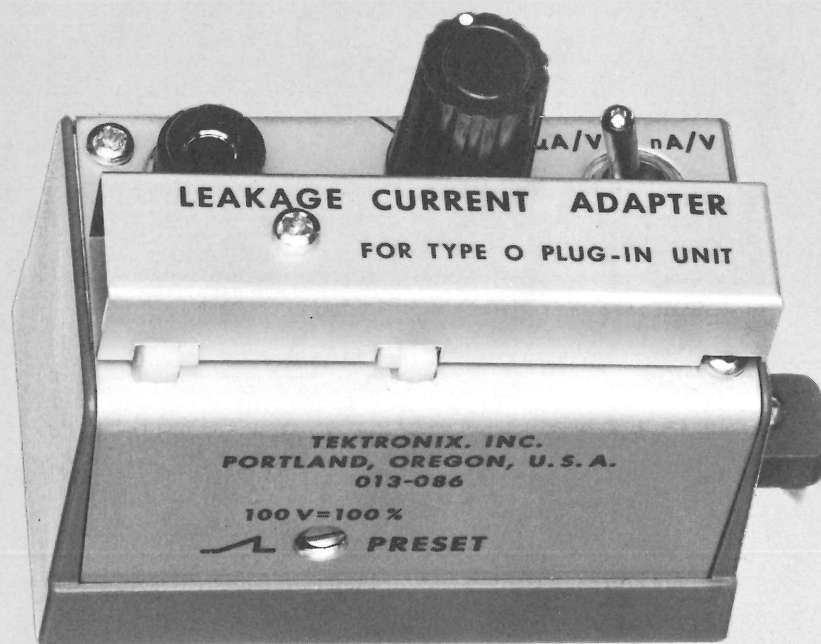


# INSTRUCTION MANUAL

## LEAKAGE CURRENT ADAPTER



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*Tektronix, Inc.*

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

# LEAKAGE CURRENT ADAPTER for TYPE O PLUG-IN UNIT

## Introduction

The Leakage Current Adapter is an accessory for the Tektronix Type O Operational Amplifier Plug-In Unit. It can be used with either the A or B operational amplifier to measure the reverse leakage current of semiconductor devices. The banana plugs on the base of the adapter allow the unit to be plugged into the jacks on the front panel of the Type O Unit.

Small-signal diodes with axial leads can be checked by placing them in the notched retainer in the swing-down cover. Small-signal transistors (JEDEC E3-44 base) can be checked by plugging them into the socket beneath the swing-down cover (leave cover open to check transistors). Leakage current of NPN transistors can be checked by positioning the transistor as shown by the black lettering; position PNP transistors as shown by the red lettering.

## CHARACTERISTICS

### Vertical Deflection Factor

1 microamp/volt or 1 nanoamp/volt selected by toggle switch.

### Vertical Deflection Accuracy

$\pm 8\%$

### Horizontal Deflection Factor (with 100-volt sawtooth, minimum)

1, 2, 5 and 10 volts/centimeter selected by HORIZ VOLTS/CM switch.

### Horizontal Deflection Accuracy

$\pm 3\%$

### Maximum Sweep Rate

1 millisecond/centimeter with toggle switch in the  $\mu\text{A}/\text{V}$  position.

0.1 second/centimeter with toggle switch in the  $\text{nA}/\text{V}$  position.

### Input Sawtooth Voltage (for 10-volt/centimeter horizontal deflection)

100 to 200 volts.

### Maximum Internal Leakage

150 picoamps at 100 volts.

## Mechanical Characteristics

Finish—Blue vinyl paint and anodized aluminum.

Weight—5 ounces.

Connectors—Input: Banana jack.

Output: Banana plugs.

## Accessories

1—Patch Cord, Banana Plugs

1—Instruction Manual

### Tektronix Part No.

012-031

070-461

## OPERATION

### Preliminary

Before making measurements with the Leakage Current Adapter, check the gain of the Type O Unit. This can be done by setting the Volts/Cm switch to 20 and the Vertical Display switch to Dc +. Connect a 100-volt calibrator waveform to the Ext. Input connector. Adjust the Type O Unit Gain Adj. for exactly 5 centimeters of vertical deflection. (If the graticule is only 4 centimeters vertically, set the Volts/Cm switch to 5, the Oscilloscope Calibrator to 20 and adjust the Gain Adj. control for exactly 4 centimeters of deflection.) Disconnect the calibrator signal.

