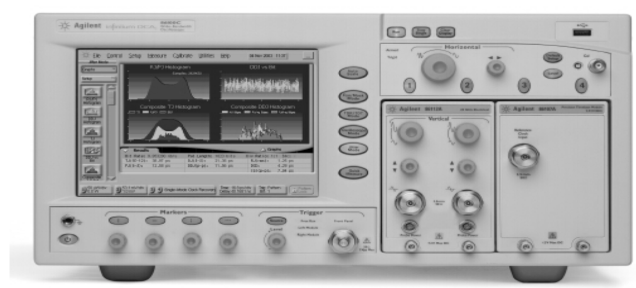
Advanced Jitter Generation and Analysis up to 3.35 Gbps with the Agilent 81134A Pulse Pattern Generator & 86100C Infiniium Wide-Bandwidth DCA-J Oscilloscope

Product Note



Agilent Technologies

Introduction

For the characterization and validation of high-speed serial interconnects, high performance pulse pattern generators and real-time or wide-bandwidth sampling oscilloscopes are commonly used. A pulse pattern generator provides the stimulus signal to a device, such as a receiver, or a backplane bus. An oscilloscope is typically used to capture and analyze the response signal. Real-time oscilloscopes have the capability to capture transient signals. Wide-bandwidth sampling oscilloscopes, also known as communications analyzers, can be used for in-depth analysis of repetitive signals.

Today's high-speed digital busses, e.g. Serial ATA, Infiniband and PCI Express, require test instruments with advanced jitter generation and analysis features. Examples are compliance tests that may comprise receiver sensitivity or "stressed eye" tests. Adequate instrumentation is needed to perform these complex tests.

The Agilent Pulse Pattern Generator 81134A offers full control over the signal integrity of clock and data stimulus signals. For example, it allows the user to vary the cross-over point as well as adding deterministic jitter to the output signal. The 86100C Digital Communications Analyzer DCA-J provides jitter analysis with breakthrough speed and accuracy, including detailed jitter subcomponent analysis. Together, these instruments add up to the leading stimulus/response for applications that require jitter decomposition of repetitive signals.

The Need for the perfect Signal

On one hand, characterization and validation tests require pure, clean, low-jitter stimulus signals. Examples comprise receiver sensitivity tests, as required by the PCI Express compliance procedure. Fig. 1 shows a 2.5 GHz stimulus signal generated with the 81134A Pulse Pattern Generator.

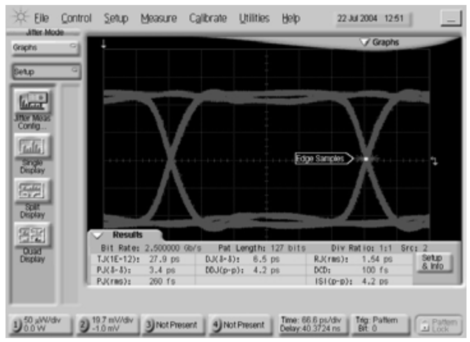


Fig. 1: Clean stimulus signal at 2.5 GHz

The jitter signature of this signal is revealed by the 86100C DCA-J. Total jitter amounts to 27.9 ps, deterministic jitter to 6.5 ps and random jitter to 1.54 ps (rms) as given in Fig. 2.

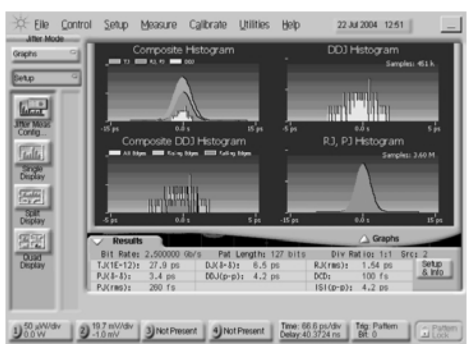


Fig. 2: Jitter analysis

Jitter, please!

