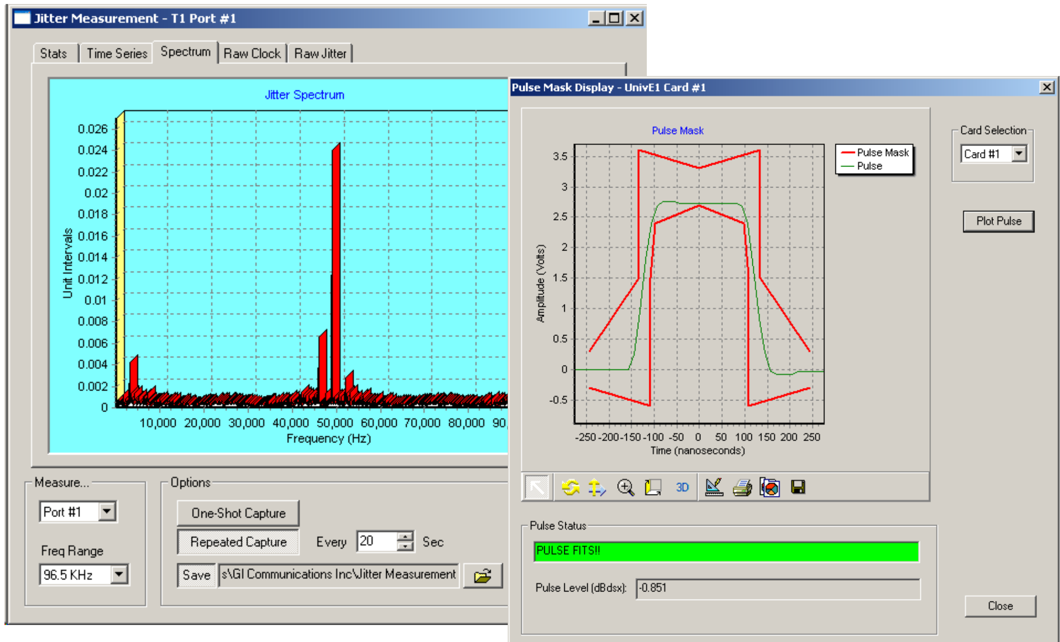
- **Jitter Measurement for T1/E1 Signals—Save to CSV files**
- **Jitter Measurement One Shot Capture, Repeated Capture**
- **Jitter Measurement Statistics Results in UI units**
- **Time Series & Spectrum Graphs**
- **Save, View, Edit, and Print Customized Graphs**
- **Verify Pulses at the Physical / Electrical Level**
- **Measure Pulse Shape, Width, & Amplitude of T1 E1 Signals**
- **Standards Compliance per ITU G.703 & ANSI T1.102-1993**
- **T1 Pulse Masks Normalized to Pulse Amplitude of 1.0 V**
- **E1 Pulse Masks Normalized to Pulse Amplitude of 2.37/ 3.0 V**

Jitter Measurement and Pulse Mask Compliance



Jitter Measurement and Pulse Mask Display

Overview

GL's **Jitter Measurement** software allows one to accurately measure jitter associated with an incoming T1 or E1 signals. It also allows evaluation of the jitter on either a tick-by-tick or a cumulative basis. In addition to these, the application recognizes the very slow variations in a clock signal (below 1 Hz), and the Frequency Offset or Deviations in clock rates. Jitter is the time discrepancy between the time of arrival of a clock pulse and its theoretical arrival time. Jitter arises from a number of sources, including aging of clock circuits, thermal and loading effects, Doppler shifts, and de-multiplexing from higher bit rate data streams. Since no clock is perfect, all clocks exhibit some degree of jitter. Jitter is always computed by comparing a clock signal (called the "nominal clock" or the "clock under test") with a clock having superior accuracy (called the "reference clock").

GL's **Pulse Shape Measurement** software can determine if the pulse shape fits within a "pulse mask" as specified by standards ITU G.703 and ANSI T1.102-1993. The software is available in both visual and tabular formats. Tabular formats are convenient for automation and scripted test environments.

It is also quite common for T1/E1 signals, within a central office environment or an enterprise telecom room, to NOT meet pulse mask requirements due to interference, too long or short cable lengths, improper impedances, or simply poor transmitter design. In such cases, jitter measurement & pulse mask compliance is very useful in diagnosing problems.

For more details, please visit our web page http://www.gl.com/jitter-measurement.html,http://www.gl.com/pulse-mask-testing.html, and http://www.gl.com/wcspulsemask.html.

