

LA354 Dual Delay

What is Dual Delay and how does it work?

Dual delay allows examination of two separate portions of a waveform using an analog oscilloscope. The LeCroy LA354 is equipped with Dual Delay as a standard feature.

To aid in understanding analog operation, consider the following analogies:

- 1) Analog delayed sweep is similar to the DSO zoom trace.
- 2) CRT sweep length is similar to DSO memory length (NOT sample rate).
- 3) Analog display updates in real time as each successive sweep overwrites the previous sweep.

In an analog scope, the channel base sweep (hereafter referred to as the A sweep) is generated from a rising linear saw tooth waveform. The electron beam is deflected across the CRT at a rate corresponding to the slope of the A sweep saw tooth. The saw tooth fall & recovery time until the next saw tooth represents rearm & display update. The greater the slope, the smaller the time/division (faster sweep speed). In the LA354 the total recovery time from each sweep is

$\leq 1\mu\text{Sec}$ (1MHz update rate) at 5nSec/Div sweep speed.

In NORMAL trigger mode the A sweep saw tooth begins with a signal trigger event. A delayed sweep (hereafter referred to as B sweep) is obtained by generating and adding a second saw tooth of equal or greater slope occurring during the A sweep saw tooth. The beginning of the second saw tooth with respect to the beginning of base saw tooth is the "time delay" after trigger. The amplitude location on the A sweep saw tooth where the B sweep saw tooth begins is the delay time (after trigger). The greater the A sweep saw tooth amplitude where the B sweep saw tooth begins, the longer the time after trigger the delay begins. Conversely, the smaller the amplitude the shorter delay after trigger. The minimum delay for B sweep after A sweep trigger is 1nSec.

The greater the slope of the delayed saw tooth the smaller the time/division. The fastest delayed sweep speed is 500pSec/Div.

By adding a third saw tooth, a second delay is obtained. The two B sweep saw tooth waveforms both have the same slope

(Time/Division) but their location along the A sweep saw tooth (delay after trigger) can be independently adjusted or tracked together.

The 16 bit (65,536 count) D/A Converter FUNCTION knob control provides for delayed sweep step increments of 2pSec.

Dual delay can be configured for continuous delay or triggered delay operation. In continuous delay, the B sweep delay position is adjusted along the A sweep saw tooth. The delayed sweep is generated after the A sweep is triggered. In triggered delay, the delay saw tooth is armed for a trigger after the A sweep. The delay is sequentially positioned from delay trigger point to trigger point.

The LA354 is a single beam scope. However, the display characters and scales are not drawn by the electron beam, they are digitally generated and added to the composite video. As a result no beam sharing is required for character or scale generation. The electron beam writes to the trace 100% of the time.



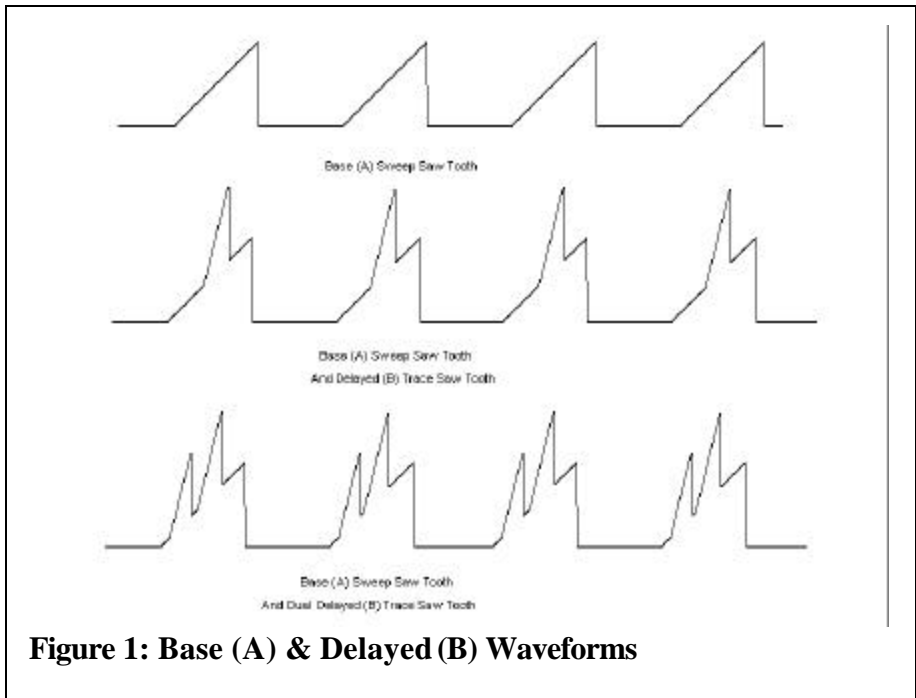


Figure 1: Base (A) & Delayed (B) Waveforms

When multiple traces are drawn, there are two user selectable options, ALT and CHOPPED. ALT sweep mode each trace is completely drawn before the beam is deflected to draw a subsequent trace. CHOP sweep mode the beam is shared between the traces. Each channel trace is partially drawn by the beam while it is switched between traces at a rate of ~555kHz. Chopped mode is available for sweep speeds \geq 50uSec/Div. Chopped mode aides in viewing multiple traces at slow sweep speeds (large time/division)

Enabling Dual Delay

Display two intensified portions of any or all channel(s) A sweep(s). Up to 15 traces displayed. One A sweep & two B sweeps per

channel (12 traces), plus one A sweep and two B sweeps for math sweep (3 traces).

