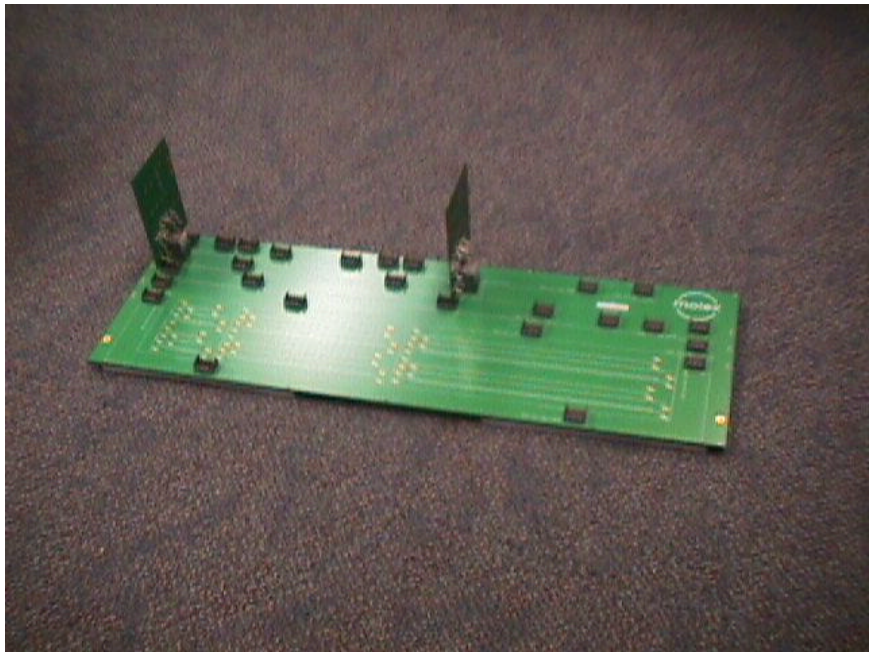
## GbX™ Reference Backplane

**Backplane Dimensions:**

- **38” x 13”**
- **0.225”**



**Layout and Design Overview**

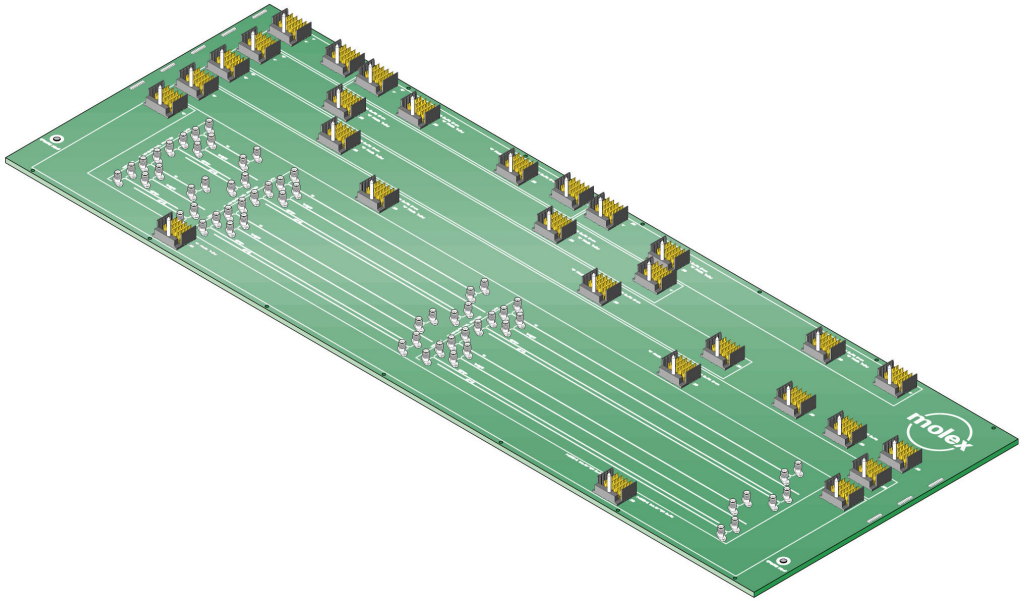
## GbX™ Reference Backplane

**Layout and Design Objectives:**

- **Develop test and demonstration vehicle containing representative CEI channel lengths.**
- **Maintain routing densities that are consistent with GbX™ connector column pitch.**
- **Allow 2.5 inches of channel length portion in each daughter card.**
- **Use good practice routing conventions that include significant stub lengths to exercise range of channel performance.**
- **Include channel-through-pinfield routing with option of routing active traffic on through-routed pinfields.**
- **Allow for signal stimulus and reception ports through both passive and active daughter cards.**

## Features:

- Molex GbX™ Reference Backplane is an OIF relevant test vehicle
- Molex GbX™ Reference Backplane contains 7 dedicated test lengths - Silicon-to-Silicon includes 8”, 15”, 20”, 25”, 30”, 1.0-meter and 1.25-meter channels
- 6+ Gbps operation with press-fit 5-pair GbX™ connector
- Built to accommodate active and passive daughter cards individually or in combination
- Each group length (except 8”) includes 8 distal lanes and 8 intermediate pass-through lanes – 8” group contains distal lanes only



