Electrical performance of Joy Signal Z-Trace 1X2 connector and cable assembly
Test 534
Catalin Muntean, Signal Integrity Engineer
03/23/06

Purpose
This test was performed to gather electrical data for Joy Signal's Z-Trace 1X2 connector. The data collected includes connector impedance profiles, risetime degradation, signal attenuation and return loss using three different headers.

Samples Tested
6, 15 and 24 inch Joy Signal double ended cable assemblies constructed using Joy Signal's 26awg #018 coax. (Joy P/N: 790171)

Test Procedure
All measurements were done using three different pin mating headers (board connectors): simple breakaway type without plastic carrier (Z-Trace connector sitting all the way to the PCB), with 0.100inch and 0.150inch plastic carriers (see Figures 14, 15 and 16). These were soldered to 50-ohm stripline PCB traces terminated in SMAs. Impedance profiles were obtained for all 6 connectors (three different length cable assemblies) at three different incoming pulse rise-times: 60ps, 100ps and 250ps. Risetime degradation measurements were taken at incoming pulse risetime of 60ps. Attenuation (S21) and Return Loss (S11) were also taken using the three configurations.

Test Equipment
Tektronix CSA8200 Digital Sampling Oscilloscope with 80E04 TDR sampling heads atSpeed's *Oculus*™ for S-parameter extraction from TDR measurements

Test Results

Impedance measurements were done at risetimes measured at 20-80%.

No Plastic Carrier Header (connector all the way to the board level)								
Cable Assembly			**Z @ 60ps risetime**		**Z @ 100ps risetime**		**Z @ 250ps risetime**	
Sample #	**Length (in)**	**Connector End #**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**
1	6	1	43.0	**52.6**	45.3	**50.6**	47.3	49.9
-	-	2	42.2	52.6	**44.8**	50.6	47.2	**50.2**
2	15	1	42.6	52.6	45.3	50.6	47.6	49.8
-	-	2	42.6	52.2	45.2	50.3	47.3	49.8
3	24	1	**41.9**	52.1	44.9	50.2	47.2	49.8
-	-	2	43.0	51.3	45.2	49.4	**46.9**	49.8
Average			42.6	52.2	45.1	50.3	47.3	49.9

Table 1) Impedance measurements without plastic carrier header

0.100in Plastic Carrier Header								
Cable Assembly			**Z @ 60ps risetime**		**Z @ 100ps risetime**		**Z @ 250ps risetime**	
Sample #	**Length (in)**	**Connector End #**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**
1	6	1	44.6	62.6	47.5	56.5	51.0	50.2
-	-	2	**44.2**	63.0	47.2	56.0	50.2	50.7
2	15	1	45.2	63.6	47.7	56.5	50.6	**51.3**
-	-	2	44.4	63.1	**46.9**	56.0	50.0	50.7
3	24	1	44.2	63.3	46.9	56.1	50.2	50.7
-	-	2	44.5	**63.8**	46.9	**56.7**	**50.0**	51.0
Average			44.5	63.2	47.2	56.3	50.3	50.8

Table 2) Impedance measurements for 0.100in plastic carrier header

0.150in Plastic Carrier Header								
Cable Assembly			**Z @ 60ps risetime**		**Z @ 100ps risetime**		**Z @ 250ps risetime**	
Sample #	**Length (in)**	**Connector #**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**	**Min (ohms)**	**Max (ohms)**
1	6	1	48.7	74.5	49.2	**65.0**	50	**55.5**
-	-	2	48.6	74.5	49.0	65.0	50	55.3
2	15	1	49.0	**74.5**	49.4	64.9	50	55.5
-	-	2	48.4	74.1	48.7	64.2	50	54.9
3	24	1	48.3	73.8	48.6	64.1	50	54.8
-	-	2	**48.2**	74.4	**48.3**	64.6	50	55.0
Average			48.5	74.3	48.9	64.6	50	55.2

Table 3) Impedance measurement for 0.150in plastic carrier header.

Propagation Delay					
Cable Assembly		**No Plastic Carrier**		**0.100in Plastic Carrier**	**0.150in Plastic Carrier**
Sample #	**Length (in)**	**Assembly Electrical Length (ns)**	**Propagation Delay (ns/ft)**	**Assembly Electrical Length (ns)**	**Assembly Electrical Length (ns)**
3	**24**	2.30	1.15	2.32	2.33

Table 4) Electrical length of 24in assembly using different plastic carrier headers.

Note: For the following risetime degradation measurements, the incident pulse risetime was 60ps (20-80%).

No Plastic Carrier						
Sample #	**Length (in)**	**Measured risetime (ps)**	**Risetime degradation (ps)**	**-3dB Attenuation (GHz)**	**-10dB Return Loss (GHz)**	**-15dB Return Loss (GHz)**
1	**6**	80	20	5.43	1.80	1.00
2	**15**	85	25	5.72	1.81	1.05
3	**24**	93	33	2.92	2.35	1.70

Table 5) Risetime degradation, attenuation and return loss for all assembly lengths on headers without plastic carriers

0.100in Plastic header						
Sample #	**Length (in)**	**Measured risetime (ps)**	**Risetime degradation (ps)**	**-3dB Attenuation (GHz)**	**-10dB Return Loss (GHz)**	**-15dB Return Loss (GHz)**
1	**6**	115	55	1.91	1.64	0.63
2	**15**	114	54	2.98	1.71	1.00
3	**24**	124	64	2.76	1.55	0.60

Table 6) Risetime degradation, attenuation and return loss for all assembly lengths on headers with 0.100in plastic carriers

0.150in header						
Sample #	**Length (in)**	**Measured risetime (ps)**	**Risetime degradation (ps)**	**-3dB Attenuation (GHz)**	**-10dB Return Loss (GHz)**	**-15dB Return Loss (GHz)**
1	**6**	152	92	1.53	0.79	0.64
2	**15**	141	81	1.39	0.98	0.63
3	**24**	157	97	1.97	0.84	0.62

Table 7) Risetime degradation, attenuation and return loss for all assembly lengths on headers with 0.150in plastic carriers

Summary

While risetime degradation measurements were somewhat affected by the length of the assemblies, the type of header used has the biggest impact. Risetime degradation increases as the plastic carrier thickness increases due to increased impedance mismatches (see Figures 1 to 3 and 5 to 7). Insertion and return loss measurements follow the same trend. The worst performance is obtained with the 0.150in plastic carrier while the best with the Z-Trace connector sitting right on the surface of the board.

