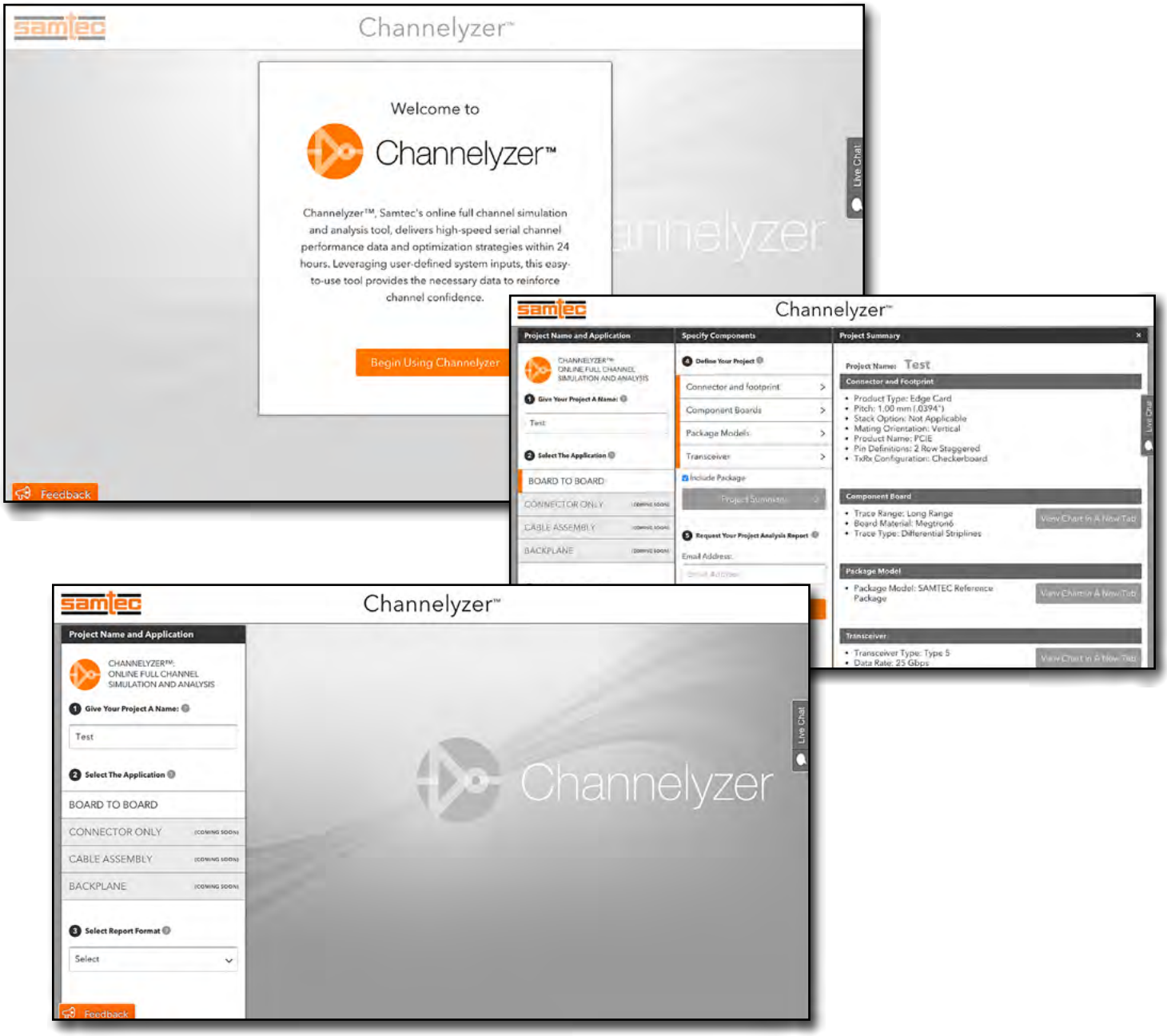

Channelyzer™

Getting Started Guide

AUGUST 2016

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Updated Documentation

Please visit www.samtec.com/channelyzer to get access to the latest Channelyzer™ documentation and to ensure that you have the latest version of this document.

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Change History

Revision #	Reason	Date
Draft 00	Working Draft	02/18/2016
Draft 01	Added details in sections 4 and 5	02/23/2016
Release 001	Initial Release	02/29/2016
Release 002	Updated various figures, added support for “Backplane Applications"	08/11/2016

1.0 Introduction

As data rates continually increase in many applications, signal integrity simulation and analysis are required to optimize the high-speed serial channel. Several design considerations are driven by signal integrity concerns. Connector selection drives performance. PCB design decisions (placement, routing, material selection, trace lengths, impedance matching, etc.) can enhance or adversely affect the performance of the high-speed serial channel. Routing breakout from the connector is often overlooked.

In response to these factors, large electronics OEMs have developed in-house signal integrity expertise. They have the scope and scale to hire teams of engineers dedicated to signal integrity simulation and analysis. They also have the resources in place to afford the expensive industry-standard signal integrity tools used in simulating and analyzing their systems.

Small and medium-sized electronics OEMs often do not have these resources. Their typical path of signal integrity support is through any number of signal integrity consultants. Over the years, Samtec has consulted with numerous electronics OEMs on signal integrity issues in support of their products.

A combination of customer demand and our in-house signal integrity expertise enables Samtec to develop and release the CHANNELYZER™ ONLINE FULL CHANNEL SIMULATION AND ANALYSIS tool.

Samtec's Channelyzer™ delivers high-speed serial channel performance data and optimization strategies within 24 hours. Leveraging user-defined system inputs, this easy-to-use tool provides the necessary data to reinforce channel confidence. Features of Channelyzer™ include:

- Channel modeling defined by package model, connector selection, PCB material, trace type and length and other system variables
- Produces results for standards (IEEE 100GBASE-KR4, OIF CEI-28G-SR, OIF CEI-28G-MR and OIF CEI-25G-LR) and transceivers at varying equalization levels and data rates
- Generates individual receiver performance data per user-defined Tx/Rx assignments
- Channelyzer™ reporting details include:
    - Channel overview and strategies for improved performance
    - Differential impedance, insertion loss, return loss, PSXT
    - Voltage bathtub curves
    - COM as a function of BER
    - Probability density eye summary

2 Getting Started

2.1 Launch Channelyzer™

Go to www.samtec.com/channelyzer.

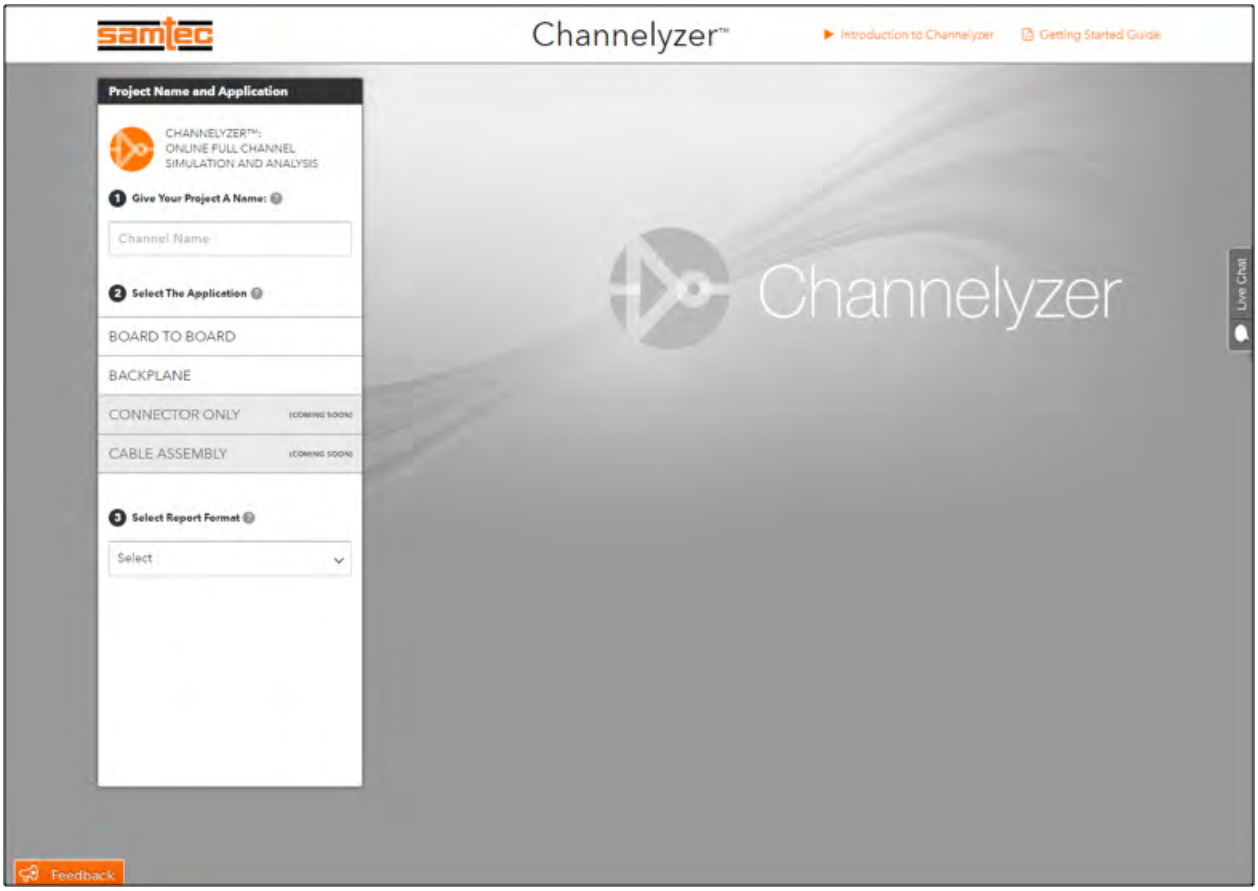

Figure 1 - Channelyzer™ Introduction Screen

2.2 Enter a Project Name

Enter a project name in the box marked "Give Your Project A Name."

