Noisecom

Jitter in High Speed Services

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Webinar Agenda

- Basic Concepts
- Serial Data Standards
- Products by Application
- Product Summary

What is Noise?

- Unwanted interference on a data signal
- Random noise is caused by thermal changes in conductive elements - thermal noise
- Noise coupled to data signals can be used to assess interoperability among system components

Adding Jitter Noise Concepts

- Where: High speed data signals that connect components on PC mother boards, or network systems.
- How: Emulate real world signal interference by adding precise amounts of noise to a digital system.
- Methods: Amplified broadband noise is fed into phase modulator that produces edge movement, or added directly to a signal via AM coupling.
- Products: AWGN Noise Modules and Instruments.
- Results: Changes in BER or Scope persistence eye-diagram.

Current Standards Addressed

- PCI-Express Gen I and Gen II
- 10 & 40 Gigabit Ethernet
- USB 3.0 - data rate at 4.8Gbps
  - Server Back Planes
- SATA Revision 3.0 (6 Gbps)

View in Time & Frequency Domain

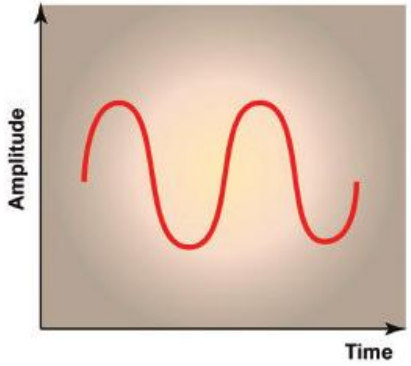
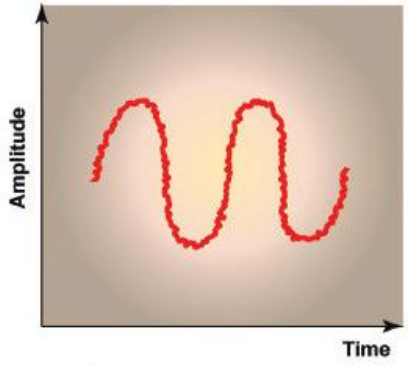
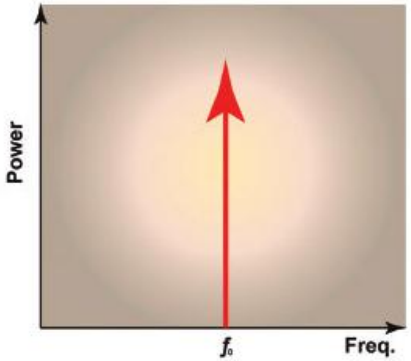
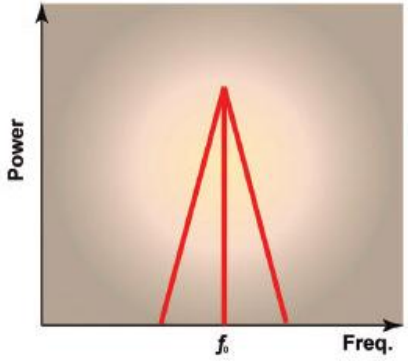
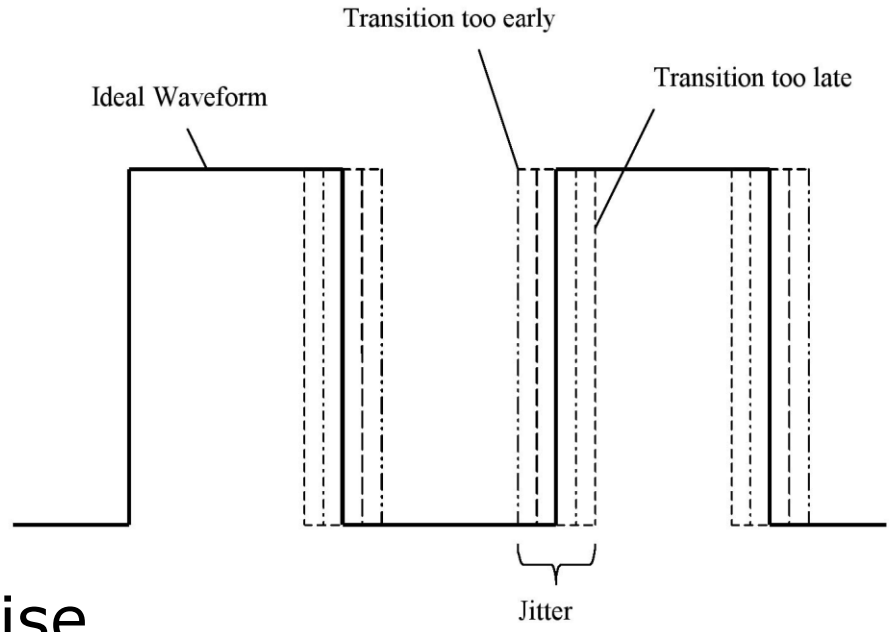
Views in	A Clean Signal	Noise Added	Observation
Time Domain	 a.) Time Domain – Ideal Oscillator	 a.) Time Domain – Noisy Oscillator	Transition or edge timing variation
Frequency Domain	 b.) Frequency Domain – Ideal Oscillator	 b.) Frequency Domain – Noisy Oscillator	Spreading of the spectrum

