

LA354 Analog Storagescope

Analog Color Storagescope

The LeCroy LA354 500 MHz Color Analog Storage Oscilloscope is equipped with user selectable colors as a standard feature. Color permits the user to optimize his display for viewing waveforms by assigning persistence trace, scale, text and background to different colors. The LA354 utilizes a unique display intensification technique, which combines CRT, CCD TFT LCD & Video RAM. The LA354 operation can be described as a combination of: a conventional analog oscilloscope, video camera and display monitor.

SCAN CONVERTER TUBE

Typically the term “scan converter” refers to a video format converter. Video format converters (a.k.a. transcoders) are circuits employed to convert from one video format to another. In the LA354 the term Scan Converter tube (SCT) is the device used to convert the trace of CRT into video format by means of a Charge Coupled Device (CCD).

The scan converter tube consists of:

- a) Meshless flat expansion CRT (P-31 Phosphor)
- b) Optical Fiber Plate (OFP)

- c) Charge Coupled Device (CCD)

The CRT has approximately 20KV acceleration potential applied between the cathode & grid. The electron beam from K (cathode) is deflected by VERTICAL and HORIZONTAL deflection plates during active sweep time as a function of the channel(s) signal stimuli. The beam is expanded by the box lens and then projected onto the phosphor. The phosphor is excited by the applied beam and is illuminated.

The input waveform is displayed on CRT phosphor and captured by CCD through the Optical Fiber Plate (OFP).

The OFP is a bundle of many thin optical fibers. The OFP provides: a) electrical isolation of the screen potential (+20kV nominal) from the CCD potential (0V) and b) direct connection CCD pixel to CRT without diffusion. The 10mm separation distance of CCD to CRT provides a significant increase in writing intensity.

Considering that the typical CRT to eye distance is 30cm, the shortened distance (10mm) results in a gain of the square of the distance. (approximately 900x)

Beam density

The LA354 CRT target area of the screen is approximately 10mm x 8mm.

A conventional oscilloscope CRT has 10cm x 8cm display area.

Ratio of electron beam density is 100 times.

Total brightness ratio

Total ratio of brightness is 100 times x 900 times = 90000x.

But, sensitivity of CCD (< 50%) and loss of OFP (about 70%) reduce the gain ratio. The nominal gain of the LA354 Scan Converter is approximately 20k times brightness above a conventional CRT.

What is writing speed?

Writing speed is the analog ability to visibly display a transition. The Writing Speed is similar to single shot bandwidth of DSO. Writing Speed is expressed as divisions/unit time, this represents electron beam moving across the CRT and producing a visible trace. The LA354 has 5 ns/cm Visual Writing Speed.

LA354 Signal Capture

AUTO or NORM sweep mode

The oscilloscope CRT sweep circuit runs by trigger (NORM) or free-run (AUTO).

The waveform is displayed on the CRT phosphor and the CCD captures the image. The CCD is simi-



lar to a video camera in RECORD mode. The CCD output video signal is input to Video RAM, then to both the display monitor & rear panel composite video output BNC.

SINGLE sweep mode

The oscilloscope is ready to sweep CRT & is awaiting a trigger. CCD video signal is not output to display monitor.

Monitor shows no waveform on the oscilloscope screen.

A trigger signal evokes a sweep and the output of video picture signal. In fast sweep rates (when sweep period is shorter than two TV frames about 66mSec)

Video RAM records the waveform for 2 TV frames (66ms).

Example

Sweep rate 0.1uSec/Div, total sweep period 1uSec

Trigger signal evokes the sweep start and record to VIDEO RAM. After 1uSec the CRT sweep stops, but recording to video RAM is continuing for approximately 66mSec.

After stopping the sweep, the CRT displayed waveform still remains on the screen because the screen phosphor (P31) has a finite decay time.

The reason for 2 video frames recording:

The trigger evokes the start of recording, but the start timing is not always the same as the first line of TV frame.

So, first recorded frame has not whole frame, the 2nd frame is

overwritten to make complete one frame picture.

In slow sweep rate (sweep period is longer than two TV frames)

Video RAM records a waveform for one sweep

Example

Sweep rate 0.1s/div, total sweep period 1s

Trigger signal evokes the sweep start and record to VIDEO RAM. During 10s sweep period, video RAM stores the waveform up to sweep stop. This ensures the displays total 1Sec waveform from start to stop.