The header plastic carrier has little effect on the electrical length and the propagation delay as shown in Table 4.

In actual systems, cable attenuation, reflections and attenuation due to other connectors and PCBs will interact to drop the total interconnect performance below what was measured in this report. The Z-Trace connector is useful for risetimes as short as 100ps and frequencies above 3GHz depending on the type of header used.

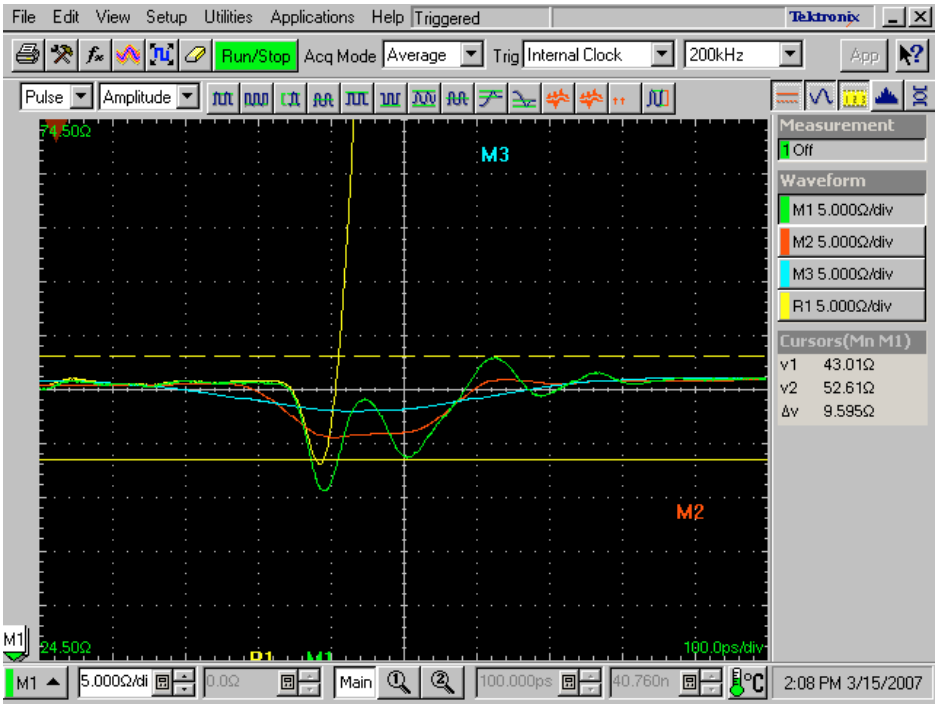

Figure 1) Connector impedance without header plastic carrier. Yellow trace is the open at the end of the header pins. Green, red and blue are connector impedance traces at 60ps, 100ps and 250ps risetime respectively.

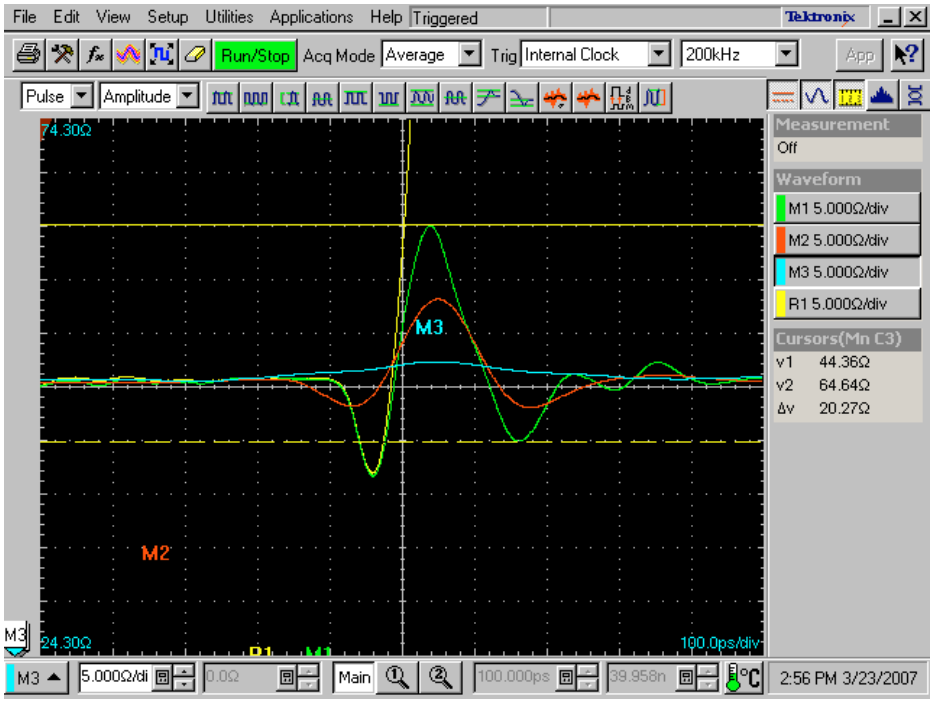

Figure 2) Connector impedance using 0.100inch plastic carrier. Yellow trace is the open at the end of the header pins. Green, red and blue are connector impedance traces at 60ps, 100ps and 250ps risetime respectively.

