

# Analog Displays

## Scopes & Sunglasses

### CRTs

In a DSO the display is an adjunct function. In an analog scope, the CRT display is the “heart” of the oscilloscope. Deflection amplifier & tube response characteristics determine analog scope performance.

The LeCroy analog oscilloscopes utilize a meshless flat scan expansion CRT with standard P31 phosphor. The unique CRT design produced by LeCroy has some significant advantages. Our analog competitors use domed mesh CRTs. The advantage of a meshless CRT is that the electron beam writing to the phosphor does not pass through any obstacle (the domed mesh). Typically, a domed mesh CRT has a transparency limitation of 50% compared to a meshless CRT. As a result LeCroy analog CRTs are twice as bright as a domed mesh CRT with the same acceleration potential.

Additionally, the domed mesh and corresponding internal curvature of the CRT introduce display astigmatism, which changes with sweep speed. In a domed mesh CRT the astigmatism adjustment is typically located on front panel (a screwdriver type). The LeCroy meshless CRTs are flat expansion and

astigmatism free. The meshless CRT astigmatism is affected only by the High Voltage power supply adjustments. Hence, there are no front panel astigmatism adjustments for the LeCroy analog scopes. LeCroy analog scope astigmatism (X, Y and diagonal) is adjusted only during calibration when the high voltage power supply is adjusted.

Another factor to consider is acceleration potential. Brightness is proportional to the square of difference in acceleration potential. Consider two CRTs, both with the same geometry. One CRT has 16kV (e.g. LA302/303) acceleration potential, the other has 20kV (e.g. LA314 & 314H) acceleration potential. The difference is 4kV or a factor of 16 when comparing brightness.

Other items to consider when comparing brightness are:

- 1 CRT display dimension
- 2 External CRT Filter
- 3 Ambient lighting
- 4 Halation

All other things being equal consider the following:  
1) CRT display dimension: the larger the viewing area (electron beam target area) the more the beam is dispersed. However, a larger viewing area enhances viewing

waveform details. Conversely, the smaller the viewing area the brighter the display but, resolution becomes limited.  
2&3) Some scopes utilize a black matte external CRT filter. The filter enhances beam contrast against a black background but has an additional transparency loss of about 75%! Use of such filters is typical in bright ambient lighting conditions where CRT glass and graticle reflections of light interfere with viewing waveforms.  
4) Halation is the result of phosphor illumination caused by unwanted internal CRT electron beam reflections. Halation is typically most pronounced when in MAG10X operation at or near maximum brightness. The result is a poorly defined trace contrast against a bright background as stray reflections from main beam randomly illuminate the phosphor. LeCroy analog scopes have meshless CRTs hence, less susceptible to halation than are competitive techniques.

As you can see, frequency bandwidth is not the only consideration for a customer application.