Application Note

# 3G SDI Evaluation Board

Revision Date: July 2, 2009



Developed in collaboration between
Samtec, Inc
Brioconcept Consulting
Gennum Corporation

**System:** 3G SDI Evaluation Board
**Standard:** 3G SDI (SMPTE-424)

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Brioconcept Consulting Inc. is an emerging business in the field of design contractor. The business offers services from turnkey solutions to high speed design, high speed simulation as well as thermal simulation. Brioconcept Consulting Inc can support you with all the common issues known in video such as the pathological problems, the return loss and more… Mr. Lavoie is the president and the co-founder of Brioconcept Consulting Inc. His formal training is in Electronic Engineering and he has spent over 14 years developing digital video products and high speed products. He can be reached at rlavoie@brioconcept.com

About Samtec Inc

Samtec, Inc. is a worldwide manufacturer of P.C. Board level interconnects. Worldwide Samtec sales for 2008 were approximately $409 million. Samtec was founded in 1976 and is privately held. Samtec, Inc. is ISO/TS 16949:2002, ISO 9001:2000, and ISO 14001:2004 registered with a 5-A1 Dun and Bradstreet rating, the highest available for a corporation this size. At Samtec, we focus on creating superior capabilities and differentiation within niche products and markets, and we have six Core Values that have become our Mission Statement to assist us in achieving this goal.
www.samtec.com

About Gennum corp.

Gennum Corporation (TSX: GND) is a leading designer and manufacturer of semiconductor solutions for the global video and data communication markets. A winner of a Technical Emmy® award for advances in high definition (HD) broadcasting, Gennum's broad portfolio of products and technologies include image processors, video timing and transport products, ICs for optical transceivers and backplane interconnects. Gennum is headquartered in Burlington, Canada, and has global design, research and development and sales offices in Canada, Japan, Korea, Taiwan and the United Kingdom.
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# Abstract

The video broadcast market has been forced to increase the speed of the serial digital interface (SDI) to meet the higher resolution and picture quality required for the 1080p television and digital cinema.

The SMPTE-424 standards specify SDI rate equal to 2.97Gbps and 2.97Gbps/1.001. This high speed stream is transmitted over 75 ohm coaxial cable. To ensure product compatibility, OEM manufacturers' must respect the tight return loss specifications.

This Application Note first describes the evaluation board developed by Brioconcept consulting in collaboration with Samtec and Gennum. Additionally, this document explains what parts have the most impact in the video circuit's IRL (input return loss) and on the ORL (output return loss). Finally, this document provides the simulation, and the lab results lead by Brioconcept.

**Figure 1. 3G SDI Demonstration Board**

A User Guide explains how to use the board. All the documents including schematics can be found at http://www.brioconcept.com/download/EVB-3G/ or at www.samtec.com.

 

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# Introduction

This Application Note is separated into the circuit's basic blocks: the BNC connector, the microstrip line (with or without via), the second connector that connects the passive and the active board, the adaptive network composed of a resistor and inductor. Finally, the path is terminated by the Equalizer or cable driver itself.

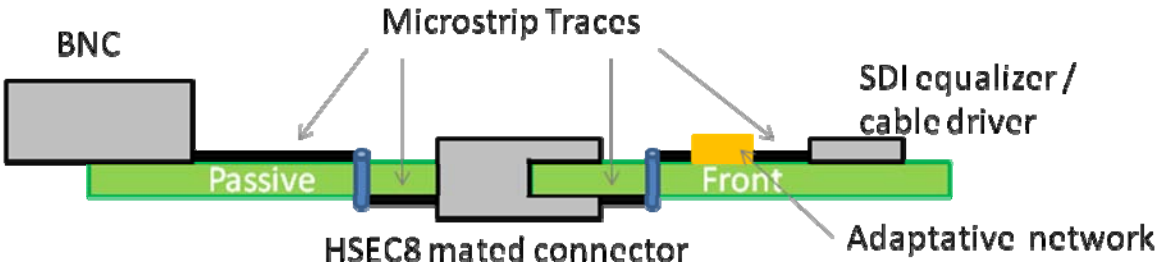


Figure 2. Mated passive and active module

# Full Channel Path Description

The following picture shows the basic blocks for the equalizer/cable driver path.