**GbX™ Connector**

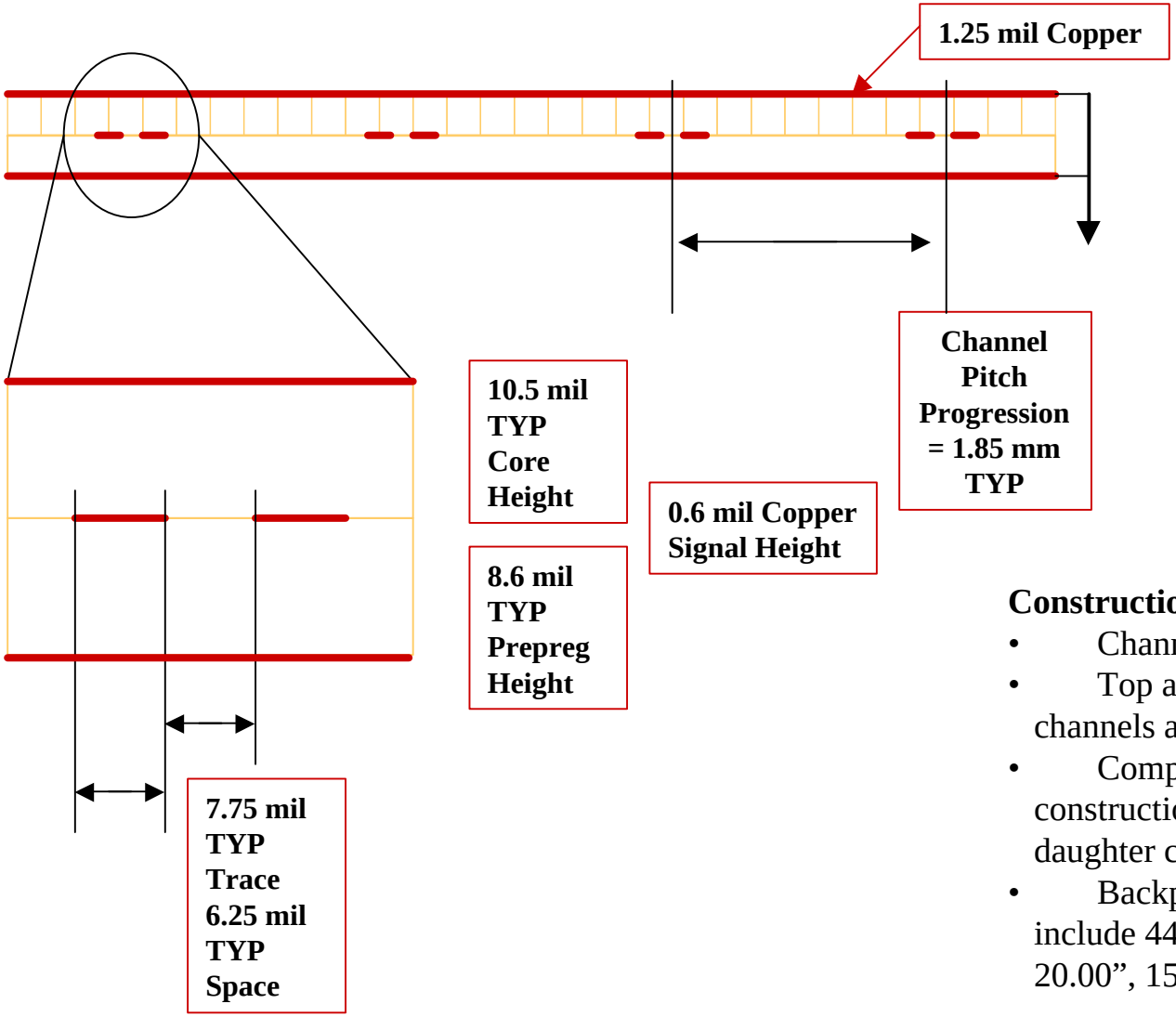
**Design Notes:**

- 5 – Pair GbX™ Daughter Card and Header assembly chosen for Reference Backplane.
- 69 pairs per inch available with column routing.
- Eye-of–the-needle compliant section is used for interface to PCB.
- Dual beam contacts are used in mating region.
- Connector is available with or without alignment guides.

| Layer No. | Material Type | Construction | Description / Dk ParkNelco Dk Values | Trace width/space/width | Region |
|---|---|---|---|---|---|
| | | | Soldermask / **3.20** | | |
| 1 | **Cu – ½ oz.** | **½ oz. + Plating** | | Top Gnd. | Top |
| | **N4000-13 SI** | 2 (2116) + 1 (2116) | Prepreg / **3.20** | | |
| 2 | **Cu – 1oz.** | | | G | |
| | **N4000-13 SI** | 1 (2116) + 1 (2116) | Core / 3.25 | | |
| 3 | **Cu – ½ oz.** | | | Diff. S1 7.75/6.25/7.75 | Moderately coupled |
| | **N4000-13 SI** | 2 (1080) + 1 (1080) | Prepreg / **3.15** | | |
| 4 | **Cu – 1oz.** | | | G | |
| | **N4000-13 SI** | 1 (2116) + 1 (2116) | Core / 3.25 | | |
| 5 | **Cu – ½ oz.** | | | Diff. S2 7.75/6.25/7.75 | Moderately coupled |
| | **N4000-13 SI** | 2 (1080) + 1 (1080) | Prepreg / **3.15** | | Top |
| 6 | **Cu – 1oz.** | | | G | Middle |
| | **N4000-13** | | Core / 3.65 | | |
| 7 | **Cu – ½ oz.** | | | Diff. S3 | |
| | **N4000-13** | | Prepreg / **3.57** | | |
| 8 | **Cu – 1oz.** | | | G | |
| | **N4000-13** | | Core / 3.81 | | |
| 9 | **Cu – ½ oz.** | | | Diff. S4 | |
| | **N4000-13** | | Prepreg / **3.31** | | |
| 10 | **Cu – 1oz.** | | | G | |
| Center | **N4000-13** | | Core / 3.85 | Central Core | Middle |

**Construction Notes:**

- Relative dielectric constant is per ParkNelco design guide and measured at 2.5 GHz.
- Top half of board construction is shown. Bottom half is mirrored below central core.
- Metal layer count is 20.
- Soldermask thickness is included in total overall thickness of 225 mils.




**Construction Notes:**

- Channels are edge-coupled.
- Top and bottom region channels are shown.
- Comparable channel construction is used in passive daughter card build.
- Backplane channel lengths include 44.21”, 34.37”, 25.00”, 20.00”, 15.00”, 10.00” and 3.00”.

