

MODEL 554A

OSCILLOSCOPE

The Model 554A oscilloscope is a precision triggered oscilloscope employing a dc-to-5 mc vertical amplifier and a 5-inch cathode-ray tube, and accurately presents the waveform ranging from 0.1 to 500 volts over the time-base from 0.2 usec to 25 sec on a calibrated 8 cm by 10 cm screen. Sweep circuit well synchronizes with randomly recurring pulses. Other features include 5X magnifier and regulated square-wave voltage calibrator.

SPECIFICATION

Power Requirement	100 volts, 50 to 60 cps, approx. 130 VA
Size - Cabinet	230 W x 310 H x 451 D mm
Maximum	240 W x 330 H x 498 D mm
Weight	Approx. 16 kgs.

Items Supplied with Equipment

- 1 - #43786 Scale (8 cm x 10 cm)
- 1 - #43216 Filter (green, orange, or blue)
- 1 - 951A Low Capacitance Probe
- 1 - 941B Terminal Adaptor
- 1 - Operation Manual
- 1 - Test Data

Cathode-Ray Tube	5 UPl-F or P2, P7, or P11.
Accelerating Voltage	Approx 1600 volts.

Vertical Axis

Input Terminal	UHF type receptacle (accepts either UHF-type or M-type plug)
Input Impedance	1 megohm shunted by 35 pF. In all ranges.
Maximum Input	600 volts p-p.
Sensitivity	8 ranges. From 0.1 volt/cm to 20 volts/cm in 1 - 2 - 5 step.
Accuracy	Within 3%
Frequency Response	2 cps to 5 mc in AC position 0 cps to 5 mc in DC position
Rise-Up Time	Less than 0.07 usec
Overshoot	Less than 2%
Sag	Less than 1%

Horizontal Axis

Circuit	Start-stop and recurring sweeps
Sweep	19 ranges. From 1 usec/cm to 1 sec/cm in 1 - 2 - 5 step. Also equipped with continuously variable control (1 usec/cm to 2.5 sec/cm) and 5X magnifier.

Accuracy	Within 5%
Trigger Input	-INT, +INT, -EXT, +EXT, and LINE
Voltage Calibrator Outputs	1, 2, and 5 volts p-p. Approx. 1000 cps square-wave. Regulated with a zener diode.
Accuracy	Within 3%.

FUNCTIONS OF CONTROLS AND TERMINALS

POWER OFF

Combined power switch and lamp switch to turn scale illuminating lamp. Turning this switch clockwise, it steps

- 1 POWER OFF - Power line is off, lamp is off.
- 2 - Power line is on, lamp is off.
- 3 ILLUM - Power line is on, lamp is on.

Within 20 seconds after power is applied, the equipment is in operating condition.

INTENSITY

A knob for adjustment of intensity of the trace. As this knob is turned clockwise, intensity increases. When this knob is turned fully counter clockwise, deflection sensitivity drops approximately by 3% due to increase in accelerating potential. Deflection sensitivities of both vertical and horizontal amplifiers are calibrated with intensity control set at maximum position.

FOCUS

A knob for adjustment of focus of the spot. The best sharpness is usually obtained around the center position.

ASTIG ASTIG

A knob for adjustment of minimizing astigmatism of the cathode ray tube. Any input is applied and a trace extending all over the screen is obtained. Then, this adjustment is adjusted in conjunction with FOCUS control so that maximum sharpness is obtained at any point of the trace.

VERTICAL POSITION HORIZONTAL POSITION

These knobs are to move the spot or trace vertically or horizontally on the screen. Turning VERTICAL POSITION clockwise, the spot or trace moves upward; and turning HORIZONTAL POSITION clockwise, the spot or trace moves leftward.

CAL V OUT

Output terminals at which calibration voltages are obtained for adjustment of deflection sensitivity of an amplifier or low capacitance probe. These outputs are approximately 1000-cps square-waves and are regulated against change in power line voltage.

VERT INPUT
and GND

Input terminals of the waveform to be observed. UHF-type receptacle accepts either UHF-type plug or M-type plug. Input impedance is 1 megohm with shunt capacitance of 35 pF and is constant in all ranges. When 951A Low Capacitance Probe is used, input impedance increases to 10 megohms shunted by 12 pF, however, sensitivity decreases to 1/10.