Figure 1 *Figure 2*

Transition Jitter

Edge timing is critical for correct data detection



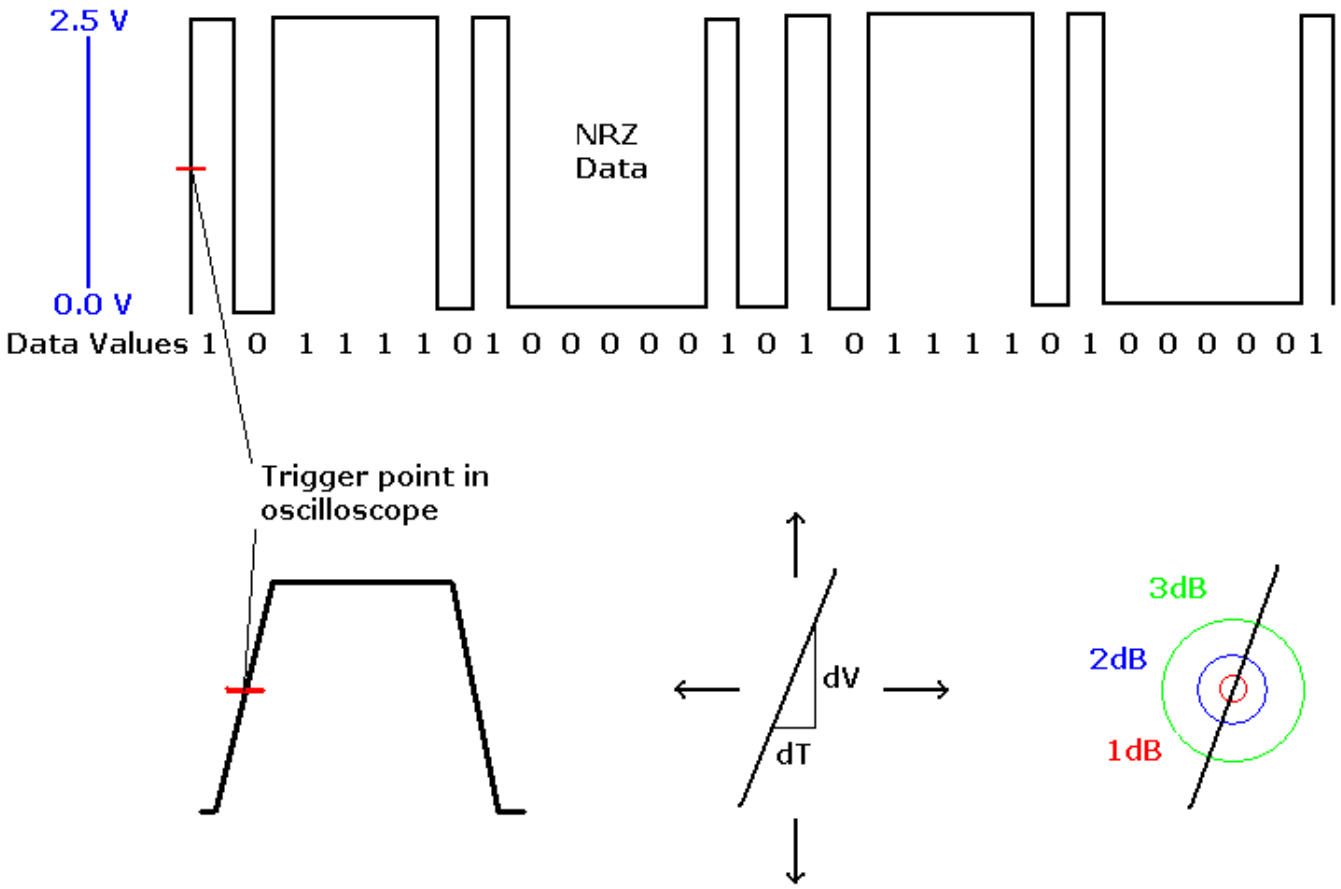
Time Domain

- Jitter causes unstable timing transitions

Frequency Domain

- Manifests as phase noise
- Causes spectral dispersion issues

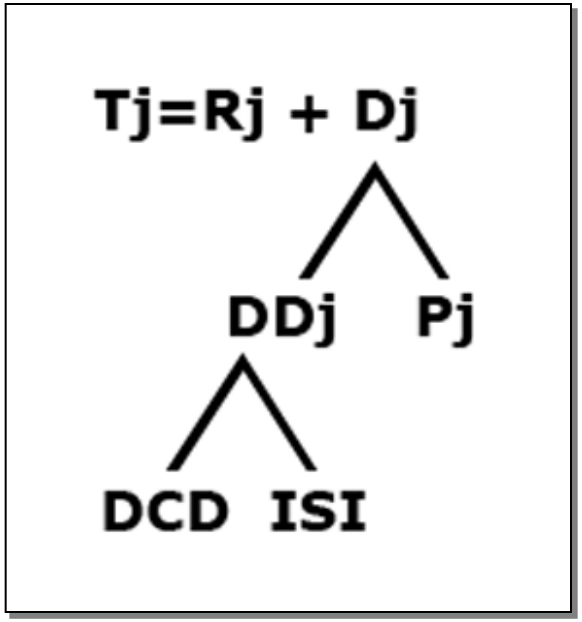
