Benefit of Large Memory Depth in modern Scopes

When many people are looking for a new scope, Memory Depth is very often only the third or fourth point on their list of key parameters. The initial specifications that everyone is thinking about are bandwidth, sample, and Acquisition Rate. But a fundamental spec that can provide great benefit is memory depth.
In this paper the relation of different parameters and the importance of memory depth will be explained and with the help of a practical example underpinned.
If the only task for the scope is to capture short or fast signals, the main focus will be on High Sample Rate and adequate Bandwidth (keyword Rise Time). But, if the signal has to be monitored over a longer time period and if there are additionally some peaks or drop outs within the signal which have to be analyzed, then it is absolutely necessary to have a deep memory or a corresponding combination of intelligent triggering and memory segmentation available.

The graphic below is based on the simple relation between sample rate, time base settings and memory depth.

This all can be written into the following mathematical formula:

$$\boldsymbol{Sample\ Rate} * \frac{\boldsymbol{Time}}{\boldsymbol{div}} * \boldsymbol{No.of\ Divisions} = \boldsymbol{Acquisition\ Memory}$$

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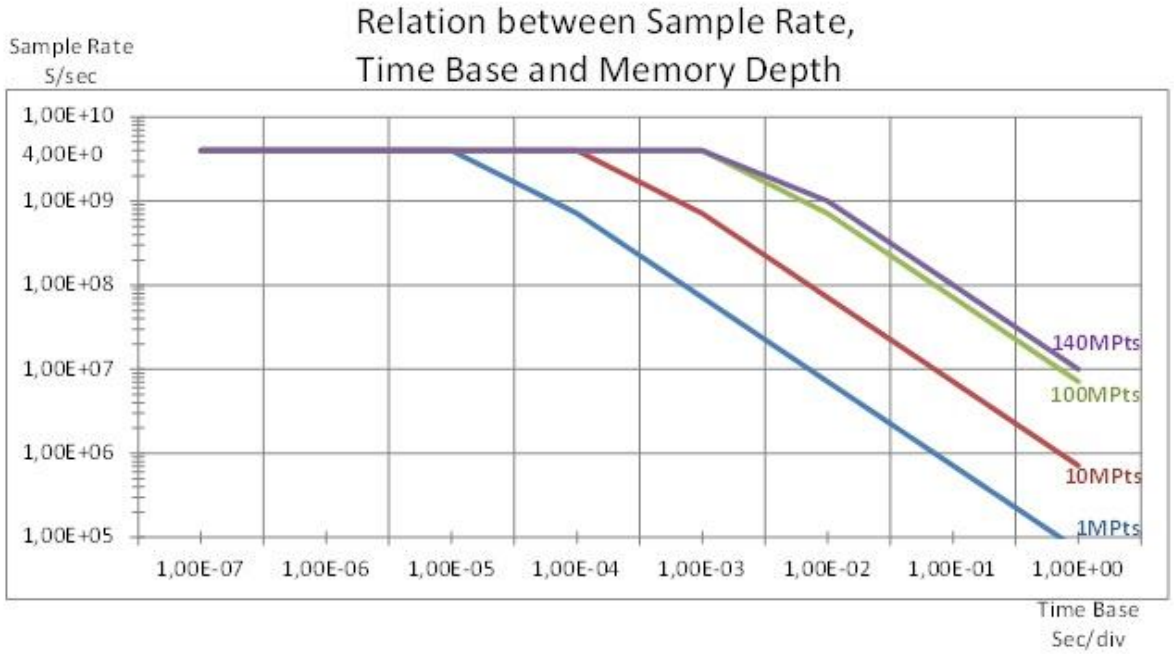
Changing the formula over to:

$$\frac{\boldsymbol{Time}}{\boldsymbol{div}} * \boldsymbol{No.of\ Divisions} = \frac{\boldsymbol{AcquisitionMemory}}{\boldsymbol{Sample\ Rate}}$$

With this we can see that if we select a longer displayed time span, the only possibility is to lower the sample rate, because the maximum available acquisition memory is fixed.

