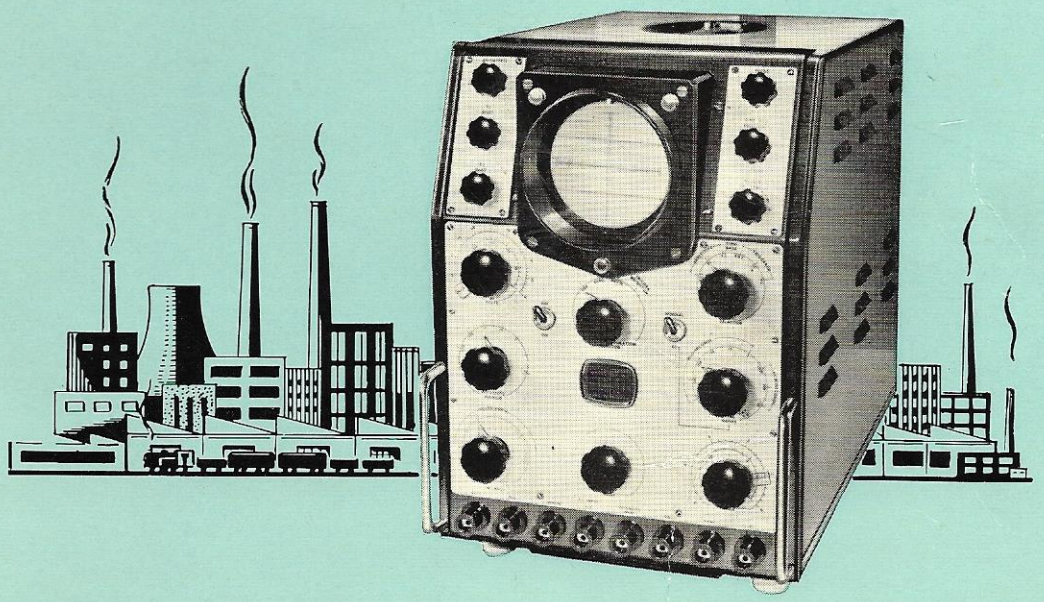
J. M. C. EVELAND.

COSSOR

INDUSTRIAL OSCILLOGRAPH



Model 1049 Mk IV

Operating and Servicing

COSSOR CATHODE-RAY TUBES

Fluorescent Screens

Cossor Oscillographs, Models 1035 and 1049, are supplied with cathode-ray tubes using standard screen materials which produce a suitable fluorescence for general-purpose use. For some applications, it may be necessary to fit these oscillographs with a CRT which has a screen material capable of being used for faster photographic recording or for the provision of a long after-glow for transient phenomena. Again, when photographic recordings are not essential, a green fluorescence may be preferred for continuous observation. The list below gives the Cossor reference letter (suffix to CRT type) for the screen materials available.

Suffix D Green response for general oscillographic work with negligible after-glow (2—3 msec)

J Blue response of high actinic value for photographic work with negligible after-glow (100—200 μsec)

L Blue-green initial response with long yellow-green after-glow (3—5 sec)

Z Blue initial response with very long yellow-green after-glow (5—10 sec)

Times quoted are approximate, referring to half-light in dark ambient conditions and with a CRT final accelerating potential of 2 kV.

The Z screen, which provides a very long after-glow, also possesses an important property of being able to store some of the incident energy. By flooding the screen with infra-red radiation, the stored energy can be released; thus, information displayed on the screen at different times may be viewed together at any time—up to several weeks, if necessary—after the information was originally displayed.

When making use of the storage facility, the Z type screen does not possess a high-speed writing characteristic, the maximum writing speed being only a few centimetres per millisecond. The intensity/decay time of the stored display can be controlled by the intensity of the infra-red radiation, for example, it is over 1 minute at low intensity and, if desired, this radiation can be given in several short bursts.

Since the screen must be protected from ultra-violet radiation, which excites the screen, and must be viewed in darkness, a special adapter assembly is available. This assembly includes: the appropriate filters, lamps and control for infra-red illumination, viewing hood and illuminated graticule for use with all Marks of Cossor Oscillographs, Models 1035 and 1049.

