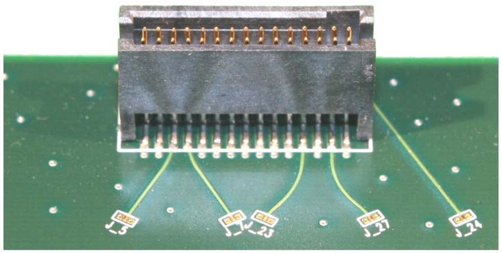
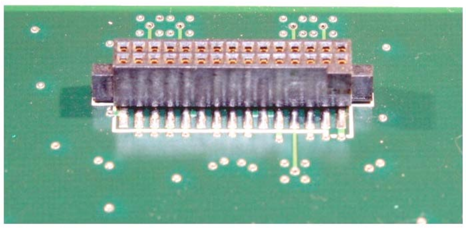
High Speed Characterization Report

TFM-115-32-S-D



Mated With

SFM-115-02-S-D



Description:
Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

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Report Revision: 5/3/2017

Series: SFM/TFM
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Connector Overview

Micro 1.27mm (.050") pitch interfaces (SFM/TFM Series) are available with up to 50 contacts per row and board-to-board spacings of 4.57mm (0.1799"), 6.35mm (0.250"), 8.13mm (0.320"), 9.91mm (0.390") and 11.81mm (0.465") between boards. The data in this report is applicable only to the 11.81mm (0.465") board-to-board stack height version.

Connector System Speed Rating

SFM/TFM Series, Micro Board-to-Board, 1.27 mm Pitch, 11.81mm (0.465") Stack Height

Signaling	Speed Rating
Single-Ended:	**4 GHz / 8 Gbps**
Differential:	**4.5 GHz / 9 Gbps**

The Speed Rating is based on the -3 dB insertion loss point of the connector system. The -3 dB point can be used to estimate usable system bandwidth in a typical, two-level signaling environment.

To calculate the Speed Rating, the measured -3 dB point is rounded up to the nearest half-GHz level. The up-rounding corrects for a portion of the test board's trace loss, since trace losses are included in the loss data in this report. The resulting loss value is then doubled to determine the approximate maximum data rate in Gigabits per second (Gbps).

For example, a connector with a -3 dB point of 7.8 GHz would have a Speed Rating of 8 GHz/ 16 Gbps. A connector with a -3 dB point of 7.2 GHz would have a Speed Rating of 7.5 GHz/ 15 Gbps.

Series: SFM/TFM
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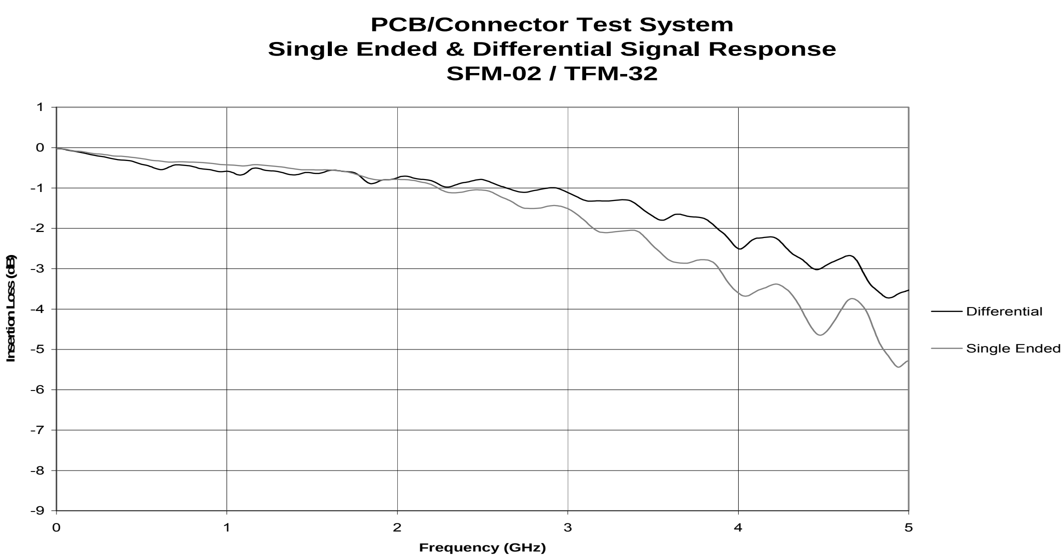
Frequency Domain Data Summary

Table 1 - Single-Ended Connector System Performance		
Test Parameter	**Configuration**	
Insertion Loss	GSG	**-3dB @ 3.90 GHz**
Return Loss	GSG	≤ -3 dB to 3.90 GHz
Near-End Crosstalk	GAQG	≤ -8dB to 3.90 GHz
	GAGQG	≤ -25dB to 3.90 GHz
	Xrow, GAG to GQG	≤ -12dB to 3.90 GHz
Far-End Crosstalk	GAQG	≤ -12dB to 3.90 GHz
	GAGQG	≤ -25dB to 3.90 GHz
	Xrow, GAG to GQG	≤ -15dB to 3.90 GHz

Table 2 - Differential Connector System Bandwidth		
Test Parameter	**Configuration**	
Insertion Loss	GSSG	**-3dB @ 4.46 GHz**
Return Loss	GSSG	≤ -5dB to 4.46 GHz
Near-End Crosstalk	GAAQQG	≤ -18dB to 4.46 GHz
	GAAGQQG	≤ -35dB to 4.46 GHz
	Xrow, GAASS to GQQG	≤ -15dB to 4.46 GHz
Far-End Crosstalk	GAAQQG	≤ -25dB to 4.46 GHz
	GAAGQQG	≤ -35dB to 4.46 GHz
	Xrow, GAASS to GQQG	≤ -20dB to 4.46 GHz



Series: SFM/TFM
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Time Domain Data Summary

Table 3 - Single-Ended Impedance (Ω)

Signal Risetime	30±5ps	50 ps	100 ps	250 ps	500 ps	750 ps	1 ns
Maximum Impedance	70.4	62.4	56.6	51.6	51.3	50.9	50.6
Minimum Impedance	30.1	33.6	38.1	44.6	46.9	47.8	48.4

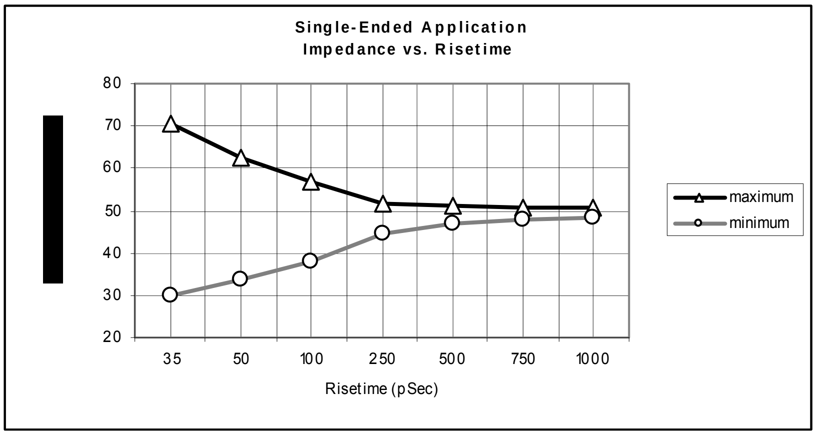

Table 4 - Differential Impedance (Ω)

Signal Risetime	30±5ps	50 ps	100 ps	250 ps	500 ps	750 ps	1 ns
Maximum Impedance	113.4	103.7	103.5	103.2	103.0	102.8	102.8
Minimum Impedance	55.9	60.9	69.2	80.7	86.6	90.0	92.2

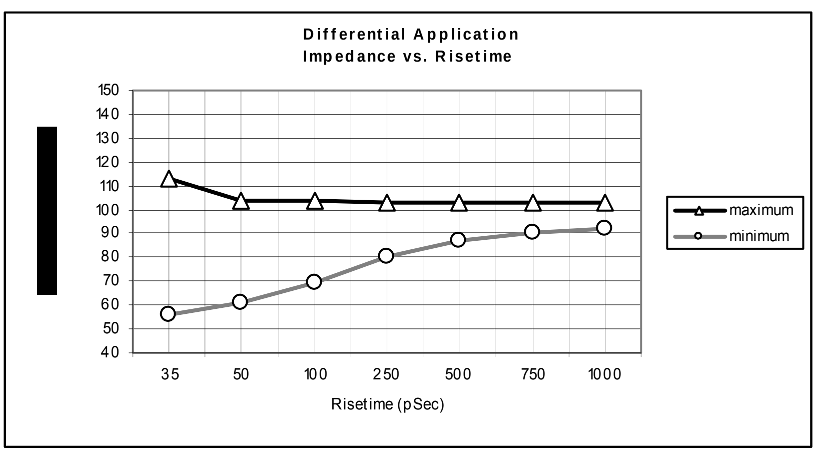

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Table 5 - Single-Ended Crosstalk (%)

Input (t_r)		30±5ps	50 ps	100 ps	250 ps	500 ps	750 ps	1 ns
NEXT	GAQG	12.4	12.0	11.2	7.4	4.4	3.1	2.4
	GAGQG	4.2	3.0	1.8	1.0	< 1.0	< 1.0	< 1.0
	$Xrow^{se}$	10.8	8.7	7.5	5.2	2.9	2.0	1.6
FEXT	GAQG	7.1	6.1	4.7	2.4	1.2	0.8	0.6
	GAGQG	3.0	2.4	1.6	< 1.0	< 1.0	< 1.0	< 1.0
	$Xrow^{se}$	7.4	6.2	4.5	2.4	1.2	< 1.0	< 1.0

Table 6 - Differential Crosstalk (%)

Input (t_r)		30±5ps	50 ps	100 ps	250 ps	500 ps	750 ps	1 ns
NEXT	GAAQQSS	4.9	4.1	3.9	2.5	1.5	1.1	< 1.0
	GAAGQQG	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	$Xrow^{diff}$	6.1	5.4	4.7	2.8	1.6	1.2	< 1.0
FEXT	GAAQQSS	1.3	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	GAAGQQG	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	$Xrow^{diff}$	3.3	2.4	1.6	< 1.0	< 1.0	< 1.0	< 1.0

Table 7 - Propagation Delay (Mated Connector)

Single-Ended	126ps
Differential	125ps

Series: SFM/TFM
Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

Characterization Details

This report presents data which characterizes the signal integrity response of a connector pair in a controlled printed circuit board (PCB) environment. All efforts are made to reveal typical best-case responses inherent to the system under test (SUT).

In this report, the SUT includes the test PCB from drive side probe tips to receive side probe tips. PCB effects are not removed or de-embedded from the test data. PCB designs with impedance mismatch, large losses, skew, cross talk, or similar impairments can have a significant impact on observed test data. Therefore, great design effort is put forth to limit these effects in the PCB utilized in these tests. Some board related effects, such as pad-to-ground capacitance and trace loss, are included in the data presented in this report. But other effects, such as via coupling or stub resonance, are not evaluated here. Such effects are addressed and characterized fully by the Samtec Final Inch® products.

Additionally, intermediate test signal connections can mask the connectors' true performance. Such connection effects are minimized by using high performance test cables, adapters, and microwave probes. Where appropriate, calibration and de-embedding routines are also used to reduce residual effects.

Differential and Single-Ended Data

Most Samtec connectors can be used successfully in both differential and single-ended applications. However, electrical performance will differ depending on the signal drive type. In this report, data is presented for both differential and single-ended drive scenarios.

Connector Signal to Ground Ratio

Samtec connectors are most often designed for generic applications, and can be implemented using various signal and ground pin assignments. In high speed systems, provisions must be made in the interconnect for signal return currents. Such paths are often referred to as “ground”. In some connectors, a ground plane or blade, or an outer shield is used as the signal return, while in others, connector pins are used as signal returns. Various combinations of signal pins, ground blades, and shields can also be utilized. Electrical performance can vary significantly depending upon the number and location of ground pins.