On the other hand, the next set of characterization, validation and compliance tests, e.g. jitter tolerance and common-mode tests, require "jittered" signals. These are signals with defined jitter components. The most natural way to achieve this is to add specific jitter to a low-jitter stimulus signal such as the 81134A.

As an example, a "stressed eye" at 2.5 GHz is shown in Fig. 3. This signal was generated by adding sinusoidal jitter to the signal given in Fig. 1. The details of the jitter insertion are given below. As the same scaling is used in both figures, the impact of the jitter, e.g. on the opening of the eye diagram, is obvious.

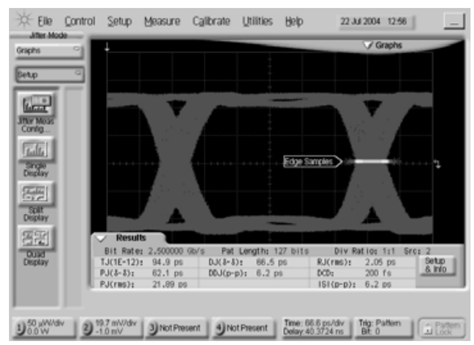


Fig. 3: Stressed eye (low-jitter stimulus plus sinusoidal jitter) at 2.5 GHz

For the jitter insertion into the output signal of the 81134A Pulse Pattern Generator, basically a Function / Arbitrary Waveform Generator, such as the Agilent 33250A, is connected to the 81134A's Delay Control input. For details, see the Agilent Product Note 5988-9411EN.

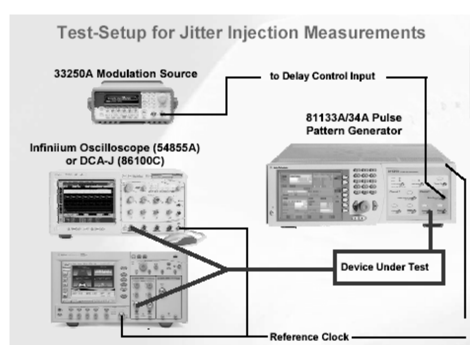


Fig. 4.: Jitter insertion setup

The signature of the jittered signal can be depicted from fig. 5. Total jitter has now tripled to 94.9 ps. In comparison to Fig. 2, determin-istic jitter increased to 66.5 ps, due to the sinusoidal delay modu-lation

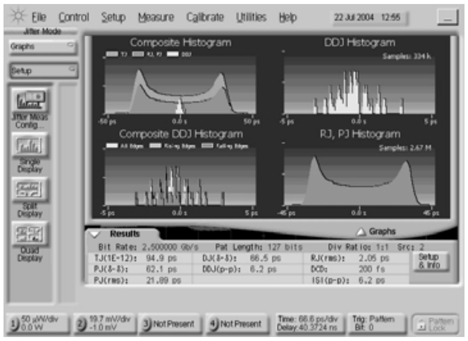


Fig. 5: Jitter decomposition of the stressed eye signal at 2.5 GHz

Jitter, continued

Using non-traditional jitter signals further evidences the potential of the 81134A/86100C stimulus/response solution.

Another "stressed eye" at 2.5 GHz is shown in Fig. 6. Adding a square signal to the clean signal given in Fig. 1 generated this waveform. Again, the same scaling is used in both figures. The eye diagram now exhibits a bi-modal behavior, an imperfection often found during the early stages of high-speed designs.

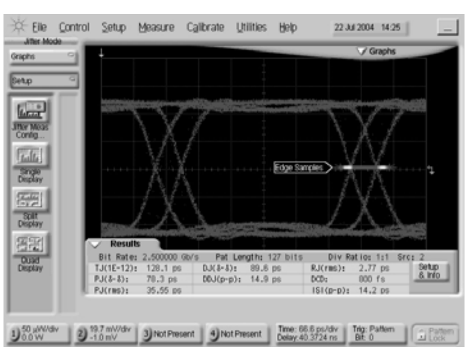


Fig. 6: Stressed eye (low-jitter stimulus plus bi-modal jitter) at 2.5 GHz

The jitter characteristic of the bi-modal waveform is depicted in Fig. 7. Although random jitter still is only 2.60 ps (rms), total jitter is 116.9 ps. The influence of the periodic delay modulation on the deterministic part of the total jitter can be seen easily.

