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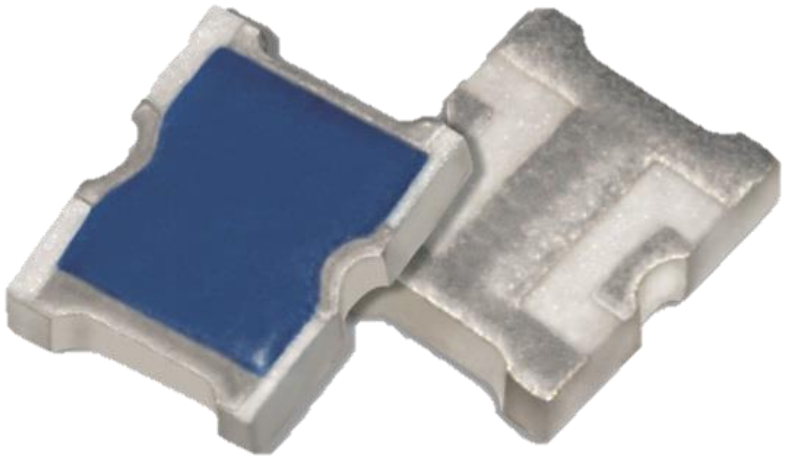
Qualification Test Report

TT9 Series Attenuators
Part Number: TT9XX.0SMT

Matt Mazzochette, 07/30/2018



1. Introduction

The purpose of this report is to show the testing performed to qualify the design of the TT9XX.0SMT product line. To qualify the product line, 10 units of part numbers TT903.0SMT, TT906.0SMT, and TT910.0SMT (30 units total) were tested per TP-9215. The test plan consists of Group A, B, and C testing. The process flow chart for Group A, B, and C is shown in Figure 1.

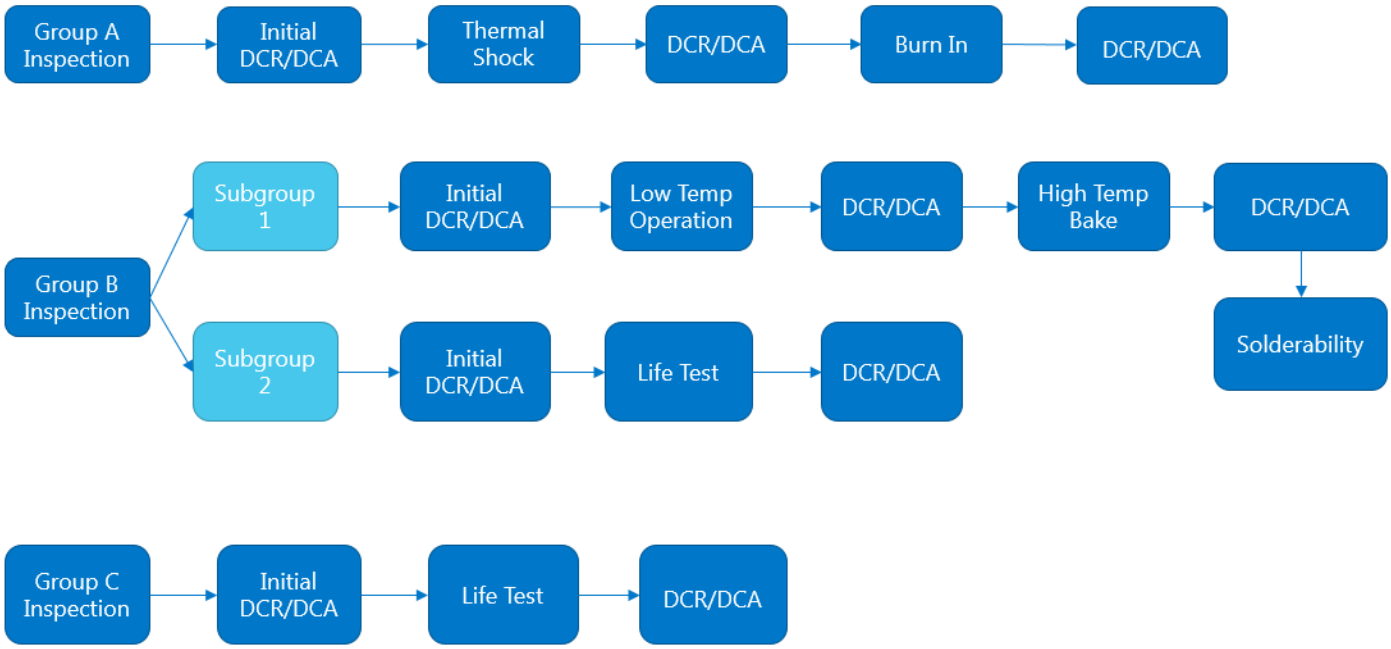


Figure 1 - Test Flow per TP-9215

2. Specifications

- Nominal Impedance: 50 Ω
- Frequency Range: DC-20 GHz
- Attenuation Values: 0-10 dB
- Attenuation Accuracy: ±5 dB @ 1 GHz
- Input Power CW: 500 mW @ 125°C Base plate, derated linearly to 0 W @ 150°C
- VSWR: DC-20 GHz 1.40:1 Typical
  DC-20 GHz 1.70:1 Max

3. Test Procedure

Group A: 10 units of part numbers TT903.0SMT, TT906.0SMT, and TT910.0SMT were subjected to Group A testing for a total of 30 units. All 30 units must pass final DC resistance (DCR) and DC attenuation (DCA) in order to proceed to Group B and C testing.

