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Requirements and Compatibility

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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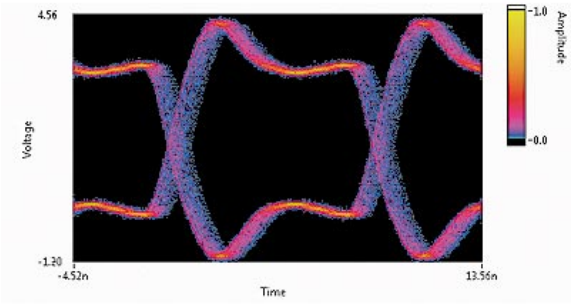
NI LabVIEW Jitter Analysis Toolkit



- Hardware-agnostic: Automate and perform measurements using any oscilloscope or digitizer
- Optimized for measurement throughput: Dynamically provides thread-safe measurement acceleration when taking advantage of multicore processors
- Advanced visualization: VIs for easily constructing and displaying eye diagrams and bathtub curves
- Offline analysis: Easily analyze your saved waveforms at any time
- Enables eye mask definition and mask limit testing
- Example programs for eye diagram and mask testing, and random and deterministic jitter (RJ/DJ) separation using both dual-Dirac and spectrum-based separation methods
- Requires LabVIEW 2010

Overview

The NI LabVIEW Jitter Analysis Toolkit provides a library of functions optimized for performing the high-throughput, jitter, eye diagram, and phase noise measurements demanded by automated validation and production test environments. While many oscilloscopes offer built-in jitter measurement packages, these packages are typically designed and optimized for interactive use and, as such, are usable only on that particular oscilloscope. The LabVIEW Jitter Analysis Toolkit is designed to provide the fastest measurement throughput of any jitter measurement or analysis package on the market today. In addition, it is hardware-agnostic, which means that you can use it in a test system for automating measurements with any instruments, such as third-party oscilloscopes and digitizers or NI high-speed and high-resolution digitizers.

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Requirements and Compatibility

OS Information

- Windows 7
- Windows Server 2003 R2 32-bit
- Windows Server 2008 R2 64-bit
- Windows Vista
- Windows XP

Software Compatibility

- LabVIEW Full Development System
- LabVIEW Professional Development System

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Application and Technology

Toolkit Features

Subpalette	Clock Recovery VIs	Eye Diagram Measurement VIs	Jitter VIs	Level VIs	Signal Generation VIs	Timing VIs	Standard LabVIEW Functions
	Recovery of embedded clocks	VIs for:	VIs for measuring:	VIs for measuring:	Generates a signal with jitter that can be	VIs for measuring:	▪ Statistics

Description	from data streams. VIs for: ▪ Mean (constant) clock recovery ▪ First- and second-order PLL clock recovery	Eye visualization (color, scaling, data segmenting) ▪ Eye mask definition ▪ Eye width, height, and quality factor measurements	Cycle-to-cycle jitter ▪ N-cycle jitter ▪ Period jitter ▪ N-period jitter ▪ Periodic jitter (PJ) ▪ Time interval error (TIE) ▪ Total jitter (TJ) ▪ Duty cycle distortion (DCD) ▪ Data dependent jitter (DDJ) ▪ Inter-symbol interference (ISI) ▪ Phase noise ▪ Cycle-to-cycle measurement ▪ N-cycle measurement ▪ Bathtub plot support	Area ▪ Find transitions ▪ Max and min voltages ▪ Overshoot and undershoot ▪ Peak-to-peak voltage ▪ RMS voltage ▪ Reference levels ▪ State levels	used to validate and/or debug user-defined VIs	Burst width ▪ Channel-to-channel skew ▪ Duty cycle ▪ Fall time ▪ Level crossing ▪ Negative width ▪ Period ▪ Phase ▪ Positive width ▪ Rise time ▪ Setup and hold time	▪ Spectral analysis

Jitter Measurements

When measuring and analyzing jitter with the LabVIEW Jitter Analysis Toolkit, you can use a typical workflow to acquire and analyze your signal data. This workflow includes the following actions:

Acquire or Import Waveform Data

To automate jitter measurements in a test system, you can stream data from hardware using the LabVIEW instrument drivers for third-party instruments (ni.com/idnet) or NI modular instruments (ni.com/drivers). If you are postprocessing data, you can also perform measurements on signal data previously saved to disk by reading the data into LabVIEW using functions appropriate for the file format you are using.