Waveform Capturing

The LA354 has only one scan converter tube. In multiple channel operation the traces are sequentially captured from CH1 through 4 in order. In delayed operation the traces are captured in sequential order from CH1, CH1 delay1, CH1 delay 2 CH2, CH2 delayed, CH2 delayed 2, etc. In the LA354, n channel waveforms are captured by n sweeps.

Example:

CH1, 2 and 3 are active, SINGLE sweep Mode: The first trigger evokes sweep to display CH1 waveform and video RAM stores it. The second trigger evokes the second sweep to display CH2 waveform and video RAM over writes it. Third trigger evokes the third sweep to display CH3 waveform and video RAM over writes it.

Documenting

The LA354 has a composite NTSC video output. The output can be applied to a video monitor, video printer, VCR, or computer image acquisition card to document & record images. The LA354 does not provide front panel attachments for any kind of trace recording camera. The LA354 utilizes a LCD display instead of CRT.

Any LCD has limited viewing angle. LA354 implements wide viewing angle type LCD (approximately 12deg).

Trace recording cameras do not have wide viewing angles at close distances. Trace Recording Cameras focusing point are typically about 30cm. Trace cameras are not recommended to capture a waveform with uniformity.

FAQ's

1) *What do you mean by the phrase: storagescope?*

The term storage refers to the fact that the LeCroy LA354 analog is capable capturing and displaying a single shot of a waveform. Storage may be accomplished by depressing STORE to capture the currently displayed trace or infinite persistence capturing multiple traces. Consider the attached .jpg image of a 440pSec pulse (Wavetek 9500 Scope Calibrator) into a LA354 at 500pSec/Div time base. The waveform was single shot captured & stored to my laptop (via Snappy card about \$100, visit www.play.com for info).

2) What is the implication of no CRT phosphor burn limitation?

The LA354 has no limitation on high intensity writing time. The discontinued Tektronix 2467B is limited to approximately 2 minutes before auto shutdown. "Display intensity limitation: 2467 Display intensity is automatically reduced and eventually extinguished after periods of no front panel activity. The time elapsed before intensity reduction is shortened by high intensity settings and high duty factor/sweep speed/trigger rate combinations."

3) Is the LA354 a dual beam scope?

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. When multiple traces are drawn, there are two user selectable options, ALT and CHOPPED.

In ALT sweep mode, each trace is completely drawn before the beam is deflected to draw a subsequent trace.

