MODEL 583
CURVE TRACER

OPERATION MANUAL

KIKUSUI ELECTRONICS CORP.

1. INTRODUCTION

The Model 583 Curve Tracer is designed for oscilloscope observation of the static characteristics of diodes, thyristors, and Triacs, by impressing voltage waveforms from the commercial power supply. The tracer can supply test voltages up to 10 kV, has a DC power source for gate. Calibrated multi-range selectors for changing-over horizontal and vertical axis sensitivities facilitate wide-range measurement.

By decreasing the repetition frequency of test voltages the power consumption in test samples can be minimized.

The peak voltmeter mounted on the front panel permits direct reading of terminal peak voltages.

CONTENTS

2. SPECIFICATIONS

SPEC. 61071 OSCILLOSCOPE
SPEC. 61091 TEST VOLTS SOURCE UNIT

Power supply	-----V, 50/60 Hz SPEC 61071	approx. 70VA
	SPEC 61091 (no load)	approx. 60VA
	(at 10kV 0.1A peak load and 50 pps)	approx. 900VA (FORWARD)
	* This unit employs an autotransformer outside the body. (for voltage-change)	
Dimensions (max.)	510 (540) W x 600 (620) H x 457 (517) Dmm	
Weight	Approx. 74 kg	
Accessories	Operation Manual	1
	Test Data	1
	Safety Control Connector	1
	Plug for gate power supply and meter external calibration	2
Scale Plate	10 DIV x 10 DIV, 8mm/DIV, white or red illumination	
Cathode-Ray-Tube	5 UP 1 F, acceleration voltage approx. 1400V	
Internal Test Voltage Supply	Power supply frequency half-wave rectified and sine wave	
Range (4 ranges)	0 ~ 30V peak, max. 10A peak 0 ~ 300V peak, max. 1 A peak	} low voltage

	0 -- 3kV peak, max. 0.1A peak) 0 -- 10kV peak, max. 0.1A peak) high voltage
Function (3 positions)	FORWARD half-wave rectified, A(+) - K(-) REVERSE half-wave rectified, A(-) - K(+) SINE sine wave
Peak Voltage Indicator	Peak voltage indication interlocks with range selection; with meter full scale 10, 30 selector switch. In case of SINE, with POSITIVE PEAK and NEGATIVE PEAK selector switch, accuracy ... full scale 5% (at sine half-wave 50 pps)
Over Current Relay	Interlocking with sensitivity of current axis, actuated in 6 ~ 8 DIV up and down from the center.
TEST CIRCUIT FUSE	7A
REPETITION (6 steps)	1, 2, 5, 10, 25, 50 pps (power supply 50 Hz) or 1, 2, 6, 12, 30, 60 pps (power supply 60 Hz)
Dissipation Limiting Resistor	
For low voltage (13 steps)	0/1/3/10/30/100/300/1k/3k/10k/30k/100k/300kΩ
For high voltage (6 steps)	0/10k/30k/100k/300k/1MΩ
Parallel Capacity Compensation	Max. approx. 150 pF

Gate DC Power Supply	Output voltage	0 ~ 10V continuously variable
	Output current	Max. 1A
	Output voltmeter	Full scale 10V, accuracy 3%
	Output ampere meter	Full scale 1A, accuracy 3%
	Series resistance	0 ~ 200Ω continuously variable
	Polarity	Positive and negative to cathode; with OFF switch

Voltage Axis Sensitivity (HORIAONTAL)	For low voltage (9 steps) accuracy 3% 0.1/0.2/0.5/1/2/5/10/20/50V/div For high voltage (9 steps) 10/20/50/100/200/500/1k/2k/5kV/DIV
Current Axis Sensitivity (VERTICAL)	19 Steps accuracy 3% 1/2 ..... 200/500μA/1 ..... 500/1000mA/DIV
Calibration Voltage (amplifier sensitivity)	Voltage axis 1V p-p square wave/10 DIV Current axis 0.5V p-p square wave/10 DIV

3. FUNCTIONS OF CONTROLS AND TERMINALS (SPEC. 61091 TEST VOLTS SOURCE UNIT)

POWER — A power supply switch. If this is set upwards, the power supply is connected to light a neon lamp.

RANGE — A selector switch to change-over test voltages. There are 4 ranges: 0 ~ 30V, 0 ~ 300V, 0 ~ 3kV, and 0 -- 10kV. If this RANGE knob is changed-over when test voltage is impressed, a protective relay is actuated to turn off the voltage.