Adding Noise on a Signal Edge



The PCI-SIG Tj Model

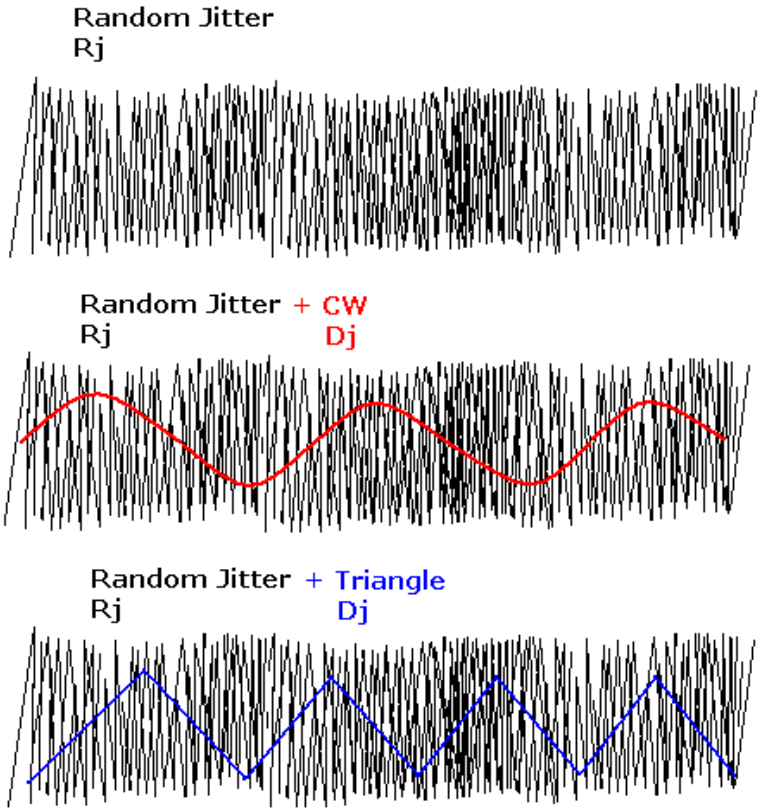
The Total Jitter Equation

- Tj is Total jitter
- Rj is Random jitter
- Dj is deterministic jitter
  - Pj is Periodic jitter
  - DDj is Data Dependent jitter
    - DCD is Duty Cycle Distortion
    - ISI is Inter-Symbol Interference