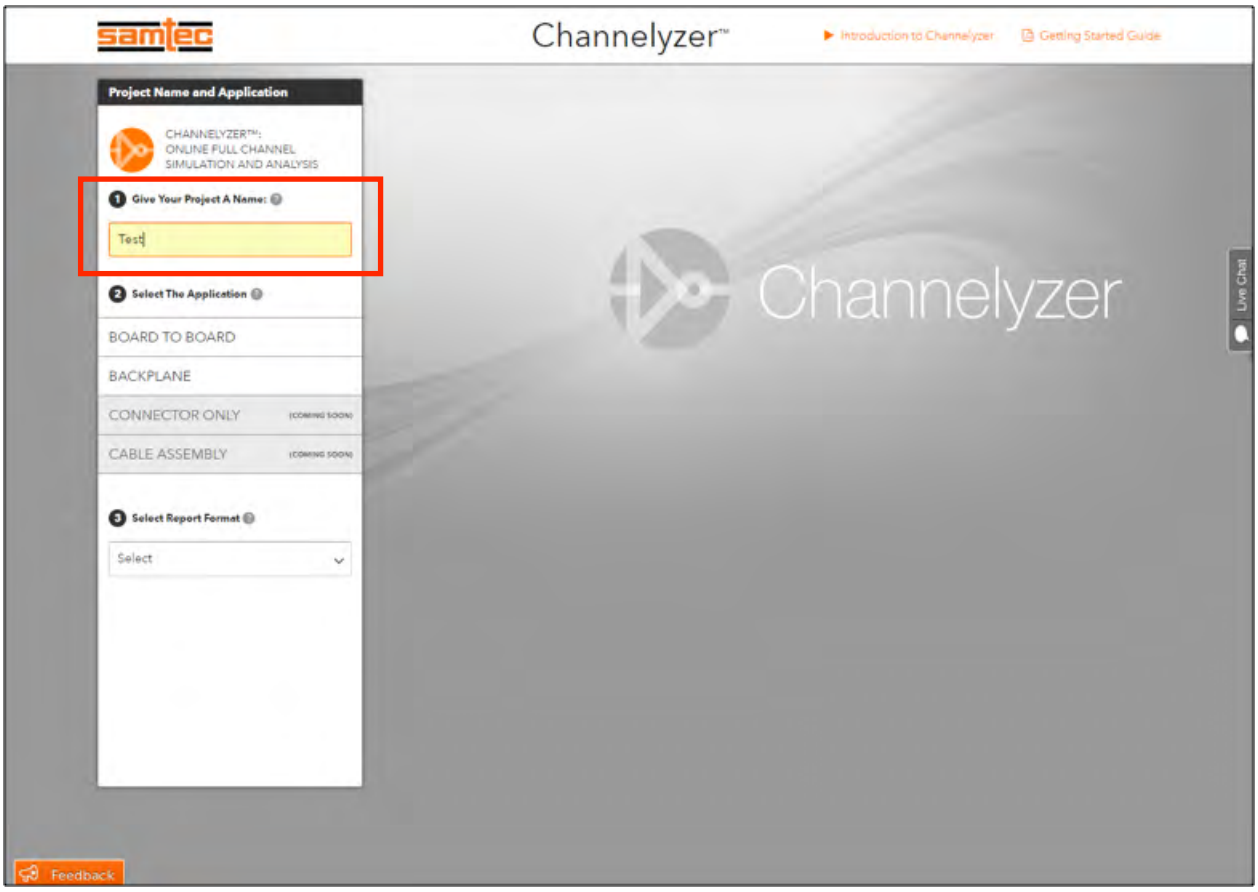

Figure 2 - Channelyzer™ Home Screen

3 Select the Application

3.1 Board-to-Board Applications

Under "Select The Application," choose "Board-to-Board." The "Board-to-Board" option enables a user to define a high-speed serial channel between mated connectors attached to PCBs. This is illustrated in a pop-up window when highlighted.

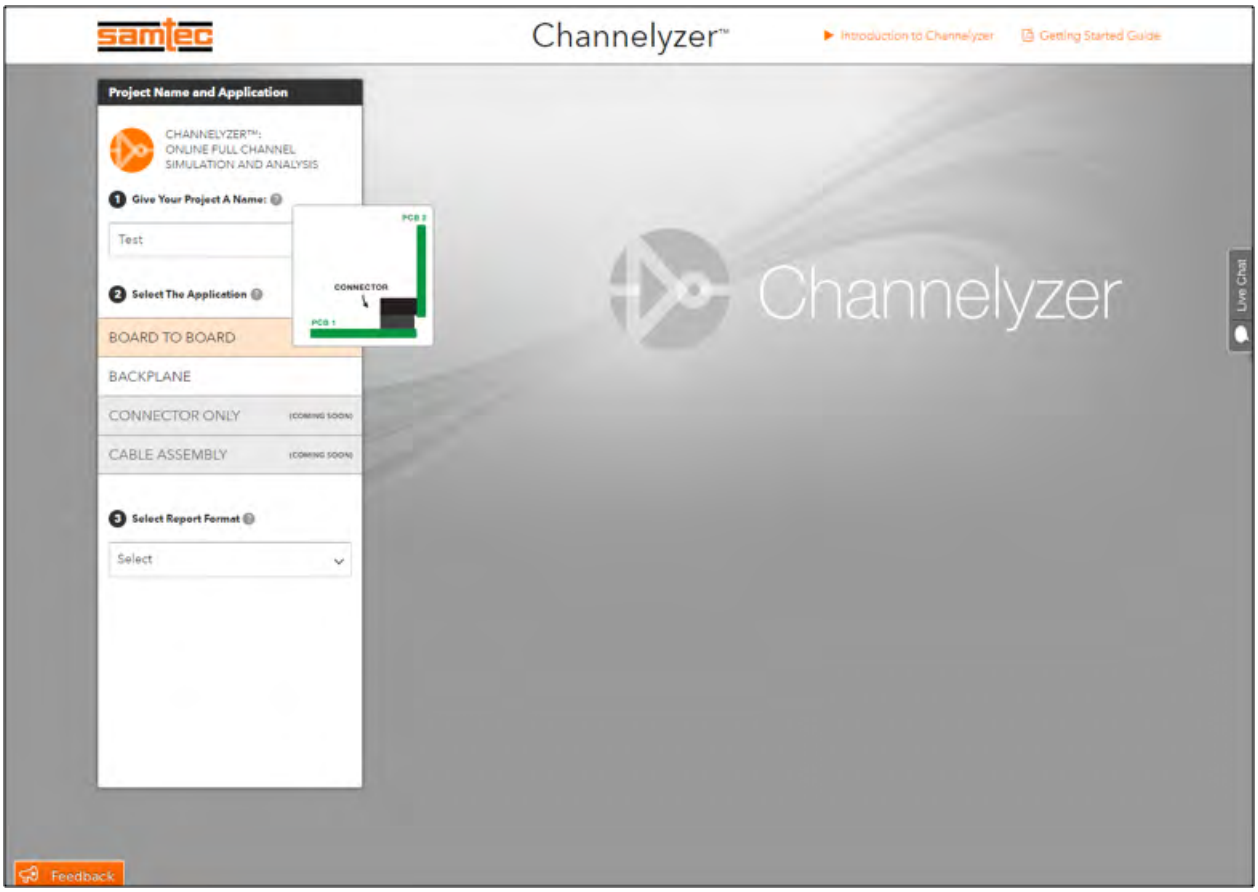

Figure 3 - Select Board-to-Board Application

Once the "Board-to-Board" option is selected, it will turn orange. Users can then proceed to the next step.

3.2 Backplane Applications

Under "Select The Application," choose "Backplane." The "Backplane" option enables a user to define a high-speed serial channel routed through two linecards, two pair of mated backplane connectors and the backplane itself. This is illustrated in a pop-up window when highlighted.

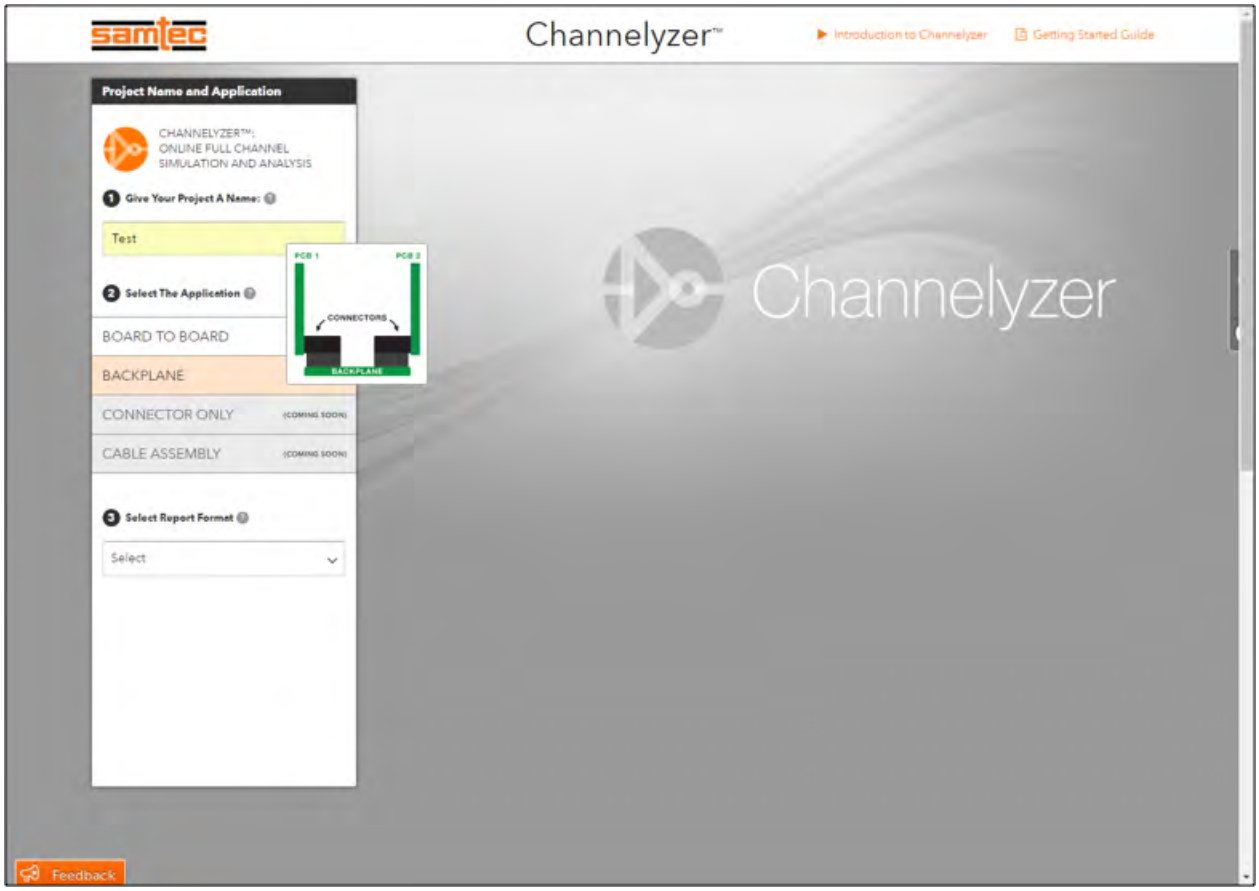

Figure 4 - Select Backplane Application

Once the "Backplane" option is selected, it will turn orange. Users can then proceed to the next step.

