

oscilloscope

model

321

NAGARD

LTD



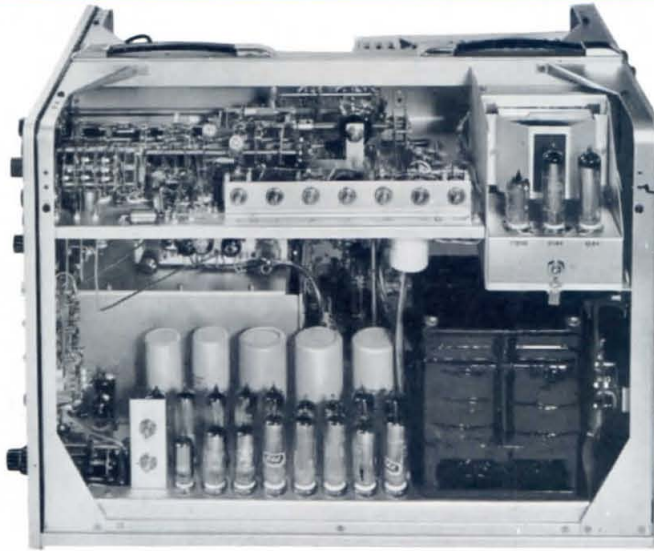
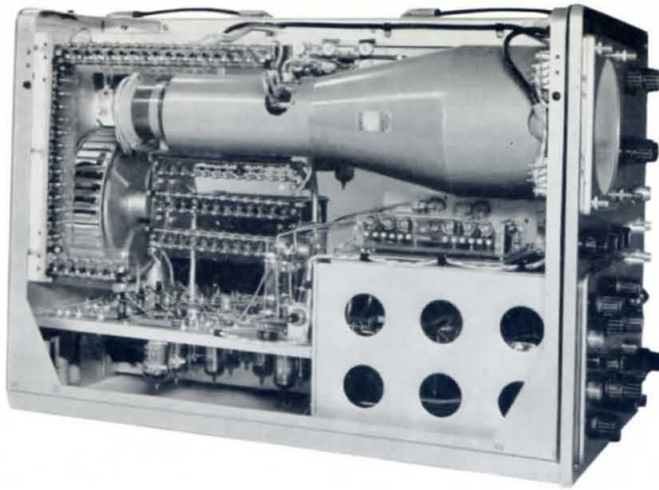
A high performance double beam oscilloscope which uses plug-in pre-amplifiers to cater for high speed or high sensitivity requirements. Pre-amplifiers are available which provide a bandwidth of D.C. to 20 Mc/s (-3dB) with a sensitivity of 1cm/10mV and a bandwidth of D.C. to 5Mc/s with a sensitivity of 1cm/mV. Identical deflecting amplifiers with signal delays are used for each beam.

The Time Base, which drives the common X-plates, is similar to that used in the Nagard Oscilloscope type 301 and provides a range of sweep times from 20ns/cm to 1.2s/cm. Very versatile triggering arrangements are incorporated and a signal giving 1mm of Y deflection is sufficient to provide a stable display when triggering internally. Delayed sweep operation is possible when used with Sweep Delay Unit type 3201.

Electronic regulators supply all the high tension voltages, the accelerating potentials and the pre-amplifier heater voltage.

The 5" double-gun C.R.T. has a helical post deflection accelerator which is operated at 10kV, ensuring small spot size and adequate intensity for single-stroke recording at the fastest time base speeds.

The minimum display overlap is 2cm.

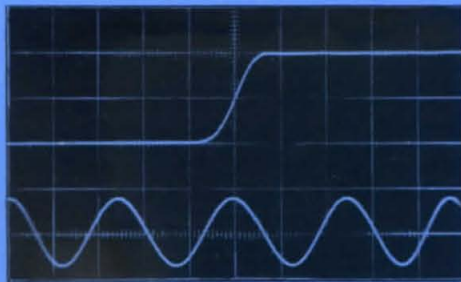


Careful attention has been paid to the mechanical design in order to achieve maximum accessibility without deterioration of the electrical performance.

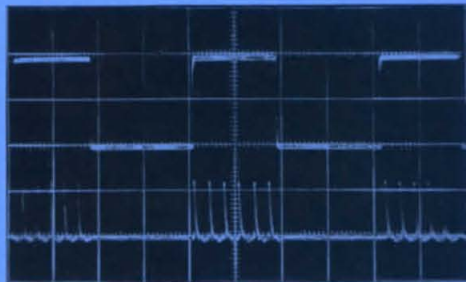
The unusual combination of bandwidth and sensitivity in this double beam oscilloscope make it an invaluable general purpose laboratory instrument, fulfilling a range of requirements that could previously only be met by a range of less versatile oscilloscopes.

