InifiniBand 1X Interface and Probe Kit

Characteristics and Applications

The InfiniBand 1X board to cable connector set is now a standardized commercial product which consists of two differential pair contacts, specifically designed to support digital speeds commensurate with the InfiniBand Architecture. The **IB 1X Probe** kit that is described below and illustrated in Figure 1 is intended to be used in a variety of probing, testing, analysis and interoperability applications at full InfiniBand data rates. The design of the **IB 1X Probe** kit is based on the InfiniBand Architecture standard and uses the actual InfiniBand 1X standardized connector set. In order to give the user the full bandwidth specified by the standard, all components within the kit that are added to the standardized connectors far exceed the bandwidth of the standard connector set. Full characteristics of the kit and some applications are described below.

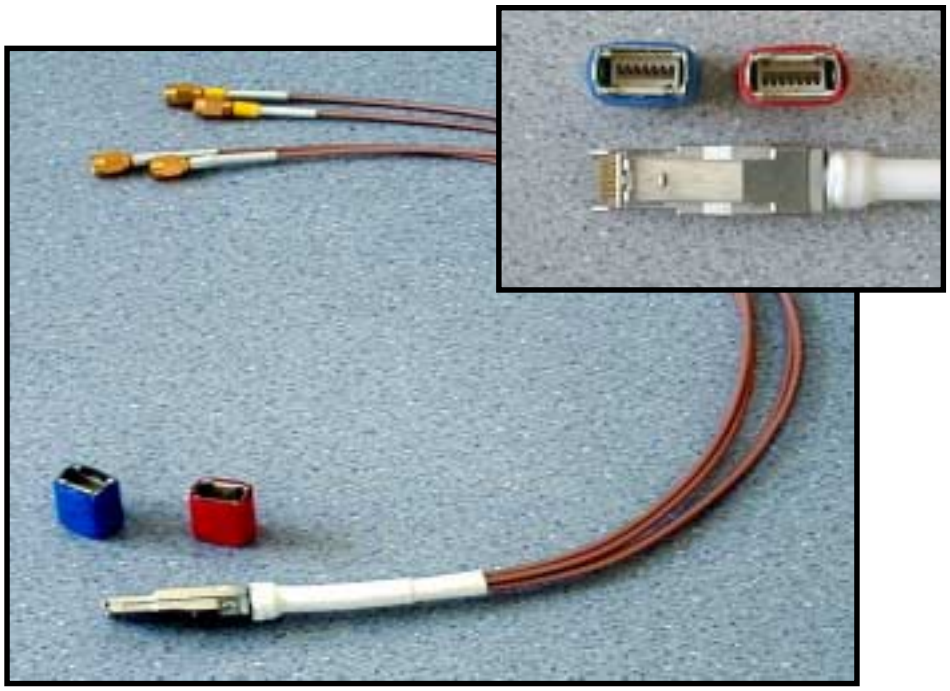

Figure 1. IB-1X Probe and terminations

I. Probe Kit Design.
II. Termination Design.
III. Bandwidth Characteristics.
IV. IB-1X Probe as an InfiniBand Interface.
V. IB-1X Probe as an Instrument Interface.
VI. Summary Specifications.

I. Probe Kit Design.

The probe kit consists of the probe assembly and includes matched and shorted terminations, as illustrated in Fig. 1. The probe is constructed from a standardized IB-1X plug that has been modified to accommodate four coaxial leads that replace the standard multiconductor cable. The leads are 40 cm long, are made of low loss coaxial cable and are terminated with 12 GHz, SMA connectors. The two differential pairs of the probe are coded with white and yellow bands on the coaxial leads for easy identification in both application and characterization environments. (The probe can be made also with other high bandwidth connectors on special request.)

II. Termination Design.

The matched and shorting terminations are constructed from standardized IB-1X receptacles. The matched loads are terminated with 50 Ω, +/− 0.5 % precision chip resistors in the single-ended configuration and with two such chip resistors in series for the differential configuration. The shorts and the matching resistors within the receptacles are placed as close to the ends of the receptacles as is permitted by mechanical and geometrical constraints so as to locate them within 2mm of the point at which the connection to the circuit board is made in standard applications. This allows the maximum amount of the probe and its corresponding receptacle to be calibrated out in the TDR normalization process[1].

[1] http://literature.agilent.com/litweb/pdf/5988-2490EN.pdf

III. Bandwidth Characteristics.

Both time domain and spectral characteristics of the **IB 1X Probe** kit are shown in figures 2 through 5 and are summarized in the accompanying table. Because the commercial InfiniBand 1X connector assembly is not exactly symmetrical in internal details, the differential pairs, labeled with white and yellow bands on the coaxial cables of the **IB 1X Probe** kit, show different spectral characteristics. This difference is shown in Figure 2 and manifests itself mainly as two accentuated reflective resonances on the yellow-banded differential pair. For that reason, this path is considered worst case and is used to generate the eye pattern diagrams (EPD) for 2.5 Gb/s, Figure 3, and for 5.0 Gb/s, Figure 4. The shown eye pattern diagrams correspond to 60 and 30 ps signal risetimes, respectively.