3.3 Future Applications

Other applications will be supported in future versions of Channelyzer™. These include "Connectors Only" and "Cable Assembly."

4 Select Report Format

Channelyzer™ supports various user selectable report formats. These come in three basic types: (1) basic signal integrity (SI) reports, (2) bit error rates (BER) reports and (3) standards-defined reports. All three report types are currently available for both Board-to-Board and Backplane application selections.

4.1 SI Report Format

When a user selects the "SI Report" option, Channelyzer™ will output basic SI metrics based on the high-speed serial channel defined by the user. Typical SI metrics produced by Channelyzer™ include differential impedance, differential return loss, differential insertion loss, differential power sum crosstalk (PSXT) and others.

4.2 BER Report Format

When a user selects "BER Report," Channelyzer™ simulates the full end-to-end performance of the user-defined high-speed serial channel. In building the channel, users can define the connector, the PCB, the package model and the transceivers. Channelyzer™ supports several industry standard and custom package models as outlined in Table 1. See Section 5.5 for more details.

Table 1 - Package Models

Name	Impedance	Package Length	Capacitance Matrix
25 G COM Package – Case 1	39.1 Ω	12 mm	[0.25 pf 0.18 pf]
25 G COM Package – Case 2	39.1 Ω	30 mm	[0.25 pf 0.18 pf]
Samtec Reference	45.0 Ω	12 mm	[0.25 pf 0.18 pf]*0.5

Channelyzer™ also allows the user to define the transceivers. Users first pick transceiver signal condition and equalization level as outlined in Table 2.

Table 2 - Transceiver Models

Name	FFE	CTLE (dB)	DFE Taps
Transceiver 1	None	0	0
Transceiver 2	1 Pre, 1 Post	0	0
Transceiver 3	1 Pre, 1 Post	9	0
Transceiver 4	1 Pre, 1 Post	9	1
Transceiver 5	1 Pre, 1 Post	9	5

After selecting the appropriate Transceiver Type, users then pick the appropriate data rate supported by Channelyzer™:

- 10 Gbps
- 12.5 Gbps
- 16 Gbps
- 25 Gbps
- 28 Gbps

4.3 Standards Defined Report Format

The last option enables a user to define a high-speed serial channel based on standards-based transceiver types. Currently, Channelyzer™ supports four different 25 G transceiver specifications. These include:

- IEEE 100GBASE-KR4 COM Report
- OIF 25G CEI Short Ranges (SR) Report
- OIF 25G CEI Medium Range (MR) Report
- OIF 25G CEI Long Range (LR) Report

NOTE: The transceiver defined for the IEEE 100GBASE-KR4 COM Report comes with signal conditioning outlined in Table 3.

Table 3 - IEEE 100GBASE-KR4 COM Transceiver Details

Name	FFE	CTLE (dB)	DFE Taps
COM Transceiver*	1 Pre, 1 Post	12	14

5 Define Your Project

This section of Channelyzer™ enables the user to specify the components of the high-speed serial channel they would like to simulate and analyze. Depending on the Report Format selected as described in Section 4, there are four basic components Channelyzer™ supports: (1) Connector and Footprint, (2) Component Boards, (3) Package Models and (4) Transceiver.

Selections will vary for different Applications.

5.1 Connector and Footprint Board-to-Board

Users can define the connector pair they are targeting for their high-speed serial channel. The connector models are representative of the mated connector set with the reference plane set at the contact pad. This does not include PCB effects or breakout.

Connector definition options for Board-to-Board Applications include: (1) Product Name, (2) Stack Options, (3) Mating Orientation, (4) Pin Definitions, (5) Tx/Rx, (6) Product Type and (7) Pitch.

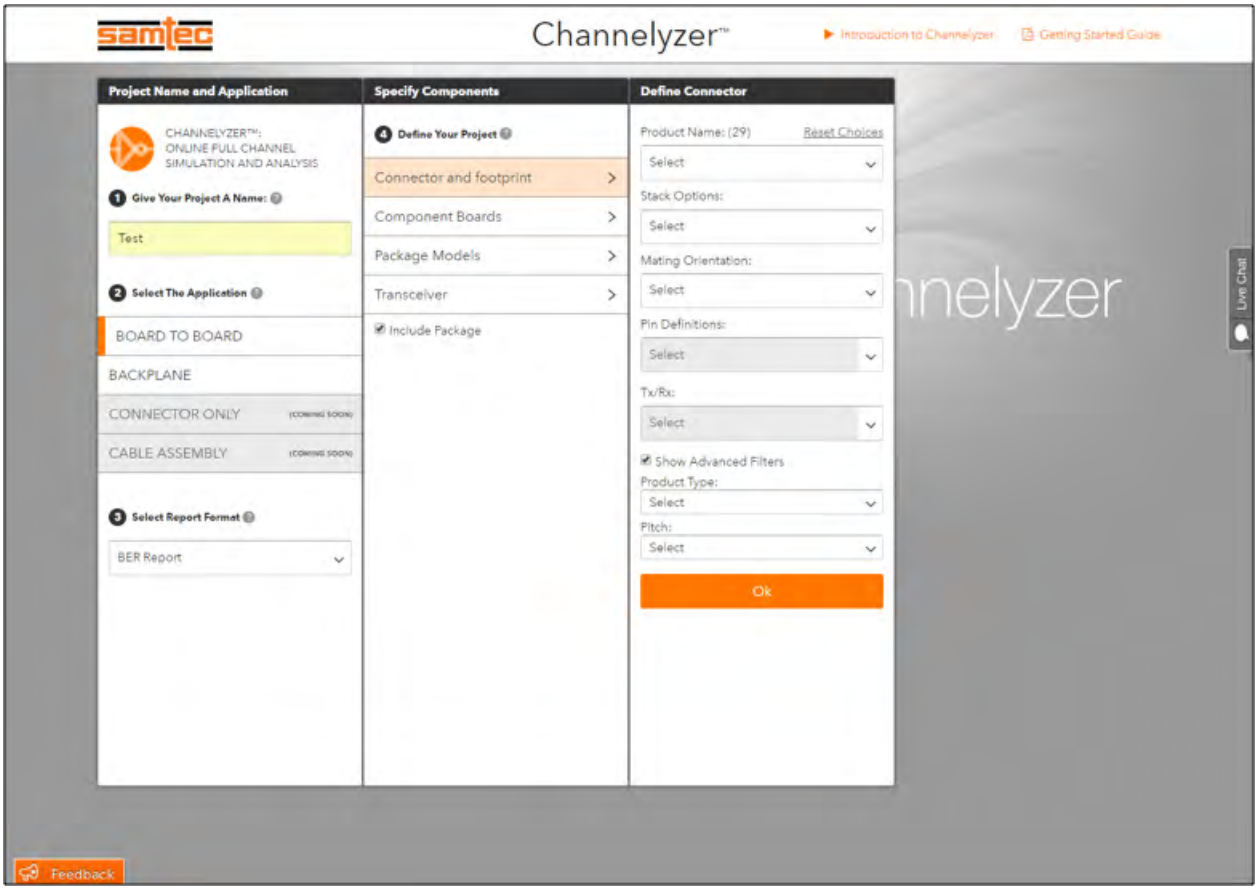

Figure 5 - Connector Definition Options – Board-to-Board

5.1.1 Product Name

Pick from one of 29 Samtec product families currently supported by Channelyzer™.

5.1.2 Stack Options
Select the desired connector stack height supported by the selected Product Name.

5.1.3 Mating Orientation
Select the desired mating orientation supported by the selected Product Name.

- Parallel
- Right-Angle
- Coplanar
- Vertical
- Perpendicular
- Edge Mount

5.1.4 Pin Definition
Select the desired pin definition supported by the selected Product Family.

- xRow
- 2 Row Staggered
- Offset
- Optimal Horizontal
- Optimal Vertical
- High-Density Horizontal
- High-Density Vertical

5.1.5 Tx/Rx Assignments
Users can simulate transceiver routing schemes inside of Channelyzer™. The tool offers three different transmit and receive assignments: (1) All Thru, (2) All Next and (3) Checkerboard. Tx/Rx assignments vary with connector types as illustrated below.

Figure 6 - All Thru (Arrays)

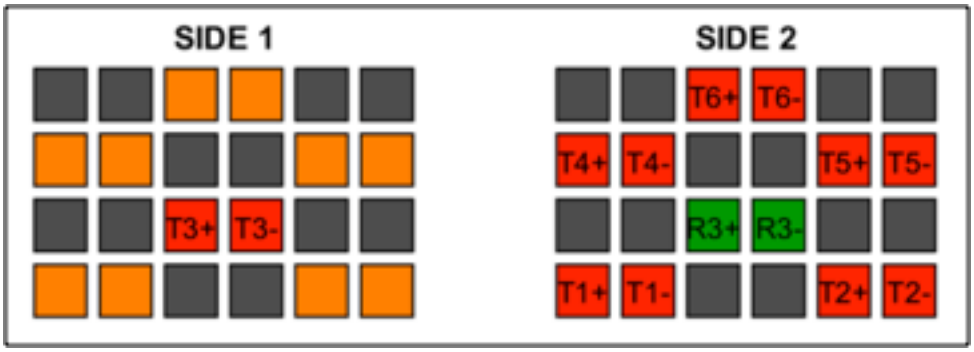

Figure 7 - All Next (Arrays)

Figure 8 - Checkboard (Arrays)

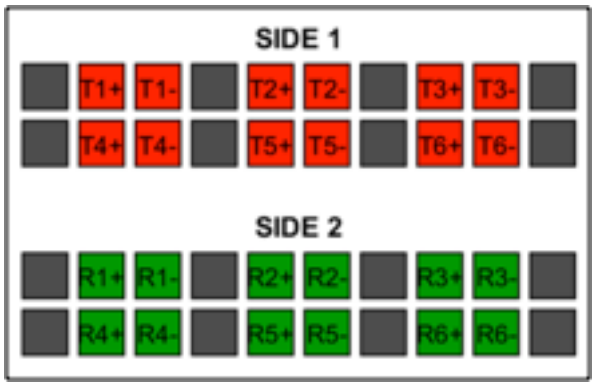

Figure 9 - All Thru (2 Row or Edge Card)

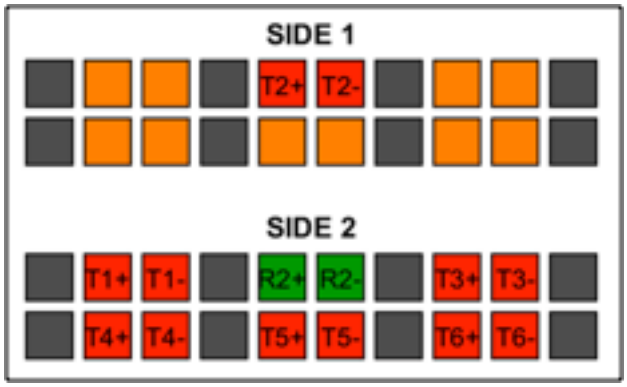

Figure 10 - All Next (2 Row or Edge Card)

Figure 11 - Checkerboard (2 Row or Edge Card)

5.1.6 Product Type

Users define the Product Type of the selected Product Name. The Product Type will be fixed for certain Product Names. This option is only visible when the "Advanced Filter" box is checked. Product types include:

- Array
- Edge Card
- 2 Row

5.1.7 Pitch

Select the desired connector pitch supported by the selected Product Family. This option is only visible when the "Advanced Filter" box is checked.

