SV VITA 67.3 NanoRF Contacts Qualification Test Report

Figure 1: SV NanoRF Contacts in test fixture SK-3637 (Test Groups 5 and 6)

1. Introduction

1.1 Purpose

Qualification testing was performed on SV Microwave's VITA 67.3 NanoRF Backplane Pin (8341-40001) and Plug-In Socket (8351-40001) Contacts for Ø.047 cable to determine their conformance to the ANSI/VITA 67.3 specification.

1.2 Scope

This report covers the mechanical, electrical, and environmental performance of SV Microwave's ANSI/VITA 67.3 NanoRF Backplane and Plug-In Contacts. Testing was performed at SV Microwave's West Palm Beach, Florida facility and Precision Test Solutions in Orlando, FL.

1.3 Conclusion

SV Microwave's NanoRF Backplane and Plug-In Contacts meet the mechanical, electrical, and environmental performance requirements set forth in the ANSI/VITA 67.3 specification up to 40 GHz (bandwidth limited by 2.92mm terminated test specimens).

1.4 Test Specimens

Test specimens are listed in Table 1 and are representative of normal production lots.

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Table 1 - Test Specimens

Test Group	Quantity	Part Number	Description
1	5	8341-40001 (Rev -)	NanoRF Backplane Contact for Ø.047 Cable
2	5	8351-40001 (Rev -)	NanoRF Plug-In Contact for Ø.047 Cable
3	10	SK-3757 (Rev -)	NanoRF Plug-In Contact to 2.92mm Male on Ø.047 FleXtra Cable Assembly (10”)
4	10	SK-3758 (Rev -)	NanoRF Backplane Contact to 2.92mm Male on Ø.047 FleXtra Cable Assembly (10”)
5	1	N/A	Test Group 3 mounted in 2313376-1 in test fixture SK-3637
6	1	N/A	Test Group 4 mounted in 2313225-1 in test fixture SK-3637

Figure 2 - 8341-40001 in Test Group 1 (Left), 8351-40001 (Right) in Test Group 2

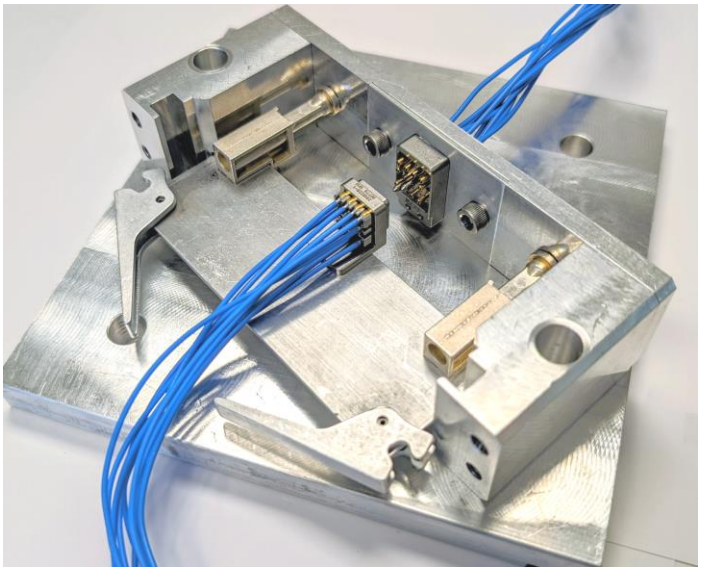

Figure 3 - Test Group 5 (left) and 6 (right)

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1.5 Qualification Test Sequence

Table 2 - Qualification Test Sequence

Section	Test or Examination	Test Group					
		1	2	3	4	5	6
		Test Sequence					
2.1	Critical Dimension Inspection	1	1	1	1	1	1
2.2	Mating End Dimensions	2	2	2	2		
2.3	Initial Examination of Product	3	3	3	3	2	2
2.4	Low Level Contact Resistance (LLCR)	4, 8	4, 7				
2.5	Mating Forces	5, 9	5, 8				
2.6	Spring Force	6, 10					
2.7	Voltage Standing Wave Ratio (VSWR)					3	3
2.8	Insertion Loss					4	4
2.9	Durability (500 cycles)	7	6			5	5
2.10	Insulation Resistance					6	6
2.11	Dielectric Withstanding Voltage (DWV)					7	7
2.12	Crosstalk					8	8
2.13	Vibration					9	9
2.14	Shock					10	10
2.15	Thermal Shock					11	11
2.16	Humidity / Moisture Resistance					QBS	QBS
2.17	Operating Temperature					12	12
2.18	Final Examination of Product	11	9	4	4	13	13

1.6 Environmental Conditions

Unless otherwise stated, the following environmental conditions were observed during testing:

Temperature: 15°C to 35°C

Relative Humidity: 20% to 80%

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2. Summary of Testing

2.1 Critical Dimension Inspection

All test specimens met critical dimensions as highlighted on product data drawings and internal engineering documentation.

2.2 Mating End Dimensions

All test specimens meet mating end dimensions per VITA 67.3 or SV specifications as applicable.

2.3 Initial Examination of Product

All test specimens met all visual requirements and were free of damage before the start of testing.

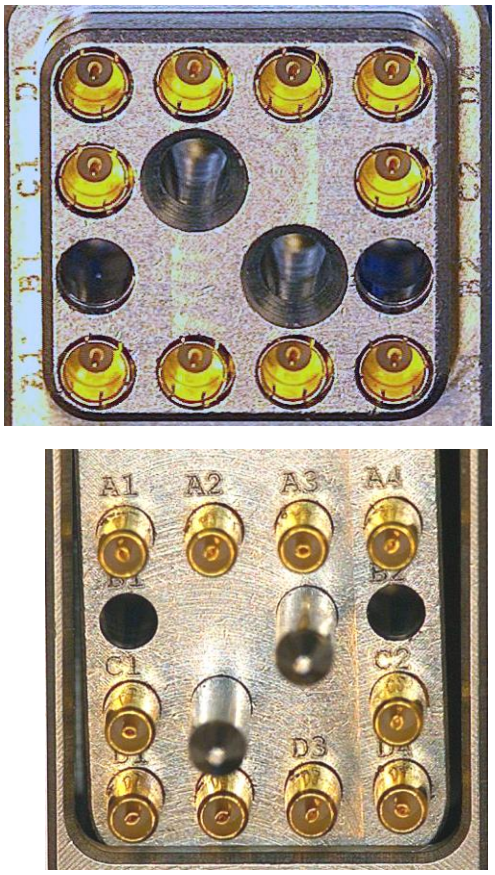

Figure 4 - Initial photos of Test Groups 5 (top) and 6 (bottom)

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2.4 Low Level Contact Resistance (LLCR)

All test specimens met the requirement of 8 mΩ max for the center conductors and 2 mΩ max for the outer conductors.