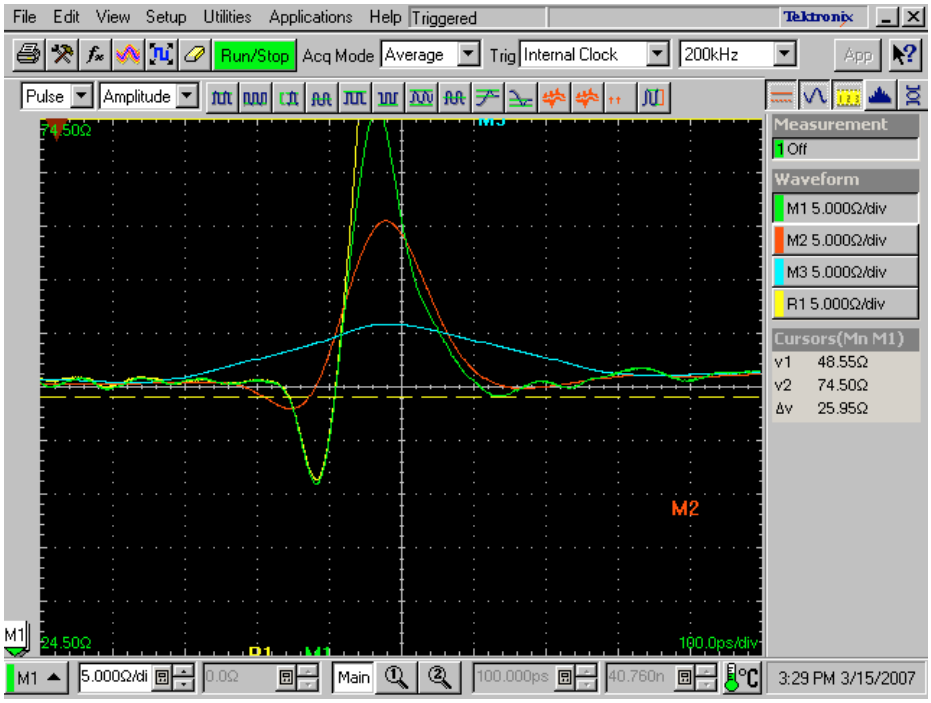

Figure 3) Connector impedance using 0.150inch plastic carrier. Yellow trace is the open at the end of the header pins. Green, red and blue are connector impedance traces at 60ps, 100ps and 250ps risetime respectively.