5.2 Connector and Footprint Backplane

Users can define the connector pair they are targeting for their high-speed serial channel. The connector models are representative of the mated connector set with the reference plane set at the contact pad. This does not include PCB effects or breakout.

Connector definition options for Backplane Applications include: (1) Product Name, (2) Pairs Per Column, (3) Pin Definitions and (4) Tx/Rx.

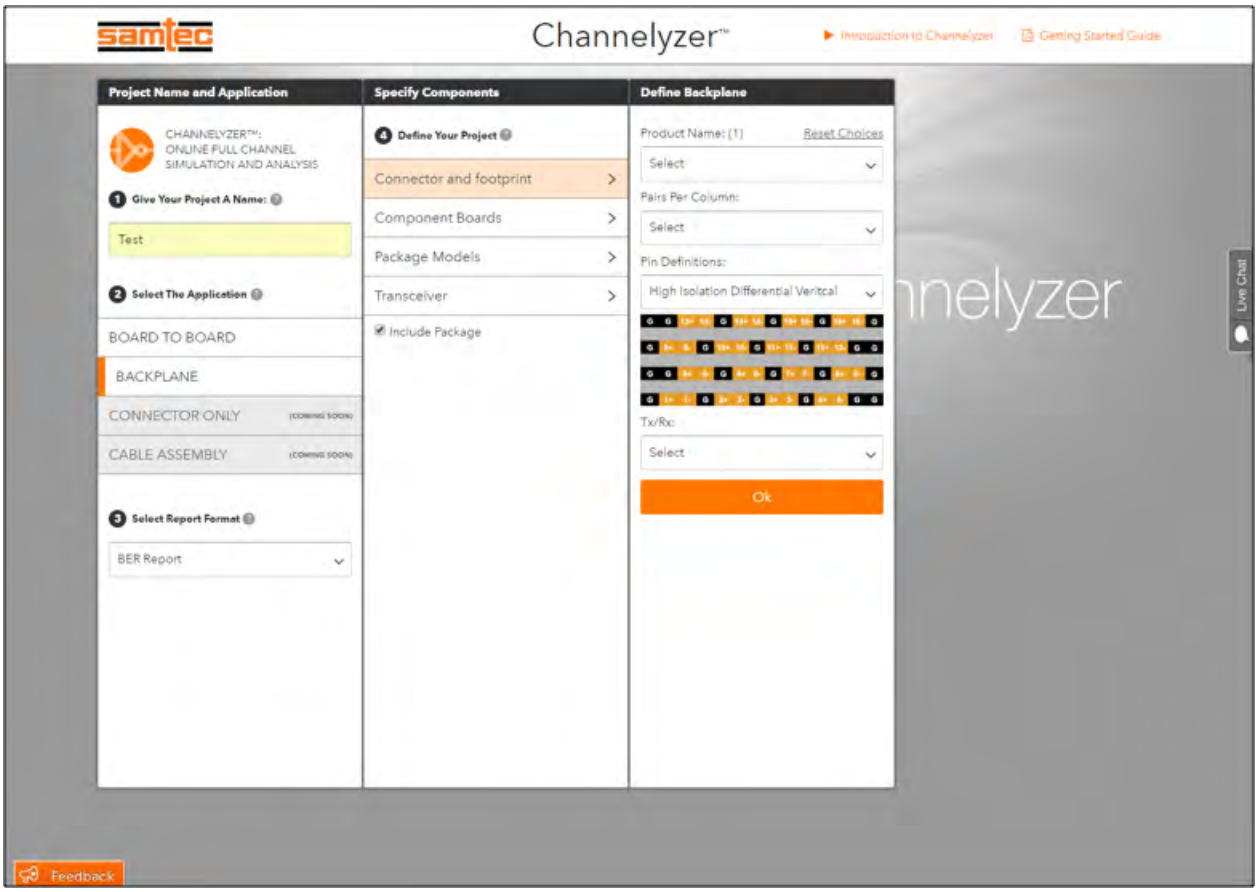

Figure 12 - Connector Definition Options – Backplane

5.2.1 Product Name

Pick the backplane product series supported by Samtec: EBTM/EBTF-RA.

5.2.2 Pairs Per Column

Select the desired Pairs Per Column: 4 or 6.

5.2.3 Pin Definition

Select the desired pin definition supported by the EBTM/EBTF-RA mated pair: High Isolation Differential Vertical.

Figure 13 - High Isolation Differential Vertical

5.2.4 Tx/Rx Assignments

Users can simulate transceiver routing schemes inside of Channelyzer™. The tool offers three different transmit and receive assignments in Backplane Applications: (1) All Thru, (2) Full Crossover and (3) Half Crossover. Tx/Rx assignments vary with connector types as illustrated below.

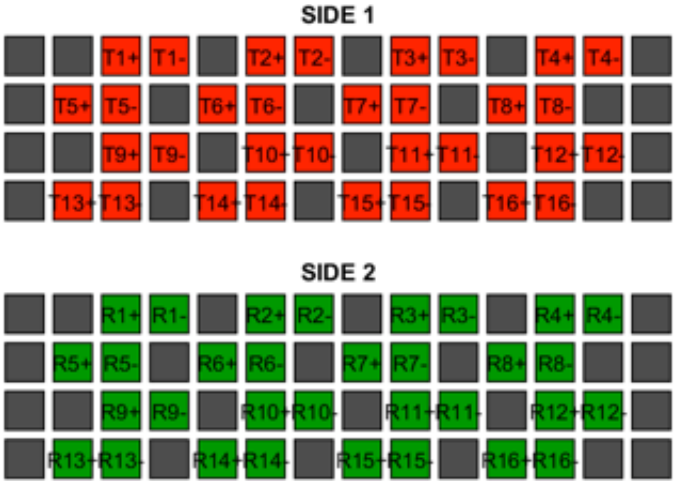

Figure 14 - All Thru

Figure 15 - Full Crossover

Figure 16 - Half Crossover

5.3 Component Boards

Users can define the PCB they are targeting for their high-speed serial channel. PCB definition options include: (1) Trace Range, (2) Board Material and (3) Trace Type.

In Board-to-Board Applications, both Component Boards will be populated automatically. In Backplane Applications, both Component Boards and the backplane will be populated automatically.

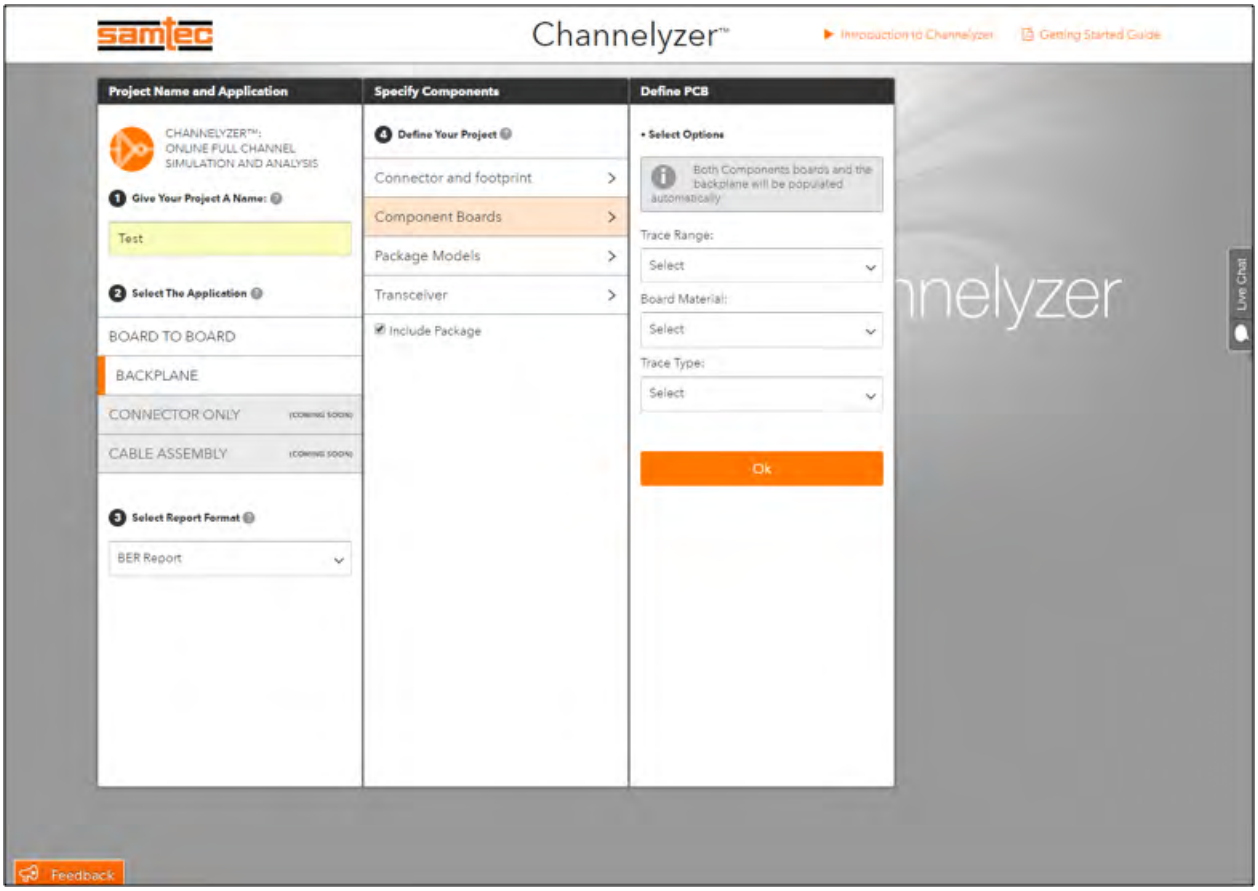

Figure 17 - PCB Definition Options

5.3.1 Trace Range

Users can define what Trace Lengths or Ranges Channelyzer™ can simulate. Table 4 provides further details.