Plug the Leakage Current Adapter into the A or B operational amplifier. Set the  $Z_i$  and  $Z_f$  switches to Ext. Connect the sawtooth output signal from the Oscilloscope to the Sawtooth IN jack of the adapter. Connect a 10X probe to the Ext. Input connector of the Type O Unit and set the Volts/Cm switch to 2. With the HORIZ VOLTS/CM switch set to 10, touch the probe tip to the diode clip located on the left side (under the swing-down cover).

### CAUTION

Do not clamp the probe tip to the diode clip; it cannot support the probe weight.

Position the start of the sawtooth to the lower left corner of the graticule. If the Oscilloscope has a 6-centimeter graticule, adjust the Sawtooth PRESET adjustment for exactly 5 centimeters vertical deflection at the 10th Graticule mark (see Fig. 1). For a 4-centimeter graticule, adjust the Sawtooth PRESET adjustment for exactly 4 centimeters vertical deflection at the 8th graticule mark (see Fig. 2).

### NOTE

If the amplitude of the sawtooth is less than 100 volts, the adapter can be used for precise measurements if the Sawtooth PRESET adjustment is set to provide some percentage of 100 volts. The correct value of horizontal voltage can be obtained by multiplying the HORIZ VOLTS/CM switch setting by this percentage.

## Leakage Current Adapter

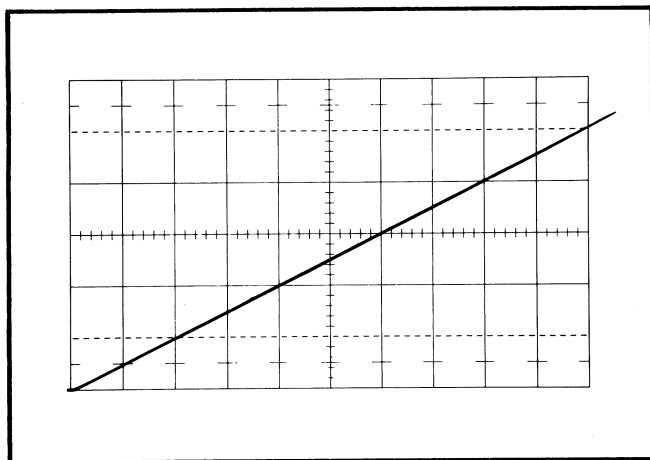


Fig. 1. Correct adjustment of Sawtooth PRESET for 6-centimeter graticule.

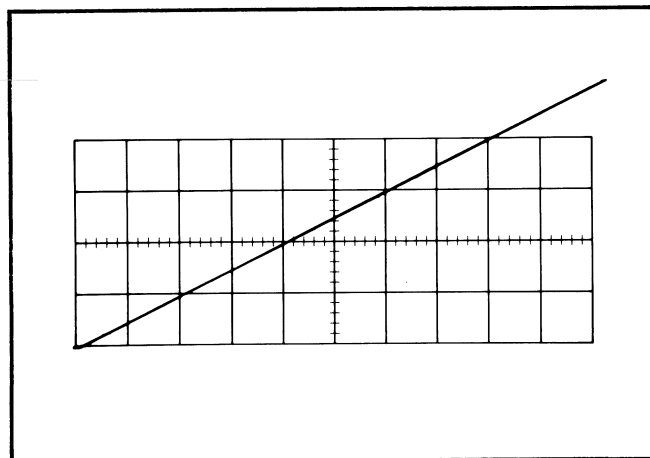


Fig. 2. Correct adjustment of Sawtooth PRESET for 4-centimeter graticule.

### Measuring Reverse Leakage of Diodes

Reverse leakage current of small-signal diodes can be checked by using the following procedure:

1. Set the HORIZ VOLTS/CM switch for the desired horizontal deflection.

#### NOTE

The reverse breakdown characteristics of the device under test should be known before making this adjustment. If not, set the HORIZ VOLTS/CM switch to 1 to prevent damage.

2. Set the Oscilloscope Time/CM switch to the maximum sweep rate useable for the  $\mu\text{A/V}$ - $\text{nA/V}$  switch setting; 1 mSec in the  $\mu\text{A/V}$  position or 0.1 Sec in the  $\text{nA/V}$  position.

3. Place the diode in the notched, swing-down cover and close the cover to make contact with the test fixture. Place the diode as shown on the cover for reverse leakage testing.

