

BOONTON

Technical Note

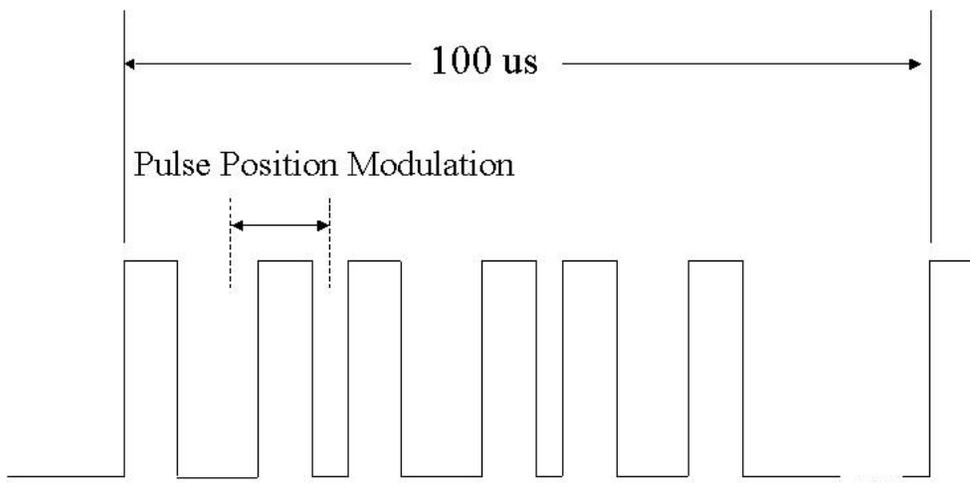
4400A/4500A Delay By Events Trigger Qualifier

Pulse power measurement in radar, remote sensing and tracking, and certain wireless communication applications such as TDMA and GSM frame has become increasingly complex. Peak power meter in these applications may need to measure pulses that are position modulated within a burst of pulses. They may also need to analyze specific pulses within a burst of pulses to verify, peak and average power, rise/fall times, pulse widths and delays. The instruments used to measure these complex signals must have sufficient trigger capabilities to allow for synchronization to a specific pulse within a burst of pulses.

In the Boonton 4400A/4500A, 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. The option 04 adds an additional qualifier to the 4400A/4500A trigger system to permit trigger delay by events rather than by time only. This capability is useful for selecting a particular pulse in a burst of pulses.