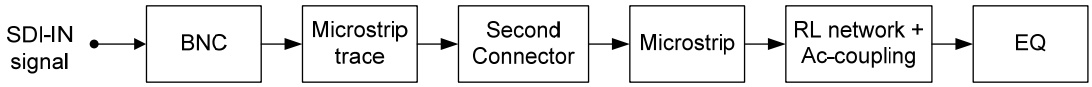


Figure 3. Entire circuit's path

This block diagram shows the typical application for hot swappable board. Extra circuits can be added to handle the analog video signal on the same BNC; those extra circuits are not in the scope of this document.

## BNC Connector

The BNC connector itself is a controlled structure with constant impedance. In our case, the BNC matches the 75 ohms impedance +/- 5%. Samtec's true 75 Ohm BNC edge mount connector part number is BNC7T-J-P-HN-ST-EM1.[1]

[1] Samtec connector - Edge mount: BNC7T-J-P-HN-ST-EM1, Right-angle: BNC7T-J-P-HN-RA-BH1 and straight: BNC7T-J-P-HN-ST-TH1

 

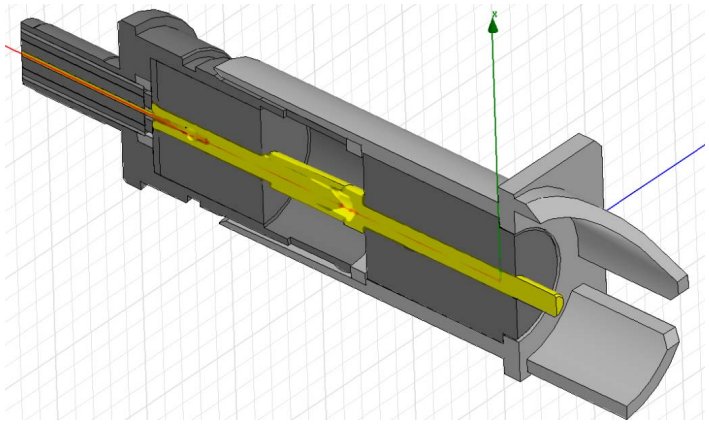

**Figure 4. Mated edge mount BNC model's**

The previous figure shows that the 75 ohm is maintained, i.e. the center pin is wider when the dielectric is the air and smaller when the dielectric is the PTFE.

A major concern when designing with connectors is board escaping sometimes referred to as the “breakout region”. Brioconcept and Samtec have tried different configurations to demonstrate how to optimize the board escaping. Each breakout region is connector specific.

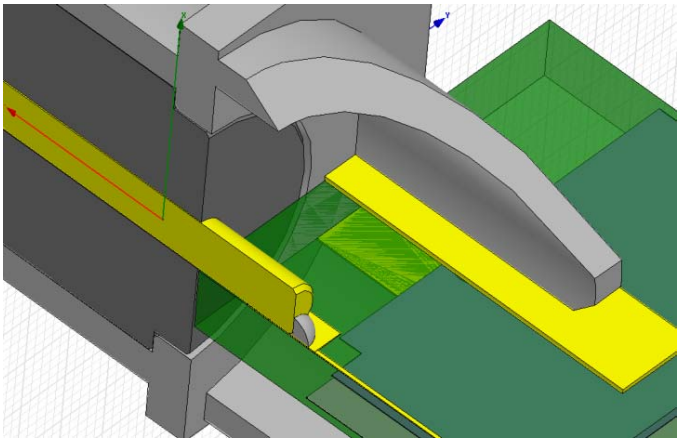

**Figure 5. Edge mount BNC's Breakout region**

The breakout region is the critical part of the transmission line. Special attention on this section needs to be paid to minimize the parasitic capacitance under the connector’s pins, the signal return path. This state-of-the-art footprint has been optimized by Brioconcept’s team with Ansoft HFSS™ (a 3D full wave solver).