Initial DC Resistance / DC Attenuation: 30 units were subjected to DCR/DCA testing. For this test, the following three DC resistance measurements were taken for each part: input to output, input to ground, and output to ground. The resulting DC attenuation values were calculated and plotted in the below graphs. All DCA values must be within ±0.5 dB of nominal in order to pass this test. All 30 units must pass DCR/DCA in order to proceed to thermal shock.

Thermal Shock: All 30 units that passed initial DCR/DCA were subjected to thermal shock per MIL-STD-202 Method 107. The temperature profile and durations are show in table 1:

Table 1 – Thermal Shock Profile per TP9215

STEP	TEMPERATURE (°C)	TIME (MINUTES)
1	-55 (+0/-3)	15 min.
2	+25 (+10/-5)	5.0 max.
3	+125 (+3/-0)	15 min.
4	+25 (+10/-5)	5.0 max.

After the completion of thermal shock, the DCR/DCA was recorded per the above test procedure. All DCA measurements must be within ± 0.2 dB of the initial DCR/DCA measurements in order to pass thermal shock. All 30 units must pass DCR/DCA in order to proceed to the next test.

Burn In: All 30 units that passed thermal shock were subjected to a 168 hour burn in test. To burn in the parts, the units were solder with Sn96 solder to test board 008-40-232. The test board with the part soldered to it was then mounted to a heatsink part number 005-01-280 to create FX-1263. A picture of FX-1263 is shown in figure 2.

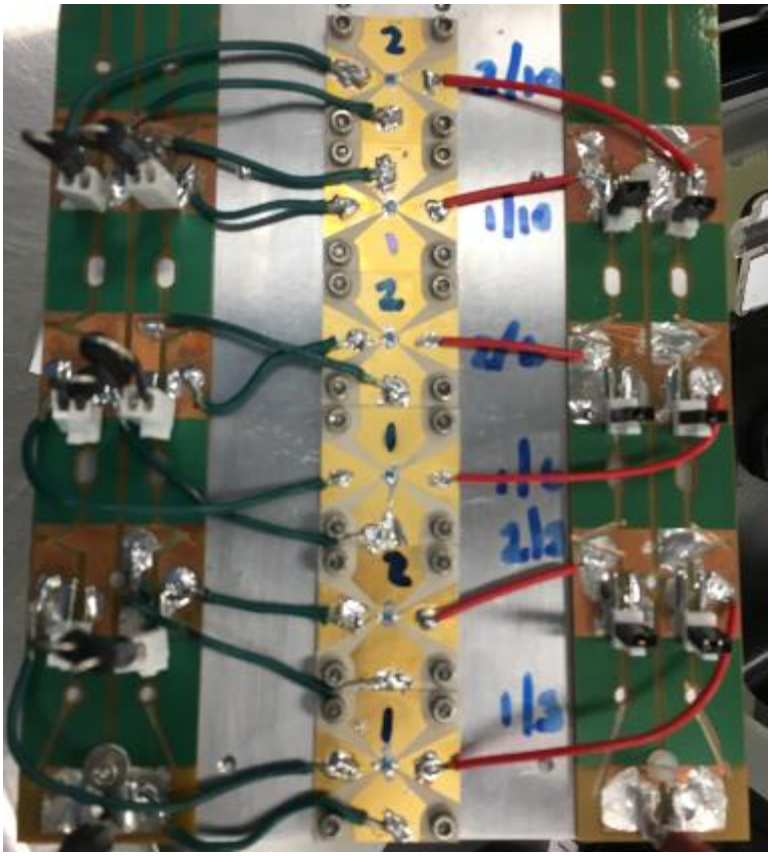


Figure 2 - Burn in Fixture FX-1263

After burn in, all 30 parts were DCR/DCA tested per the above procedure. All DCA measurements must be within ±0.2 dB of the pre-burn in measurements. All 30 units must pass DCR/DCA in order to proceed to Group B and C testing.

Group B Subgroup 1: Two units of each value that passed Group A testing were subjected to group B sub group 1 testing for a total of 6 units. The serialization from group A was kept throughout this test. All units must pass final DCR/DCA testing in order to pass this group of testing.

Initial DCR/DCA: For this test, the DCR/DCA measurements taken after group A Burn in were used.

Low Temp Operation: For this test, the samples were cooled to -55°C +5°C/-0°C and were held at that temperature for 1 hour. After 1 hour, the parts were exposed to full power @ -55° for 45 minutes. After 45 minutes the parts were allowed to stabilize @ 25°C for 24 hours. After the 24 hour stabilization period, the parts were DCR/DCA tested per the above procedure listed in Group A. All 6 units must pass DCR/DCA testing in order to proceed to the next test.

High Temp Bake: The 6 units that passed low temp operation were then baked @ 125°C for 100 hours. After the 100 hour bake was complete, the parts were allowed to stabilize @ 25°C for 4 hours. After the stabilization period was completed, DCR/DCA measurements were taken for all 6 units. All 6 units must pass DCR/DCA in order to pass high temperature bake.

Group B Sub Group 2: 4 units of each value that passed Group A testing were subjected to group B subgroup 2 testing for a total of 12 units. The serialization from Group A testing was kept throughout this test. This test was run in parallel with group B subgroup 1. All 12 units must pass final DCR/DCA in order to pass group B sub group 2.

Initial DCR/DCA: For this test, the DCR/DCA measurements taken after Group A burn in were used.

Life Test: 12 units selected for group B sub group 2 testing were subjected to a 1000 hour burn in test. For the burn in test the parts were mounted to the burn in plate using the same procedure described in the Group A burn in section. DCR/DCA measurements were taken after 250, 500, and 1000 hours. All 12 units must pass DCR/ DCA after 1000 hours in order pass the life Test.