## Transmit–to-Receive Pin Map

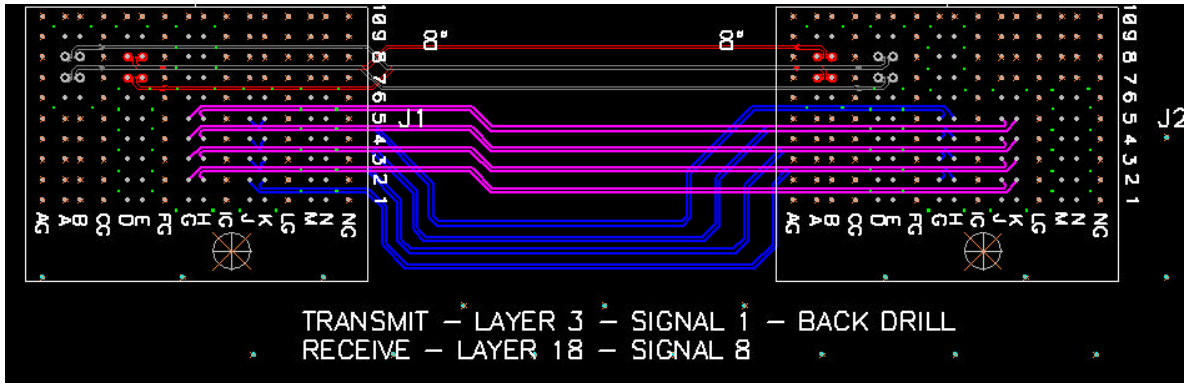
**Outbound/Inbound**

| TX | RX |
|---|---|
| J2/K2 | G2/H2 |
| J3K3 | G3/H3 |
| J4/K4 | G4/H4 |
| J5/K5 | G5/H5 |

## Transmit–to-Receive Pin Map

**Outbound Traffic Moves Left-to-Right** **Tx ⟶ Rx**

**Inbound Traffic Moves Right-to-Left** **Rx ⟵ Tx**




**Construction Notes:**

- All transmit ports initiate with J/K terminal pairs.
- All receive ports terminate with G/H pairs.
- Consistent transmit-to-receive pin mapping allows for only one line card port design.
- 8” backplane channel routing is shown.
- Channels are blocked in groups of 4 transmit pairs and 4 receive pairs.

## Outbound Traffic – 8” Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 3 (S1) | 36.5 (BD) |
| J3/K3 | 3(S1) | 36.5 (BD) |
| J4/K4 | 3(S1) | 36.5 (BD) |
| J5/K5 | 3(S1) | 36.5 (BD) |
| G2/H2 | 3 (S1) | 36.5 (BD) |
| G3/H3 | 3(S1) | 36.5 (BD) |
| G4/H4 | 3(S1) | 36.5 (BD) |
| G5/H5 | 3(S1) | 36.5 (BD) |

**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias are backdrilled.

## Inbound Traffic – 8” Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 18(S8) | 33.9 |
| J3/K3 | 18(S8) | 33.9 |
| J4/K4 | 18(S8) | 33.9 |
| J5/K5 | 18(S8) | 33.9 |
| G2/H2 | 18(S8) | 33.9 |
| G3/H3 | 18(S8) | 33.9 |
| G4/H4 | 18(S8) | 33.9 |
| G5/H5 | 18(S8) | 33.9 |

**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.

## Outbound Traffic – 1 meter Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 3 (S1) | 191.2 |
| J3/K3 | 3 (S1) | 191.2 |
| J4/K4 | 3 (S1) | 191.2 |
| J5/K5 | 3 (S1) | 191.2 |
| G2/H2 | 3 (S1) | 191.2 |
| G3/H3 | 3 (S1) | 191.2 |
| G4/H4 | 3 (S1) | 191.2 |
| G5/H5 | 3 (S1) | 191.2 |

**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias have significant stub to assess channel robustness.

## Inbound Traffic – 1 meter Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 18(S8) | 33.9 |
| J3/K3 | 18(S8) | 33.9 |
| J4/K4 | 18(S8) | 33.9 |
| J5/K5 | 18(S8) | 33.9 |
| G2/H2 | 18(S8) | 33.9 |
| G3/H3 | 18(S8) | 33.9 |
| G4/H4 | 18(S8) | 33.9 |
| G5/H5 | 18(S8) | 33.9 |

**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.
- 1-meter channel length designed with and without stub to allow for channel performance comparison.

## Outbound Traffic – 1.25 meter Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 5(S2) | 15.4 (BD) |
| J3/K3 | 5(S2) | 15.4 (BD) |
| J4/K4 | 5(S2) | 15.4 (BD) |
| J5/K5 | 5(S2) | 15.4 (BD) |
| G2/H2 | 5(S2) | 15.4 (BD) |
| G3/H3 | 5(S2) | 15.4 (BD) |
| G4/H4 | 5(S2) | 15.4 (BD) |
| G5/H5 | 5(S2) | 15.4 (BD) |