 

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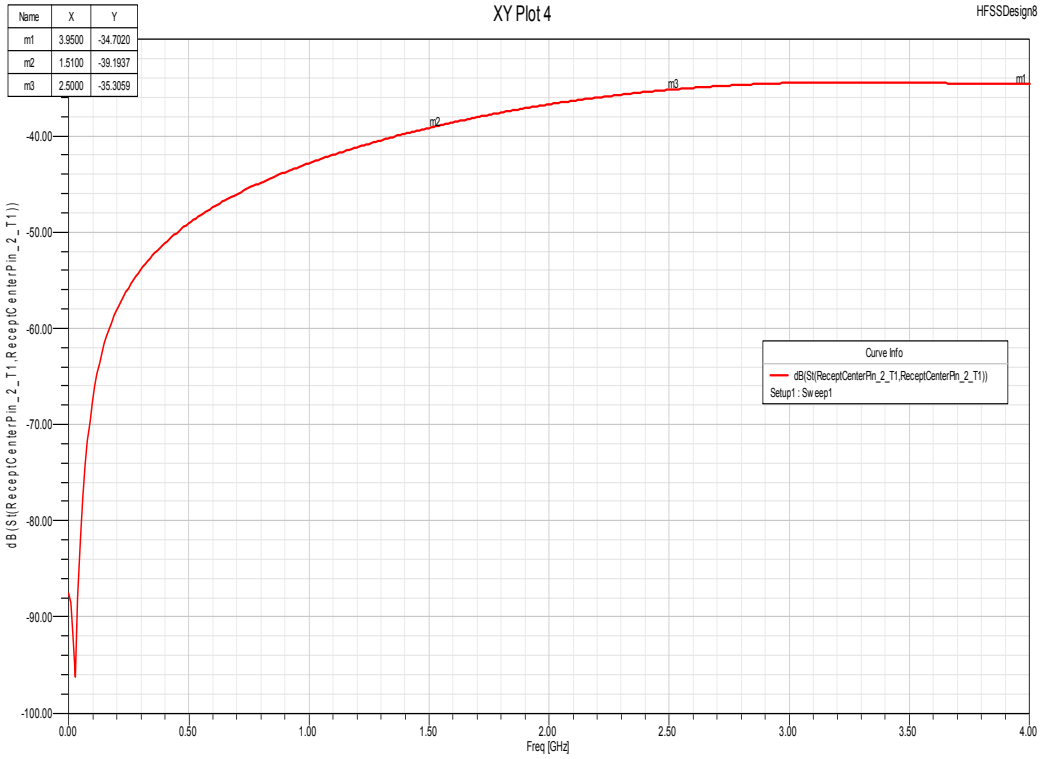


**Figure 6. Mated Connector and footprint return loss**

## Microstrip Line

The passive board thickness is 63 mils with two grounds in the middle. The distance between the top traces and the ground is 10 mils. The microstrip transmission line is 7 mils wide. Care should be taken if the microstrip trace is narrower than 5 mils over FR4 or equivalent, loss due to skin effect and over etching become more significant.

## Second Connector

The active-passive board connection could be accomplished by various connector solutions. Brioconcept has chosen Samtec's HSEC8-130-01-S-D-EM2 connector for its price, high speed performance, and the large selection of models inside the HSEC8 Series family.

The HSEC8 Series connector has been designed for 50Ω single-ended and 100Ω differential signals. Brioconcept with HFSS™ adjusted the ground and signal configuration to be 75 Ω single-ended inside the HSEC8 Series.

 