Specimens were tested before and after 500 cycles durability. The connections for the outer conductor were made via clips attached to the outer conductors directly to the ohmmeter. The center conductor measurements were taken by plugging a short length of trimmed Ø.047 semi rigid cable into the contact cable socket in order to make them accessible to the tester leads. The additional resistance was included in the measured recording since the values were still under the maximum limits. The sample number indicates a mated pair of connectors from Test Groups 1 and 2.

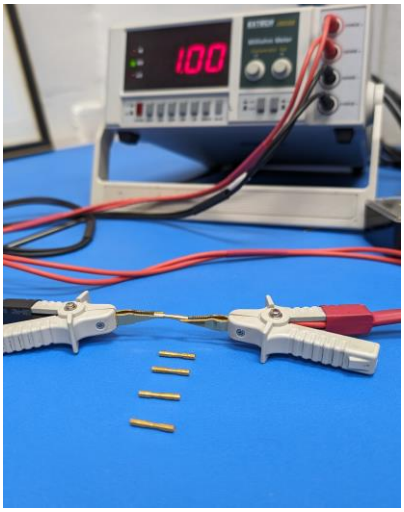

Figure 5 - LLCR test of outer conductor (Test Groups 1 and 2)

Table 3 - LLCR of Center and Outer Conductors

	Center Conductor			Outer Conductor		
Sample Number	**Specification**	**LLCR Initial (mΩ)**	**LLCR Post Durability (mΩ)**	**Specification**	**LLCR Initial (mΩ)**	**LLCR Post Durability (mΩ)**
1	8 mΩ MAX	2.90	2.95	2 mΩ MAX	1.00	0.98
2		2.95	2.94		1.05	1.01
3		2.80	2.90		1.00	1.02
4		2.91	2.97		0.91	0.95
5		2.87	2.85		0.96	0.94

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2.5 Mating Insertion Force

All test specimens met the SV internal specification of 5.5 N (1.24 lbf) MAX in order to ensure positive interface mating action happens before the backplane spring begins to compress (see Section 2.6).

All test specimens met the requirement of 1.4 N (5.0 oz) MIN mating withdrawal force during initial and post durability (500 cycle) testing.

Specimens were tested using a Wagner Model FDIX Force Tester with a 0.5 oz (0.14 N) resolution, mounted into adjustable collets as shown.

Figure 6 - Test Groups 1 and 2 mounted for mating force testing

Table 4 – Insertion and Withdrawal Forces, initial and post 500 mating durability

	Insertion			Withdrawal		
Sample Number	**Specification**	**Initial (N)**	**Post Durability (N)**	**Specification**	**Initial (N)**	**Post Durability (N)**
1	5.5 N MAX (1.24 lbf)	4.03	3.90	1.4 N MIN (5.0 oz)	1.81	1.67
2		4.31	4.03		1.81	1.67
3		4.17	3.90		1.81	1.67
4		4.03	3.90		1.81	1.67
5		4.17	4.03		1.81	1.67

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2.6 Spring Force

All test specimens met the 1.5 lbf typical forces expected at nominal deflection and 2.5 lbf maximum at full deflection.

Nominal deflection (pre-load) is defined as a compressed spring length of .188” (4.78mm) typical when installed in a backplane cavity dimension per ANSI/VITA 67.3 Figure 3.3.1-3.

Full deflection is defined as an additional compression of .060” (1.52mm) (compressed spring length of .188 - .060 = .128” (3.25mm)).

Spring force was tested at both compression lengths with the QC-057D fixture.

Figure 7 - Spring from Test Group 1 (8341-40001) in QC-057D test fixture

Table 5 – Spring Forces at Nominal and Full Deflection

Sample Number	Nominal Deflection Specification	Nominal Deflection Force	Full Deflection Specification	Full Deflection Force
1	1.5 lbf TYP	1.42	2.5 lbf MAX	1.84
2		1.40		1.81
3		1.39		1.85
4		1.43		1.89
5		1.45		1.85

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2.7 Voltage Standing Wave Ratio (VSWR)

All test specimens met the gated VSWR requirement of 1.40:1 MAX, DC – 40 GHz per ANSI/VITA 67.3 Rule 3.3.5.1-1, tested in accordance with EIA-364-108.

Plots are named according to their position in the modules.

To confirm intermateability between manufacturers, additional plots below show performance when SV-manufactured contacts (SV) are mated with TE Connectivity-manufactured contacts (TE).