Procedure for selecting dual delay

For purposes of illustration only one channel will be used initially. Note: The FUNCTION knob operates as follows:
 Fine = stop knob rotation each detent
 Step = momentarily depress knob
 Slew = simultaneously depress & rotate knob

Selection of display channel

1. Input a signal to scope and depress CH1, CH2, CH3 or CH4 to select appropriate single channel ON. Configure scope to display at least one full cycle of waveform.

2. Simultaneously depress [A] key and [B] key of the HORIZ DISPLAY mode simultaneously to select ALT Horiz mode.
3. Observe A sweep and B sweeps are displayed.
4. Depress [A (or) B] (Grey color coded) key to select B.
5. Observe the B LED indicator lights.
6. Rotate [TIME/DIV] knob to set the B-sweep time.
7. Select Continuous Delay. The [SOURCE] key will select between Continuous Delay (no B sweep trigger source) or Triggered Delay (B sweep has associated trigger source).

Enable Dual Delay

8. Depress [Δ t] key to enable dual delay.
9. Observe the “f: B-DELAY” display changes to “f: B-DLY-TCK” or “f: B-DLY-1” or “f: B-DLY-2”

Adjusting DLY1

10. Depress [TCK/INDEP] key to select “f: B-DLY1” in CRT Function knob readout.
11. Rotate [FUNCTION] knob to control first intensified portion to the measuring point.



12. Observe the DLY1 delay time after trigger is displayed in upper right corner.

Adjusting DLY2

13. Depress [TCK/INDEP] key to select "f: B-DLY2" in CRT Function knob readout.

14. Rotate [FUNCTION] knob to control second intensified portion to the measuring point.

15. Observe the DLY2 delay time after trigger is displayed in upper right corner.

Adjusting Tacking Delay

16. Depress [TCK/INDEP] key to select "f: B-DLY-TCK" in CRT Function knob readout.

17. Rotate [FUNCTION] knob to control both intensified portions to the measuring point.

18. Observe the Δ DLY1-2 delay times after trigger difference is displayed in upper right corner.

Exit Dual Delay

19. Depress [Δ t] key.

20. Observe the "f: B-DLY" display changes to "f: DELAY"

Trace Separation Display in Dual Delay Function

In ALT sweep mode, both A & B Sweeps are displayed. The B sweep is located above the A Sweep. In dual delay mode both B sweeps are displayed. In dual delay

B (only) mode DLY1 is located above the DLY2. The Trace Separation control allows operator to control vertical distance between different sweeps (ALT Horiz = trace separation between A & B sweeps. In B Horiz (only) dual delay mode = trace separation between DLY 1 & DLY 2). Trace Separation can be continuously varied from a) direct overlay of A & B, to b) maximum of ~4 divisions separation.

Procedures for adjusting Trace Separation

Trace separation is only valid in ALT (A&B) Mode or, B Dual Delay Mode. In other modes trace separation is not applied because only one trace per channel is displayed.

Selecting ALT (A&B) sweep

1. Set ALT by simultaneously depressing A and B keys of the HORIZ DISPLAY mode. Observe A sweep waveform and B-sweep waveforms are simultaneously displayed. [Note] B Sweep time per division default is 5nSecs/Division. Depending upon input waveform, it may be necessary to adjust the B time per division to optimize B trace display.

Enable Dual Delay

2. Depress [Δ t] key

3. Observe Dual delay enabled

Enable display of only delay traces.

4. Depress [B] key.

Setting Delayed Trace Separation

5. Depress [DELAY/TRACE SEP] key to select f: TR-SEP.

6. Observe the function display toggles between f: B DLY and f: TR-SEP.

Controlling B waveform position

7. Set the vertical position of the B sweep waveform by rotating [FUNCTION] knob (only upward position from direct overlay is available).

The [FUNCTION] knob has three speeds for control of TR-SEP positioning:

Fine adjustment = rotate the [FUNCTION] knob for single line steps

Step adjustment = momentarily depress [FUNCTION] knob for decade steps in the direction of last [FUNCTION] knob rotation.

Slew = simultaneously depress & rotate [FUNCTION] knob.

Select ALT or B of the horizontal display mode.

In dual delay, B Horiz mode, the FUNCTION knob "f: TR-SEP" controls trace separation the vertical position of DLY1 and DLY2.



