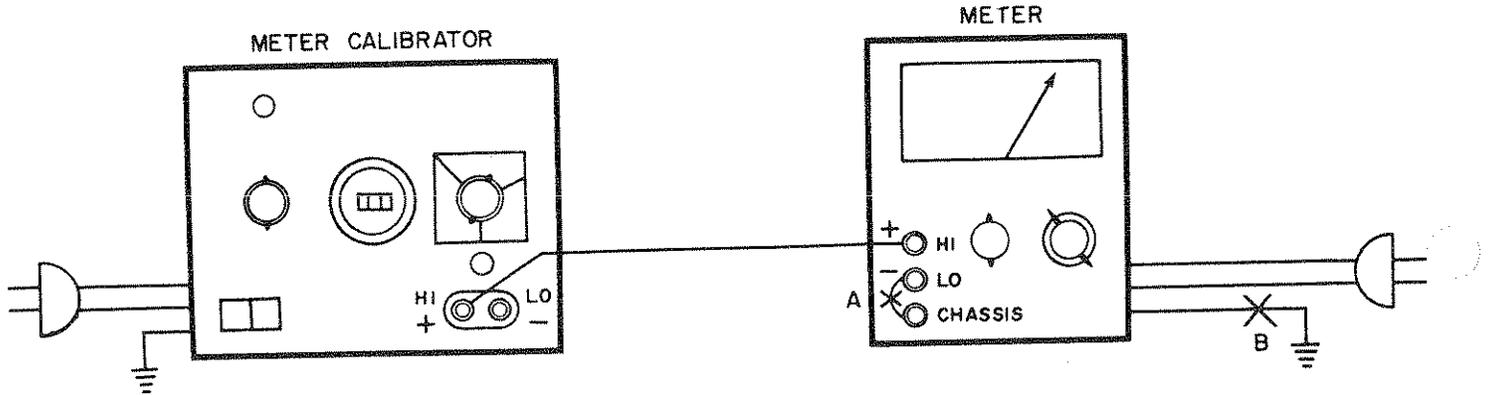
II. TESTING CURRENT METERS FOR GROUND PROBLEMS

A)



DISCONNECT LO TERMINAL FROM CHASSIS GROUND AT A, OR IF THIS CANNOT BE DONE BREAK EXTERNAL GROUND LEAD AT B.

B)



BREAK AT A, OR IF NOT POSSIBLE BREAK LEAD AT B.

FIG. 3-3

3-35 CALIBRATING TRUE RMS AC METERS

3-36 In ac ranges the output waveform of the 6920B will be the same as that of the input power line, which will not be perfectly sinusoidal. The ac reference of the meter calibrator insures that the average value of the output will remain correct regardless of line distortion. The output dial is calibrated in terms of the sinusoidal RMS equivalent of the average value of the output. Thus, any ac meter which is average-sensing, RMS calibrated will be correctly calibrated. Meters of this type include multimeters and most electronic and digital voltmeters.

3-37 For true-reading RMS meters an error will exist as a function of the line distortion. Table 3-2 shows the possible error in terms of second, third and fourth harmonic content of the line.

3-38 If greater accuracy is needed for true RMS meters, an external sine wave oscillator capable of supplying 60Hz, 15 volts \pm 10% at 2mA, can be used to supply the signal to the ac reference regulator. To do this, refer to Figure 3-5. Move slide switch S1 on rear panel to EXTERNAL. Connect a pair of shielded leads from the 15 volt ac source to the points shown, the low side going to A1 and the high side going to A2.