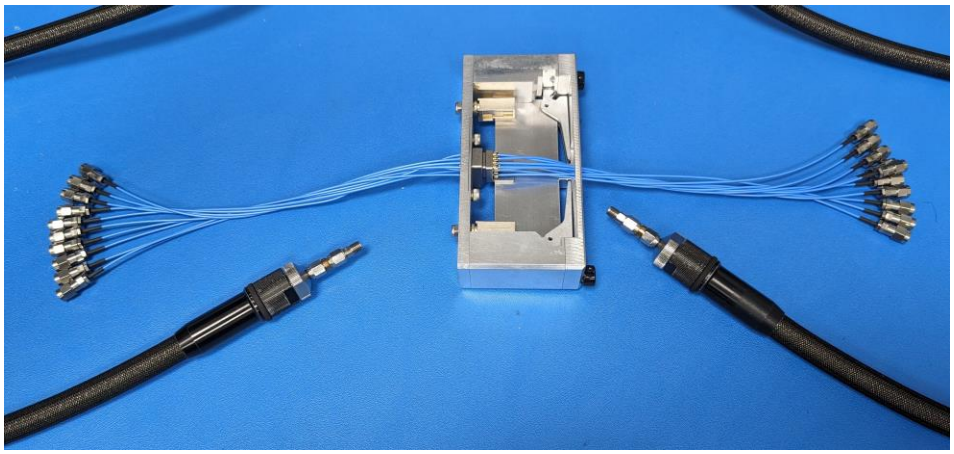

Figure 8 – VSWR & Insertion Loss Test Set Up, Test Group 5 & 6 shown

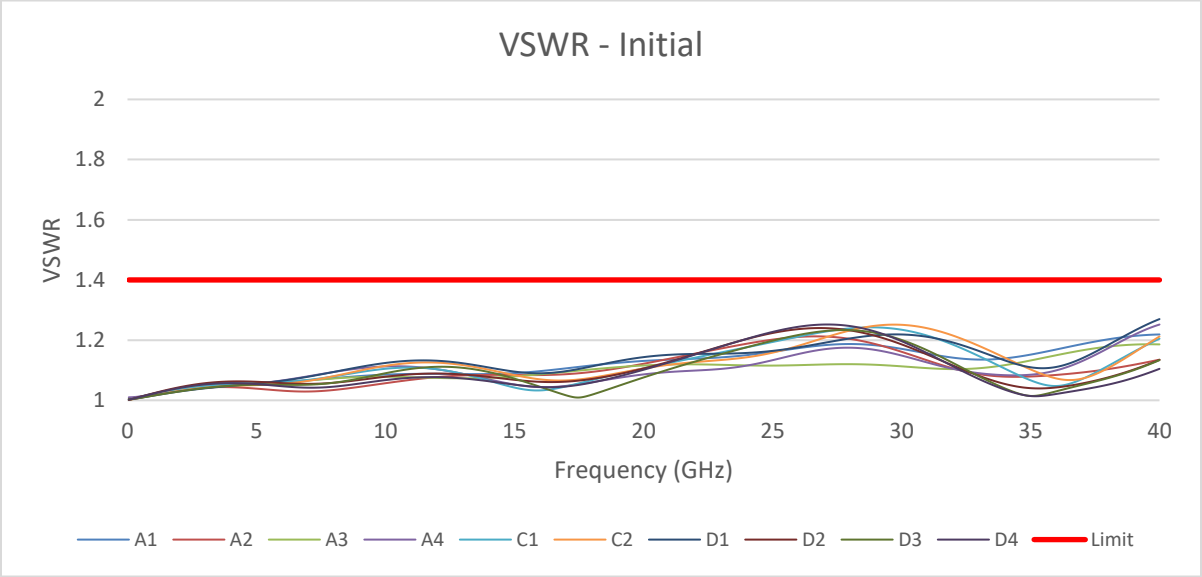

Figure 9 - VSWR (Initial) of Mated Test Group 5 and 6, DC - 40 GHz

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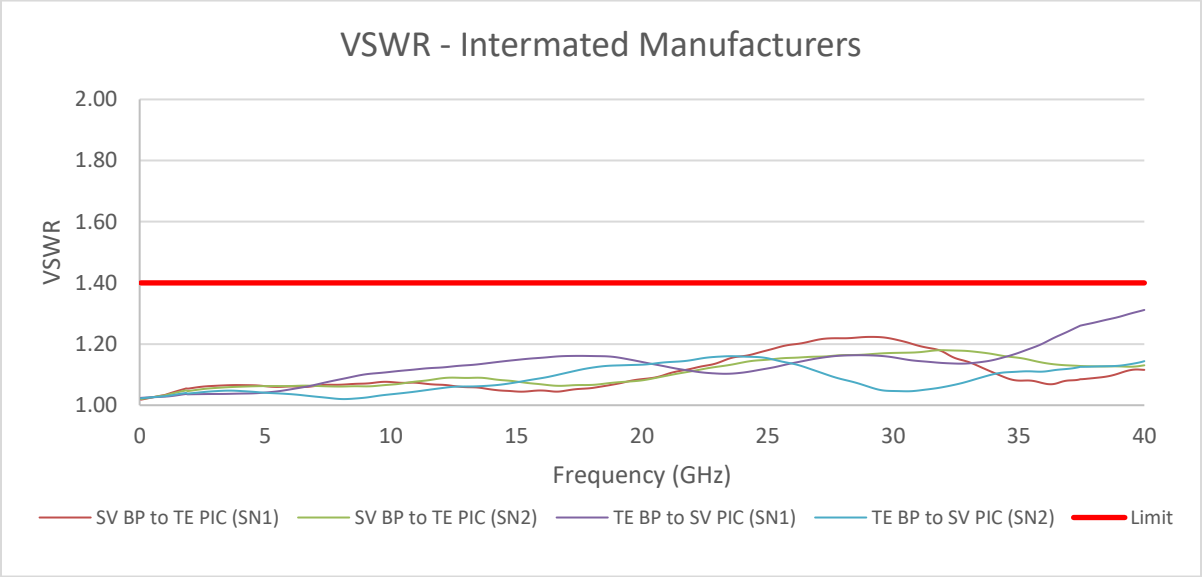

Figure 10 - Representative VSWR for intermated manufacturer pairs of NanoRF contacts

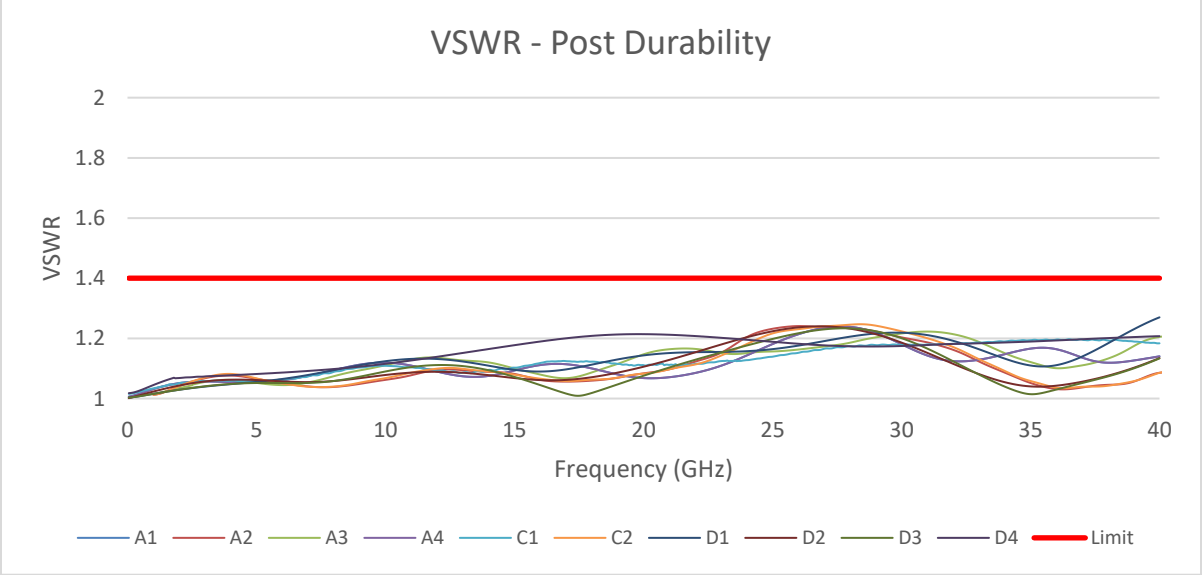

Figure 11 - VSWR (Post Durability) of Mated Test Group 5 and 6, DC - 40 GHz

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2.8 Insertion Loss

All test specimens met mated insertion loss requirement of .12√f (GHz) dB MAX due to the contacts themselves per ANSI/VITA 67.3 Rule 3.3.5.4-1, tested in accordance with EIA-364-101.