Table 4 - PCB Trace Ranges

Reach	Side 1	Side 2
Very Short Range (VSR)	100 mm (3.94")	50 mm (1.97")
Short Range (SR)	200 mm (7.87")	100 mm (3.94")
Medium Range (MR)	400 mm (15.75")	100 mm (3.94")
Long Range (LR)	500 mm (19.67")	200 mm (7.87")

All Trace Ranges are supported in both Board-to-Board and Backplane Applications.

5.3.2 Board Material

Users can define what Board Materials Channelyzer™ can simulate. The Debye model is used to calculate material performance. Table 5 provides further details.

Table 5 - PCB Materials List

Material Name	Dielectric Constant (Dk)	Dissipation Factor
FR4	4.2	0.02
FR408	4.0	0.015
MEGTRON6	3.5	0.005
NELCO4000-13SI	3.2	0.008

All Board Materials are supported in both Board-to-Board and Backplane Applications.

5.3.3 Trace Type

Since the connector models have their reference plane at the contact pad, Channelyzer™ can simulate two trace types for breakout.

Options for Board-to-Board Applications are shown below:

- Differential Stripline
  - This refers to signal routing on an internal PCB layer
- Differential Microstrip
  - This refers to signal routing on the PCB top layer

Differential Striplines are the only trace types supported in Backplane Applications.

5.4 Package Models

Users can define the Package Model they are targeting for their high-speed serial channel.

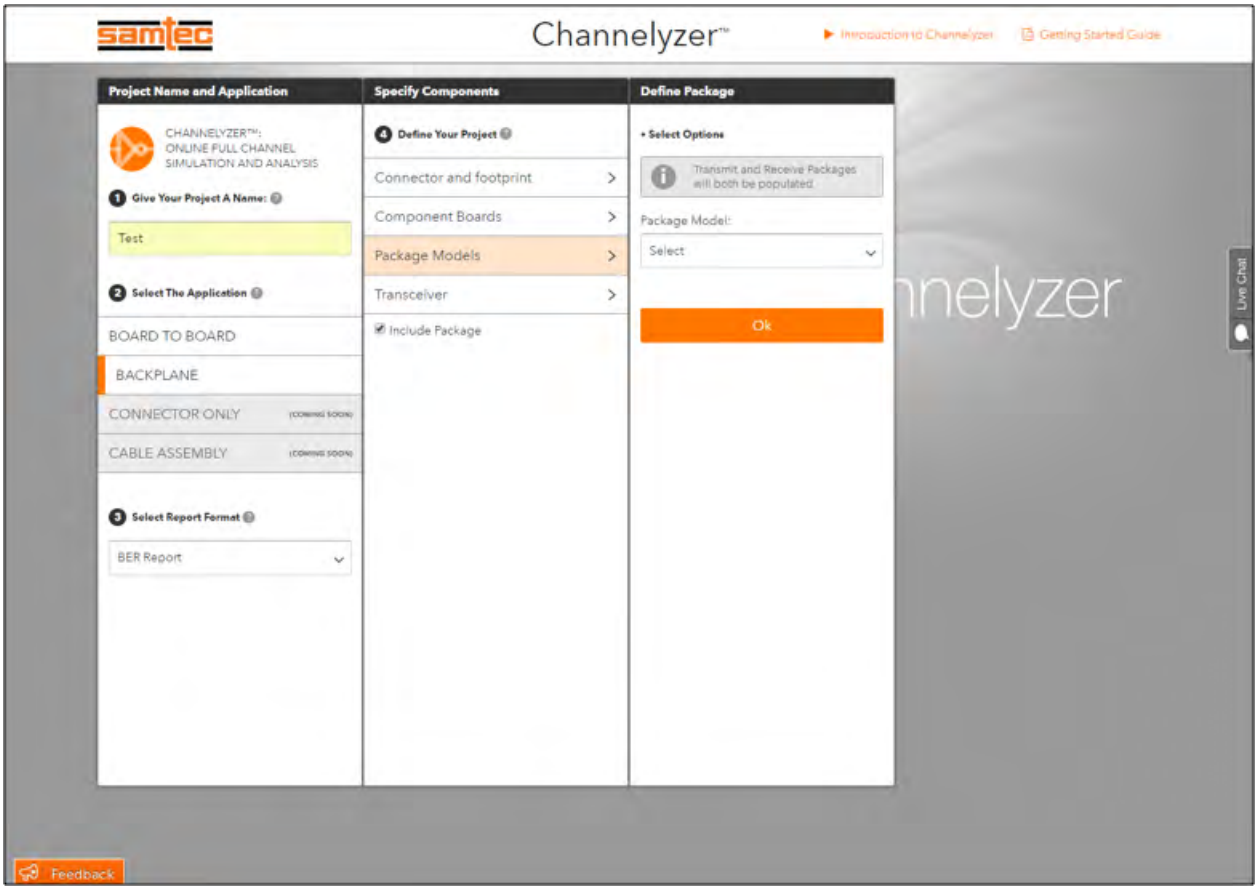

Figure 18 - Package Model Options

Transmit and Receive Packages will both be populated

- IEEE 25G COM Package – Case 1
- IEEE 25G COM Package – Case 2
- Samtec Reference Package

All Package Models are supported in both Board-to-Board and Backplane Applications.

5.5 Transceiver

When the BER Report Format is chosen as described in Section 4 of this document, the user still has to define the transceiver model that Channelyzer™ will simulate and analyze. Users can select the data rates and signal condition levels of pre-defined transceiver models supported by Channelyzer™.

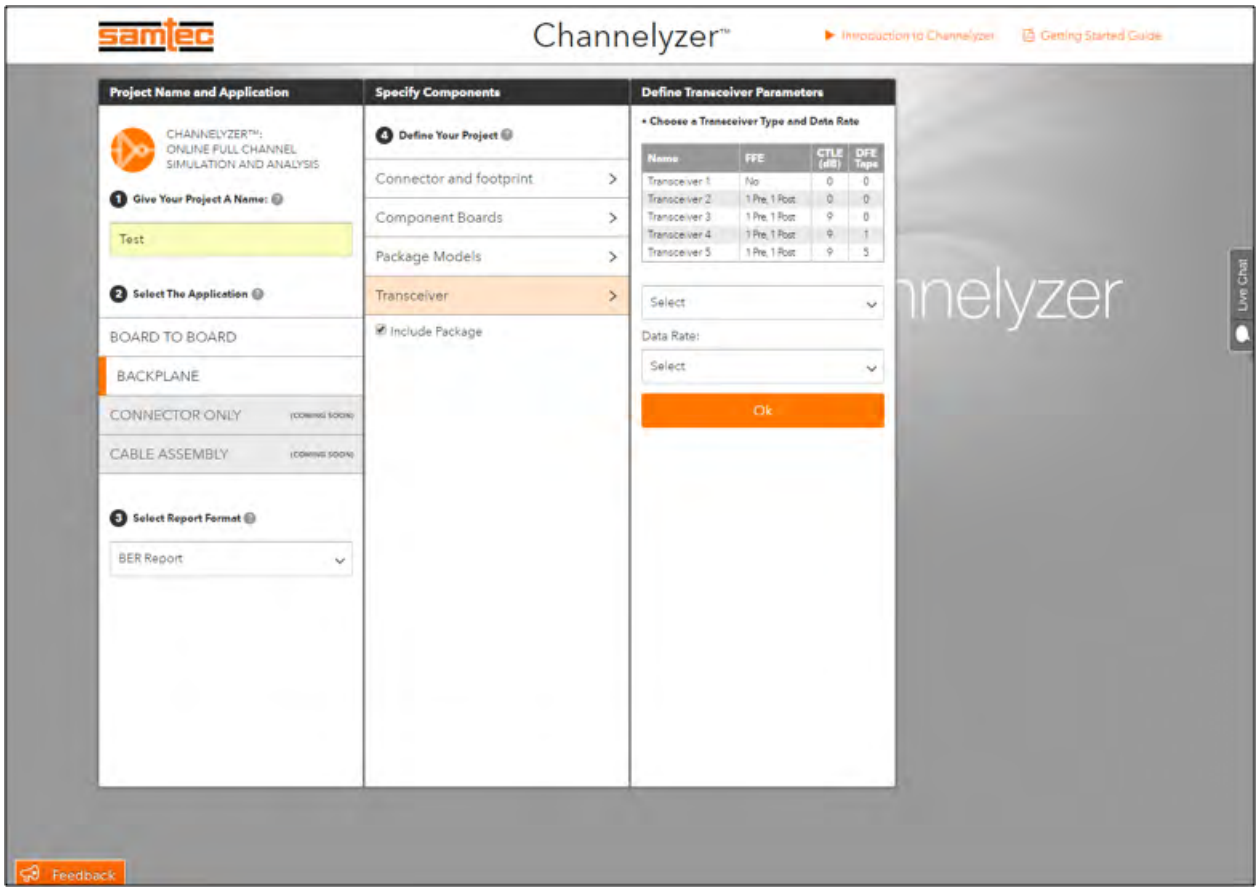

Figure 19 - Transceiver Parameter Options

Channelyzer™ supports 5 pre-defined transceiver models. Transceiver type levels are based on the amount of signal conditioning required:

- Transceiver 1 = Least amount of signal conditioning
- Transceiver 5 = Most amount of signal conditioning

Table 6 - Channelyzer™ Transceiver Types

Name	FFE	CTLE (dB)	DFE Taps
Transceiver 1	None	0	0
Transceiver 2	1 Pre, 1 Post	0	0
Transceiver 3	1 Pre, 1 Post	9	0
Transceiver 4	1 Pre, 1 Post	9	1
Transceiver 5	1 Pre, 1 Post	9	5

After selecting the appropriate Transceiver Type, users then pick the appropriate data rate supported by Channelyzer™:

- 10 Gbps
- 12.5 Gbps
- 16 Gbps
- 25 Gbps
- 28 Gbps

5.6 Project Summary

Pressing the "Project Summary" button enables the user to visually inspect and verify all of the system inputs. The user can also press multiple "View Chart In A New Tab" buttons to get additional technical details on the selections chosen. See Figure 20 for more details.