IV. IB 1X Probe as an Instrument Interface.

Since one end of the **IB 1X Probe** is terminated in an IB-1X plug while the other end is terminated in four SMA connectors, the probe allows boards equipped with an IB-1X standardized receptacle to be tested with the aid of a TDR, a VNA or any other suitable instrument. The four SMA connectors provide the two differential pairs that are needed to test the transmit/receive pathways in the 1X configuration. For example, with a TDR instrument, the probe provides a test path for full circuit board test and measurement applications. The TDR worst-case differential characteristic (yellow banded terminals) is shown in Figure 5. The reflections are shown to be contained within 60 mρ. What is particularly significant and useful, is that the probe terminations are designed in such a way as to allow for nearly the entire removal of the characteristics of

both the probe and its corresponding IB-1X receptacle from the measured characteristics in the standard TDR normalization process[1].

V. IB1X Probe as an InfiniBand Architecture Interface.

The **IB 1X Probe** can also be used in many applications that require a source/target interface such as a traffic generator, a protocol analyzer, a logic analyzer or any other system analyzer. For applications that require either system stimulation with or monitoring of the actual InfiniBand protocol, it is important that the transmission characteristics of the interface are such that the sent/received signals are representative of the actual system data. Eye pattern diagrams (EPD) generated from the characteristics shown in Figure 2 are illustrated in Figure 3 for 2.5 Gb/s and in Figure 4 for 5 Gb/s for the worst case differential pair (yellow band). The EPD are produced with 60 and 30 ps risetime signals, respectively. At 2.5 Gb/s, the benign spectral characteristics of the probe result in less than 7 ps, or less than 2% of UI, jitter. The jitter at 5 Gb/s is less than 12 ps, or less than 6% of UI. The jitter value at 2.5 Gb/s is quite small and is still an order of magnitude smaller than the IB specified maximum allowed receiver jitter at 5 Gb/s. Nevertheless, if jitter becomes an issue in a particular application, the recommendation from atSpeed Technologies is that the entire transmitter/receiver path is taken into account in any plan for equalization. (See archived web based broadcast, **Design Advances for the InfiniBand Architecture Phisical Layer** which deals with the **Signal Conditioning for Loss and Dispersion at High Speed:** http://www.atspeed.net/library.html.)

VI. Summary Specifications.

The specifications used to describe the suitability of the **IB 1X Probe** for various applications are summarized in the table below.

IB-1X Probe Properties	
3 dB Bandwidth[2]	> 5 GHz
6 dB Bandwidth[2]	> 10 GHz
Input Z	100 +0, -4 Ω
Length	40 ± 0.5 cm
Delay[2]	2.5 ± 0.05 ns
Pair skew	< 10 ps
Jitter, 2.5 Gb/s	< 7 ps; 2% UI
Jitter, 5.0 Gb/s	< 12 ps; 6% UI
Cross Talk	< 1.5 % at 75 ps risetime

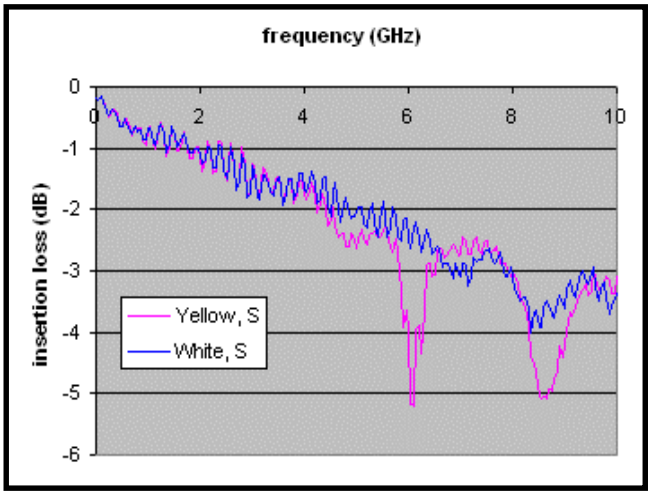

Figure 2. Typical differential mode insertion loss[2] of probe.

[2] The insertion loss values shown are half of the values determined in a round trip propagation measurement made on a probe terminated with a short.