Illuminated Graticule	Model 1459
Viewing Hood with Mains Transformer, filters etc.	Model 1460

The graticule can be used separately for visual measurement when another hood is used or for photographic recording purposes.

To prolong the useful life of the screen material of any CRT, the brilliance control should always be set to minimum when the instrument is not in use. This procedure is very necessary when using L or Z type screens. For example, when using the 4 kV EHT facility in Model 1049 to investigate transient phenomena, brilliance precautions must be carefully observed at all times.

COSSOR

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Model 1049 Mk IV

Operating and Servicing

THE DESIGN IS SUBJECT TO MODIFICATION

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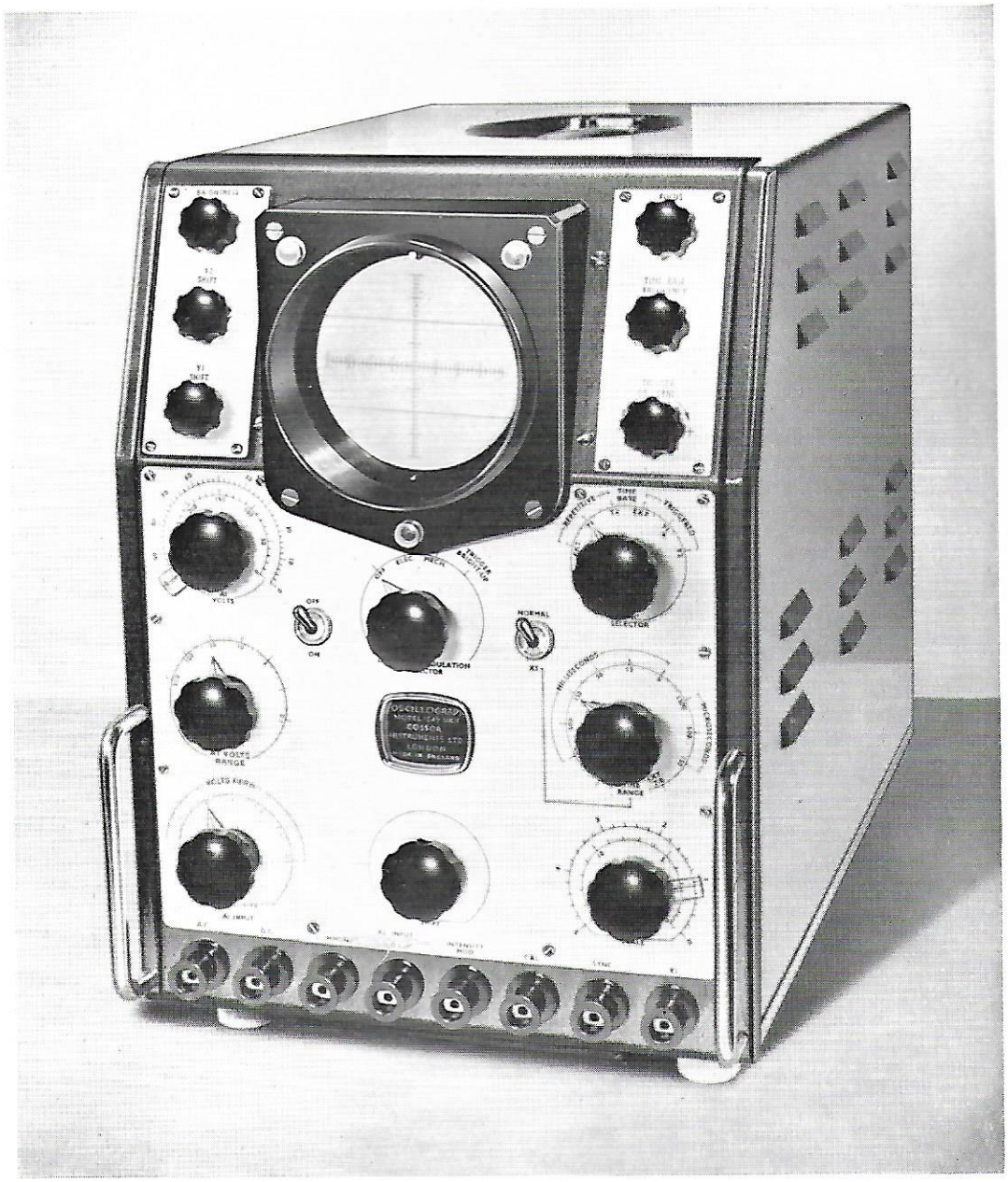