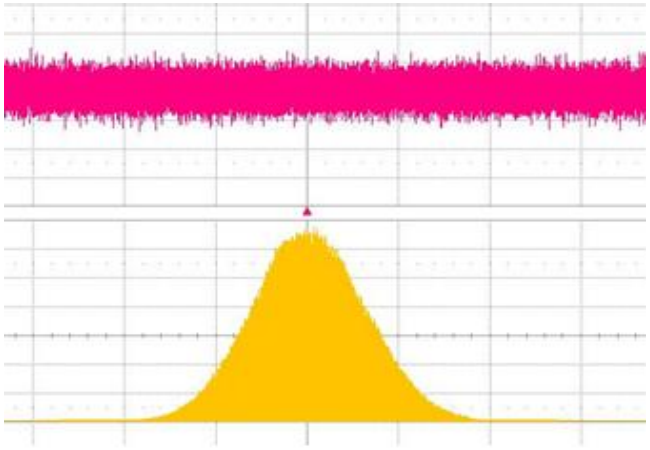
Jitter Types

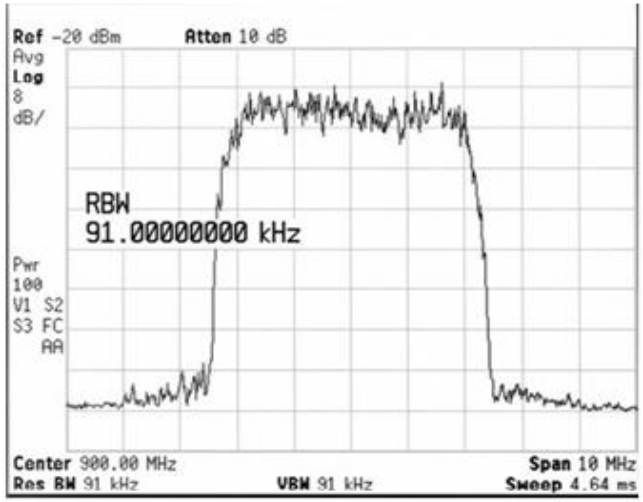
- White Noise Random Jitter Rj
- Rj + Deterministic Jitter Dj (CW)
- Rj + Deterministic Jitter Dj (Triangle)
  - SSC - Spread Spectrum Clock



Providing True Gaussian Noise

- A high Crest factor of 7σ (sigma) or 18 dB
- Time Domain
  - AWGN signal on Scope (magenta)
  - Histogram (yellow) - Gaussian amplitude distribution
- Frequency Domain
  - Flat and Smooth across full band
- Statistical Domain
  - 1 σ ≈ RMS
  - nσ/σ = PK-PK Crest Factor

