WAVECREST Corporation

A Comparison of Network Analyzers, Protocol Analyzers & *WAVECREST*'s DTS207x™ + DTS550™ + *Virtual Instruments*™

Technical Bulletin No. 8

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Introduction

As *WAVECREST* products enter the data communication testing market, they are often compared with Network Analyzera. Network analyzers are considered the standard for data communication testing. Product offerings income from companies such as Tektronix, Rhode and Schwartz, Hewlett-Packard and Wandel & Golterman/Wavetek.

In tele-communication (teleCOM) device testing, jitter specification tests include jitter transfer, jitter tolerance and jitter generation. Data-communications (dataCOM) jitter specifications also call out jitter tolerance, jitter transfer and jitter generation, however, jitter generation testing for dataCOM requires that the individual jitter components be extracted and evaluated for compliance. Jitter elements include Random Jitter (RJ), Periodic Jitter (PJ), Duty Cycle Distortion (DCD) & Inter-Symbol Interference (ISI) and Bounded Uncorrelated Jitter (BUJ). Please note that Deterministic Jitter (DJ) is the sum of PJ, DCD+ISI and BUJ. Separation of jitter components is necessary in order to reliably estimate bit error probability. Total Jitter (to some σ level of reliability) is calculated using RJ and DJ.

Most network analyzers today offer such features as jitter modulation injection, Bit Error Rate Testing (BERT) and oscilloscope verification. In terms of Jitter Analysis, network analyzers do not have the capability of directly measuring jitter. Some network analyzers test for jitter tolerance by inducing jitter and then checking for errors. Other network analyzers use oscilloscope "Eye Diagrams" to check for jitter. Eye Diagrams are not capable of separating the key elements that comprise jitter, namely, RJ, PJ and DCD+ISI. In the presence of a pattern marker, however, an oscilloscope can measure DCD+ISI through arduously evaluating the mean of the threshold crossing points for each transition edge of a given pattern. This is a manual process and is the only element of jitter that can be extracted accurately using an oscilloscope.

Basic Operation of a Network Analyzer

As seen in Figure 1.1, network analyzers are typically comprised of a signal source and a signal measurer. In some cases a system controller (typically a PC, not shown) and oscilloscope option are available. Figure 1.1 shows the typical configuration of a network analyzer with the optional oscilloscope.

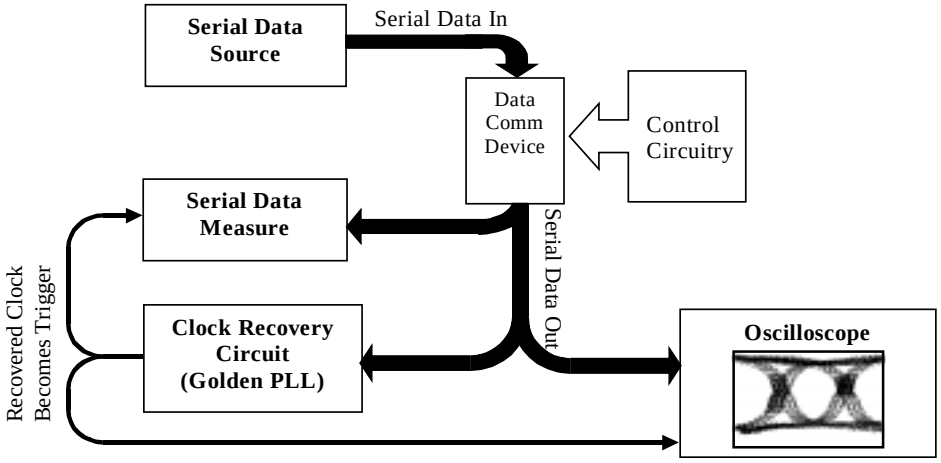

Figure 1.1 Typical network analyzer as configured with optional Oscilloscope and Clock Recovery Circuit.

In some cases, the clock recovery circuit is internal to the Serial Data Measure unit. In other cases, the reference clock is generated by the Serial Data Source. It is important to note that in all cases, a reference clock is needed to trigger the measuring device of a network analyzer (either the scope for time measurements or the Serial Data Measure for data validity tests.) Also, in some cases, an optional controller (typically a PC) is used to simplify the control of all these components.