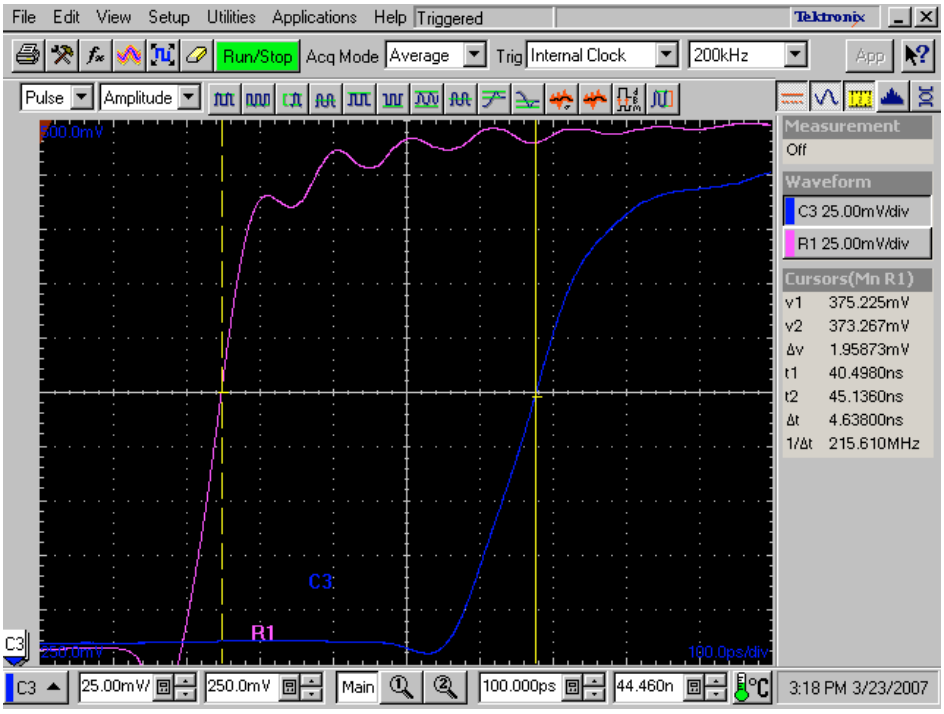

Figure 4) Propagation delay of the 24in assembly using 0.100in header

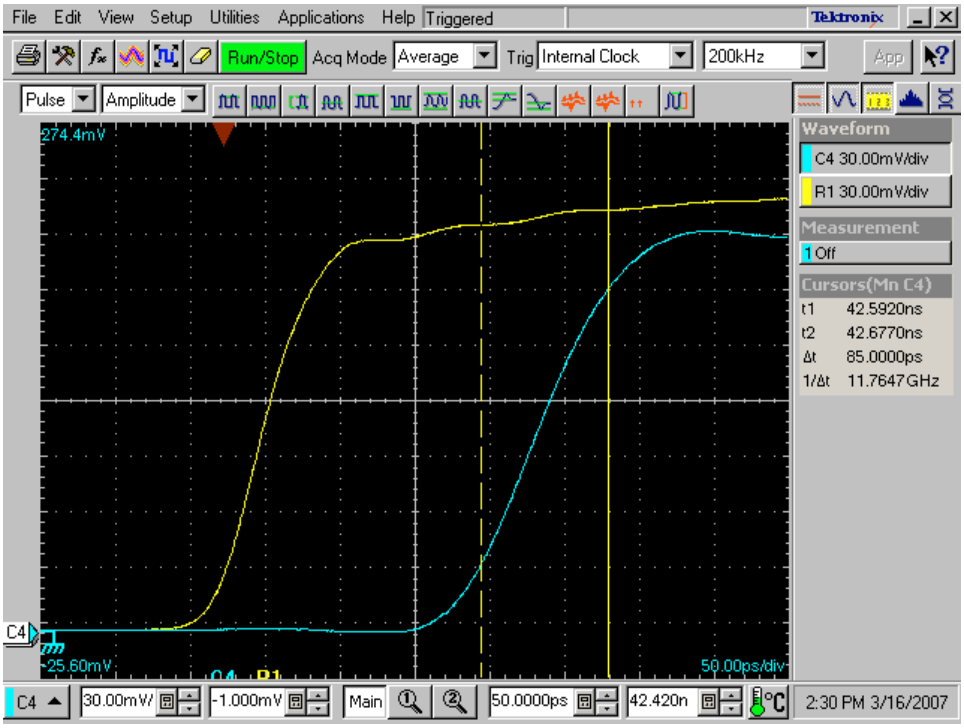

Figure 5) Risetime degradation of 15in assembly without the header plastic carrier The yellow is the incoming step risetime.

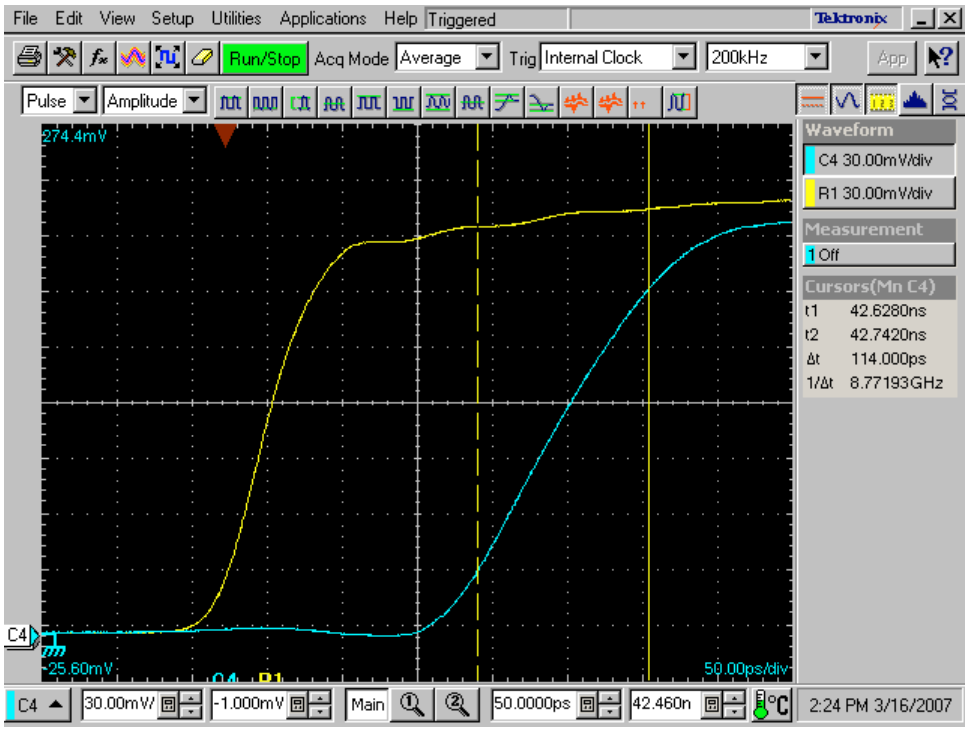

Figure 6) Risetime degradation of the 15in assembly with 0.100in plastic. The yellow trace is the incoming step risetime.