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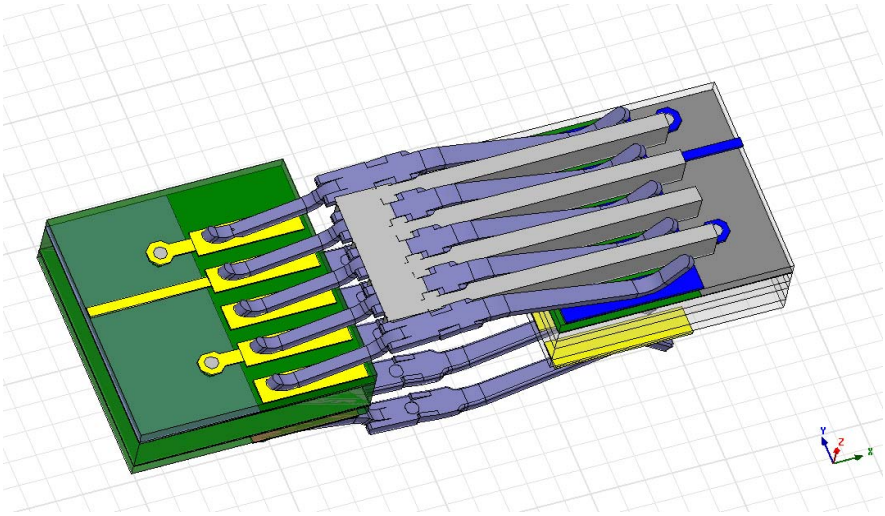

**Figure 7. Mated HSEC8 with 75Ω trace configuration**

The evaluation board demonstrated is one of the tightest HSEC8 Series configuration without any crosstalk issues (the input signals are voluntary placed close to the outputs to reflects the worst case scenario).

To achieve the 75 Ω single-ended trace inside the HSEC8 Series, one of the closest pins have been left floating, so the final configuration is ground – float – trace – ground. The return loss of this configuration is show in the following picture.

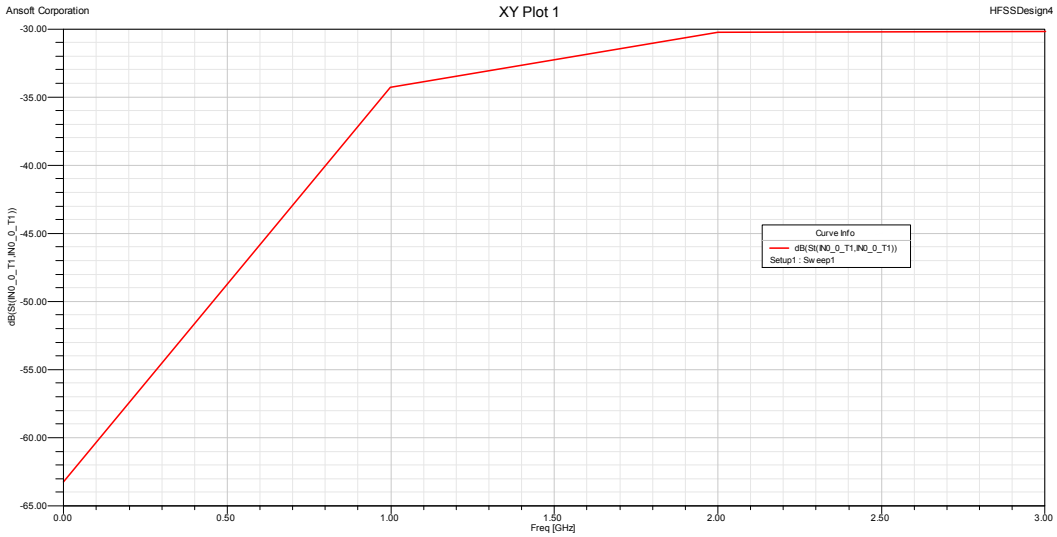


**Figure 8. Mated HSEC8 return loss at 75 Ω**

 

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### RL Network

The matching network is used to optimize the return loss. The component should be placed as close as possible to the equalizer/cable driver. The ground underneath the components should be removed to reduce the parasitic effect (impedance mismatch).

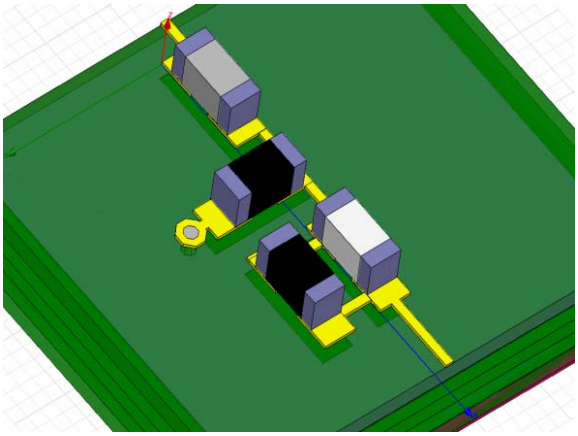

**Figure 9. Matching network**

### EQ/Cable Driver

The equalizer and cable driver have been modeled in HFSS™ to give more precise simulation results. The generated model is Gennum's proprietary and cannot be published in this application notes.