Total loss of the signal path was multiplied by a conservative 12% to eliminate the contributions of to the length of cable (20") and 2.92mm connectors. This factor was used in all subsequent insertion loss plots as well for consistency.

Plots are named according to their position in the module.

To confirm intermateability between manufacturers, additional plots below show performance when SV-manufactured contacts (SV) are mated with TE Connectivity-manufactured contacts (TE).

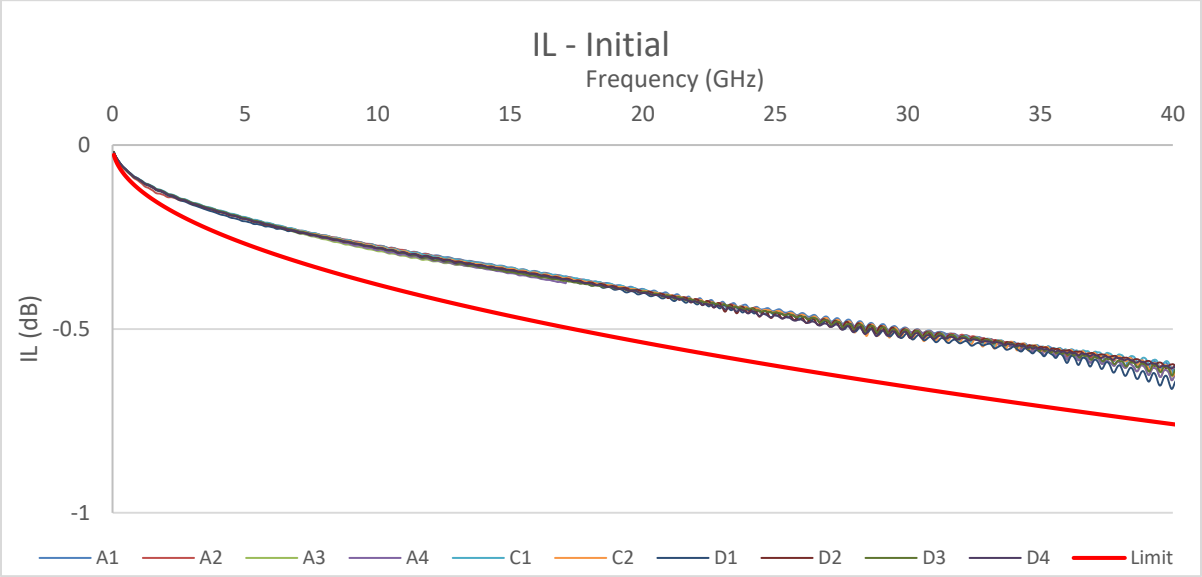

Figure 12 - Insertion Loss (Initial) of Mated Test Group 5 and 6, DC - 40 GHz

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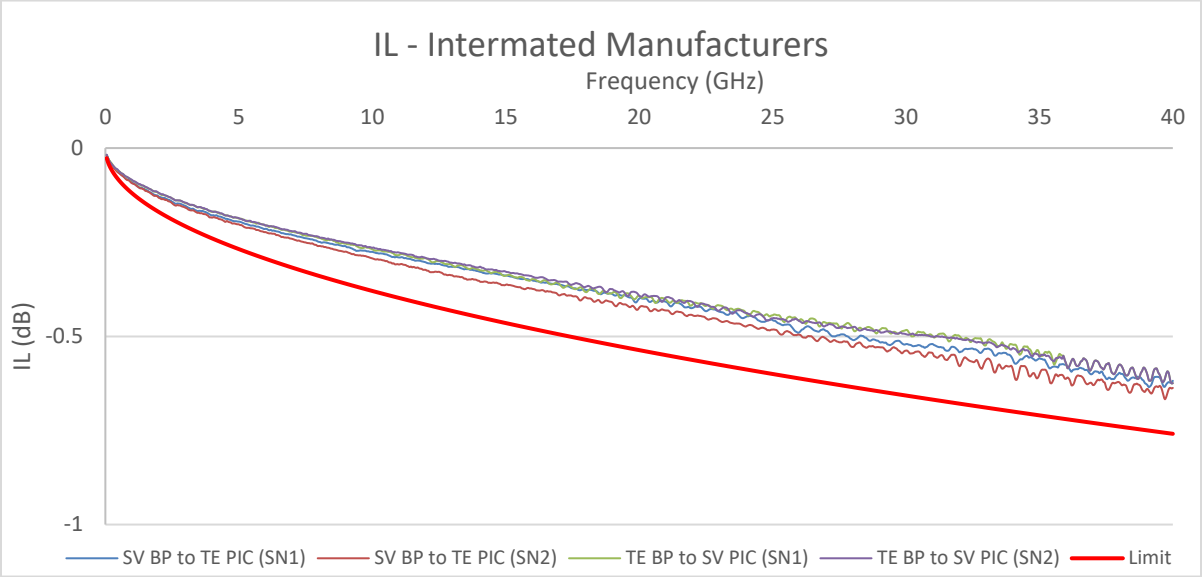

Figure 13 - Representative Insertion Loss for intermated pairs of NanoRF contacts

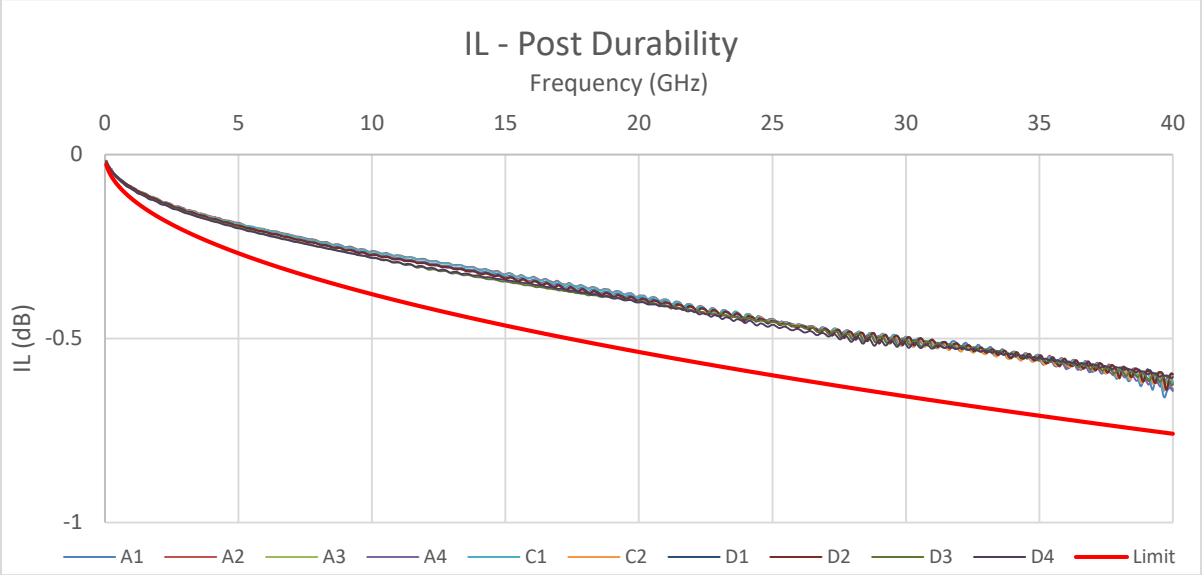

Figure 14 - Insertion Loss (Post Durability) of Mated Test Group 5 and 6, DC - 40 GHz

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2.9 Durability

All test specimens were subject to 500 mates. Test Groups 1 and 2 were cycled 500 times using SV's CheckMate durability fixture using SK-3765B/C fixtures, while Test Groups 4 and 5 were manually cycled 500 times using the ejector handles to simulate realistic use at the assembled level.