In general, the more pins dedicated to ground, the better electrical performance will be. But dedicating pins to ground reduces signal density of a connector. So care must be taken when choosing signal/ground ratios in cost- or density-sensitive applications.

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For this connector, the following configurations were evaluated:

Single-Ended Impedance:
- GSG (ground-signal-ground)

Single-Ended Crosstalk:
- Electrical "worst case": GAQG (ground-active-quiet-ground)
- Electrical "best case": GAGQG (ground-active-ground-quiet-ground)
- Across row: $Xrow^{se}$ (from one row of terminals to the other row or across the ground blade when applicable)

Differential Impedance:
- GSSG (Ground-positive signal-negative signal-ground)

Differential Crosstalk:
- Electrical "worst case": GAAQQG (ground-active-active-quiet-quiet-ground)
- Electrical "best case": GAAGQQG (ground-active-active-ground-quiet-quiet-ground)
- Across row:$Xrow^{diff}$ (from one row of terminals to the other row or across the ground blade when applicable) (ground-active-active-static-static-ground) across the row of terminals to (ground-quiet-quiet-ground)

In all cases where a center ground blade is present in the connector it is always grounded to the PCB. Only one single-ended signal or differential pair was driven for crosstalk measurements.

Other configurations can be evaluated upon request. Please contact sig@samtec.com for more information.

In a real system environment, active signals might be located at the outer edges of the signal contacts of concern, as opposed to the ground signals utilized in laboratory testing. For example, in a single-ended system, a pin-out of "SSSS", or four adjacent single ended signals, might be encountered, as opposed to the "GSG" and "GSSG" configurations tested in the laboratory. Electrical characteristics in such applications could vary slightly from laboratory results. But in most applications, performance can safely be considered equivalent.

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Signal Edge Speed (Rise Time):
In pulse signaling applications, the perceived performance of an interconnect can vary significantly depending on the edge rate or rise time of the exciting signal. For this report, the fastest rise time used was 30 +/-5 ps. Generally, this should demonstrate worst case performance.

In many systems, the signal edge rate will be significantly slower at the connector than at the driver launch point. To estimate interconnect performance at other edge rates, data is provided for several rise times between 30 ps and 1.0 ns.

For this report, rise times were measured at 10%-90% signal levels.

Frequency Domain Data

Frequency domain parameters are helpful in evaluating the connector system's signal loss and crosstalk characteristics across a range of sinusoidal frequencies. In this report, parameters presented in the frequency domain are insertion loss, return loss, and near-end and far-end crosstalk. Other parameters or formats, such as VSWR or S-parameters, may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

Frequency performance characteristics for the SUT are generated from time domain measurements using Fourier Transform calculations. Procedures and methods used in generating the SUT's frequency domain data are provided in the frequency domain test procedures in Appendix E of this report.

Time Domain Data

Time Domain parameters indicate impedance mismatch versus length, signal propagation time, and crosstalk in a pulsed signal environment. Time Domain data is provided in Appendix E of this report. Parameters or formats not included in this report may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

Reference plane impedance is 50 ohms for single-ended measurements and 100 ohms for differential measurements. The fastest risetime signal exciting the SUT is 30 ± 5 picoseconds.

In this report, propagation delay is defined as the signal propagation time through the PCB connector pads and connector pair. It does not include PCB traces. Delay is measured at 30 ± 5 picoseconds signal risetime. Delay is calculated as the difference in time measured between the 50% amplitude levels of the input and output pulses.

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Crosstalk or coupled noise data is provided for various signal configurations. All measurements are single disturber. Crosstalk is calculated as a ratio of the input line voltage to the coupled line voltage. The input line is sometimes described as the active or drive line. The coupled line is sometimes described as the quiet or victim line. Crosstalk ratio is tabulated in this report as a percentage. Measurements are made at both the near-end and far-end of the SUT.

Data for other configurations may be available. Please contact our Signal Integrity Group at sig@samtec.com for further information.

As a rule of thumb, 10% crosstalk levels are often used as a general first pass limit for determining acceptable interconnect performance. But modern system crosstalk tolerance can vary greatly. For advice on connector suitability for specific applications, please contact our Signal Integrity Group at sig@samtec.com.

Additional information concerning test conditions and procedures is located in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

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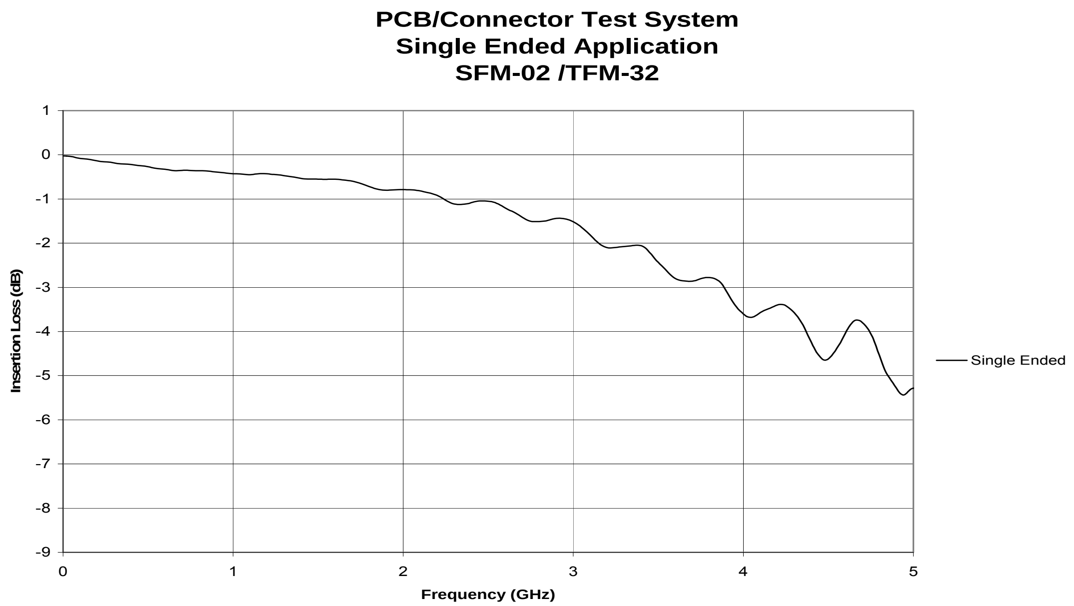
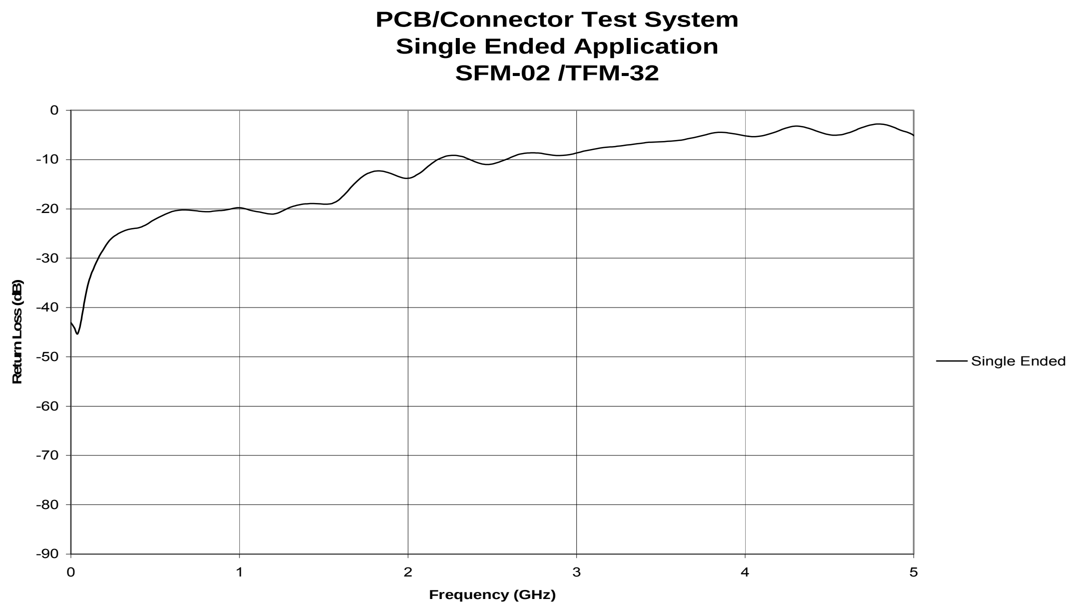
Appendix A – Frequency Domain Response Graphs

Single-Ended Application – Insertion Loss



Single-Ended Application – Return Loss



Series: SFM/TFM
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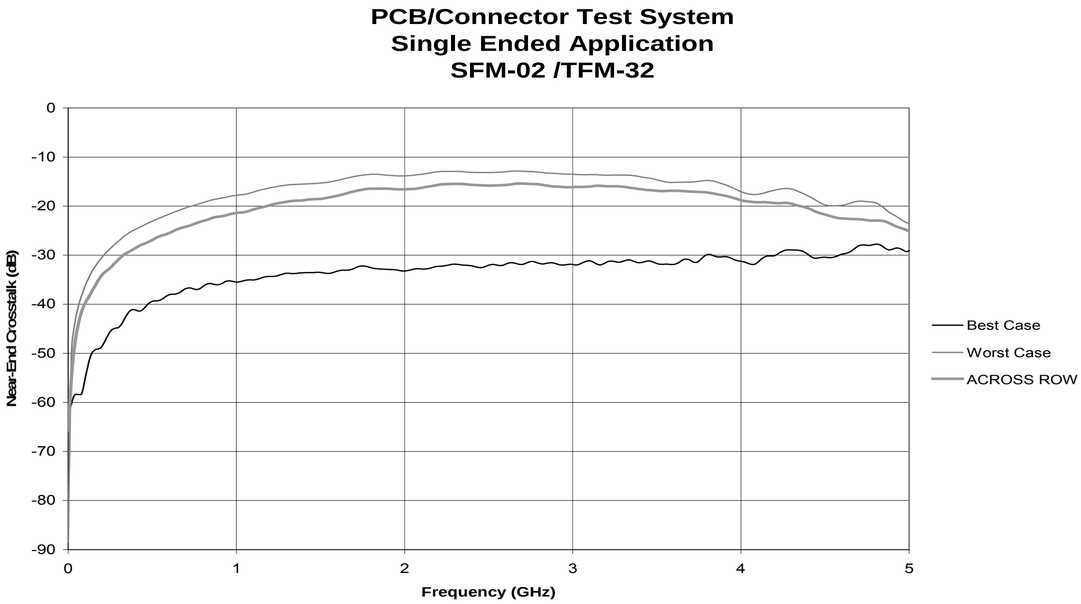
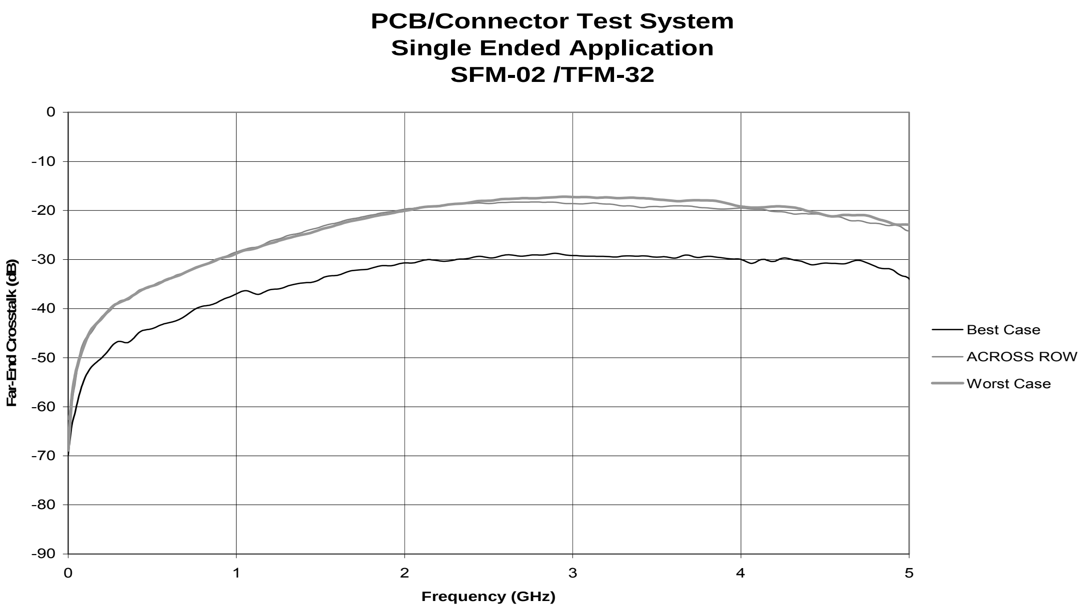
Single-Ended Application – NEXT