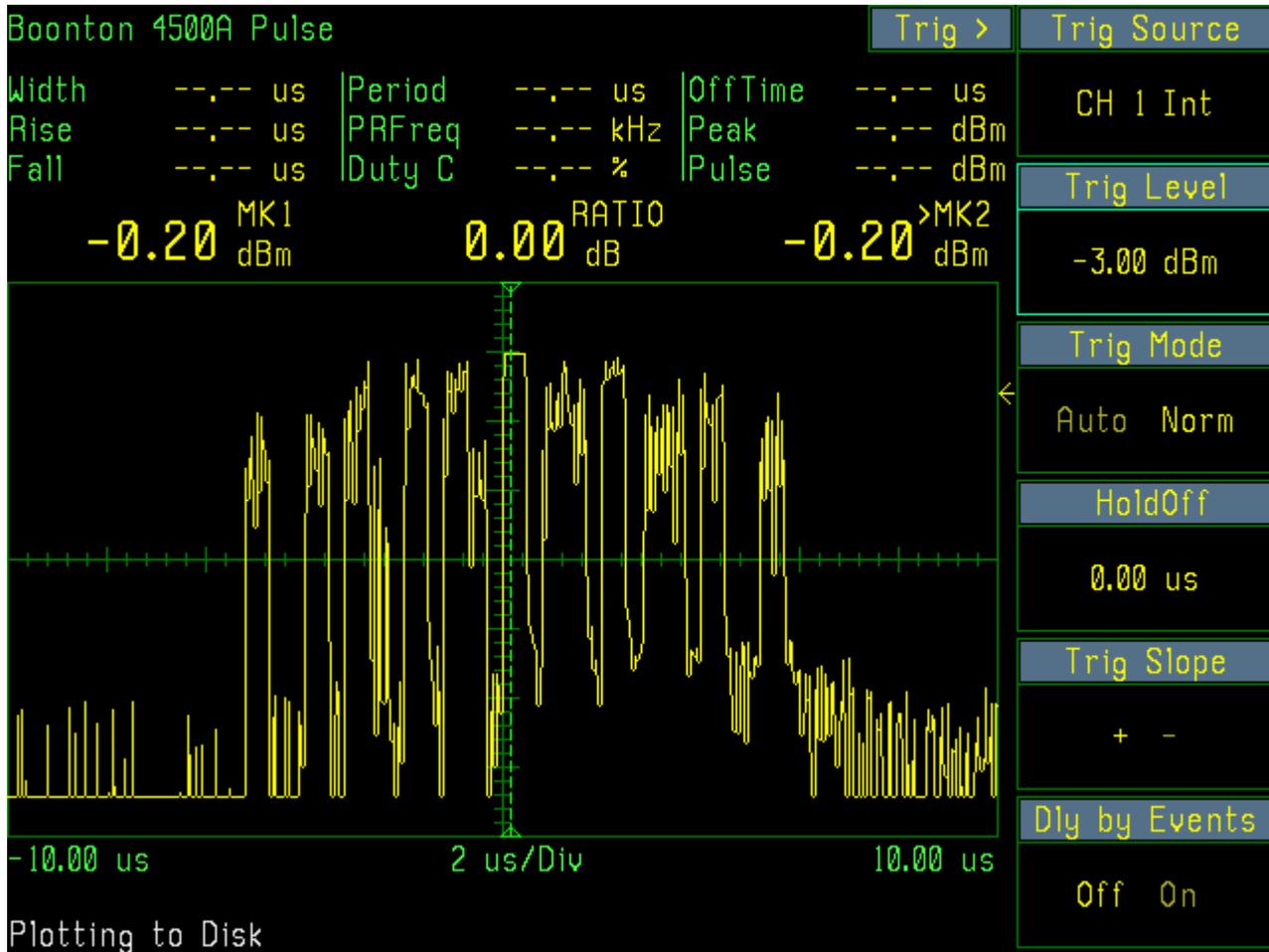
Pulse Position Modulation Example:

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.