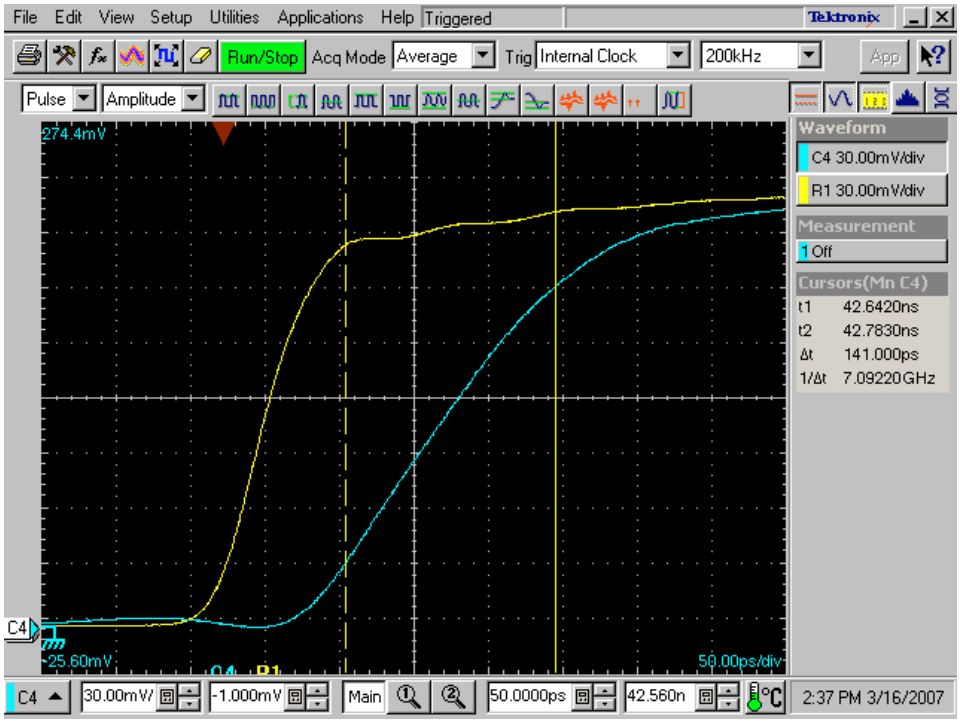

Figure 7) Risetime degradation of the 15in assembly with 0.150in plastic. The yellow trace is the incoming step risetime.

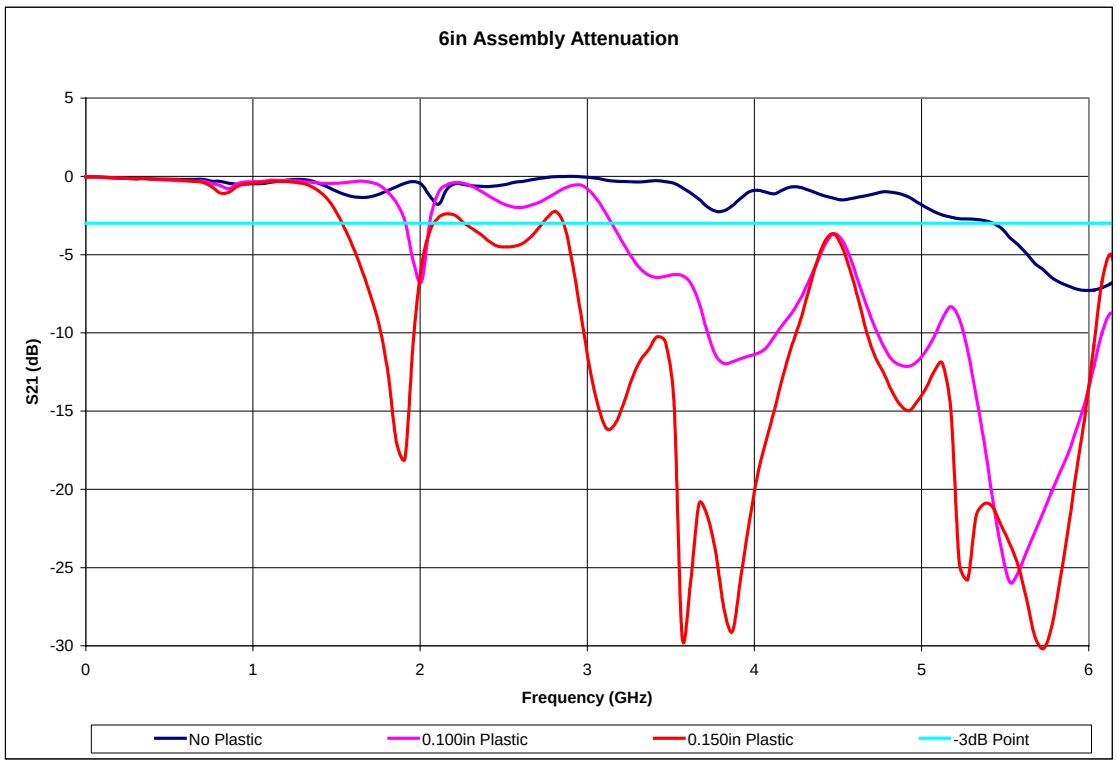

Figure 8) 6in assembly attenuation using no plastic, 0.100in and 0.150in plastic carriers