Measure State and Reference Levels

You can use the State Levels VI with the Reference Levels VI to measure state levels (high and low voltages) and define reference levels (percentages of state-level amplitude) for a waveform.

Identify Transitions and Level Crossings

You can use the Level Crossing VI to measure waveform transitions and to return the time locations at which level crossings within the transitions occur.

Use Clock Recovery to Recover Level Crossings

When analyzing data streams with embedded clocks, you can use the Clock Recovery VIs to recover the level crossings of the embedded clock waveform from the data signal.

Measure and Analyze Jitter

The LabVIEW Jitter Analysis Toolkit provides VIs for measuring time interval error (TIE), period jitter, and cycle-to-cycle jitter. You can gain a deeper understanding of the statistical nature of jitter using LabVIEW Probability and Statistics VIs.

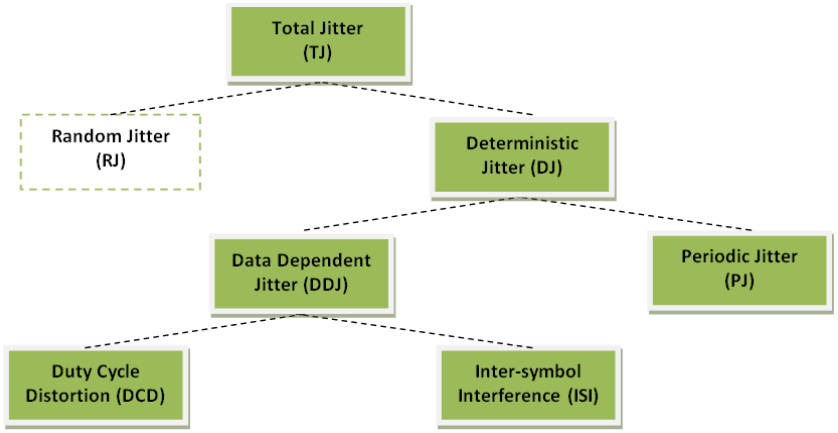

Figure 1. The NI LabVIEW Jitter Analysis Toolkit provides VIs for the measurement of TJ, DJ, DDJ, DCD, and PJ (solid boxes); RJ/DJ separation (dashed-line box) is included in the toolkit as an example program.

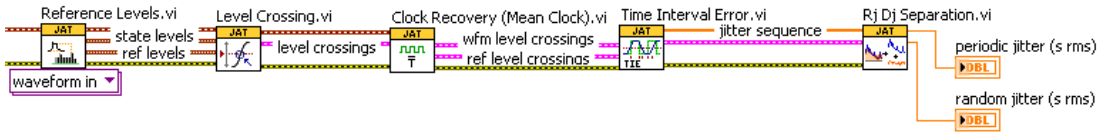

Figure 2. The typical jitter measurement workflow includes defining reference and state levels for the measurement, identifying level crossings in the signal, performing clock recovery (if required), calculating TIE, and measuring jitter components.

Accelerate Measurement Speed

Take Advantage of Multicore Processors

Acquiring data and performing jitter measurements across multiple channels simultaneously can be very processor-intensive, which results in long measurement times. By using a stand-alone software approach, you can take advantage of the latest processor technology in your test system. LabVIEW has the inherent ability to dynamically assign code across multiple CPU cores, which results in dramatically improved execution speeds when using multicore processors. In a multichannel scenario, you can easily improve execution speed by performing measurements across multiple channels in parallel.

Use a Platform Optimized for Automated Test: PXI

Bandwidth and latency are two of the most important considerations for an automated test system because the combination of the two dictates the overall speed of your measurement system. Latency describes the amount of time it takes for an instrument to respond to a remote command like a measurement query. Bandwidth refers primarily to the data throughput capacity of the data bus that connects the measurement instrument with the host PC or controller. A high-bandwidth bus results in lower test times, no matter if the application is transferring a large data record one time or transferring small data records multiple times in a row.

