

**wide
band
oscilloscope**

model

301

NAGARD
LTD



A new high-performance Nagard Oscilloscope, with direct-reading time and voltage calibrations.

Time Base of advanced design covering more than a *100 million to 1* range of sweep times from $10 \text{ m}\mu\text{sec/cm.}$ to 1.2 sec/cm. , very linear, easily controlled, and with versatile triggering system.

Vertical Amplifier response D.C. to 40 Mc/s (-3dB) at a maximum sensitivity of 1 cm/100 mV.

Rise time $9 \text{ m}\mu\text{sec.}$

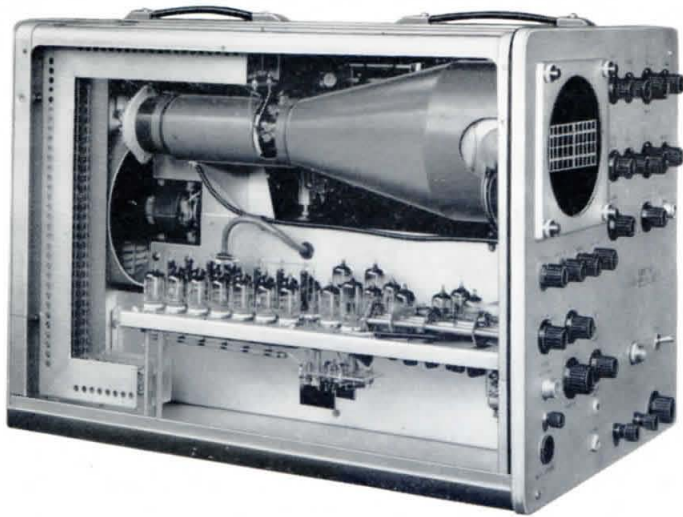
Built in pre-amplifier, increasing sensitivity to 10 mV/cm. over a band of 2.5 c/s to 20 Mc/s.

Low noise and high stability.

Signal delay incorporated.

Fully stabilised power supplies.

5° C.R.T. with fine trace and high efficiency screen enabling single stroke recording at the maximum sweep speed.



Note the clean design, with all parts of the instrument easily accessible for servicing. The E.H.T. unit plugs in and may be removed for exchange or service.

The instrument is built to exacting standards using only the best obtainable components. It is subjected to scrupulously careful testing, including a long 'soak' test, after which all calibrations are checked. A first class maintenance service is available from us, and comprehensive instructions are given with the instrument to aid servicing by the user.

Designed to make the utmost use of the latest type of helical P.D.A. Cathode Ray Tube, this instrument provides the essential features of a wide band oscilloscope with accurate measuring facilities and a wide range of sweep speeds.

These features have been achieved without excessive complication, resulting in a rugged and reliable design produced to the highest standard of workmanship at an economical price.

The Circuit design is such as to give the valves very favourable conditions so that the instrument will continue to operate faithfully in spite of valve ageing.

GENERAL SPECIFICATION

Vertical Deflection

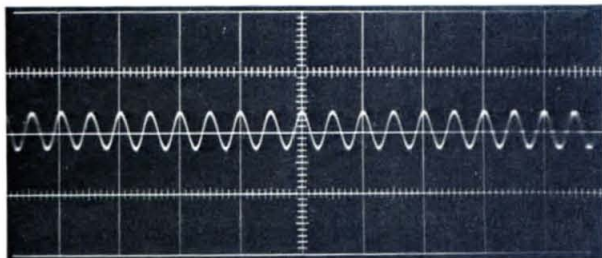
<i>Bandwidth</i>	D.C. to 40 Mc/s (-3dB) irrespective of attenuator or gain control settings.
<i>Rise-time</i>	9 m μ sec.
<i>Sensitivity</i>	1 cm/100 mV. to 1 cm/20 V. in seven ranges continuously variable, extended to 1 cm/200 V. by R.C. probe.
<i>Input impedance</i>	Constant at 1 M Ω shunted by 25 μ F.
<i>Voltage measurement</i>	Sensitivity is calibrated in volts/cm. Overall measurement accuracy $\pm 3\%$.
<i>Calibrator</i>	Square-wave output, 4v, 0.4v and 0.04v.
<i>D.C. Level check</i>	Locates zero D.C. level of input signal.