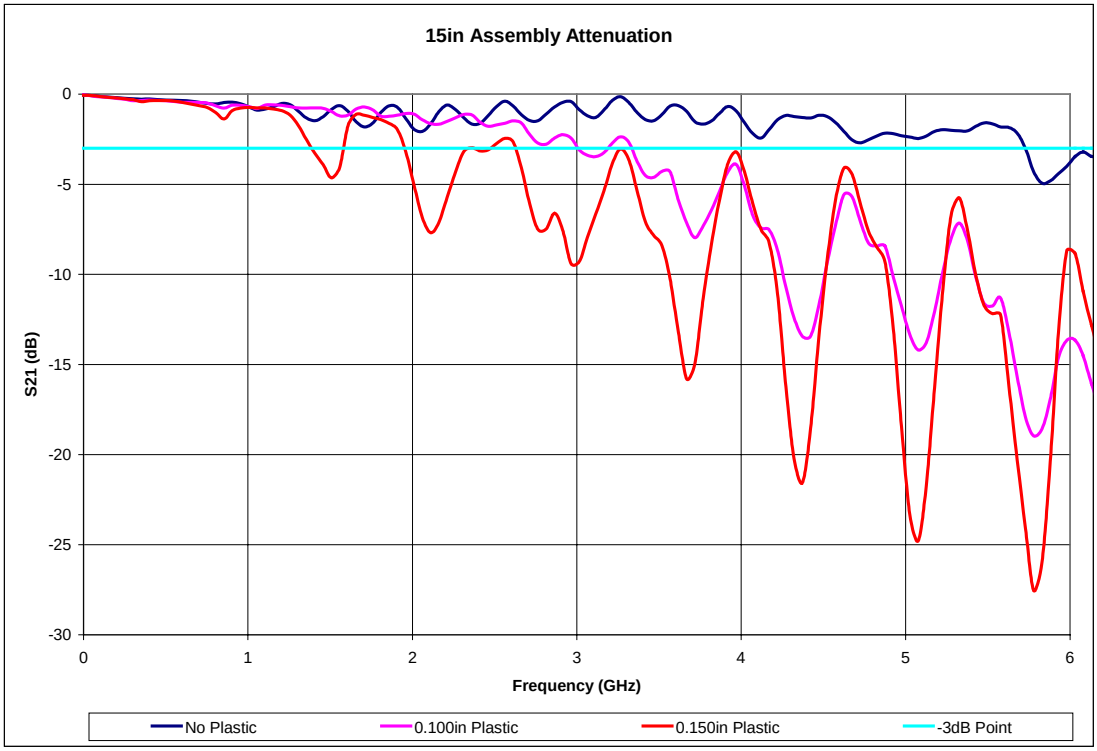

Figure 9) 15in assembly attenuation using no plastic, 0.100in and 0.150in plastic carriers

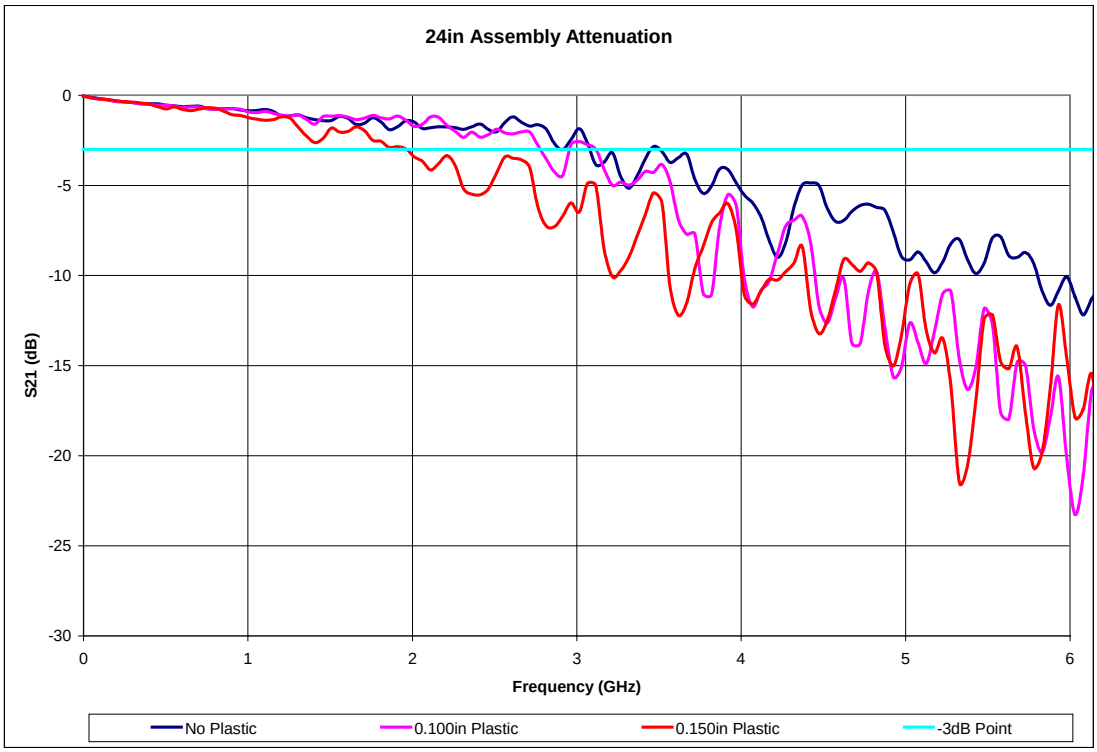

Figure 10) 24in assembly attenuation using no plastic, 0.100in and 0.150in plastic carriers