INTRODUCTION

Oscillograph Model 1049 has established itself as an instrument for use in the fields of Servo-control, Electrical Engineering, Vibration Analysis, Electro-medical Instrumentation and many other industries. The Mark IV version incorporates eighteen time-base ranges and a facility for trigger bright-up which enables greatly improved quality of photographic recording to be achieved in the single-stroke mode of operation.

The two d.c. amplifiers have a wide frequency response and are pulse corrected. Triggered or repetitive operation of the time-base is available and the scan may be synchronized from either of the amplifiers or externally. Duration of the scan is variable over a wide range. Two methods of external intensity modulation are provided.

Links enable an E.H.T. voltage of twice the normal value to be used for high writing speeds and photographic work. Stabilized H.T. and E.H.T. potentials are provided and the A1 amplifier is compensated for variations in heater voltage.

Spring-loaded terminals permit quick connection and disconnection of leads and the insertion of small clip connectors or 4 mm continental plugs into their coaxial sockets. Model 1049 Mk IV is hammer finished in grey enamel with maroon fittings and polished chromium handles.

SPECIFICATION

Cathode-ray Tube ... Cossor 4 in. (10 cm) double-beam, type 89J, with blue fluorescence, operating at 2 kV (a3) or 4 kV.
Y sensitivity direct to plates 3 V/mm (0·33 mm/V).
X sensitivity direct to plates 2·6 V/mm (0·38 mm/V).
Sensitivities will be 6 V/mm and 5·2 V/mm when 4 kV is employed.
Direct connections from X and Y plates, E (chassis) and COMMON terminals are available at the side of the instrument.

A1 Amplifier ... ... Maximum gain: 900. Five valves. Frequency-compensated input attenuator.
Frequency response: d.c. to 200 kc/s at 30 per cent down.
Maximum rise-time: 2 μsec.
Maximum overshoot: 5 per cent on attenuated ranges.
Maximum input: 1000 V d.c. or peak a.c.
Maximum output: full screen up to 90 kc/s, 2 cm at 400 kc/s.
When INPUT a.c. terminal is used, there is a reduction of gain of less than 10 per cent at 50 c/s relative to 1000 c/s.
Input impedance: 0·5 MΩ to 1·5 MΩ, 10 pF to 70 pF.
Directly calibrated voltage scale.
Heater supply variations compensated for $\pm$10 per cent change in mains voltage.

A2 Amplifier ... ... Maximum gain: 30. Two valves. Frequency-compensated input attenuator.
Frequency response: d.c. to 400 kc/s at 30 per cent down.
Maximum rise-time: 1 μsec.
Maximum overshoot: 5 per cent on attenuated ranges.
Maximum input: 1000 V d.c. or peak a.c.
Maximum output: full screen up to 180 kc/s, 2 cm at 800 kc/s.
Input impedance: 0·5 MΩ to 5 MΩ, 10 pF to 50 pF.
Range switch scaled in deflection sensitivities from 0·1 V/mm to 10 V/mm.

Time-base ... ... Repetitive or Triggered (single-stroke) operation.
Directly calibrated time scale with eighteen ranges from 150 μsec to 7·5 sec.
Maximum time-base start time on 150 μsec range with maximum trigger sensitivity (+ve or −ve) is 1 μsec.
Time scale can be extended by a factor of 5 on each setting of the Time Range switch, by operation of switch marked Normal/X5.

Trigger and Synchronization ... ... Input impedance 3 MΩ, 30 pF.

A six-position switch selects External Repetitive/Triggered or Internal Repetitive/Triggered from A1 or A2 output signals.

