Boonton

Application Note

Boonton 4500B and the Trailing Edge Characteristic of a Pulse Power Measurement

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Abstract

When demonstrating the Boonton 4500B to customers, a question often arises regarding the nature of the shape of the observed pulse when viewing in logarithmic mode. The trailing edge appears to display a slow decay, and there can be concern that the instrument is not showing a faithful reproduction of the pulse. The following article explains this phenomenon, which is present for all diode power sensors regardless of manufacturer, and shows that it has a negligible effect on measurement.

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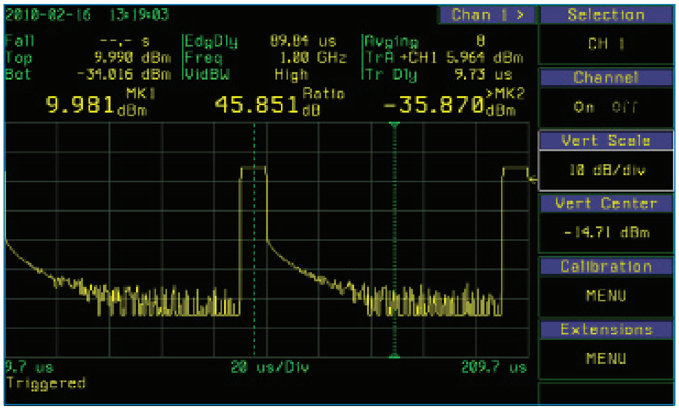
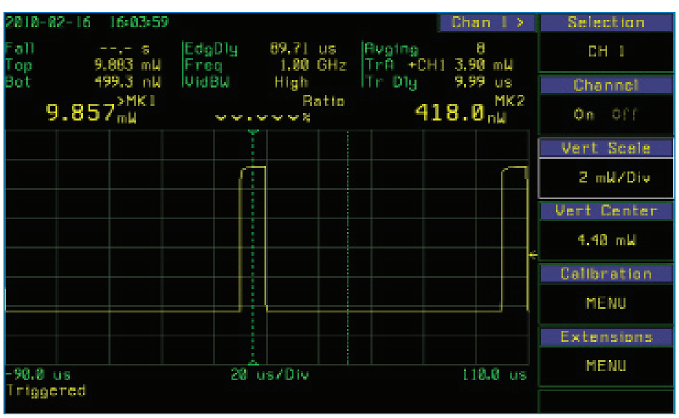
Pulse Power in Logarithmic Scale

In the Boonton 4500B, pulse power is a triggered mode of operation with a setup very similar to an oscilloscope including selections for auto or normal trigger mode, source selection, level, slope, holdoff and delay. 4500B has an integrated standard feature which allows automatic delay by events rather than by time only. This capability is useful for selecting a particular pulse in a burst of pulses.



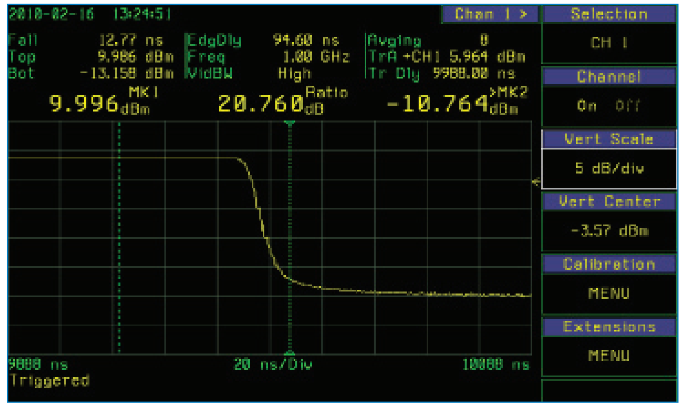
Pulse Power in Linear Scale

A practical example to illustrate the need for sophisticated triggering in a Power meter is the analysis of a pulse position modulated (PPM) signal. As the name implies, PPM is a data-encoding scheme where the position of the transmitted pulses is modified. Typically this will result in a long stream of pulses that are unevenly spaced in time. For the purposes of this technical note the signal to be measured is a group of six 1 us wide pulses in a burst that repeats every 100 us.



Trailing Edge Characteristics

Returning to a logarithmic scale, the next screen shot focuses on the beginning of this tail.



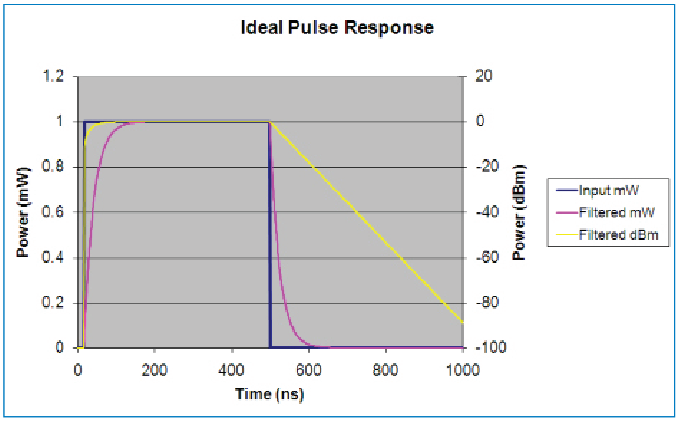
The markers show that te break point occurs approximately 20dB below the top of the pulse, equating to about 1% of the pulse power. With this in mind it should be noted that a pulse fall time is normally measured between the 90% and 10% levels, and so will not be influenced by this characteristic.

The falling edge of most diode detectors is slightly slower than the rising edge, and this difference is magnified by the asymmetry introduced by the display units. There are two reasons for this slower falling edge, the first being due to the fact that the effective series impedance of the detector diodes is lower at high signal levels. From the point of view of the output capacitance, the diode impedance is in parallel with an external load impedance. So at low levels the time constant will be somewhat extended. In the fastest sensors the load impedance term dominates, so this effect is negligible. In higher sensitivity "slow" sensors such as CW sensors or the 56518, the load impedance is large enough that the level dependent diode impedance comes into play, reducing bandwidth at low signal levels.

Secondly, the sensor's built-in amplifier has some settling time. Since this is a multi-stage amplifier, the settling is more visible on the falling edge, again primarily due to the logarithmic units.

Comparison Between Linear and Logarithmic Scale

The following chart once again illustrates a pulse in both the logarithmic and linear displays. An Excel spreadsheet has been used to introduce filtering, and the result shows the pulse in both dBm and mW.



The leading edge compression and trailing edge expansion is very clear when the log scale is used. In linear mW, the leading and trailing edges appear symmetrical.

Conclusion

As previously mentioned, the detectors in other manufacturers' sensors are similar to Boonton's, and will therefore also generate tails. Our tests in the past have indicated that some models include circuitry which "cancels out" this tail, and while it makes the visible trace drop to the noise floor much more quickly, there is still a behind-the-scenes noise floor. This means that it can be difficult to detect a low level pulse immediately following a high level pulse. Boonton does not disguise this effect, and so such problems are not an issue.

References:

[1] Boonton 4500B Peak Power Analyzer (http://boonton.com/products/power-meters/4500b-peak-power-meter)

[2] Boonton 4500B Data Sheet (http://boonton.com/~/media/Boonton/Datasheets/4500B_Datasheet_WEB.ashx)

[3] Boonton 4500B Instruction Manual (http://boonton.com/~/media/Boonton/Manuals%20and%20Software/4500B_Instruction_Manual.ashx)

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