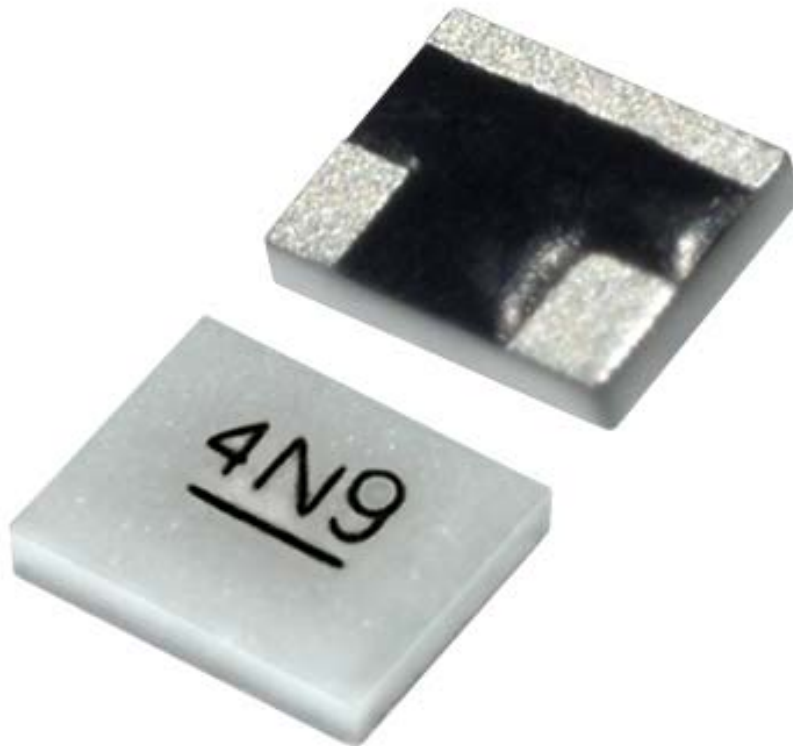


# Test Report

## HC Series Attenuators Part Number: HCM020CN05W3S

Chris Hawn, 11/30/2017



## 1. Introduction

The purpose of this report is to document the testing performed for part number HCM020CN05W3S. This is a high reliability version of MTVA0200N05W3S tested per Smiths Interconnect test plan TP-9191. The HCMXXXXNXXW3S series is available with group, A, B, or C inspections. The following report documents testing through the entire test flow including group A sample inspection, group B subgroups 1 and 2, and group C testing. Figure 1 shows the test flow options available in the HC series of high reliability products.