**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias are backdrilled.

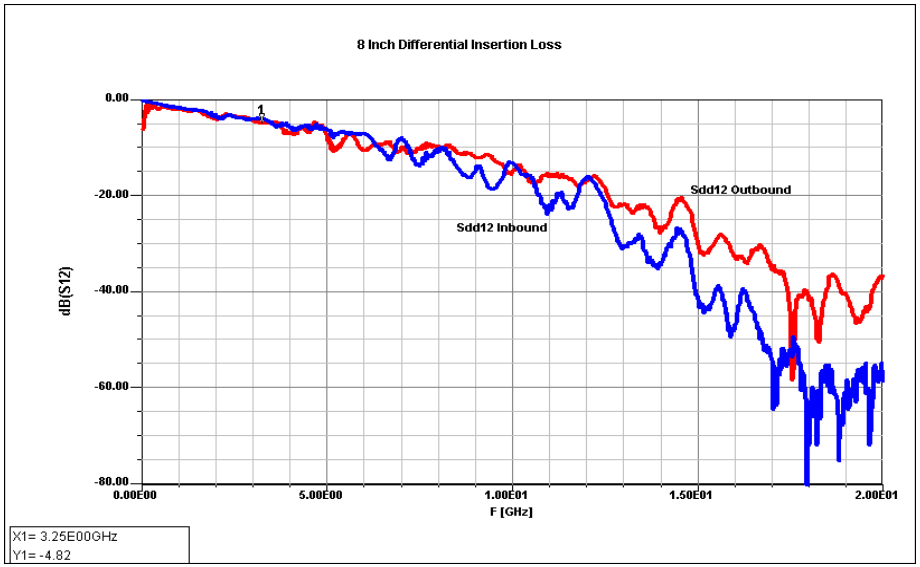
## Inbound Traffic – 1.25 meter Channel

| Pair | Layer | Stub Length (mils) |
|---|---|---|
| J2/K2 | 16(S7) | 15.9 (BD) |
| J3/K3 | 16(S7) | 15.9 (BD) |
| J4/K4 | 16(S7) | 15.9 (BD) |
| J5/K5 | 16(S7) | 15.9 (BD) |
| G2/H2 | 16(S7) | 15.9 (BD) |
| G3/H3 | 16(S7) | 15.9 (BD) |
| G4/H4 | 16(S7) | 15.9 (BD) |
| G5/H5 | 16(S7) | 15.9 (BD) |

**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.
- Channel vias are backdrilled.

| Test Structures | 1.25 m | 1.0 m | 0.203 m |
|---|---|---|---|
| OIF Designation | | Long Reach | Short Reach 2 Connectors (+1) |
| Passive Card Installation Phase 1.1 | Distal Position | Distal Position | Distal Position |
| Measure Differential S-Parameters End-to-End | Return Loss Insertion Loss Crosstalk (1-4 Actives/1 Quiet) | Return Loss Insertion Loss Crosstalk (1-4 Actives/1 Quiet) | Return Loss Insertion Loss Crosstalk (1-4 Actives/1 Quiet) |
| Intermediate Traffic Status | Off | Off | Off |

