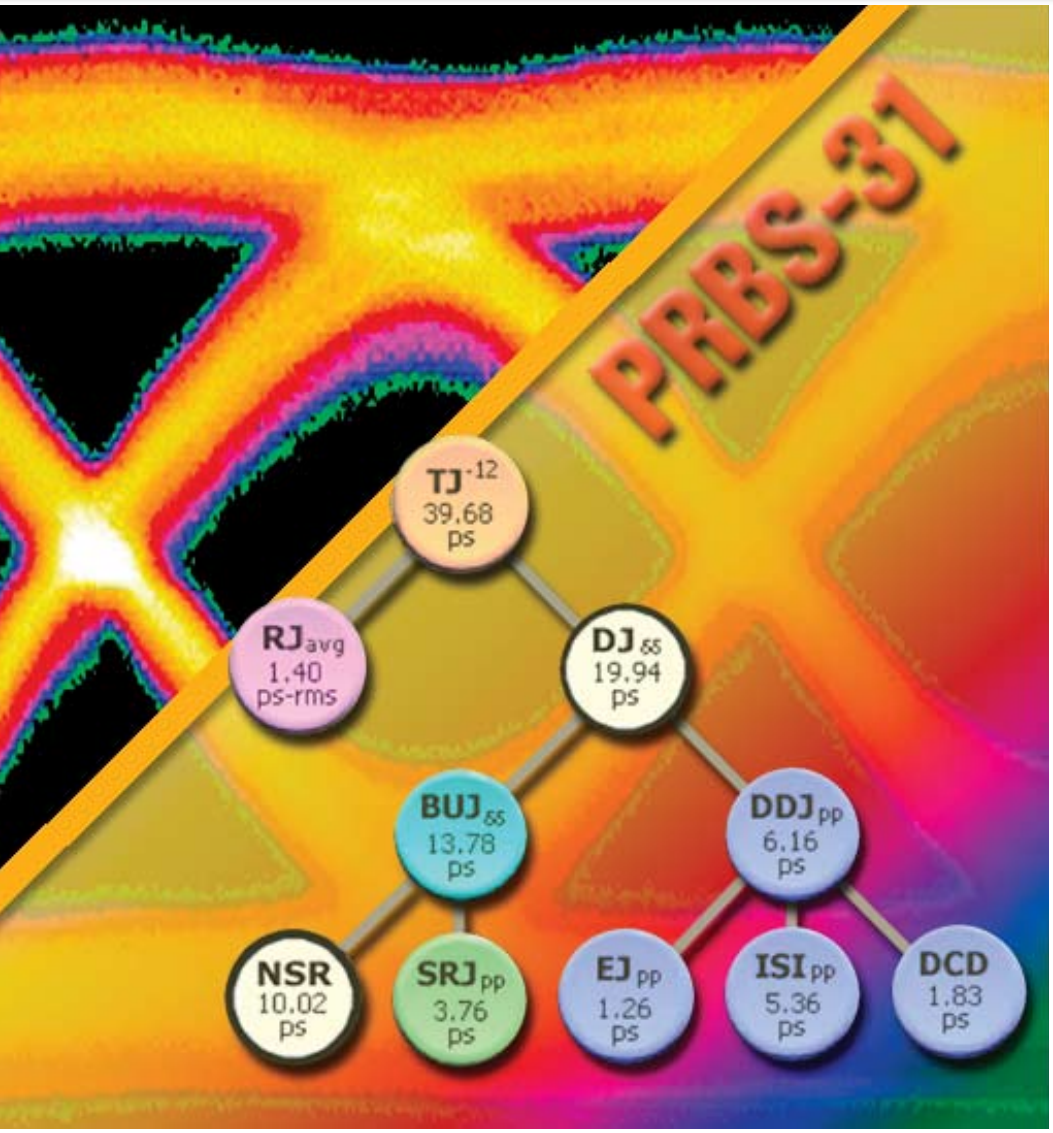
BERTScope™ Jitter Map

Automated Jitter Decomposition with Long Pattern Jitter Triangulation



- BER-Based Jitter Decomposition
- Jitter Separation on Long Patterns Such as PRBS-31
- Easy Standards Compliance

The Vision of a Scope, the Confidence of a BERT And Clock Recovery you can Count on.