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Document Number: XX012-6.14-01

Jitter Measurement

Main Features

- Easy, accurate, visual pulse shape and jitter measurement for T1/E1 signals (available with Universal T1/E1 cards and tProbe™ T1E1 Analyzer only).
- Jitter measurement provides an option to select T1 or E1 port for monitoring & the frequency range of interest.
- Jitter measurement supports One-Shot capture and Repeated Capture options for jitter measurement.
- CSV files are generated for further analysis using spreadsheet – one containing the raw clock counts, and raw jitter counts, the other file containing the FFT data which can be used within a data analysis tool to plot the jitter frequency spectrum.
- Graphs generated can be saved to a file, zoomed-in/zoomed-out, printed, and more.
- Jitter generation (coming soon).

Jitter Measurement - User Interface

The user interface provides various pages that display the jitter measurement results in decimal and graphical formats.

Jitter Measurement Statistics (Stats) Page

The Stats page displays measurement values for the current 2048 point measurement. The measurement period constitutes the "observation interval" for TIE peak-to-peak jitter measurement purposes. This page constitutes the Rx line frequency, frequency offset, observation interval, T1/E1 Precision value, +/- VE Peak value, and peak-to-peak value for measurement purposes.

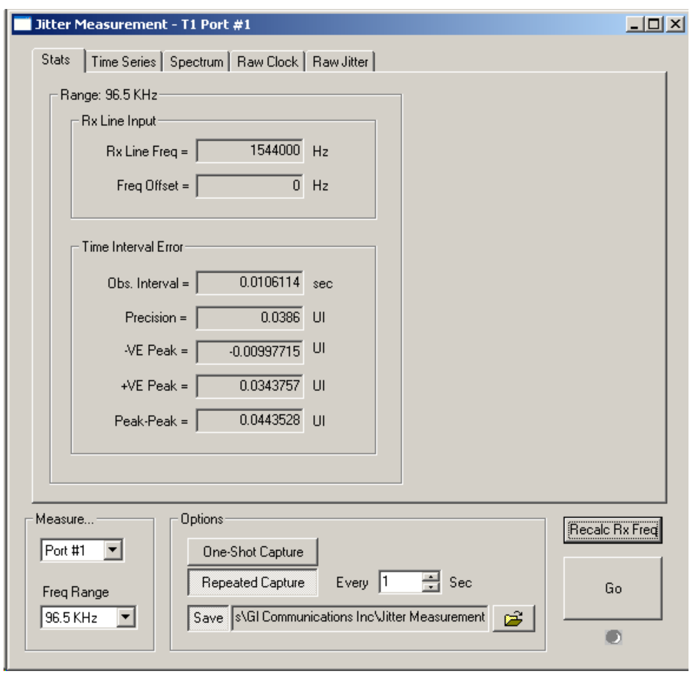

Figure: Statistics Tab

Jitter Time Series and Spectrum Page

The time series displays the captured jitter values on either a cumulative or tick-by-tick basis. The frequency spectrum of the captured jitter values will be displayed in the spectrum page. The Peak-to-peak jitter is displayed as a function of jitter frequency.

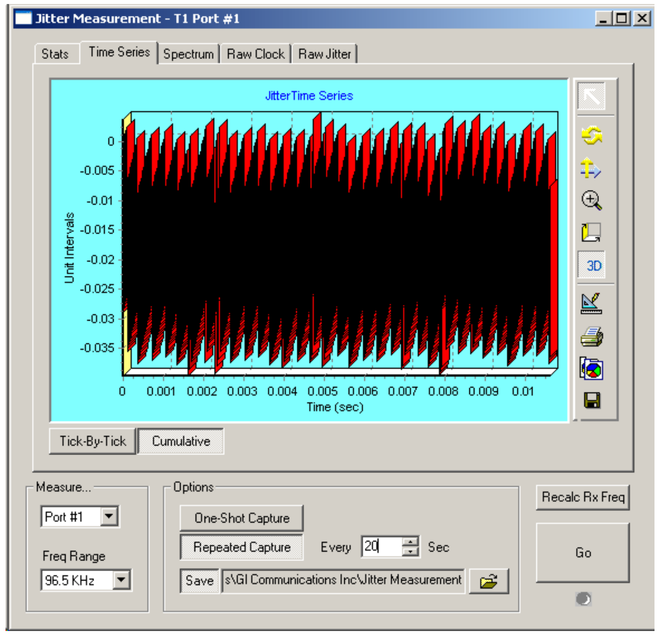

Figure: Time Series

Jitter Measurement - Theory of Operation

GL's Jitter Measurement module computes jitter by comparing the incoming signal against a much higher rate **reference clock**. The **nominal clock** signal (the "Clock Under Test" or "CUT") is recovered from the incoming data stream. The number of reference clock ticks for each incoming nominal clock tick thus extracted is captured for analysis. Reference clock values are captured in blocks of 2048 consecutive measurements. The strategy is illustrated in the figure below and the precision is given by the following formula:

$$precision = \frac{Nc}{2048} Hz = \frac{Nyq}{1024} Hz$$

Where,

- Nc is the nominal clock rate in bits per second
- Nyq is the Nyquist frequency corresponding to that nominal clock rate
- 1024 is the number of frequency "bins" in the computed frequency spectrum.