In 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

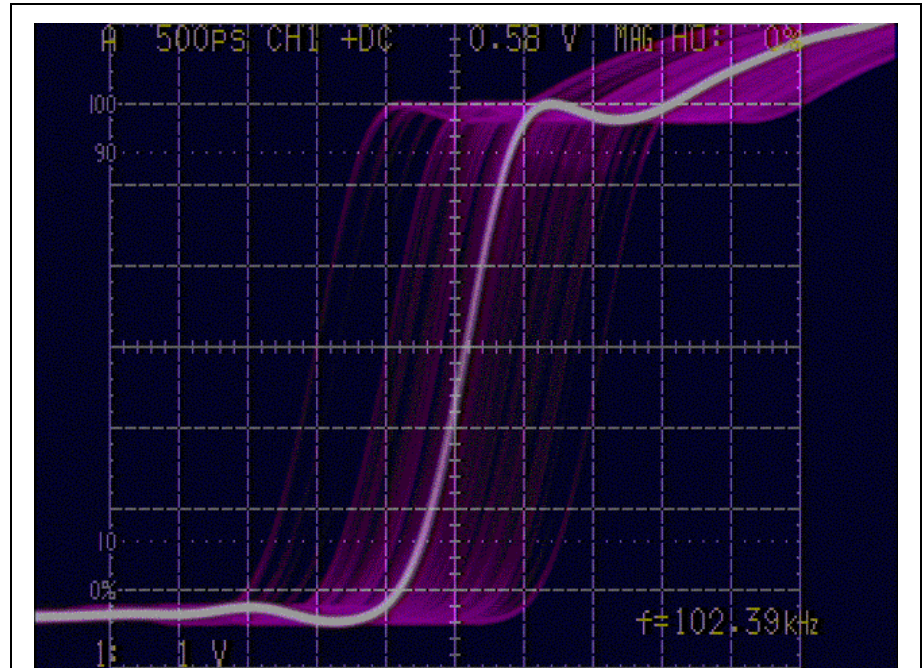


Figure 1: LA354 Default color scheme & scale

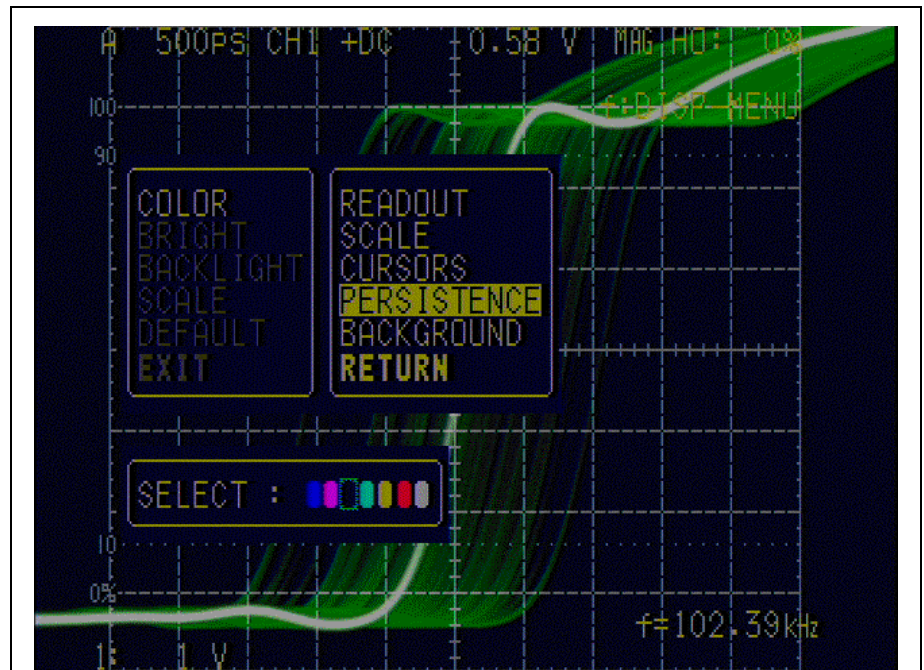


Figure 2: Color Menu

available for sweep speeds \geq 50uSec/Div.

Chopped mode aides in viewing multiple traces at slow sweep speeds (large time/division)

Selecting Colors/Scale Types

- 1) Apply power to LA354
- 2) Ensure scales and text are displayed (adjust SCALE intensity as necessary)
- 3) Ensure no “f: ____” displayed in CRT FUNCTION knob readout.
- 4) Depress and hold FUNCTION knob until menu box appears on left side of screen (see figure 2)
- 5) Rotating the FUNCTION knob will select submenu for adjustment
- 6) Depressing FUNCTION knob will activate highlighted submenu for adjustment.
- 7) Rotating FUNCTION knob will scroll through the choices for selected submenu.
- 8) To activate and store selection, momentarily depress FUNCTION knob.
- 9) Observe desired selection is activated & FUNCTION knob reverts to previous higher submenu.
- 10) To restore to factory settings select DEFAULT.
- 11) To exit, select EXIT.

Images

The following images were taken using a LA354 in infinite persist mode. The signal was ~500pSec rise pulse. The persistence trace was used to capture pulse timing jitter.