AC

A toggle switch to block DC component of waveform when this switch is placed in AC position, and to pass it when this switch is placed in DC position.

DC

VERTICAL V/CM
VARIABLE

A dual knob for setting deflection sensitivity of vertical amplifier.

External black-colored knob (V/CM) is to set the sensitivity from 20 volts/cm to 0.1 volt/cm in steps of 1 - 2 - 5. Sensitivity is calibrated when internal red-colored knob is turned fully clockwise.

Internal red-colored knob (VARIABLE) is to continuously vary the sensitivity. When this knob is turned from fully clockwise position to fully counter clockwise position, sensitivity decreases down to approximately 1/3.

DC BAL

A screw driver adjustment to obtain optimum balance of vertical DC amplifier. When VARIABLE knob of VERTICAL V/CM is turned counter clockwise, the trace may move vertically according to the setting of VARIABLE knob. Then, this adjustment is turned to return the trace to the original position.

EXT TRIGGER IN

Input terminals for external triggering signal. Input impedance is approximately 680 kilohms shunted by 30 pF. Triggering signal of at least + or - 1 volt at its peak is required for successful triggering.

TRIGGER
LEVEL

A dual knob to select trigger signals and to adjust trigger level.

External black-colored knob (TRIGGER) is to select trigger signal to be supplied to sweep oscillator, and can select any one of positive or negative excursion of observed waveform (+INT and -INT) or externally supplied trigger signal (+EXT and -EXT).

Internal red-colored knob (LEVEL) is to set the level at which sweep oscillator is triggered, and starts to sweep. At its fully counter clockwise position (AUTO), sweep oscillator is automatically triggered.

STABILITY

A knob to adjust the operation point of sweep oscillator. With this knob turned fully clockwise, sweep oscillator works in free-running condition, and turned fully counter clockwise, sweep oscillator stops its oscillation.

**SWEEP TIME/CM
VARIABLE
(PULL 5X MAG)**

A dual knob for setting sweeping speed.

External black-colored knob (TIME/CM) is to set the speed from 1 sec/cm to 1 usec/cm in steps of 1 - 2 - 5. Sweeping speed is calibrated when internal red-colored knob is turned fully clockwise.

Internal red-colored knob (VARIABLE) is to continuously the sweeping speed. When this knob is turned from fully clockwise position to fully counter clockwise position, sweeping speed decreases down to approximately $1/2.5$

When this knob is pulled out, 5X magnifier operates, and sweep width is expanded to 50 cm. Turning HORIZONTAL POSITION, details of waveform can be observed.

OPERATION

To become familiar with the operation of this equipment, with the aid of preceding FUNCTIONS OF CONTROLS AND TERMINALS, it is recommended that the operator first follow the procedure outlined below in the order given.

Setting Controls

Prior to turning power switch on, various controls are set as follows:

<u>Control</u>	<u>Set At</u>
POWER ILLUM	POWER OFF
INTENSITY	Fully clockwise
FOCUS	Center
VERTICAL POSITION	Center
HORIZONTAL POSITION	Center
VERTICAL V/CM	1 V/CM
VERTICAL VARIABLE	Fully clockwise
DC BAL	As was
AC ↔ DC	AC
TRIGGER	+INT
TRIGGER LEVEL	Fully counter clockwise (AUTO)
STABILITY	Fully clockwise
SWEEP TIME/CM	0.5 S
SWEEP VARIABLE	Fully clockwise

Power Line

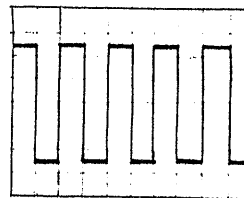
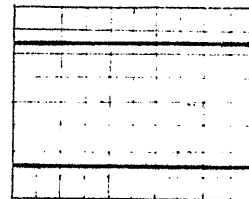
This equipment works on 100 volt 50 to 60 cps power line. Although, this equipment does not employ voltage regulation circuit for the amplifiers, the amplifiers are so designed that they are little affected by line voltage changes. However, it should be noted that, if line voltage varies suddenly over wide range, the normal operation may be disturbed, and when sweeping speed is low, the spot may swing.