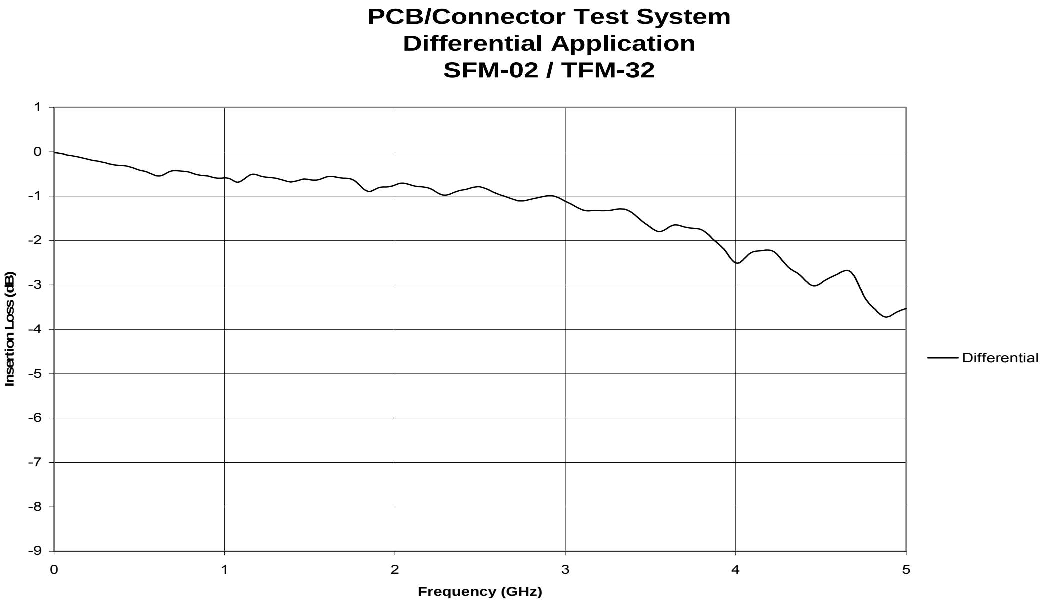


Single-Ended Application – FEXT

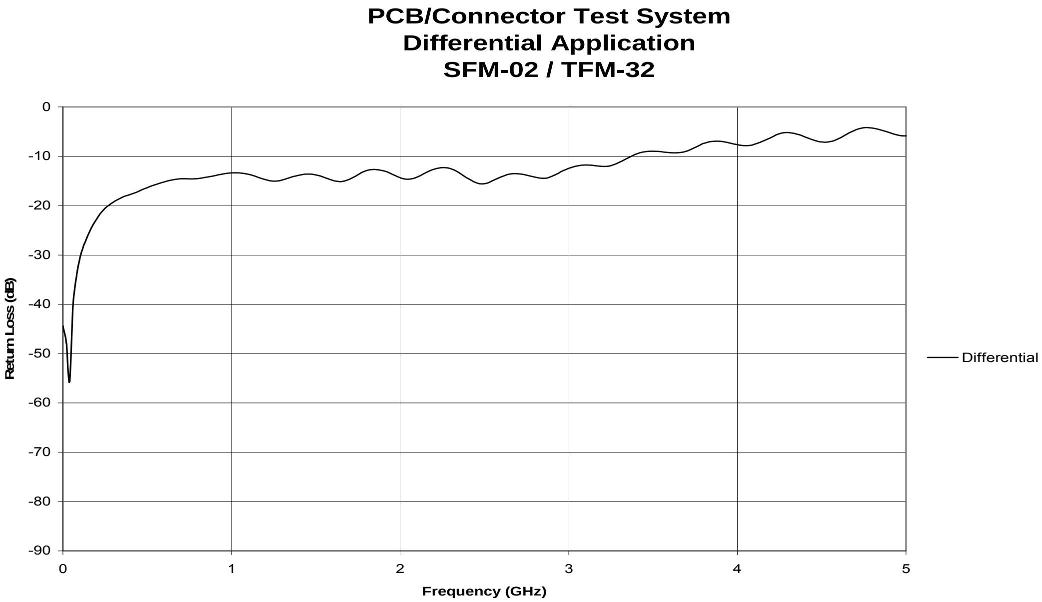


Series: SFM/TFM
Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

Differential Application – Insertion Loss

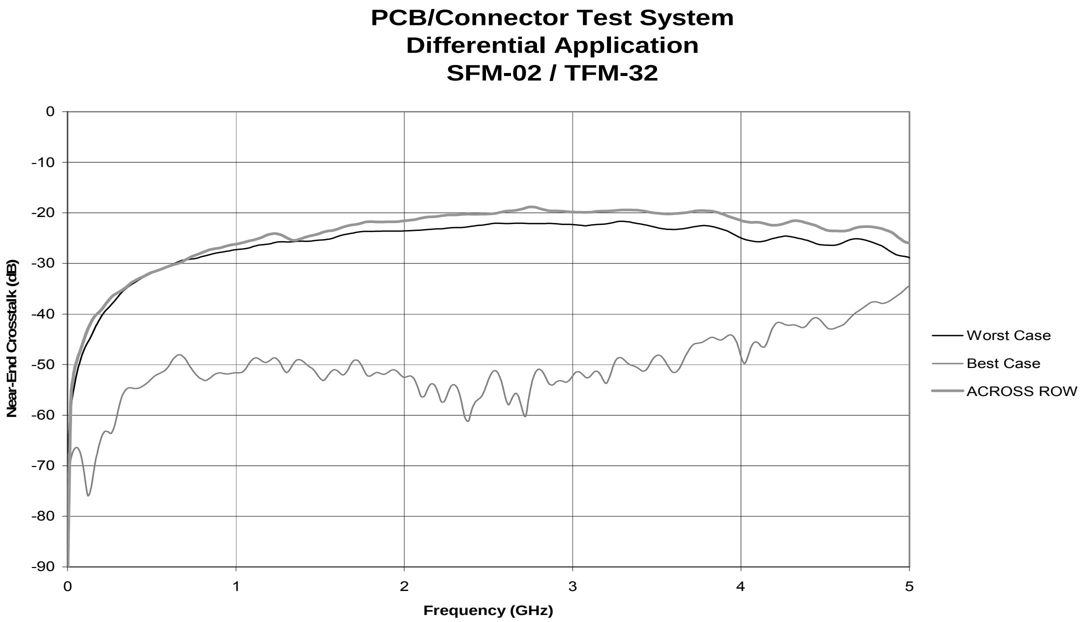


Differential Application – Return Loss

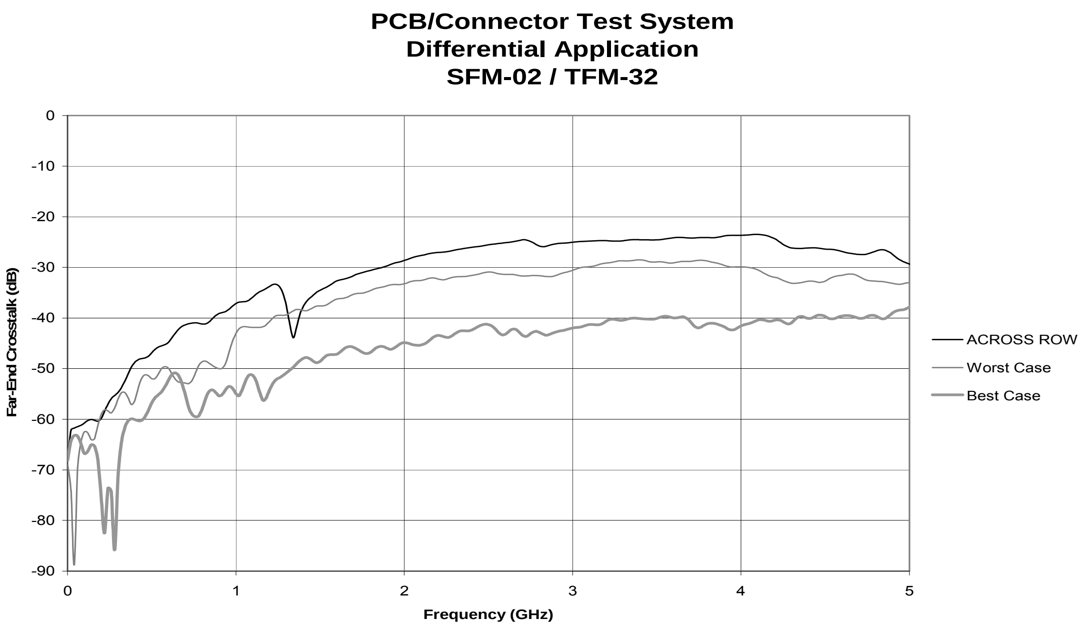


Series: SFM/TFM
Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465") Stack Height

Differential Application – NEXT



Differential Application – FEXT



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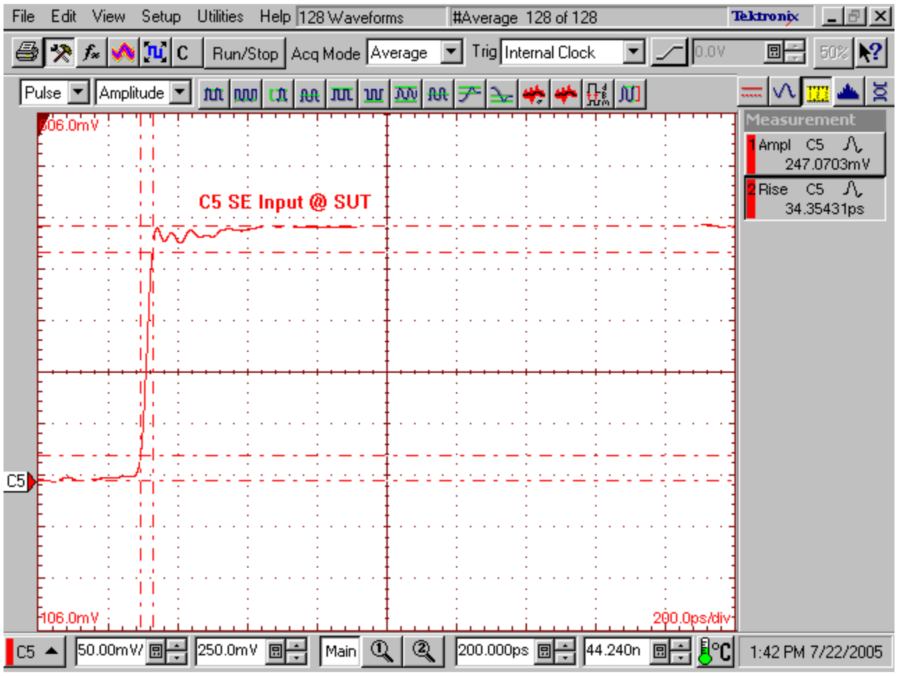
Appendix B – Time Domain Response Graphs