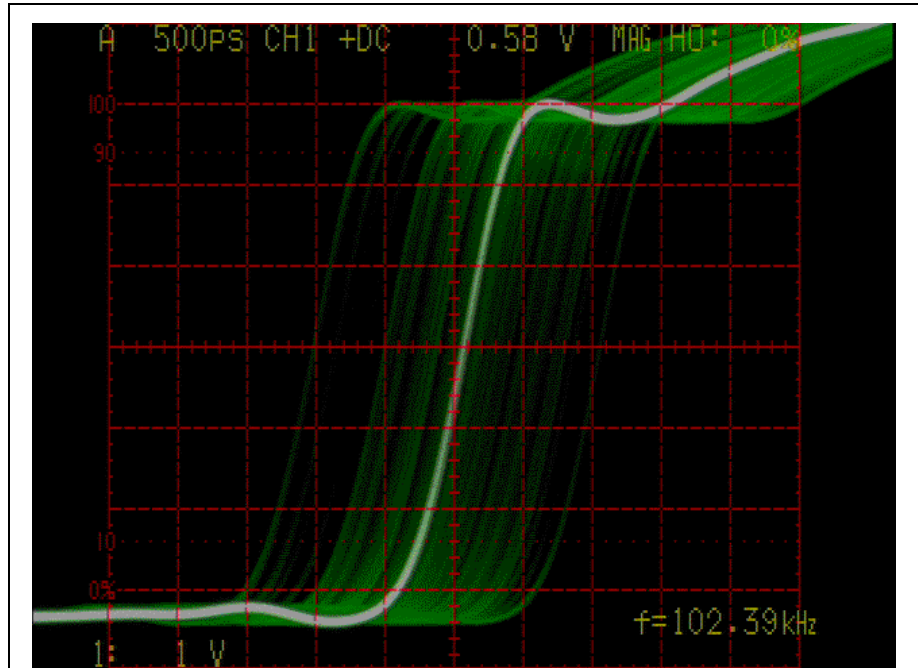


Figure 3: Colors & contrast after adjustment

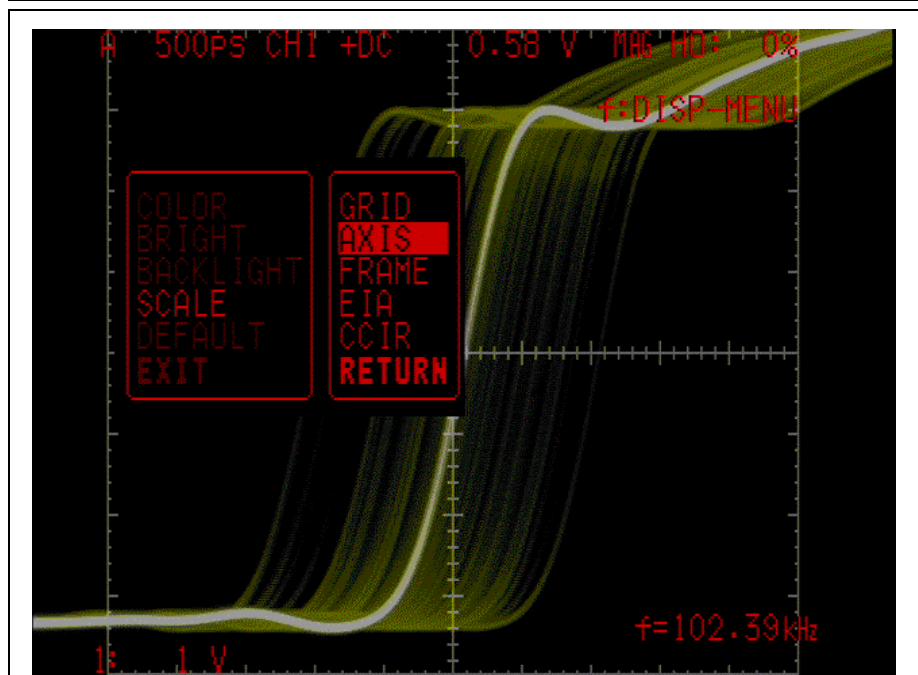


Figure 4: Scale selection menu

Filename: NAB_1301_Color.doc
Directory: \\Apini\work\LAB1301
Template: C:\Documents and Settings\kpazmino\Application
Data\Microsoft\Templates\Normal.dot
Title: Pulse Width Modulated Waveforms
Subject:
Author: Authorized Gateway Customer
Keywords:
Comments:
Creation Date: 2/26/1999 4:47 PM
Change Number: 4
Last Saved On: 3/2/1999 4:00 PM
Last Saved By: LeCroy Corporation
Total Editing Time: 13 Minutes
Last Printed On: 8/22/2001 3:21 PM
As of Last Complete Printing
Number of Pages: 4
Number of Words: 1,390 (approx.)
Number of Characters: 7,926 (approx.)