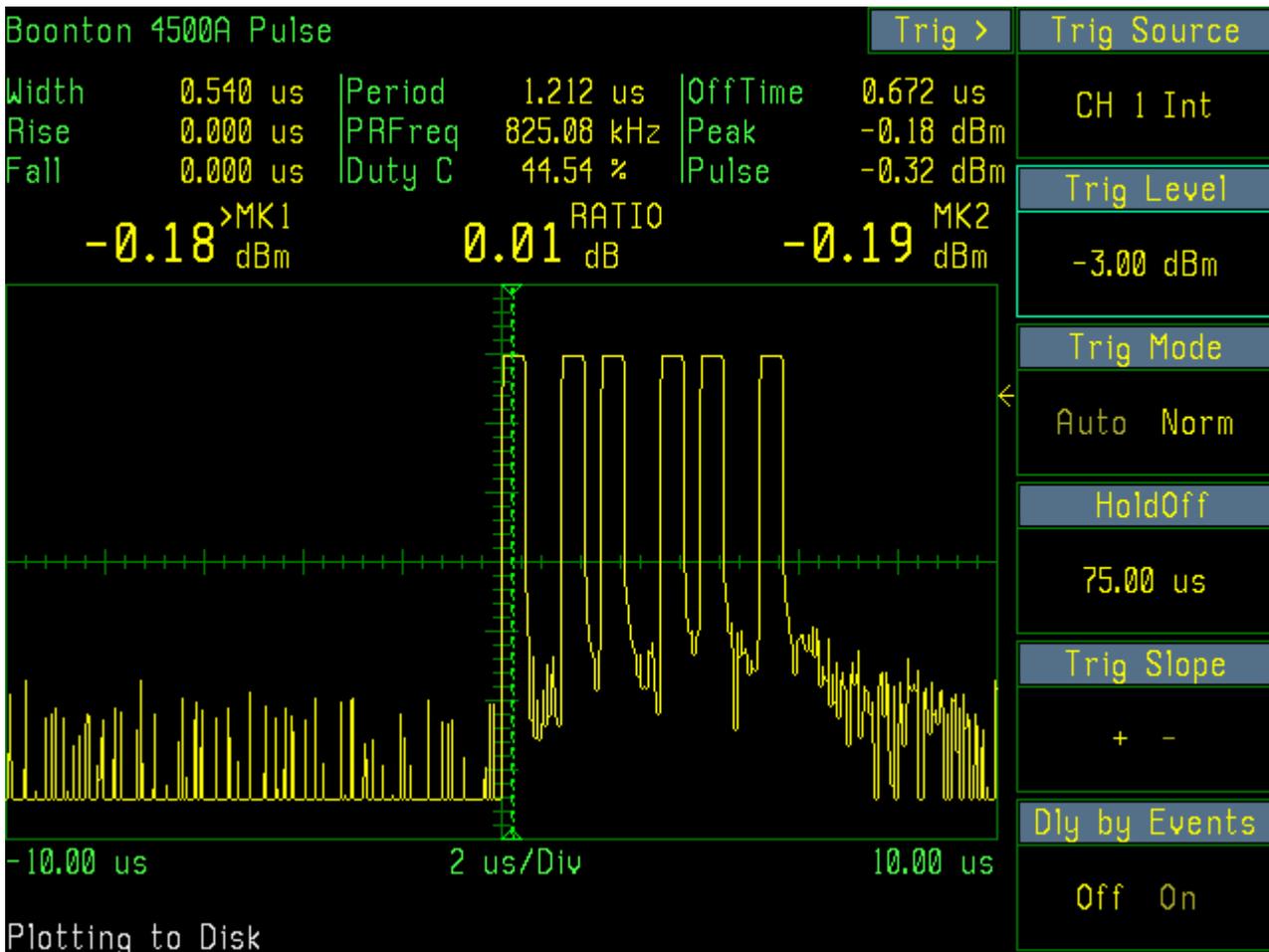
Simple Edge Trigger Limitations:

The 4500A screen image below illustrates the limitations of simple edge trigger for applications that produce a burst of pulses. In this example, the peak power analyzer will successfully trigger on the edge of a pulse but that pulse is random. The trigger point is in the center of the screen and the resultant waveform is an average built from a number of triggers events. The peak power analyzer cannot synchronize to any particular edge or in the burst given this trigger setup.



Trigger Holdoff:

Trigger holdoff is an effective way to stabilize the display of complex waveforms and is especially useful in pulse burst applications. The holdoff function allows you to specify a period of time when triggering is inhibited. This time should be slightly less than the burst cycle time. The peak power analyzer will “lock-on” to the first edge of the pulse train when this is setup correctly. In this example the burst cycle time is 100 us and the delay was set to 75 us.