PERFORMANCE USING SWITCHED PRE-AMPLIFIER:

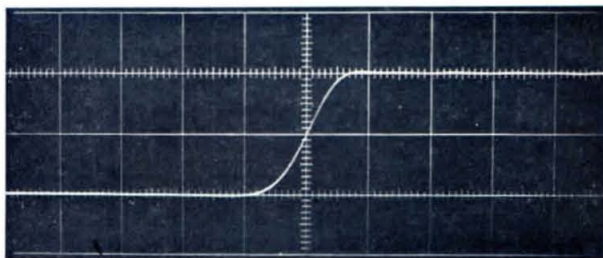
<i>Bandwidth</i>	2.5 c/s to 20 Mc/s.
<i>Rise-time</i>	17 m μ sec.
<i>Sensitivity</i>	1 cm./10 mV maximum. The pre-amplifier increases overall sensitivity by a factor of 10.
<i>Balanced delay line</i>	0.18 μ sec. signal delay.
<i>Trace position indicator</i>	Vertical position of the trace is indicated by two neon lamps on the amplifier panel.
<i>R.C. probe</i>	Input impedance 10M Ω shunted by 8 μ F, attenuation 10:1. This is included with the standard instrument.
<i>Cathode follower probe</i>	Input impedance 1 M Ω shunted by 5 μ F, taking supplies from socket on amplifier panel. Attenuation 2:1. This is an optional extra and only supplied to order.

Horizontal Deflection

<i>Calibrated Sweep Rates</i>	0.1 μ Sec/cm. to 5 sec/cm. in 21 fixed steps, accuracy $\pm 3\%$.
<i>Sweep expansion</i>	$\times 10$, extending maximum sweep velocity to 1 cm/0.01 μ sec.
<i>Continuously variable velocity</i>	Fine control permits adjustment of sweep time to any value between 0.01 μ s/cm. and 1.2 sec/cm.



Trace showing input signal of 2 mV R.M.S. at 20 Mc/s, Time-base velocity 0.1 μ sec/cm., showing sensitivity and low noise level when switched to high-gain conditions.



Trace showing leading edge of pulse at maximum time base velocity 10 m μ sec/cm. Input signal rise time 3 m μ sec.

Triggering and Synchronization

<i>Level Control</i>	Permits triggering to take place at a pre-determined potential.
<i>Stability control</i>	Permits time-base to be stopped, triggered, synchronized or free run.
<i>Polarity</i>	Determines whether triggering signal is positive-going or negative-going at instant of triggering.
<i>Trigger Mode</i>	Selects the following conditions:— Internal direct-coupled. External direct-coupled. Internal sharp pulse } External sharp pulse } (Excludes D.C. component.) Internal H.F. synchronization. External H.F. synchronization.
<i>Trigger sensitivity</i>	Internal, 1 mm. deflection. External, 0.1V. peak to peak.
<i>Synchronization</i>	Effective with sine-wave inputs up to 50 Mc/s.

Cathode Ray Tube

<i>Cathode Ray Tube</i>	5 BHP1-FF green, normally supplied, (alternative phosphors available). Diameter 5", flat faced. Acceleration voltage 10 Kv. Direct connection deflection factors. Vertical 7v/cm. approx. Horizontal 30 v/cm. approx. Window area: 4 × 10 cms. min.
<i>Graticule</i>	Adjustable illumination, ruled in centimetres with centrally placed vertical in millimetres and two horizontal rulings spaced 2 cms. apart. Ideal for rise time measurement.

VALVE AND SEMI-CONDUCTOR COMPLEMENT

25—E180F 2—E810F 9—A2293 8—6BQ7A 7—ECF82 4—U37 3—EF86 3—EL822 2—EL84 1—EB91 1—90C1
16—OA210 1—CG1E 1—OA10 4—CC3L 1—5BHP1FF C.RT.

<i>Dimensions overall</i>	23½" × 15½" × 14" (60 × 39 × 36 cm).
<i>Weight</i>	73 lbs. (33 Kgs.)
<i>Consumption</i>	475 VA approx.

ACCESSORIES SUPPLIED AS STANDARD

- 1 Signal input lead and connector (3 feet).
- 1 Terminal adaptor for input sockets.
- 1 R/C Probe with 3½ feet of cable.

OPTIONAL ACCESSORIES SUPPLIED TO ORDER

- Cathode Follower Probe with 3½ feet of cable.
- Camera attachment.

Standard model is for operation on 50 cycle supplies at 190-250 V.

A model for 110 V. 60 cycle supplies is available to order.