Applying Power

1. Power cord is connected to an outlet of the power line supplying specified power.
2. POWER ILLUM knob is turned clockwise from OFF position. If necessary, this knob is further turned to ILLUM position to illuminate the scale.
3. Within about 20 seconds after power is applied, approximately 10-cm long horizontal line appears on the screen. Within initial a few minutes, however, this line may swing due to warm-up of DC-coupled amplifiers.
4. Turning VERTICAL and HORIZONTAL POSITION, this horizontal line is moved to the center of the screen.
5. Adjusting FOCUS, the best sharpness of the line is obtained.

Automatic Trigger

1. 941B Terminal Adaptor, supplied with equipment, is mounted on input terminal. Using a wire, 5 volts p-p calibration voltage at CAL V OUT is applied to input terminal.
2. Then, two horizontal lines appear on the screen as illustrated in the figure.
3. Then, STABILITY control is gradually turned counter clockwise from fully clockwise position. Sweep oscillator then synchronizes to the input signal, and a stationary square-wave appears as illustrated in the figure. (If this knob is further turned counter clockwise, sweep oscillator stops its operation, and the trace on the screen disappears.)
4. The waveform on the screen measures 5 cm in vertical amplitude and 2 cm horizontally per one-cycle of square-wave. Therefore;

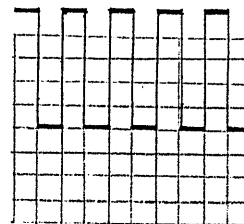


$$\begin{aligned} \text{Voltage} &= 5 \text{ cm} \times 1 \text{ volt/cm} = 5 \text{ volts p-p} \\ \text{Time per Cycle} &= 2 \text{ cm} \times 0.5 \text{ msec/cm} = 1 \text{ msec.} \end{aligned}$$

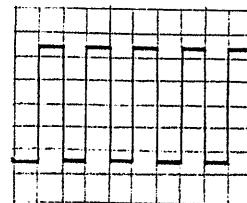
The frequency is therefore;

$$\text{Frequency} = 1/\text{Time per Cycle} = 1000 \text{ cps.}$$

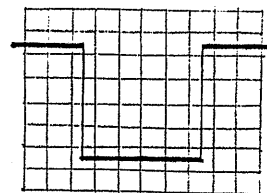
5. AC ↔ DC switch is put in DC position. Then waveform shifts upward by 1/2 of the vertical amplitude (this is equal to DC component of calibration voltage), as illustrated in the figure.



6. AC ↔ DC switch is returned to AC position, and TRIGGER knob is put in -INT position. Then, the polarity at starting point of the sweep reverses as illustrated in the figure.



7. SWEEP TIME VARIABLE knob is pulled out to operate 5X magnifier. Then, the waveform is enlarged 5 times horizontally as illustrated in the figure. Turning HORIZONTAL POSITION, details of the waveform can be observed.



8. The functions of VERTICAL V/CM and VARIABLE knobs are attempted. Increasing the sensitivity, note that waveform is not distorted and synchronization is stable even if waveform is appearing in excess of the area of the screen. Decreasing sensitivity, note that synchronization is stable till waveform reduces its amplitude down to 0.5 cm.

9. The functions of SWEEP TIME/CM and SWEEP VARIABLE knobs are attempted.

Trigger Level

Turning TRIGGER LEVEL knob clockwise from AUTO position, sweep can be made starting from any point of the observed waveform. When AUTO switch is turned off, the trace may disappear instantly, but as further turning clockwise, the trace again appears on the screen. Square-wave is not suitable for observation of trigger level, however, movement of waveform can be recognized according to the setting of this knob.

Attachment of Photographic Equipment

Replacing bezel of this equipment with CES Standard No. 130C Frame, camera hood for such cameras as Nikon, Canon, Asahi Pentax, and Polaroid Land can be attached.

Illumination of Scale

Removing bezel and rotating scale sheet by 180 degrees, the color of

illumination can be changed from white to red.

Horizontal Line on the Screen

Horizontal line appearing on the screen of the cathode-ray tube may in some cases incline due to the effect of terrestrial magnetism. To compensate this effect, the cathode-ray tube is rotated. Opening lefthand side board and loosening mounting screws at the base of cathode-ray tube, socket is slowly rotated together with filter and scale. Note - Do not touch the pins of socket at which a high voltage of -1400 volts is exposed.

Replacement of Cathode-Ray Tube

Unless otherwise specified, 5UP1-F, a tube with green fluorescence medium-persistence screen, will be used in the equipment. However, tubes with other types of screens can also be used for special order. Following table shows the available types of tubes.

