

Measuring Crest Factor

Yiu-Fai Kwan

Microwave Engineer, Noisecom



Abstract

This document provides Noise Com's method of measuring crest factor of a noise source using LeCroy Wavepro 7200 Oscilloscope.

Measuring Crest Factor

Crest Factor

The Crest Factor (CF) is defined as the ratio of the peak amplitude of a waveform to its RMS value. It is a numerical value without units.

$$CF = 20 * \text{Log} \left(\frac{V_p}{V_{rms}} \right) \text{ dB}$$

CF is the Crest Factor

V_p is the peak voltage

V_{rms} is the RMS voltage

Statistical evaluation of related occurring events present always certain kinds of distribution curves. Gaussian distribution, also known as normal distribution, is the most common way events take place. Most white noise sources provide Gaussian distribution of their spectral power. The randomness of noise sources requires a mathematical model that allows calculating the probability density of events. Gaussian distribution right and left of the mean probability is of equal size. Crest factor is also an important quantity for noise sources. It allows calculating the likelihood of unwanted events relative to the mean probability. Such renegade events may cause an overload of an amplifier input, distortion of a signal, or a bit error. Obviously, the fewer of those natural but unwanted events happen, the better. High quality white Gaussian noise sources offer crest factors of up to 18 dB, placing the probability of unwanted events far beyond reasonable measurement capabilities.

Procedure

The LeCroy Wavepro 7200 Oscilloscope is used for measuring crest factor. This is a four channel oscilloscope, any one channel can be used to perform the measurement. For the following instructions, channel 3 was chosen.

1. Turn the touch screen on.
2. Press the "3" button under "VERTICAL".
3. Press the "C3" box on screen (on lower left hand corner).
4. Set "Trace on" with a check mark and set the following parameters to:
 - Volt/div = 1.00 V
 - Offset = 0.00 V
 - Bandwidth = full
 - Coupling = DC50 ohm
 - Averaging = 1 sweep
 - Interpolation = Linear
 - Deskew = 0
 - Probe Atten = divided by 1

Figure 1 shows the Oscilloscope display.

- Next, press the "Timebase" box to adjust the following parameters:

Time/div = 5.00 μ s

Max sample Points = 500 kS

Active Channel = 10GS/s

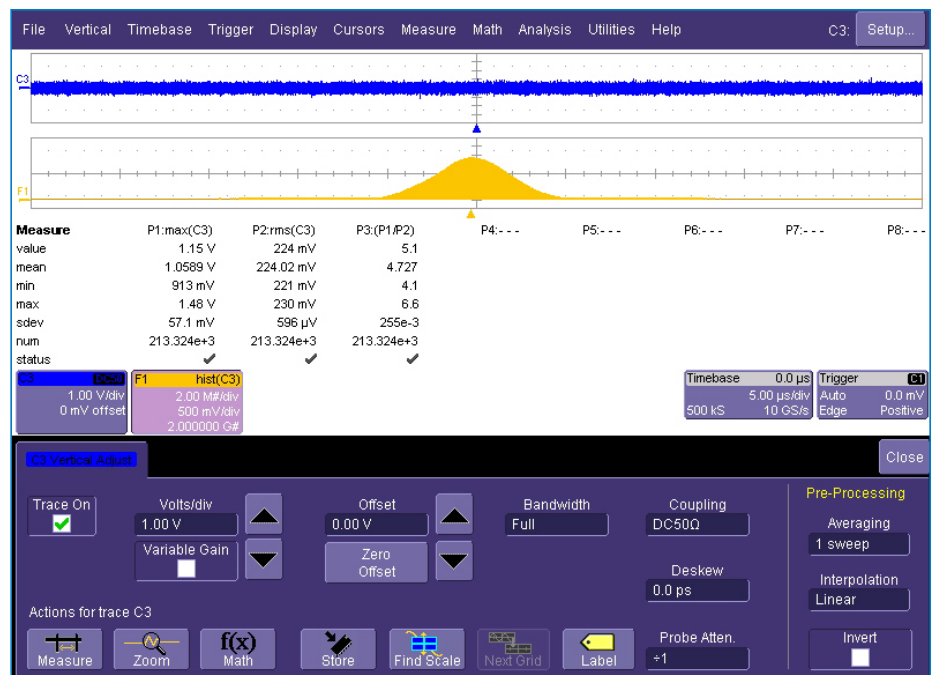


Figure 1

Figure 2 shows the Oscilloscope display.

- Press "Math" under "Wavepilot " on the panel.
- On the touch screen, press "F1" and set a check mark to "Trace on".