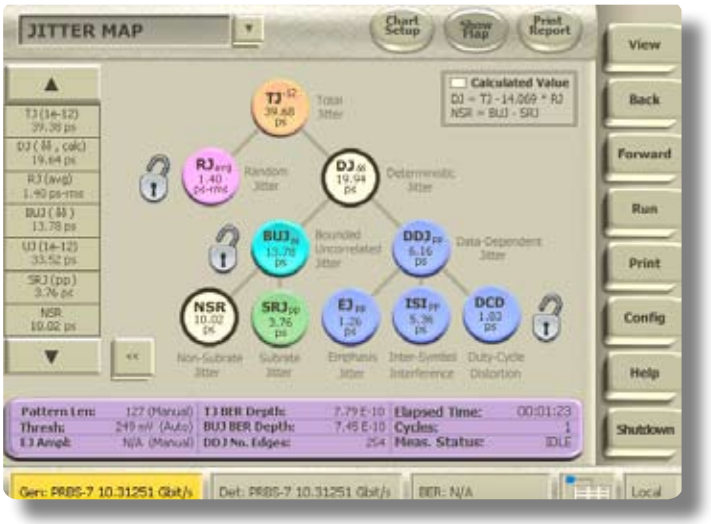
SYNTHESYS RESEARCH, INC.

Why Choose Jitter Map?

Jitter continues to be a serious issue in Gb/s systems. Jitter Map provides answers to your jitter questions. With jitter decomposition that is based on bit error ratio (BER) measurements—the gold standard for measuring Total Jitter (TJ), Jitter Map makes jitter characterization and test easy.

In the past, BER Testers (BERTs) have been limited to jitter measurements using the dual-Dirac method as outlined in MJSQ[1]. Jitter Map continues to provide MJSQ-compliant jitter measurements TJ, Deterministic Jitter (DJ), and Random Jitter (RJ), and uses the ability to lock onto a data pattern to provide additional insight into sub-components of DJ. These include Bounded Uncorrelated Jitter (BUJ), Data Dependant Jitter (DDJ), Inter-symbol Interference (ISI), and Duty Cycle Distortion (DCD).

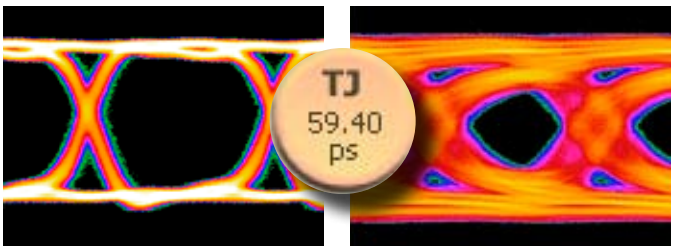
- Jitter Map uses BER measurements and is capable of direct TJ measurements down to 10^{-12} BER and beyond.
- It runs directly on patterns of length up to PRBS-15, or can run in Jitter Triangulation Mode on longer patterns such as PRBS-23 and PRBS-31.
- Correlated and uncorrelated jitter are separated, so long pattern DDJ is not mistaken for RJ.
- Crosstalk is a common problem in many systems, as addressed by standards such as Fibre Channel and SFP+ (SFF-8431). It does not need to be dealt with in a special manner as is common in other types of instruments - Jitter Map effectively handles it as well as many other types of stress.



Jitter Map uses a navigable "tree" to convey relationships between jitter components, allowing an intuitive way of accessing detailed information by pressing individual buttons.