TEST VOLTS — A knob for continuous variation of test voltages. The variation can be made in the range specified by the RANGE knob. In order to carry out the resetting in case the test voltage is turned off by an action of several protective circuits during test voltage impression, a resetting switch is provided which is actuated at the position where the TEST VOLTS knob is turned fully counterclockwise (the position of minimum test voltage). The operator is requested to make it a rule for safety to reset this knob to ZERO as soon as a test is finished.

FUNCTION — A selector switch to change-over test voltage waveforms. There are 3 positions:

	Waveform	Polarity
FORWARD ...	half-wave rectified	A terminal (+) K terminal (-)
REVERSE ...	"	A terminal (-) K terminal (+)
SINE ...	sine wave	

In each of above-mentioned positions, the "K" terminal is on the low potential side relative to the chassis (a current detecting resistance is connected between the chassis and "K" terminal; max. 50 kΩ. When a 10-DIV current axis is conducted, the voltage between them equals 0.5V).

If the FUNCTION knob is turned when the TEST VOLTS knob is not set in the resetting position, the protective relay, as in case of the RANGE knob, is actuated to open the test voltage supply circuit.

DISSIPATION LIMITING RESISTOR

Series resistance selector knobs for limiting dissipation. For low voltages (0 ~ 30V and 0 ~ 300V ranges) and for high voltages (0 ~ 3kV and 0 ~ 10kV ranges).

CAPACITY BAL Knobs for compensating the parallel capacity across the test sample. The inner red knob is used for fine adjustment. The knobs are designed for decreasing looping trace on the screen due to parallel capacity across the test sample.

Readjust the knob each time when the sensitivity (CURRENT/DIV) of current axis (VERTICAL) is changed-over.

REPETITION A knob for changing-over the repetition frequency of test voltages in order to decrease the power loss in sample during measurement. There are 6 steps: 1/2/5/10/25/50 pps (or 1/2/6/12/30/60 pps)

GATE DC POWER SUPPLY

Supplies DC voltage to sample (thyristor, etc) gate. 0 -- 10V voltages to be impressed to "K" and "G" terminals and current up to 1A can be supplied.

- o OUTPUT — Gate power supply voltage adjusting knobs, permitting continuous variation in the range 0 -- 10V. The inner red knob is used for fine adjustment.
- o SERIES RESISTOR — A knob for adjusting series resistance of gate circuit. The range of continuous variation equals approximately 200Ω. The internal resistance of gate power supply circuit at "O" position of this knob is about 5 Ω.
- o POLARITY — A switch for changing-over the polarity of gate power supply. If this is turned upwards to (+), the voltage at "G" terminal is positive relative to "K" terminal, and if it is turned downwards to (-), the polarity is reversed. "G" terminal is opened at the center "OFF" position.
- o EXT VOLTAGE — An external terminal for a gate voltage measuring device. An external voltmeter can be connected in parallel with the internal voltmeter by the aid of an attached jack.
- o EXT CURRENT — An external terminal for a gate current ammeter. An external ammeter can be connected in series with the internal by the aid of an attached jack.

METER POLARITY

A switch selecting the polarity to be indicated by the peak voltmeter when the FUNCTION knob is set to SINE. At POSITIVE, the peak value wherein "A" terminal is (+) relative to "K" terminal (right side from the basic spot on the Cathode Ray Tube screen), is indicated, and reversed at NEGATIVE.

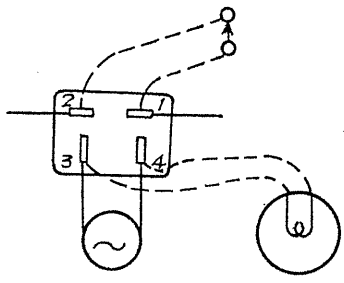
METER FULL SCALE RANGE

A selector switch to change-over the peak voltmeter range. Two ranges; full scale 30 and 10. The switch interlocks with the RANGE knob for TEST VOLTS. In case of the 0 -- 3kV range, for example, 30 equals 3kV in full scale and 10 —— 1kV in full scale.

TO EXT SAFETY CONTROL (LINE VOLTAGE)

A connector to be used for connecting an internal protective circuit with an external protective interrupting circuit such as a door switch, if fitted.
The wiring is shown below.

Fig. 1



External door switch, etc.

100V AC

External indicating lamp, etc.

If the external door switch is opened, the internal protective relay is actuated to turn the test voltage supply circuit off.