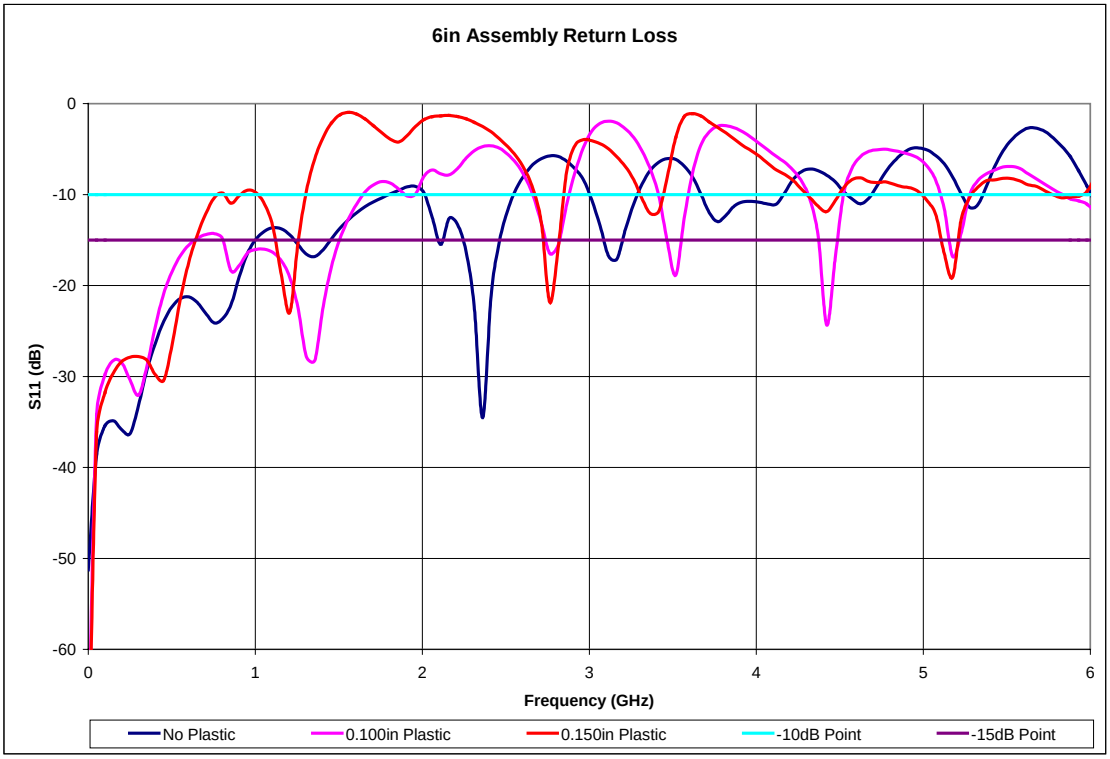

Figure 11) 6in assembly return loss using no plastic, 0.100in and 0.150in plastic carriers

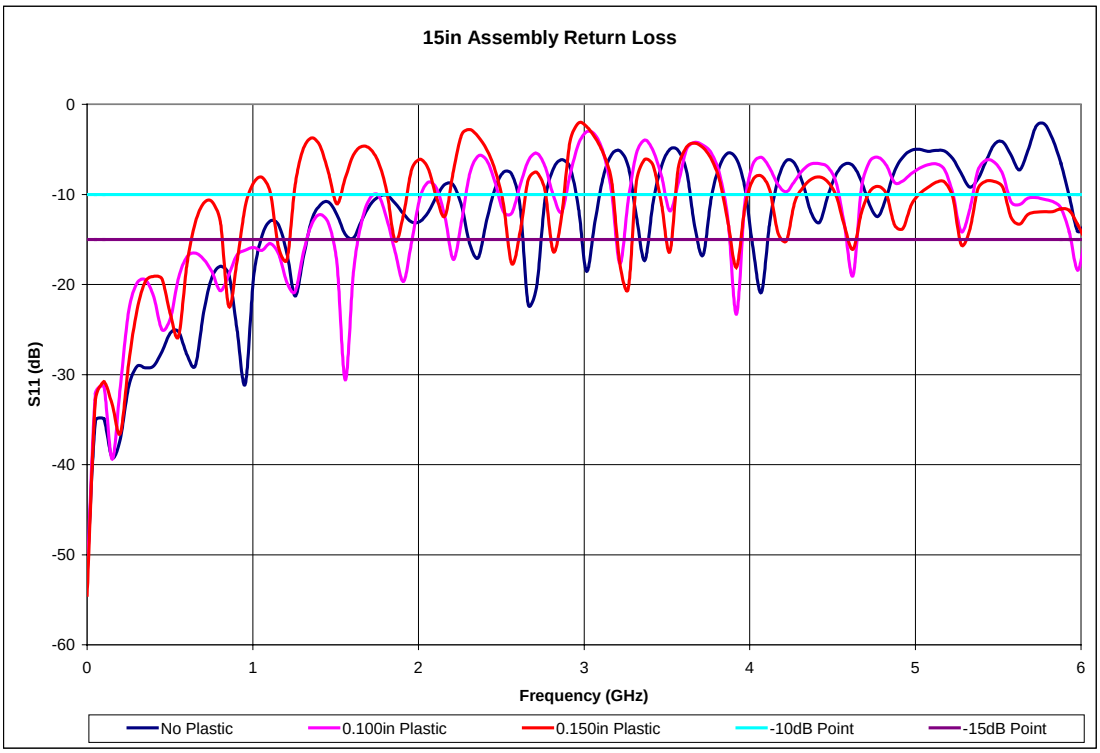

Figure 12) 15in assembly return loss using no plastic, 0.100in and 0.150in plastic carriers