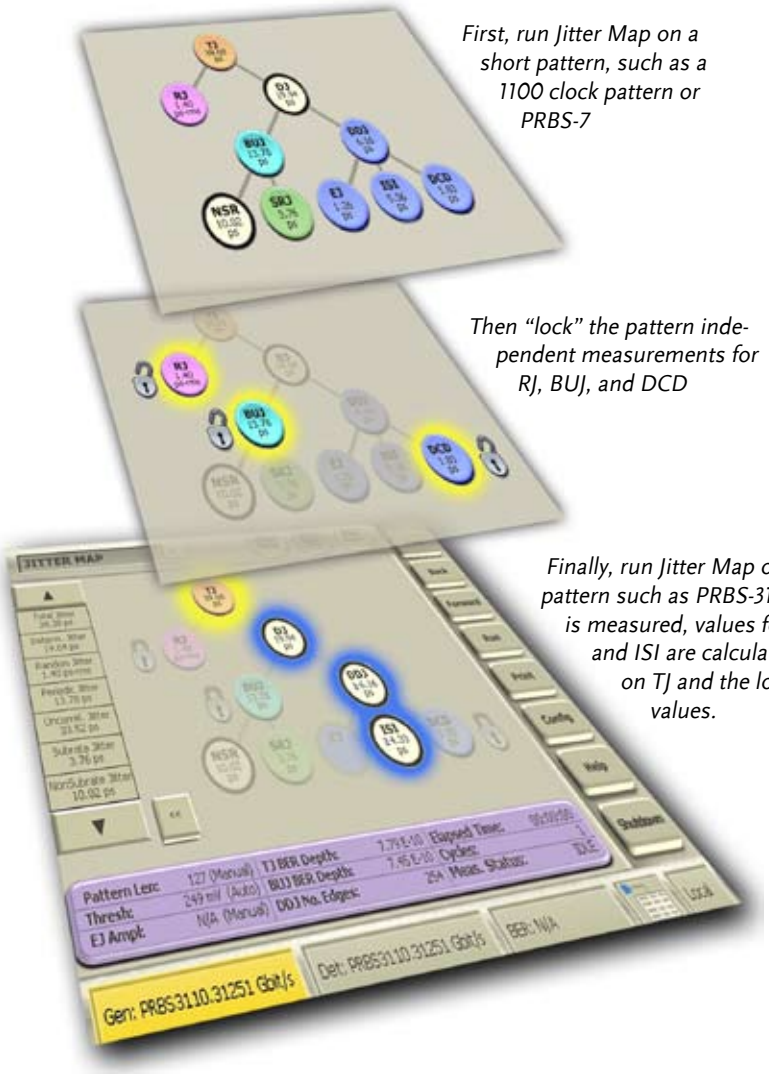
- TJ measurement depth is user settable, down to 10^{-16} BER
- Additional jitter measurements such as J2 and J9, F/2 (or "F2") Sub-rate Jitter[2] (SRJ), which is jitter on every other bit regardless its logic level, Data Dependent Pulse Width Shrinkage (DDPWS), which is a specific method of DDJ measurement, and Non-ISI Jitter comply with popular standards (see next page).
- The navigable jitter tree is informative and intuitive.

Tighten Your Jitter Budget



Two vastly different eye diagrams result in the same TJ measurement. The eye diagram on the left is dominated by RJ, while the eye diagram on the right is dominated by Sinusoidal Jitter (SJ) and ISI.

Understanding how jitter separates into its sub-components can help design engineers reduce jitter in their system. For example, ISI, which is jitter caused by dispersion commonly found over long backplanes, can be corrected by signal processing methods such as transmitter pre-emphasis or receiver equalization. On the other hand, jitter caused by crosstalk from neighboring lanes will show up as BUJ, which is not easily corrected by signal processing. Instead, engineers must turn to options such as proper isolation of transmission lines or re-design of pin configurations.



First, run Jitter Map on a short pattern, such as a 1100 clock pattern or PRBS-7

Then "lock" the pattern independent measurements for RJ, BUJ, and DCD

Finally, run Jitter Map on a long pattern such as PRBS-31. After TJ is measured, values for DJ, DDJ, and ISI are calculated based on TJ and the locked values.

Long Pattern Jitter Triangulation

Jitter Map can perform jitter decomposition on data patterns of any length, including the 2+ billion bit long PRBS-31, provided that it can first run successfully on a shorter data pattern.

Long patterns have long been used to test high speed digital optical communication devices and interfaces. Engineers working with standards such as 10 Gigabit Ethernet (10 GbE) (IEEE 802.3ae-2002), OIF-CEI 2.0, SFP+, XFP, future CEI-25/28G, and 40 & 100 GbE (IEEE 802.3ba draft) routinely turn to PRBS-31 for a rigorous test pattern. In addition, standards are starting to specify the use of longer patterns, for example 8 GT/s PCI Express® (PCIe) 3.0 (draft) includes PRBS-23 and DisplayPort 5.4 Gb/s (draft) includes PRBS-16 .