4. Set the Type O Unit Volts/CM switch to display the largest signal without overscanning the display area.

Voltage can now be read from the horizontal axis of the display, and current on the vertical axis. Voltage is determined by the setting of the HORIZ VOLTS/CM switch. Current can be read from the Type O Unit Volts/CM switch with the  $\mu\text{A/V}$ - $\text{nA/V}$  switch determining the range. For example, with the Volts/CM switch set to 5 and the  $\mu\text{A/V}$ - $\text{nA/V}$  switch set to  $\text{nA/V}$  the vertical deflection would be 5 nanoamps/centimeter.

A typical waveform of reverse leakage current measurement is shown in Fig. 3.

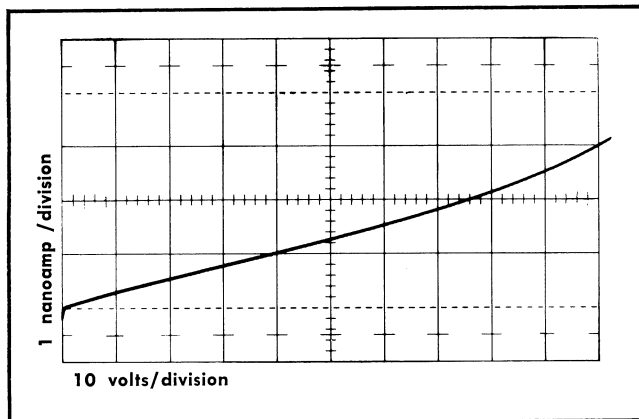


Fig. 3. Typical reverse leakage waveform. For example, leakage current is approximately 39 nanoamps at 5 volts reverse bias.

### Measuring Reverse Leakage of Transistors

The four-pin transistor socket located beneath the swing-down cover accepts either NPN or PNP transistors. NPN transistors are tested for reverse leakage current positioned as shown by the black lettering; PNP as shown by the red lettering. Leave the swing-down cover open during measurement.

The emitter and base contacts of the transistor socket are connected together. Therefore, when all three leads of the transistor are inserted into the socket, the leakage measurement is made between the collector and the common-connected base and emitter. To measure the leakage current between the collector and base only or the collector and emitter only, leave the undesired lead out of the socket.

Operation of the Leakage Current Adapter when measuring leakage current of a transistor is the same as for diodes.

