Model 9650A

Four Channel Digital Delay Generator

FEATURES

- **t = 0 output plus four individually delayed outputs**
- **Variable output pulse width**
- **Up to 15 V pulses into 50 Ω**
- **Two difference outputs**
- **RS232 or GPIB control**
- **Internal trigger generator**
- **Low insertion delay**
- **10 ps resolution**
- **Very low jitter**

APPLICATIONS

- **Pulsed laser experiments**
- **Time-of-flight system timing**
- **Gate positioning in boxcar averager systems**
- **Semiconductor device testing**

DESCRIPTION

The model 9650A generates four adjustable-width output pulses, A, B, C and D, each of which can be delayed from a time datum by a predetermined amount. It also has two additional difference outputs, A.B and C.D, representing pulses which start on the rising edge of one output and finish on the rising edge of a second.

The instrument is triggered either by its own internal clock or by an external trigger and generates a timing pulse, T_0, approximately 35 ns later. This is the time datum to which all other outputs of the generator are referenced. The four delays are adjustable over the range 0 to 100 ms with a 10 ps resolution with the output pulse widths (A, B, C and D) being variable from 30 ns to 1 ms.

Operating modes include 'Scan', where continuously increasing delay times can be generated, and 'Burst' which is a special scan mode that will generate a burst of output pulses. The generator incorporates a 5 × 7 dot matrix alphanumeric display for setup purposes and a power shutdown memory to retain the current settings. Up to 30 extra groups of settings can also be stored for recall. All settings are input through the front panel keys or through the optional GPIB or RS232 computer interfaces.

The model 9650A is the ideal instrument for delaying trigger signals in signal recovery applications or for synchronizing multiple laser experiments where accurate time relationships are essential. It is also useful for building sophisticated boxcar systems using the models 4161A and 4121B.

Specifications

General

Four channel digital delay generator using interruptible ramp technique to generate precise delays without the normal errors associated with trigger to internal clock synchronization. Adjustable output pulse widths. RS232 and GPIB control options. LabVIEW driver available.

External Trigger

0 to 2 MHz. Threshold variable from -2.8 V to +3.0 V in 200 mV steps, positive or negative slope. Preset TTL, NIM and ECL switch selectable.

Input Impedance	50 Ω or 1 MΩ in parallel with 15 pF

Internal Trigger

Single Shot or 0.001 Hz to 999 kHz. Three digit resolution from 1 Hz to 999 kHz, 0.001 Hz resolution below 1 Hz

Accuracy	±0.1%
Jitter	< 0.2% over 90% of range
Settling time	< 2 seconds over 90% of range.

Triggers (general)

External or internal trigger rate should be < 1/(longest delay + 330 ns + output pulse width) for delays up to 80 μs and < 1/(longest delay + 500 μs) for delays longer than 80 μs

Specifications

Model 9650A (continued)

Trigger Inhibit
Rear panel active low TTL input inhibits internal and external triggers

Insertion Delay
35 ns typical (from input trigger to T_0)

Delays
Four independent delays adjustable with respect to T_0 in the range 0 to 100 ms.

Internal Timebase

Stability
±20 ppm (0 to 50 °C)

Delay Accuracy
(delay) × (timebase stability) ±0.3 ns

Jitter
Between the trigger or any output and the succeeding output:
$< 50 \text{ ps} + ((1 \times 10^{-8}) \times \text{delay})$

Output Pulse Widths

T_0, A, B, C and D
30 ns to 1 ms (screwdriver adjustable)

A.B and C.D
Minimum settable width for valid output: 5 ns. Pulse starts on rising edge of A (or C) and stops on rising edge of B (or D), with edges typically 1 ns later than A (C) and B (D) leading edges when the latter are set to 5 V output levels.

Output Levels

T_0, A, B, C and D
Low impedance outputs which generate +5 V, +10 V or -0.8 V into 50 Ω loads, with higher levels when terminated in higher impedances. Typical pulse transition times when driving a 50 Ω load: +5 V and +10 V: 1 ns/V risetime, 2.5 ns/V falltime, < 5% under/overshoot; -0.8 V : +300 mV undershoot, 200 mV overshoot

A.B and C.D
Low impedance outputs which generate TTL levels into low or high impedance loads. Typical pulse transition times for a 0.7 V to 2.7 V swing: 5 ns risetime, 5 ns falltime for a 50 Ω load; 3 ns risetime, 4 ns falltime for a 100 Ω load.

Output Protection
Outputs are short circuit and overload protected and limit if the maximum aggregate current of all outputs averaged over 5 ms exceeds 0.7 A

Scan Mode
Channel A delay scans with the delay controlled by the following parameters:-

Initial Delay	0 to 80 µs in 1 ns steps
Triggers/ Step	1 to 49,999
Delay Step Size	0 to 80 µs in 1 ns steps
Delay Steps/Scan	1 to 899 subject to the overall restriction that the max delay in scan mode is 80 µs
Max trigger rate	6 kHz external or internal at each delay step; inter-step delay while unit increments delay setting is typically 20 ms

Scan Inhibit
Rear panel active low TTL input inhibits outputs on completion of current scan.

Burst Mode
Special case of scan mode where Delay Step Size = 0. Allows the generation of 1 to 49,999 pulses using external or internal triggers at up to 6 kHz. Use of scan inhibit input and internal triggers allows the unit to generate "n" pulses on receipt of a single trigger pulse.

Display
5 × 7 dot-matrix alphanumeric vacuum fluorescent.

Setup Storage
The model 9650A automatically stores the current setup when power is removed and restores it when power is reapplied. Up to 30 additional setups may be saved for future use.

Computer Interface
The optional RS232 (-/96) or GPIB (IEEE-488) (-/97) interfaces allow remote setting of the A, B, C and D channel delays, the internal rate generator and the scan settings.

Options

9650A/93
Rack Mounting Shelf (for one or two units)

9650A/94
5 MHz External Trigger Option

9650A/96
RS232 Serial Interface (cannot be installed with 9650A/97)

9650A/97
GPIB (IEEE-488) Interface (cannot be installed with 9650A/96)

9650A/98
+15 V Outputs (Increases +10 V output pulse amplitude setting to +15 V)

Software Support
A LabVIEW driver software suitable for version 4.01 and later of LabVIEW is available by download from our website at **www.signalrecovery.com**

General

Power Requirements

Voltage	110/120/220/240 VAC
Frequency	50/60 Hz
Power	40 VA max

Dimensions

Width	8¼" (210 mm)
Depth	13¾" (350 mm)
Height	5¼" (135 mm)
Weight	10lb (4.5 kg)

Why should you choose *SIGNAL RECOVERY* products?

Models 9650A Digital Delay Generator

SIGNAL RECOVERY Product Features	Benefit to you
• Adjustable pulse width **and** delay	Use pulses to directly drive laser diodes and LEDs
• Pulse width independent of delay	Predictable performance as delays are changed
• RS232 or GPIB interface options	Use RS232 to control from any PC and save the cost of a GPIB card
• Excellent LabVIEW driver	Saves programming time
• Bright, vacuum fluorescent display	Easy to read