At the same time the 100V power supply circuit for external pilot lamp is also turned off. In case on external circuit is not provided, the terminals 1 -- 2 for a door switch should be short-circuited by means of the attached plug (see Fig. 1).

4. FUNCTIONS OF CONTROLS AND TERMINALS
(Spec. 61071 Oscilloscope)

POWER ON OFF	A power supply switch for the oscilloscope. When the switch is set upwards, the circuit closes to light the pilot lamp.
ASTIG	A knob for controlling trace astigmatism on the CRT screen. Adjust the knob together with the FOCUS knob so as to obtain a sharp trace.
INTENSITY	A knob to control the brightness of trace on the screen. When the knob is turned clockwise, the brightness increases. It is recommended that brightness be decreased when the oscilloscope is not observed in order to secure a long service life of the phosphor screen.
FOCUS	A knob to focus the trace on the screen. Adjust the knob, together with the ASTIG knob, to obtain a sharp trace.
SCALE ILLUM	A knob to control the intensity of illumination of the scale plate illuminating lamp. By mounting the scale plate upside down, the color can be changed from white to red.
VERTICAL CURRENT/DIV	A knob to select the sensitivity of vertical (current) axis. A figure shows the current value per division. 19 steps from 1μA/DIV to 1 A/DIV.

o POSITION — A knob to control the trace position in the vertical direction on the screen. When the knob is set in the center, the trace is positioned on the horizontal line approximately at the center, and the trace moves upwards if the knob is turned clockwise.

o 10 DIV CALIBRATION PUSH TO CAL, GAIN ADJ

Used for calibration of the vertical (current) axis amplifier. Depress the PUSH TO CAL button, and a bright line for about 10 divisions in length in the vertical direction appears on the screen. Then remove the cover of GAIN ADJ and turn the semi-fixed resistance with a screw driver to adjust the bright line correctly to 10 divisions. The PUSH TO CAL push button can be locked if it is turned clockwise in depressed state.

HORIZONTAL . VOLTS/DIV

A selector knob for changing-over the sensitivity of horizontal (voltage) axis. A figure indicates the voltage per division.

The outer blue figures are used for the LOW VOLTAGE RANGE (9 ranges from 0.1V/DIV to 50V/DIV) and inner black figures are for the HIGH VOLTAGE RANGE (9 ranges from 10V/DIV to 5KV/DIV).

They are used according to the RANGE switch position of the TEST VOLTS SOURCE UNIT.

o POSITION — A knob for adjusting the trace position in the horizontal direction on the screen. When the knob is set in the center, the trace is positioned on the vertical line approximately at the center, and the trace moves to the right when the knob is turned clockwise.

o 10 DIV CALIBRATION PUSH TO CAL GAIN ADJ.

For calibration of horizontal (voltage) axis amplifier sensitivity. Push the PUSH TO CAL button and a bright line for about 10 divisions appears in the horizontal direction on the screen. Then remove the cover of GAIN ADJ and turn the semi-fixed resistance with a screw driver to adjust the bright line correctly to 10 divisions.

5. OPERATING CAUTIONS AND MEASUREMENT

OPERATING CAUTIONS

1. Be extraordinarily careful of electric shock from high voltages contained in this tracer.
   Be sure to turn off POWER switch of the TEST VOLTS SOURCE UNIT When you inspect inside, disconnect the power supply plug without fail.

2. For safety it is recommended to reset TEST VOLTS knob to "O" and to set RANGE knob to LOW VOLTAGE position as soon as you finish measurement.

3. It is not recommended, for securing the tracer and sample being tested, to change-over switches during high-voltage impression.

MEASUREMENT

1. Connect the Oscilloscope Unit and the TEST VOLTS SOURCE UNIT between the panel and the rear side (overcurrent circuit), and turn on the power supply of the oscilloscope.

2. Set TEST VOLTS knob to "O" and turn on the power supply of the TEST VOLTS SOURCE UNIT.

3. To connect a sample set TEST VOLTS knob to "O".
   It is recommended for safety to set RANGE knob to a low voltage range. It is safer to turn-off POWER switch of the TEST BOLTS SOURCE UNIT each time a sample is connected.

4. According to measurement items set FUNCTION, RANGE, GATE POWER SUPPLY knobs to adequate positions.
The DISSIPATION LIMITING RESISTOR knob should be set to a higher resistance position at first.

