When you buy a test instrument like an oscilloscope or a logic analyzer, you probably will inquire about the instrument’s sampling rate. And you’ve probably been taught that the higher the sampling rate of the instrument, the better it is. However, this “truism” is not necessarily accurate for all conditions and all test instruments – faster doesn’t always mean better. A logic analyzer’s high-speed timing sample rate is a good example. The sample rate is only one factor that affects your measurements; memory depth is the other critical factor.

With logic analyzers, we normally sample at the conventional timing speed of the logic analyzer, but with the timing zoom feature available on Keysight Technologies, Inc. logic analyzers, you get a sampling rate of 4 GHz. You need to figure out what sampling rate you really need for the system you are working with, which is dependent on its timing speed.

This application note outlines the requirements for high-speed timing measurements. Sampling speed and memory depth both contribute to your ability to gain insights into your system activity. Faster sampling speed provides you with more details, and greater memory depth allows you to look at a larger quantity of data. The best instrument gives the longest capture time at high resolution. Additional features like View Scope and Eye Scan are great tools that provide additional insight into signal integrity issues.
**Timing Zoom**

Keysight’s timing zoom samples at 8 to 10 times the conventional timing sample rate of the logic analyzer timing speed. This provides finer resolution and simultaneous state and timing measurements without double probing. The viewing area on the waveform display is adjustable from 100% pretrigger to 100% posttrigger. Timing zoom stores up to 64 K of memory depth with 250 ps of high-resolution data.

Figure 1 shows the timing zoom trace labeled “My Bus 1 (TZ)” in the logic analyzer’s waveform display. A timing zoom trace provides more information. Data B8 and A8 were captured in timing zoom and not in the conventional timing trace. In this example, in conventional timing, we are sampling every 4 ns, yet with timing zoom we are sampling every 250 ps. In the 2-ns timing frame, timing zoom shows transitions on the bus that may be glitches in the system under test.
Timing Speed in Relation to Sampling Rate

The Nyquist sampling theorem states that a signal must be sampled at a rate that is at least twice the highest frequency component to avoid the loss of information. For today’s complex signals, higher sampling rates of 8x to 10x are recommended. 4 GHz timing zoom at 250 ps sample rate more than meets the timing sample requirements of most buses that can be measured with a logic analyzer.

You need to know the timing speed of the system under test to determine how much sampling you need.

Table 1 provides signal speed of your system with reference to the number of samples per clock period you can achieve with 4 GHz timing zoom. Thus, 4 GHz of timing zoom is more than sufficient for the majority of parallel bus measurements.

For further signal integrity checks and parametric measurements, you can use the View Scope feature on Keysight 16800 and 16900 Series logic analyzers. View Scope allows accurate time correlation between the logic analyzer and oscilloscope traces.

Figure 2 shows an oscilloscope trace, glitch_bit 7 of logic_bus (TZ\[7\]) imported to the logic analyzer waveform window using the View Scope feature, the industry’s first cost-effective solution that connects scope and logic-analyzer measurements using off-the-shelf BNC and LAN cables.

Table 1. Signal speed in relation to the number of 250-ps samples per clock period.

<table>
<thead>
<tr>
<th>Signal speed</th>
<th>Signal clock period</th>
<th>4 GHz timing zoom (Number of 250 ps samples per clock period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MHz</td>
<td>10 ns</td>
<td>40</td>
</tr>
<tr>
<td>200 MHz</td>
<td>5 ns</td>
<td>20</td>
</tr>
<tr>
<td>300 MHz</td>
<td>3.33 ns</td>
<td>13.3</td>
</tr>
<tr>
<td>400 MHz</td>
<td>2.5 ns</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 2. Using View Scope, you can see a deep oscilloscope trace integrated into the logic analyzer display.
64 K Memory Depth

Memory depth is the other key timing zoom specification that is really important. Timing zoom provides 64 K of memory depth with adjustable trigger position to give you insight into the timing relationship between traces.

Figure 3 shows that for a conventional timing speed of 333 MHz, timing zoom is able to show 16 μs of acquired time at 4 GHz, which is actually 8 times more than 16 K of memory depth with 2 μs of acquired time. Note that you cannot trigger on timing zoom traces and have to rely on deep memory to store all the events, especially when a trigger event is not found. This will help to ease debugging work, and you will not lose valuable time taking multiple traces to find the problem.

Conclusion

When you are deciding which logic analyzer to buy for debugging high-speed timing traces, you need to take into consideration the timing speed of the system under test and the memory depth of the logic analyzer. Faster doesn’t necessarily mean better. For a 450-MHz signal, which is the maximum state speed of the logic analyzer, 4 GHz of timing zoom provides 10x sampling, and this is more than enough to provide insight into the timing relationships in your high-speed parallel buses. The best solution acquires the most measurement data at a high sample rate, giving you more information to find and solve your toughest debug challenges.
Keysight Technologies’ Test and Measurement Support, Services, and Assistance

Keysight Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Keysight products for your applications and apply them successfully. Two concepts underlie Keysight’s overall support policy: “Our Promise” and “Your Advantage.”

Our Promise

Our Promise means your Keysight test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you receive your new Keysight equipment, we can help verify that it works properly and help with initial product operation.

Your Advantage

Your Advantage means that Keysight offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Keysight engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Keysight instruments and systems, and obtain dependable measurement accuracy for the life of those products.
Evolving Since 1939
Our unique combination of hardware, software, services, and people can help you reach your next breakthrough. We are unlocking the future of technology. From Hewlett-Packard to Agilent to Keysight.

myKeysight
www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

http://www.keysight.com/find/emt_product_registration
Register your products to get up-to-date product information and find warranty information.

Keysight Services
www.keysight.com/find/service
Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—one-stop calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight’s measurement expertise and product breadth, combined with channel partner convenience.

For more information on Keysight Technologies’ products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas
Canada (877) 894 4414
Brazil 55 11 3351 7010
Mexico 001 800 254 2440
United States (800) 829 4444

Asia Pacific
Australia 1 800 629 485
China 800 810 0189
Hong Kong 800 938 693
India 1 800 11 2626
Japan 0120 (421) 345
Korea 080 769 0800
Malaysia 1 800 888 848
Singapore 1 800 375 8100
Taiwan 0800 047 866
Other AP Countries (65) 6375 8100

Europe & Middle East
Austria 0800 001122
Belgium 0800 58580
Finland 0800 523252
France 0805 980333
Germany 0800 6270999
Ireland 1800 832700
Israel 1 809 343051
Italy 800 599100
Luxembourg +32 800 58580
Netherlands 0800 0233200
Russia 8800 5009286
Spain 800 000154
Sweden 0200 882255
Switzerland 0800 805363
Opt. 1 (DE)
Opt. 2 (FR)
Opt. 3 (IT)
United Kingdom 0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-9-7-17)

DEKRA Certified
ISO 9001:2015 Quality Management System

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015 Quality Management System

This information is subject to change without notice.
© Keysight Technologies, 2017
Published in USA, December 1, 2017
5989-5585EN
www.keysight.com