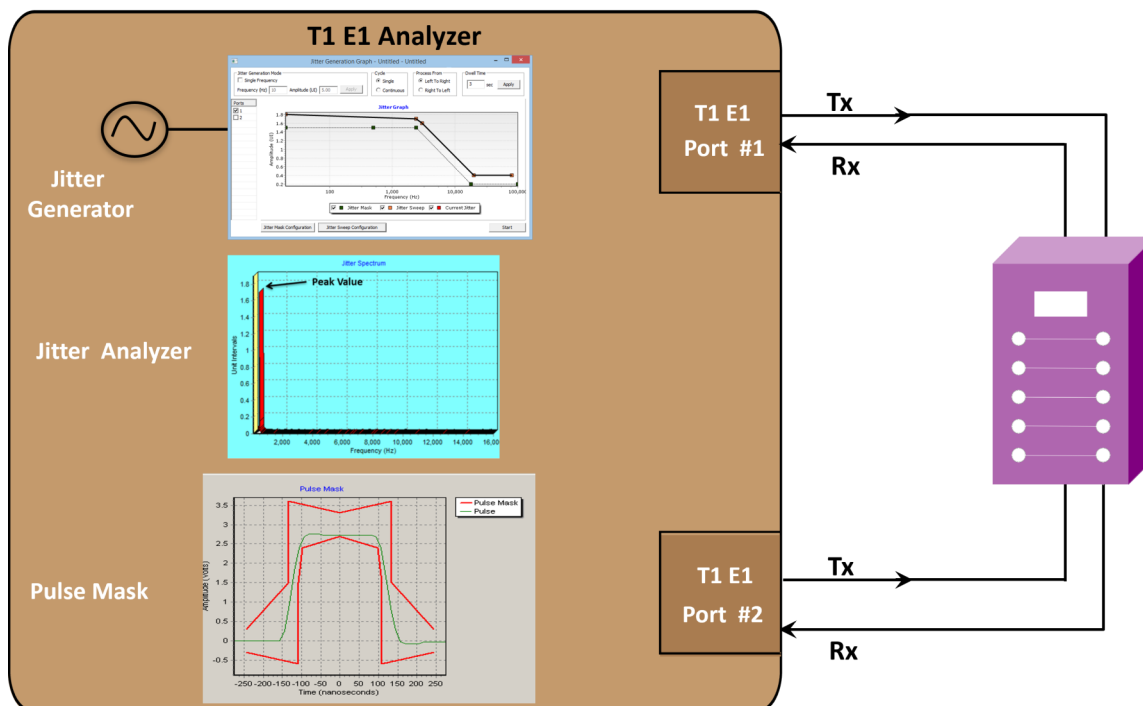


Jitter Generator and Measurement Pulse Mask Compliance



Overview

GL's **Jitter Generation** software has been developed to generate jittered output T1 E1 signal with user-selected frequency and amplitude. It is suitable for testing jitter tolerance and compliance with standards such as G.823.

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. This application in conjunction with GL's Jitter Generation application, can be used test jitter transfer function to confirm that there is no amplification of jitter by network elements (NEs) in the transmission system.

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, and pulse mask compliance is very useful in diagnosing problems.

Now, Jitter Generation and Measurement, Pulse Mask Compliance (XX012) application is available as a part of basic applications in T1 E1 analyzer.

The jitter and pulse mask compliance test capability is available in GL's [Dual T1 E1 Express \(PCIe\) Boards](#) and [tProbe™ T1 E1 Analyzer](#) units.

For more details, visit [Jitter Generation on T1 E1 Lines](#), [Pulse Mask Compliance Testing](#), and [WCS Jitter Measurement and Pulse Mask](#) webpages.