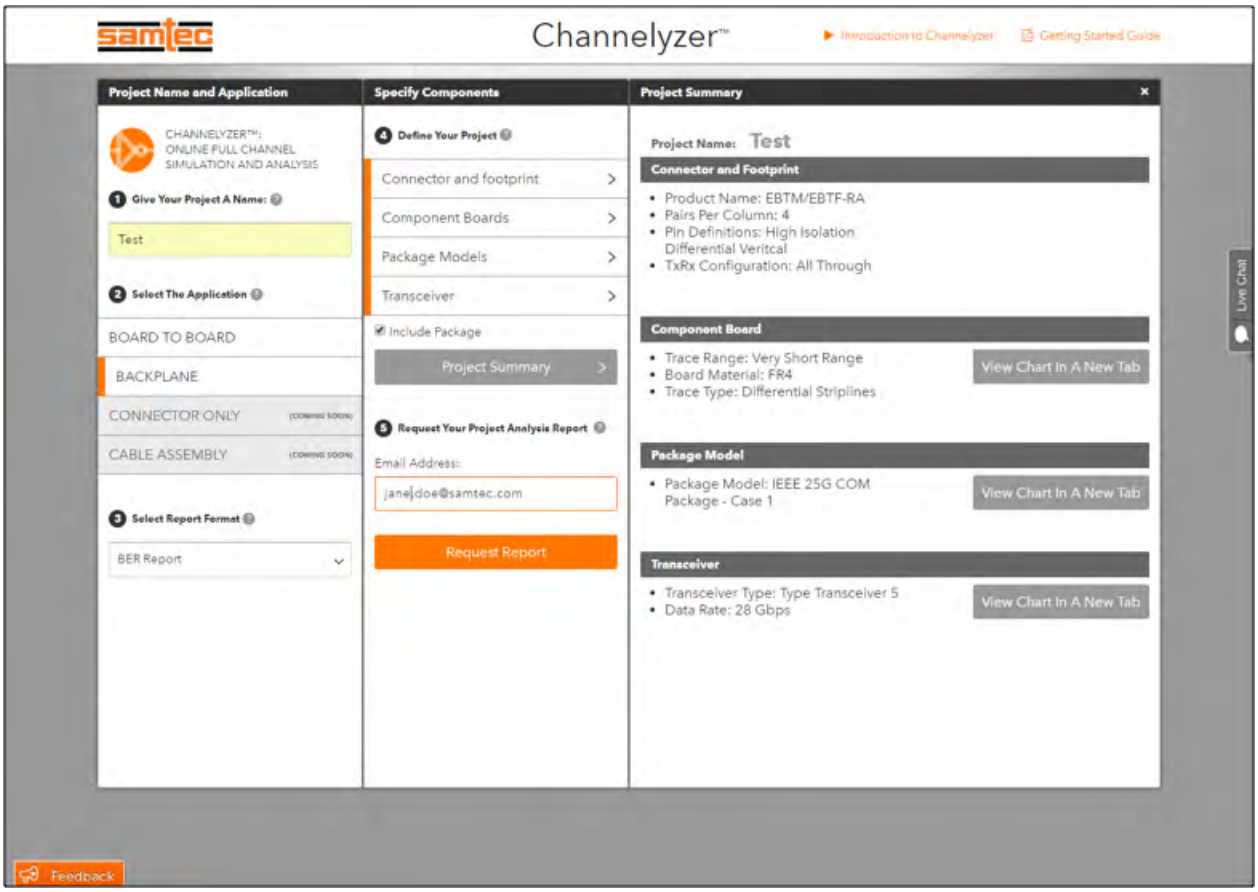

Figure 20 - Project Summary Details

6 Request Your Project Analysis Report

After the high-speed serial channel has been defined and verified by the user, the project analysis can be requested. Users must input a valid e-mail address. After pushing the "Request Report" button, Channelyzer™ will provide visual feedback that the request has been submitted. See Figure 21 for details.

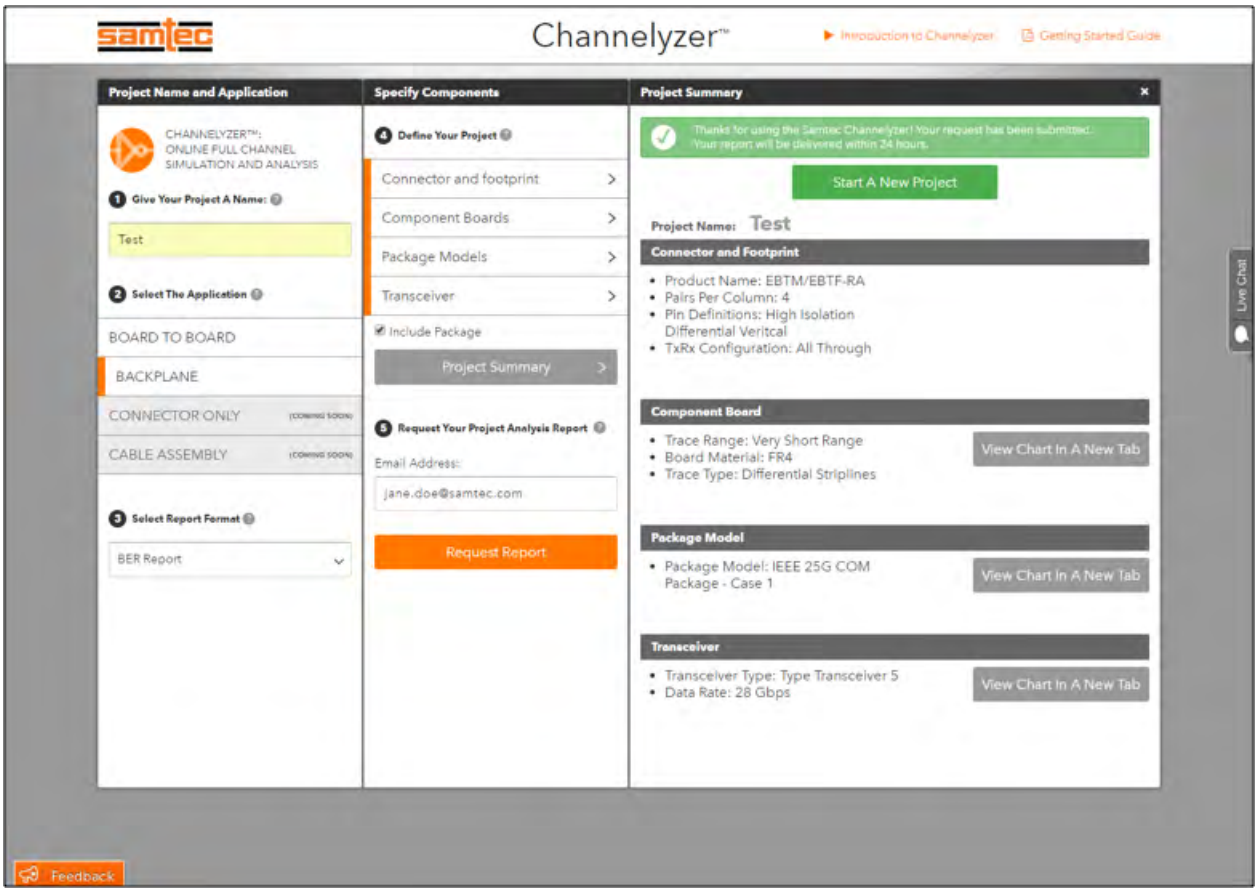

Figure 21 – Request Report Feedback

Users will then receive two e-mails. The first e-mail confirms that the request has been submitted and received by Samtec. The second e-mail contains the signal integrity simulation and analysis report based on the user defined inputs. Users should receive the second e-mail within 24 hours depending upon Channelyzer™ activity.

7 Technical Support

Samtec has provided several methods for users to receive support for any questions related to Channelyzer™. These include Tool Tips, the Channelyzer™ Chat feature and e-mail.

7.1 Tool Tips

Users may develop specific questions as they progress through a Channelyzer™ session. Samtec has provided Tool Tips along every step of Channelyzer™. These appear as a white question mark in a grey circle. Clicking on Test Tip enables a text box that provides additional details on that specific portion of the tool. Figure 22 provides an example of a Tool Tip.

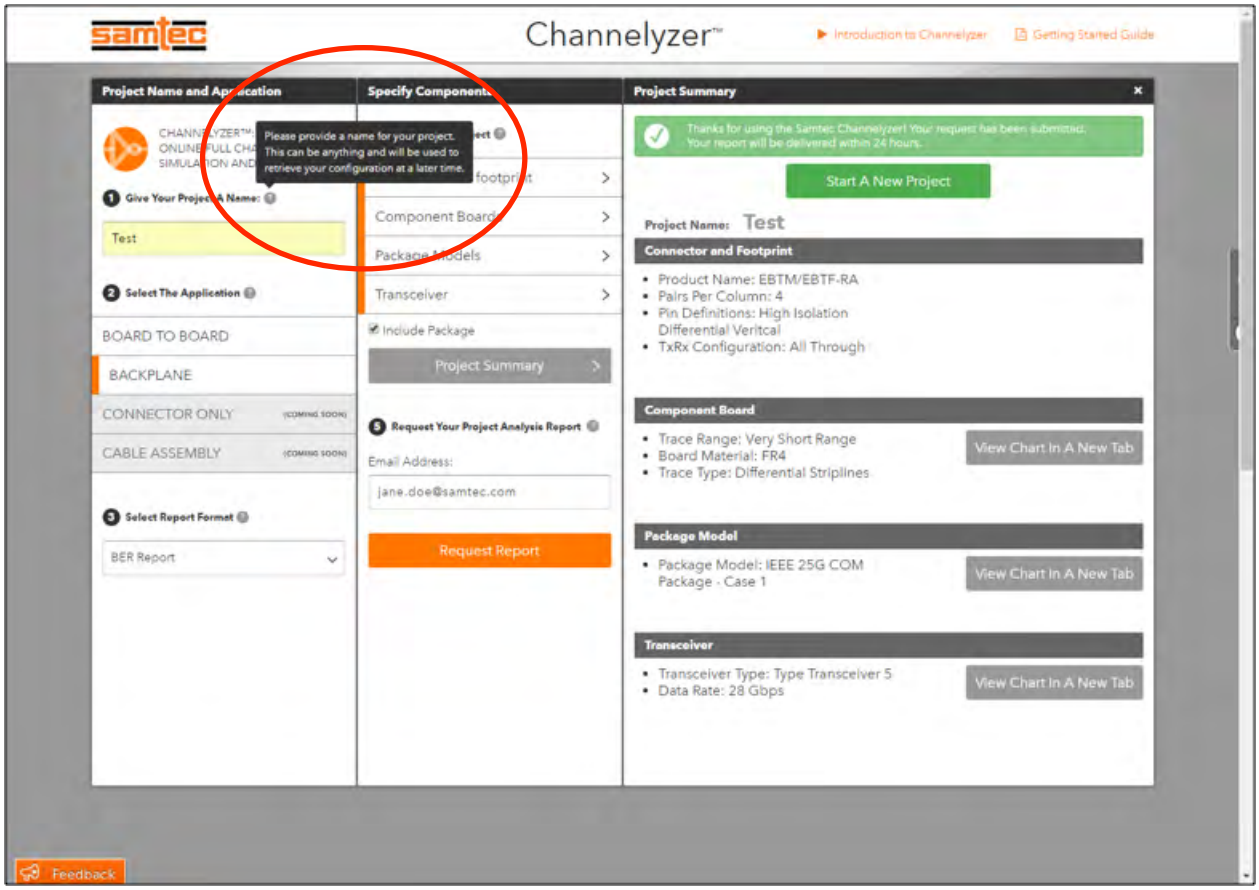

Figure 22 - Channelyzer™ Tool Tips Example

7.2 Chat

For immediate personal response, Samtec has included a "Live Chat" feature inside of Channelyzer™. As shown in Figure 23, the "Live Chat" tab on the right hand side of a Channelyzer session is available anytime for immediate support.