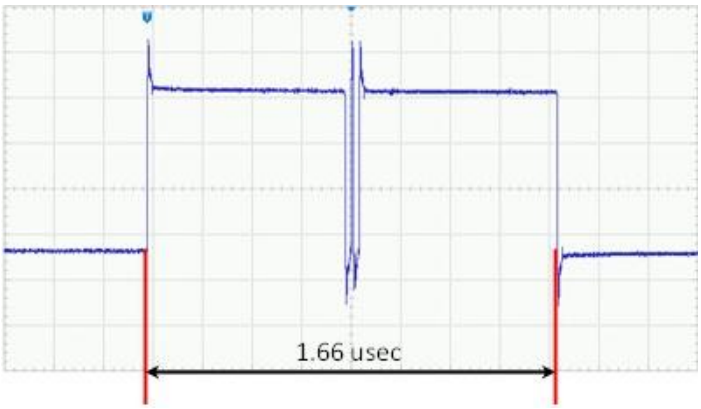


The graph also shows the influence of using different memory depths. As you can see, Larger memory depths allow you to maintain the maximum sample rate at longer time base scales. This provides more detailed waveforms over longer time spans.

Let's pick out two examples from the graph:

1MPts Memory (blue line) allows a max. time span of 250usec @ max. Sample Rate 4GS/sec
10MPts Memory (green line) allows a max. time span of 25 msec still @ max. Sample Rate of 4GS/sec

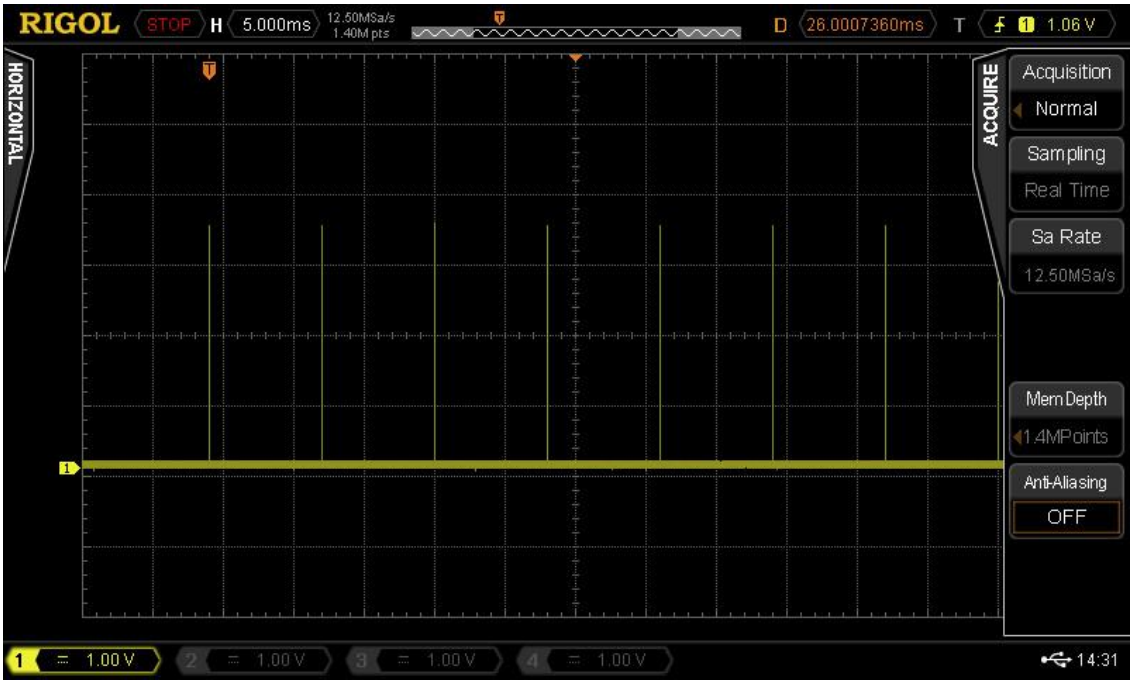
Now let's look at a practical example. Consider a test signal that contains 8 bursts. The time between two bursts is around 8 msec and each burst has the following shape:



To capture all 8 Bursts with one single acquisition we have to set the time base to 5msec / div. Based on a scope with 14 horizontal divisions, we have a total visible time span of 70 msec. The trigger mode is set to edge trigger, trigger type is set to rising edge with a level of 2 V, and single acquisition is activated.