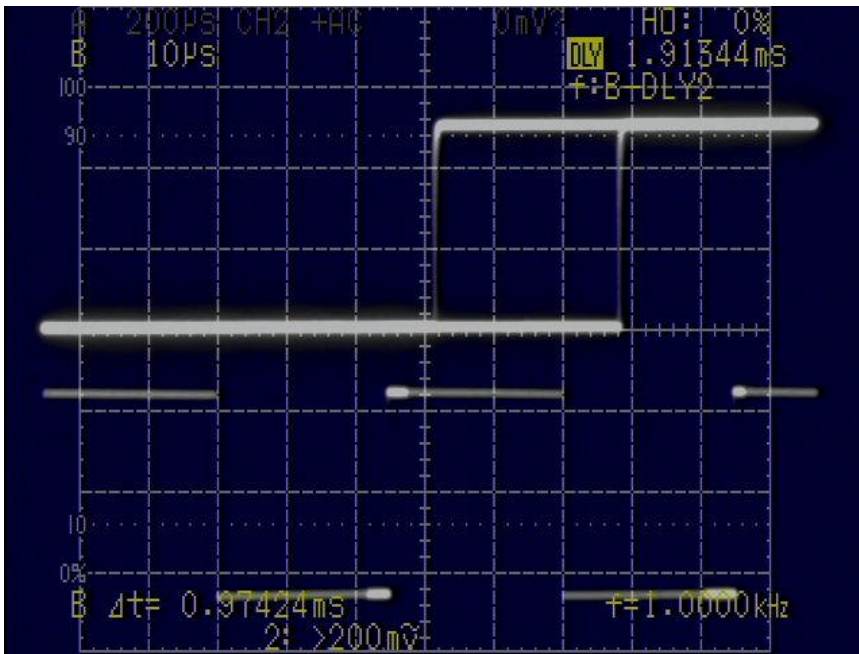


Figure 2: A Sweep & Dual Delay B Sweeps

3 Measuring Delta Delay Time
 When in continuous delay mode, the dual delays can be used to measure time between “zoomed” portions of A sweep. Setting DLY1 and DLY2 coincident (0 delta delay) on area of interest of A sweep. Ensure DLY1 & DLY2 overlap exactly (appear as a single trace). Using one DLY as reference, the other DLY can be moved to area of interest. The difference in time is displayed in lower left corner of CRT readout (BΔt=). The procedure can be reversed to measure time difference from points of interest to zero time delay.

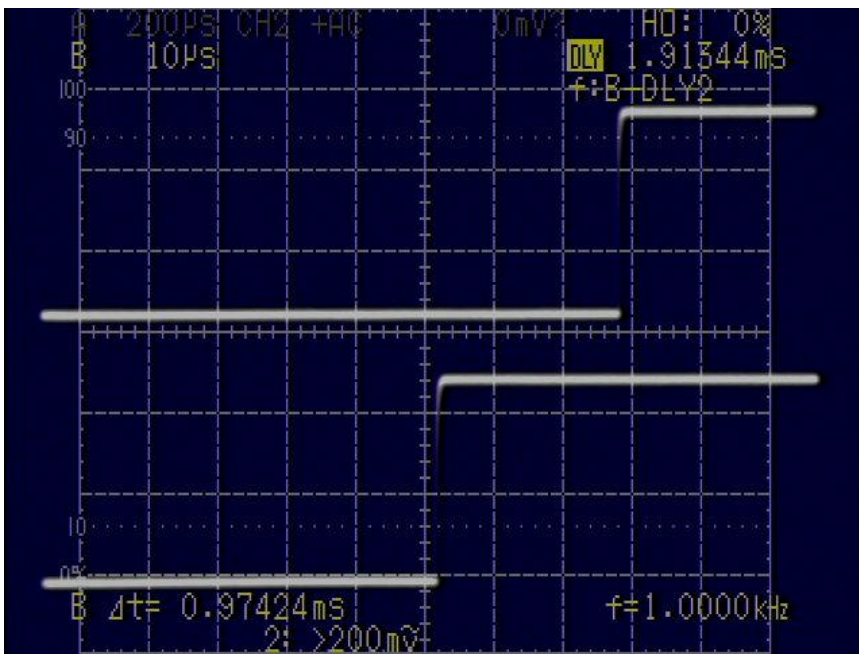


Figure 3: Dual Delay B Sweeps

The delay time after trigger for each delay sweep is displayed in the upper right hand corner. Selecting the delay for readout is accomplished by depressing the TCK/INDEP key.

In critical time measurements, skew compensation for channel propagation delay can be adjusted by:

- a) Turn on both CH1 & CH2
- b) Setting the Time/Div - $\leq 5\text{nSec/Div}$
- c) Simultaneously depressing A B (ALT Horiz) key
- d) Observe “f: CH2 Delay” Rotating the FUNCTION knob will adjust channel 2 delay by approximately 3nSec.

ALT Horiz (A&B), the FUNCTION knob “f: TR-SEP” controls trace separation the

vertical position of A sweep and B sweep(s) {DLY1 and/or DLY2}.



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