

# A Wide Range Delayed Double Pulse Generator

WITH ACCURATE TIME AND VOLTAGE CALIBRATIONS

## RISE TIME — OPTIMUM

10  $\mu$ secs independent of pulse width

## SQUARE WAVE OUTPUT

0.25 c/s to 2.5 Mc/s  
10 million to 1 range of pulse rate, width and delay calibrated by direct reading dials within 5%

## INTERNAL MULTIVIBRATOR

of new type gives highly stable frequencies continuously variable from 0.1 c/s to 1 Mc/s

## EXTERNAL TRIGGER

from signals of any waveform and polarity at amplitudes down to 0.2 V and frequencies up to 2.5 Mc/s

## DELAY OF PRE-PULSE

to main pulse—jitter free and continuously variable from 0.2  $\mu$ sec to 2 secs  
Pre-pulse output 20 volts positive or negative—0.2  $\mu$ sec wide

## SINGLE PULSES

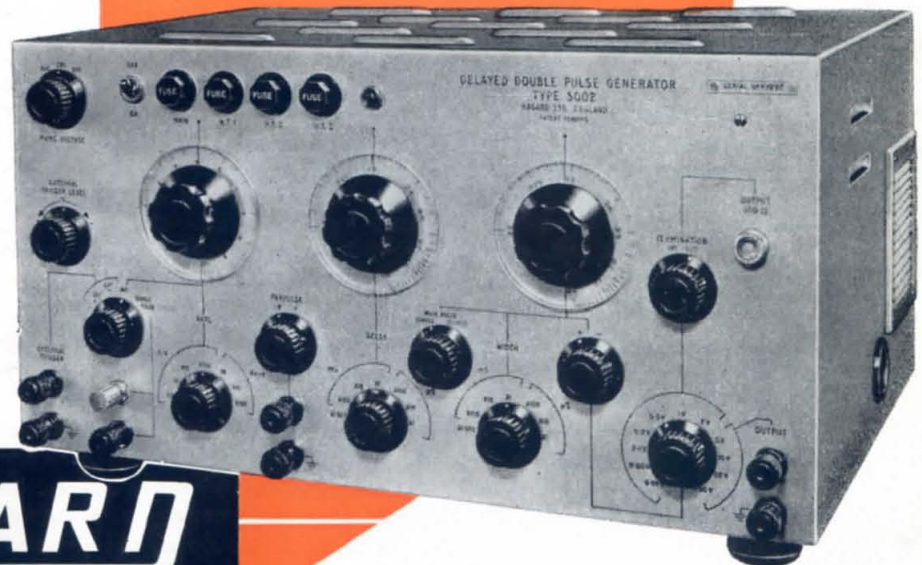
at any range setting by push button, or a single pair of pulses

## MAIN PULSE

amplitude—20 mV to 50 V positive or negative

Introduced in 1956, this instrument has since become the *Standard* in many laboratories and test departments, and has achieved a reputation for *Accuracy* and *Reliability*. The 10,000,000—1 range of Calibrated pulse dimensions makes it invaluable.

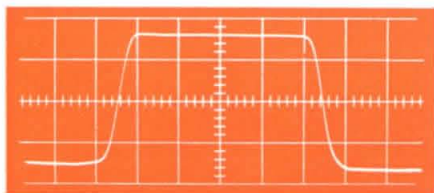
Types  
5002 &  
5002 A



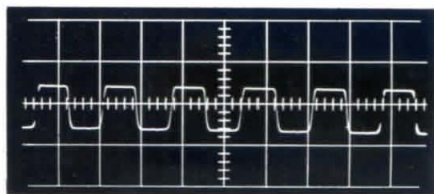
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LTD

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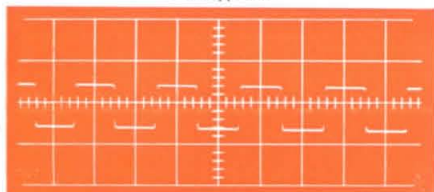
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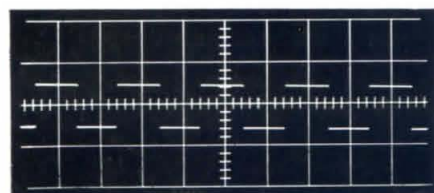
0.2  $\mu$ sec. positive pulse at time-base velocity  
25cm/ $\mu$ sec.



3 Mc/s Square wave at time-base velocity  
5 cm/ $\mu$ sec.



1 Mc/s Square wave at time-base velocity  
2 cm/ $\mu$ sec.



250 Kc/s Square Wave at time-base velocity  
0.5 cm/ $\mu$ sec.

## THE NAGARD WIDE RANGE DELAYED DOUBLE PULSE GENERATOR TYPE 5002

This instrument was designed to meet the need for a generator of fast-rising pulses and square waves, while at the same time providing a wide range of amplitude, repetition rate, width and delay with direct-reading calibrations, together with full flexibility as to polarities of main pulses, pre-pulse and trigger pulse and the ability to trigger from any form of external signal. These features have not hitherto been made available in such an instrument. The very fast rise-time, in conjunction with the above features, enable most searching investigations to be made. This rise-time necessitates the use of a special high-frequency connecting cable since the output contains important frequency components of several hundred megacycles. This cable is supplied with the instrument, together with suitable terminating arrangements.