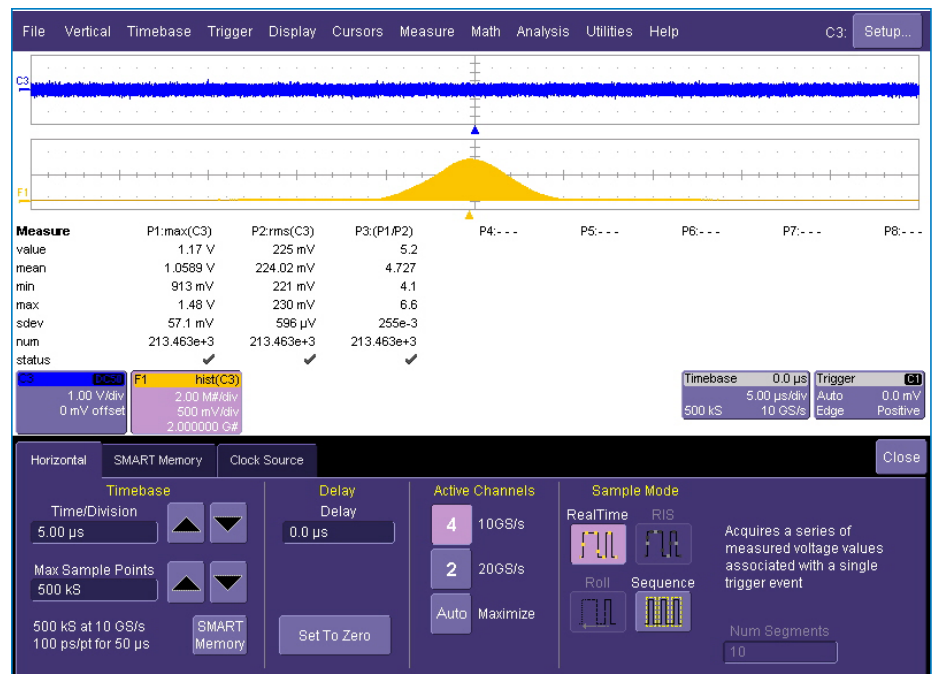


Figure 2

8. Set "Source 1" to "C3" and "Operator 1" to "Histogram" (see Figure 3).
9. At the right side box on screen, press "Histogram" tab.

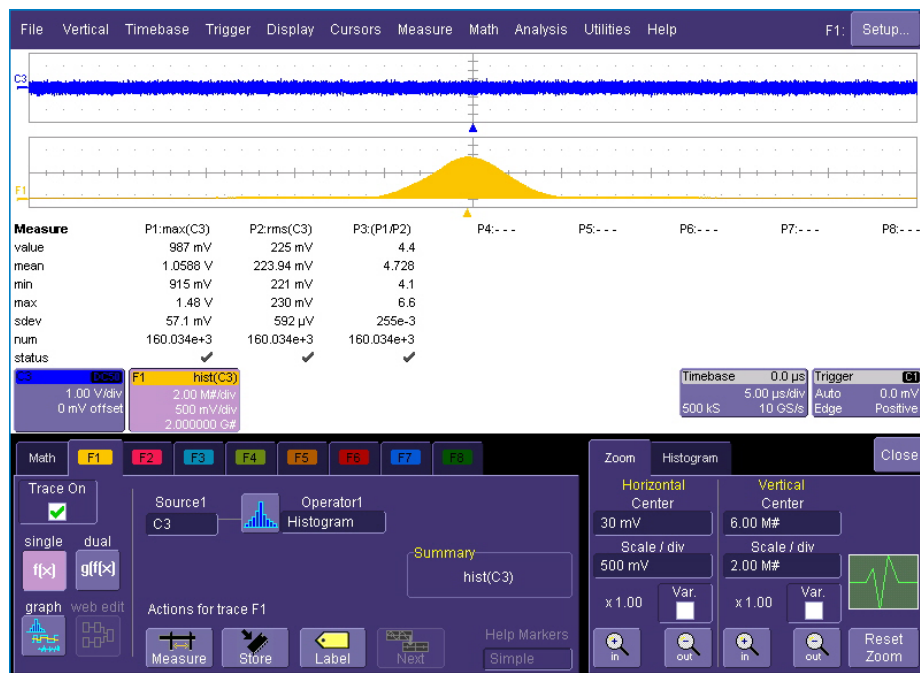


Figure 3

10. Set "Buffer" value to max (2 billion) and " # Bins" to max (2.00e+3) (see Figure 4).
11. Press "Clear Sweep" on the lower right corner panel. Now, the screen should have two curves. One is the output and the other one is the histogram of the output.
12. Press "Measure" under "Wavepilot".
13. Set check mark on "Show Table" and "Statistics".
14. Press "P1" tab and set "Source 1" to "C3".