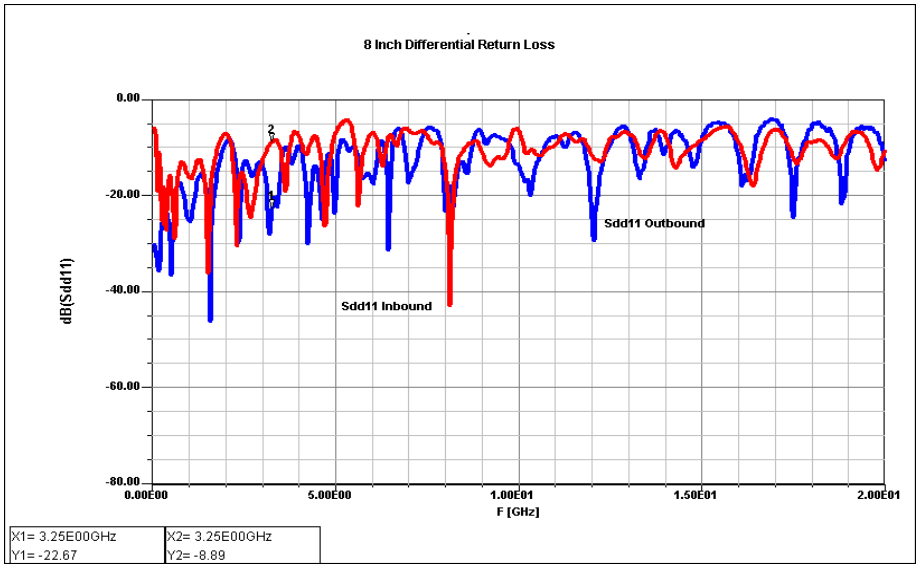



**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias are backdrilled.

**Top Plot:**

- **Red – 8” Inbound Insertion Loss**
- **Blue – 8” Outbound Insertion Loss**

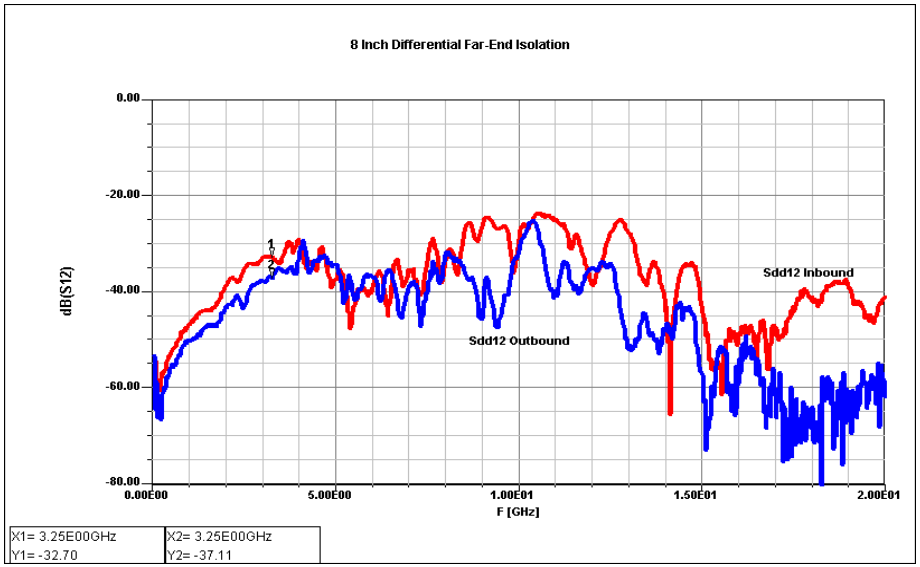


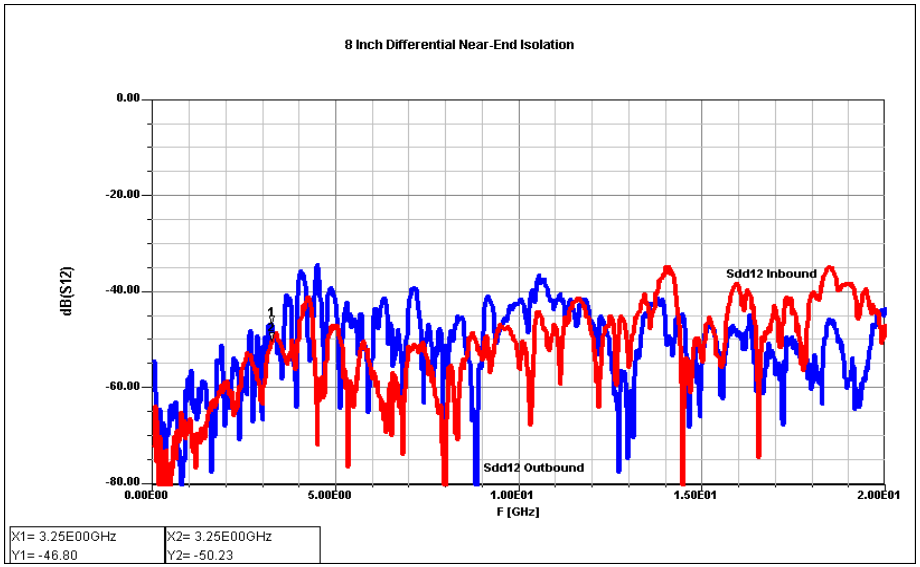

**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.

**Bottom Plot:**

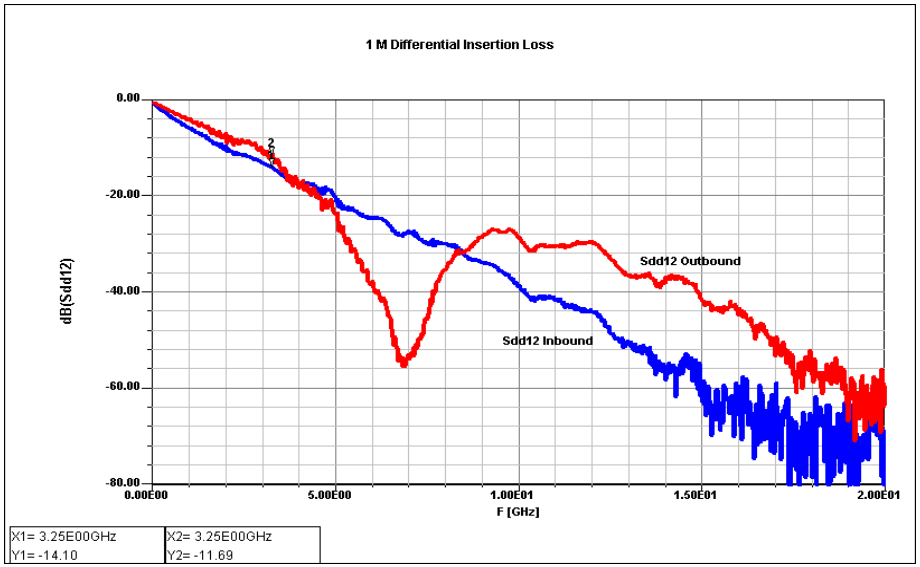
- **Red – 8” Inbound Return Loss – Y2**
- **Blue – 8” Outbound Return Loss – Y1**