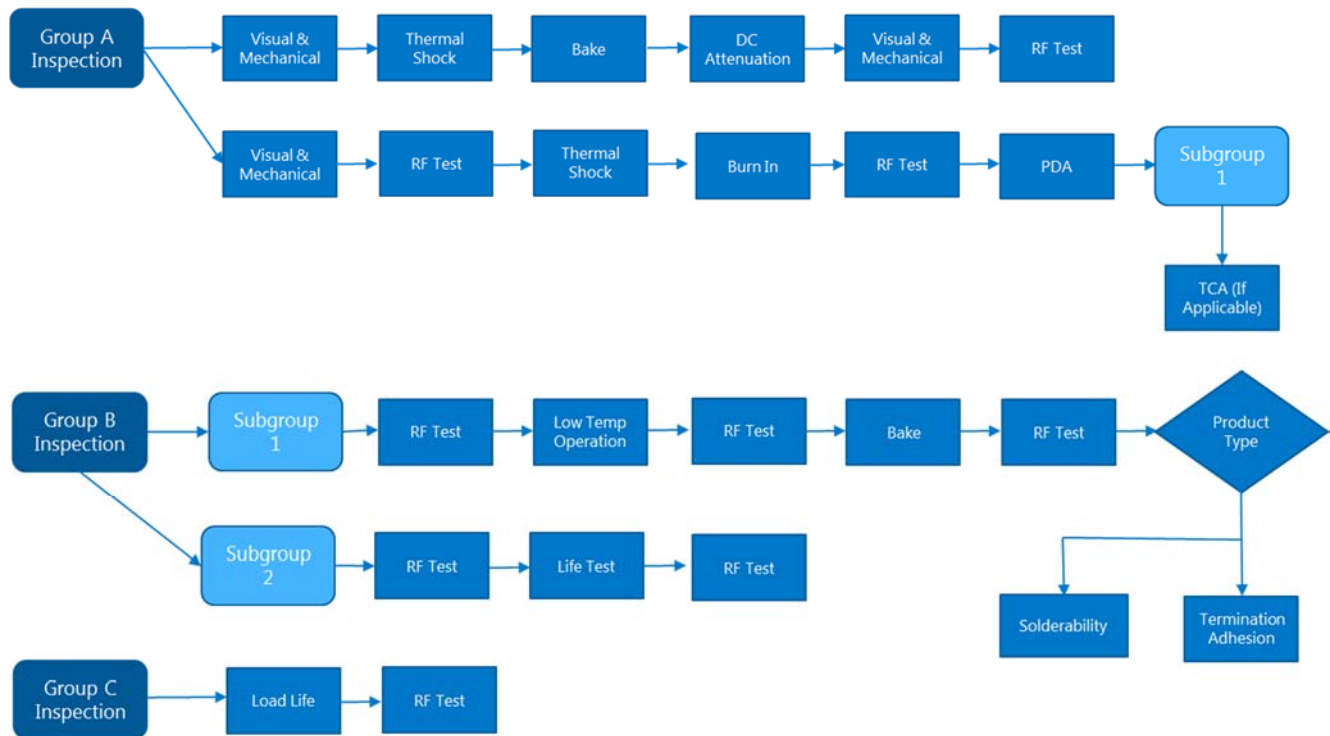


Figure 1 - Test Flow per TP-9191

## 2. Specifications

- Nominal Impedance: 50 Ohms
- Frequency Range: DC-12.4 GHz
- Attenuation Value: 2.0 dB
- Attenuation Accuracy @ 25°C:  $\pm 0.5$  dB @ 1 GHz
- VSWR: 1.30:1 Max @ 1 GHz
- Input Power: 200 milliwatts full rated power to 125°C, derated linearly to 0 watts at 150°C
- Temperature Coefficient of Attenuation:  $-0.005$  dB/dB/°C
- Temperature Coefficient of Attenuation Tolerance:  $\pm 0.001$  dB/dB/°C
- Operating Temperature:  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

### 3. Test Results

The lot (577351) quantity was 5000 pieces that went through Group A, B, and C. The results are shown below.

Prior to starting the tests 100% of the lot when through pre-cap visual inspection where the products were examined for gross workmanship defects per MIL-PRF-55342: conductor metallization defects, resistor defects, substrate defects and foreign material. This is performed prior to application of the protective coatings. The inspection is to be performed at 30X and 60X magnification with 30X being the referee power. The products are considered unacceptable if any of the following defects were found.

**Group A Inspection:** 100 % of the lot (5000 pieces) went through group a testing that consists of visual mechanical inspection, thermal shock 10 cycles (-55°C to +125°C) in accordance with MIL-STD-202 method 107 and a bake @ 150°C for 96 hours. DC attenuation was measured in accordance to the device specification and 100% of the lot was deemed passing.

**Group A Sample Inspection:** 40 pieces were subject to group A sample inspection testing that consists of visual mechanical inspection, initial RF test (VSWR and attenuation), thermal shock 10 cycles (-55°C to +125°C) in accordance with MIL-STD-202 method 107, RF test (VSWR and attenuation), Burn-in 125°C for 168 hours with input power per the specification and a final RF test. The products must meet a PDA (Percent Defective Allowable) of 10%. The products were all deemed passing. The results can be found in Figures 2, 3 and 4.

**Subgroup 1:** 3 pieces from group A sample inspection were subject to TCA testing and verification. This consists of measuring and recording DC attenuation at DC over temperature in 20°C increments over the range of -55°C to +125°C. This data is plotted and the slope of the curve is determined using linear regression. TCA is then calculated using the following formula:

$$TCA = \frac{Slope}{Attenuation @ 25^{\circ}C}$$

All of the sample subjected to TCA testing were deemed passing, the results and calculations can be found in Figures 5, 6 and 7.