Examination of test specimens revealed no physical damage. Mating forces, LLCR, VSWR, and Insertion Loss tests were subsequently done to ensure the integrity of the test specimens with data presented in the relevant sections.

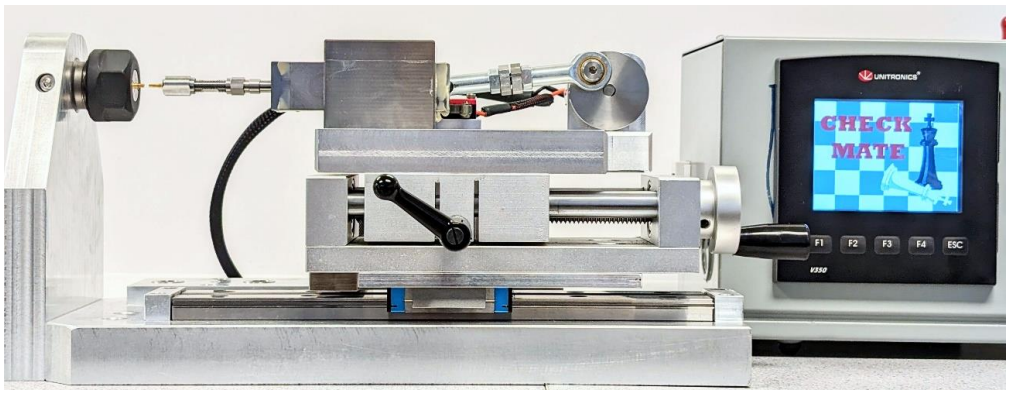

Figure 15 – Test Groups 1 and 2 mounted in the CheckMate durability tester

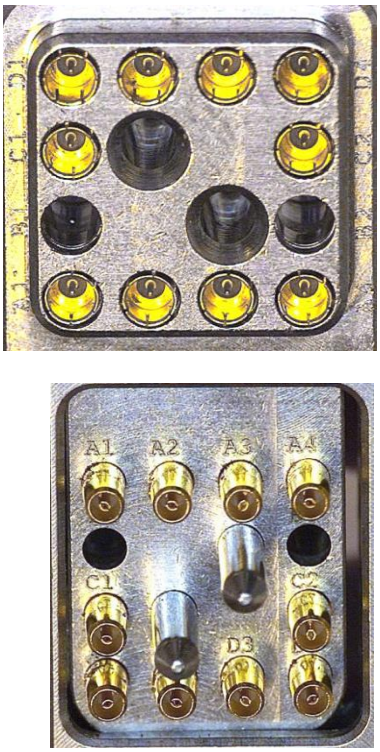

Figure 16 - Test Groups 5 and 6 post 500 mating cycles

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2.10 Insulation Resistance

All test specimens passed the EIA-364-21E insulation resistance requirement using a Chroma 19073 HiPot tester set to 500 VDC, 2 minute hold between single contact to all others and between shell and all contacts, 5000 MΩ minimum.

The backplane feature of the test fixture was connected to ground, and voltage was applied to the 2.92mm male for each signal path via a female socket connected to the test lead.

2.11 Dielectric Withstanding Voltage (DWV)

All test specimens met the EIA 364-20E DWV requirement using a Chroma 19073 HiPot tester set to 325 VRMS, 1 minute hold, 5 mA max leakage current, no breakdown or flashover occured.

The backplane feature of the test fixture was connected to ground, and voltage was applied to the 2.92mm male for each signal path via a female socket connected to the test lead.

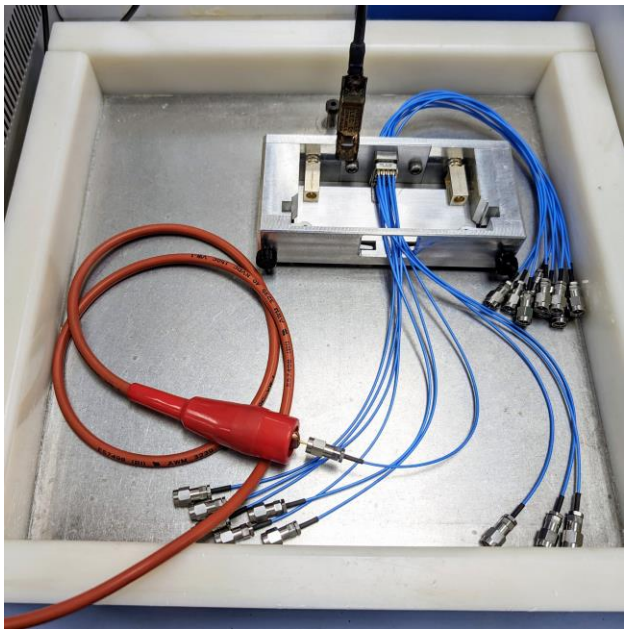

Figure 17 - Setup for Insulation Resistance and DWV (Test Group 5 and 6)

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2.12 Crosstalk

All test specimens met the crosstalk requirement set forth per ANSI/VITA 67.3 Table 3.3.5.2-1. Isolation testing was performed between adjacent ports to establish worst case scenario data. Data shows test specimens performed at or below noise floor and are named for the two adjacent ports in the modules under test.

For plot A1-A2, Port 1 of the analyzer was connected to the 2.92mm connector of the cable assembly leading to the A1 backplane contact and the 2.92mm leading from the A1 Plug-In contact was terminated with a 50Ω load. Port 2 was connected to the 2.92mm connector of the cable assembly leading from the A2 Plug-In contact and the 2.92mm leading from the A2 backplane contact was terminated with a 50Ω load.