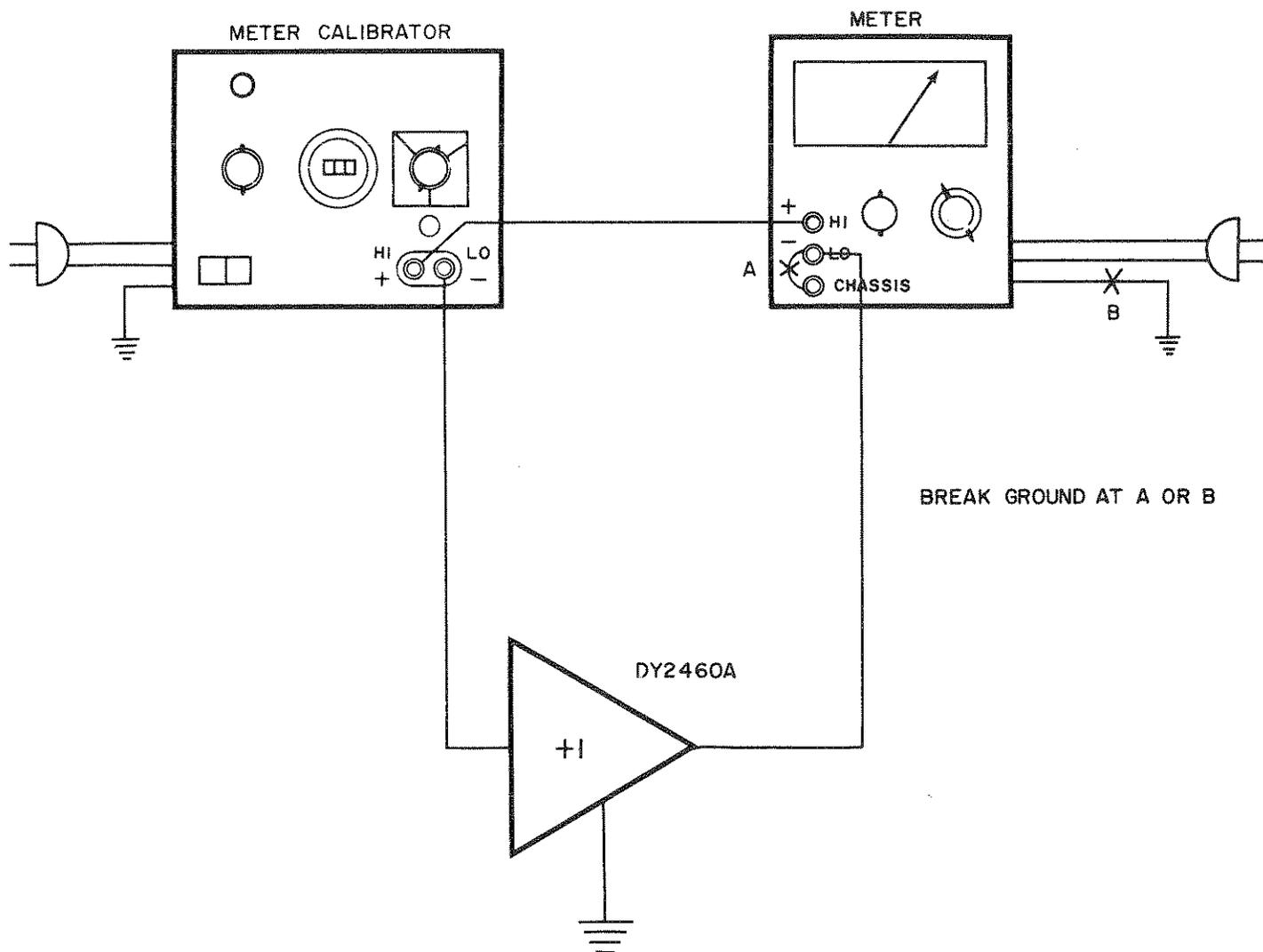


FIG. 3-4 ELIMINATING GROUND PROBLEMS WITH +I AMPLIFIER

% HARMONIC	% ERROR AVERAGE-SENSING RMS CALIBRATED METER	% ERROR TRUE RMS METER
0	0	0
1% Second	0	-0% to +0.02%
2% Second	0	-0% to +0.02%
5% Second	0	-0% to +0.12%
10% Second	0	-0% to +0.50%
20% Second	0	-0.07% to +1.98%
1% Third	0	-0.65% to +0.69%
2% Third	0	-0.65% to +0.69%
5% Third	0	-1.54% to +1.79%
10% Third	0	-3.14% to +3.53%

TABLE 3-2 OUTPUT ERROR DUE TO LINE WAVEFORM DISTORTION

NOTE

The calibrator should never be operated without the 15 volt ac being present as damage to the inverter may result.

3-39 EFFECTS OF RAPID LINE VOLTAGE CHANGES

3-40 In order to prevent distortion of the ac waveform in the ac reference circuit, the ac reference

feedback loop has been made slow compared with 60Hz. Hence, sudden changes in line voltage will not be immediately corrected, producing a momentary shift in the ac output. If a particularly noisy line is causing excessive instability of the ac output, an external oscillator capable of supplying 60Hz, 15 volt \pm 10% at 2mA, can be used to replace the line-derived ac input normally used. See Paragraph 3-38 and Figure 3-5 for instructions on this procedure.