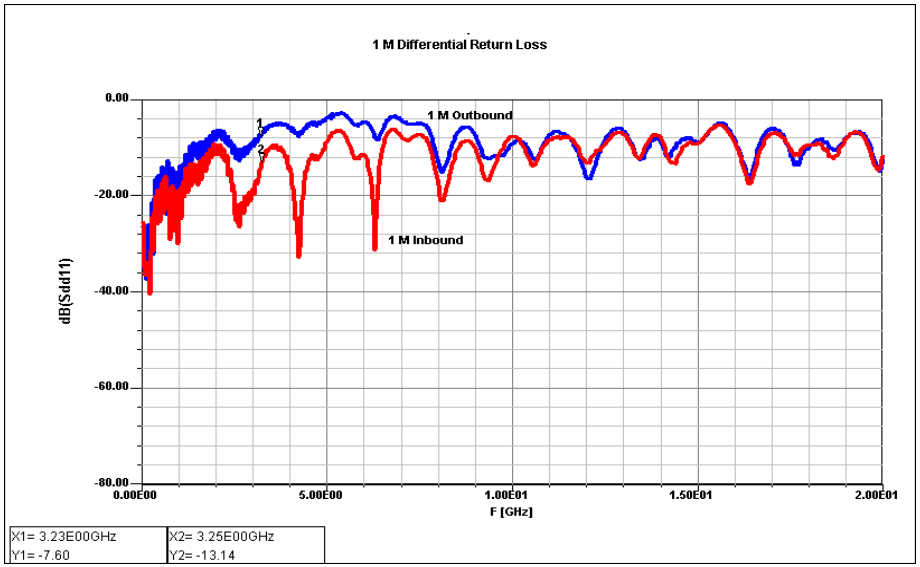



**Top Plot:**
- **Red – 8” Inbound FEXT – Y1**
- **Blue – 8” Outbound FEXT – Y2**

**Bottom Plot:**
- **Red – 8” Inbound NEXT – Y2**
- **Blue – 8” Outbound NEXT – Y1**




**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias have significant stub.

**Top Plot:**

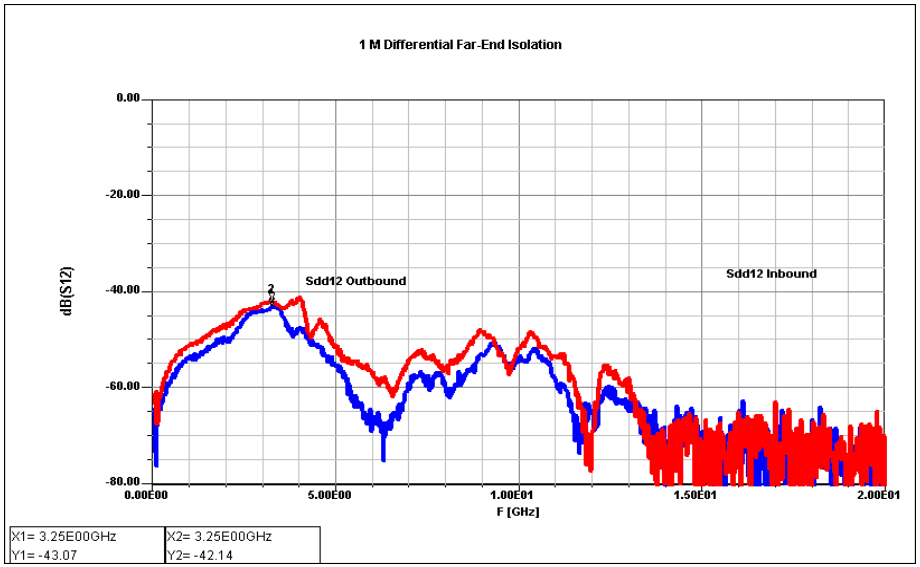
- **Red – 1m Outbound Insertion Loss - Y2**
- **Blue – 1m Inbound Insertion Loss - Y1**

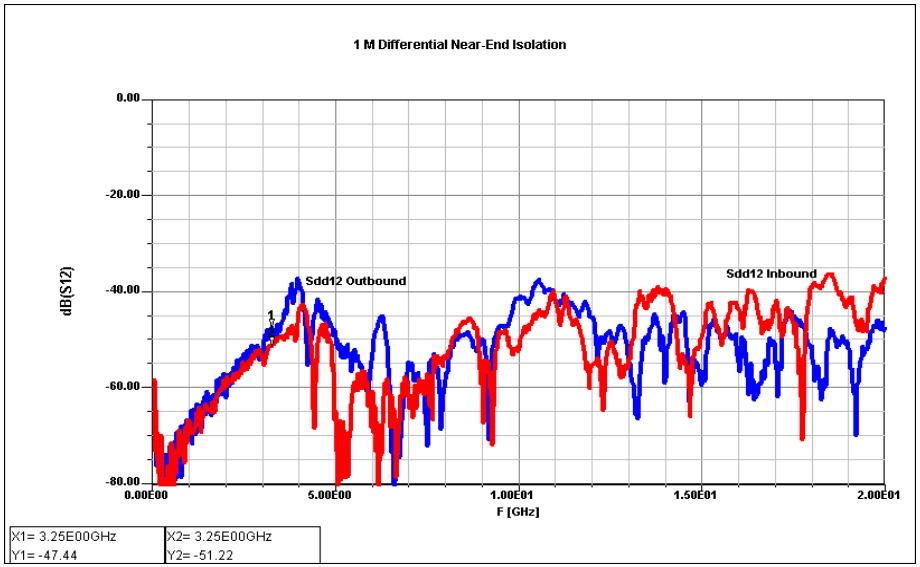
**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.

**Bottom Plot:**

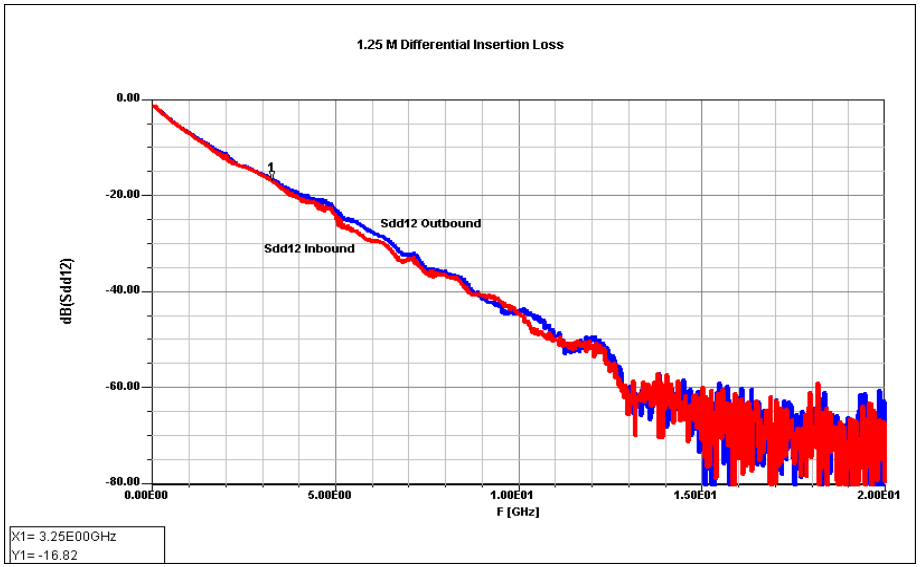
- **Red – 1m Inbound Return Loss – Y2**
- **Blue – 1m Outbound Return Loss – Y1**