Single-Ended Application – Input Pulse



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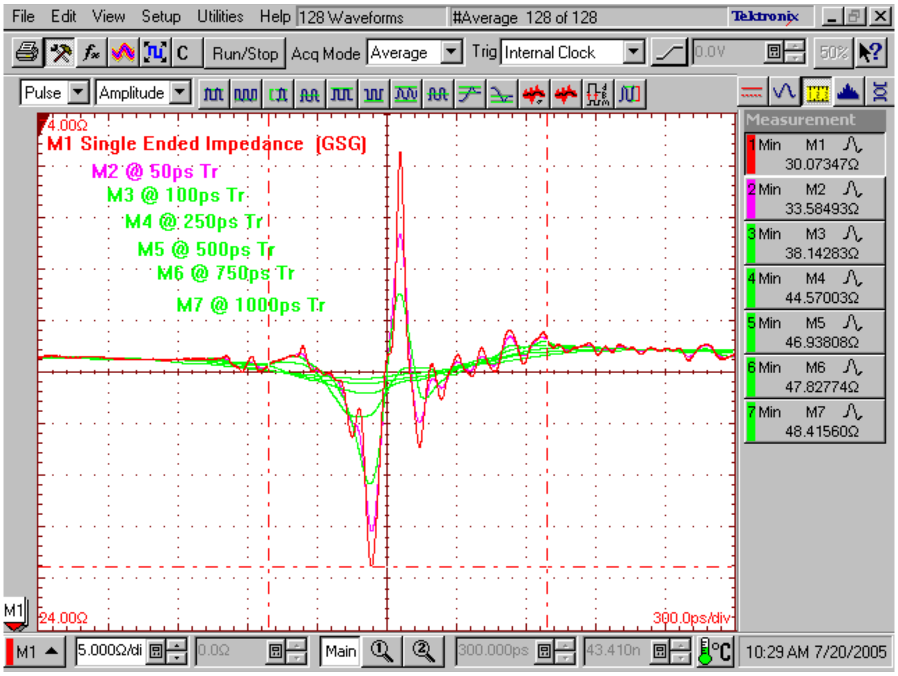
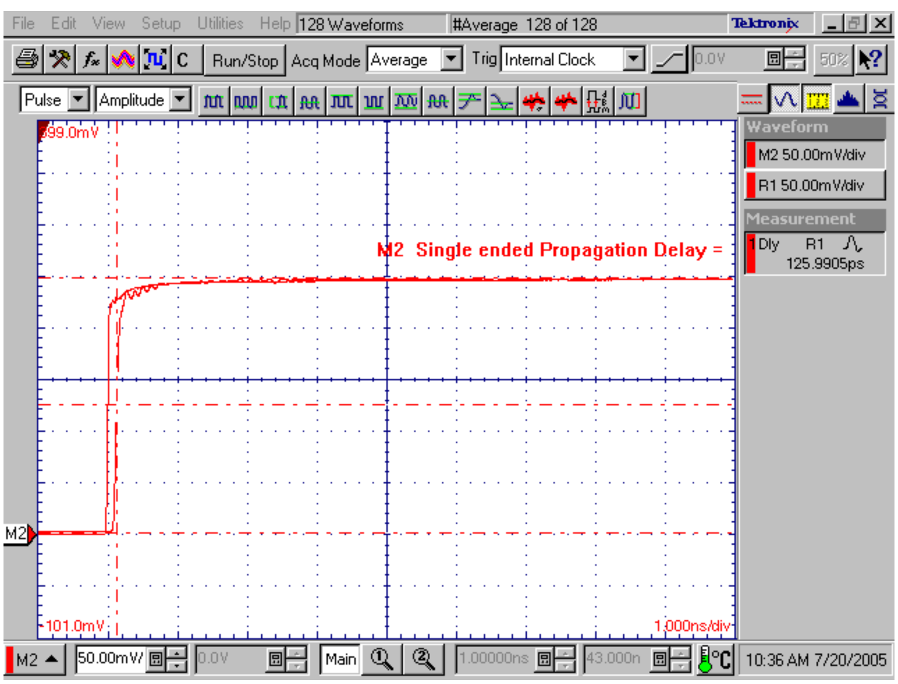
Single-Ended Application – Impedance



Single-Ended Application – Propagation Delay



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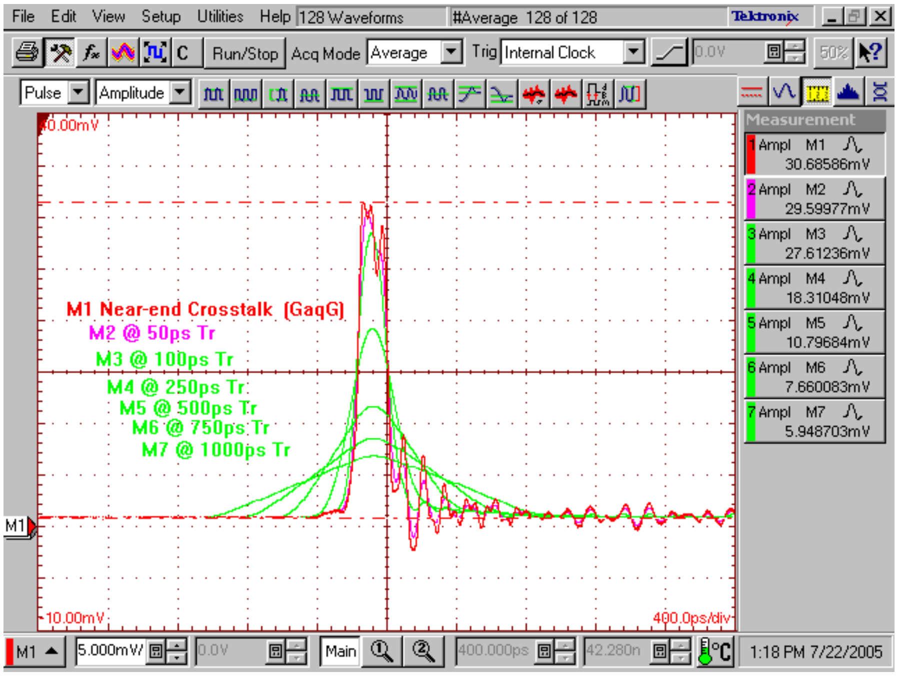
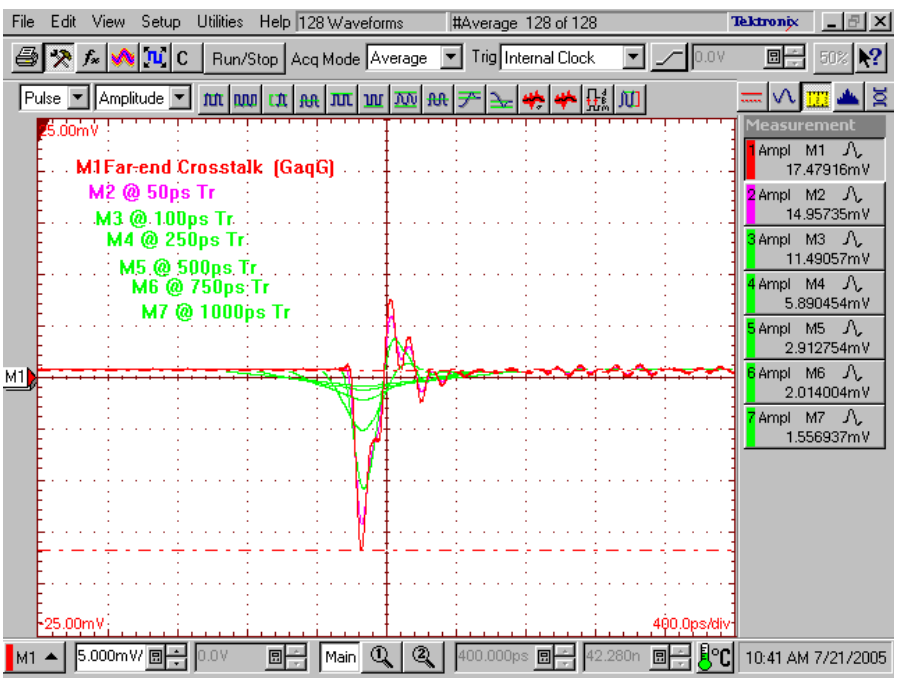
Single-Ended Application – NEXT, “Worst Case In Row” Configuration



Single-Ended Application – FEXT, “Worst Case In Row” Configuration



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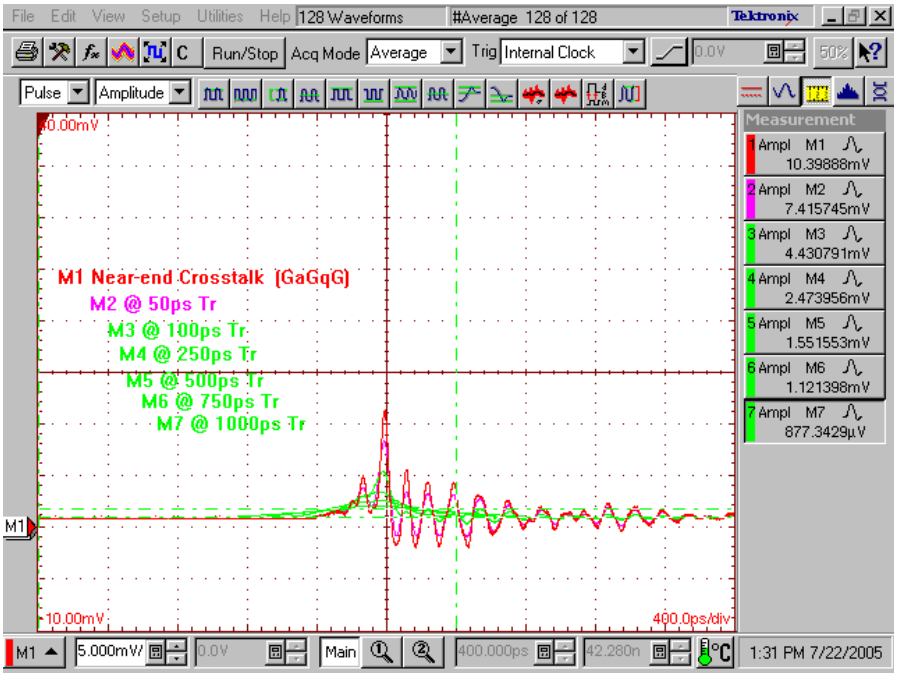
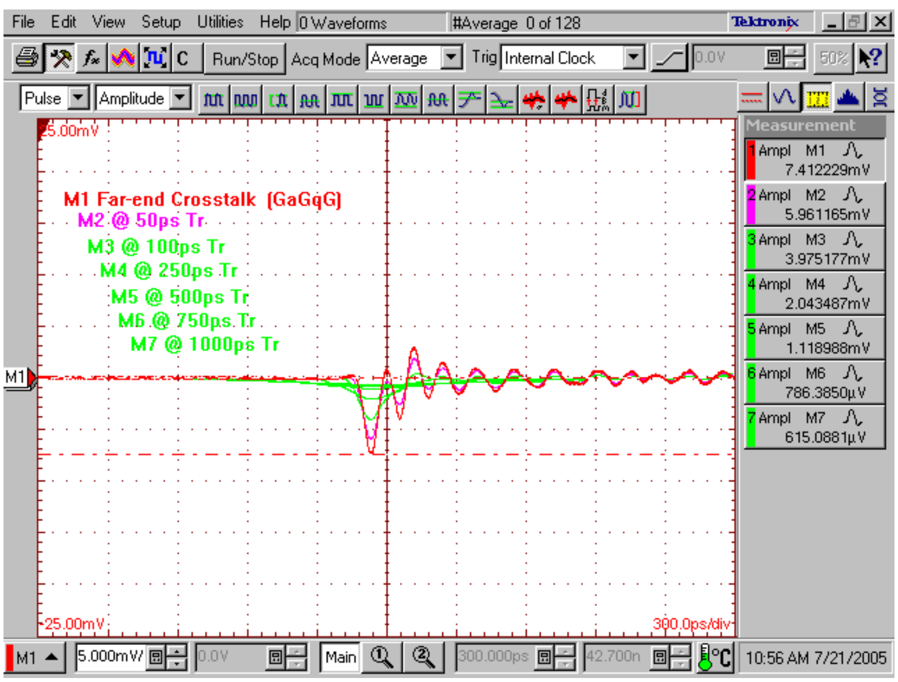
Single-Ended Application – NEXT, “Best Case In Row” Configuration