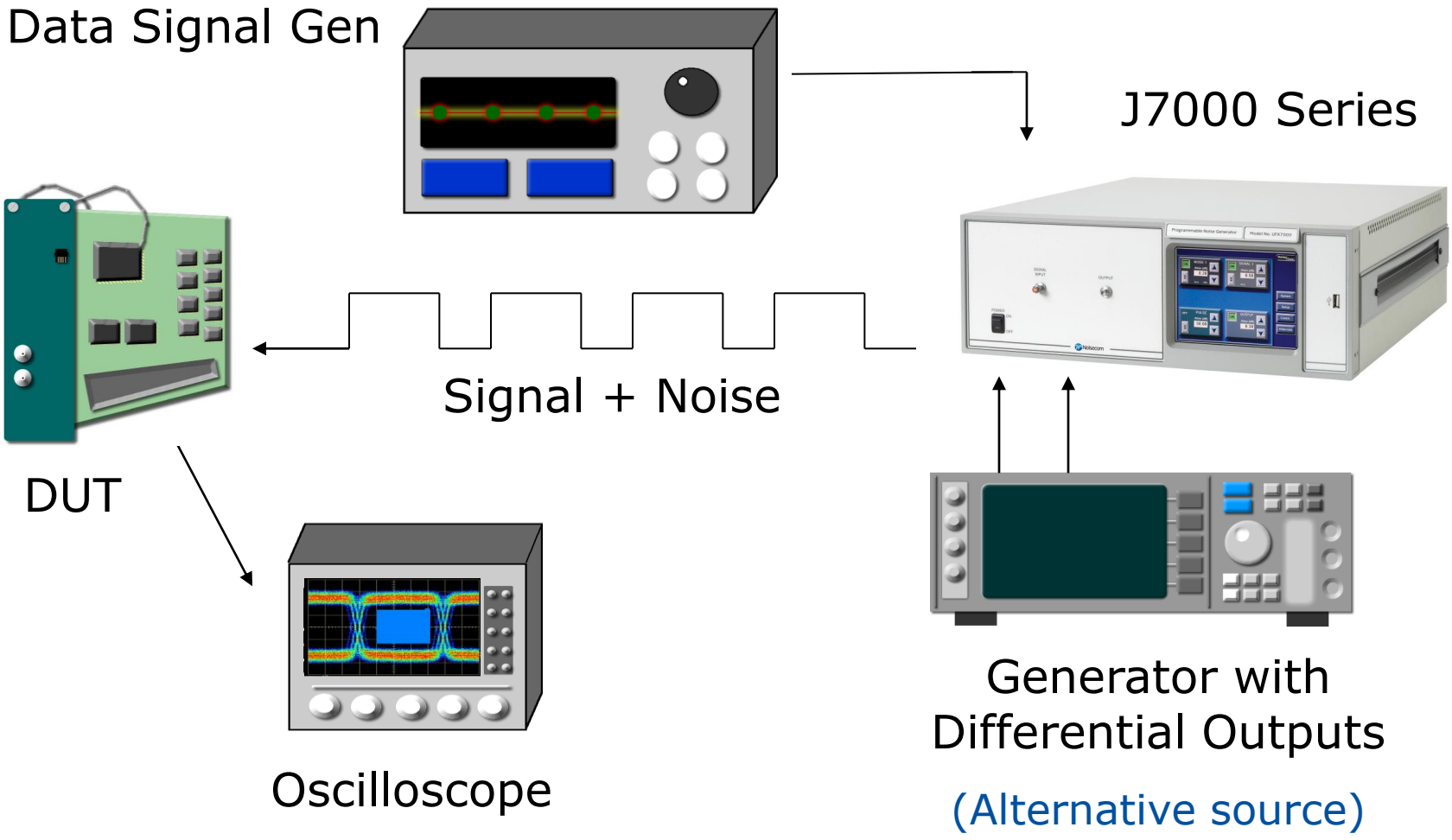




Noise Implementation

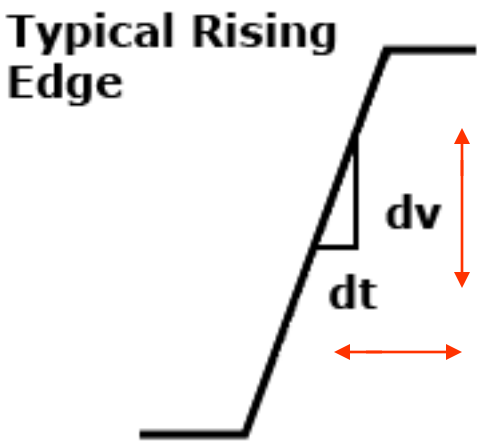
- Amplitude Modulated (AM) on data signal
- Phase modulated (PM) on data signal via BERT timebase input port