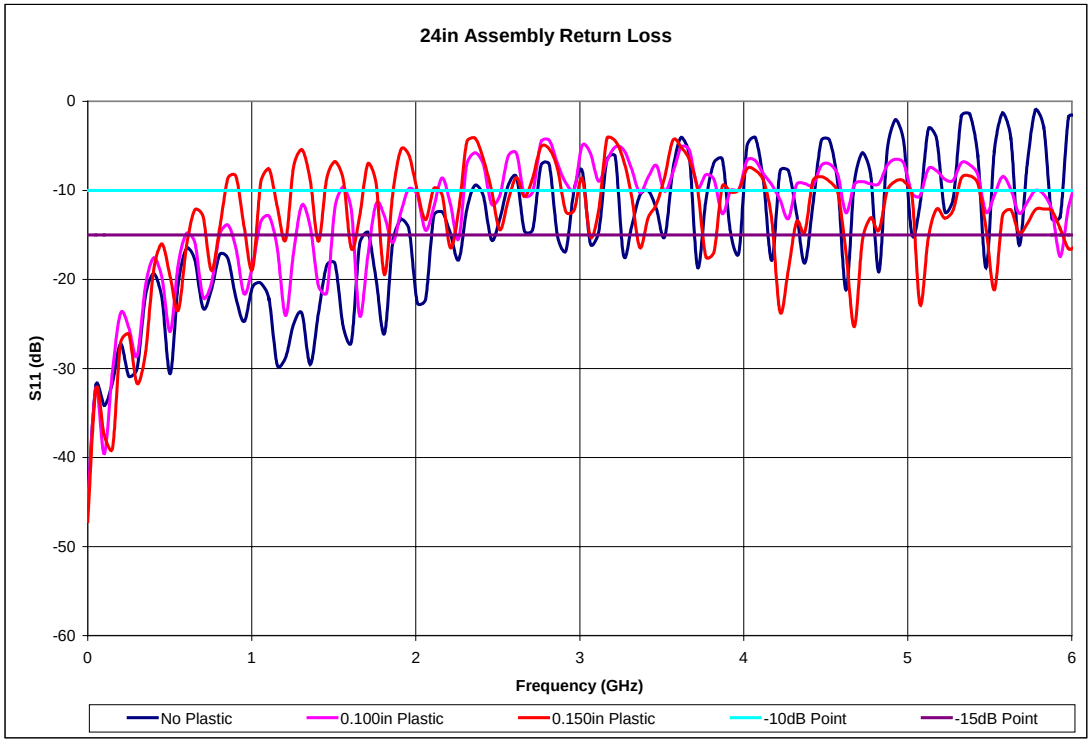

Figure 13) 24in assembly return loss using no plastic, 0.100in and 0.150in plastic carriers

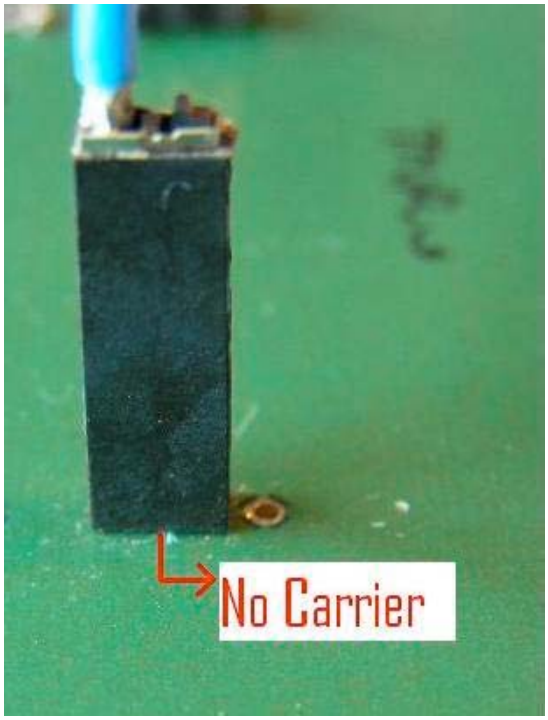

Figure 14) Z-trace sitting all the way to the board (no plastic carrier)

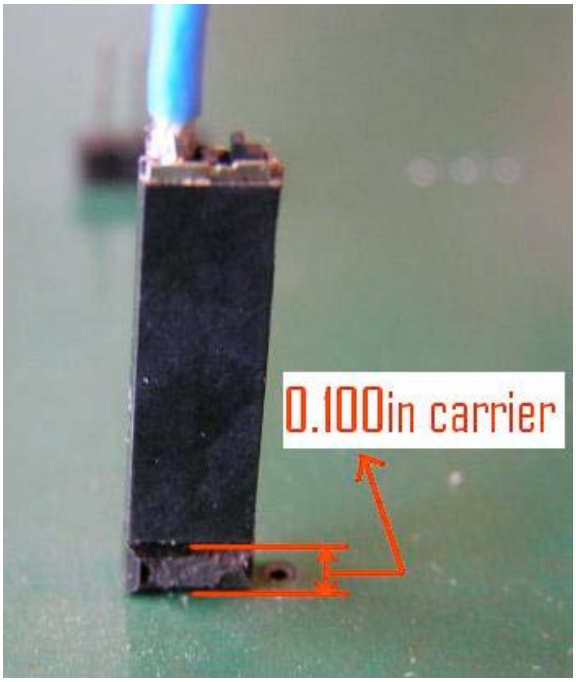

Figure 15) Z-trace on header with 0.100in plastic carrier

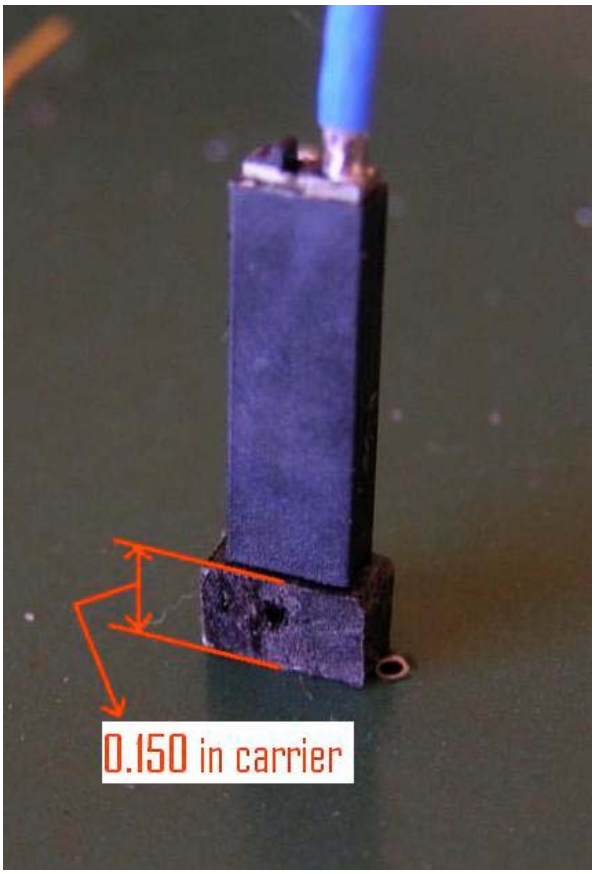

Figure 16) Z-trace on header with 0.150in plastic carrier