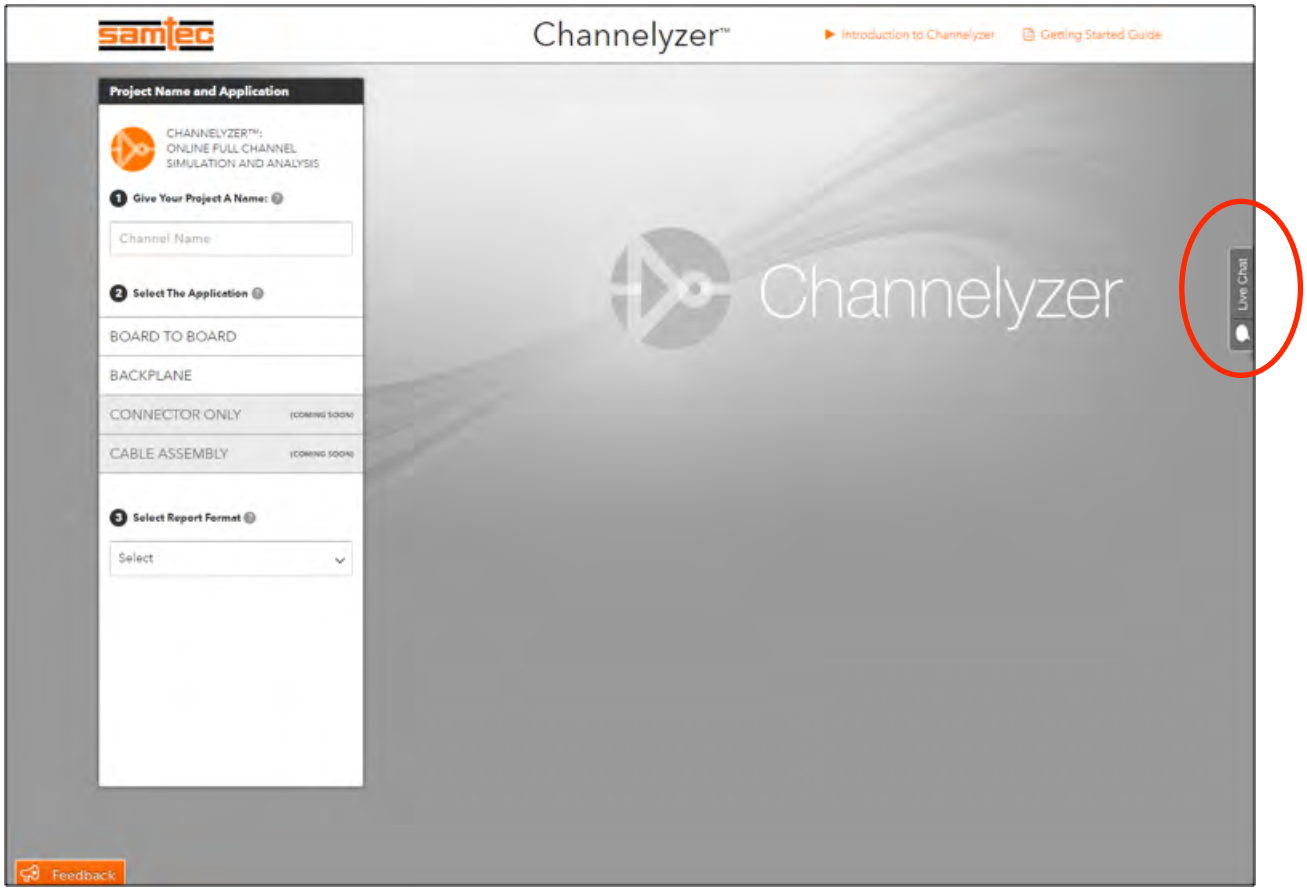

Figure 23 - Channelyzer™ Chat Tab

Users first click the "Live Chat" tab and then press "Start Chat." Users will then be asked to enter their name, e-mail address, and company name as shown in Figure 24.

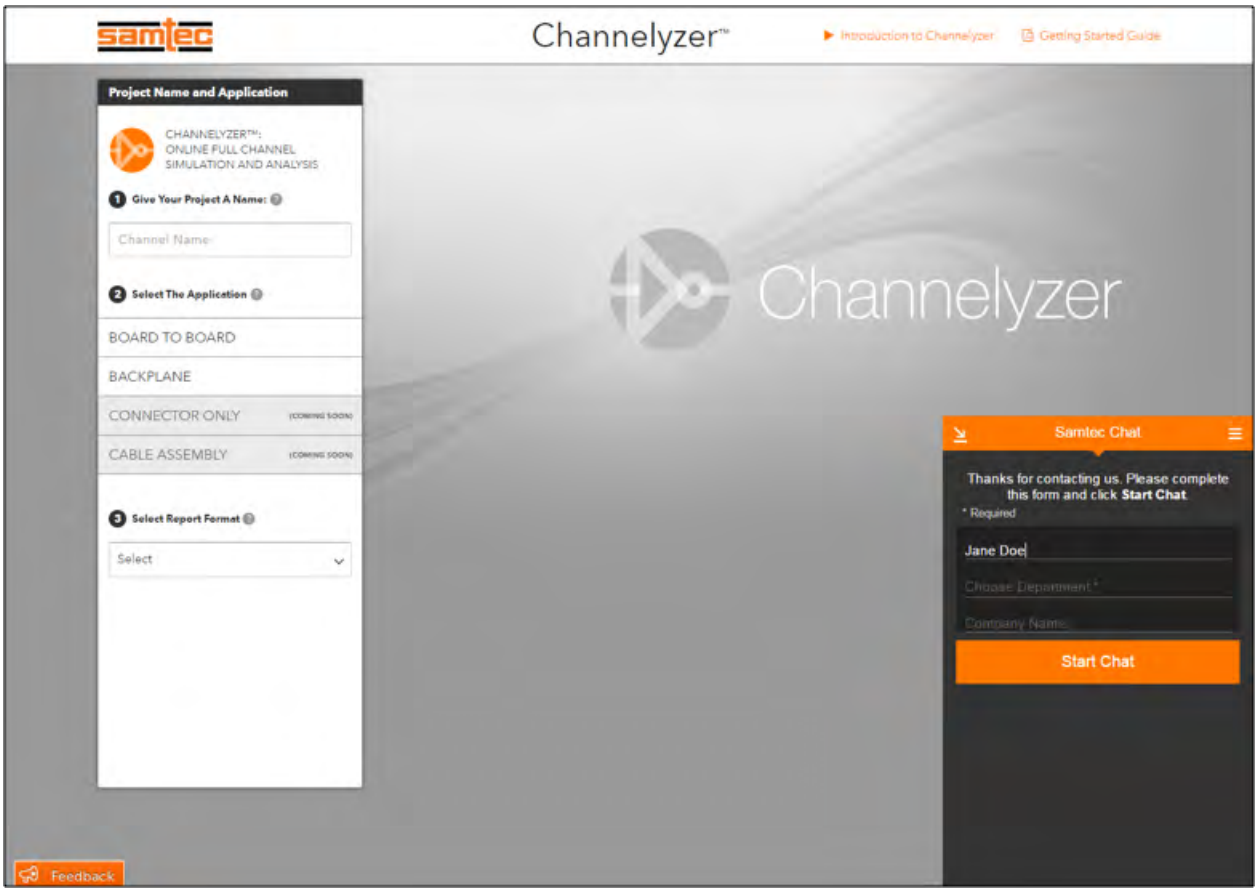

Figure 24 - Channelyzer™ Chat User Detail

Users can then select which Samtec department they want to chat with. Samtec department options include:

- Pricing and Delivery
- Order Status/Order Documents
- Custom Products
- Part Specs/Prints/Test Reports
- RF
- Cabling (IDC/Discrete Wire/IP68)
- High Power
- High-Speed Board-to-Board
- Application Support Group
- Other
- Web Help