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Pulse Mask Display

Main Features

- Easy, accurate, visual pulse shape measurement for T1/E1 signals (available with Universal T1/E1 cards and tProbe™ T1E1 Analyzer only).
- Pulse mask plots the pulse measured within a predefined template.
- Compares the incoming T1/E1 pulses against the pulse mask display.
- For T1 pulses, the x-axis measures time in unit intervals (UI), while for E1 pulse, the x-axis measures time in nanoseconds (ns),
- The y-axis in pulse mask measures the normalized amplitude in volts.
- The Pulse Mask image can be saved to a file, zoomed-in/ zoomed-out, printed, and more

T1 Pulse Mask Operation

The transmit data path is selected and measured at the end of the transmission line for each T1 line.
The specification for T1 requires that the T1 signal must fit within the pulse mask at the end of the line when transmitting an isolated pulse, regardless of the way the T1 device is configured. The amplitude of the isolated signal at time zero should be within 20% of 3.0 volts. If the amplitude requirement is met, then the signal is scaled linearly to determine if it fits the pulse mask.

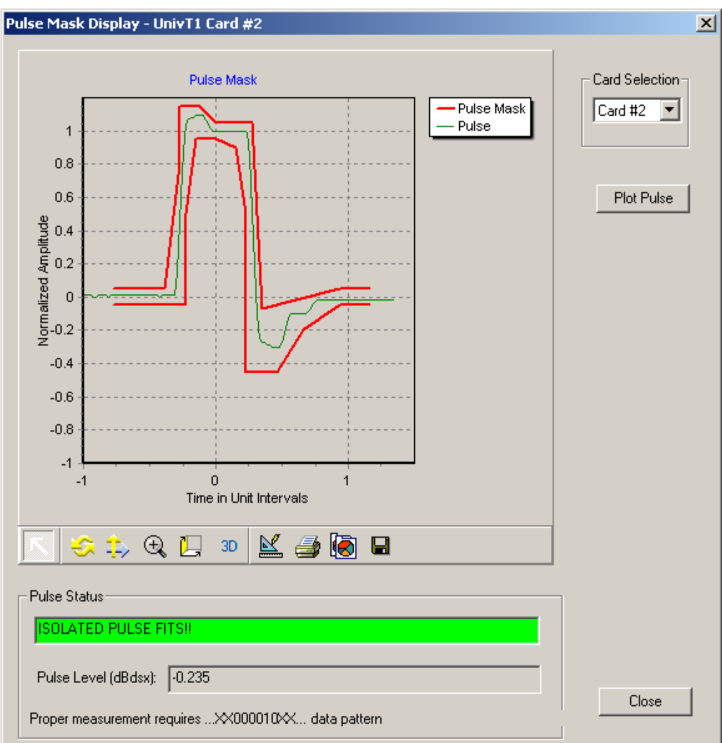


Figure: T1 Pulse Mask

E1 Pulse Mask Operation

The specification for E1 requires that all the pulses meet the template and not just an isolated pulse. Another difference is the fact that that pulses are measured at transmitter output, rather than after some length of cable, while T1 pulses must meet the template for the entire line length.
There are two types of cables used in E1 mode: 75 Ohm coax cable and a 120 Ohm twisted pair. Both cables have different nominal amplitudes associated with them. For the 75 Ohm coax cable, the amplitude must be 2.37V ± 10% at T0.
For the 120Ohm twisted pair, the amplitude must be 3.0V ± 10%.