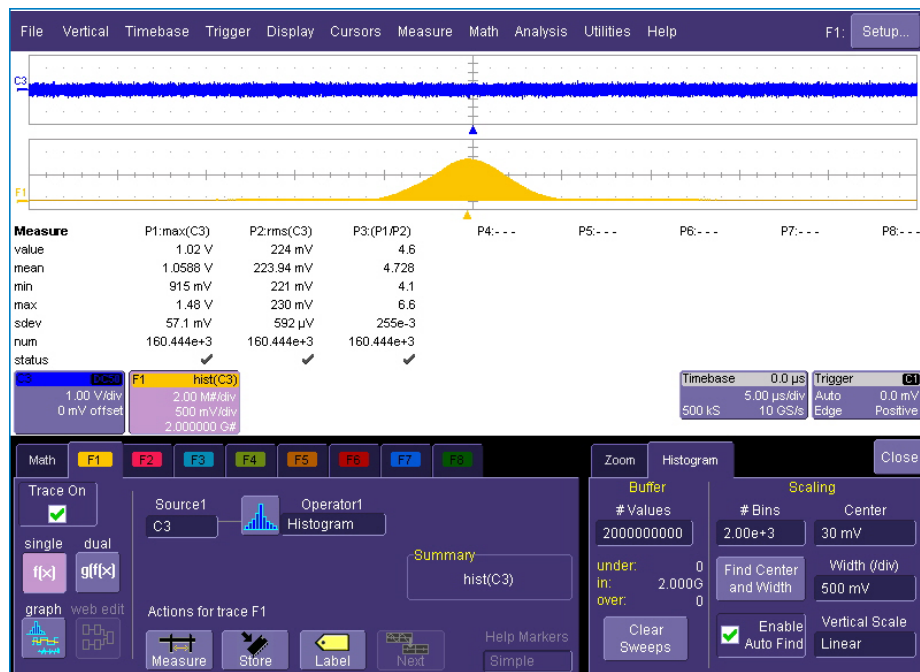


Figure 4

15. Set "Measure" to "Maximum"
(see Figure 5).
16. Press "P2" and set "Source 1" to
"C3".

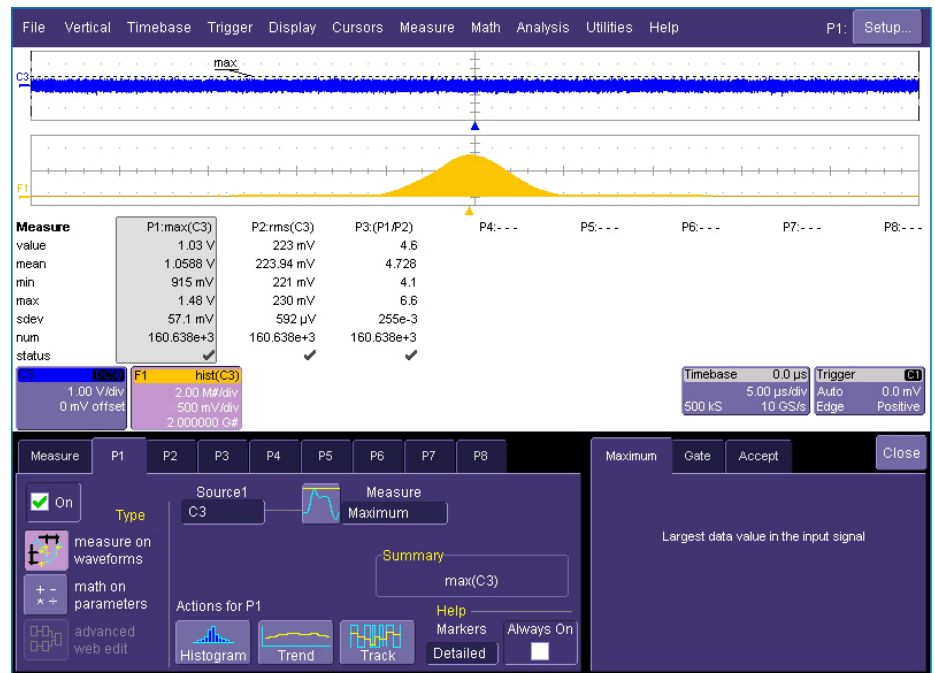


Figure 5

17. Set "Measure" to "RMS"
(see Figure 6).
18. Press "P3" and press "Math on
Parameters".

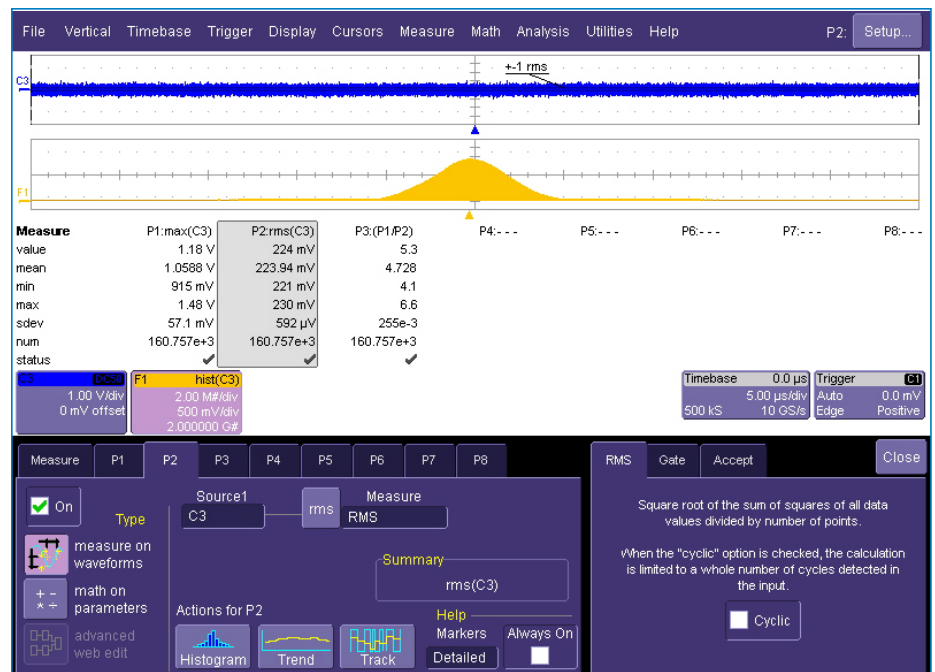


Figure 6

19. Choose the "Math Operator" to "Pn / Pm" (see Figure 7).
20. Make sure the "ON" box of P1, P2, & P3 has a check mark.