### Group A Sample Inspection VSWR @ 1.0 GHz

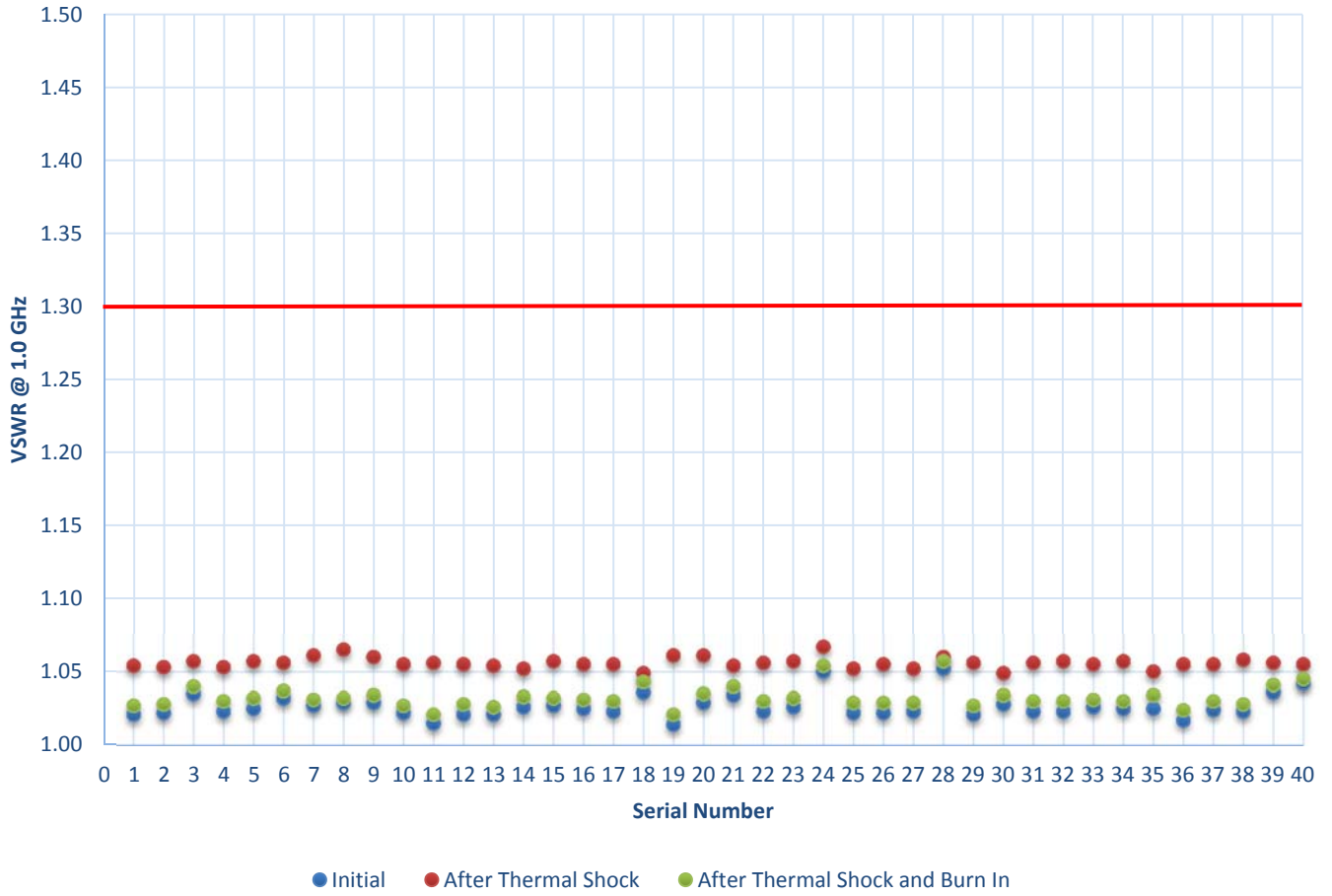


Figure 2 - Group A Sample Inspection VSWR

### Group A Sample Inspection