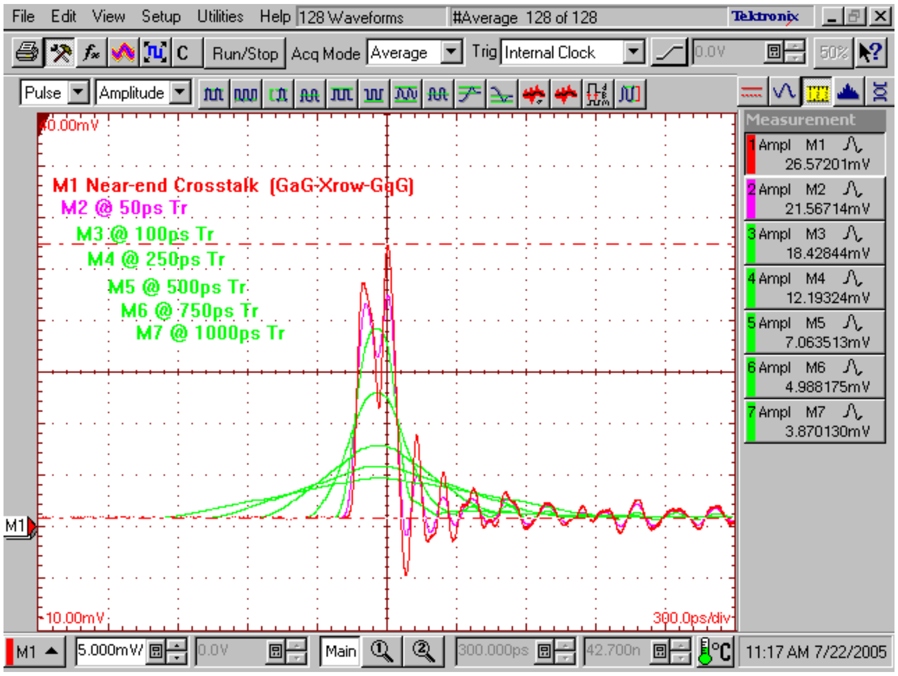


Single-Ended Application – FEXT, “Best Case In Row” Configuration

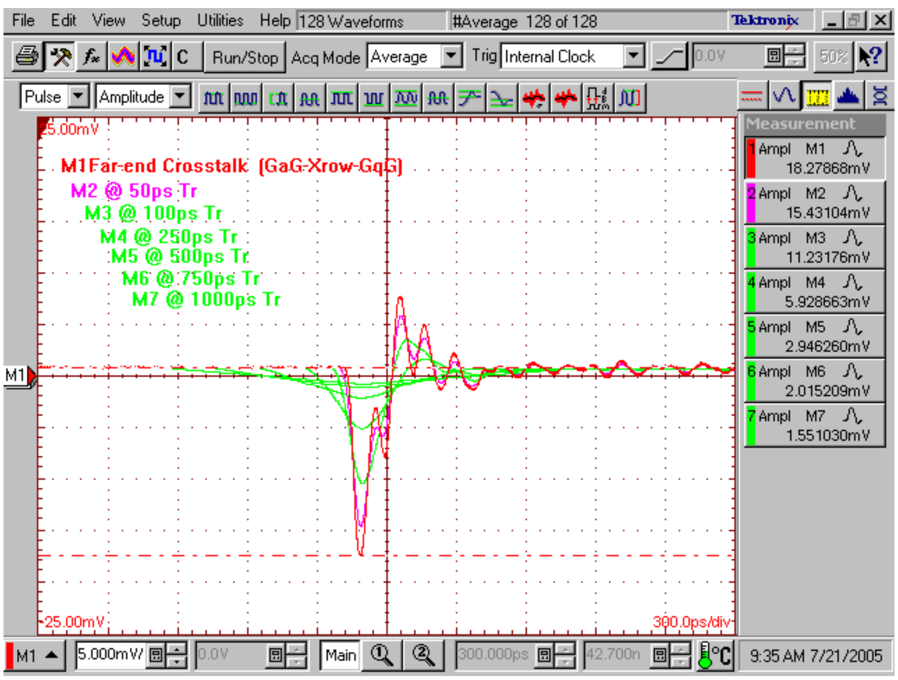


Series: SFM/TFM
Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

Single-Ended Application – NEXT, “Across Row” Configuration

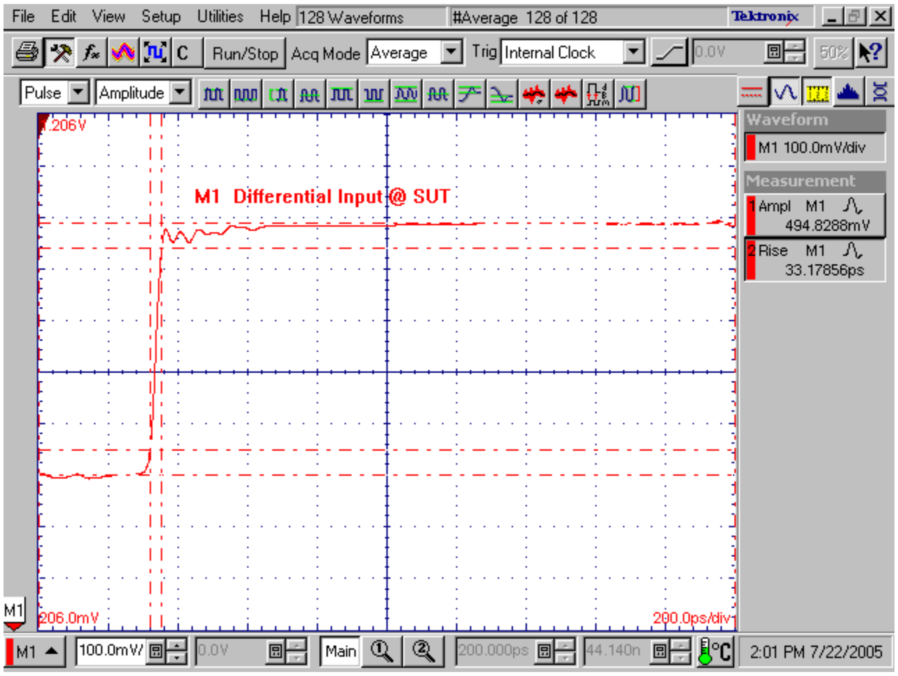


Single-Ended Application – FEXT, “Across Row” Configuration



Series: SFM/TFM
Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465") Stack Height

Differential Application – Input Pulse



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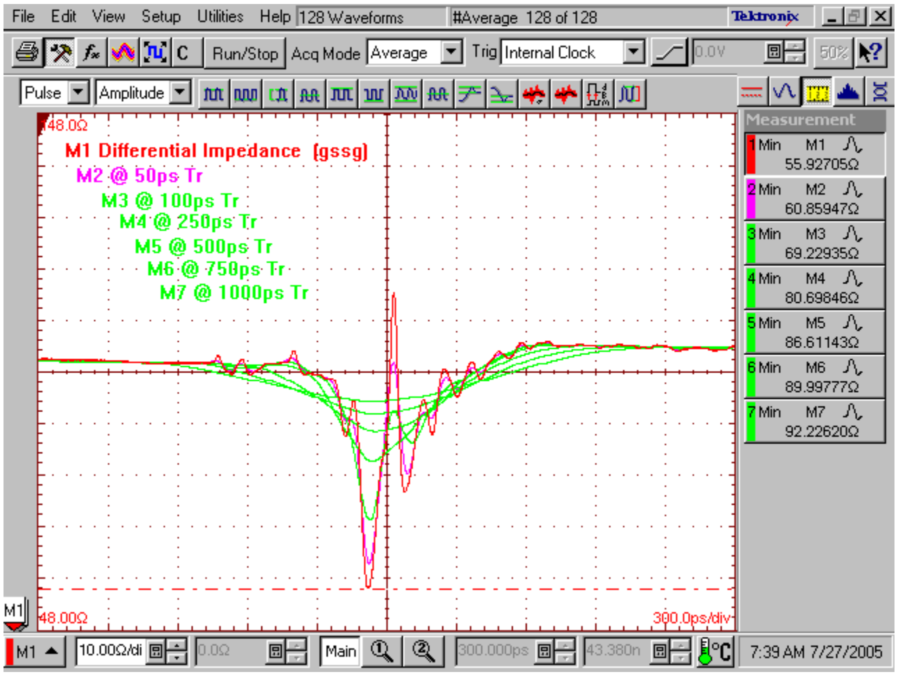
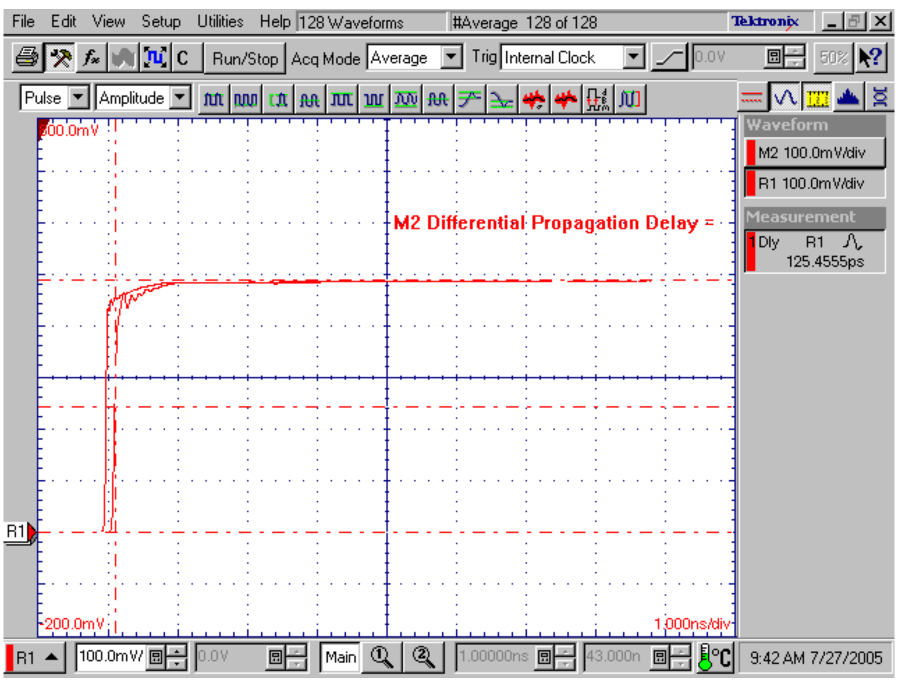
Differential Application – Impedance