The best obtainable components are used throughout, ensuring maintenance of calibration accuracy and trouble-free operation. After a scrupulously careful period of inspection and testing every instrument undergoes a soak test of at least 24 hours, after which all calibrations are checked before the instrument is despatched to the customer.

The high standard of performance of the instrument has been achieved without excessive complication, resulting in a rugged and reliable design produced to the highest standard of workmanship at an economical price.



with 321A Upper trace: Leading edge of pulse with an input rise-time of 3ns and amplitude 20mV
Lower trace: Sine-wave 20Mc/s 20mV pk-pk } Sweep velocity 1cm/20ns.



with 321D The traces show the Gate and Group outputs of the Nagard Pulse Group and Square Pulse Generator type 5101.
Upper trace: 2mV amplitude square pulses, 25 Kc/s repetition frequency, from the Gate Output.
Lower trace: 10V amplitude spikes, 0.2µs wide, 300Kc/s repetition frequency, from the Group Output.
Sweep velocity 1cm/10ns.

VERTICAL DEFLECTION

WITH PRE-AMPLIFIER TYPE 321A

*Bandwidth	D.C. to 20Mc/s (-3dB) irrespective of attenuator or gain control settings.
Rise-time	18ns.
Sensitivity	1cm/10mV to 1cm/5V in nine ranges, continuously variable. Extended to 1cm/50V by R.C. probe.
Inputs	Single-sided.
Input impedance	Constant at 1MΩ shunted by 35pF.
Voltage measurement	From graticule, sensitivities are calibrated in Volts/cm. Measurement accuracy ±3%.
D.C. Level Check	Locates zero D.C. level of input signals.

WITH PRE-AMPLIFIER TYPE 321D

*Bandwidth	D.C. to 5Mc/s (-3dB) irrespective of attenuator or gain control settings.
Rise-time	70ns.
Sensitivity	1cm/1mV to 1cm/20V in fourteen ranges, continuously variable. Extended to 1cm/200V by R.C. probe.
Inputs	Balanced.
In-phase rejection ratio	Better than 500:1 at 5Mc/s for 5V pk-pk input and maximum sensitivity.
Input impedance	Constant at 1MΩ shunted by 35pF (each side).
Voltage measurement	From graticule, amplifier gain controls and 1, 10 or 100 times attenuator are calibrated in mV/cm. Measurement accuracy ±3%.

* This is the bandwidth of the combination of pre-amplifier and main amplifier.

MAIN AMPLIFIERS

Bandwidth	D.C. to 27Mc/s (-3dB).
Rise-time	13ns.
Signal Delay	Balanced delay lines. 170ns.
Beam position indicators	on both channels.
Calibrator	Square wave output, 0.2mV to 100V pk-pk in 18 fixed steps.

HORIZONTAL DEFLECTION (Common X-plates)

Calibrated Sweep Rates	0.1µs/cm to 0.5s/cm in 21 fixed steps. Measurement accuracy ±3%.
Sweep Expansion	×5 extends maximum sweep velocity to 1cm/20ns. Measurement accuracy in expanded condition ±5%.
Continuously variable Control	Fine control permits adjustment of sweep rate to any value between 20ns/cm and 1.2s/cm.

TRIGGERING AND SYNCHRONISATION

Level Control	Determines the potential level of the input triggering signal at which triggering occurs.
Stability Control	Permits time base to be stopped, triggered, synchronised or free run.
Trigger Mode	Selects the following conditions:— Internal direct-coupled from upper or lower channel. External direct-coupled.

Trigger Mode— <i>Contd.</i>	Internal sharp pulse from either channel. External sharp pulse. Internal H.F. synchronisation from either channel. External H.F. synchronisation.	} Excludes D.C. Component.
Trigger Sensitivity	Internal 1mm of deflection. External 0.1V pk-pk.	
Synchronisation	Effective with sine-wave inputs up to 50Mc/s.	
Single Stroke Operation	When the time base is switched to this mode of operation, a single sweep is initiated by the first trigger pulse to occur after the Manual Release button has been pressed. Unless the Release is operated again, further trigger pulses have no effect.	
Delayed Sweep Operation	The Nagard Delayed Sweep Trigger Unit type 3201 is designed for use with this oscilloscope. The delaying unit provides continuously variable delays up to 50ms, the calibration accuracy being $\pm 3\%$. The delay jitter is of the order 1 part in 20,000 of the delay time.	