Continuously variable Trigger or Sync amplitude control, positive or negative.

Sensitivity

- EXT
  - 10 V peak-to-peak above 20 c/s.
  - 20 V peak-to-peak from 2–20 c/s.
- Y1, Y2
  - 1 cm deflection above 20 c/s.
  - 2 cm deflection from 2–20 c/s.

Test Waveform Voltage ... 50 V peak-to-peak (nominal) between CAL and COMMON terminals.

Intensity Modulation ... Controlled by a four-position switch:

OFF.

EXT ELECTRICAL: can be used to cut off the beam by applying a negative voltage to the INTENSITY MOD terminal. A 7 V r.m.s. signal will switch the beams on and off at frequencies up to 100 kc/s with the CRT operating on 2 kV or 4 kV.

EXT MECHANICAL: enabling beam to be cut off by shorting INTENSITY MOD and COMMON terminals.

TRIGGER BRIGHT-UP: cuts off the beams while stationary. When the time-base is triggered, the traces appear immediately. It is operated in conjunction with the BRIGHTNESS control.

Power Supply ... ... Mains: 200 V to 215 V, 216 V to 234 V and 235 V to 255 V for standard model.

105 V to 115 V and 120 V to 130 V for low-voltage model.

Frequency: 50 c/s to 100 c/s.

Consumption: 180 W.

Size and Weight ... ...

Height	$16\frac{1}{2}$ in.	(41·9 cm).
Depth	$21\frac{3}{4}$ in.	(55·3 cm).
Width	12 in.	(30·5 cm).
Weight	77 lb	(35·0 kg).

OPERATING THE OSCILLOGRAPH

Caution: The instrument will not operate and may suffer serious damage if connected to a d.c. supply or to a supply of a frequency less than 50 c/s.

Do not touch any part of the circuit while the mains supply is connected. The mains fuses are in the unswitched side of the mains and will be live when the mains supply is connected, even though the instrument is switched off.

POWER SUPPLY

Ensure that the mains selector, accessible by dropping the sliding panel at the rear of the instrument, is set to the range covering the voltage of the supply from which the instrument is to be operated.

Connect the cable lead to a suitable plug and insert this plug into a mains power socket. Move the On/Off switch to the ON position.

REPLACEMENT OF FUSES AND VALVES

If a fuse requires replacing, first remove the instrument power plug from the mains supply socket.

Whenever a valve is replaced, the setting-up procedure for the relevant circuit must be carried out as described under Servicing.

BRIGHTNESS AND FOCUS

Adjust the BRIGHTNESS and FOCUS controls to give suitable brightness and the best definition.

GRATICULE

To rotate the graticule, use the thumb and one finger to grip the small pin located near the periphery and apply a turning movement. Position the graticule so that the two plain lines are horizontal and parallel to the trace on the CRT.

RAISING MEMBER

Use the adjustable raising member under the front of the instrument, as required, to provide a convenient viewing angle. To bring the raising member into use, grip one of the chromium handles and lift the front of the instrument. Release the raising member from its two spring clips and pull it fully forward.

Note: The raising member can be used to advantage when the instrument is operated at low eye-level in order to obtain better reading accuracy on the graticule.

VIEWING HOOD

The plastic viewing hood, held in position by four screws, serves to locate the graticule and to shield the tube face from unwanted illumination.

VOLTAGE MEASUREMENT

Caution: The input to the A1 or A2 amplifier must not exceed 1000 V d.c. or peak-to-peak a.c.

A1 Amplifier

Use the A1 INPUT d.c. or a.c. terminal.

Put the A1 Volts Range switch to a position such that the waveform to be measured is between 1 cm and 5 cm amplitude.

Set the cursor on the A1 VOLTS scale to zero.

Turn the Y1 SHIFT control to position the waveform (or portion of it) to be measured so that its base is coincident with the centre horizontal line of the graticule or other convenient index line.

Move the cursor so that the top of the waveform (or portion of it) is brought down to the horizontal line or other index line chosen.

If the A1 Volts Range switch is positioned at 1 V or a multiple of ten of this figure, read the voltage direct from the **outer** scale of the A1 VOLTS control, placing the decimal point according to the range setting.