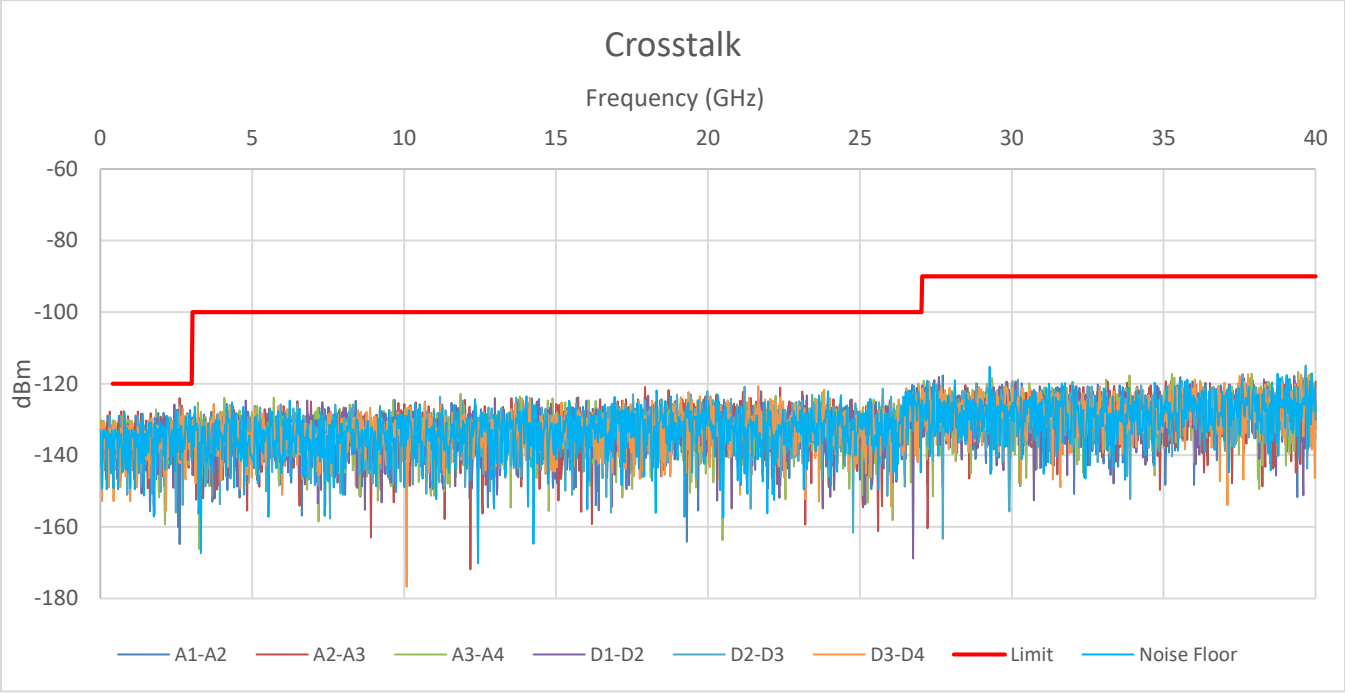

Figure 18 - Crosstalk plots, 30 MHz - 40 GHz

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2.13 Vibration

All test specimens passed vibration testing IAW MIL-STD-810H Change 1, Method 514.8, Procedure I. Three mutually perpendicular axes, 1 hour each. Cables were secured to the vibrating surface <4" from shell. No discontinuities of 10 ns minimum using 100 mA were recorded. No physical damage was recorded after testing.

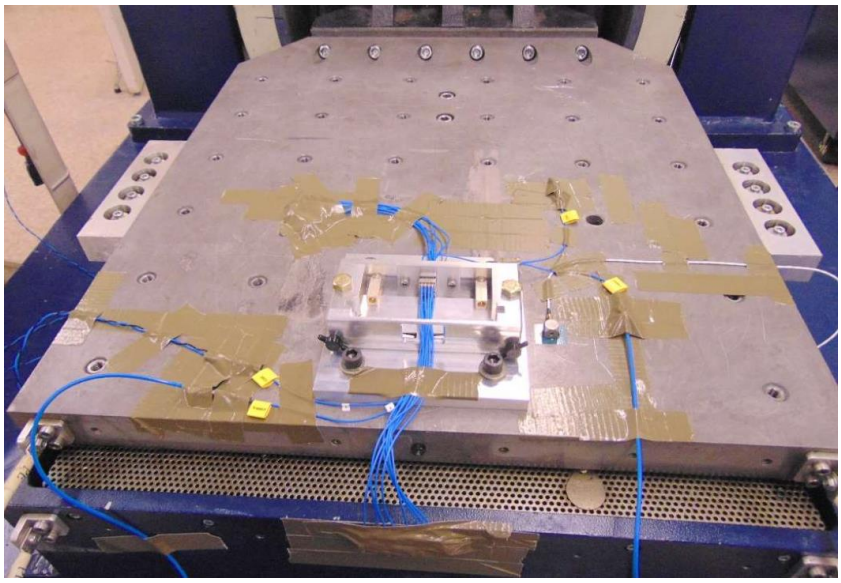
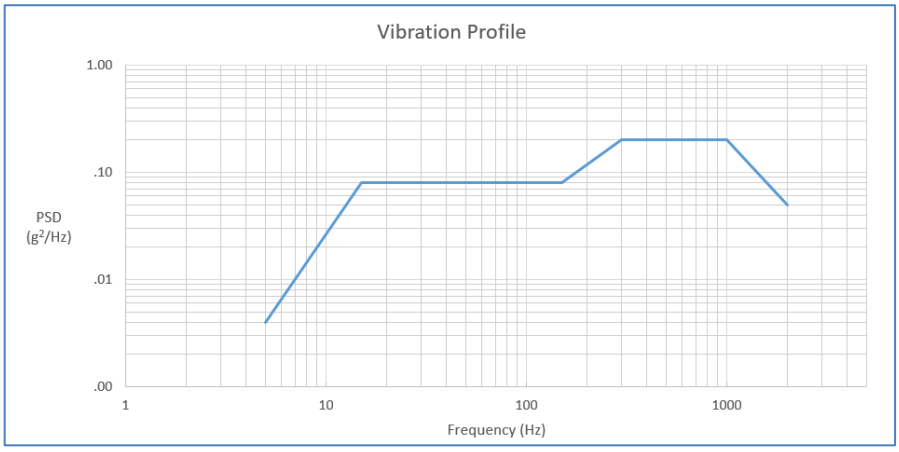


Figure 19 – Representative vibration setup with Test Group 5 & 6, X-axis shown



Frequency Range (Hz)	PSD (g^2/Hz)
5	.004
15	.08
150	.08
300	.20
1000	.20
2000	.05
g_{rms}	16.5 g_{rms}

Figure 20 - Vibration Profile

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2.14 Shock

All test specimens passed shock testing IAW MIL-STD-810H Change 1, Method 516.8, Procedure I. The specimens withstood exposure to $40g_{peak}$, 11 ms pulse duration, terminal saw tooth shock in 3 axes. Cables were secured to the vibrating surface <4" from shell. No discontinuities of 10 ns minimum using 100 mA were recorded. No physical damage was recorded after testing.