21. The max value of P3 is the crest factor ratio, which is the max of P1 divided by the mean of P2. Take the log of the max value of P3 and multiplied by 20. That would be the crest factor of the noise module in dB. In this case, the crest factor is 16.39 dB.

$$CF = 20 * \log \left(\frac{\text{Max}(P1)}{\text{Average}(P2)} \right) \text{ dB}$$

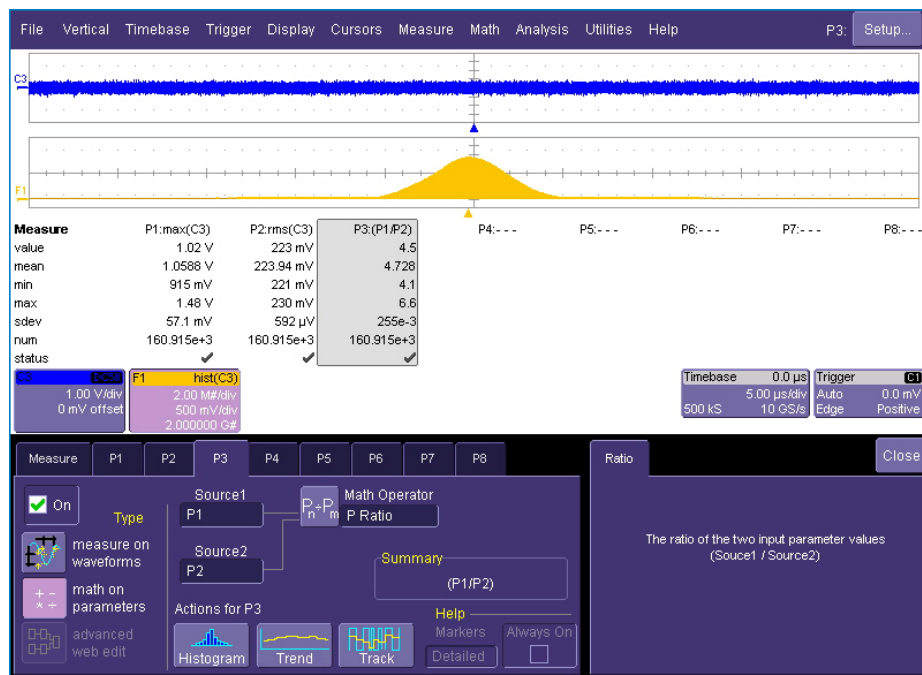


Figure 7

Wireless Telecom Group Inc.
 25 Eastmans Rd
 Parsippany, NJ
 United States
 Tel: +1 973 386 9696
 Fax: +1 973 386 9191
 www.noisecom.com

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