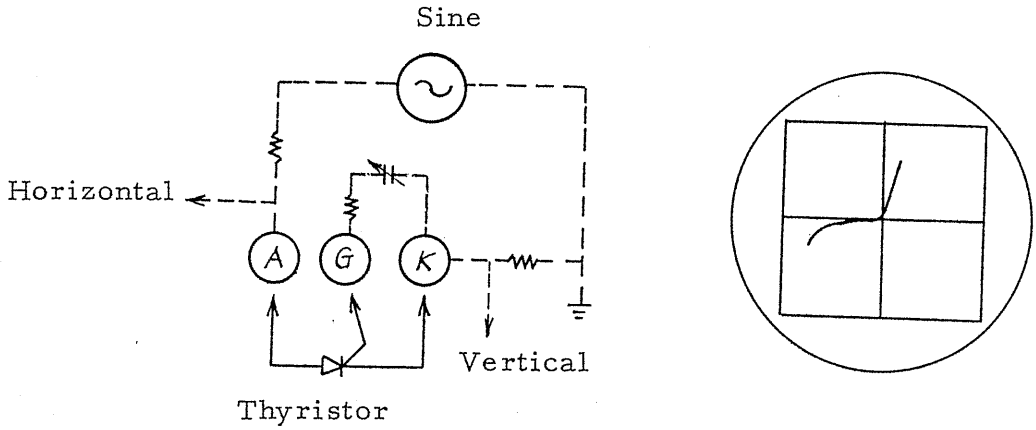


Fig. 2

5. It is recommended to position the basic trace spot at the left bottom corner of the oscilloscope screen in case of FORWARD or REVERSE measurement, and at the center in case of SINE measurement.
The trace runs to the right in case of FORWARD or REVERSE and in both directions in case of SINE, the right side trace corresponds to FORWARD (see Fig. 2).

6. Observing the trace on the screen, gradually turn the TEST VOLTS knob to increase the test voltage. Carry out measurement, change-over HORIZONTAL and VERTICAL sensitivity of oscilloscope as required.

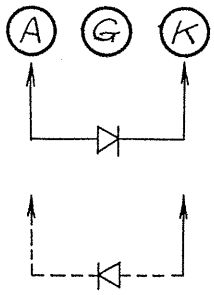
7. Compensate, using the CAPACITY BALANCE knob, the parallel capacity of samples that causes a loop trace. As a large parallel capacity makes the compensation difficult, lead wires, etc., should be connected so as to minimize the parallel capacity. Imppessed voltage influence on junction capacity of diodes, makes complete compensation difficult.

8. When trace on the screen deviates more than approx. ±6 div, the overcurrent relay is actuated to turn off the test voltage source. This actuating point can be varied, if necessary, by turning the inside semi-fixed resistor . Resetting can be made by turning the TEST VOLTS knob to "O".

9. If the REPETITION is used under 25 pps (or 30 pps) in case of SINE (sine wave), the test voltage waveform shows a sharp rise when the inside thyristor is energized. This disturbs the trace and makes it difficult to compensate parallel capacity.
This disturbed waveform, especially in high sensitivity ranges of current axis, actuates the overcurrent circuit, making measurement difficult. Therefore, it is recommended to carry out measurement in FORWARD or REVERSE that causes less waveform disturbance if a high sensitivity range of current axis is used under above-mentioned REPETITION, or to use 50 pps (or 60 pps) REPETITION if SINE is necessary for measurement.

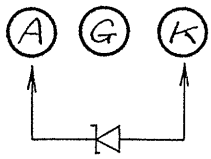
10. Connection of Sample and Measurement

Diode



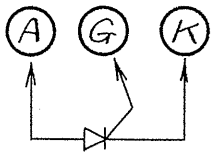
In case of connection shown left, set the FUNCTION to FORWARD to observe the forward characteristics, to REVERSE for reverse characteristics, observation. If the connection is reversed, reverse the knob setting.
If the FUNCTION is set to SINE, both characteristics can be observed simultaneously.

Zener diode



In case of connection shown left, set the FUNCTION to FORWARD for Zener characteristics observation.
If the connection is reversed, set the knob to REVERSE.

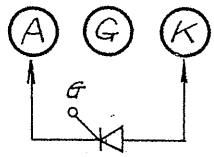
SCR (Reverse Blocking Triode Thyristor)



In case of this connection, set the GATE DC POWER SUPPLY to OFF and the FUNCTION to FORWARD for observing the forward blocking voltage characteristics. For reverse voltage observation set the FUNCTION to REVERSE.