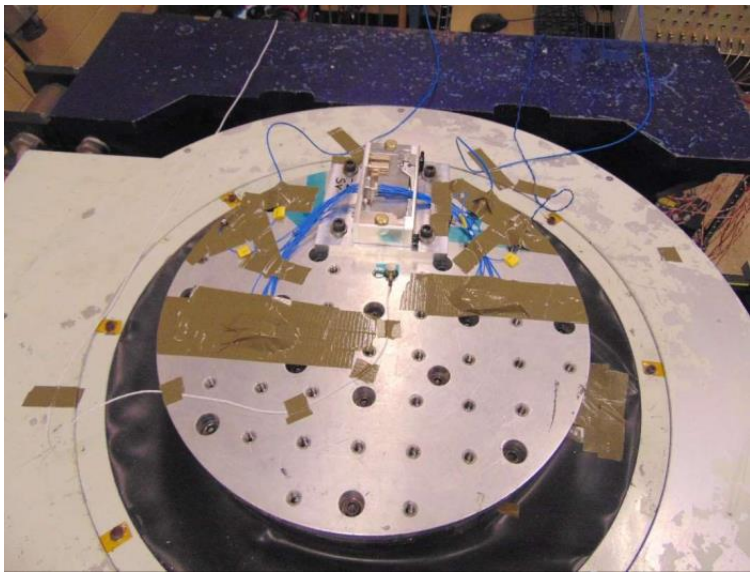

Figure 21 - Representative shock setup with Test Group 5 & 6, Z-axis shown

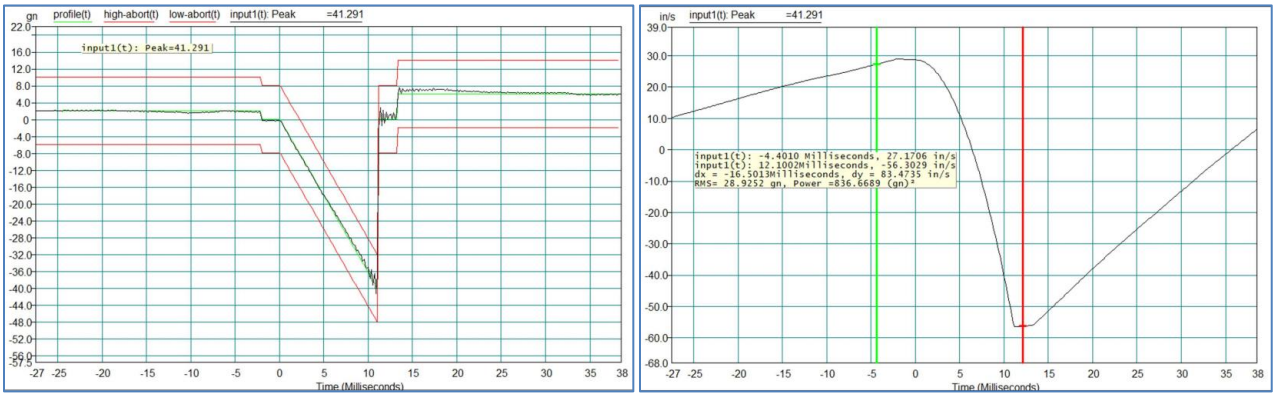

Figure 22 - Representative shock profile, Z-axis negative pule pulse shown

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2.15 Thermal Shock

Test specimens were tested per thermal shock requirement, meeting visual requirements and no physical damage after 5 cycles from -55°C to +125°C with 1 hour dwell at extremes and 1 minute maximum transition between temperatures. Representative plot from position A4 shown below.