A Brief Word on Protocol Analyzers

At this point it is important to address the difference between a protocol analyzer and a network analyzer. In most cases, the protocol analyzer is a protocol specific network analyzer. For example a SONET analyzer is only capable of testing SONET parts/systems. This is because the serial data source is only loaded with patterns necessary to complete industry standard tests for that specific protocol. This approach simplifies the design of the analyzer and typically reduces the cost. Also, protocol analyzers rarely have any type of scope option and also use their internal data source to generate the recovered clock. At this time, the Fibre Channel and Ethernet markets use protocol analyzers only at the "In Network" testing for the analysis of gross functionality (ie. Is the data valid relative to protocol standards?) Protocol analyzers are not useable for Jitter Analysis.

The Optimum Solution

The best solution truly depends on the application. In most cases, a network analyzer is useful for detecting gross functional errors. In this arena, data patterns are run on the device to determine if the device is at least functioning to some degree. Sometimes it is even interesting to induce jitter modulation at this level for investigating some coarse level of jitter modulation tolerance. Once the device is deemed functional, the next phase of product development involves characterization and timing optimization.

Ideally, a device would be able to tolerate all levels and combinations of jitter modulation and random jitter injection, hence, it would not matter how much jitter a device generated, transferred or was subjected to. All communications devices, however, have a finite limit to the amount of jitter they can tolerate. Therefore, during characterization stage, it is important to know exactly how much and what kind of jitter is being injected into, or generated by, the device. To do this, high-precision measurement tools are necessary. An optimum solution for this stage is an instrument package incorporating the *WAVECREST* DTS207x, DTS550 and *Virtual Instrumentsÿ (VIÿ)* **S**oftware. Figure 1.2 best describes this configuration.

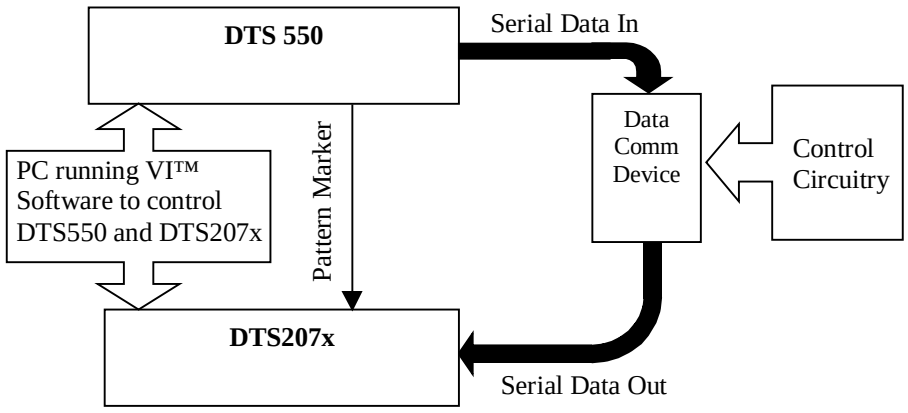

Figure 1.2 *WAVECREST* Data Communications characterization setup.

It is often advantageous to compliment a network analyzer configuration, as in Figure 1.1, with a *WAVECREST* DTS207x instrument. This configuration enables the use of the network analyzer for functional "Go-No-Go" testing and the DTS207x for timing characterization. Figure 1.3 shows the *WAVECREST* DTS207x instrument configured into a network analyzer test setup. In this setup, the DTS207x is connected in parallel with the oscilloscope. The oscilloscope, in this case, is optional and is only used as a second measurement source. Also, if the network analyzer is not capable of jitter modulation, a DTS550 may be substituted in for the Serial Data Source.