Noise Coupled to Data Signal

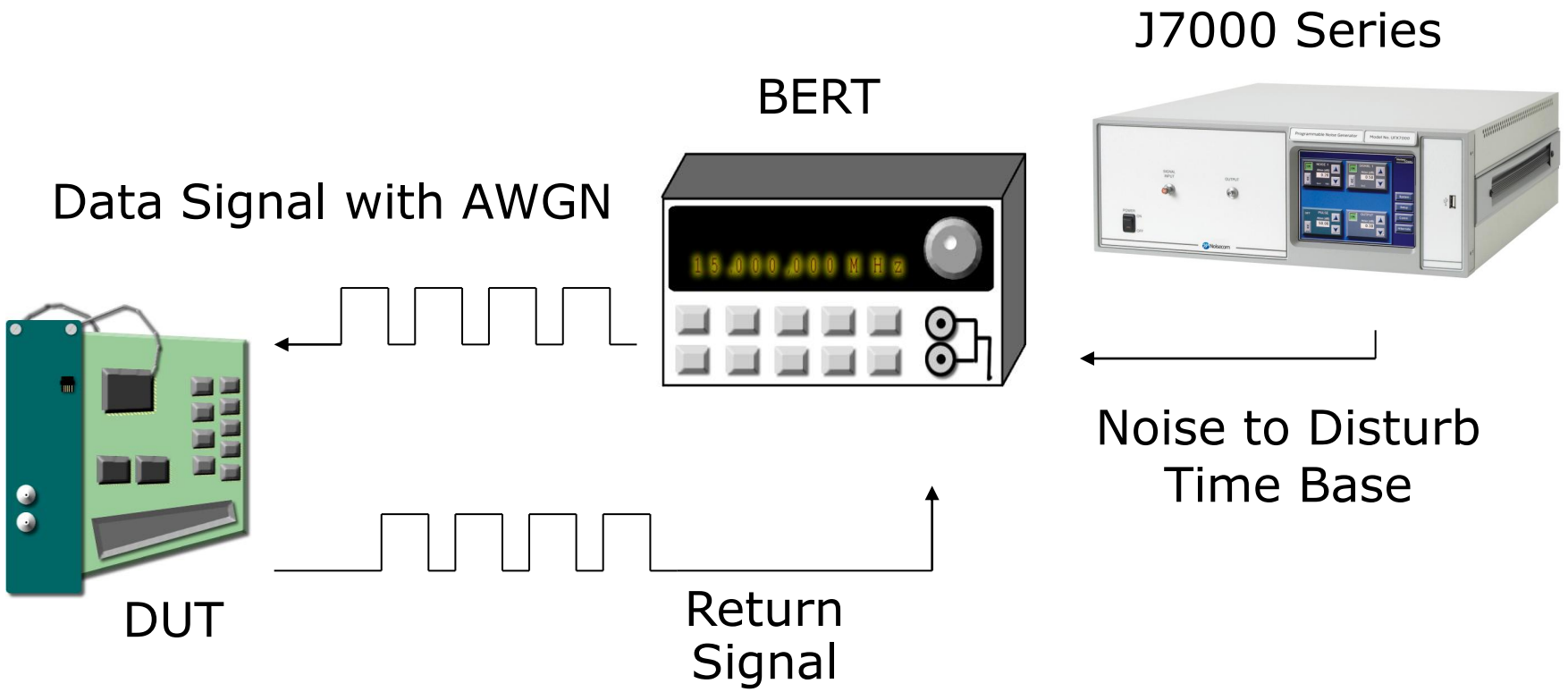


Noise Coupled to Signal

- Rj noise added directly to the signal
- AWGN disturbs signal horizontally & vertically
- Transition rise time effects dv/dt magnitude
- Precision attenuators adjust this disturbance

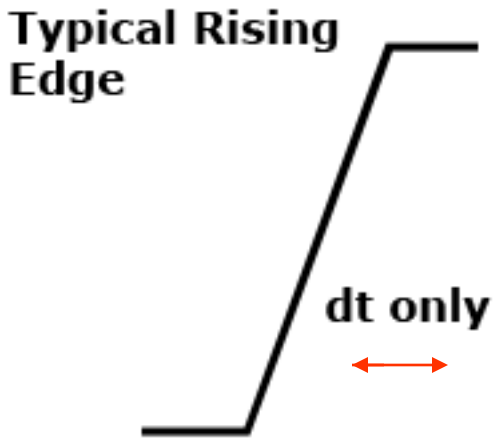


Modulated Time Base (Injected)