To observe SCR turn-off characteristics, set the FUNCTION to FORWARD and the RANGE to a low voltage range, adjust the TEST VOLTS so as to impress approx. 6V, then operate the GATE DC POWER SUPPLY so as to gradually impress positive polarity voltages wherein "G" is positive relative to "K" until the SCR is energized and the meters indicate the gate voltage

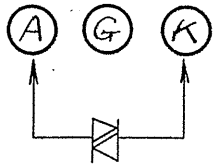
and current at this time. The holding current can also be observed.



In case of connection shown left, set the FUNCTION reversed of the above for observing the forward blocking voltage characteristics and reverse characteristics. The SCR cannot be turned on as the GATE DC POWER SUPPLY impresses voltage between "G" and "K".

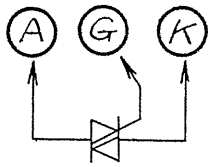
In this case never connect the SCR gate terminal with "G".

SSS (Bidirectional Diode Thyristor)



To measure the blocking voltage characteristics in case of this connection, set the FUNCTION to SINE and operate the TEST VOLTS so as to impress voltages. Blocking voltage in both directions can be observed and measure simultaneously.

TRIAC (Bidirectional Triode Thyristor)

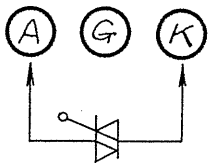


To measure the blocking voltage characteristics in this connection. To begin with, set the GATE DC POWER SUPPLY to OFF, the FUNCTION to SINE and gradually impress test voltages. Blocking voltages in both directions can be observed simultaneously. To observe the Triac turn-on first phenomenon characteristics, set the FUNCTION to FORWARD and the RANGE to a low voltage range, impress

an approximately 6 V test voltage and then adjust the GATE DC POWER SUPPLY so as to impress negative or positive polarity voltage until the meter shows the gate voltage and current when the Triac is energized.

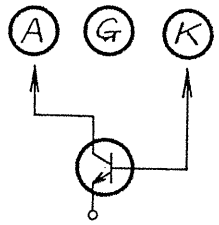
To measure the third phenomenon characteristics, set the FUNCTION to REVERSE, impress an approx. 6V test voltage by means of TEST VOLTS and operate the GATE DC POWER SUPPLY so as to impress negative polarity voltage.

To observe simultaneously the turn-on characteristics of first and third phenomena, set the FUNCTION to SINE, impress an approx. ±6 V test voltage and adjust the GATE DC POWER SUPPLY so as to impress negative polarity voltage. Thus, turn-on characteristics in both directions as well as the holding current can be observed.

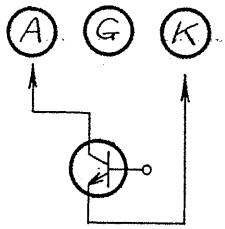


In case of connection shown left, blocking voltage characteristics in both directions can be observed at SINE position. In this case the procedure is reversed for the first and third phenomena characteristics. Triac gate turning-on is impossible in this connection. Be sure not to connect the Triac gate terminal to "G" (the terminal for connecting a sample).

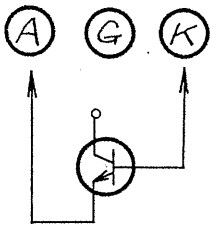
Transistor



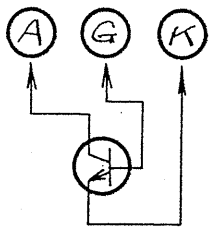
In case of connection shown left, the FUNCTION is set to FORWARD to observe VCBO-ICBO characteristics. In case of PNP transistor, the FUNCTION is set to REVERSE.



In the case shown left the FUNCTION is set to FORWARD to directly observe VCEO-ICEO characteristics of NPN transistor. In case of PNP transistor set the FUNCTION to REVERSE.



In the case shown left NPN transistor VEBO-IEBO characteristics can be observed if the FUNCTION is set to FORWARD. In case of PNP transistor, set the FUNCTION to REVERSE.



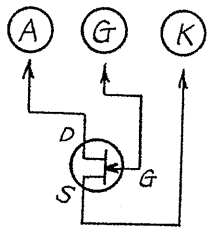
In the case shown left, to obtain transistor VC-IC characteristics on the screen, set the FUNCTION to FORWARD and the GATE DC POWER SUPPLY to positive polarity, and gradually impress gate voltages until a NPN transistor VC-IC characteristic line appears on the screen.

If the values of gate or base voltage and current of the sample are too small that they can not be read accurately on meters, connect external meters with the aid of

the attached plug for meter external calibration.