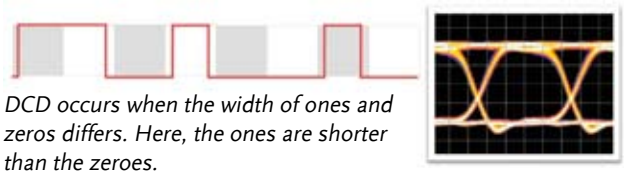
How does it work?

Jitter Map leverages pattern-independent jitter measurements RJ, BUJ, and DCD as well as its ability to measure TJ on any data pattern. Simply run Jitter Map on a shorter, synchronized data pattern, use the locking mechanism to fix RJ, BUJ, and DCD, and run again using a long pattern. Jitter Map will complete the job by "triangulating" the remaining measurements, calculating values for DJ, DDJ, and ISI.

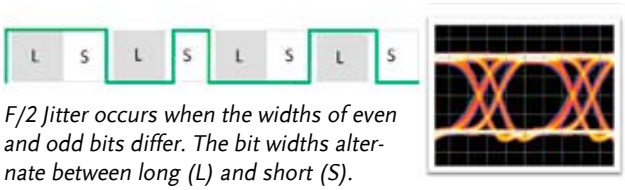
Compliance Made Easy

Today's standards require jitter measurements that are often beyond the basic TJ separation into DJ and RJ. These new measurements can be found in both transmitter testing, where jitter must not exceed specified amounts, and in creating calibrated stressed eyes using a recipe of jitter types for receiver tolerance testing. Some examples include:

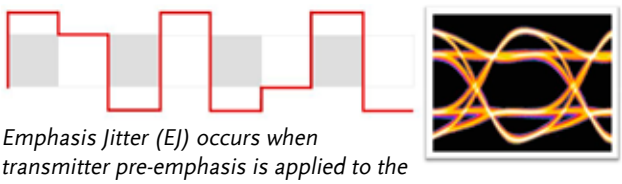
- DDPWS supports 16G and 8G Fibre Channel, SFP+, and the 100 GbE draft
- Uncorrelated Jitter (UJ) is reported in both rms and peak-peak terms, useful for 16G and 8G FibreChannel, SFP+, and IEEE 802.3aq (10GBASE-LRM) testing
- Non-ISI is used in DisplayPort
- DCD is included in Fibre Channel for data rates at 4G and below, is part of the stress recipe in SFP+, and is also used in OIF-CEI 2.0 and future CEI-25/28G
- F/2 Jitter[2] is implied in IEEE 802.3ap (10GBASE-KR)
- J2 and J9 for 100 GbE



DCD occurs when the width of ones and zeros differs. Here, the ones are shorter than the zeroes.



F/2 Jitter occurs when the widths of even and odd bits differ. The bit widths alternate between long (L) and short (S).



Emphasis Jitter (EJ) occurs when transmitter pre-emphasis is applied to the signal, where transition bits have a higher amplitude than non-transition bits, resulting in different edge slopes.