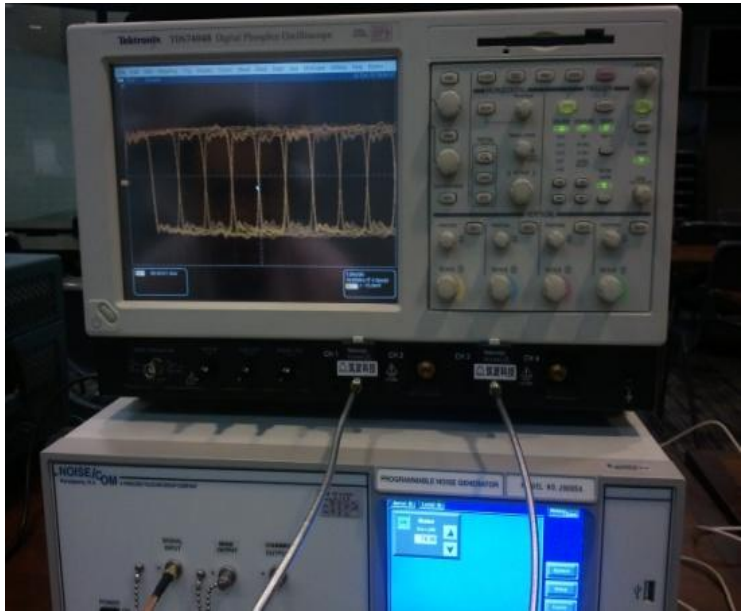


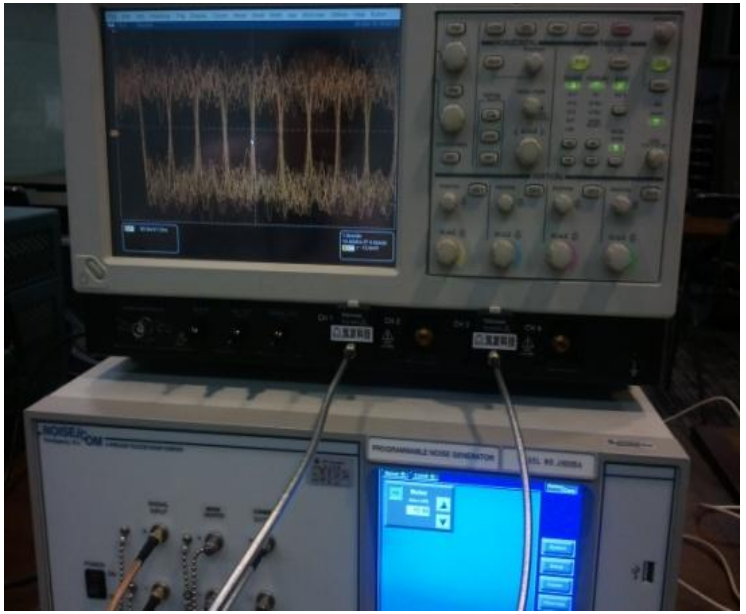
Noise Injected into Time Base

- Noise added directly to instrument time base
- AWGN disturbs signal on the time axis
- Precision attenuators adjust amount of disturbance
- Translates to seconds



Effects of Varying Amount of Noise





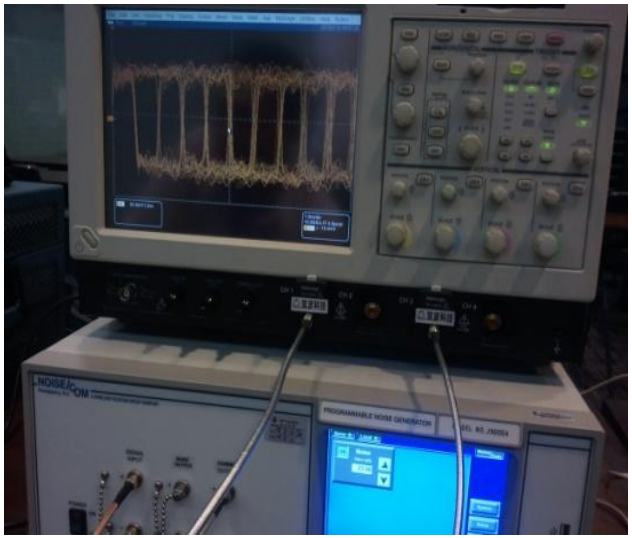
Amplitude Jitter on Scope:

Amplitude variation on digital signal with low amount of noise added.

Amplitude Jitter on Scope:

Amplitude variation on digital signal due to moderate amount of noise added.

Effects of Varying Amount of Noise



Amplitude & Phase Jitter on Scope:
amplitude variation due to moderate amount of noise & edge transition due to low amount of noise added.

Injecting controlled amount of Rj + Dj noise into HS data device

- Stress test circuitry to withstand rigors of HS transmission
- Determine a more accurate jitter budget.