Group C: 4 units of each value that passed group A testing were selected for group C testing for a total of 12 units. The serialization from group A was kept throughout group C testing. Group C testing was run in parallel with group B subgroups 1 and 2. All parts must pass final DCR/DCA testing in order to pass group C.

Initial DCR/DCA: The DCR/DCA measurements taken after Group A burn in were used for this test.

Life Test: 12 units selected for group C testing were subjected to a 1000 hour burn in test. For the burn in test the parts were mounted to the burn in plate using the same procedure described in the Group A Burn in section. DCR/DCA measurements were taken after 250, 500, and 1000 hours. All 12 units must pass DCR/DCA after 1000 hours in order pass the life test.

4. Results

Table 2 - TT903.0SMT Group A DC Attenuation Results

TT903.0SMT	Group A Testing				
Serial Number	Initial Attenuation (dB)	After Thermal Shock Attenuation (dB)	After Burn In Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	2.67	2.67	2.67	0.00	0.00
2	2.67	2.67	2.67	0.00	0.00
3	2.68	2.67	2.68	0.00	0.00
4	2.67	2.68	2.78	0.11	4.12
5	2.67	2.67	2.67	0.00	0.00
6	2.68	2.68	2.68	0.00	0.00
7	2.71	2.70	2.70	-0.01	0.37
8	2.68	2.68	2.69	0.01	0.37
9	2.65	2.65	2.66	0.01	0.38
10	2.68	2.68	2.69	0.01	0.37

Table 3 - TT903.0SMT Group B DC Attenuation Results

TT903.0SMT	Group B Testing						
Serial Number	Low Temperature Opertation - Atteunuation (dB)	High Temperature Opertation - Atteunuation (dB)	Life Test After 250 Hours Attenuation (dB)	Life Test After 500 Hours Attenuation (dB)	Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	2.67	2.71	2.54	0.13	4.87
2	-	-	2.68	2.68	2.68	0	0.00
3	-	-	2.67	2.7	2.68	-0.01	0.37
4	-	-	2.68	2.83	2.68	0	0.00
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	2.75	2.8	-	-	-	0.05	1.82
10	2.7	2.67	-	-	-	-0.03	1.11

Table 4 - TT903.0SMT Group C DC Attenuation Results

TT903.0SMT	Group C Testing				
Serial Number	Load Life Test After 250 Hours Attenuation (dB)	Load Life Test After 500 Hours Attenuation (dB)	Load Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	2.72	2.76	2.72	0.00	0.00
6	2.69	2.69	2.69	0.00	0.00
7	2.65	2.65	2.57	-0.08	3.02
8	2.68	2.69	2.69	0.01	0.37
9	-	-	-	-	-
10	-	-	-	-	-

Table 5 - TT906.0SMT Group A DC Attenuation Results

TT906.0SMT	Group A Testing				
Serial Number	Initial Attenuation (dB)	After Thermal Shock Attenuation (dB)	After Burn In Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	5.94	5.94	5.94	0.00	0.00
2	6.37	6.39	6.36	-0.01	0.16
3	5.95	5.95	5.95	0.00	0.00
4	5.98	5.98	5.99	0.01	0.17
5	6.00	6.00	6.01	0.01	0.17
6	5.94	5.94	5.94	0.00	0.00
7	5.95	5.96	5.96	0.01	0.17
8	5.93	5.94	5.94	0.01	0.17
9	5.94	5.94	5.94	0.00	0.00
10	5.96	5.96	5.88	-0.08	1.34

Table 6 - TT906.0SMT Group B DC Attenuation Results

TT906.0SMT	Group B Testing						
Serial Number	Low Temperature Opertation - Atteunuation (dB)	High Temperature Opertation - Atteunuation (dB)	Life Test After 250 Hours Attenuation (dB)	Life Test After 500 Hours Attenuation (dB)	Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	5.96	5.95	5.95	0.01	0.17
2	-	-	5.99	5.98	5.99	0	0.00
3	-	-	6.05	6.10	6.00	0.05	0.83
4	-	-	5.95	6.12	5.95	0	0.00
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	5.94	6.01	-	-	-	0.07	1.18
10	6.35	6.43	-	-	-	0.08	1.26

Table 7 - TT906.0SMT Group C DC Attenuation Results

TT906.0SMT	Group C Testing				
Serial Number	Load Life Test After 250 Hours Attenuation (dB)	Load Life Test After 500 Hours Attenuation (dB)	Load Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	5.95	5.97	5.95	0.00	0.00
6	5.94	6.03	5.94	0.00	0.00
7	5.94	5.96	5.95	0.01	0.17
8	5.96	5.95	5.96	0	0.00
9	-	-	-	-	-
10	-	-	-	-	-

Table 8 - TT910.0SMT DC Attenuation Group A Results

TT910.0SMT	Group A Testing				
Serial Number	Initial Attenuation (dB)	After Thermal Shock Attenuation (dB)	After Burn In Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	10.28	10.27	10.27	-0.01	0.10
2	10.27	10.28	10.27	0.00	0.00
3	10.24	10.23	10.23	-0.01	0.10
4	10.33	10.35	10.32	-0.01	0.10
5	10.39	10.35	10.34	-0.05	0.48
6	10.26	10.23	10.23	-0.03	0.29
7	10.29	10.27	10.27	-0.02	0.19
8	10.26	10.25	10.24	-0.02	0.19
9	10.25	10.25	10.25	0.00	0.00
10	10.25	10.22	10.22	-0.03	0.29