DESIGN FEATURES

Vertical Amplifier

The vertical amplifier makes use of high mutual-conductance valves in a distributed amplifier circuit, giving a high sensitivity with a wide bandwidth usable up to 50 Mc/s. This drives the Y plates of the C.R. tube via a balanced delay line. D.C. shift compensation is applied to cancel the small difference in gain between D.C. and A.C. signals. This can be adjusted by a preset control should it become necessary due to valve replacement. The gain of the main amplifier is adjustable to cover the steps between the attenuator positions, and the basic gain of the amplifier and the pre-amplifier can be adjusted by preset front panel controls to provide direct calibration of the Y axis in volts per cm. An internal square-wave generator with various output voltages is available for this. This generator can itself be checked using an accurate D.C. voltmeter.

The input attenuator is calibrated in volts/cm. and presents a constant impedance under all conditions. This permits the use of the resistance-capacity probe, which extends the range of voltage measurement upwards by a factor of ten, raises the input resistance and reduces the input capacitance.

A cathode follower probe is available as an optional extra. This takes its supplies from a socket on the amplifier front panel. This probe permits low-capacitance connections to be made to circuits under test, in the same ways as the Resistance-Capacity probe, but without introducing such a high degree of attenuation. The pass-band of the probe is such that it does not materially impair the performance of the Oscilloscope.

The A.C. pre-amplifier can be switched in or out of circuit as required by the input selector switch, and provides a tenfold increase in gain with a 50% reduction of the bandwidth.

The main amplifier is D.C. coupled but the D.C. component may be excluded by switching the input selector switch from D.C. to A.C.

A fourth position on this switch provides the useful facility of locating the zero D.C. level of the input signal. When the switch is turned to this position the input signal is automatically disconnected, the attenuator input is earthed and the time-base free-runs, irrespective of the condition to which it may previously have been adjusted. A horizontal trace is thus produced, which indicates precisely the position corresponding to zero D.C. level of the input signal. This may be adjusted if desired to a particular point on the graticule by means of the shift control.

Turning the selector switch back to the D.C. position reconnects the input signal and the time base reverts to normal operation.

Time Base

The time-base provides an exceptionally wide range of sweep velocity, adjustable over a range of more than *100 million to one*. The $\times 10$ sweep expansion operates symmetrically, so that a point on an unexpanded trace, adjusted by the \times shift control to be in the centre of the screen, will remain in the centre of the screen when expanded. In addition to a coarse \times shift control, a fine control is provided so that precise adjustment of \times shift may be achieved, particularly when the trace is expanded. The sweeps are highly linear at all settings.

Triggering Circuit

The triggering circuit is very versatile and sensitive. The time-base may be triggered by or synchronised to, signals derived either externally or from the Y amplifier. The triggering signal may be of any shape, and the precise potential at which triggering takes place is adjustable. Distinction may be made as to whether the time base is triggered by a positive-going or negative-going signal when it reaches this potential. The starting times of the trigger circuits and time base generators are very short, so that the trace is well under way before the vertical signal has reached the Y plates of the C.R. tube.

A fast-rising D.C. coupled brightening pulse of adequate amplitude is produced by the time base. This produces uniform brightening of the spot during the scan at all time base speeds, keeping the spot extinguished during the fly-back and while it is stationary. Provision is made for external modulation of the trace brightness, for example, the injection of time markers.

Cathode Ray Tube

The Cathode Ray Tube is of the latest type operating at 10 Kv. and employing a helical post deflection accelerator. The normal phosphor supplied is of a new type with a very high efficiency, such that a single stroke writing speed of the order of 5,000 Km/sec. (1 cm/2m μ sec) is visible and also photographically recordable using an f/1 lens and fast film. Good resolution of fine detail is obtained due to the small spot size.

A camera is available capable of recording single scans even at the highest time-base velocity of 1 cm/10 m μ sec.

Power Unit

The power unit incorporated provides fully stabilized supplies electronically regulated and uses the latest type of silicon junction rectifiers throughout, ensuring long life and maximum efficiency. The C.R.T. supplies, including the P.D.A. supply, are derived from a plug-in stabilized supply unit using an R.F. oscillator, itself fed from stabilized supplies.

The instrument is ventilated by a fan, the air supply for which is filtered to exclude dust.

A thermal cut-out switch is fitted, which disconnects the mains supply should the instrument become too hot, due, for example, to a clogged air-filter restricting the ventilation.

A mains-tapping switch is fitted to the rear of the instrument to deal with major changes in mains supply voltage, in order that the valve heater voltages shall be within the manufacturers' limits. Two neon indicators on the front panel show whether the tapping in use is suitable for the mains supply voltage. Normally these indicators are not illuminated, but should an important change in supply voltage occur, an immediate indication to this effect is given, together with the sense of the error.

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