If the A1 Volts Range switch is positioned at 0·3 V or a multiple of ten of this figure, read the voltage direct from the **inner** scale of the A1 VOLTS control, placing the decimal point according to the range setting.

A2 Amplifier

N.B. The input attenuator provides a d.c. path to earth and, if this is likely to cause interference to the apparatus being tested, an external capacitor must be used.

Use the A2 INPUT d.c. terminal. Position the waveform (or portion of it) to be measured as described for the A1 amplifier but using the Y2 SHIFT control.

To determine the voltage of a signal, or part thereof, measure its amplitude in millimetres with the graticule and multiply by the factor indicated by the A2 SENSITIVITY control.

If the 4 kV E.H.T. supply is in use, multiply this factor by 2 because the deflection sensitivity of the CRT is inversely proportional to its anode voltage.

TIME-BASE

Range Selection

For general use, choose a Time Range so that the input waveform appearing on the screen is between 2 and 6 cycles.

Selection of Trigger or Sync

Use the Sync Selector switch to trigger or synchronize the time-base from either amplifier or from an external signal applied between the SYNC and COMMON terminals.

Select the polarity of the synchronizing triggering pulse applied to the time-base by turning the TRIGGER or SYNC control as required.

Note: The + and — symbols are read when signals are applied to the Sync terminal. Selection of Sync or Trigger from either amplifier will be of reversed polarity to signals applied to Sync terminal.

To find the centre zero position of the TRIGGER or SYNC control, rotate the knob until the engraved dot is uppermost.

Time Measurement

If the time-base is in the repetitive condition, resolve the trace into an almost stationary waveform by selection of the appropriate scanning speed with the Time Range Switch and TIME-BASE FREQUENCY control. Lock the trace by minimum rotation of the TRIGGER or SYNC control.

Note: The repetition rate of the scan is adjusted by the TIME-BASE FREQUENCY control which does not vary the velocity of the spot. Therefore, maintaining a constant spot velocity with a varying repetition rate will involve a change in sweep amplitude and the trace length is, for a given Time Range setting, inversely proportional to the repetition rate of the time-base.

When the time-base deflection is locked to the signal, set the TIME SCALE control to zero and use the X SHIFT control to position the point of the trace from which measurement is required to the vertical datum line on the graticule.

Rotate the TIME SCALE control to move the trace through the 'distance' to be measured and read the Time interval direct from the control dial, the **outer** scale being used on the 500 msec, 50 msec, 5 msec and 500 μsec time-base ranges and the **inner** scale on other ranges.

X5 Scale

When a greater time range is required, move the Normal/X5 switch to the X5 position, giving scales of 750 μsec, 2·5 msec, 7·5 msec, 25 msec, 75 msec, 250 msec, 750 msec, 2·5 sec and 7·5 sec. For these time ranges, divide the scale reading by two and place the decimal point appropriately for the range in use.

INTENSITY MODULATION

Caution: When operating in the triggered mode, the Intensity Modulation Selector should be set to the TRIGGER BRIGHT-UP position so that, if the triggering signal ceases, then the beams will be cut off automatically, thus protecting the CRT screen.

The Intensity Modulation Selector has four positions:

OFF. All modulation systems are inoperative and the traces are displayed at an intensity determined only by the BRIGHTNESS control.

ELEC. In this position, the beams may be switched off by applying a negative d.c. pulse or switched on and off by applying an alternating voltage to the INTENSITY MOD terminal. A 7 V r.m.s. signal will switch the beams at rates up to 100 kc/s, the return or positive connection being made to COMMON. The control is practically instantaneous in action and the effect is maintained as long as the voltage remains applied. However, there is no direct connection from this terminal to the CRT grid. The switching potential affects the operation of a high-frequency oscillator circuit which, in turn, is responsible for the tube bias excursions. Hence, the possibility of a dangerous high-voltage shock from this point is removed.

MECH. The beams are switched off for the duration of a short circuit made between the INTENSITY MOD and COMMON terminals which impose a resistive electrical load upon the external switch or contactor of less than 2 mA at 70 V.

