APPLICATION NOTE

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APPLICATION NOTE
Improving Insertion Loss Budgets by using VersaLink Bridge

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REVISION HISTORY

REVISION	DATE	REVISED PAGES	REVISIONS
1	4/14/2021		Engineering Release

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1.0 Purpose

This document describes the advantage of using Glenair's VersaLink Bridge solution to maintain high speed signal integrity that is otherwise degraded when a conventional PCB microstrip topology is employed.

2.0 Referenced Documents

Document Number/Name	Description
GT-19-284	Signal Integrity Characterization Report For Glenair VersaLink Connectors
853-064	VersaLink Pin Connector
853-065 and 853-067	VersaLink PCB Connectors
691-CB151	VersaLink Connector Test PCB
691-CB232	Microstrip Test PCB
963-043-26	100 Ohm Impedance Matched Twinax Cable
691-CB229	Twinax Cable to SMA Test PCB

3.0 Responsibility

This document is the responsibility of the Engineering team.

4.0 VersaLink Bridge to PCB Microstrip Performance Comparison

4.1 Measured Performance

Twelve-inch and six-inch PCB microstrip signal data was measured and compared to VersaLink Bridge test data. Test articles used for this note are depicted in Figure 1.

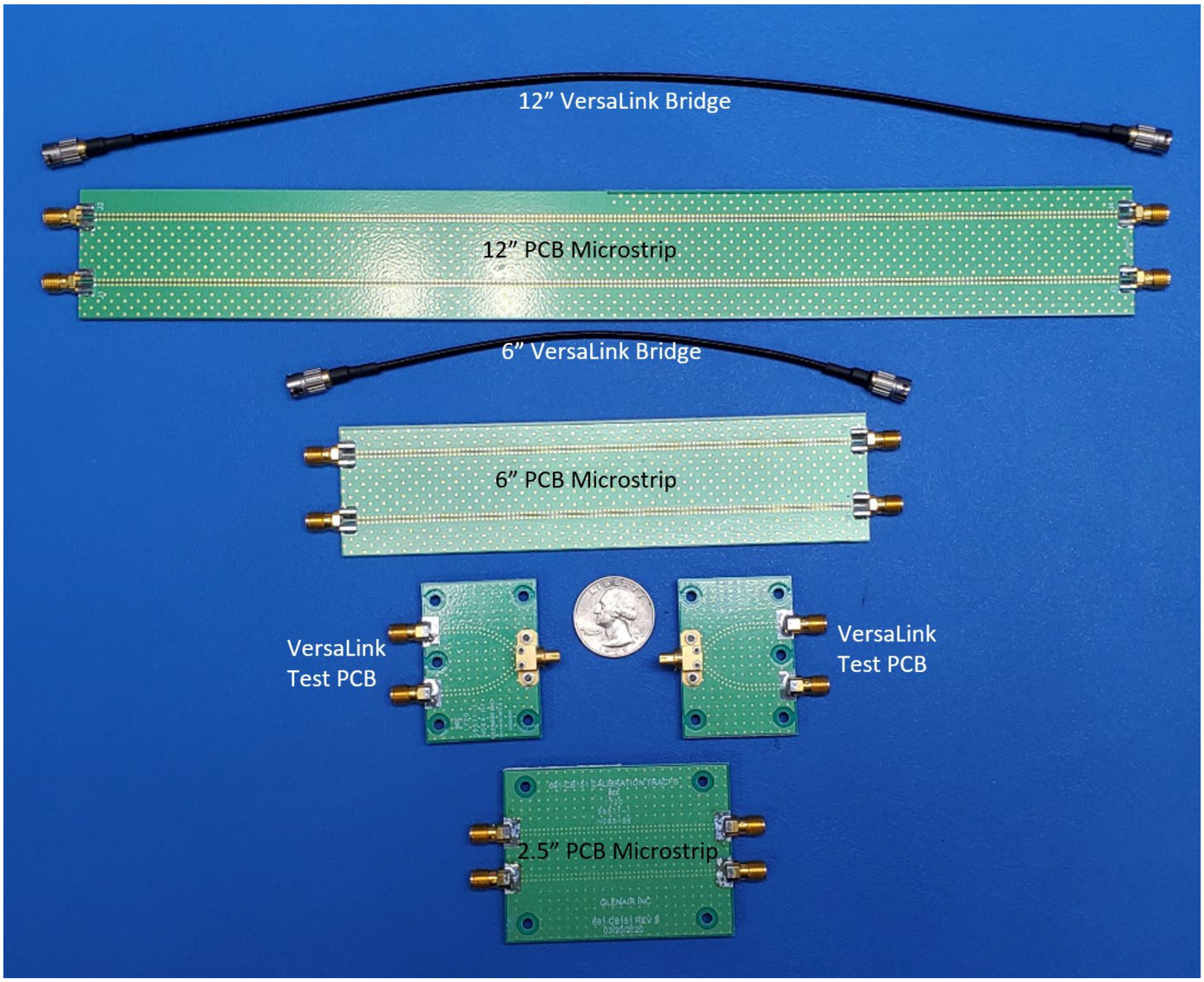

Figure 1 – Comparison Test Articles

Figure 2 shows the PCB installation and connection of the VersaLink Bridge.

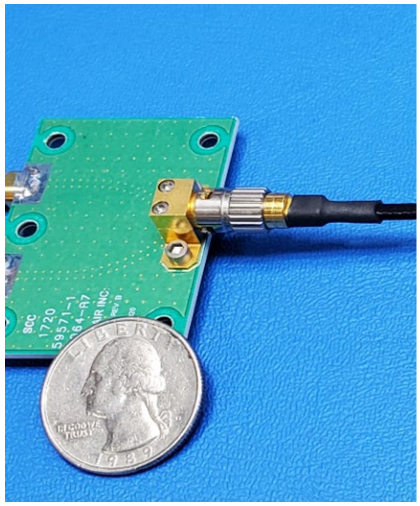

Figure 2 – Installation/Connection of VersaLink Bridge

Further details of the VersaLink Bridge test can be found in Glenair test report GT-19-284.

Insertion losses of the test cases are shown in Figure 3.

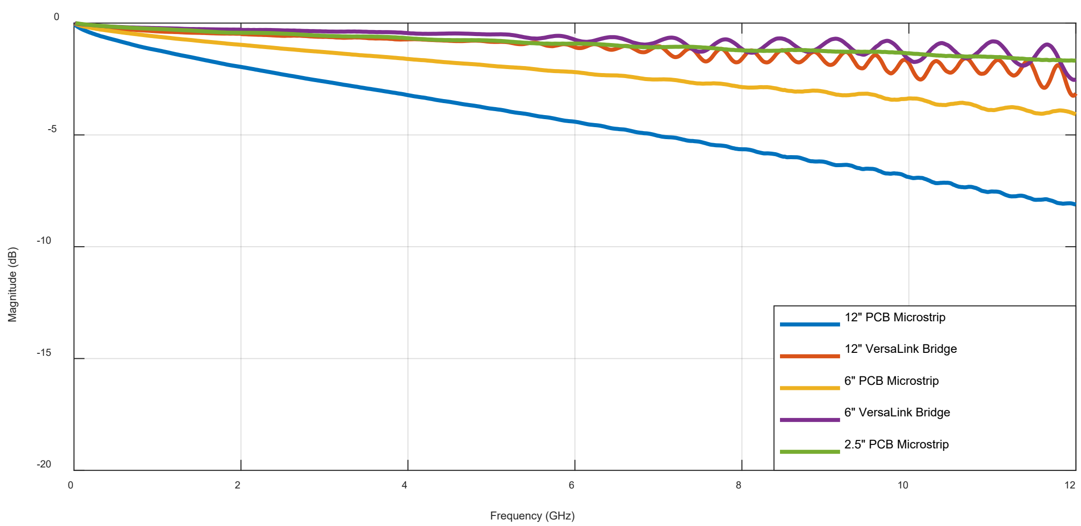

Figure 3 – VersaLink Bridge and PCB Microstrip Insertion Loss

Note that the 12” VersaLink Bridge insertion loss performance matches closely with that of the 2.5” PCB differential microstrip. An equivalent length VersaLink Bridge gains 5dB of channel margin over a very low loss 12” PCB differential microstrip at 10GHz (20Gb/s data rate).