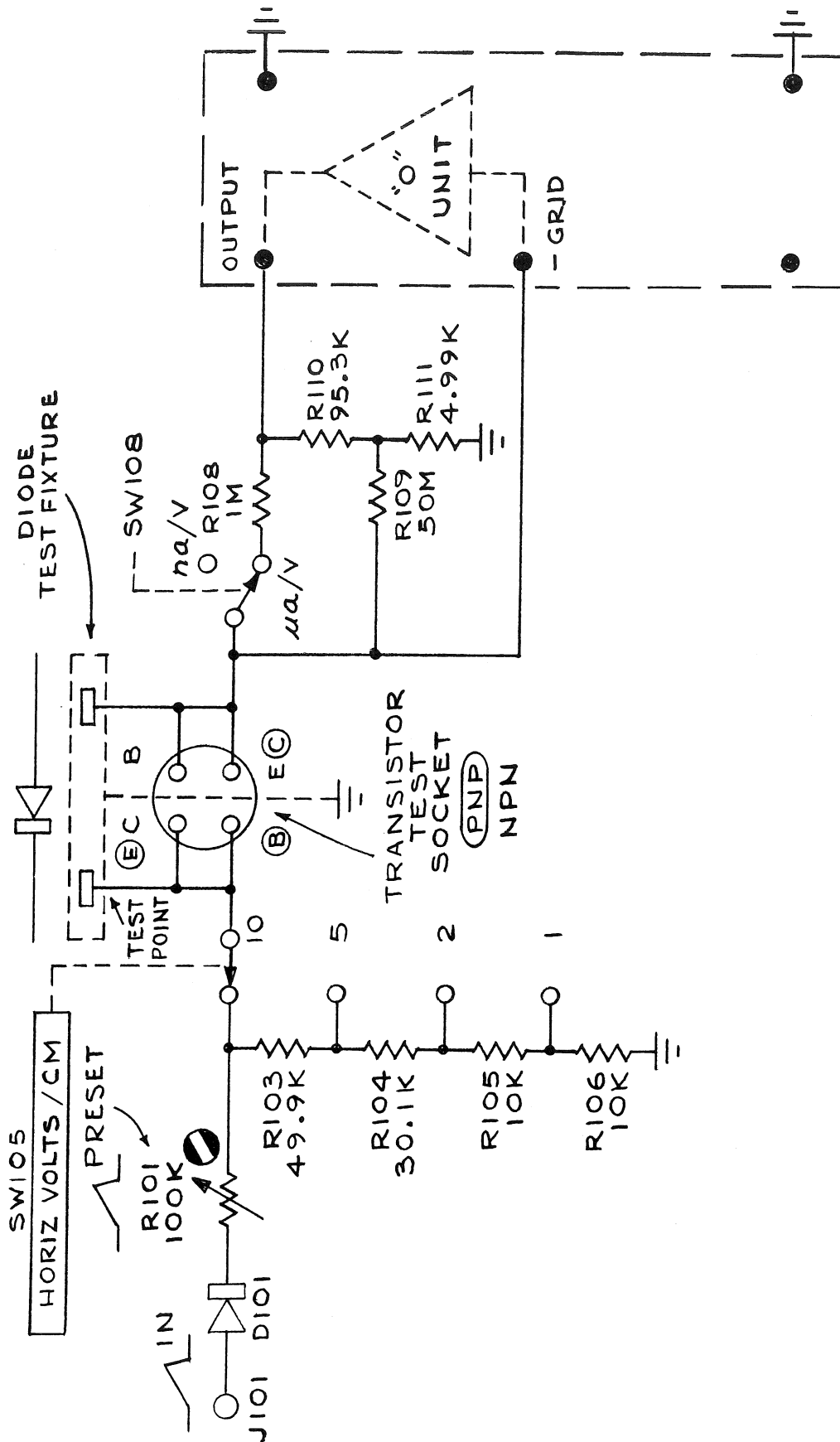
### Measuring Resistance

The Leakage Current Adapter can be used to measure resistance values as high as  $10^{12}$  ohms. The resistance must be calculated from measured values of current and voltage. Use the techniques described for measuring reverse leakage of diodes to obtain a value of current and voltage.

### Parts Replacement

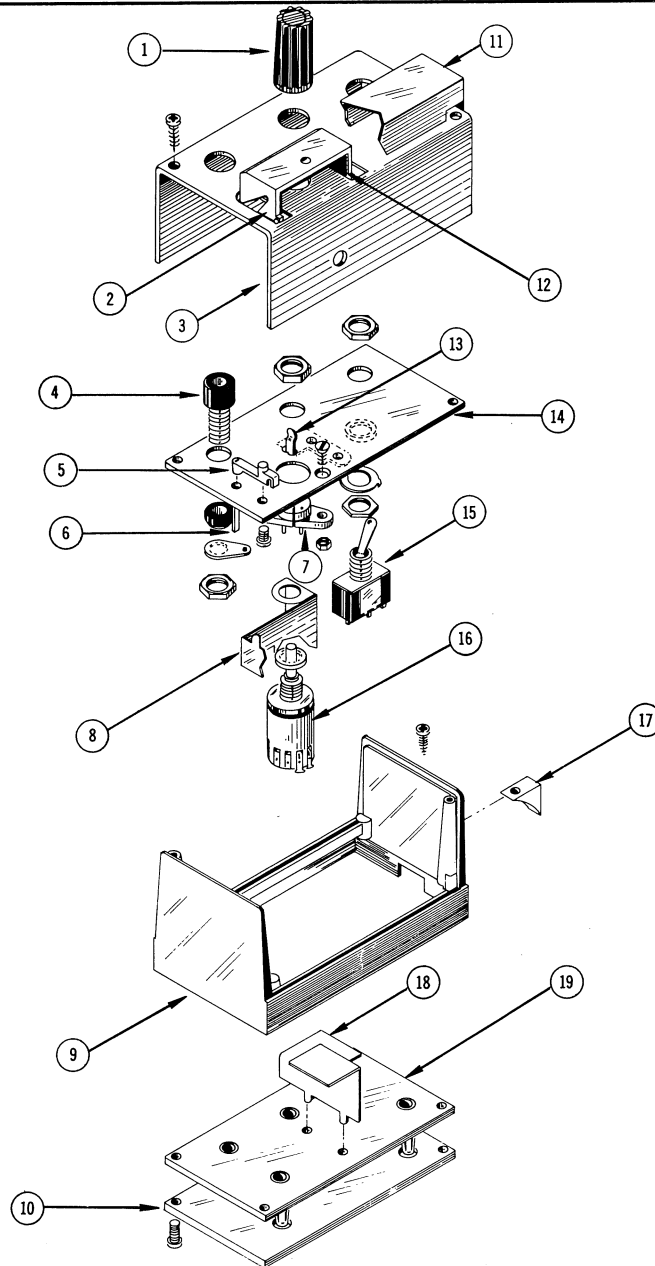
Electrical and mechanical replacement parts for the Leakage Current Adapter are shown at the back of this manual.