Now, we capture the waveform/burst sequence twice. Once with memory depth on Auto, which leads to the 140MPts (standard on Rigol DS4000 Series), and once with manually limited Memory Depth of 1.4 MPts. After both acquisitions, we can zoom in on the captured peaks.

The first acquisition is done with the reduced memory depth (1.4M Points). As a result of the time base selection, the sampling rate drops from the maximum 4GSa/sec down to 12.5MSa/sec. With this setting the used memory is at only 875kPts.



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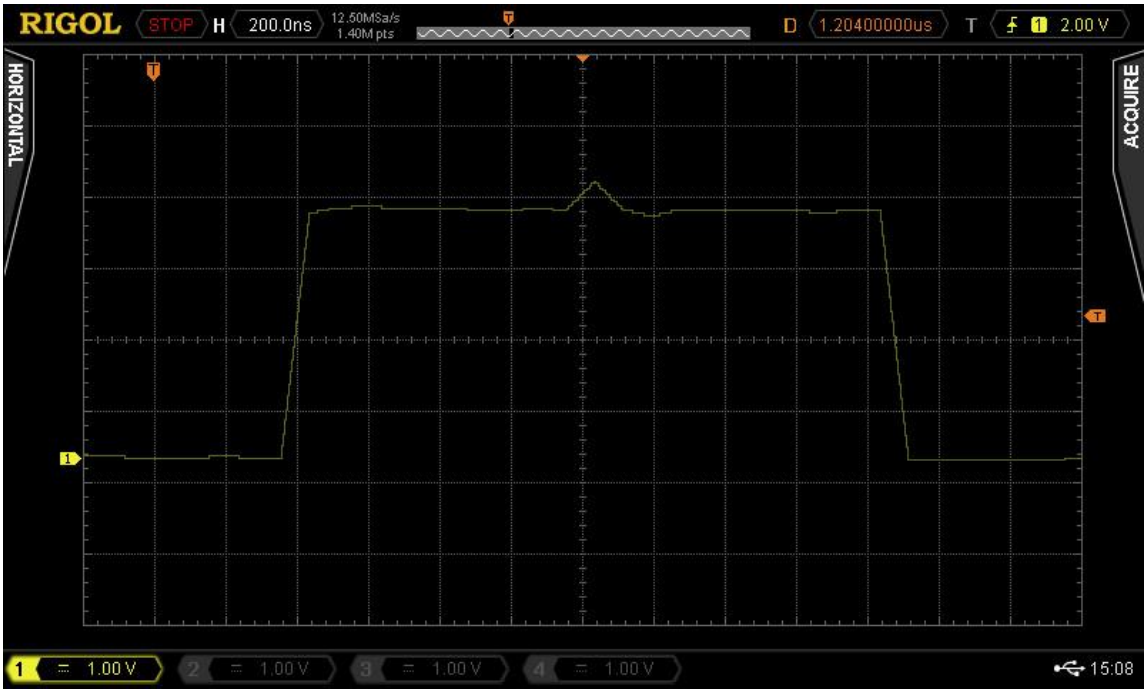
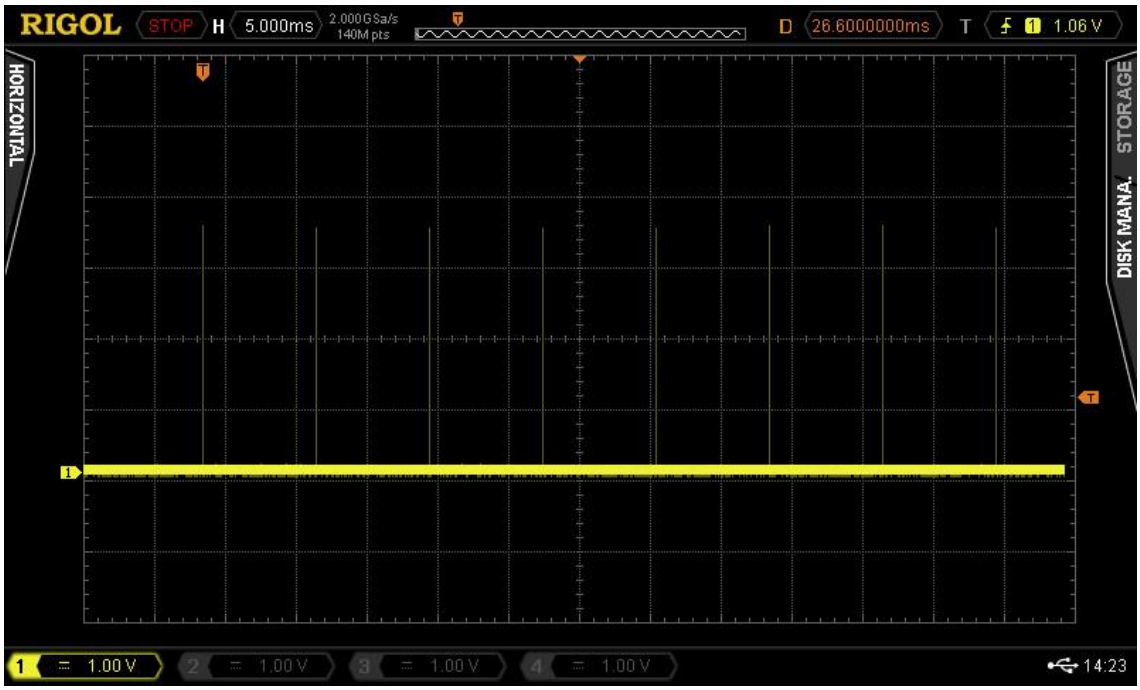
When we zoom into one of the bursts. You can see that the peak in the middle of the burst is totaly lost.