In case of PNP transistor set the FUNCTION to REVERSE, and the base voltage polarity should be reversed to that in case of NPN transistor.

FET (Field Effect Transistor)



To observe N channel type FET static characteristics using the connection shown left, set the FUNCTION to FORWARD, adjust the GATE DC POWER SUPPLY to negative 0 volt and gradually increase TEST VOLTS.

Thus, the static characteristics of FET at VGS = O can be observed.

Increase the GATE VOLTAGE to observe the static characteristics corresponding to GATE VOLTAGE that appear on the screen as a line.

6. MAINTENANCE
(SPEC. 61091 TEST VOLTS SOURCE UNIT)

Refer to Drawing No. 33042
Variable resistor layout

1. To adjust the 1/100 DIVIDER (RV_{101}) for voltage axis input of oscilloscope, set the FUNCTION to FORWARD, the RANGE to 10 kV, the HIGH VOLTAGE DISSIPATION LIMITING RESISTOR to 1 MΩ and the TEST VOLTS to O, remove the TEST VOLTS CIRCUIT FUSE 7A, switch on the POWER switch of Spec 61091 and turn off the oscilloscope power supply.
   Then, impress on the sample terminal A and GND a positive DC 1000 V and adjust RV_{101} until the voltage between the VOLTAGE SAMPLING INPUT A(oscilloscope) and GND equals 1/100 of 1000 V or 10 V. For measuring this voltage use a high input resistance digital voltmeter and adjust the accuracy of 1/100 within 0.5%.
   If the voltage divider for the voltage axis is normal after accomplishing the above adjustment and oscilloscope gain adjustment, the voltage axis can be measured with or accuracy within 3% of the total range.

2. Adjust the peak voltmeter on the basis of thus calibrated voltage axis. First, adjust the DC BAL RV_{204} for the peak voltmeter circuit input FET so that the Tr 2SC515 emitter voltage of this circuit output equals 0 V.
   In this case make sure that the emitter voltage is 0 V by changing-over the METER FULL SCALE RANGE to 10 or 30 and also turning-over the FUNCTION.
   For the adjustment of peak voltmeter the REPETITION should be set to 50 pps (or 60 pps).

3. Adjustment of 30 V Range

3.1 Set the FUNCTION to FORWARD, the METER FULL SCALE RANGE to 10, the HORIZONTAL to 1V/DIV , and slowly turn the TEST VOLTS knob clockwise until the HORIZONTAL deflects to 10 DIV, (or, 10V output). Adjust the RV_{208} so that the peak voltmeter reaches full scale.

3.2 Set the FUNCTION to SINE, the METER FULL SCALE RANGE to 10, the HORIZONTAL to 1 V/DIV and the METER POLARITY to POSITIVE, turn the TEST VOLTS knob gradually until the HORIZONTAL covers 10 DIV to the right from the basic spot (make sure the basic spot as the trace runs to both sides), that is, obtain a 10 V output of POSITIVE PEAK, and adjust the RV_{207} until the peak voltmeter reaches full scale.

3.3 Set the FUNCTION to FORWARD, the METER FULL SCALE RANGE to 30, the HORIZONTAL to 5V/DIV, and slowly turn the TEST VOLTS knob clockwise until the HORIZONTAL deflects to 6 DIV, that is,a 30 V output is obtained. Adjust RV_{206} until the peak voltmeter reaches full scale.

3.4 Set the FUNCTION to SINE, the METER FULL SCALE RANGE to 30, the HORIZONTAL to 5V/DIV, the METER POLARITY to POSITIVE, and slowly turn the TEST VOLTS knob until the HORIZONTAL covers 6 DIV to the right from basic spot (make sure the basic spot as the trace runs to both sides), that is, obtain a 30V output of POSITIVE PEAK, and adjust the RV_{205} until the peak voltmeter reaches full scale.

4. Adjustment of 300V Range

Set the FUNCTION to FORWARD, the METER FULL SCALE RANGE to 30, the HORIZONTAL to 50V/DIV, and slowly turn the TEST VOLTS knob clockwise until the HORIZONTAL deflects to 6 DIV, that is an output of 300V is obtained. Adjust the RV_{203} so that the peak voltmeter reaches full scale.

5. Adjustment of 3kV Range

Set the FUNCTION to FORWARD, the METER FULL SCALE RANGE to 30 , the HORIZONTAL to 500V/DIV, and slowly turn the TEST VOLTS knob clockwise until the HORIZONTAL deflects to 6 DIV, or, an output of 3kV is obtained. Adjust the RV_{201} so that the peak voltmeter shows full scale.