Table 9 - TT910.0SMT DC Attenuation Group B Results

TT910.0SMT	Group B Testing						
Serial Number	Low Temperature Opertation - Atteunuation (dB)	High Temperature Opertation - Atteunuation (dB)	Life Test After 250 Hours Attenuation (dB)	Life Test After 500 Hours Attenuation (dB)	Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	10.22	10.24	10.24	-0.02	0.20
2	-	-	10.33	10.16	10.34	-0.01	0.10
3	-	-	10.35	10.35	10.35	0.00	0.00
4	-	-	10.24	10.22	10.23	0.01	0.10
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	10.28	10.27	-	-	-	-0.01	0.10
10	10.28	10.27	-	-	-	-0.01	0.10

Table 10 - TT910.0SMT DC Attenuation Group C Results

TT910.0SMT	Group C Testing				
Serial Number	Load Life Test After 250 Hours Attenuation (dB)	Load Life Test After 500 Hours Attenuation (dB)	Load Life Test After 1000 Hours Attenuation (dB)	Δ Attenuation (dB)	Percent Change Attenuation (%)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	10.29	10.29	10.29	0.00	0.00
6	10.25	10.28	10.33	0.08	0.78
7	10.26	10.25	10.27	0.01	0.10
8	10.23	10.22	10.24	0.01	0.10
9	-	-	-	-	-
10	-	-	-	-	-

5. Data Analysis

The above data shows that the DC Attenuation for each value passes the requirements listed in TP-9215. For example the data shown in tables II thru IV indicate that the DCA did not move more than ±0.2 dB after each group A test. The maximum change observed was -0.04 dB which is most likely due to measurement error.

The above graphs also show that the DCA during Group B and C testing did not exceed the specification limit of nominal ± 0.5 dB. There was some change in the DCA during group B testing for the 3 and 6dB, but it did not exceed the specification limit per TP-9215.

6. Conclusion

The above data validates the current TT9XX.0SMT design is capable of dissipating 500 mW. Tables II-IV show that there was very little change in DCA throughout Group A testing. More importantly the data shows that there was no change in DCA during burn in testing. The above graphs also show that DCA did not exceed the required specification limits listed in TP-9215. Given all the data collected, verifies that the design meets the requirements for the TT9SMT product line. Further data is available upon request.