The monotonic drop of the insertion losses was fitted with first order equations and Table 1 shows the loss rate (slope) as a function of frequency.

Item	Loss Rate (dB/GHz)
2.5" PCB Microstrip	-0.13
6" PCB Microstrip	-0.31
12" PCB Microstrip	-0.63
6" VersaLink Bridge	-0.12
12" VersaLink Bridge	-0.18

Table 1 – Loss Rates

The VersaLink Bridge has the advantage of a much lower loss per hertz as compared to a PCB microstrip topology. A 12” PCB microstrip has a loss rate 3.5 times greater than that of a 12” VersaLink Bridge.

4.2 Cable Considerations

An important component of the VersaLink Bridge is the cable. Glenair cable 963-043-26 was used for the VersaLink Bridge tests of Section 4.1. High-speed data was measured for three lengths of 963-043-26 using the Twinax to SMA test PCB, part number 691-CB229. The resulting insertion loss is presented in Figure 4.

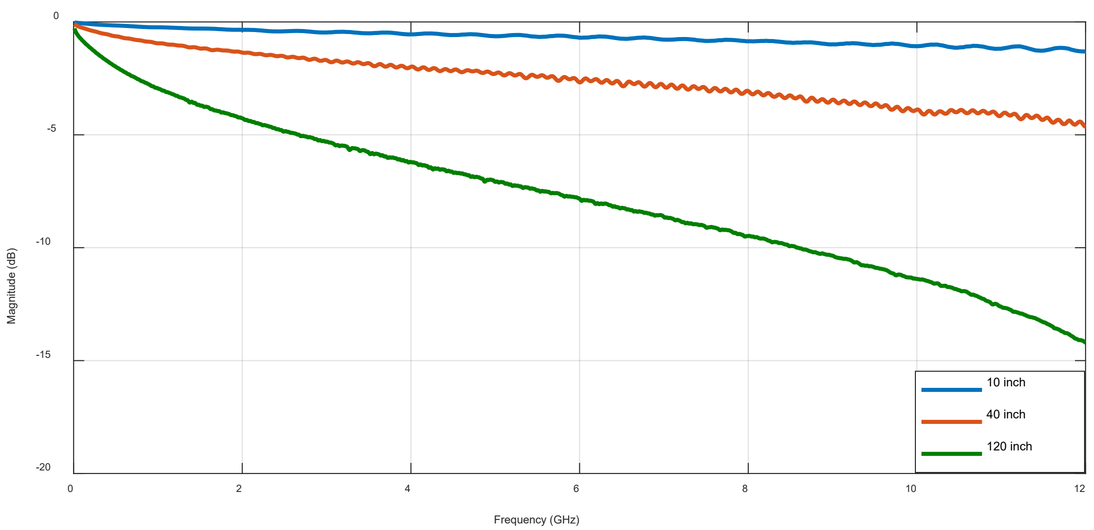

Figure 4 – Twinax Cable Insertion Loss

The following RF cable loss formula was used to calculate the 963-043-26 K factors from fitting the normalized insertion loss data:

$\alpha = K1\sqrt{f} + K2 * f$

where,

α is attenuation in dB/100ft, and f is frequency in MHz

The resulting K factors for 963-043-26 are:
K1 = 0.6803
K2 = 0.004677

Figure 5 shows a plot of the K factor derived cable loss fit against measured insertion loss data.