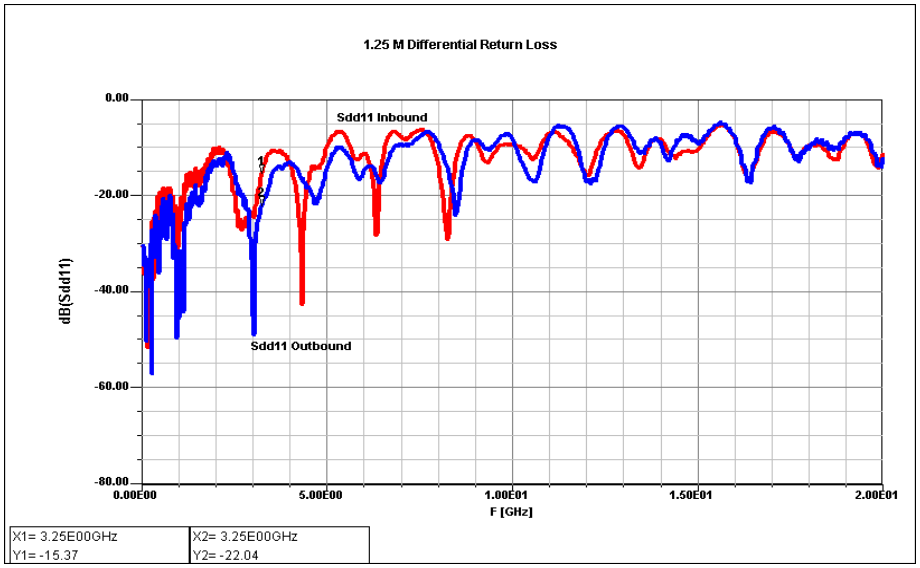



**Top Plot:**
- **Red – 1m Inbound FEXT – Y2**
- **Blue – 1m Outbound FEXT – Y1**

**Bottom Plot:**
- **Red – 1m Inbound NEXT – Y2**
- **Blue – 1m Outbound NEXT – Y1**




**Construction Notes:**
**Outbound**

- Channel routed in top of PCB.
- Channel vias are backdrilled.

**Top Plot:**

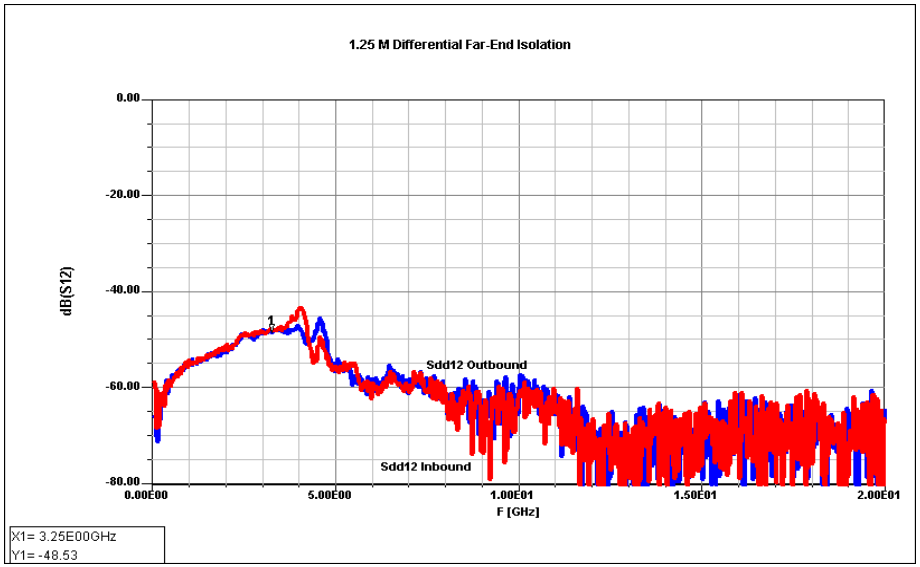
- **Red – 1.25m Inbound Insertion Loss**
- **Blue – 1.25m Outbound Insertion Loss**

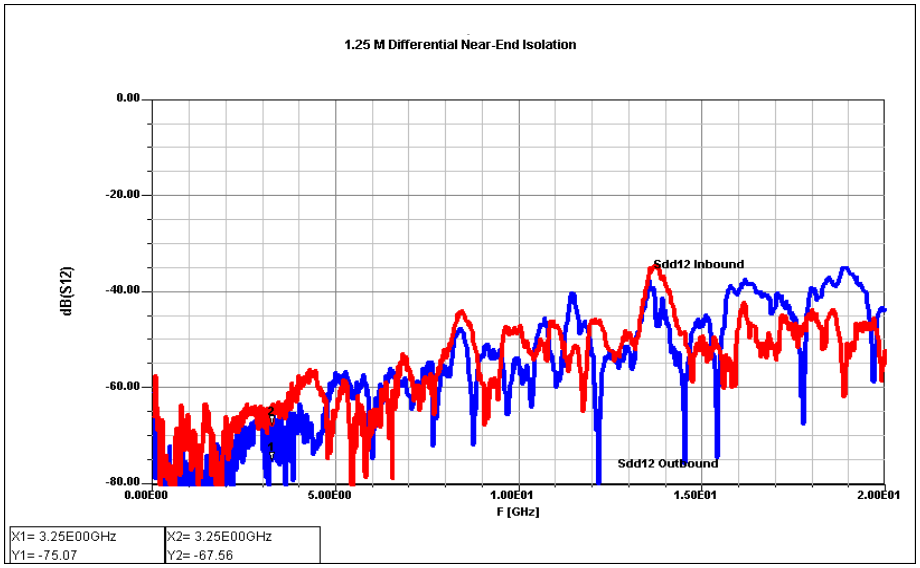
**Construction Notes:**
**Inbound**

- Channel routed in bottom of PCB.
- Channel vias are backdrilled.

**Bottom Plot:**

- **Red – 1.25m Inbound Return Loss - Y1**
- **Blue – 1.25m Outbound Return Loss - Y2**