## Characterization Results

This section shows the simulation result compared with the empirical measurement. The simulation ensures the design has enough margins to palliate for the PCB process, etching, and components variations.

### Return Loss Specification

The specification stipulate a return loss lower than -15dB from DC to 1.5 GHz and a lower than -10dB from 1.5 GHz to 3 GHz (SMPTE-424).

 

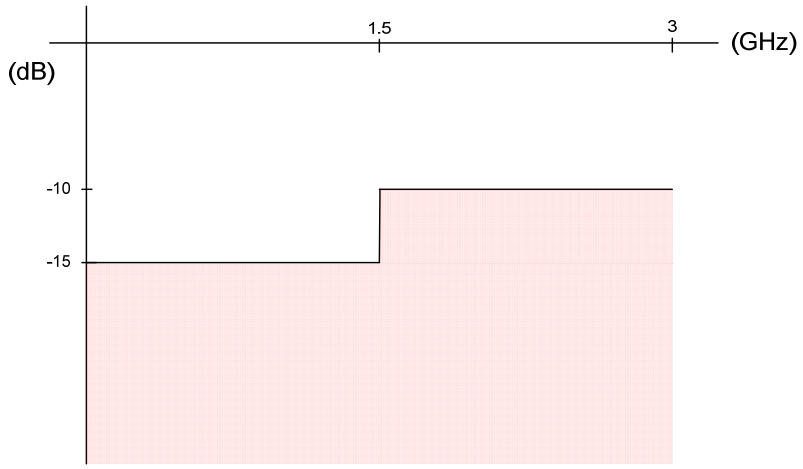


**Figure 10. Return Loss SMPTE specification.**

The final comparison shows the results of the entire path (refer to Figure 3). The first image shows the simulation and the second shows the empirical measurement.

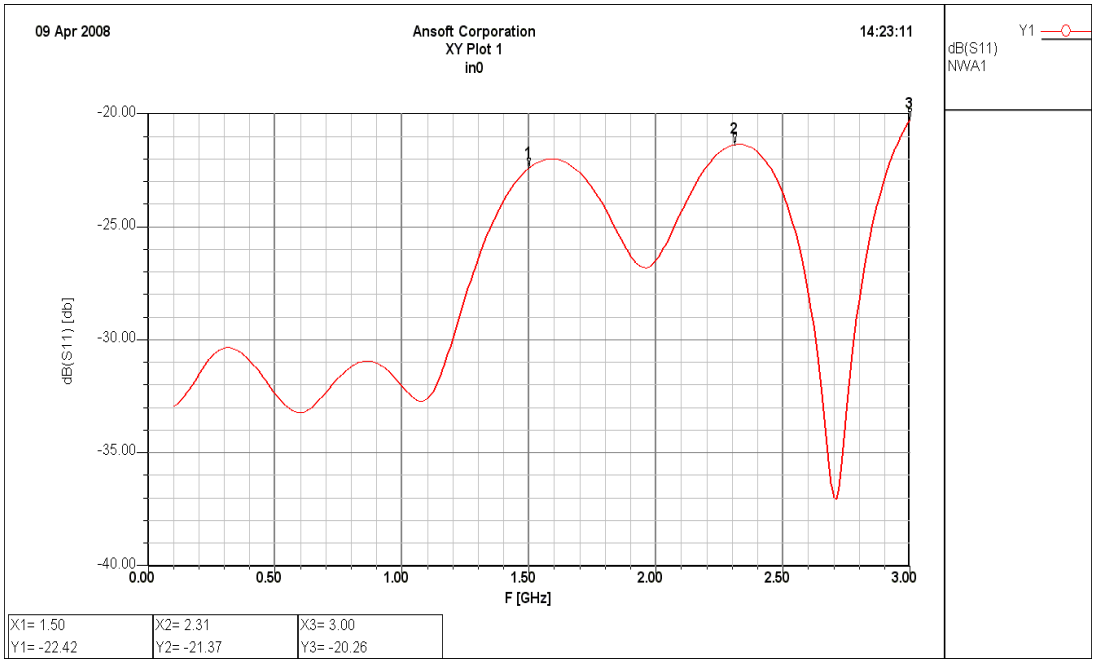


**Figure 11. Simulation result**

 