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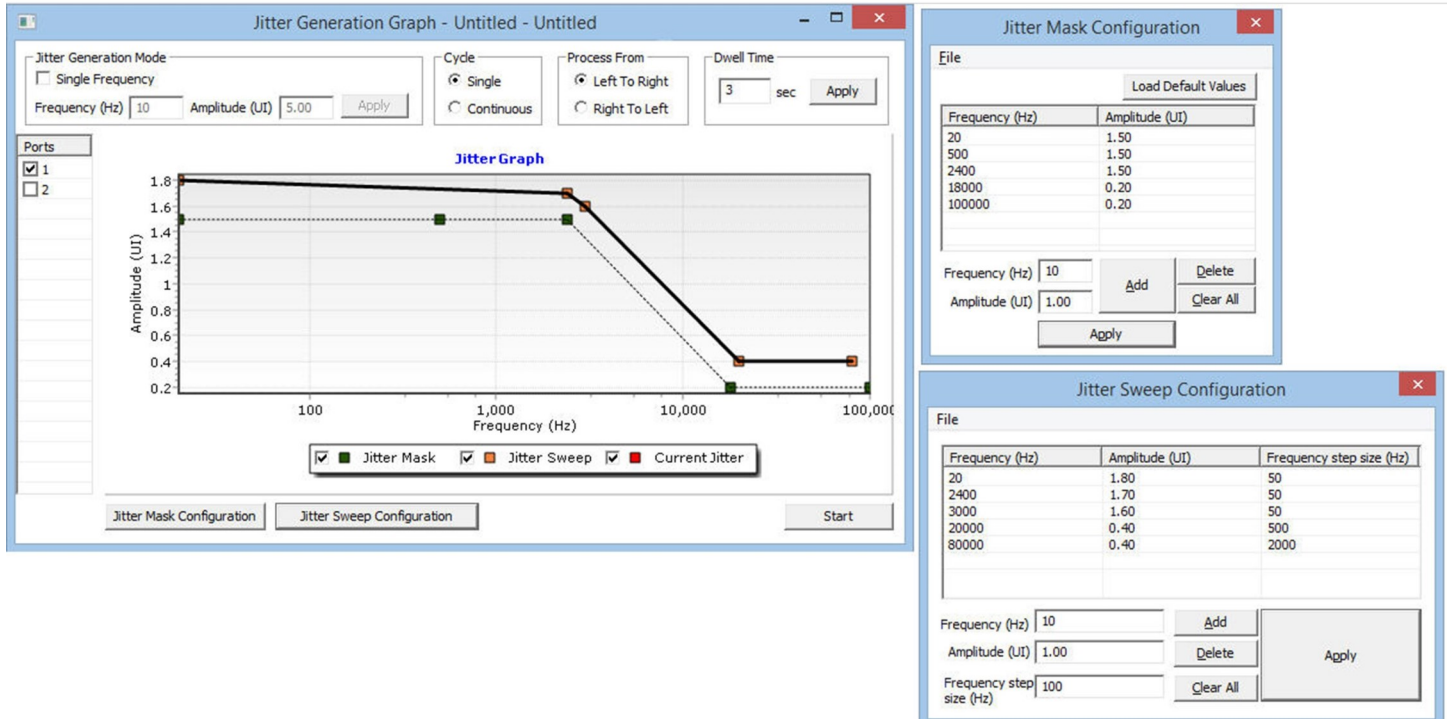
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Jitter Generation

Background

When the signal traverses a network, the jitter generated by the DUT becomes the input jitter to the next part of the network. If this jitter is amplified, it can exceed the jitter tolerance of the subsequent DUT. In this way, excessive jitter may accumulate and cause errors as the signal progresses through the network equipment.

GL's [Jitter Generation](#) software has been developed to generate jittered output T1 E1 signal with user-selected frequency and amplitude. It is suitable for testing jitter tolerance and compliance with standards such as G.823. In conjunction with GL's Jitter Measurement application, Jitter Generation may be also be used to test and measure jitter transfer.



Jitter Generation User Interface

Main Features

- Generates intrinsic jitter without any error as per G.823 standards
- Generates user-defined jitter value against a input jitter tolerance mask to test DUTs capability to tolerate large amounts of generated jitter
- In conjunction with Jitter Measurement provides peak-to-peak jitter value for a given frequency at the system output
- Evaluate the jitter in real-time on either a tick-by-tick or a cumulative basis

Working Operations

Jitter tolerance mask defines a boundary to tolerate intrinsic jitter. The table provides Jitter tolerance mask defined as per the standard specification. Jitter is generated based on user-defined frequency and amplitudes. Jitter tolerance mask is defined as per the transmission standard to create a benchmark for the generated jitter.