The instrument has two output circuits. The main output consists of either a single or double pulse, as desired, of either polarity and of controllable amplitude calibrated to  $\pm 2\%$ . The rise time is independent of width throughout the ten million to one range available.

At the other output terminal a pre-pulse of either polarity is produced. When switched to single-pulse operation this pre-pulse precedes the main pulse output by a calibrated time interval controllable also over a range of ten million to one. When switched to double-pulse operation the pre-pulse is almost coincident with the first main pulse at their leading edges. The second main pulse is delayed as desired.

These pulses are initiated by an extremely flexible trigger circuit. This may be accomplished either by the internal generator or by an external signal source, and, in addition, a single pulse or pair of pulses by a pushbutton on the panel or a remote contact.

A built-in oscillator is provided for internal triggering. This consists of a new type of multivibrator in which the usual causes of frequency instability have been eliminated (British Patent No 803,597). This oscillator is continuously variable and directly calibrated from 0.1 c/s to 1Mc/s in seven decade ranges. These ranges are effectively doubled when set for double pulses.

Provision is made for triggering by external signals of any type. The instrument will trigger from either the positive or the negative going portion of the signal as desired, and the triggering level is adjustable. The input signal may have any rise-time. With the sine-wave inputs the circuit will trigger from signals of less than 0.1V and operates at frequencies up to 2.5 Mc/s. Single pulses or pairs of pulses for transient testing may be obtained by use of a push button on the panel or from remote contacts connected to a pair of terminals. In all these conditions the delaying circuit is in operation giving a calibrated time delay between pre-pulse and main single pulse outputs or between consecutive pulses when doubling switch is in use.

There are no duty-cycle limitations; consequently the pulse width and/or repetition rate can be set so as to give a square wave output when required. Square waves of any frequency from 0.25 c/s to 2.5 Mc/s can be obtained in this way. The main output circuit is D.C. coupled, so that there is no sag with long pulses. This also permits the user to make even more accurate measurements of output amplitude when the calibration provided is insufficient. The output signal is of sufficient power to operate electro-mechanical devices such as relays, counters, etc. The three high-tension supplies are each electronically stabilised and separately fused, the latest type of metal rectifiers being employed in the interests of long life. The instrument is suitable for use with alternating current supplies at 190-250 V R.M.S. or can be supplied to order for 115V 60 c/s. Forced draught ventilation is employed to ensure stability and reliability, and the latest types of valves are used throughout, facilitating replacement should the need arise.

## PERFORMANCE SPECIFICATION

Main pulse width .. .. .	0.2μsec to 2 secs	} All continuously variable and calibrated.
Delay from pre-pulse or between pairs of double pulses (between leading edges) .. .. .	0.2μsec to 2 secs	
*Internal Oscillator .. .. .	0.1 c/s to 1 Mc/s	
Rise-time (20mV to 2 volts) .. .. .	approximately 0.01 μsec negative	
	approximately 0.015 μsec positive.	
Rise-time (5-50 volts) .. .. .	Dependent on load conditions (see graph page 4).	
Output impedance .. .. .	100 to 2500 ohms according to output voltage.	
Amplitude range .. .. .	20mV to 50 volts in eleven integral steps. Positive or negative.	
Pre-pulse output .. .. .	0.2μsec. 20 volts. Positive or negative.	
Square wave output .. .. .	0.25 c/s to 2.5 Mc/s.	
External triggering .. .. .	From waveforms of any shape up to 2.5 Mc/s. From either positive or negative going portion.	
Single pulses or pairs of pulses .. .. .	By push button or remote contact.	
* This is effectively doubled in the condition for double pulse output.		

MODEL 5002A is a modified version of the above in which the Main Pulse Width range is from 0.1 μ sec to 1 sec, all other facilities being the same.

ATTENUATOR PAD—TYPE 6126 is available (as an extra when ordered) reducing the Amplitude by a factor of 100, so making the minimum amplitude 200 μ V instead of 20 m V.

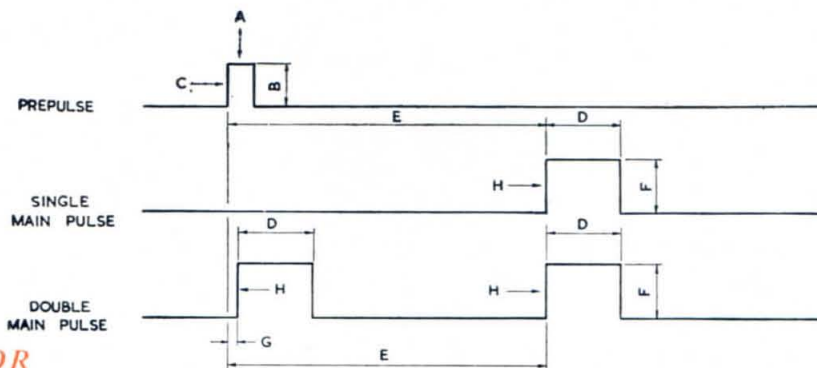
## ACCURACIES

At any point in the control range will not be worse than:-

Output amplitude .. .. .	±2%	
Internal oscillator .. .. .	±5%	
Delay period .. .. .	±5%	±0.02μsec.
Main pulse width .. .. .	±5%	±0.02μsec.
.. .. . Model 5002A	±5%	±0.03μsec.