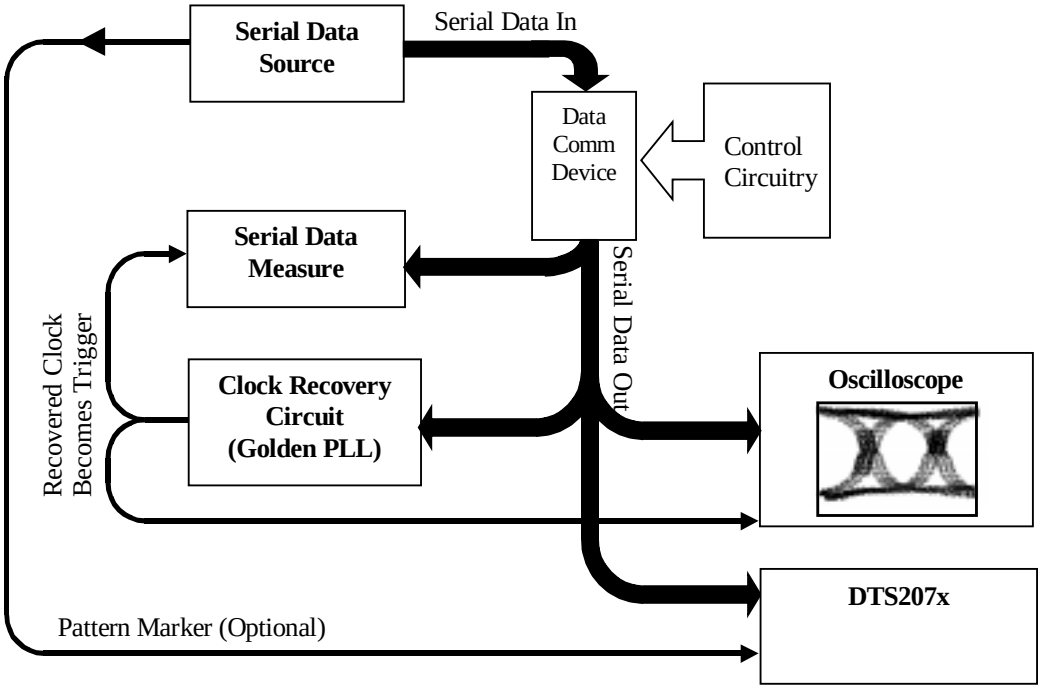

Figure 1.3 Typical Network Analyzer and DTS 207x setup.

Product Comparison Table

ADVANTAGES

Protocol Analyzer	Network Analyzer	DTS550+DTS207x+VI™
• Low Cost • Dedicated Solution • Complies with Industry Standard Testing Requirements • Easy to use • Ideal for protocol testing (ie. Does header and payload comply with protocol standards.) • Limited Functional Testing	• Full Go-No-Go Testing • Incumbent Solution • Can perform protocol analysis in addition to timing analysis • Can Test Jitter Tolerance (Using muxed function generator), Jitter Transfer and Jitter Generation (Intrinsic Jitter) • Ideal for Functional Testing	• Low Cost High Timing Accuracy. • User definable jitter profile injection. (Amplitude and frequency of both Random and Deterministic) • Does not require reference clock • Protocol independent (can be used for SONET, Gigabit Ethernet, Fibre Channel, etc)

DISADVANTAGES

Protocol Analyzer	Network Analyzer	DTS550+DTS207x+VI™
• Cannot be used on other products outside of intended protocol. • Cannot measure Jitter directly, uses pass fail mode of comparators while varying the input • Patterns are fixed based on protocol. • Must use reference clock • Not useable for timing tests.	• Most Expensive Solution • Cannot separate Jitter Components: Random Jitter, Periodic Jitter, etc. • Requires reference clock. • Cannot measure Jitter directly without the use of the oscilloscope. • Oscilloscope mode measures jitter against reference clock using “Eye Diagram” technique.	• Functional Testing requires under-sampling of device • Bandwidth and maximum data rate limited to 2.5GHz and 2.5Gbps respectively • Slightly more expensive than a protocol analyzer. • VI™ link to DTS550 not available until late 2nd quarter of 1999

JITTER TESTING CAPABILITIES

Protocol Analyzer	Network Analyzer	DTS550+DTS207x+VI™
• Cannot test Jitter.	• Cannot Separate Jitter Components. • Must use Oscilloscope to measure jitter using Eye Diagram. • Only really useful for jitter tolerance testing by muxing a function generator onto output signal. • Very slow and difficult to use jitter analysis. • Cannot isolate and characterize PJ.	• Can separate Random Jitter(RJ), Periodic Jitter (PJ), Duty Cycle Distortion (DCD)+Inter Symbol Interference (ISI). • Can be used in a production environment • Very fast Bit Error Probability (BERP) testing (less than 30s for 14σ Fibre Channel) • Soon to be announced Tail-Fit Algorithm for fast RJ.

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