TRIGGER BRIGHT-UP. This facility is provided for use with the time-base operating in the triggered mode and will cause the stationary beams to be cut off. A slight readjustment of the BRIGHTNESS control may be necessary to obtain complete black-out. When the sweep is triggered, the beams immediately operate at normal brightness during the forward stroke and are blacked out during fly-back and until the next trigger.

DIRECT CONNECTION TO CRT PLATE

Caution: Do not touch any link or terminal when the power is applied to the instrument. Switch off the power supply and allow 30 seconds, at least, before touching the links.

Terminals are provided, behind the side panel, to allow for direct connection of the signal to the deflector plates. Each terminal has three sockets beside it, the centre socket being connected to the plates, the right-hand sockets to the time-base and amplifiers, and

the left-hand sockets to the four terminals. To apply an external signal to any plate the plugs must be transposed to connect the centre to the left-hand socket.

Normally, the chassis and case of the instrument, connected to the E (CHASSIS) terminal on the side panel, are linked to the COMMON terminal by the wire link provided. When direct connection to the CRT plates is required, operate the plates at or near the potential of the third anode, that is, 325 V above COMMON. Positive or negative inputs within 150 V of earth potential can be applied by linking E (CHASSIS) to TUBE ANODE for the return path to external circuits, COMMON being left disconnected because it will become 325 V negative with respect to the instrument case.

SELECTION of 2 kV or 4 kV

Caution: The instrument must be switched OFF for at least two minutes before this adjustment is made.

To change from the normal 2 kV or 4 kV operation, transpose, to the right, the three plugs located in panel behind the rear door in the instrument case.

BEAM BRIGHTNESS ADJUSTMENT

If it is desired to correct for lowered beam brightness resulting from a greater signal excursion on one beam, carry out the procedure for this given on page 25.

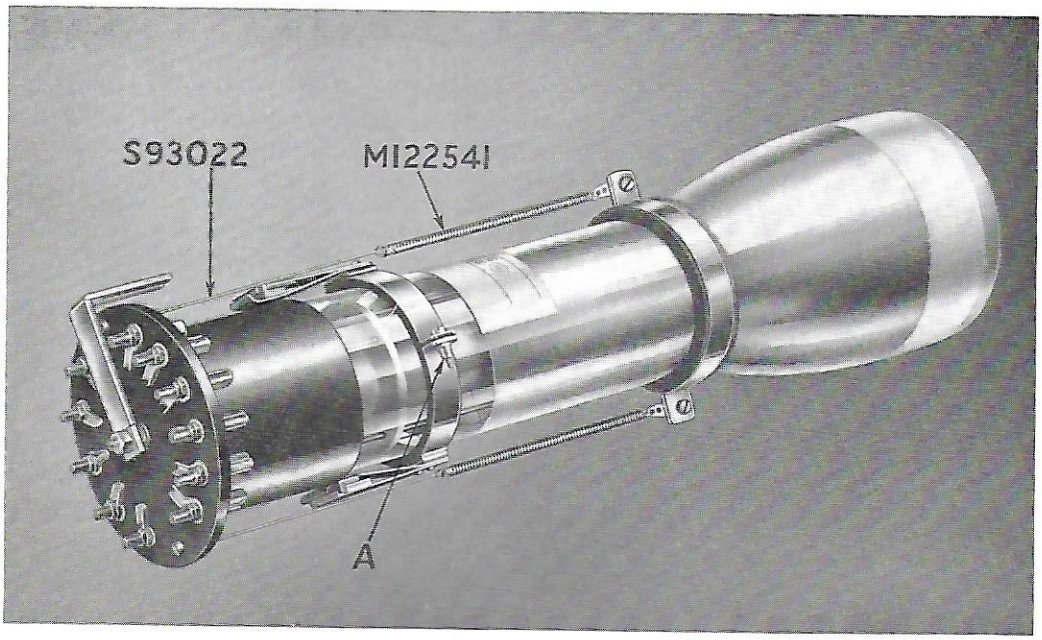

Fig. 1 *CRT with Beam Brightness Equalizer*