

# Delay-By-Events Trigger Aids Pulsed Signal Analysis

This power-meter trigger circuit allows a specific pulse within a burst to be analyzed, even when its position in time within the pulse burst is highly variable.

**m**easuring the peak and average power, rise and fall times, pulse widths, and delays of pulsed signals in ultrawideband (UWB), radar, remote sensing, digital wireless, and optical systems requires a peak power meter capable of synchronizing to a specific pulse within a burst of pulses. An option for the 4400A and 4500A series peak power meters from Boonton Electronics (Parsippany, NJ) simplifies these

PPM are fairly straightforward. The modulation format is highly efficient, and increasing employed in a variety

of radar and communications systems. But evaluating PPM pulse bursts requires special tools, such as properly equipped peak power meter. Without the ability to synchronize to a specific pulse within the burst, the task is reduced to trial and error.

measurements, especially for systems employing pulse-position modulation (PPM), in which pulses are not symmetrically spaced but vary in their time relationship to each other.

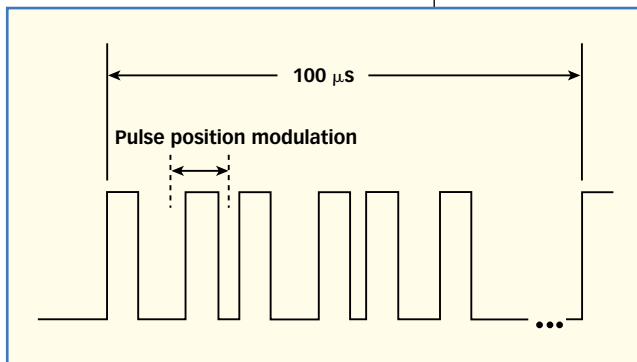
In PPM, the delay of a pulse conveys information while the amplitude and pulse width are kept constant (**Fig. 1**). The position of the pulses relative to each other is varied by each instantaneous sampled value of the modulating wave. Because of the constant amplitude and duration, transmitter requirements for

A typical measurement example shows why this is so. In this case, the signal to be measured is a group of six pulses each 1  $\mu$ s wide, in a burst that repeats every 100  $\mu$ s. The goal of the measurement is to trigger on every fourth pulse.

If an edge trigger is used, the peak power meter will trigger on an edge, but not necessarily that of the fourth pulse. A standard edge-triggered power meter is unable to synchronize to any specific edge in the burst and also unable to isolate

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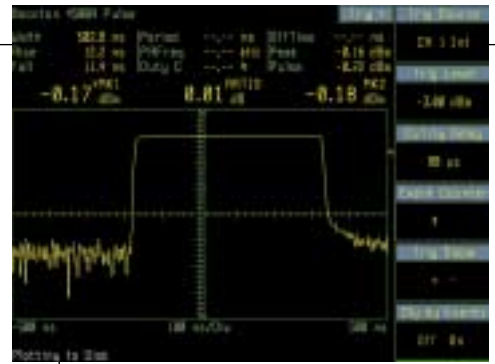


1. In pulse position modulation (PPM), pulses are unevenly spaced in time.

the fourth pulse in the burst.

By using the trigger holdoff capability of the 4400A/4500A meters, a period of time can be identified during which triggering will be inhibited (ideally slightly less the burst's cycle time). In this case, the peak power meter will

lock onto the first edge of the pulse train. Hold-off can also be used in conjunction with trigger delay to view periods of time in a burst of pulses. Trigger delay is a time specified by the user that is offset from trigger event to the point



**2. The fourth pulse in a PPM burst was selected and captured by the delay-by-events trigger, which allows detailed analysis to be performed.**

when the data is captured. In this example, trigger delay would be set to position the fourth pulse in the center of the display. However, since the trigger is not locked onto the edge of the fourth pulse, it provides little benefit when evaluating PPM signals.

The optional delay-by-events-trigger capability solves this problem by combining trigger hold-off with an event counter to ensure that synchronization is achieved not just with the start of a pulse burst, but with any pulse up to 65,534 events afterward. This, in effect, eliminates synchronization problems associated with PPM as well as with time jitter. A user simply selects the trigger hold-off time and chooses a specific event to trigger on. The circuit counts the events and holds the trigger until the specified event count has been reached, even if this requires counting into subsequent bursts or the hold-off time has elapsed.

The user then has the ability to analyze the desired pulse in great detail. For example, the pulse rise and fall times can be controlled to minimize jitter, with the edges just fast enough to achieve low jitter but not so fast that they are out of band. In **Fig. 2**, the fourth pulse in the burst has been locked-on and the time scale has been changed to allow an accurate measurement of its rise and fall times to be made. The delay-by-events trigger option is available for all models of the 4400A and 4500A series meters, and can be added to instruments already in service. **Boonton Electronics (a Wireless Telecom Group Co.), 25 Eastmans Rd., Parsippany, NJ 07054; (973) 386-9696, FAX: (973) 386-9191, Internet: [www.boonton.com](http://www.boonton.com).**

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