The PXI platform – upon which NI high-speed digitizers are built – provides high speed for a wide range of applications with both high bandwidth and low latency via the PCI and PCI Express buses. PXI Express, the instrument platform that uses the high-speed PCI Express bus, has a backplane bandwidth of 1 GB/s with PCI Express Gen 1 and even higher rates with PCI Express Gen 2. Both PXI and PXI Express data throughput rates are significantly faster than those of GPIB, USB, or LAN, which are other popular buses for automating test instrumentation.

Figure 3. This PXI Express system includes the NI PXIe-8133 controller, which is capable of a maximum system bandwidth of 8 GB/s, as well as an NI high-speed digitizer.

Jitter Visualization

Eye Diagrams

An eye diagram provides quick and intuitive visualization of signal integrity by displaying both the timing and amplitude behavior of a signal over multiple unit intervals. The LabVIEW Jitter Analysis Toolkit offers an easy way for constructing and customizing eye diagrams. You use two VIs to separate the data into segments (user-definable; segments default to two-unit intervals) and graphically display an eye diagram. A third VI provides the ability to customize the view of the eye diagram (figures 4–6).

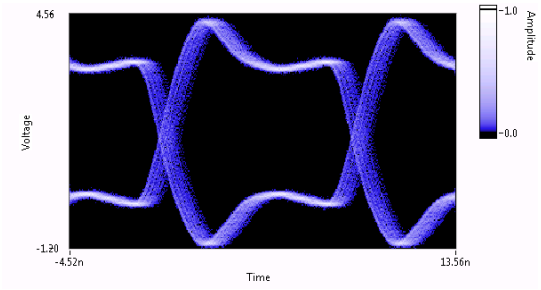

Figure 4. Single-Hue Persistence Eye Diagram

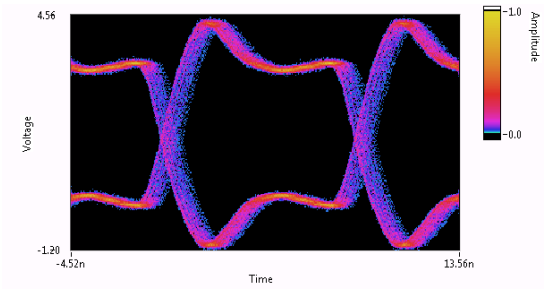

Figure 5. Color-Graded Persistence Eye Diagram

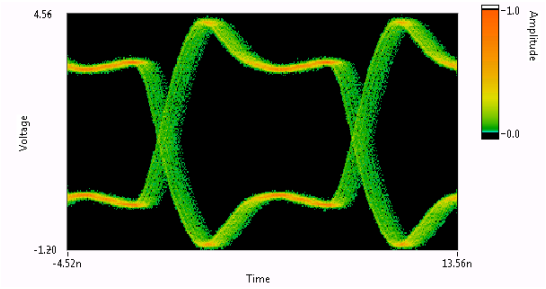

Figure 6. Three-Hue Persistence Eye Diagram

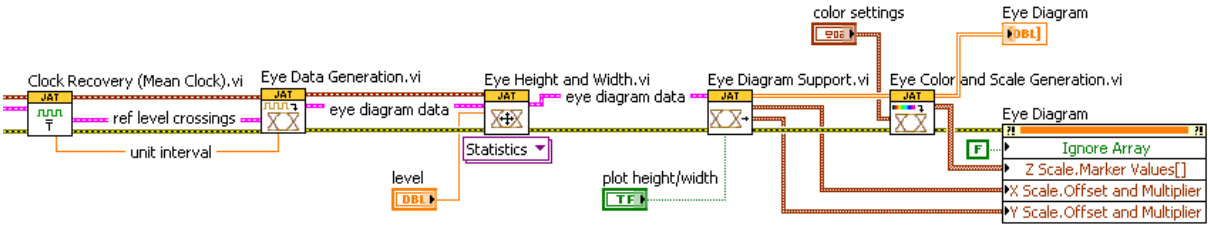

Figure 7. A Typical Workflow for an Eye-Diagram Generation

Mask Limit Testing