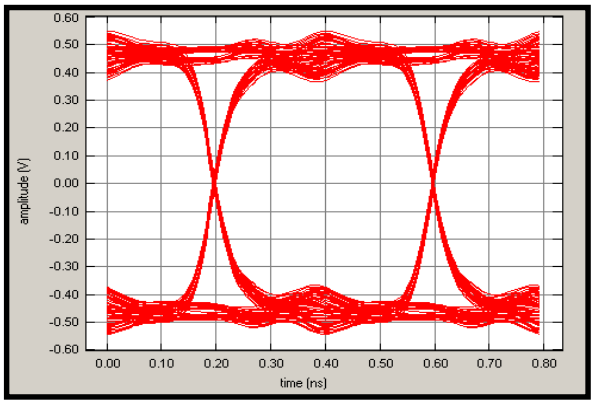

Figure 3. EPD at 2.5 Gb/s on yellow differential channel (worst case) derived from characteristics shown in Figure 2.

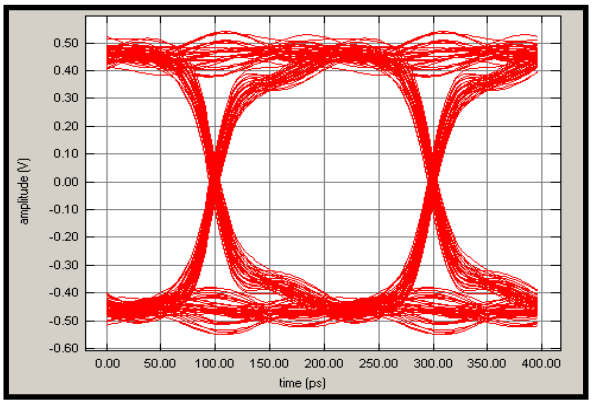

Figure 4. EPD at 5.0 Gb/s on yellow differential channel (worst case) derived from characteristics shown in Figure 2.

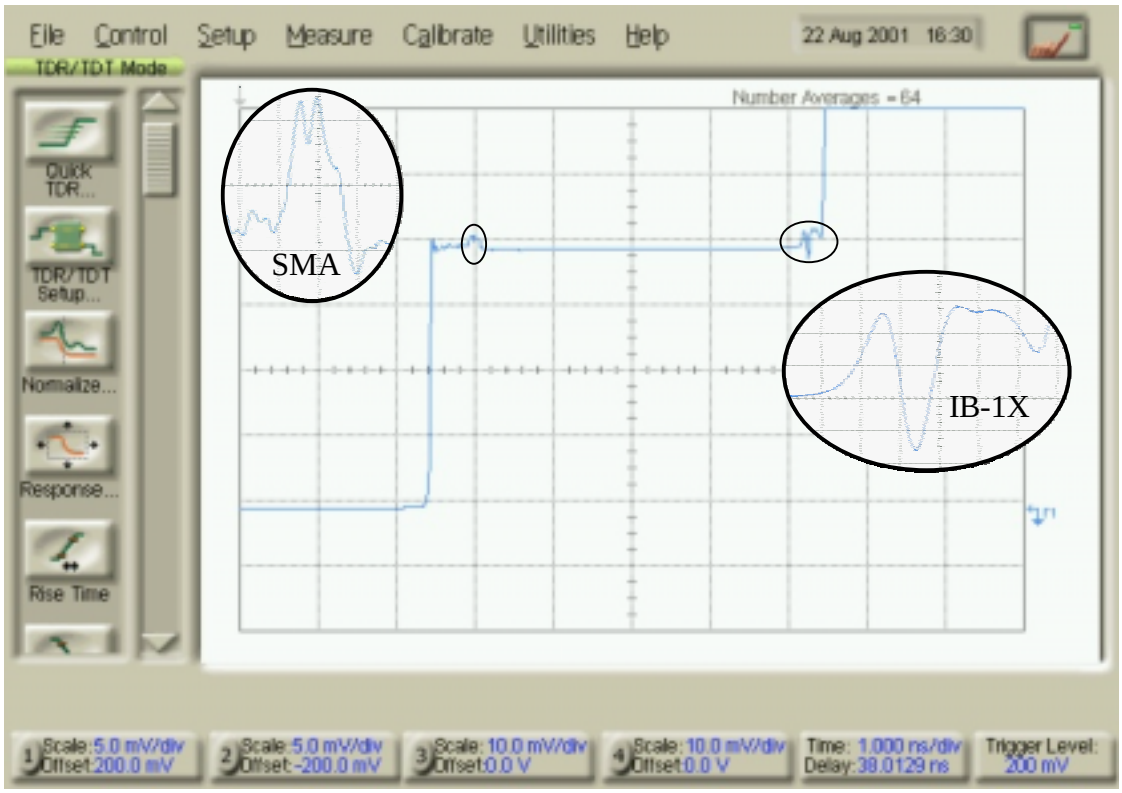

Figure 5. TDR of IB-1X probe assembly. Reflections due to the SMA portion of the probe appear on the left and reflections due to the IB-1X portion of the probe appear on the right.