Differential Application – Propagation Delay



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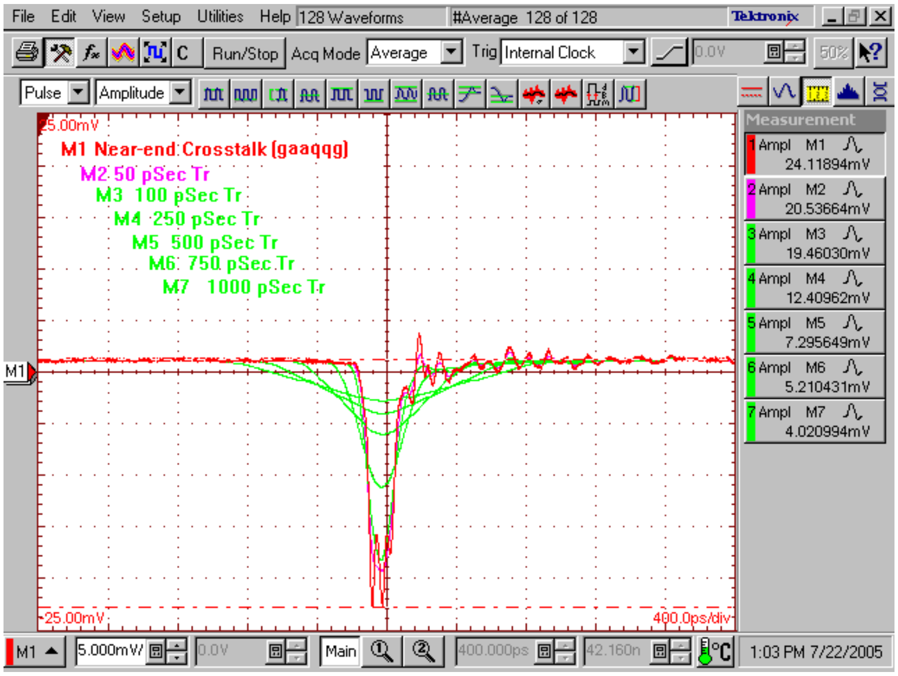
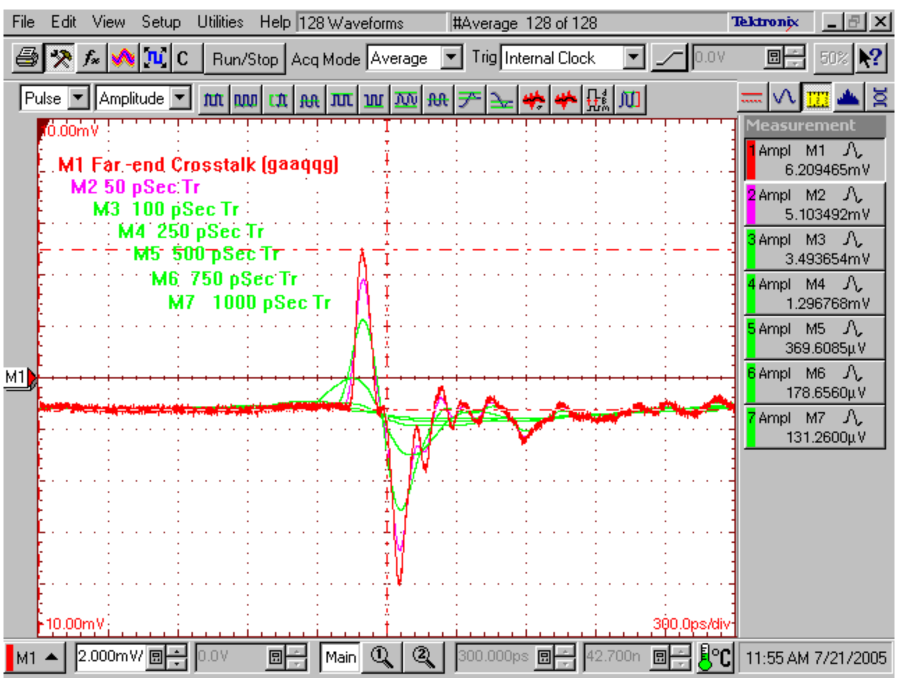
Differential Application – NEXT, "Worst Case In Row " Configuration



Differential Application – FEXT, "Worst Case In Row" Configuration



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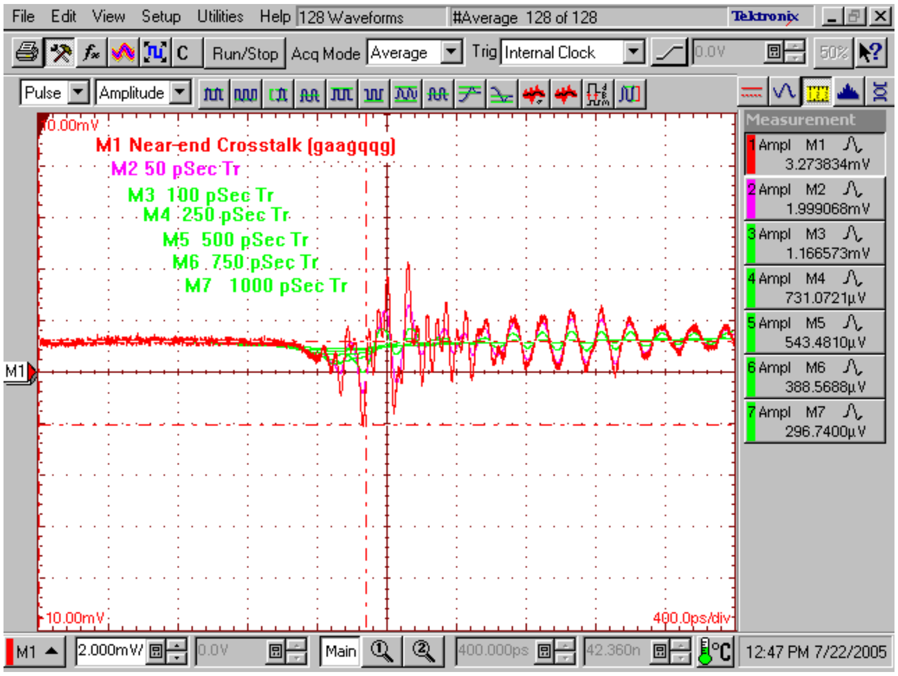
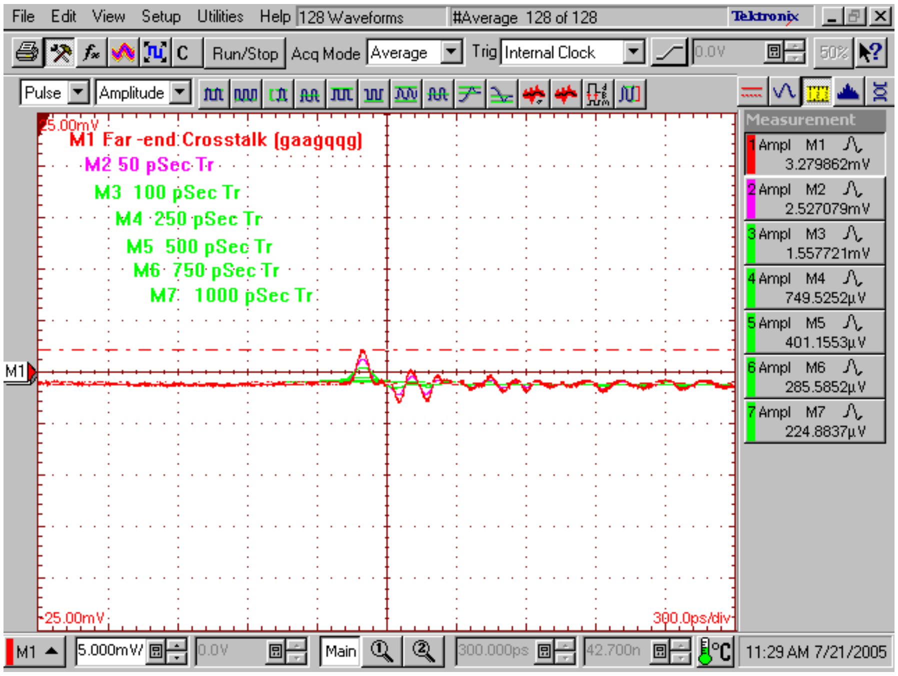
Differential Application – NEXT, "Best Case In Row" Configuration



Differential Application – FEXT, "Best Case In Row" Configuration



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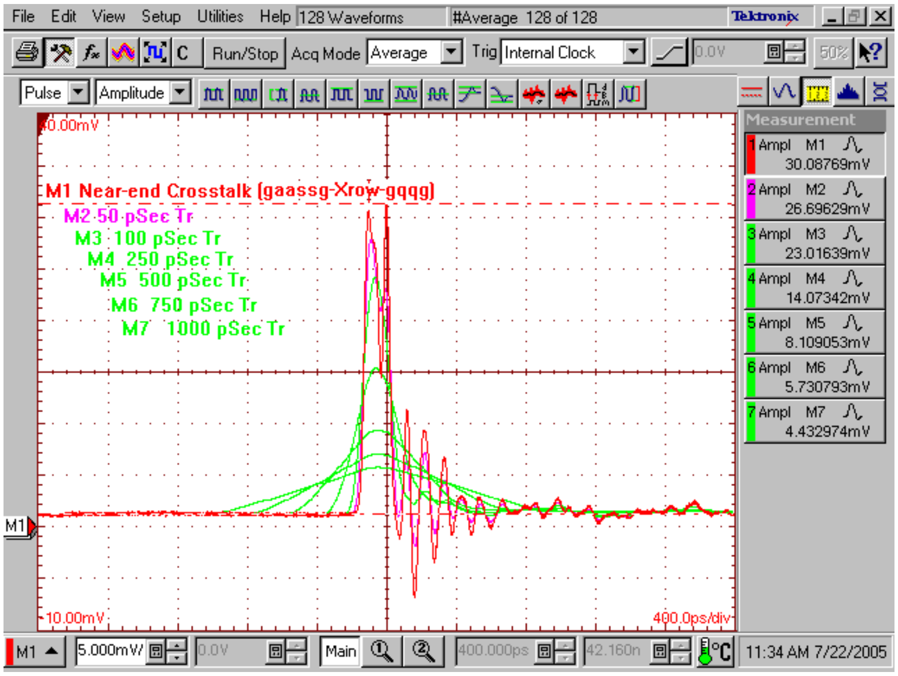
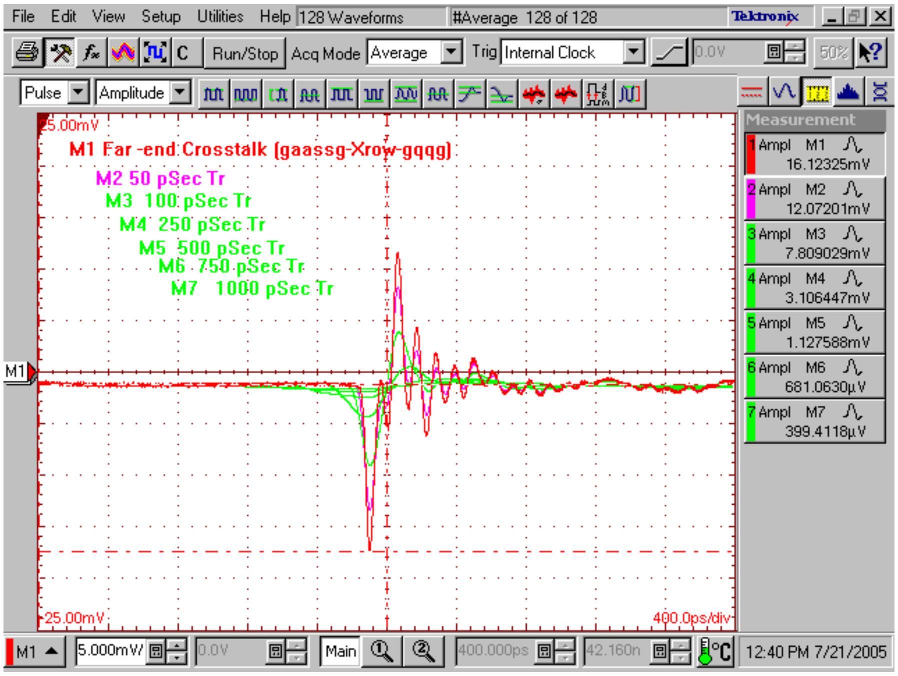
Differential Application – NEXT, “Across Row” Configuration



Differential Application – FEXT, “Across Row” Configuration



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Appendix C – Product and Test System Descriptions

Product Description

Product samples are surface mount SFM-115-02-S-D & SFM-130-02-S-D micro sockets. Mating micro terminal samples are the TFM-115-32-S-D & TFM-130-32-S-D respectively. Once mated a board-to-board stack height of 11.81mm (0.465”) exists between boards