Available Products

- Jitter Products -

  Module

- Jitter Products -

  Instrument

Module Jitter Products

- Part of system or instrument
- Could be BITE, or full-size module
- Require DC supply voltage for operation
- Some models include attenuation capability and gated input
- Control Signal Source
  - An External Source
  - TTL Type Switching

NC1000 Series

- Control Signal Source
  - Bandwidth
  - Power Output
- TTL Controlled
  - Step Attenuators
  - Burst Noise Switch
- Differential Output

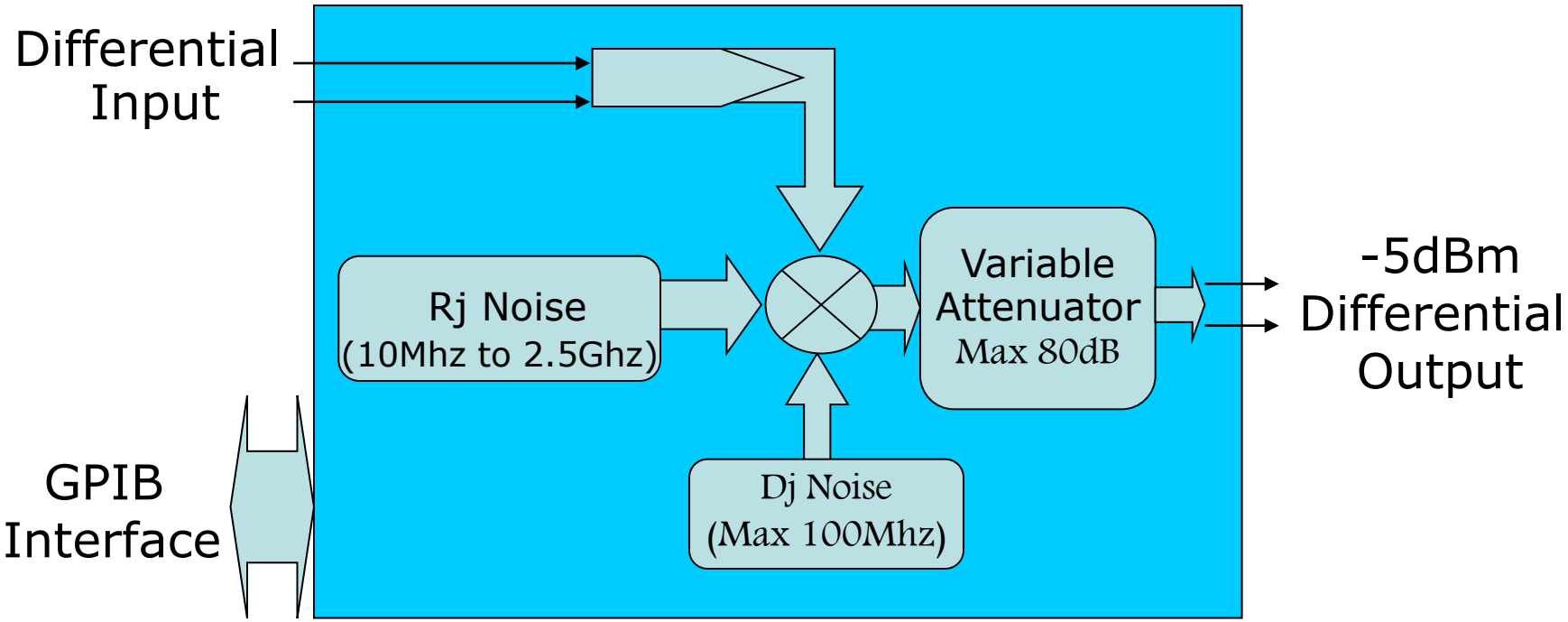
Instrument Jitter Products

- Stand-alone or part of ATE system
- NC6000 series – manual control
  - Requires AC Outlet Power
- PNG, UFX, and J series – computer control
  - Requires AC Outlet Power
  - Requires external computer for remote control
  - Internal motherboard allows remote control of switches, combiners, filters & additional sources

J7000 Series

- Precision Noise Generator
- A High Crest Factor of 7σ or 18 dB for Jitter Testing
- 7.5 in color TFT Touch Screen Display
- Ethernet, & GPIB Control

J9005A



An example solution for testing disk drive components for SATA requirements

Jitter Applications

Who Can Benefit Using Noisecom Jitter Products?

- R&D – Developer for high speed serial data buses/chips
- Manufacturing Test Engineers
- Design Verification/Validation Test Engineers

Typical Test Requirements

- Test engineers responsible for validating the design of chipsets and boards
  - Main responsibility is to determine how "jitter-Tolerant" is the designs.
- A typical user would be an engineer responsible for product qualification.

Noisecom

Thank You for Participating in Today's Webinar

Any Questions?

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