Once jitter is generated beyond the tolerance level, the DUT starts to introduce frame errors due to the applied data transition jitter. This can be verified using the Bit Error Rate (BER) Tester. The line sync loss and violations are also indicated for each port in the T1 E1 Line status window.

Specification of Jitter Tolerance Mask for T1

| | |
|--------------------------|-----------------|
| GR-499 Cat 1 | 10Hz – 5 UI |
| | 500Hz – 5UI |
| | 8KHz - 0.5UI |
| | 40KHz – 0.1UI |
| GR-499 Cat 2 | 10Hz – 10 UI |
| | 193Hz – 10UI |
| | 6.43KHz - 0.3UI |
| | 40KHz – 0.3UI |
| AT&T Pub 62411 (Dec. 90) | 1Hz – 138UI |
| | 4.9HZ – 28UI |
| | 300Hz – 28UI |
| | 10KHz – 0.4UI |
| | 100KHz – 0.4UI |

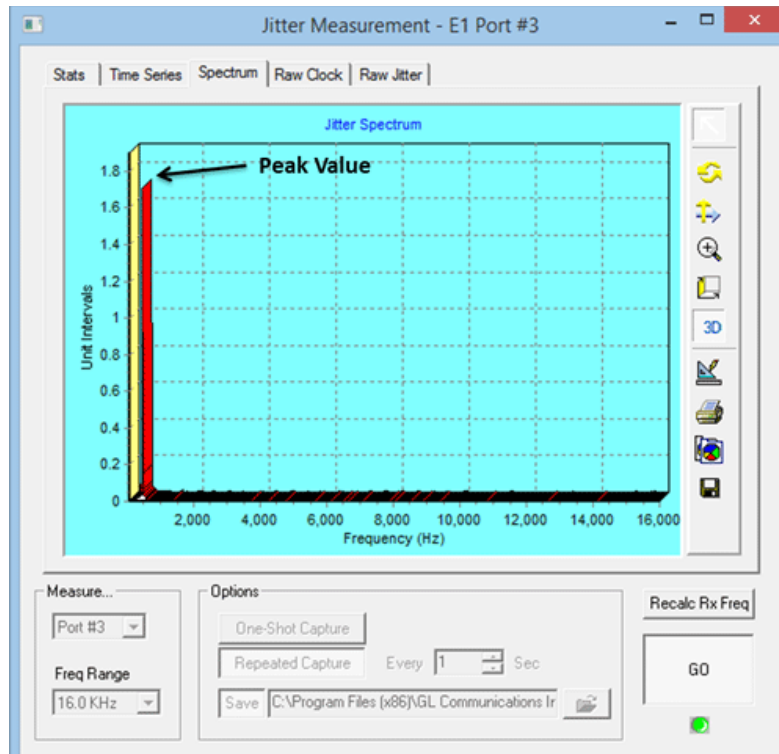
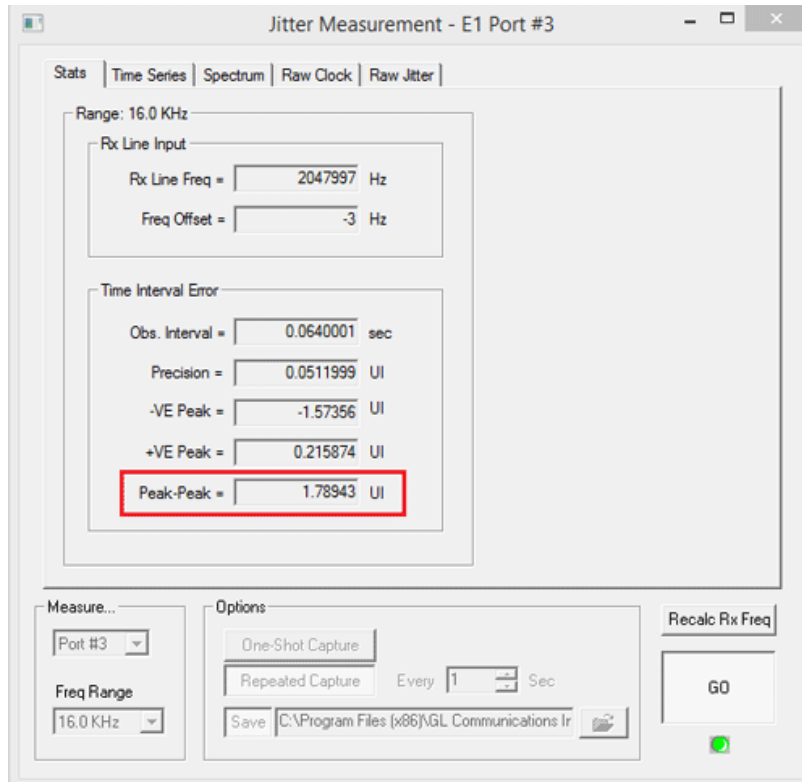
Specification of Jitter Tolerance Mask for E1