7. Appendix

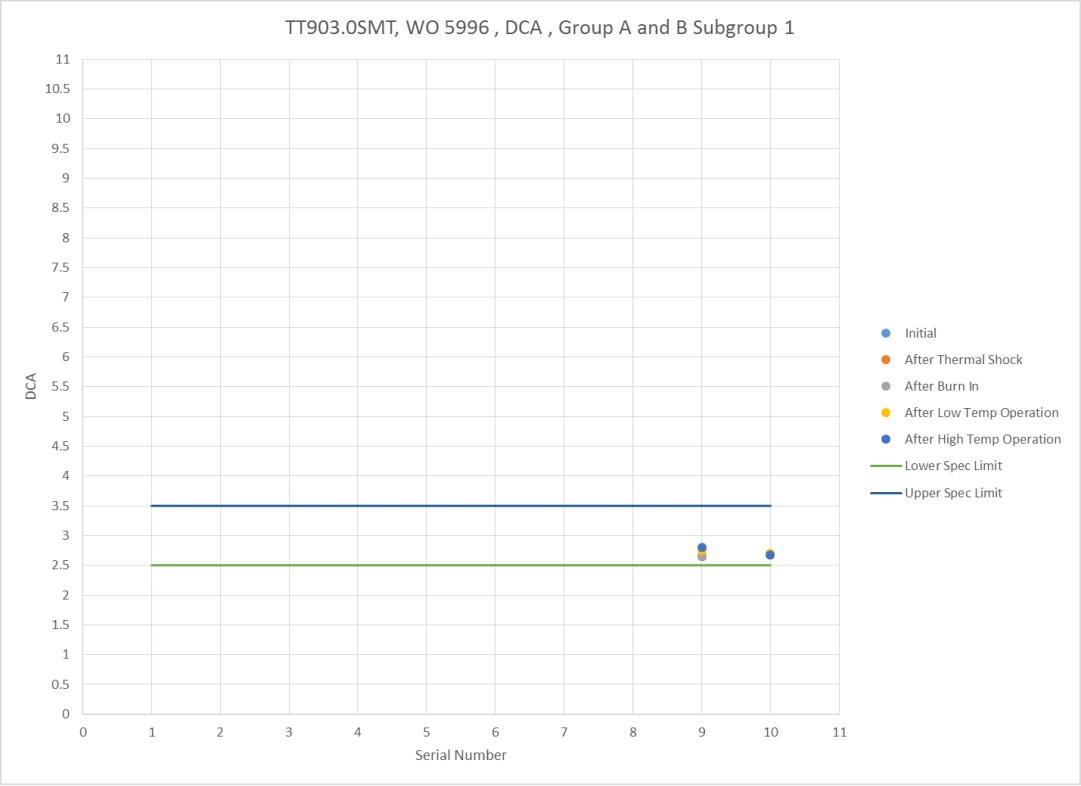


Figure 3 – TT903.0SMT DC Attenuation Group A and B Subgroup 1

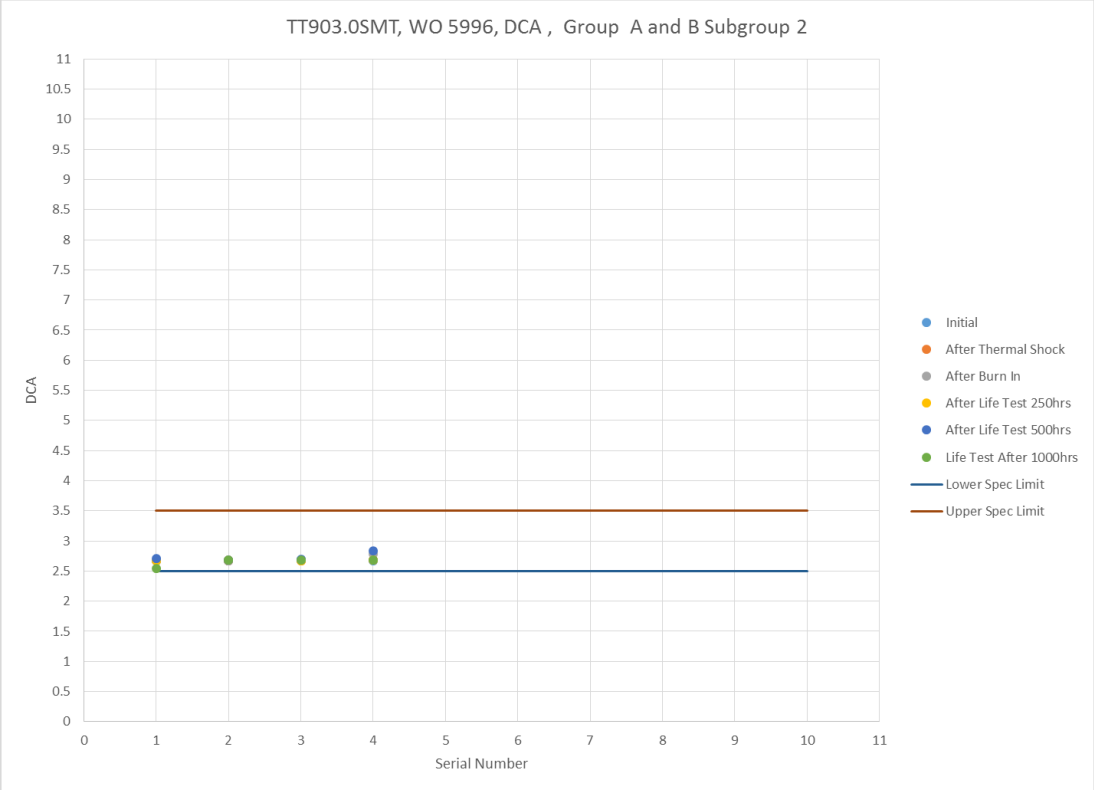


Figure 4 - TT903.0SMT DC Attenuation Group A and Subgroup 2