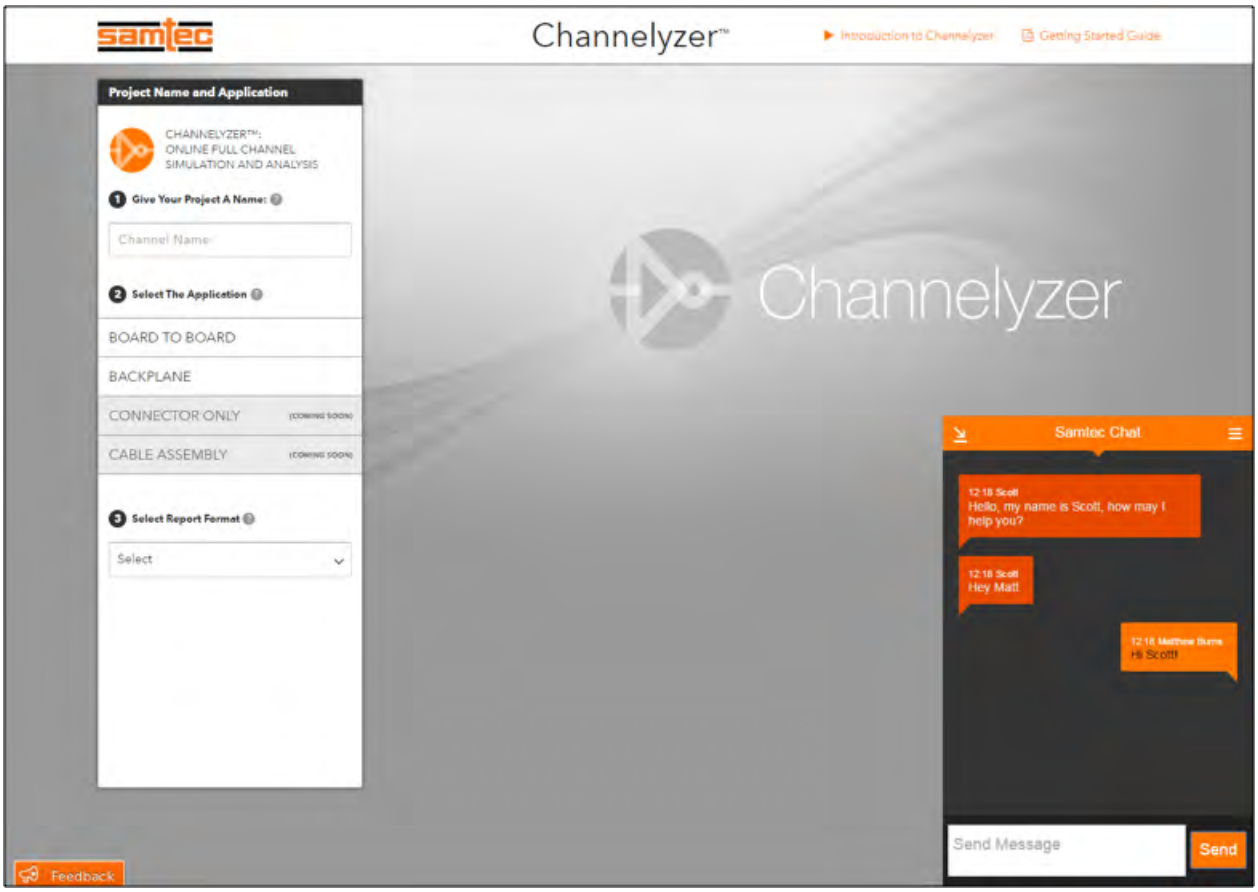

Figure 25 - Channelyzer™ Chat Tab Detail

After pressing "Start Chat" again, the appropriate Samtec associate will offer any needed support as shown in Figure 25.

7.3 E-mail

If Channelyzer™ users have any issues or questions with the tool itself, they can contact the Channelyzer™ development and support team at eHelpDesk@samtec.com.

For questions about Channelyzer™ test reports, high-speed serial channel simulation analysis or any other signal integrity related issues, please contact Samtec's signal integrity experts at SIG@samtec.com.

8 Feedback

As has been seen throughout this document, Channelyzer™ remains an organic tool with many features and capabilities to come. Users have the opportunity to provide suggestions and guide development of Channelyzer™ via the "Feedback" tab available in the lower left side of a Channelyzer™ session as show in Figure 26. The "Feedback" tab is always available during any Channelyzer™ session.

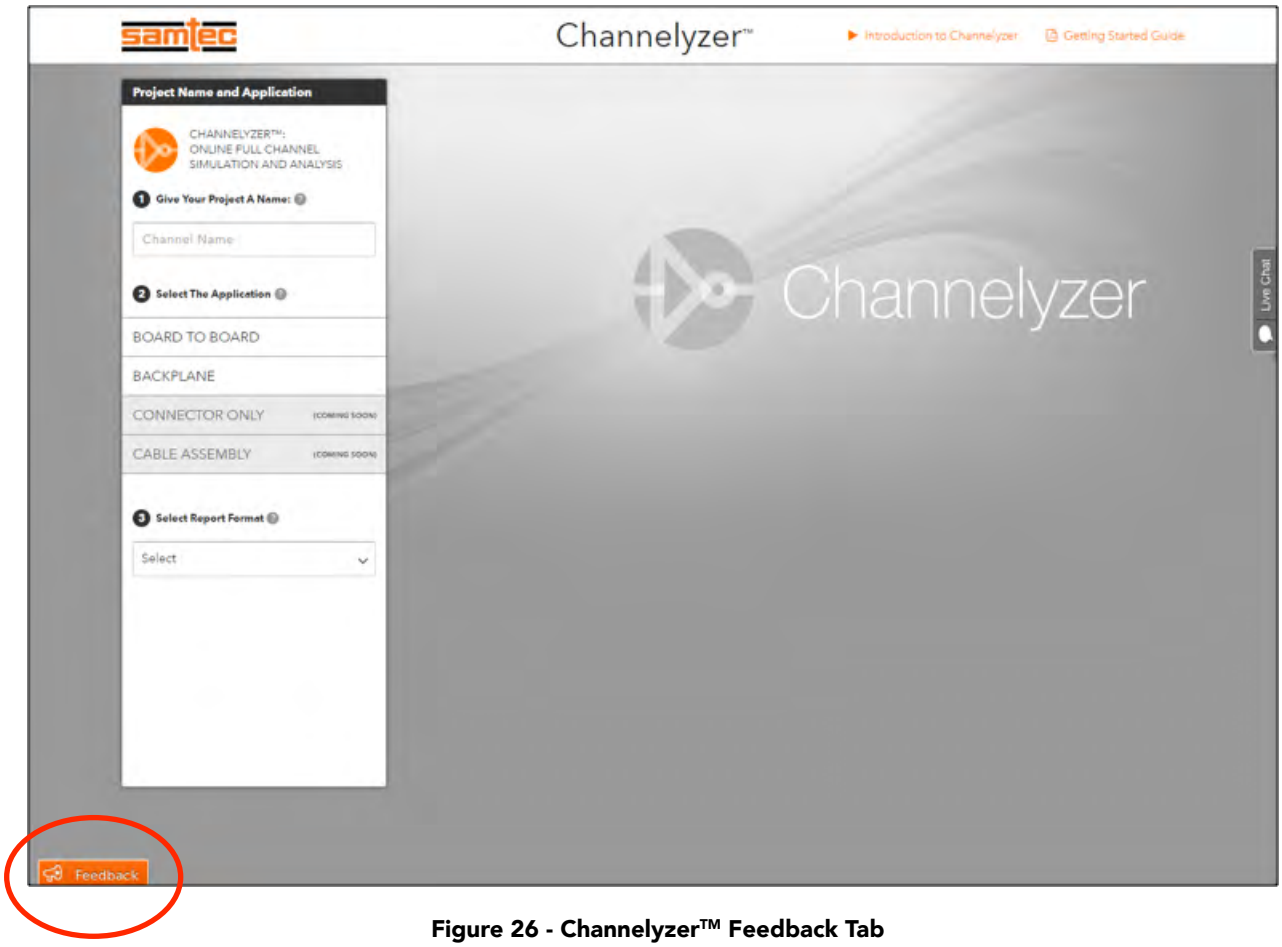

Figure 26 - Channelyzer™ Feedback Tab

After clicking on the "Feedback" tab, users can provide suggestions or request additional features using the accompanying pop up window as shown in Figure 27. Users have to supply a valid e-mail address before their feedback can be posted. All suggestions are monitored by the Channelyzer™ development team. Users may be contacted via e-mail for further detail on any suggestionsand improvements.

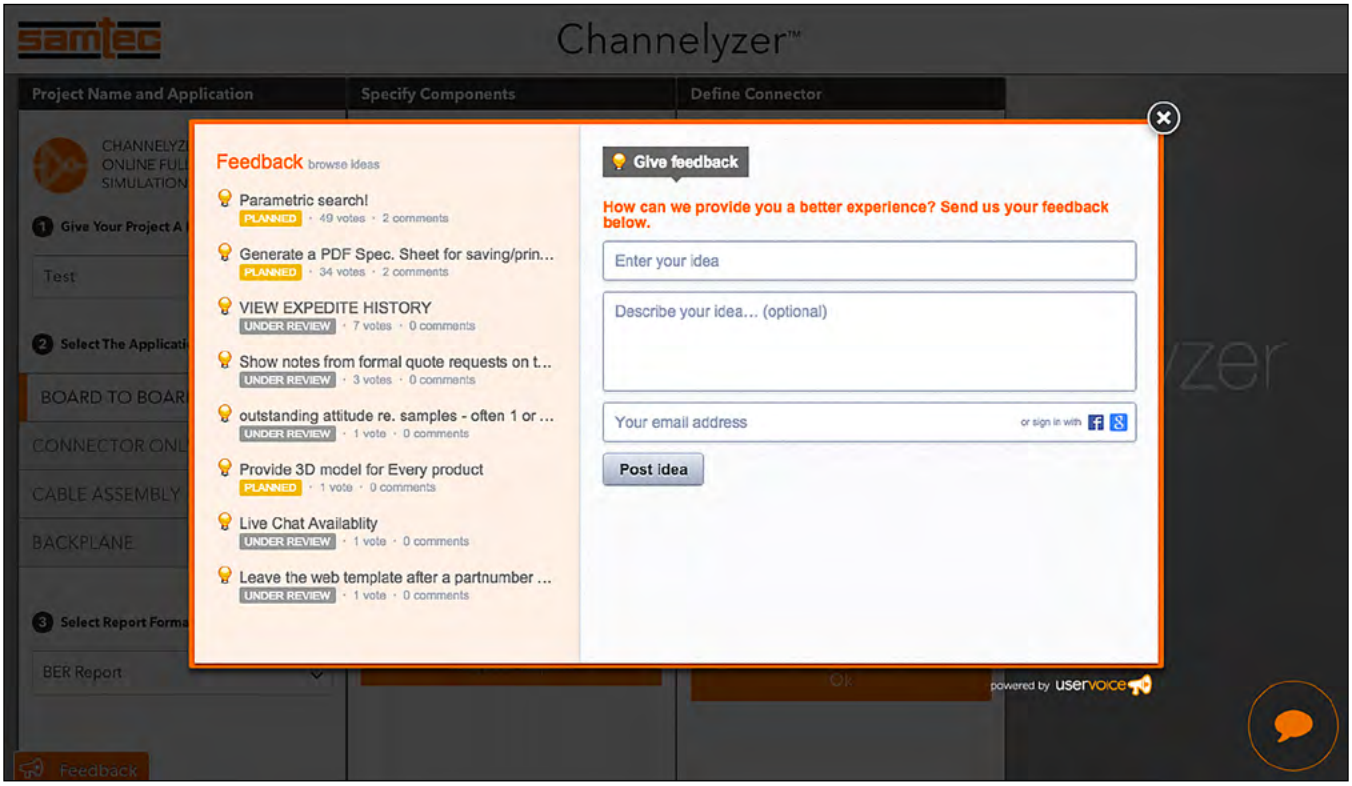

Figure 27 - Channelyzer™ Feedback Detail

9 Glossary

Acronym	Definition
BER	Bit Error Rate
COM	Channel Operating Margin
CTLE	Continuous Time Linear Equalizer
DFE	Decision Feedback Equalization
FFE	Feed-Forward Equalization
Gbps	Gigabits Per Second
GB/s	Gigabytes Per Second
GT/s	Gigatransfers per second
Rx Noise	Receiver Noise
PDE	Probability Density Eye
TOT XT	Total Crosstalk
Tx DD	Transmitter Dual-Dirac Jitter
Tx Noise	Transmitter Noise
Tx RJ	Transmitter Random Jitter

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