

**Series:** QTH / QSH

**Description:** Parallel Board-to-Board, 0.5mm Pitch, 8mm (0.315") 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:  $X_{row}^{se}$  (from one row of terminals to the other row across the ground blade)

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:  $X_{row}^{diff}$  (from one row of terminals to the other row across the ground blade)

In all cases in this report, the center ground blade of the connector was 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](mailto: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](mailto: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](mailto: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](mailto: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](mailto: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](mailto:sig@samtec.com).