<u>CRT</u>	<u>Excited Radiation</u>	<u>Persistent Radiation</u>	<u>Brilliance</u>	<u>Persistence</u>	<u>Use</u>
5UP1-F	Green	Green	High	Medium	General Use
5UP2-F	Bluish Green	Green	Low	Long	General Use
5UP7-F	Blue	Yellow	Low	Very Long	Low Speed
5UP11-F	Blue		Med	Very Short	Photographic

The cathode-ray tube can be replaced in the following manner:

1. Power cord is disconnected from power line. Then, bezel, scale, and filter are removed.
2. Lefthand side board is opened, and socket for cathode-ray tube is removed. (Care should be paid not to damage peaking coils) Loosening mounting screws at the base of tube, tube is pulled out toward front side.
3. A new tube is inserted, and following above procedure reversely, tube is temporarily mounted. Then, applying power, tube is firmly mounted so that the line appears exactly horizontally and also it coincide with horizontal lines on the scale.

ADJUSTMENT

When tubes or other parts are replaced, or when some deviation of performance is recognized after long period of use, adjustment should be required.

Adjustment on cathode-ray tube and vertical attenuator can be made opening lefthand side board. Adjustment on other points can be made opening righthand side board. Note - When equipment is operating, a high voltage of -2500 volts is exposed in the cabinet.

R601 (Intensity)

This is a screw driver adjustment to adjust the intensity of the trace when INTENSITY knob is turned fully clockwise.

1. INTENSITY knob is turned fully clockwise.
2. CAL V OUT is connected to INPUT terminal and height of the trace is adjusted to 8 cm.
3. R601 is adjusted for optimum brilliance.
4. Turning INTENSITY knob counter clockwise, height of the trace at vanishing point is measured.
5. If this height is more than 7.8 cm, adjustment is completed.
6. If this height is less than 7.8 cm, R601 should be readjusted at lower brilliance point.

R610 (Astigmatism)

This is a screw driver adjustment to minimize astigmatism of the cathode-ray tube.

1. Any input is applied and a trace extending all over the screen is obtained. Then, this adjustment is adjusted in conjunction with FOCUS control so that maximum sharpness is obtained at any point of the trace.

R205 (Calibration Voltage Output)

This is a screw driver adjustment to set calibration voltage outputs exactly as indicated.

1. An accurate +5 volts DC voltage source is applied to input terminal. Kikusui Model 4940 Square-Wave Voltage Calibrator is convenient in this adjustment. When Model 4940 is used, a 5-volt p-p square-wave is applied to input terminal.
2. AC ↔ DC switch is turned to DC position and vertical amplitude is adjusted to 8 cm.
3. Then, 5 volts p-p output at CAL V OUT terminal is applied to input terminal, and R205 is adjusted to obtain vertical amplitude of 8 cm.
4. Similarly, 2 volts p-p and 1 volt p-p outputs at CAL V OUT terminals are checked. If deviations are so great, voltage dividing resistors R206 through R208 should be replaced.
5. Varying power line voltage by $\pm 10\%$, variation of outputs at CAL V OUT is checked. The variation should be about $\pm 1\%$ or less.

R329 (Vertical Gain)

This is a screw driver adjustment to set the sensitivity of vertical amplifier.

1. VERTICAL V/CM switch is placed in 0.1 V/CM position, and VARIABLE knob is turned fully clockwise. Using Kikusui Model 494C Square-Wave Voltage Calibrator, a square-wave of 0.8 volt p-p is applied to input terminal. Turning R329, vertical deflection is adjusted to 8 cm.
2. Then, voltage of square-wave is lowered to 0.7, 0.6, --- and to 0.1 volts p-p, and linearity of vertical deflection is checked.
3. Similarly, adjusting voltage of square-wave calibrator, with VERTICAL V/CM switch placed in other positions, each range is checked.

This adjustment can also be made utilizing outputs at CAL V OUT terminals as follows:

1. VERTICAL V/CM switch is placed in 0.1 V/CM position, and 1 volt p-p output at CAL V OUT terminal is connected to input terminal. Turning VARIABLE knob, vertical deflection is adjusted to 8 cm.
2. Keeping VARIABLE knob in the same position, VERTICAL V/CM switch is now placed in 0.2 V/CM position and 2 volts p-p output is connected to input terminal. Vertical deflection should then be 8 cm.
3. Then, 1 volt p-p output is connected to input terminal and VARIABLE knob is turned fully clockwise. Then, R329 is adjusted to obtain a deflection of 5 cm.