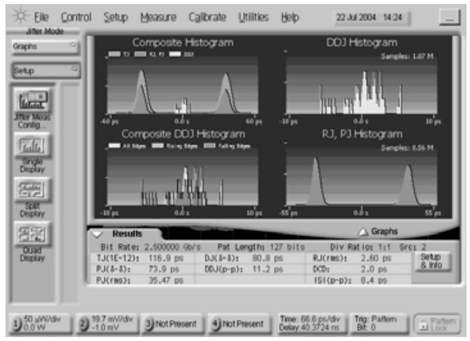


Fig. 7: Jitter decomposition of the bi-modal waveform at 2.5 GHz

Complex Data Pattern Generation

Even for a simple cable test of e.g. Infiniband cables, specifically defined worst-case Jitter Test Patterns (JTPAT) are often needed.

For a quick and easy setup of such patterns, a PC-based external Pattern Management Tool is avail-able. It alternatively runs on the 86100C's built-in PC and controls the Pulse Pattern Generator via a remote LAN, USB or GPIB connection.

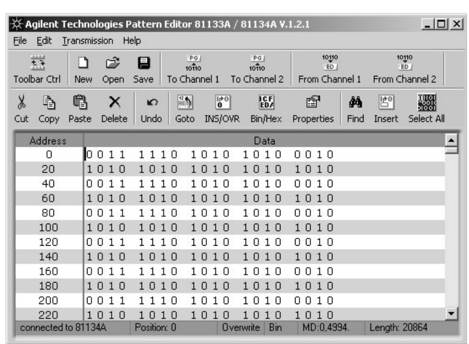


Fig. 8: The 81133A / 81134A pattern editor

Pre-defined test patterns are provided with the tool.

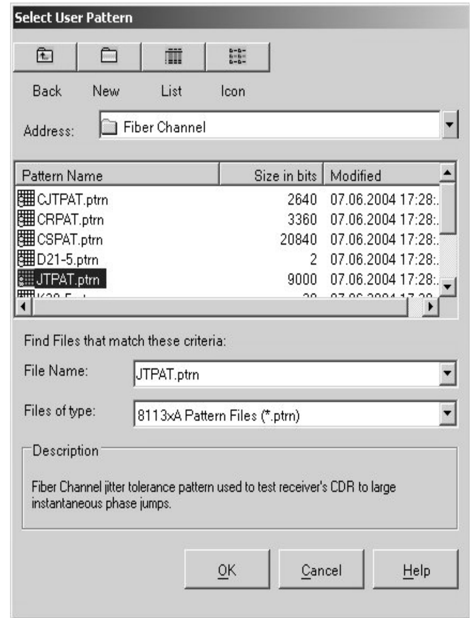


Fig. 9: Selecting pre-defined patterns

Conclusion

The Agilent 81334A Pulse Pattern Generator and the 86100C Wide-Bandwidth DCA-J Digital Communications Analyzer are the ideal stimulus/response solution for repetitive signals up to 3 GHz. This unique solution offers a broad range of possibilities for either generating clean stimulus signals or for testing the device under worst-case conditions with leading jitter analysis capabilities.

Related literature	Publication number
• Agilent Technologies 81133A and 81134A 3,35 GHz Pulse-/Pattern Generators Data-sheet	5988-5549EN
• Agilent 81133A/81134A 12 Mbit Extended Pattern Memory	5988-9591EN
• 86100C Agilent Infiniium DCA-J Brochure	5988-5235EN
• Generating/Measuring Jitter with the Agilent 81134A Pulse/Pattern Generator & 54855A Infiniium Scope Brochure	5988-9411EN

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