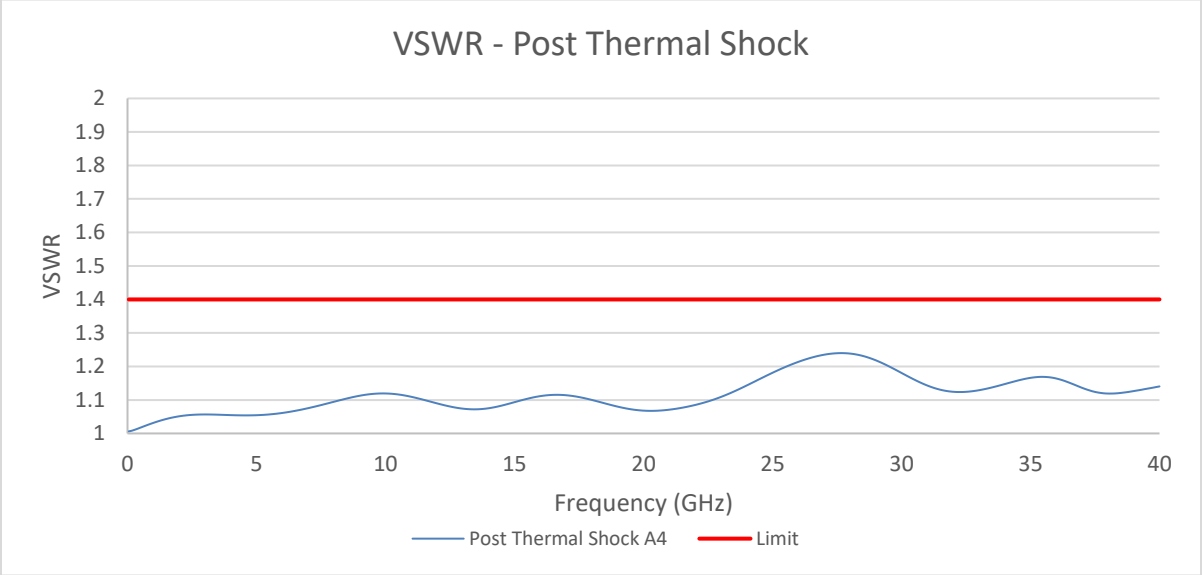

Figure 23 - VSWR (Post Thermal Shock) of Mated Test Group 5 and 6, DC - 40 GHz

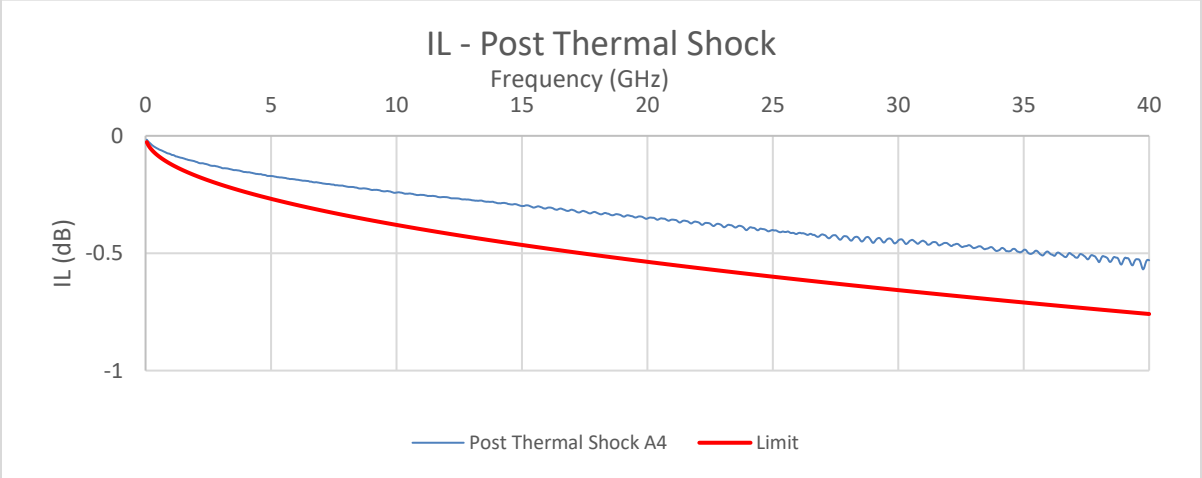

Figure 24 - Insertion Loss (Post Thermal Shock) of Mated Test Group 5 and 6, DC - 40 GHz

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2.16 Humidity/Moisture Resistance

As base material and finishes are identical to other SV V67.1/2/3 SMPM designs, test specimens here are qualified by similarity (QBS). Reference designs underwent humidity and moisture resistance testing, 10 cycles per MIL-STD-810, Method 507, Procedure II. Specimens showed no physical damage, and met the requirements of subsequent tests.

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2.17 Operating Temperature

Test specimens were tested per ANSI/VITA 67.3 mated VSWR requirement of 1.40:1 MAX, DC – 40 GHz at room temperature, -40°C, and +85°C, each after a 10 minute hold at temperature, in accordance with EIA-364-108 in an ESPEC BTZ-113 Environmental Chamber. Representative electrical plots (position A4) presented below and visual examination showed no negative effects.

Figure 25 - Environmental chamber control panel at temperature extremes

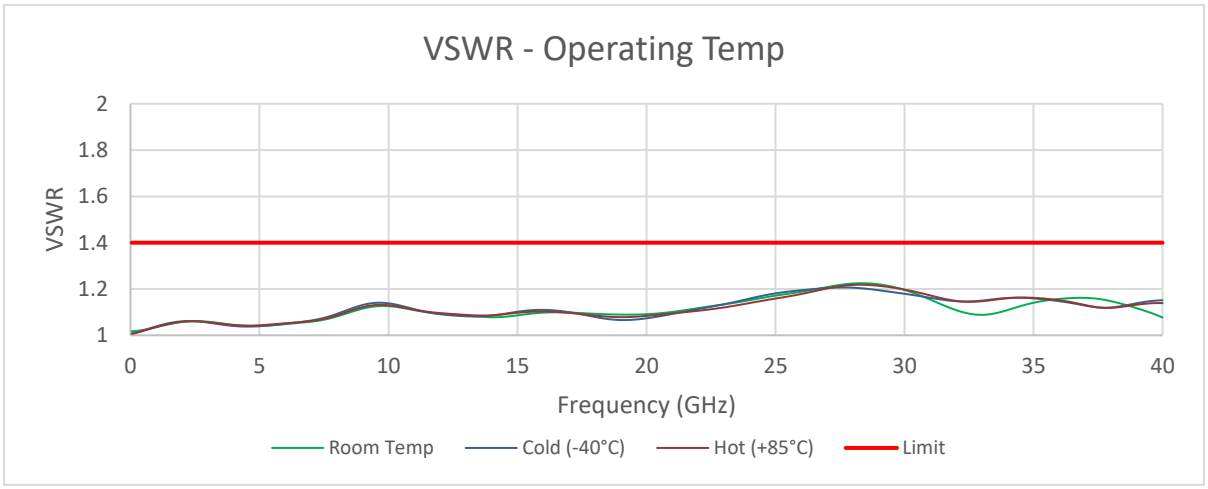

Figure 26 - VSWR at operating temperatures (representative A4 shown)

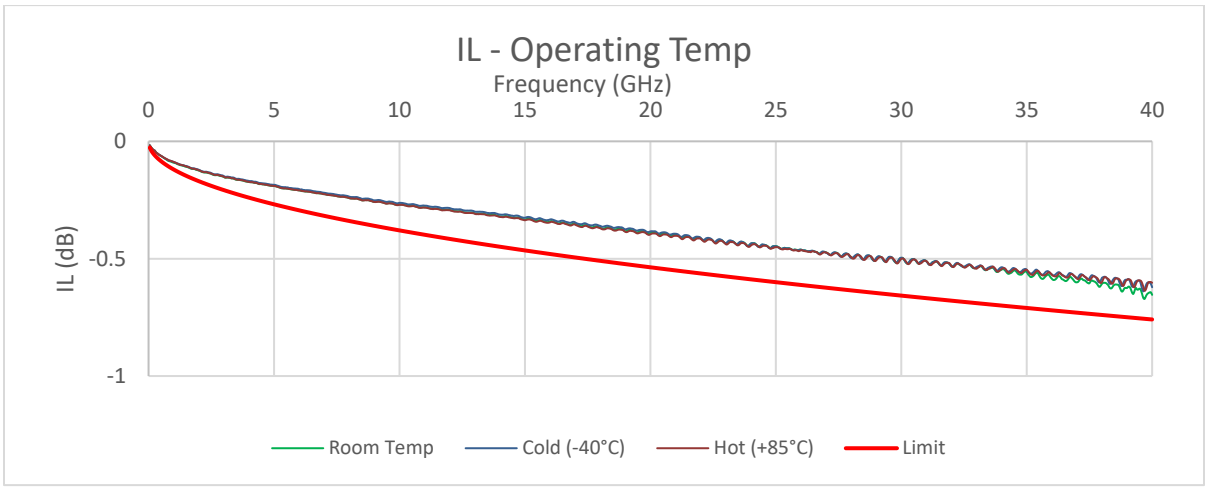

Figure 27 - Insertion Loss at operating temperatures (representative A4 shown)

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2.18 Final Examination of Product

All test specimens were verified to meet visual requirements and no physical damage was observed as a result of testing. Specimens meet or exceed the requirements set forth in ANSI/VITA 67.3 as well as SV's internal specifications.

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