## LEAKAGE CURRENT ADAPTER



# Leakage Current Adapter

## EXPLODED VIEW



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	366-153			1	KNOB, charcoal
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
2	337-695			1	SHIELD, inner
3	200-598			1	COVER
	- - - -			-	mounting hardware: (not included w/cover)
	211-079			2	SCREW, 2-56 x 3/16 inch, PHS phillips
4	136-140			1	SOCKET, banana jack
	- - - -			-	mounting hardware: (not included w/socket)
	210-895			1	WASHER, insulating
	210-223			1	LUG, solder, 1/4 inch
	210-465			1	NUT, hex, 1/4-32 x 3/8 inch

## EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
5	432-054			2	BASE, diode connector
	- - - -			-	mounting hardware for each: (not included w/base)
	213-055			1	SCREW, thread forming, 2-32 x $\frac{3}{16}$ inch PHS
6	131-365			2	CONNECTOR, diode strap
7	136-204			2	SOCKET, transistor
	- - - -			-	mounting hardware for each: (not included w/socket)
	211-087			1	SCREW, 2-56 x $\frac{3}{16}$ inch FHS
	210-405			1	NUT, hex, 2-56 x $\frac{3}{16}$ inch
8	337-693			1	SHIELD, upper
9	204-163			1	BODY
10	392-165			1	BOARD, insulated shield
	- - - -			-	mounting hardware: (not included w/board)
	211-095			2	SCREW, 2-56 x $\frac{5}{16}$ inch FHS 80°
11	337-696			1	SHIELD, outer
	- - - -			-	mounting hardware: (not included w/shield)
	211-079			1	SCREW, 2-56 x $\frac{3}{16}$ inch PHS phillips
	210-405			1	NUT, hex, 2-56 x $\frac{3}{16}$ inch
12	343-112			1	CLAMP, diode
13	344-112			1	CLIP, spring
14	387-996			1	PLATE, sub-panel
15	260-613			1	SWITCH, unwired — $\mu$ A/V - n A/V
	- - - -			-	switch includes:
	- - - -			1	NUT
	- - - -			1	LOCKWASHER
	- - - -			1	RING
	- - - -			-	mounting hardware: (not included w/switch)
	210-465			1	NUT, hex, $\frac{1}{4}$ -32 x $\frac{3}{8}$ inch
16	260-606			1	SWITCH, unwired — HORIZ VOLTS/CM
	- - - -			-	switch includes:
	- - - -			1	LOCKWASHER
	- - - -			1	NUT
17	401-022			1	CAM
	- - - -			-	mounting hardware: (not included w/cam)
	213-055			1	SCREW, thread forming, 2-32 x $\frac{3}{16}$ inch PHS
18	337-694			1	SHIELD, lower
19	388-606			1	BOARD, etched circuit
	- - - -			-	mounting hardware: (not included w/board)
	211-079			2	SCREW, 2-56 x $\frac{3}{16}$ inch PHS phillips

## ELECTRICAL PARTS

Ckt. No.	Tektronix Part No.	Description	S/N Range
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## Diode

D101	152-185	Signal, Replaceable by 1N3605	
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## Resistors

R101	311-454	100 k	1/8 w	Var		PRESET
R103	321-356	49.9 k	1/8 w		Prec	1%
R104	321-335	30.1 k	1/8 w		Prec	1%
R105	321-289	10 k	1/8 w		Prec	1%
R106	321-289	10 k	1/8 w		Prec	1%
R108	323-481	1 meg	1/2 w		Prec	1%
R109	309-450	50 meg	1/2 w		Prec	1%
R110	321-383	95.3 k	1/8 w		Prec	1%
R111	321-260	4.99 k	1/8 w		Prec	1%

## Switches

	Unwired	Wired		
SW105	260-606		Rotary	HORIZ VOLTS/CM
SW108	260-613		Toggle	$\mu$ A/V — n A/V