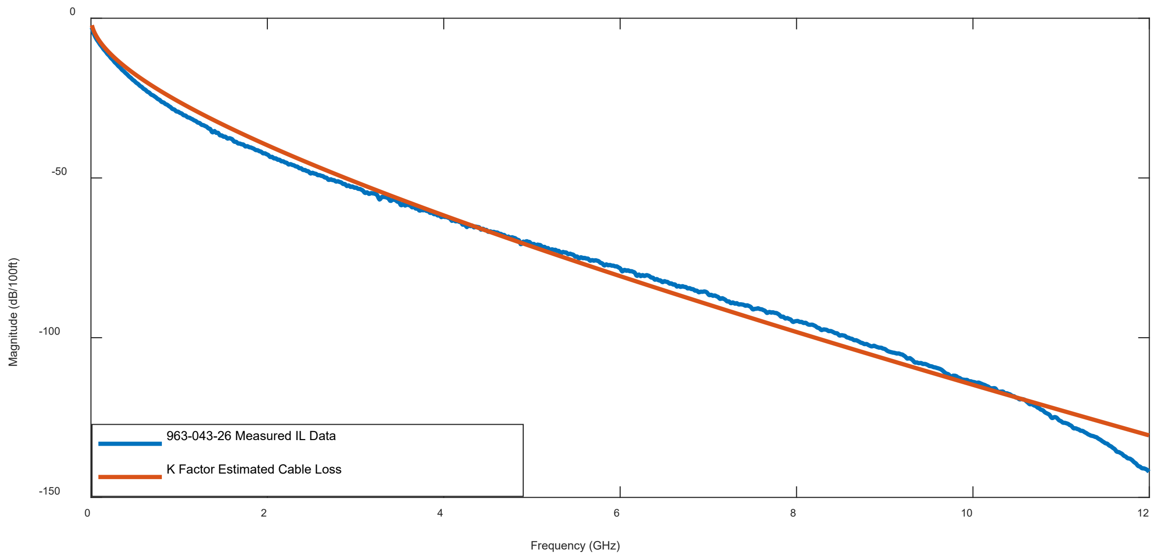

Figure 5 – Measured Cable Loss to Estimate Loss Fit

Table 2 compares the K values of a couple of similarly sized coaxial cables.

Manufacturer	Cable	K1	K2
Times Microwave Systems	SF-316	0.708	0.0012
Harbour Industries	LL120	0.41	0.0001785
Glenair	963-043-26	0.6803	0.004677

Table 2 – K Value Comparison

4.3 PCB Material Effects

Another important consideration is that the measured PCB microstrip performance data of Section 4.1 is obtained from boards with very low loss microwave grade PCB material (Dk = 2.9, Df = 0.002). Further advantage of the VersaLink Bridge can be seen over common high-speed PCB materials employing a microstrip topology. A case for a 12” link is considered below.

Using PCB signal integrity tools, insertion loss for a 12” microstrip was calculated for various high-speed PCB materials. Figure 6 graphs the insertion loss of a 12” VersaLink Bridge (measured) and various 12” high-speed PCB microstrips (measured and simulated).

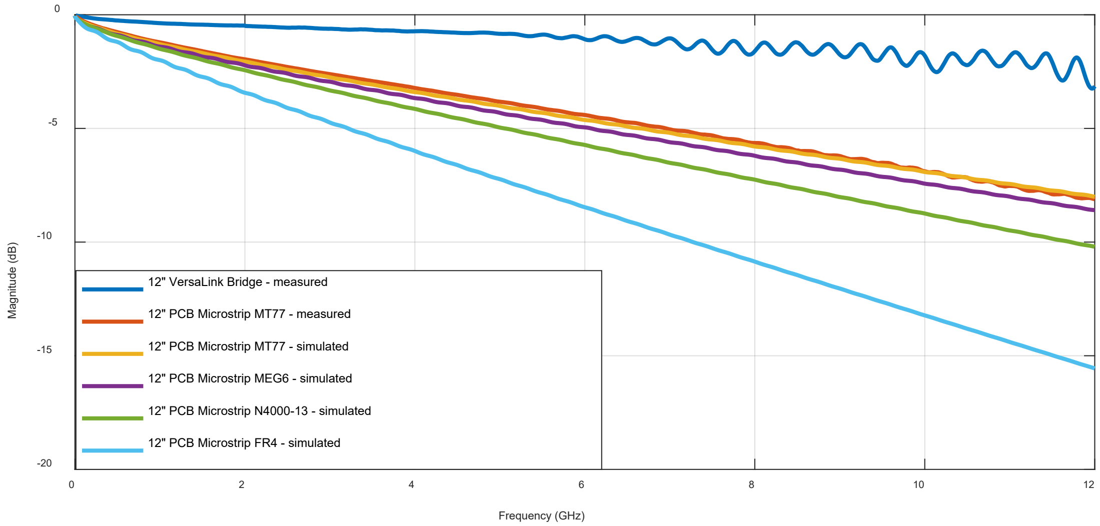

Figure 6 – 12" Link Insertion Losses

Figure 7 shows only the measured 12" PCB IL data and the simulated MT77 data to validate the accuracy of the simulated data.