| | |
|-------------|----------------|
| ITU-T G.823 | 20Hz – 1.5UI |
| | 2.4KHz – 1.5UI |
| | 18KHz – 0.2UI |
| | 100KHz – 0.2UI |

Verify Using Jitter Measurement

Generated jitter can be measured using **Jitter Measurement** software. The Peak-to-Peak jitter amplitude value in UI is computed as the highest cumulative jitter value minus the lowest cumulative jitter value and displayed under the statistics and spectral analysis tabs.

The spectrum tab displays the spectral analysis and peak amplitude value for the corresponding frequency. For T1 systems operating at 1.544 Mbps, 1 UI equals 647 nanoseconds. For E1 systems operating at 2.048 Mbps, 1 UI equals 488 nanoseconds.



Jitter Measurement Stats and Spectrum Tab

Jitter Measurement

Main Features

- Easy, accurate, visual pulse shape and jitter measurement for T1 E1 signals (available with tProbe™ T1 E1 Analyzer)
- Jitter measurement provides an option to select T1 or E1 port for monitoring , and 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 Measurement Statistics Page

The Statistics page displays measurement values for the current 2048 point measurement. The measurement period constitutes the “observation interval” for T1E 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.

Jitter Measurement - T1 Port #1

Stats | Time Series | Spectrum | Raw Clock | Raw Jitter

Range: 96.5 KHz

Rx Line Input

Rx Line Freq = 1544000 Hz

Freq Offset = 0 Hz

Time Interval Error

Obs. Interval = 0.0106114 sec

Precision = 0.0386 UI

-VE Peak = -0.00997715 UI

+VE Peak = 0.0343757 UI

Peak-Peak = 0.0443528 UI

Measure...