The following connections associated with the time base circuitry are brought to sockets on the front panel:—

External Sweep Input	A direct-coupled input requiring a sawtooth running from 0 to approximately +220V for a 10cm scan (approx. 44V for 10cm when expanded).
External Beam Brightening Input	Intended for use with Delayed Sweep Trigger Unit.
Sweep Output	A direct-coupled output giving a positive-going sawtooth of approximately 220V amplitude.
Gate Output	A direct-coupled output giving a positive-going square pulse of the same duration as the time base sweep. The pulse amplitude is approximately 40V (running between +110 and +150V).

CATHODE RAY TUBE

G.E.C. type 1374D double gun tube normally supplied with green phosphor.

Diameter	5" flat faced.
Accelerating Voltage	10kV.
Direct connection deflection factors:—	Vertical 7V/cm approx. Horizontal 30V/cm approx.
Window area	4 × 10cm minimum for each gun.
Display overlap	2cm minimum.

GRATICULE

6 × 10cm ruled in centimetre squares. The centre vertical line and three horizontal lines, spaced 2cm apart, are scaled in millimetres—ideal for rise-time measurement.

Variable intensity edge lighting.

DESIGN FEATURES

The main vertical amplifiers, which have a bandwidth of D.C. to 27Mc/s, make use of the latest type of high mutual conductance valves in the output stages. Recourse to distributed amplifier techniques is thus rendered unnecessary, with a consequent saving in space, cost and complication. The output stages drive the Y-plates of the C.R. tube via balanced delay lines. The vertical position of each trace is indicated by pairs of neon lamps close to the graticule. D.C. shift compensation is applied to the main amplifiers to cancel the small difference in gain between A.C. and D.C. signals. This can be adjusted by a preset control should it become necessary due to valve replacement. The gains of the main amplifiers are also adjustable by preset controls, to enable the main amplifier sensitivities to be standardised. A plug-in pre-amplifier which has been calibrated for use with one oscilloscope will therefore perform equally well with any other oscilloscope.

PRE-AMPLIFIER TYPE 321A

This plug-in unit provides a maximum sensitivity of 1cm/10mV with an overall bandwidth of D.C. to 20Mc/s, both channels being identical. Single-sided inputs feed constant input impedance attenuators, enabling the sensitivity to be reduced by eight steps in a 1, 2, 5 sequence to 1cm/5V. A pre-amplifier gain control, concentric with the attenuator switch interpolates between the fixed sensitivity positions. The D.C. component at the input may be excluded by switching the input selector switch from D.C. to A.C. A third position of this switch provides the useful facility of locating the zero D.C. level of the input signal. When the switch is turned to this Check Level 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. Turning the selector switch back to the D.C. position reconnects the input signal and the time base reverts to normal operation.

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PRE-AMPLIFIER TYPE 321D

This plug-in unit provides two identical channels with a maximum sensitivity of 1cm/mV and an overall bandwidth of D.C. to 5Mc/s. Balanced inputs feed constant input impedance attenuators giving attenuations of 1, 10 or 100 times. The gains of the amplifiers can be varied over a range of 200 to 1 by means of an eight position switch calibrated in mV/cm in a 1, 2, 5 sequence. Concentric with this sensitivity switch is a variable control which interpolates between the fixed sensitivity settings. The range of calibrated sensitivities thus extends from 1cm/mV to 1cm/20V, the bandwidth remaining constant. An input selector switch permits A.C. or D.C. coupling at will and earths the input not in use when singled-sided signals are being investigated. The use of cascode input stages ensures good in-phase rejection over the full bandwidth of the amplifier, and in practice this is not less than 500:1 at 5Mc/s for an input signal of 5V pk-pk and maximum sensitivity.

CALIBRATOR

A square wave generator, which produces a waveform of accurately determined amplitude, and incorporates a precision output attenuator, is built-in to the oscilloscope. The sensitivity calibration of any pre-amplifier may thus be verified and adjusted if necessary. The generator can itself be checked using an accurate D.C. voltmeter.

TIME BASE

The time base provides a very wide range of sweep rates from 0.1 μ s/cm to 1.2s/cm. A $\times 5$ expansion gives a maximum sweep rate of 20ns/cm, which ensures that the bandwidth capabilities of the deflection amplifiers can be exploited to the full. The expansion operates symmetrically, so that a point of an unexpanded trace, adjusted by the X shift controls to be in the centre of the screen, will remain in the centre when expanded. Coarse and fine X shift controls are provided so that precise adjustment of X shift may be achieved, even when the trace is expanded. The sweeps are very linear at all settings, the time measurement accuracy being $\pm 3\%$ and $\pm 5\%$ for unexpanded and expanded sweeps respectively.