**Top Plot:**
- **Red – 1.25m Inbound FEXT**
- **Blue – 1.25m Outbound FEXT**

**Bottom Plot:**
- **Red – 1.25m Inbound NEXT – Y2**
- **Blue – 1.25m Outbound NEXT – Y1**

## GbX™ Reference Backplane – 1.0 meter Data

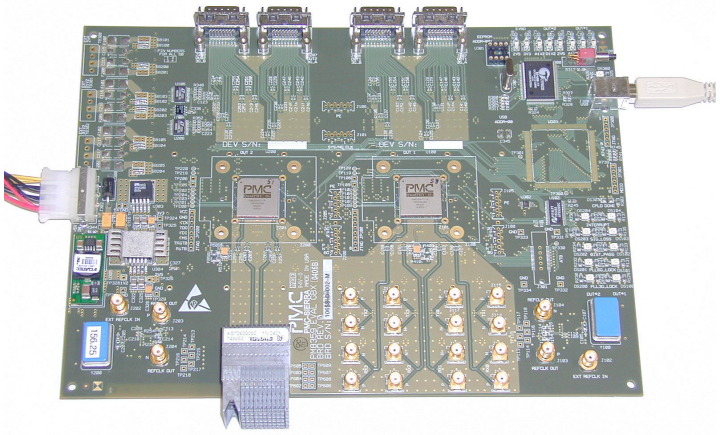
| Channel # | Channel Name | Speed Line Rate Gb/s | Jitter No Xtalk | Jitter With Xtalk | Vertical Opening No Xtalk | Vertical Opening With Xtalk | BER 0mV No Xtalk | BER 0mV With Xtalk | BER 24mV No Xtalk | BER 24mV With Xtalk |
|---|---|---|---|---|---|---|---|---|---|---|
| 290 | FR4-13SI 1m stub sj2k2g2h2 | 6.25 | 0.54 | 0.61 | 0.167 | 0.151 | -66.0423 | -50.3203 | -41.7001 | -36.4803 |
| 291 | FR4-13SI 1m stub sj3k3g3h3 | 6.25 | 0.54 | 0.68 | 0.167 | 0.127 | -67.235 | -43.6755 | -42.3558 | -29.8996 |
| 292 | FR4-13SI 1m stub sj4k4g4h4 | 6.25 | 0.55 | 0.67 | 0.165 | 0.093 | -65.3218 | -35.2009 | -41.165 | -22.9038 |
| 293 | FR4-13SI 1m stub sj5k5g5h5 | 6.25 | 0.53 | 0.58 | 0.173 | 0.157 | -71.0876 | -54.397 | -45.1641 | -39.9246 |
| 295 | FR4-13SI 1m backdrilled sj2k2g2h2 | 6.25 | 0.47 | 0.55 | 0.211 | 0.169 | -85.4748 | -58.4108 | -63.1059 | -41.3198 |
| 296 | FR4-13SI 1m backdrill sj3k3g3h3 | 6.25 | 0.46 | 0.61 | 0.217 | 0.171 | -90.5809 | -59.5612 | -67.5416 | -40.4509 |
| 297 | FR4-13SI 1m backdrill sj4k4g4h4 | 6.25 | 0.46 | 0.61 | 0.217 | 0.173 | -91.8006 | -58.9723 | -68.4028 | -41.2491 |
| 298 | FR4-13SI 1m backdrill sj5k5g5h5 | 6.25 | 0.46 | 0.54 | 0.217 | 0.199 | -90.948 | -66.6512 | -67.9721 | -48.3167 |

## GbX™ Reference Backplane – 1.25 meter Data

| Channel # | Channel Name | Speed Line Rate Gb/s | Jitter No Xtalk | Jitter With Xtalk | Vertical Opening No Xtalk | Vertical Opening With Xtalk | BER 0mV No Xtalk | BER 0mV With Xtalk | BER 24mV No Xtalk | BER 24mV With Xtalk |
|---|---|---|---|---|---|---|---|---|---|---|
| 320 | FR4-13SI 1.25 Inbound sj2k2g2h2 | 6.25 | 0.5 | 0.52 | 0.193 | 0.187 | -76.3498 | -61.177 | -54.8357 | -42.9326 |
| 321 | FR4-13SI 1.25 Inbound sj3k3g3h3 | 6.25 | 0.52 | 0.59 | 0.183 | 0.165 | -71.7958 | -54.759 | -50.4012 | -38.6588 |
| 322 | FR4-13SI 1.25 Inbound sj4k4g4h4 | 6.25 | 0.52 | 0.6 | 0.183 | 0.137 | -71.2918 | -47.0481 | -50.3036 | -31.7168 |
| 323 | FR4-13SI 1.25 Inbound sj5k5g5h5 | 6.25 | 0.52 | 0.56 | 0.183 | 0.163 | -71.9026 | -59.2942 | -50.832 | -39.0013 |
| 325 | FR4-13SI 1.25 Outbound sj2k2g2h2 | 6.25 | 0.49 | 0.49 | 0.195 | 0.187 | -76.9973 | -62.5367 | -55.6845 | -43.8628 |
| 326 | FR4-13SI 1.25 Outbound sj3k3g3h3 | 6.25 | 0.5 | 0.57 | 0.191 | 0.173 | -74.6367 | -56.8507 | -53.7548 | -40.2478 |
| 327 | FR4-13SI 1.25 Outbound sj4k4g4h4 | 6.25 | 0.49 | 0.58 | 0.191 | 0.147 | -75.4388 | -52.1418 | -54.3831 | -34.7129 |
| 328 | FR4-13SI 1.25 Outbound sj5k5g5h5 | 6.25 | 0.49 | 0.54 | 0.191 | 0.177 | -76.4474 | -65.5573 | -54.9339 | -42.5653 |

| Test Structures | 1.25 m | 1.0 m |
|---|---|---|
| OIF Designation | | Long Reach |
| Active Card Installation Phase 1.1 | Distal Position | Distal Position |
| Measure Eye Pattern Performance End-to-End With PMC-Sierra 6G Quad-PHY | 99% Confidence Level -Eye BER (1-4 Active Channels) Outbound + Inbound | 99% Confidence Level -Eye BER (1-4 Active Channels) Outbound + Inbound |
| Intermediate Traffic Status | Off | Off |
| Results To 99% Confidence Level | 200 hours Error Free 10E-15 | 65 hours Error Free 10E-15 |

**PMC-Sierra Quad PHY 6G**
**Active Paddle Card**



**4 bi-directional 6.25Gbps channels**

## GbX™ Reference Backplane

**Conclusions:**

- **GbX™ Reference Backplane contains CEI relevant channel lengths and features.**
- **GbX™ Reference Backplane demonstrates robust 6G channel performance at 1-meter.**
- **The Molex GbX™ Reference Backplane and PMC-Sierra 6G QuadPHY SERDES constitute the industry's first 1-meter silicon-to-silicon channel to be compliant with the Optical Internetworking Forum (OIF) Common Electrical I/O (CEI) 6+ Long Reach specification (Draft 4.0).**
- **GbX™ Reference Backplane will be made available for test and evaluation and interoperability exercises through arrangement with Molex. Contact:**

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