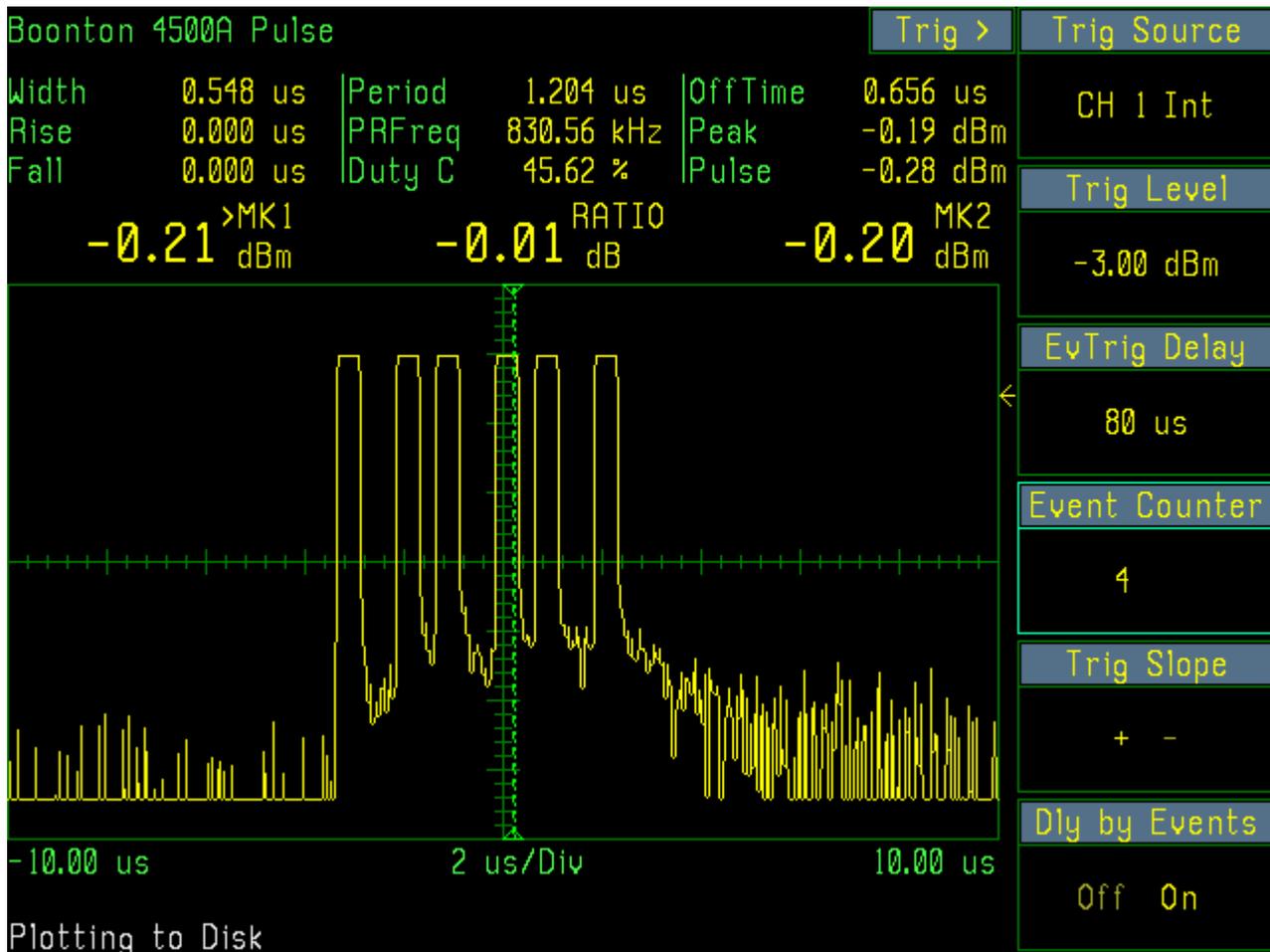


Trigger holdoff should be used in normal trigger mode to avoid any forced triggers that could occur in auto trigger mode especially when the burst cycle time is long. Trigger holdoff can also be used in combination with trigger delay to view time sections of a burst of pulses. This feature has limited use when analyzing large bursts of pulsed data because trigger delay is limited to typically less than 100 ms on most time scales in the 4500A and 4400A.