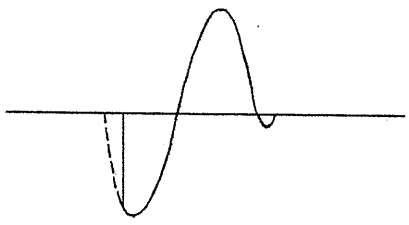
6. Adjustment of 10kV Range

Sufficient care should be taken as high voltages are impressed upon several sections. Set the FUNCTION to FORWARD, the METER FULL SCALE RANGE to 10 and the HORIZONTAL to 1kV/DIV, and slowly turn the TEST VOLTS knob the HORIZONTAL reaches 10 DIV or a 10kV output and adjust the RV_{202} so that the peak voltmeter shows full scale.

7. In case each variable resistor does not permit adjustment of above 3 ~ 6 , adjust the RV_{211} to readjust each range. Thus, the adjustment of peak voltmeter is completed.

8. Adjustment of REPETITION Circuit

This adjustment is carried out at 30V range and with FUNCTION set to SINE. First, connect the oscilloscope and counter to the output terminals and, turning the TEST VOLTS gradually to increase voltage and observing the output voltage wave-forms, change-over the REPETITION. Thus, make sure that each repetition pps is normal. Then, increase output voltage over 20V and adjust RV_{301} phase and RV_{302} width so as to obtain a voltage waveform shown below.



9. Test Fixture and TEST VOLTS Reset

Be careful when handling this equipment as it contains a high-voltage transformer. When you pull the transformer from the case, for inspection or repair be sure to disconnect the power supply cord.

When the primary side of measuring power supply transformer is energized, the range indicating lamp and a red lamp inside the test fixture are simultaneously turned on. However, it is recommended for safety to turn off the POWER switch and, moreover, disconnect the power supply cord when connecting the output terminal or when replacing the TEST CIRCUIT FUSE 7A, considering the possibility of the lamp breaking.

Pulling of the test fixture during measurement actuates the door switch for the fixture and cuts off the measuring transformer primary side and the output voltage. However, it is not desirable for safety to use the test fixture in this manner. When replacing a sample during high voltage test range, turn the TEST VOLTS knob to O (reset) without fail and pull out the test fixture completely.

It is required to check all the time the operation conditions of test fixture door switch, TEST VOLTS resetting switch, range indicating lamp, red lamp inside the test fixture and other safety devices. They should be repaired if operation is unreliable.

7. MAINTENANCE
(SPEC 61071 OSCILLOSCOPE)

Refer to Drawing No. S-61089
Layout

1. DC BALANCE

If this balance is lost, the basic spot moves at the time of GAIN ADJUSTMENT of 10, DIV CALIBRATION on panel. As to DC balance adjustment points, see the layout.

For both horizontal and vertical axis adjustment, turn the GAIN ADJ and, confirming the direction to decrease the bright spot movement, adjust the DC BAL semi-fixed resistor so as to obtain the point that does not cause spot movement.

2. 10 DIV CALIBRATION

This CALIBRATION is for sensitivity calibration of amplifiers, using 1 v p-p square wave/10 div voltage for horizontal axis and 0.5 v p-p square wave for vertical axis.

To calibrate the calibration voltage, set the horizontal axis to 0.1 V/div, apply an external DC 1 V $\pm$ 0.5% to the input A terminal, and adjust the CAL. VOLTAGE semi-fixed resistor until the movement of bright spot at this time equals the length of bright line at the time of 10 DIV CALIBRATION. Thus the calibration voltage is calibrated in both horizontal and vertical axis, and the amplifier sensitivity can be calibrated if the GAIN ADJ is controlled at PUSH TO CAL under this calibration voltage so that the bright line length both in horizontal and vertical axis equals 10 div.