Each connector structure consists of 2 rows of 15 or 30 positions mounted into a plastic housing with a surface mount design. The contacts are evenly spaced at a 1.27mm (.050”) pitch

Test System Description

The test fixtures are composed of a 4-layer FR-4 material with 50Ω and100Ω signal trace and pad configurations designed for the electrical characterization of Samtec hi-speed connector products. The pictured fixtures are specific to the SFM/TFM surface mount series connector and are identified by Samtec P/N PCB-100276-TST-01 and P/N PCB-100276-TST-02 (Figure 1)

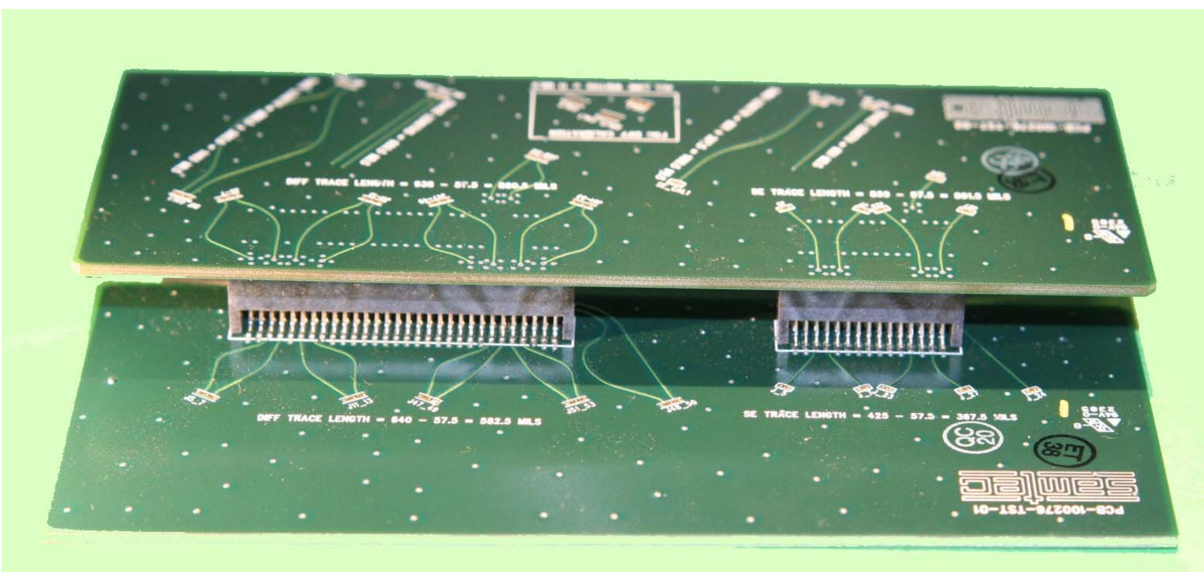

Figure 1 Mated PCB Test Fixture with Mounted Test Connectors

PCB-100276-TST-02 (Figure 1, top pcb) is designated as the test signal launch board. and contains the two SFM socket series connectors. The 15 signals/row connector is used in characterizing single ended (GSG) test signals and the 30 signals/row connect-

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or is used to characterize differential test signals(GSSG). PCB-100276-TST-02 also provides the reference plane and/or calibration standards used in generating time delay and s-parameter information. Test fixture PCB-100276-TST-01 contains the mating TFM terminal connectors (Figure 1, bottom pcb) and is the main signal monitoring section of the fixture. When the two board fixtures are mated labeled probe points coordinate to create continuous electrical transmission paths between the signal launch pads and monitoring junctions. Both the single-ended and differential fixtures “J” number represent each signal terminal’s designated position within the connector. Signals can also be launched from the header side of the connector but the response may not necessarily correlate with a socket side launch All data and waveforms presented in the report are results from a socket side signal launch. Table 8 below identifies the launch, monitoring and adjacent line termination points used in generating characterization data for this report.

Table 8 – PCB Fixture Characterization & Termination Matrix

	Single Ended				Differential			
	Launch	Monitor	50Ω to Gnd. Termination		Launch	Monitor	100Ω across Sig. Pair Termination	
USE PCB	**TST-02**	**TST-01**	**TST-01**	**TST-02**	**TST-02**	**TST-01**	**TST-01**	**TST-02**
IL, RL Z, PD	J27	J_27	J23 J24	J_23 J_24	J11-13	J11_13	J5_7	J5-7
USE PCB	**TST-02**	**TST-02**	**TST-01**	**TST-02**	**TST-02**	**TST-02**	**TST-01**	**TST-02**
NEXT(worst)	J7	J5	J_5 J_7		J51-53	J47-49	J51_53,J47_49 J48_50	J48-50
NEXT(best)	J27	J23	J_23,J_27 J_24	J24	J11-13	J5-7	J5_7, J11_13,	
NEXT(xrow)	J27	J24	J_23,J_27 J_24	J23	J47-49	J48-50	J51_53,J47_49 J48_50	J51-53
USE PCB	**TST-02**	**TST-01**	**TST-01**	**TST-02**	**TST-02**	**TST-01**	**TST-01**	**TST-02**
FEXT(worst)	J7	J_5	J_7	J_5	J51-53	J47_49	J48_50 J51_53	J48-50 J47-49
FEXT(best)	J27	J_23	J_27 J_24	J23 J24	J11-13	J5_7	J5-7,	J11_13
FEXT(xrow)	J27	J_24	J_23 J_27	J23 J24	J48-50	J47_49	J51_53 J48_50	J47-49 J51-53

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Signal Conditioning, Calibration Standards And Signal Launch/Monitoring

Figure 2 represents the layout of the footprint, connector and signal trace transitions where exact test signal configuration conditions can be determined. In general these GSG or GSSG conditions are spelled out in the characterization details section of this report. However, the geometry and signal conditioning surrounding the actual test points are not detailed and should not be assumed to have non-aggressive or response changing attributes. This graphic depicts the actual test conditions, calibration standards, and reference traces used in characterizing the SFM/TFM connector series presented in this report

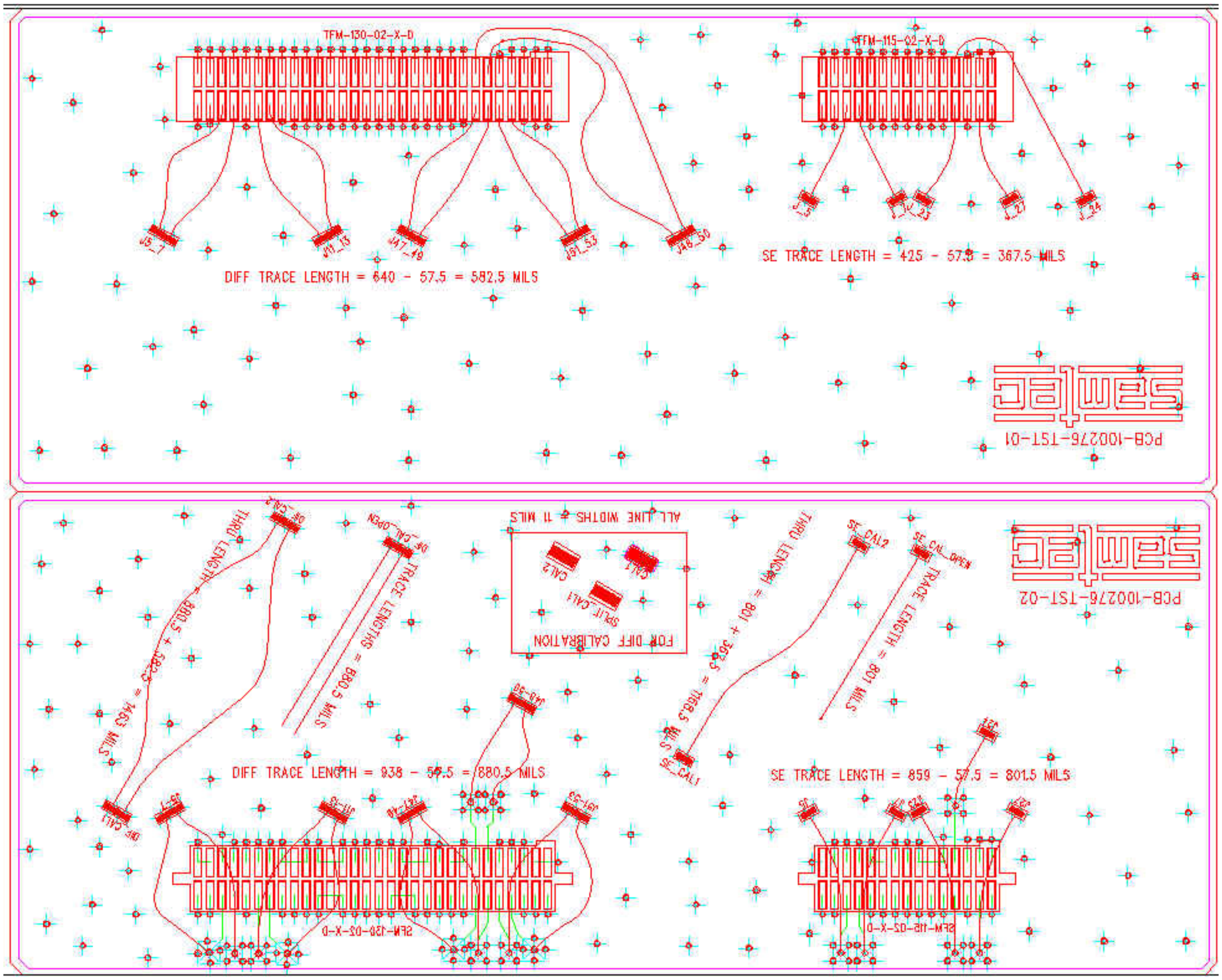

Figure 2 Signal Conditioning, Calibration Standards And Signal Launch/Monitoring Map

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Appendix D – Test and Measurement Setup

Test instruments are a Tektronix CSA8000 Communication Signal Analyzer Mainframe and the Agilent 8720ES Vector Network Analyzer. Four bays of the CSA8000 are occupied with three Tektronix 80E04 TDR/Sampling Heads and one Tektronix 80E03 Sampling Head. For this series of tests, four of the eight TDR/Sampling Head capability is used *(Figure 3)*. The 8720ES serves as a supporting test instrument for verification or troubleshooting results obtained from the TDA Systems IConnect Software package. IConnect is a TDR based measurement software tool used in generating frequency domain related responses from high speed interconnects.

The probe stations illuminated video microscopy system, microprobe positioners, and 40GHz capable probes provide both the mechanical properties and electrical characteristics for obtaining the precise signal launch and calibrations that are critical in obtaining accurate high speed measurements. The 450 micron pitch probes are located to PCB launch points with 25X to 175X magnification and XYZ fine positioning adjustments available from both the probe table and micro-probe positioners. Electrically the microwave probes rate a < 1.0 dB insertion loss, a < 18 dB return loss, and an isolation of 38 dB to 40 GHz *(Figure 4)*. Test cables and interconnect adapters are high quality and insure high-bandwidth and low parasitic measurements.