Frequency Compensating Trimmers

These trimmer capacitors are provided to compensate the higher end of the frequency response of vertical input attenuator.

1. AC ↔ DC switch is turned to DC position. Connecting square-wave output of CAL V OUT or Model 494C to input terminal, these trimmers are adjusted so as to obtain the best square-wave on the screen. This adjustment is done in the order given in following table.

Order	VERTICAL V/CM	Attenuation Ratio	Frequency Compensating Trimmers	Input Cap. Adjusting Trimmers
1	0.1	1:1	---	0315
2	0.2	1:2	0309	0311
3	0.5	1:5	0312	0313
4	1	1:10	0302	0303
5	10	1:100	0305	0306

Input Capacitance Adjusting Trimmers

These trimmer capacitors are provided to adjust input capacitance to 35 pF at all of VERTICAL V/CM positions.

1. Kikusui Model 231A L-C Meter is used in this adjustment. Connecting a coaxial cable to the L-C meter, zero point is obtained. Then, connecting other end of coaxial cable to input terminal, these trimmers are adjusted so that the L-C meter indicates 35 pF.

L351 through L358 (Peaking Coils)

These are peaking coils to compensate higher end of frequency response of the vertical amplifier.

1. VERTICAL V/CM switch is placed in 0.1 V/CM position and VARIABLE knob is turned fully clockwise. Using Kikusui Model 495A Square-Wave Generator, a square-wave of about 1000 kilocycles is applied to input terminal. Then adjusting L351 through L358 alternatively, the best square-wave is obtained. If these are adjusted properly, overshoot should be less than 2%.
2. Using constant amplitude sine-wave generator, such as Kikusui Model 331, frequency response at its higher end is checked.

Sweep Oscillator

Sweeping speed varies according to setting of R155 (horizontal gain) in all ranges. Also, it varies according to setting of R160, C150, and others, and these adjustments affect on each other. Therefore, this adjustment should be made in the order given below:

1. SWEEP VARIABLE knob is turned fully clockwise, and pushed (5X magnifier not to work).
2. Using Kikusui Model 442 Time Marker Generator, time marker is supplied to vertical input terminal and trigger signal is supplied to EXT TRIGGER IN. Sweep oscillator then synchronizes to trigger signal. Adjustment is made in the following order.

<u>Order</u>	<u>SWEEP TIME/CM</u>	<u>Model 422 Output</u>	<u>Adjust on</u>
1	10 uS	10 usec	C121 through C124

These are to adjust linearity of sweep. See note (1) below.

Followings are to adjust sweeping speeds at each range

2	1 mS	1 msec	R155 (horizontal gain)
Turning R125 (sweep length), length of horizontal line is adjusted to 10.5 cm.			
3	2 mS	1 msec	R
4	5 mS	0.1 msec	R
5	0.1 mS	0.1 msec	C
6	10 mS	10 msec	C
7	0.1 S	100 msec	C
8	1 S	1 sec	C
9	10 uS	10 usec	C
10	5 uS	1 usec	R
11	1 uS	1 usec	C
12	2 uS	1 usec	R

Note (1) This adjustment also affects on the linearity of 5X magnifier sweep.

3. SWEEP VARIABLE knob is turned fully counter clockwise, and sweeping speed is checked if they decrease to about 1/2.5. If not, R135 is replaced.
4. SWEEP V/CM switch is turned to 10 uS/CM position, and SWEEP VARIABLE knob is turned fully clockwise and pulled out (5X magnifier operates).
5. Turnign HORIZONTAL POSITION clockwise, left end of the waveform is presented on the screen. The sweeping speed at left end is checked and compared with the sweeping speed at right end. Then, trimmer capacitor C121 and C122 are adjusted so that sweeping speeds at left and right ends becomes equal.
6. If sweeping speed is in excess or in short of 5 times when 5X magnifier is operating, R127 and R128 are replaced and C121 and C122 are readjusted.
7. When liniarity of 5X magnifier sweep is adjusted, liniarity of ordinary sweep previously adjusted may be affected. Therefore, these adjustments are repeated alternatively several times.