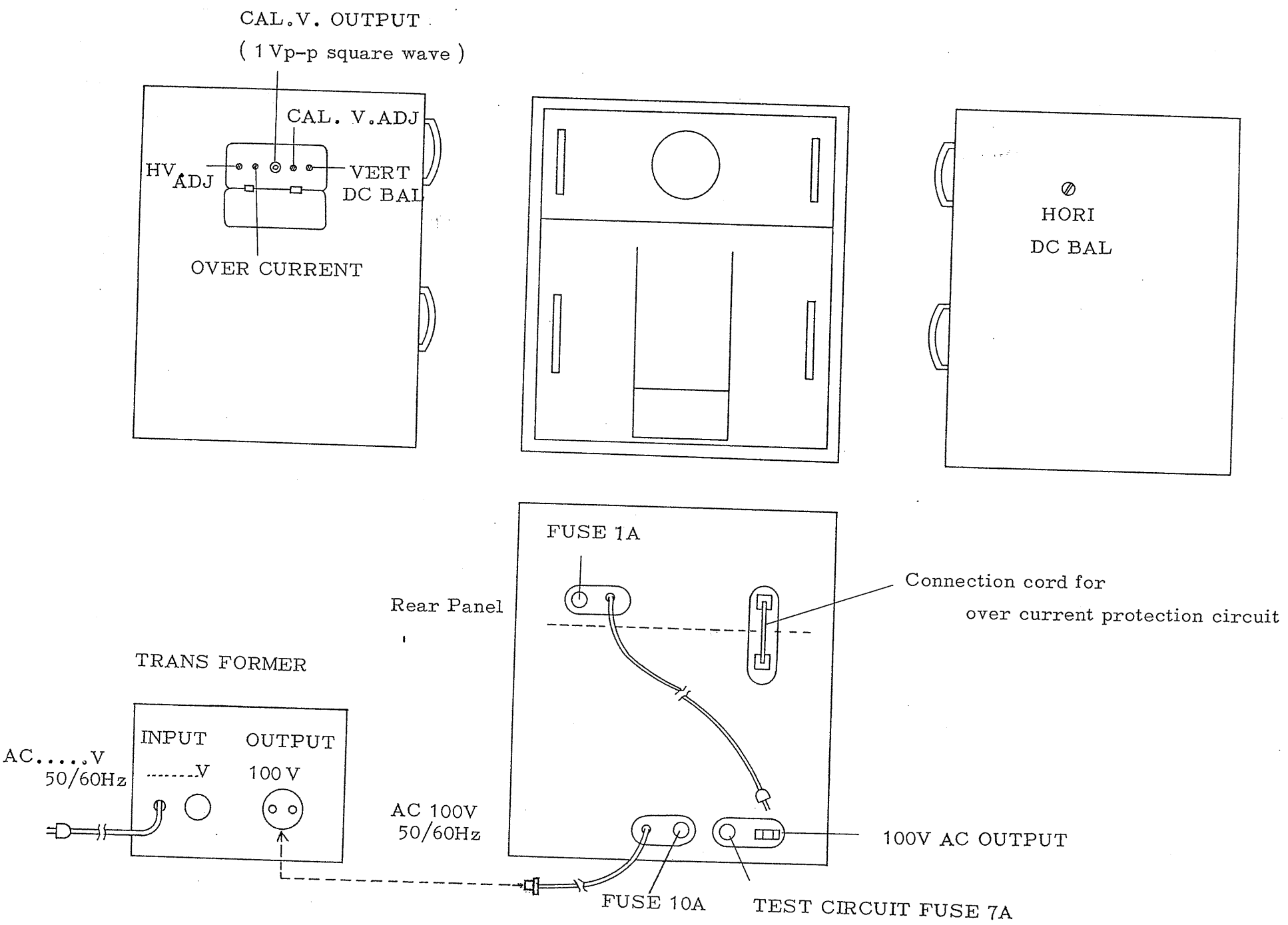
Another method of adjusting the semi-fixed resistance is by observing the CAL. VOLTAGE output terminal (see layout) by means

of oscilloscope subjected to sensitivity calibration, so as to obtain 1 v p-p square wave.

3. H. V ADJ

A voltage regulating semi-fixed resistor of high-stabilizing supply for CRT.

CRT cathode (pin No. 3) is measured by a vacuum tube voltmeter (for example, our company's 107 AVTVM) to obtain -1150 V. If this high voltage is adjusted, be sure to recalibrate the amplifier sensitivity.


CAL.V. OUTPUT
(1 Vp-p square wave)
CAL. V.ADJ
HV ADJ
VERT
DC BAL
OVER CURRENT
HORI
DC BAL
FUSE 1A
Rear Panel
Connection cord for
over current protection circuit
TRANS FORMER
INPUT
OUTPUT
AC.....V
50/60Hz
.....V
100 V
AC 100V
50/60Hz
100V AC OUTPUT
FUSE 10A
TEST CIRCUIT FUSE 7A

LOCATION