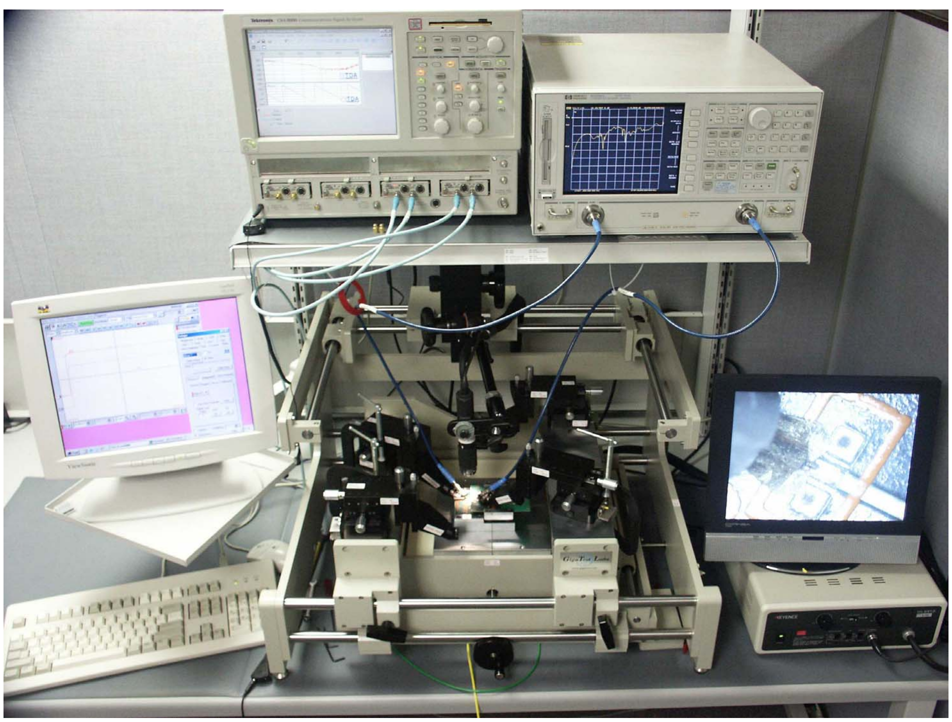

Figure 3– Probe Station Measurements Capability

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Test Instruments

QTY	Description
1	Tektronix CSA8000 Communication Signal Analyzer
3	Tektronix 80E04 Dual Channel 20 GHz TDR Sampling Module
1	Tektronix 80E03 Dual Channel 20 GHz Sampling Module
1	Agilent 8720ES Vector Network Analyzer, 50 MHz to 20 GHz

Measurement Station Accessories

QTY	Description
1	GigaTest Labs Model (GTL3030) Probe Station
4	GTL Micro-Probe Positioners
2	Picoprobe by GGB Ind. Model 40A GSG (single ended applications)
2	Picoprobe by GGB Ind. Dual Model 40A GSG-GSG (differential applications)
1	Keyence VH-5910 High Resolution Video Microscope
1	Keyence VH-W100 Fixed Magnification Lens 100 X
1	Keyence VH-Z25 Standard Zoom Lens 25X-175X
1	CS-9 GSG Picoprobe Calibration Substrate (U9450.sq)
1	CS-11 GS-SG Picoprobe Calibration Substrate (U11450.sq)

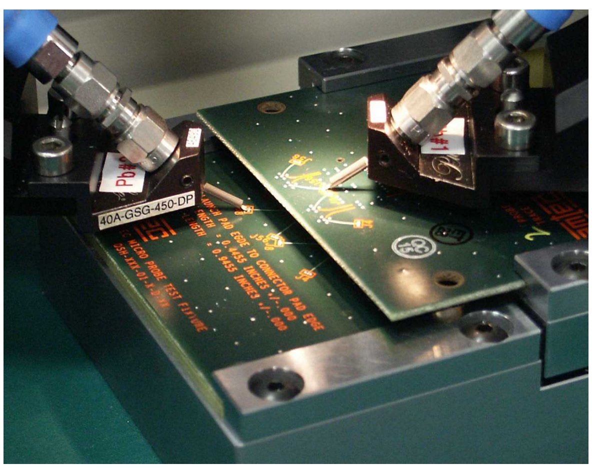

Figure 4 – 40 GHz High Performance Microwave Probes

Test Cables & Adapters

QTY	Description
4	Micro-Coax Cable Assembly 48” 3.5mm Male to 3.5mm Female, 26.5 GHz (IL = .33 dB@ 10 GHz)
2	Huber-Suhner Cable Assembly 36” SMA Female to SMA Female 26.5 GHz (IL = .34 dB @ 10 GHz)
4	Pasternack Precision Adapters, 3.5 mm Male to 2.9(K) Male, Max.VSWR 1.25 @ 34GHz

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Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

Appendix E - Frequency and Time Domain Measurements

It is important to note before gathering measurement data that TDA Systems IConnect measurements and CSA8000 measurements are virtually the same measurements with diverse formats. This means that the operator, being extremely aware, can obtain SI time and frequency characteristics in an almost simultaneous fashion.

Since IConnect setup procedures are specific to the frequency information sought, it is mandatory that the sample preparation and CSA8000 functional setups be consistent throughout the waveform gathering process. If the operators test equipment permits recall sequencing between the various test parameter setups, it insures IConnect functional setups remain consistent with the TDR/TDT waveforms previously recorded. Related time and frequency test parameter data recorded for this report were gathered simultaneously.

Frequency (S-Parameter) Domain Procedures

Frequency data extraction involves two steps that first measure the frequency related time domain waveform followed by post-processing of the time domain waveforms into loss and crosstalk response parameters versus frequency. The first step utilizes the Tektronix CSA8000 time based instrument to capture frequency related single-ended or differential signal types propagating through an appropriately prepared SUT. The second step involves a correlation of the time based waveforms using the TDA Systems IConnect software tool to post-process these waveforms into frequency response parameters. TDA Systems labels these frequency related waveform relationships as the *Step* and *DUT* reference. This report establishes the setup procedures for defining the *Step* and *DUT* reference for frequency parameters of interest. Once established, the *Step* and *DUT* references are post-processed in IConnect’s S-parameter computations window.

CSA8000 Setup

Listed below are the CSA 8000 functional menu setups used for single-ended and differential frequency response extractions. Both signal types utilize I-Connect software tools to generate S-parameter upper and lower frequency boundaries along with the step frequency. These frequency boundaries are determined by a time domain instruments functional settings such as window length, number of points and averaging capability. Once window length, number of points and averaging functions are set, maintain the same instrument settings throughout the extraction process.

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	Single-Ended Signal	Differential Signal
Vertical Scale:	100 mV/ Div:	100 mV/ Div:
Offset:	Default / Scroll	Default / Scroll
Horizontal Scale:	1nSec/ Div = 20 MHz step frequency	1nSec/ Div = 20 MHz step frequency
Max. Record Length:	4000 = Min. Resolution	4000 = Min. Resolution
Averages:	≥ 128	≥ 128

Insertion Loss

SUT Preparation - For signal launch and monitoring path guidelines reference table 8. Terminate all the suggested active or adjacent signal lines at the impedance values recommended in the table. Signal trace locations and configurations can be verified using figure 2.

Step Reference - Establish this waveform by making a TDT transmission measurement that includes all cables, adapters, and probes connected in the test systems transmission path. The transmission path is completed by inserting a negligible length of transmission standard between the microwave probes. *(**Note:** Use the split-cal1 standard in TDT mode located on Samtec PCB100260-TST-02 fixture).*

DUT Reference - Establish these waveforms by making an active TDT transmission measurement that includes all cables, adapters, and probes connected in the test systems transmission path. Insert the SUT between the probes in place of the transmission standard and record the measurement.

Return Loss

SUT Preparation – For signal launch and monitoring path guidelines reference table 8. Terminate all the suggested active or adjacent signal lines at the impedance values recommended in the table. Signal trace locations and configurations can be verified using figure 2.

Step Reference - Establish the waveform by making an active TDR reflection measurement that includes all cables, adapters, and probes connected in the test systems electrical path up to and including an open standard. *(**Note:** Use split-cal1 standard in TDR mode located on Samtec PCB100260-TST-02 fixture).*

DUT Reference – Retain same signal paths and test setup used in obtaining insertion loss waveforms. Establish these waveforms by making a TDT (matched) reflection measurement that includes all cables, adapters, and probes connected in the test systems transmission path. For this condition the quality cables and adapters located on

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the far-end of the inserted SUT serves as the resistive load impedance closely matching the test system input impedance of 50Ω single-ended and100Ω differential.

Near-End Crosstalk (NEXT)
SUT Preparation – For signal launch and monitoring path guidelines reference table 8. Terminate all the suggested active or adjacent signal lines at the impedance values recommended in the table. Signal trace locations and configurations can be verified using figure 2.

Step Reference - Establish these waveforms by making an active measurement that includes all cables, adapters, and probes connected in the test systems electrical path up to and including an open standard. ***(Note:** Use split-cal1 standard in TDR mode located on Samtec PCB100260-TST-02 fixture).*

DUT Reference - Establish these waveforms by driving the suggested signal line and monitoring the TDR coupled energy at the adjacent near-end signal line. Establish {6} measurement waveforms of worst case, best case and across row (xrow) coupling conditions for both signal types.

Far-End Crosstalk (FEXT)
SUT Preparation - For signal launch and monitoring path guidelines reference table 8. Terminate all the suggested active or adjacent signal lines at the impedance values recommended in the table. Signal trace locations and configurations can be verified using figure 2.

Step Reference - Establish these waveforms by making a TDT transmission measurement that includes all cables, adapters, and probes connected in the test systems transmission path. The transmission path is completed by inserting a negligible length of transmission standard ***(Note:** Use the split-cal1 standard in TDT mode located on Samtec PCB100260-TST-02 fixture).*

DUT Reference - Establish these waveforms by driving the suggested signal line and monitoring the TDR coupled energy at the adjacent near-end signal line. Establish {6} measurement waveforms of worst case, best case and across row (xrow) coupling conditions for both signal types.

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Description: Micro Board-to-Board, 1.27mm Pitch, 11.81mm (0.465”) Stack Height

Time Domain Procedures

Measurements involving digital type pulses are performed utilizing either Time Domain Reflectometer (TDR) or Time Domain Transmission (TDT) methods. For this series of tests, TDR methods are employed for the impedance and propagation delay measurements. Crosstalk measurements utilize TDT methods. The Tektronix 80E04 TDR/ Sampling Head provide both the signaling type and sampling capability necessary to accurately and fully characterize the SUT.

Impedance

The signal line(s) of the SUT’s signal configuration is energized with a TDR pulse. The far-end of the energized signal line is terminated in the test systems characteristic impedance (e.g.; 50Ω or 100Ω terminations). By terminating the adjacent signal lines in the test systems characteristic impedance, the effects on the resultant impedance shape of the waveform is limited. For signal launch and monitoring path guidelines reference table 8.

Propagation Delay

This connector series uses the fastest edge rate (30ps) of the TDR impedance waveform to measure propagation delay. . Differential or single ended signal delay is the measured difference of propagation between the known signal trace length delay *(reference PCB10026076-TST-02 thru lengths 1168.5 mils for single ended & 1463 mils for differential propagation delay measurements*) and the delay of a mated SUT. The measurement is a one-way propagation result. Termination of the adjacent signal lines into the test systems characteristic impedance eliminate alternate current paths providing for better measurement accuracy. For signal launch and monitoring path guidelines reference table 8.

Crosstalk

An active pulsed waveform is transmitted through a selected SUT signal line. The adjacent quiet signal lines are monitored for the coupled energy at the near-end and far-end. Active and quiet lines not being monitored are terminated in the test systems characteristic impedance. Signal lines adjacent to the quiet lines remain terminated on both ends throughout the test sequence. Failing to terminate the active near or far end, quiet lines, or in some cases, signal lines adjacent to the quiet line may have an effect on amplitude and shape of the coupled energy. For signal launch and monitoring path guidelines reference table 8.

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Appendix F – Glossary of Terms

BC – Best Case crosstalk configuration

DP – Differential Pair signal configuration

DUT – Device under test; TDA IConnect reference waveform

FEXT – Far-End Crosstalk

GSG – Ground–Signal-Ground; geometric configuration

NEXT – Near-End Crosstalk

PCB – Printed Circuit Board

SE – Single-Ended

SI – Signal Integrity

SUT – System under test

TDR – Time Domain Reflectometry

TDT – Time Domain Transmission

WC – Worst Case crosstalk configuration

$Xrow^{se}$ – Cross ground/ power bar crosstalk, single-ended signal

$Xrow^{diff}$ – Cross ground/ power bar crosstalk, differential signal

Z – Impedance (expressed in ohms)