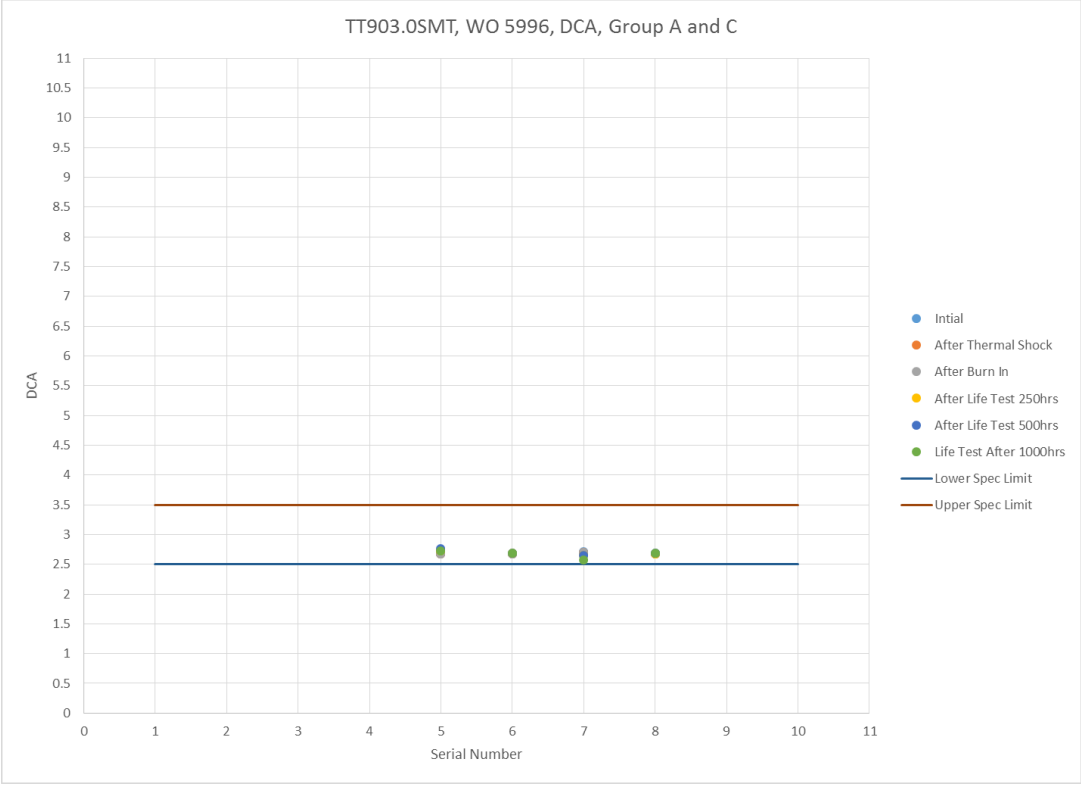


Figure 5 - TT903.0SMT DC Attenuation Group A and C

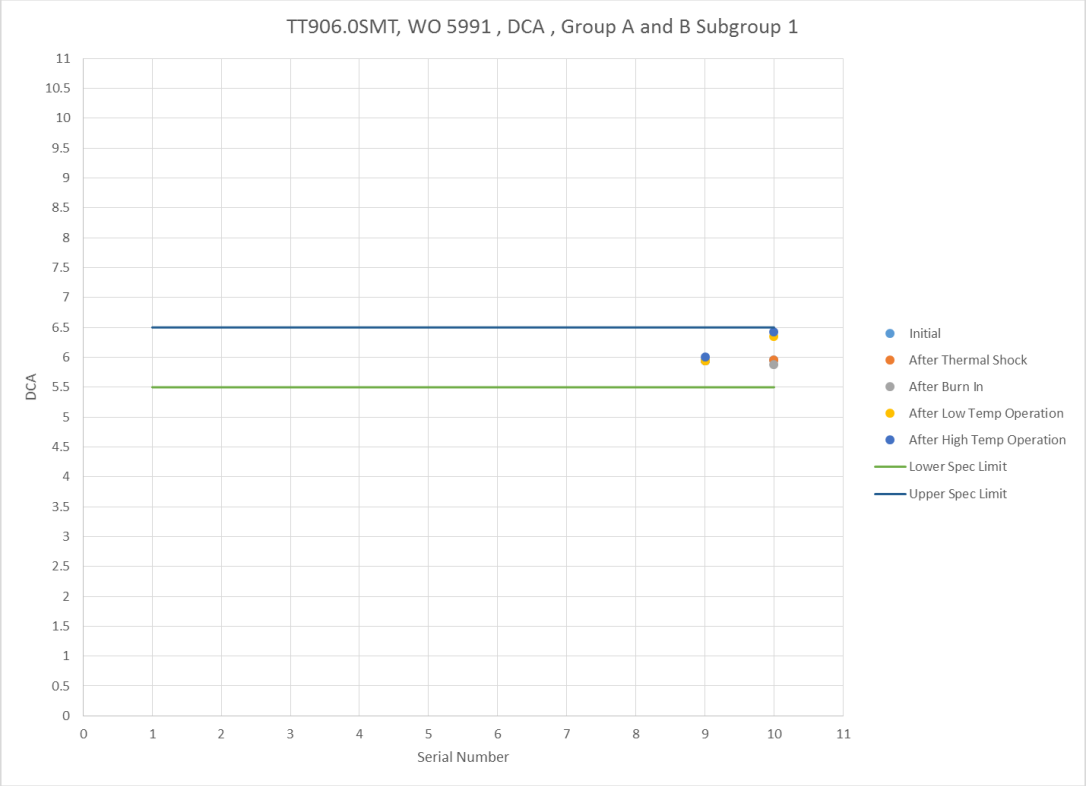


Figure 6 - TT906.0SMT DC Attenuation Group A and B Subgroup 1

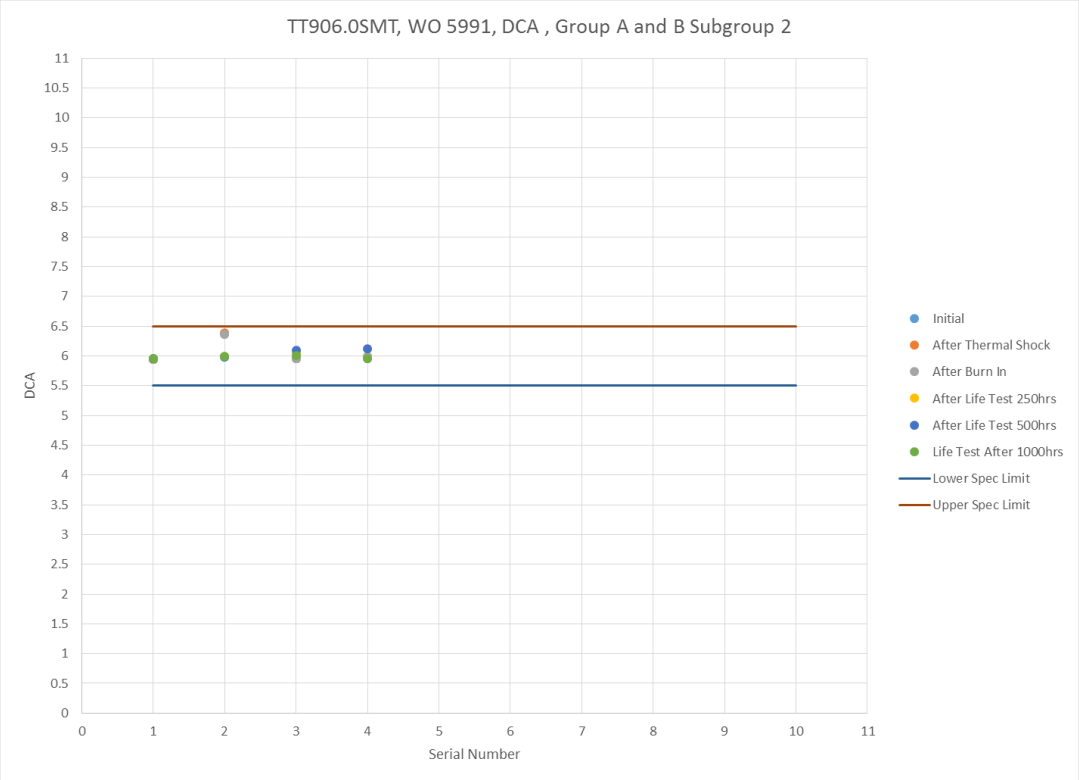


