

Why Does my Scope Show a Sine Wave when I expect a Square?

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Solution: A scope user attempting to view a square wave on an oscilloscope might view a sine wave of the same frequency in place of a square wave. This is not a necessarily a sign of a defect with the scope or the generator, however an effect of the constituent higher frequency harmonic components of the square wave itself.

To understand this aspect better, one must develop better understanding of the effects of harmonics on waves.

For example, a 25MHz square wave will be viewed as a 25MHz sine wave on a DS1052E (50 MHz scope), though the actual square wave itself is below the scope's frequency bandwidth ceiling, its harmonic components are already above the scope's 3 decibels (dB) high-frequency cutoff point. Due to this natural cutoff, the square wave's main contributing harmonic components beyond the 2nd harmonic component ($2 \times 25 = 50$ MHz) are naturally filtered out. The 3rd and 5th harmonic components however, are at 75 MHz and 125 MHz center frequency respectively. These components are naturally much greater than the square wave's 25MHz component and way above the scope's bandwidth ceiling.

For viewing a square wave signal on a scope, it's necessary that the square wave's higher (3rd, 5th, 7th order and higher) harmonic components do not exceed the scope's bandwidth ceiling.

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Rigol Technologies USA

10200 SW Allen Blvd, Suite C

Beaverton, OR 97005

877.474.4651