The triggering circuit is very versatile and sensitive. The time base may be triggered by or synchronised to signals from an external source

or derived from either deflection amplifier. The circuit will accept signals 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 generator are very short, and the signal delay lines incorporated in the deflection amplifiers ensure that the trace is well under way before the vertical signal arrives at the deflecting plates of the C.R. tube. The time base trigger circuit will also operate in a Single Stroke mode. In this condition one sweep only will be initiated by the first trigger pulse to occur after the Manual Release button has been pressed. Further trigger pulses will have no effect until the Manual Release is operated again.

DELAYED SWEEP OPERATION

The time base circuitry of this oscilloscope has been designed to operate in conjunction with the Nagard Delayed Sweep Trigger Unit type 3201, which enables an accurately known delay of up to 50ms to be introduced between the receipt of a trigger pulse and the initiation of a sweep. The oscilloscope is arranged to receive a sweep input and a beam brightening input which are provided by the Trigger Unit in addition to the time base trigger pulse. With the oscilloscope switched to External Sweep, the sweep output from the Trigger Unit, which is derived from the delaying waveform, provides a time base scan on which the triggering waveform that is being applied to the Trigger Unit can be displayed. The brightening pulse on the C.R. tube grid is an addition of the brightening waveforms produced by the Trigger Unit and the oscilloscope time base. The duration of the oscilloscope sweep is therefore shown on the trace by a portion of enhanced brightness. By operating the delay controls it is thus possible to move the occurrence of the oscilloscope sweep to coincide with a particular part of the waveform to be examined. On switching the oscilloscope to Internal Sweep, that portion of the trace which was previously of enhanced brightness will be displayed over the entire sweep.

GENERAL

In addition to the External Sweep and Beam Brightening input sockets required for use with the Delayed Sweep Trigger Unit, a Sweep

Output and a Gate Output are also available on the front panel. The Sweep Output is a positive-going sawtooth and the Gate Output is a positive-going square pulse lasting for the duration of the sweep. The brightening pulse produced by the time base is a fast-rising D.C. coupled square pulse, which ensures uniform brightness of the spot during the scan at all time base speeds. The amplitude is adequate to ensure that the spot will be extinguished during the fly-back and while it is stationary. Provision is made for external modulation of the brightness of either trace independently, for example, the injection of time markers.

The double gun Cathode Ray Tube is of the latest type, employing a helical post deflection accelerator operating at 10KV. The normal phosphor supplied is of a type with a very high efficiency so that the leading edge of a pulse resulting in a writing speed of 0.25cm/ns (2,500Km/s) is easily visible in the single stroke mode and may be recorded photographically using an f/1.5 lens and fast film. The minimum display area for each gun is 4 × 10cm, the minimum display overlap being 2cm.

The built-in power supply provides fully stabilised high tension supplies and a low voltage stabilised supply for the pre-amplifier valve heaters, ensuring negligible drift and hum. Silicon junction rectifiers are used throughout, ensuring long life and maximum efficiency. The C.R. Tube supplies, including the P.D.A. potential, are derived from a plug-in self stabilising supply unit using an R.F. oscillator, itself powered by stabilised supplies.

The instrument is ventilated by a fan, the air supply to which is filtered, ensuring favourable operating conditions for every component.

In addition to separate fuses in each of the supply lines, 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.

A camera is available capable of recording single scans even at the highest time base velocity of 1cm/20ns.

R.C. PROBES

Two probes type 10P2 are supplied as standard with each oscilloscope. These probes have an input impedance of 10MΩ shunted by approximately 8pF and introduce an attenuation of 10 times.

Probes type 50P2 can be supplied to special order. The type 50P2 has an input impedance of 10MΩ shunted by approximately 2.5pF and introduces an attenuation of 50 times.

These probes, which are of small size, are provided with various connecting arrangements and provide a means of extracting signals from a circuit under investigation with minimum circuit loading. Either type of probe can handle any signals within the oscilloscope amplifier bandwidths with negligible distortion.

ACCESSORIES SUPPLIED AS STANDARD:—

- 2 Signal input leads and connectors (3 feet).
- 2 R.C. probes type 10P2 each with 3½ feet of cable.
- 1 Terminal adaptor for input sockets.
- 1 Mains lead with connector (6 feet).

A camera attachment and type 50P2 R.C. probes are available to special order.

Power supply requirements—

190—250V 50c/s	} 750VA.
95—125V 60c/s	

or to special order

Dimensions overall 16" × 15" × 25"
(41 × 38 × 64cm)

Weight 63lb. (29Kgs.)

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