Jitter Map Offers Insight with Ease-of-Use

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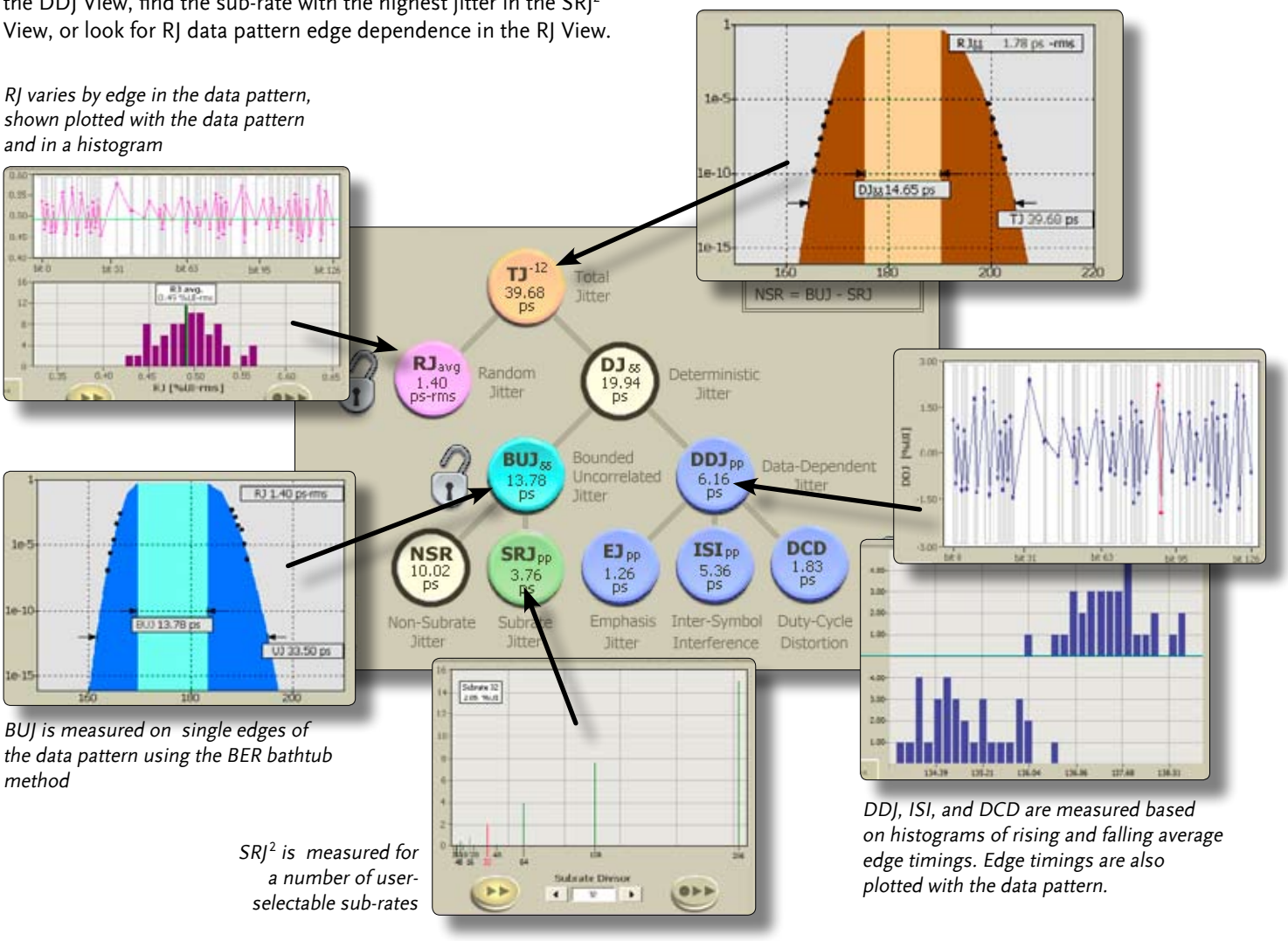
Save time getting where you need to go. Jitter Map fits right into the BERTScope's intuitive user interface so you don't waste time on a steep learning curve. Use the map to navigate to in-depth views of individual jitter components with just a single click. For example, find the slowest and fastest edges of the data pattern in the DDJ View, find the sub-rate with the highest jitter in the SRJ[2] View, or look for RJ data pattern edge dependence in the RJ View.

TJ is measured using an MJSQ[1]-compliant BERTScan (or "BER bathtub") method

RJ varies by edge in the data pattern, shown plotted with the data pattern and in a histogram



BUJ is measured on single edges of the data pattern using the BER bathtub method

SRJ[2] is measured for a number of user-selectable sub-rates

DDJ, ISI, and DCD are measured based on histograms of rising and falling average edge timings. Edge timings are also plotted with the data pattern.

Related Literature:

- BERTScope *Jitter Map Comparison Study*, September 2009
- *BERTScope Jitter Map "Under the Hood"–A New Methodology for Jitter Separation*, April 2009
- *Why Do Different Instruments Give Different Jitter Answers?*, March 2009
- *Comparing DCD and F/2 Jitter*, September 2008
- *Evaluating Stress Components Using BER-Based Jitter Measurements*, September 2005
- *Dual-Dirac, Scope Histograms, and BERTScan Measurements*, September 2005

Ordering Information:

Option J-MAP

The J-MAP option is available on any model BERTScope as an option or upgrade.

1. Fibre Channel – Methodologies for Jitter and Signal Quality Specification – MJSQ, T11.2, Project 1316-DT, Rev 14, June 9, 2004.
2. SRJ and F/2 Jitter operate on signals using single data rate clocking (i.e. up to 11.2 Gb/s on 17500A/C and 25000A/C models).

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