Figure 7 - TT906.0SMT DC Attenuation Group A and B Subgroup 2

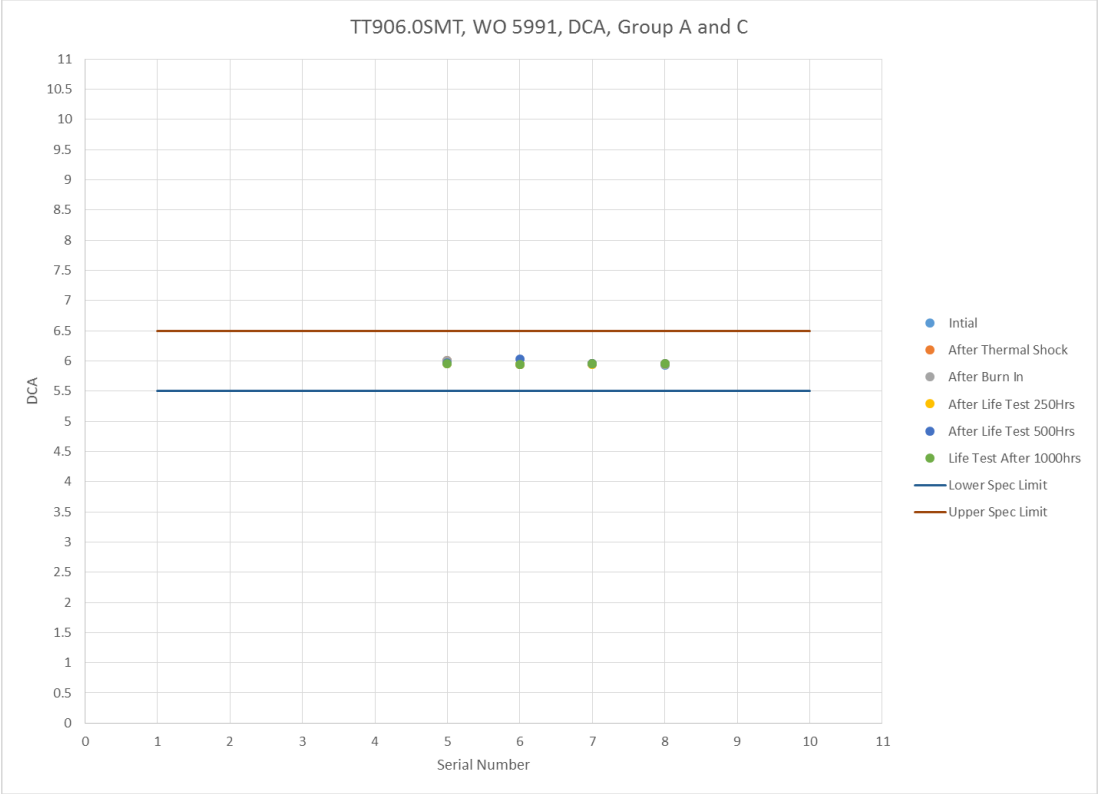


Figure 8 - TT906.0SMT DC Attenuation Group A and C

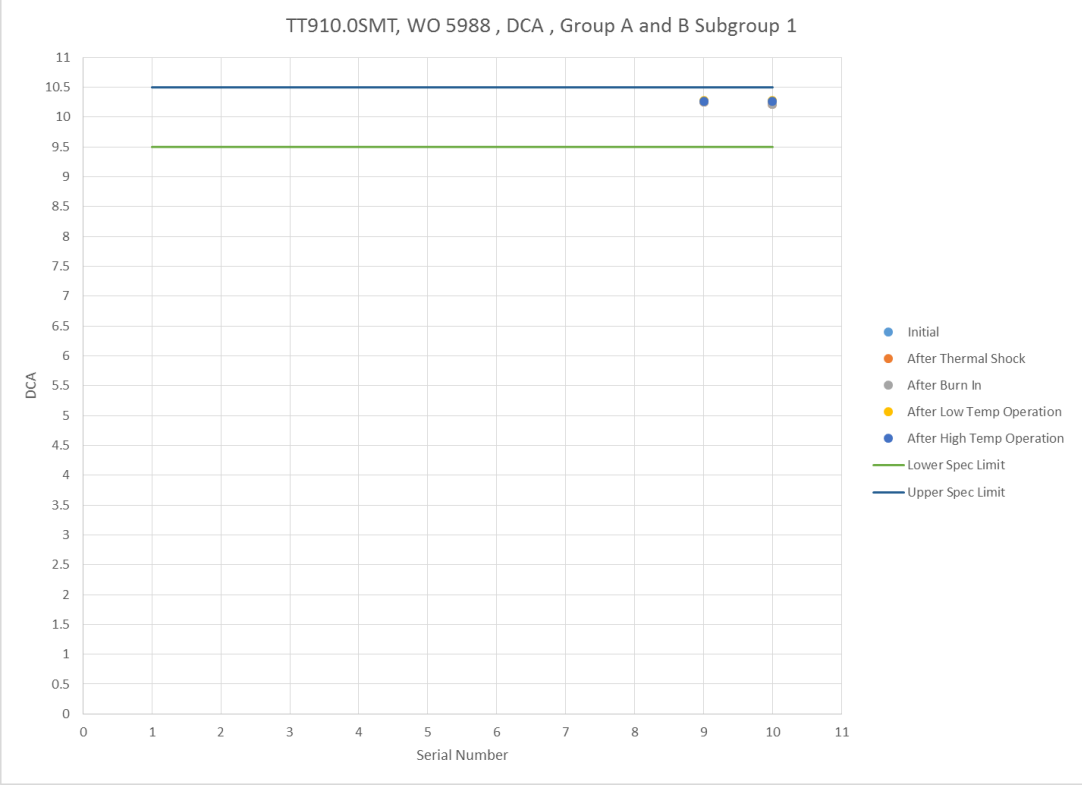