Delay By Events Trigger Qualifier

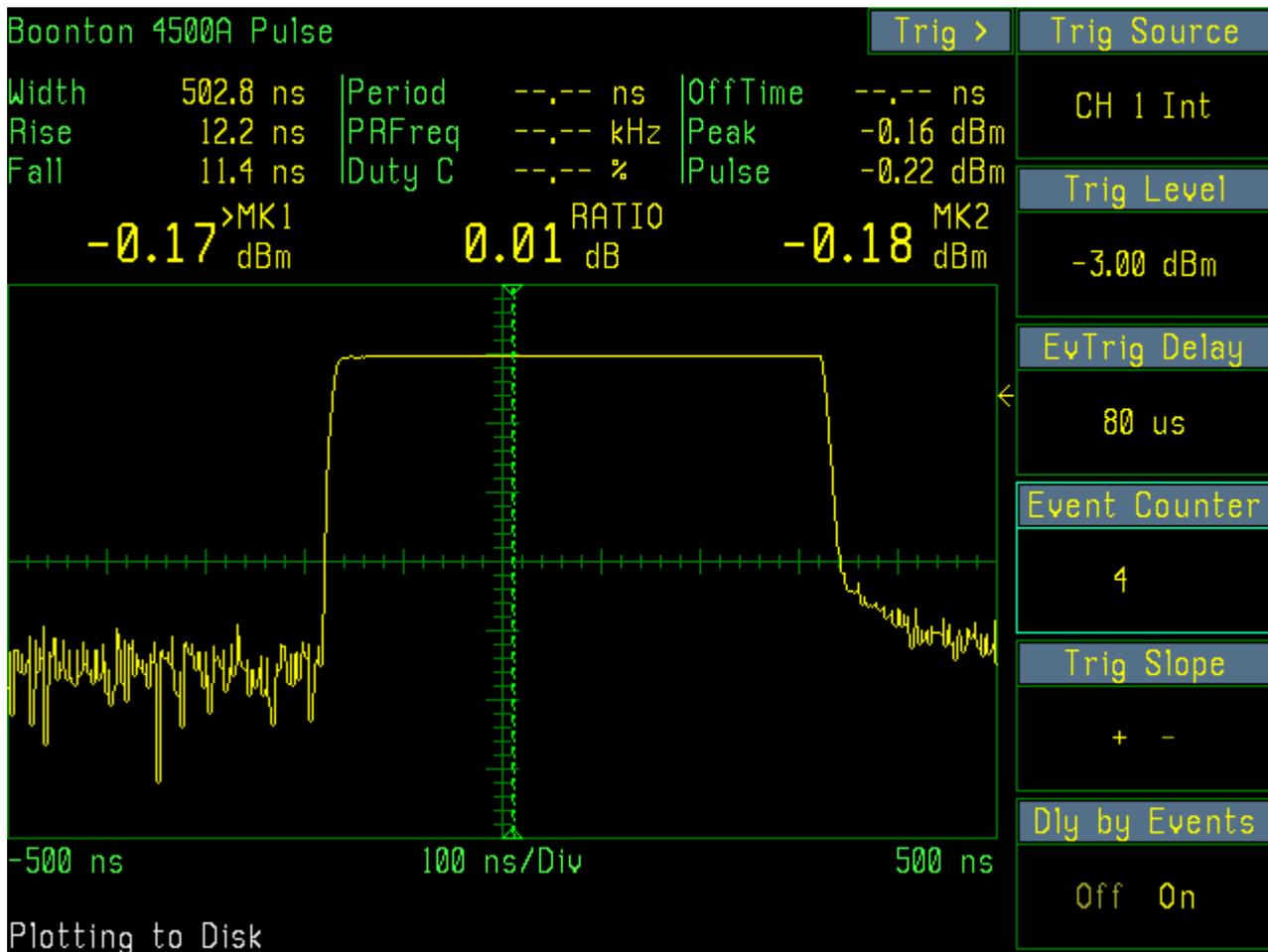
The option 04 delay by events trigger qualifier for the 4400A and 4500A extends the system functionality to trigger on specific events within a pulse burst. It combines trigger holdoff in time with an event counter to ensures synchronization not only with the start of a burst of pulses but any pulse up to 65,534 events thereafter. This feature eliminates synchronization problems associated with time jitter and pulse position modulation.

Below is the setup of the delay by events trigger qualifier. The user selects the trigger holdoff time and again this slightly less than the burst cycle time. Next the user can choose the specific event to trigger on. The circuit will count events and hold the trigger until the event count has been reached even if it needs to count into subsequent bursts or the holdoff time has elapsed. In this example the holdoff time is set to 80 us and the event counter is set to trigger on the fourth pulse in the burst.



Analyzing a Specific Pulse:

The delay by events trigger qualifier allows a user to synchronize and observe the nth pulse of a burst even if its time position is highly variable. Peak power meter users can analyze individual pulses in great detail. For example, in pulse position modulation applications the pulse rise/fall times typically need to be controlled to minimize jitter. These edges need to be fast enough to get low jitter and a good measurement of the time between pulses but not too fast to ensure they do not go out of band. In the image below the forth pulse in the burst has been “locked-on” and the time scale has been changed to make an accurate measurement of the rise/fall time of the forth pulse in the burst.



The delay by events trigger qualifier in the 4500A/4400A peak power meter is an extremely useful tool in analyzing individual sections in long burst of data.