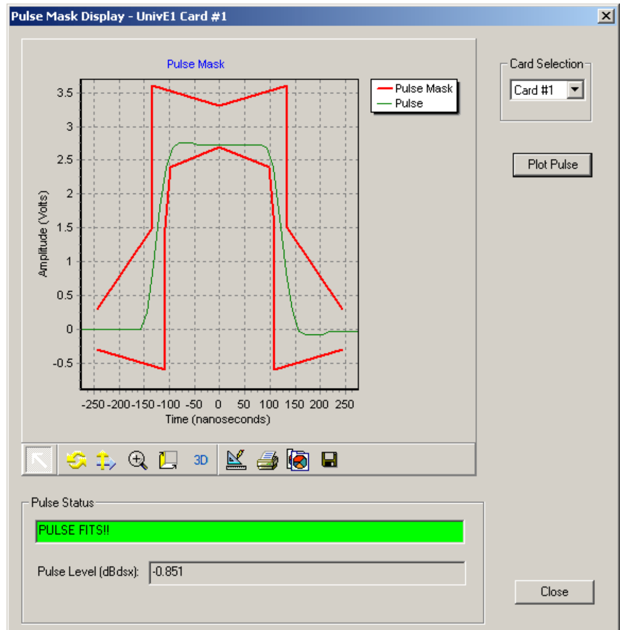
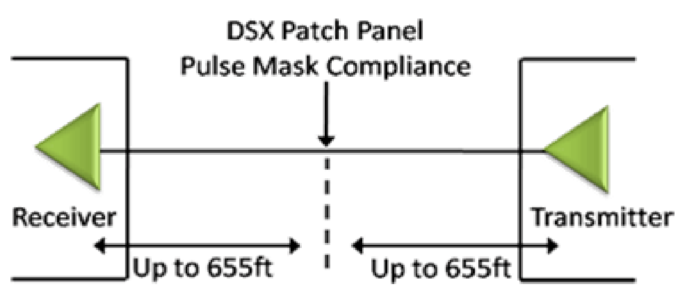


Figure: E1 Pulse Mask

Pulse Mask Background

In T1/E1 transmission systems, signals are dropped, inserted, and accessed at the electrical level at a point called DSX patch panel or at some similar point. To reliably receive, monitor, or access these signals, they must first conform to a standard that establishes parameters such as pulse width, rise time, amplitude, allowable undershoot and overshoot. If the pulse meets the pulse mask, then a properly designed receiver should be able to decode the bits transmitted. See diagram below.



WCS Jitter Measurement

The Jitter measurement can be performed through commands with the Windows Client-Server application. The jitter ranges can be monitored on a specified port using simple commands by a client application.

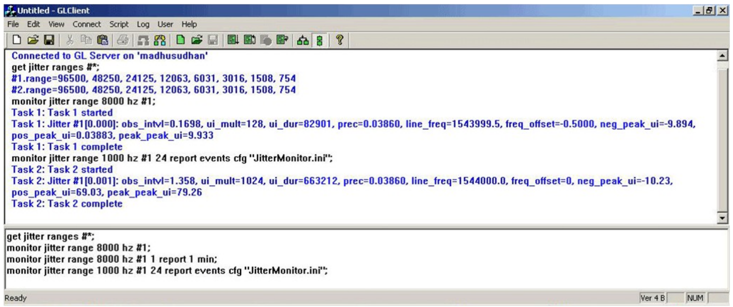


Figure: Jitter Measurement

WCS Pulse Mask

The Pulse Mask compliance testing can be performed through commands with the Windows Client-Server application. The pulse mask can be remotely controlled using simple commands by client applications.

Some of the commands supported are CheckPulseMask, Validate pulse, Stop pulse mask validation, and so on. Pulse Mask will also return all error and warning message to WCS client as task error or warning message.

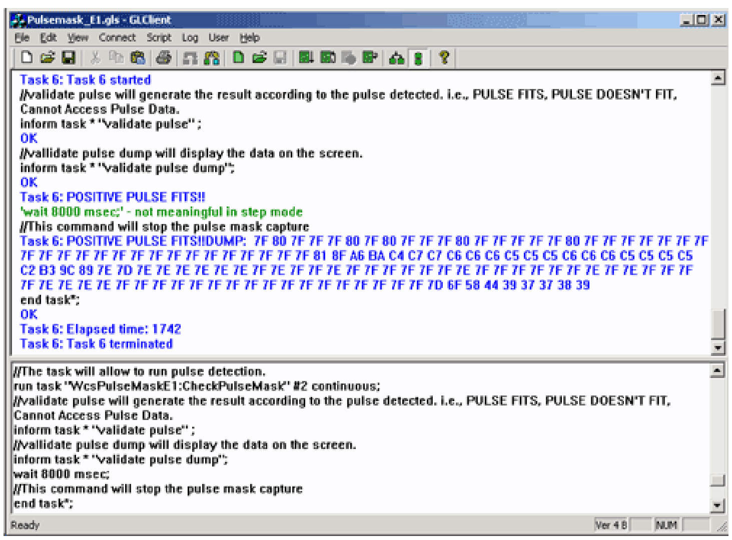


Figure: WCS Pulse Mask

Buyers Guide:

XX012 - Pulse Shape and Jitter Measurement - Easy, accurate, visual pulse shape and jitter measurement for T1 E1 signals

Related Software

XX600 - WCS Client Server

Related Hardware

PTE001 - tProbe™ Dual T1 E1 Laptop Analyzer (Require Basic Software)

HTE001 - Universal T1/E1 Card (Require Basic Software)