Figure 9 - TT910.0SMT DC Attenuation Group A and B Subgroup 1

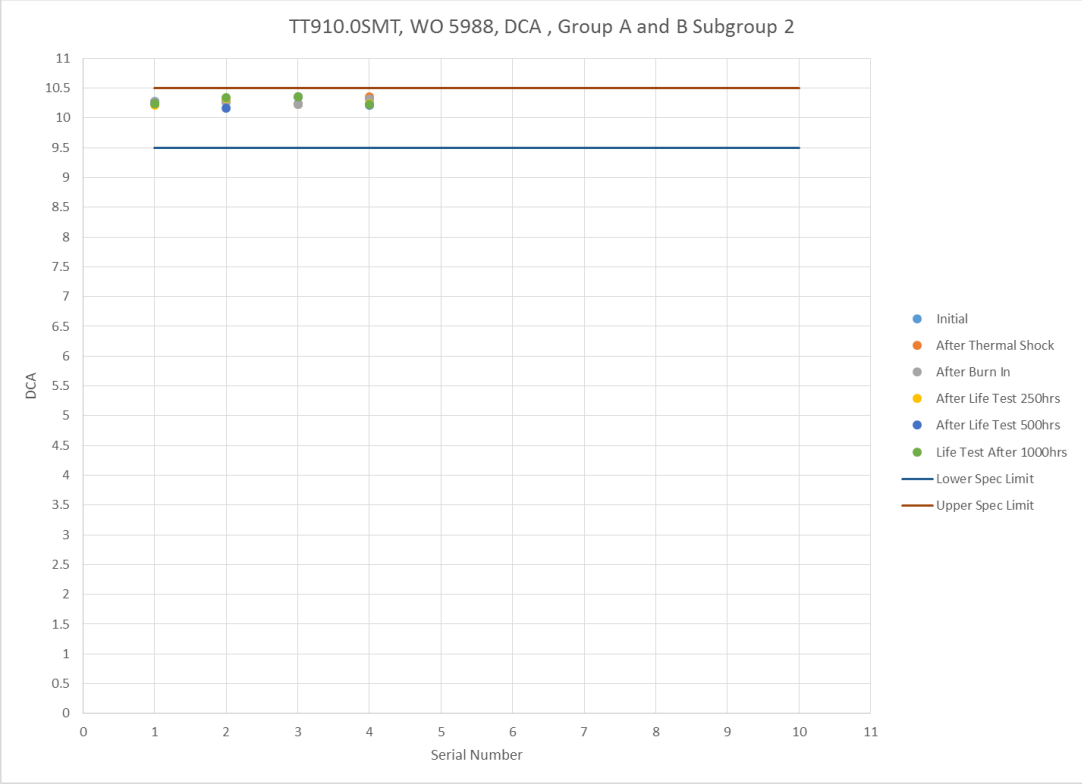


Figure 10 - TT910.0SMT DC Attenuation Group A and B Subgroup 2

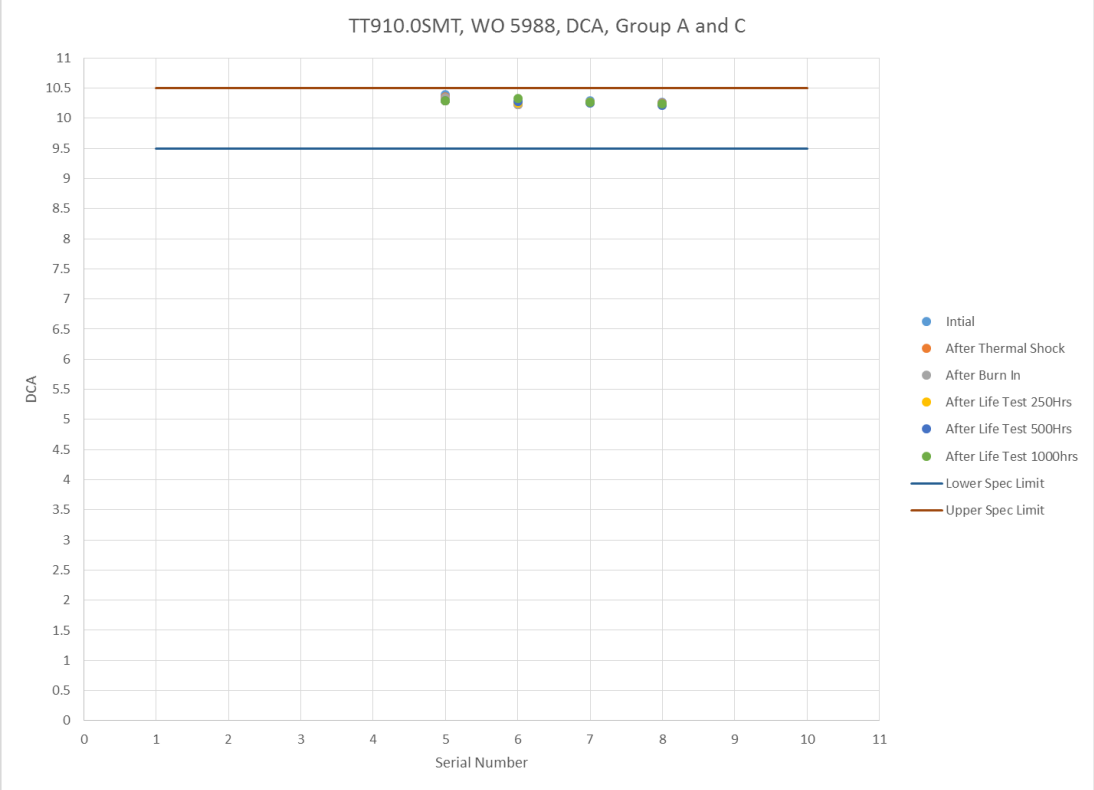


Figure 11 - TT910.0SMT DC Attenuation Group A and C