Now, let's perform the same acquisition, but use the Auto Memory depth, which will give us a depth of 140MPts.

As a result of long displayed time and max memory depth the Sampling rate only drops from 4GSa/sec down to 2GSa/sec. With this setting the used memory is at 140MPts. The first look is the same as above but the zoomed view shows the difference very clearly.



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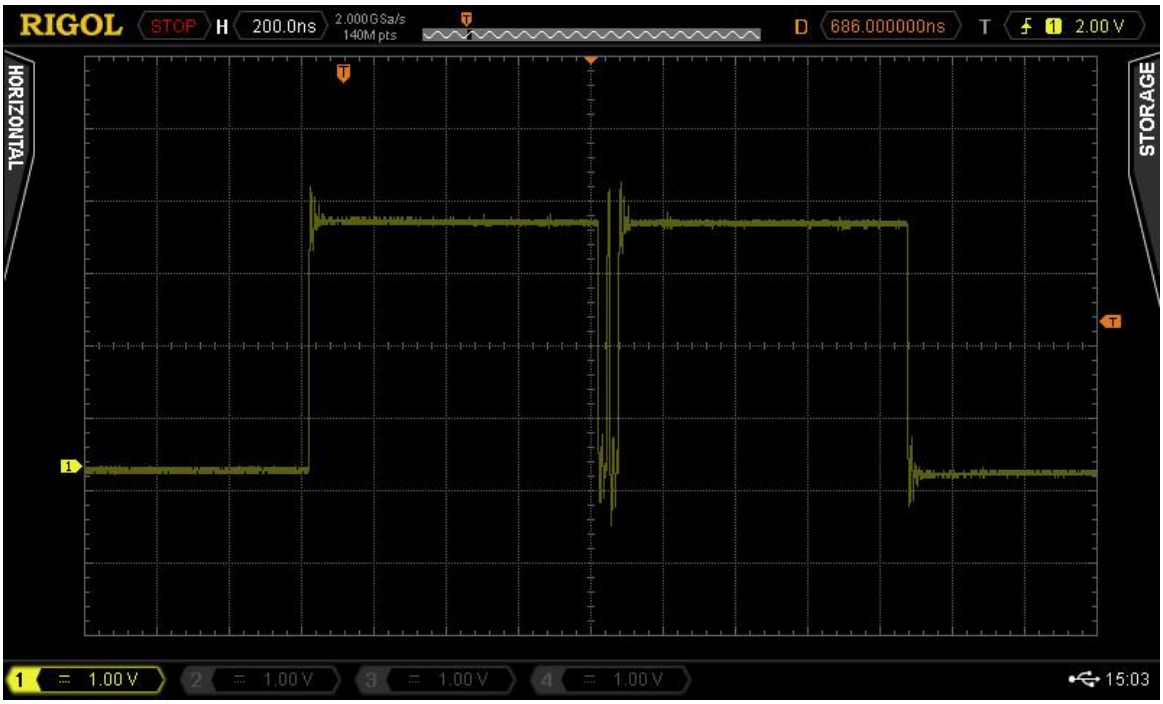
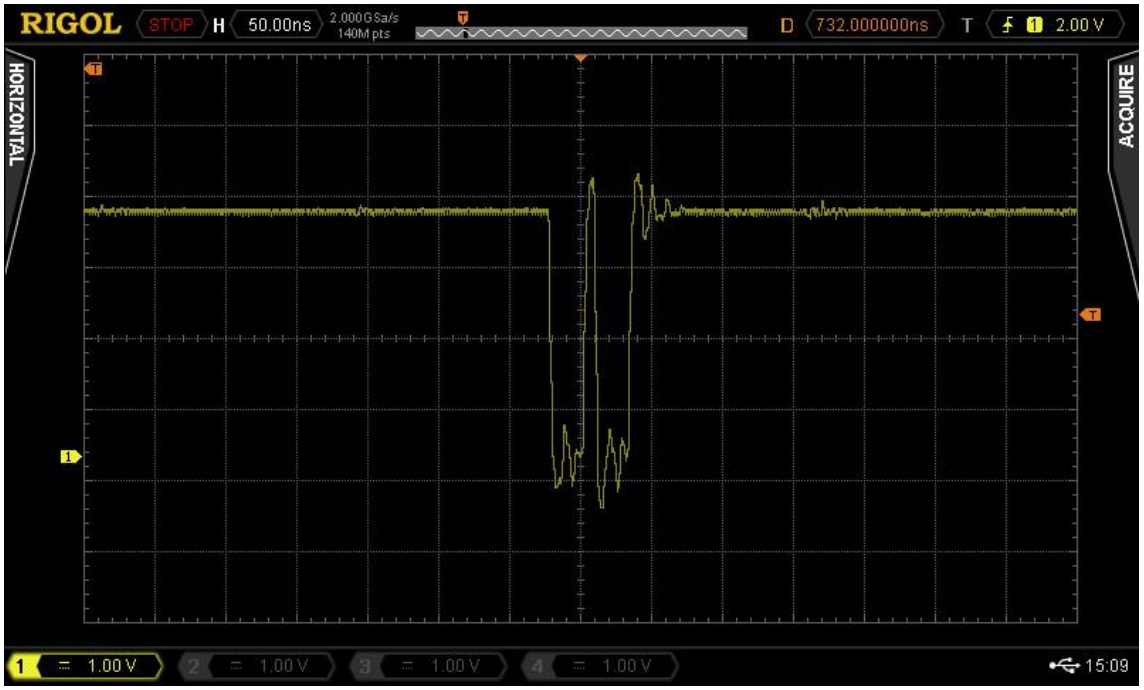
Many more details are available. The burst is almost identical to the original one.



Even when we zoom in more we can still see a very excellent data resolution.



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Summary:

The Rigol DS4000 and DS6000 Scopes provide large memory depth off the shelf. This is a key feature when your tests require maximum data resolution and long acquisition times. Acquiring longer time periods and being able to zoom into the signal without losing detailed information enable the engineer to verify the hardware design quickly or dig into failure events earlier which saves time and money in the development phase. Rigol combines large memory, intuitive record functions, and intelligent triggering to provide you with a very detailed and accurate “offline” analysis afterwards.

About RIGOL

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