Use the Eye Mask Definition VI to test whether a signal complies with your defined mask limits. Eye masks are defined with arrays of voltage and time values. The Eye Pattern Limit Test VI outputs two values: the number of failures and the total number of points tested. The Eye Diagram Support VI takes the eye diagram data and mask definition as inputs and uses them to display the test results on a front-panel graph (Figure 8).

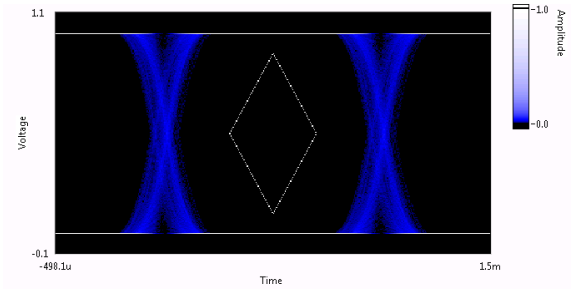

Figure 8. Mask Limit Testing Using a User-Defined Mask

Bathtub Plots

The bathtub curve characterizes the eye opening at different bit error rates by plotting the bit error rate (BER) as a function of sampling time along the unit interval.

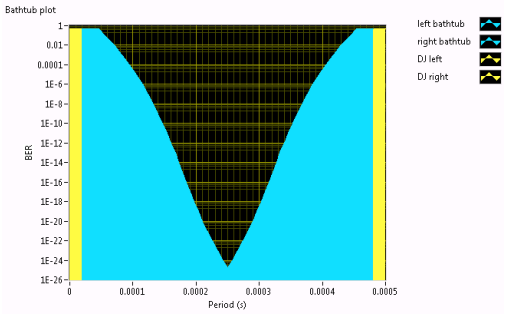

Figure 9. You can use the LabVIEW Jitter Analysis Toolkit Bathtub Plot Support VI to visually display eye opening as a function of bit error rate and provide insight into random and deterministic jitter.

LabVIEW also inherently supports other visualization techniques that prove helpful in the analysis of jitter, such as views of the jitter spectrum, trend, and histogram (figures 10–12).

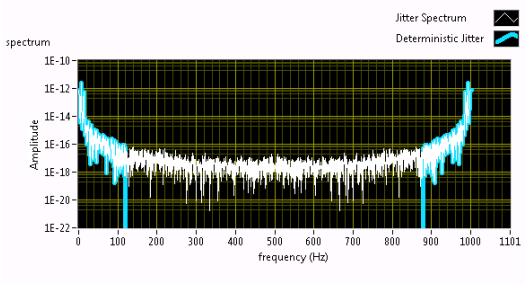

Figure 10. With the LabVIEW graphical development environment, you can enhance built-in graphs by programming them to go beyond just displaying the jitter spectrum. Figure 10 shows how you can use LabVIEW to highlight the signal's deterministic jitter components (in blue) with code from one of the toolkit's example programs.

Figure 11. Trend of Period Jitter

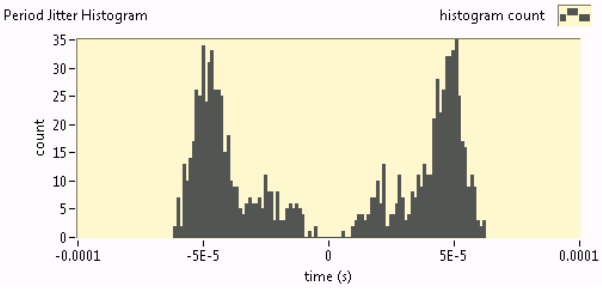

Figure 12. Histogram View of Period Jitter

Additional Resources

- Getting Started with LabVIEW Virtual Instruments
- Optimizing Automated Test Applications for Multicore Processors With NI LabVIEW

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

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- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

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