Port #1

Freq Range

96.5 KHz

Options

One-Shot Capture

Repeated Capture Every 1 Sec

Save s:\GI Communications Inc\Jitter Measurement

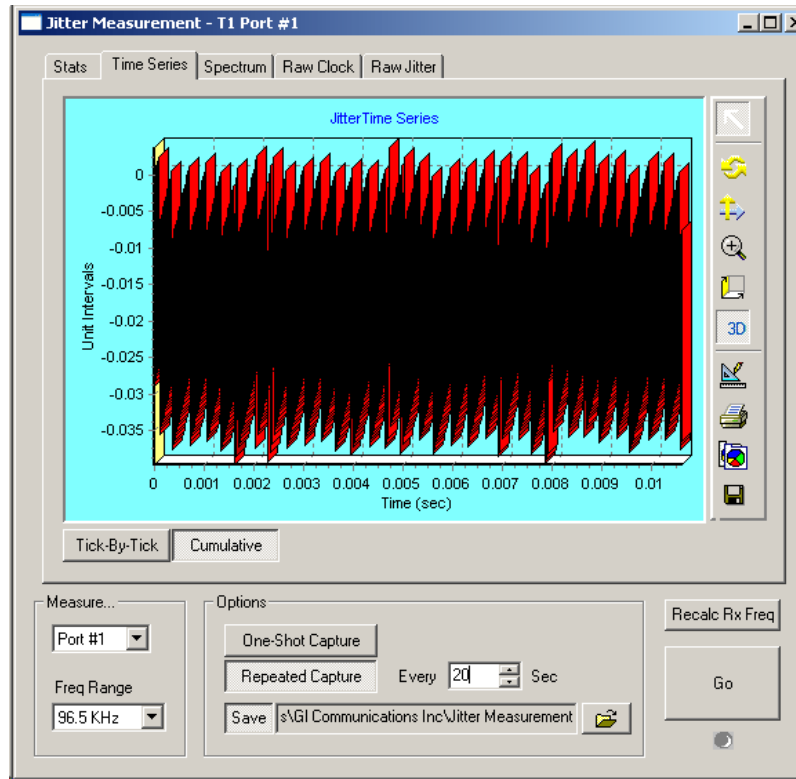
Recalc Rx Freq

Go

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.



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:

$$precision = \frac{N_c}{2048} Hz = \frac{N_{yq}}{1024} Hz$$

Where,

- N_c is the nominal clock rate in bits per second
- N_{yq} is the Nyquist frequency corresponding to that nominal clock rate
- 1024 is the number of frequency "bins" in the computed frequency spectrum

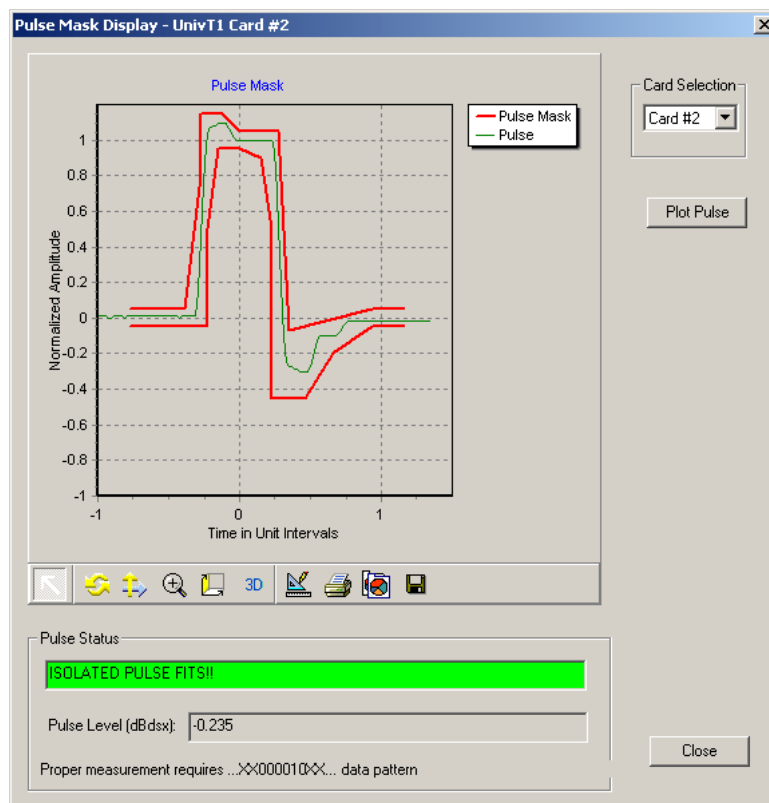
Pulse Mask Display

Main Features

- Easy, accurate, visual pulse shape measurement for T1 E1 signals (available with tProbe™ T1 E1 Analyzer)
- 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

