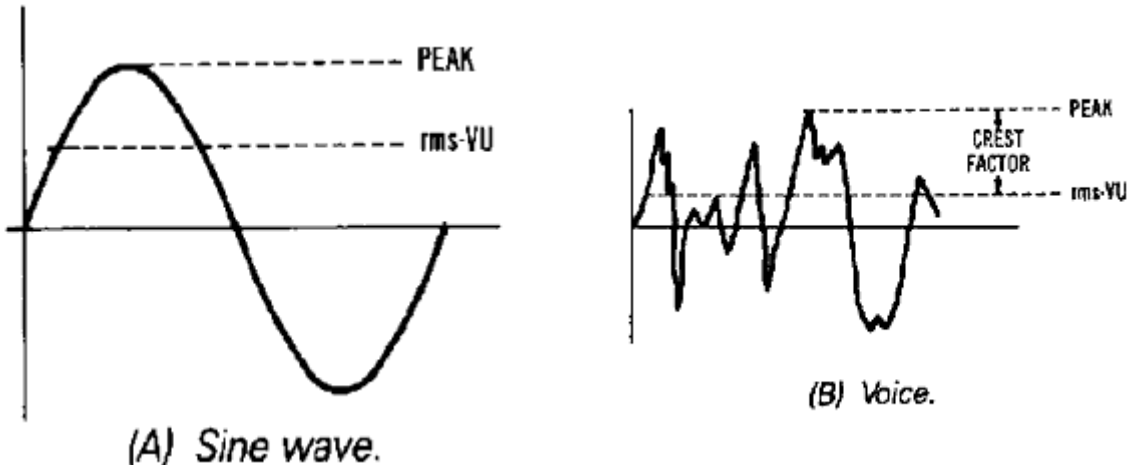


CREST FACTORS and POWER ANALYZERS

What is Crest Factor?

The Crest Factor of a waveform is the ratio of the peak excursion from 0 and the RMS value of an AC waveform. For a sine wave this is 1.414:1, for a square wave this is 1:1, for a triangle wave this is 1.732:1, and for random noise this is typically between 5 and 7.



What is a "Crest Factor Specification"?

Normally, this is the highest crest factor waveform which can be correctly measured by an instrument when the RMS value of the waveform is at the full-scale value. This has been the "defacto" standard method of specifying crest factor performance for many years in the instrumentation industry. Thus, if a waveform having a 1A RMS value is measured on the 1A range, this specification sets the highest crest factor measurable on that range for that input level. The maximum limit on crest factor increases linearly as the RMS value of the input is reduced relative to the range value. In other words, the crest factor can express the the dynamic range for an input signal.

Thus, if the instrument specifies a 2.5:1 crest factor:

- A 1A RMS waveform measured on the 1A range must have a crest factor < 2.5:1.
- A 1A RMS waveform measured on the 2A range must have a crest factor < 5:1.
- A 1A RMS waveform measured on the 5A range must have a crest factor < 12.5:1.
- A 1A RMS waveform measured on the 10A range must have a crest factor < 25:1.
- A 1A RMS waveform measured on the 20A range must have a crest factor < 50:1.

Watch Your Specifications

Some manufacturers specify their ranges as the highest peak value measurable on that range (i.e., the 1A range can only handle 1A peaks!) and thus, their instrument would have only a maximum crest factor specification of 1:1 at full-scale. This is probably why they don't specify crest factor this way, they would have a specification of only 1:1 maximum crest factor! What does it mean if there is a 20:1 maximum crest factor limit? This appears to be either the maximum displayable crest factor, or the ratio of the minimum input to the range value (i.e. a 50mA RMS minimum input on the 1A range).



Manufacturers of Engineering and Production Test Equipment

TB103 Technical Brief

Comparing Specifications

The main difference between the specifications is that some manufacturers specify their ranges as the highest peak, whereas other instrumentation manufacturers specify their ranges as nominal highest RMS input. If Xitron products (those capable of ranging) were specified in the same manner as the former, the accuracy specifications would be 0.04% instead of 0.1% (i.e., 2.5:1 better?), and the maximum crest factor specification would be 2500:1 (the minimum input on a range).

Conclusion

Some specifications can be misleading, or simply difficult for the average user to compare specifications. Specifying their accuracy in terms of the range value, when the range value is the highest peak, causes the instrument to appear significantly better (2.5 to 1) than it really is.

For example, if a specification read $\pm(0.1\%$ of reading $+ 0.1\%$ of range $+1\text{mA})$, and a 1A RMS waveform having a 2.5:1 crest factor were measured, this would require measuring on a minimum 2.5A range. Many instruments have ranges such as 1A, 2A, 5A, 10A, etc. This example would require the 5A range be used. The specification would then be $(1\text{mA} + 5\text{mA} + 1\text{mA})$, for a total of 7mA (or 0.7%), for an instrument specified using highest peak range values. This can create a large difference in accuracy numbers between instruments that *appear* to have similar specifications.