METER CALIBRATOR

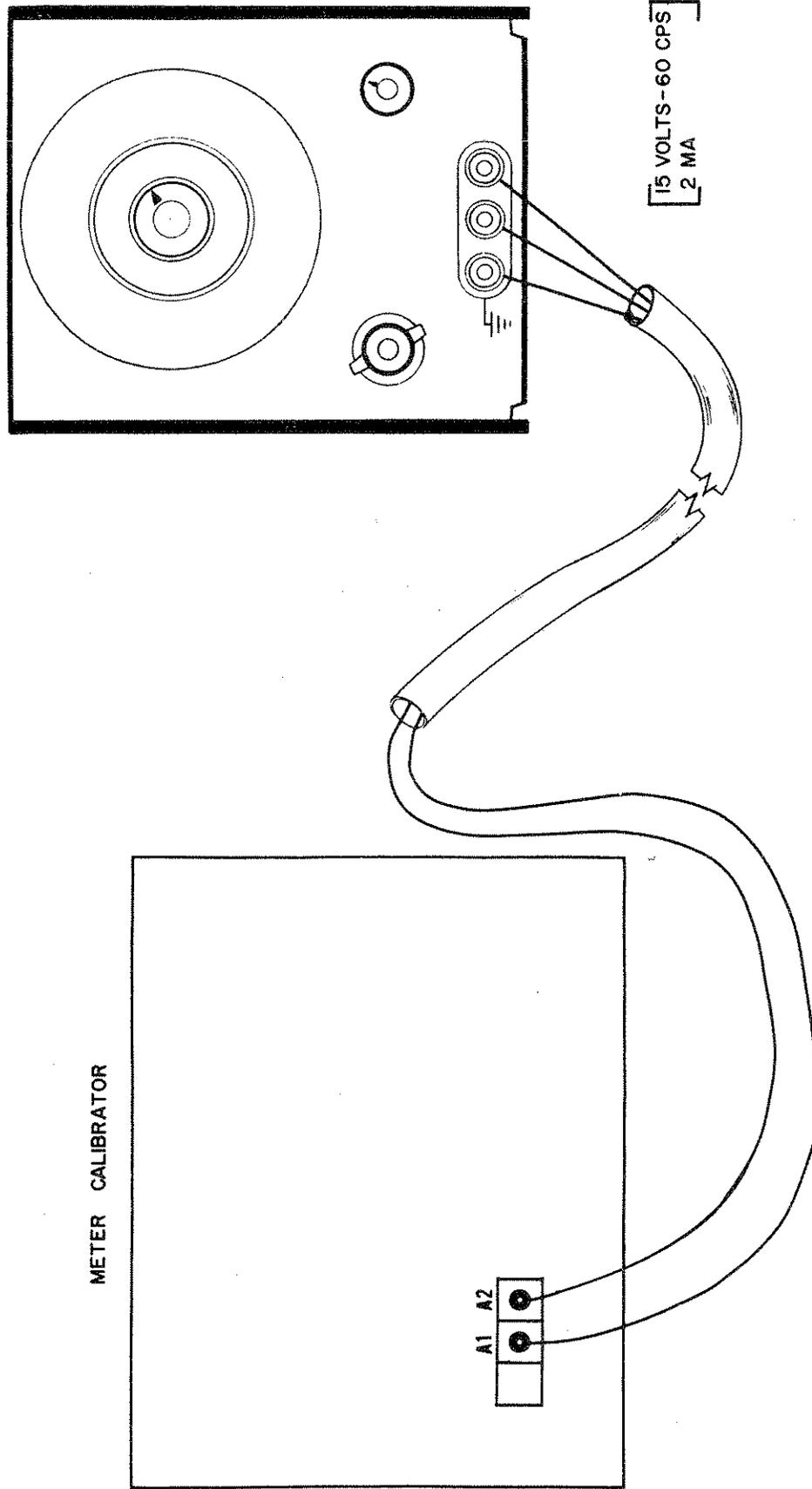


FIG. 3-5
USE OF EXTERNAL OSCILLATOR
TO OPERATE AC REFERENCE