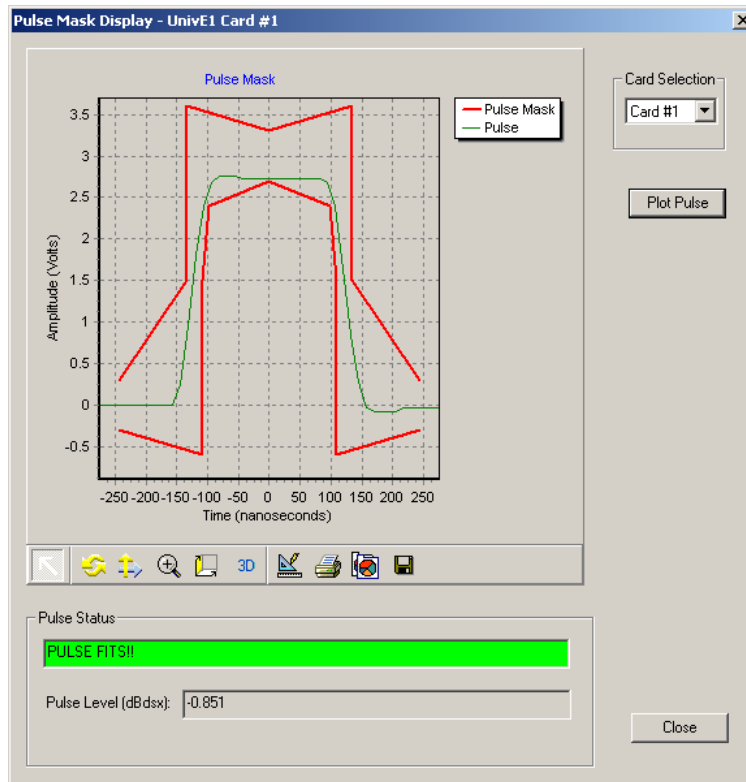
The transmit data path is selected and measured at the end of the transmission line for each T1 line. The specification for T1 requires that the T1 signal must fit within the pulse mask at the end of the line when transmitting an isolated pulse, regardless of the way the T1 device is configured. The 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.



T1 Pulse Mask

E1 Pulse Mask Operation

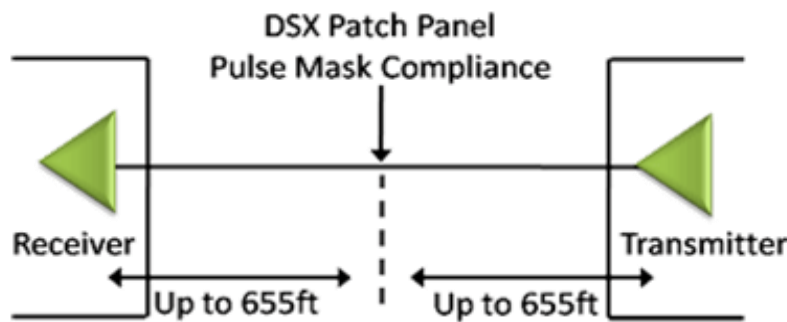
The specification for E1 requires that all the pulses meet the template and not just an isolated pulse. Another difference is the fact that pulses are measured at transmitter output, rather than after some length of cable, while T1 pulses must meet the template for the entire line length. There are two 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 $2.37V \pm 10\%$ at T0. For the 120 Ohm twisted pair, the amplitude must be $3.0V \pm 10\%$.



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 as shown in the below diagram.



Pulse Mask Background

Buyer's Guide

| Item No | Product Description |
|-----------------------|--|
| XX012 | Pulse Shape, Jitter Generation, and Jitter Measurement (Available as a part of basic applications in T1 E1 analyzer) |

| Item No | Related Hardware |
|------------------------|---|
| FTE001 | QuadXpress T1 E1 Main Board (Quad Port– requires additional licenses) |
| ETE001 | QuadXpress T1 E1 Daughter Board (requires FTE001) |
| PTE001 | tProbe™ Dual T1 E1 Laptop Analyzer with Basic Analyzer Software |
| XTE001 | Dual T1 E1 Express (PCIe) Boards |

Note: PCs which include GL hardware/software require Intel or AMD processors for compliance.

For more details, visit [Jitter Generation on T1 or E1 Lines](#), [Pulse Mask Compliance Testing](#), and [WCS Jitter Measurement and Pulse Mask](#) webpages.



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