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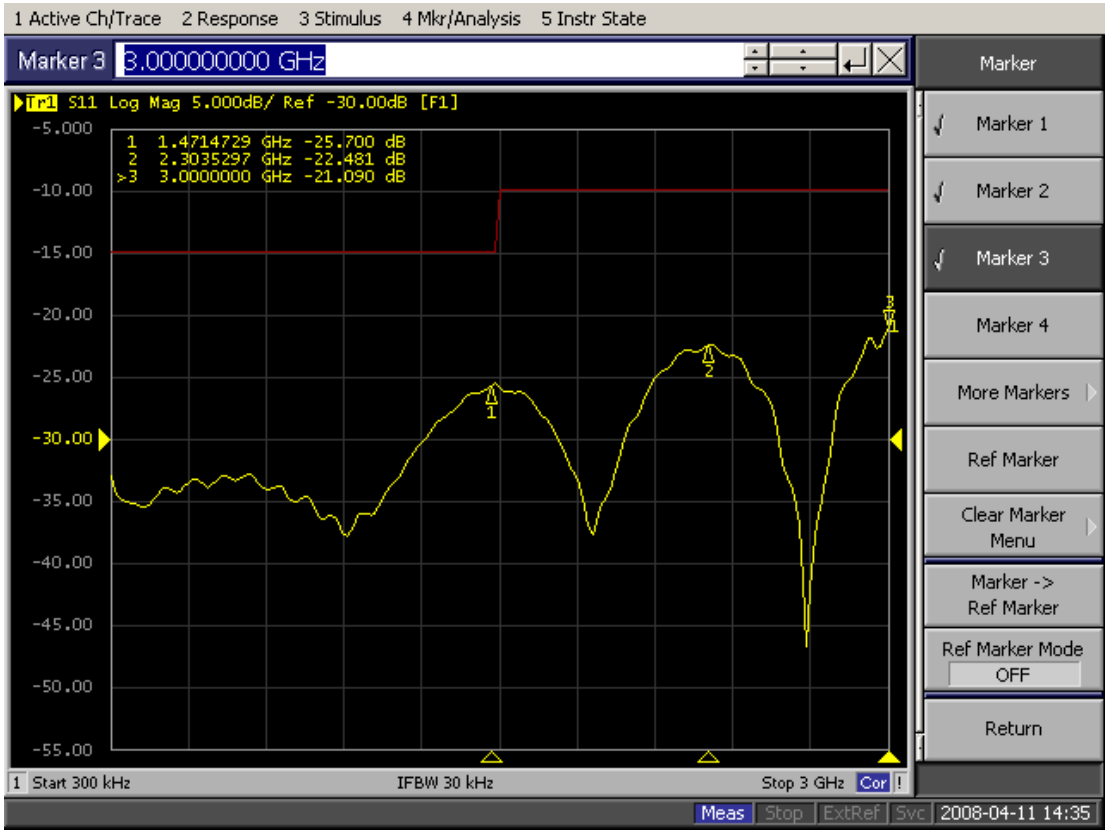


**Figure 12. Empirical Measurement**

## Conclusion

This SMPTE compliant evaluation board demonstrated the possibility of designing a SDI path that includes two connectors (one Samtec BNC7T Series true 75 ohm BNC connector and one Samtec HSEC8 Series connector). Additionally we have presented our simulation model and results to prove that simulation and good design practices can significantly reduce the time-to-market for those product. Finally the connectors and active parts should be chose carefully to ensure a good return loss and repetitive results.

 