## VALVE COMPLEMENT

10—ECF82            4—EB91            1—EL822  
6—E180F            2—A1834            1—90C1



- A. 0.2μ SEC.
- B. 20VOLTS +ve OR -ve
- C. RISE TIME 0.035μ SEC
- D. 0.2μ SEC. TO 2SEC. CONTINUOUSLY VARIABLE ±5% ±0.02μ SEC.
- E. 20mV TO 50V ±2% IN 11 STEPS VARIABLE +ve OR -ve
- G. APPROX. 0.04μ SEC
- H. RISE TIME 10-12mμ SEC. 20mV TO 2V. 5-50V DEPENDENT ON LOAD

REPETITION RATE CONTINUOUSLY VARIABLE 0.1 c/s TO 1M c/s ±5% BY INTERNAL GENERATOR, OR TO 2.5M c/s BY EXTERNAL TRIGGER SOURCE.

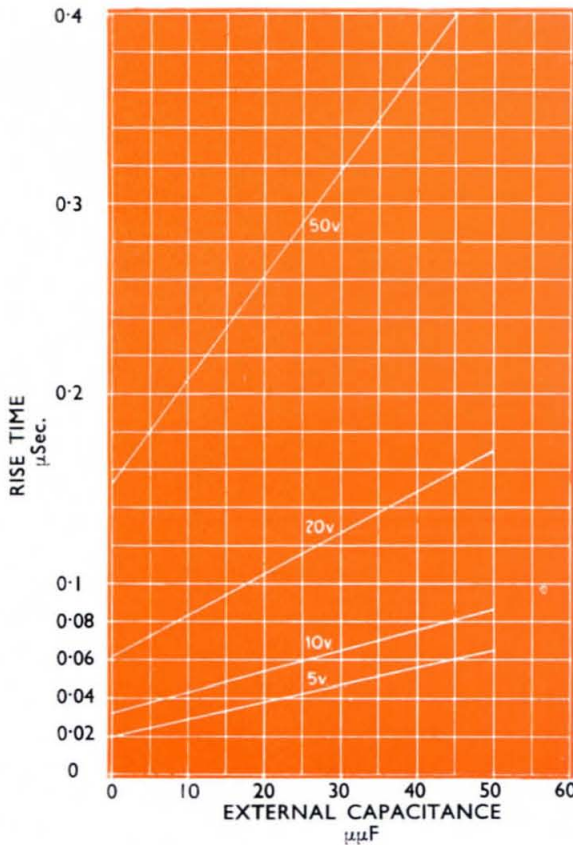
*All these features  
make the  
NAGARD 5002  
the most versatile  
PULSE GENERATOR  
available today.  
The diagram  
represents its output.*

## MAINTENANCE

The instrument has been designed for easy servicing and re-calibration, which could be difficult with the complex and critical nature of the circuitry involved if it were not so designed. All the important circuit functions are adjustable from an easily accessible control panel revealed by removal of one side of the case, and very comprehensive instructions for checking and re-calibration are given.

## OUTPUT IMPEDANCE

Voltage Setting	ohms	1V	2V	5V	10V	20V	50V
0.02V	100	100	100	100	100	100	100
0.05V	100	100	100	100	100	100	100
0.1V	100	100	100	100	100	100	100
0.2V	100	100	100	100	100	100	100
0.5V	100	100	100	100	100	100	100



When switched to double-pulse operation there is a lower limit to the separation between the two main pulses. This limit is constant at each position of the coarse width switch, and is unaffected by the position of the 10:1 fine width dial.

The limits are as follows:—

Width range	Minimum Pulse Separation
0.2 .. 2 µs.	0.15 µs.
2 .. 20 µs.	0.2 µs.
20 .. 200 µs.	1.5 µs.
0.2 .. 2 mS.	6 µs.
2 .. 20 mS.	50 µs.
20 .. 200 mS.	0.5 mS.
0.2 .. 2 sec.	5 mS.

Rise-times on the 5, 10, 20 and 50 volt ranges may be calculated from the following formula:

$$\text{Rise-time} = \sqrt{200 + (0.11 VC + 3V)^2} \text{ millimicroseconds.}$$

where V = output voltage setting  
C = external added capacitance in µµF.

Dimensions ... 18½" × 14" × 10" approximately overall.

Weight ... 42 lbs. (19 Kg.) approximately.

Consumption 220 VA approximately.

Data subject to change without notice.

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