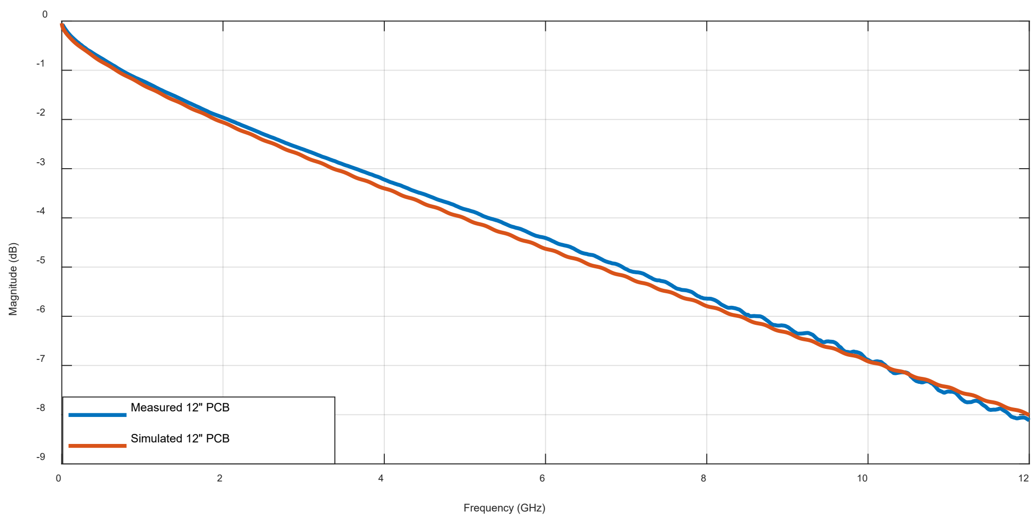

Figure 7 – 12" Link Insertion Losses

So, it can be seen that even more margin is gained by using the VersaLink Bridge over more common high-speed PCB materials.

4.4 Summary

Direct measurements show the VersaLink Bridge solution provides better signal integrity, thus dB gain, over PCB microstrips. Figure 8 summarizes the loss/ft at 10GHz for the VersaLink Bridge and the PCB microstrip materials.

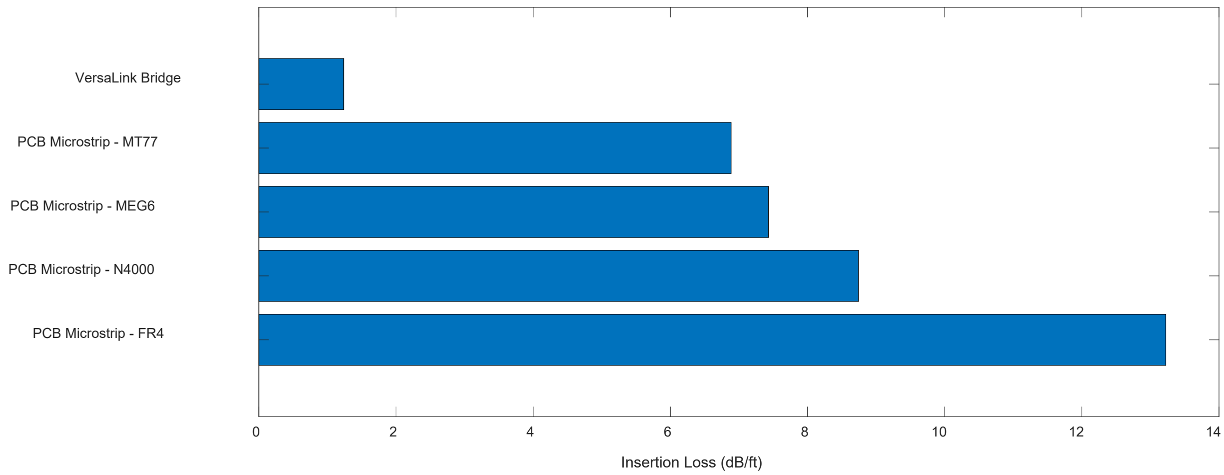

Figure 8 – 12” Link Insertion Loss at 10GHz