Attenuation @ DC

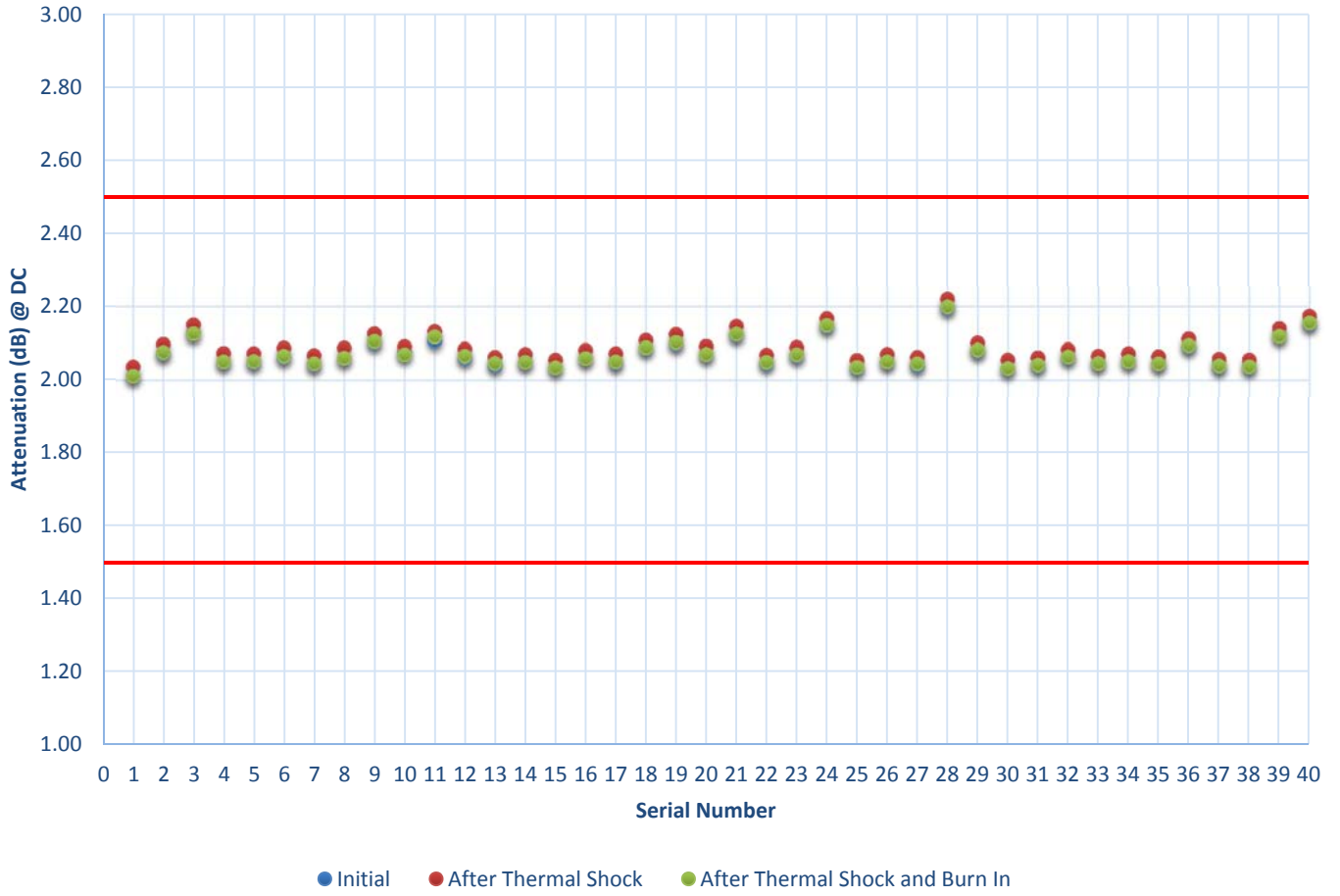


Figure 3 - Group A Sample Inspection DC Attenuation

### Group A Sample Inspection Attenuation @ 1.0 GHz

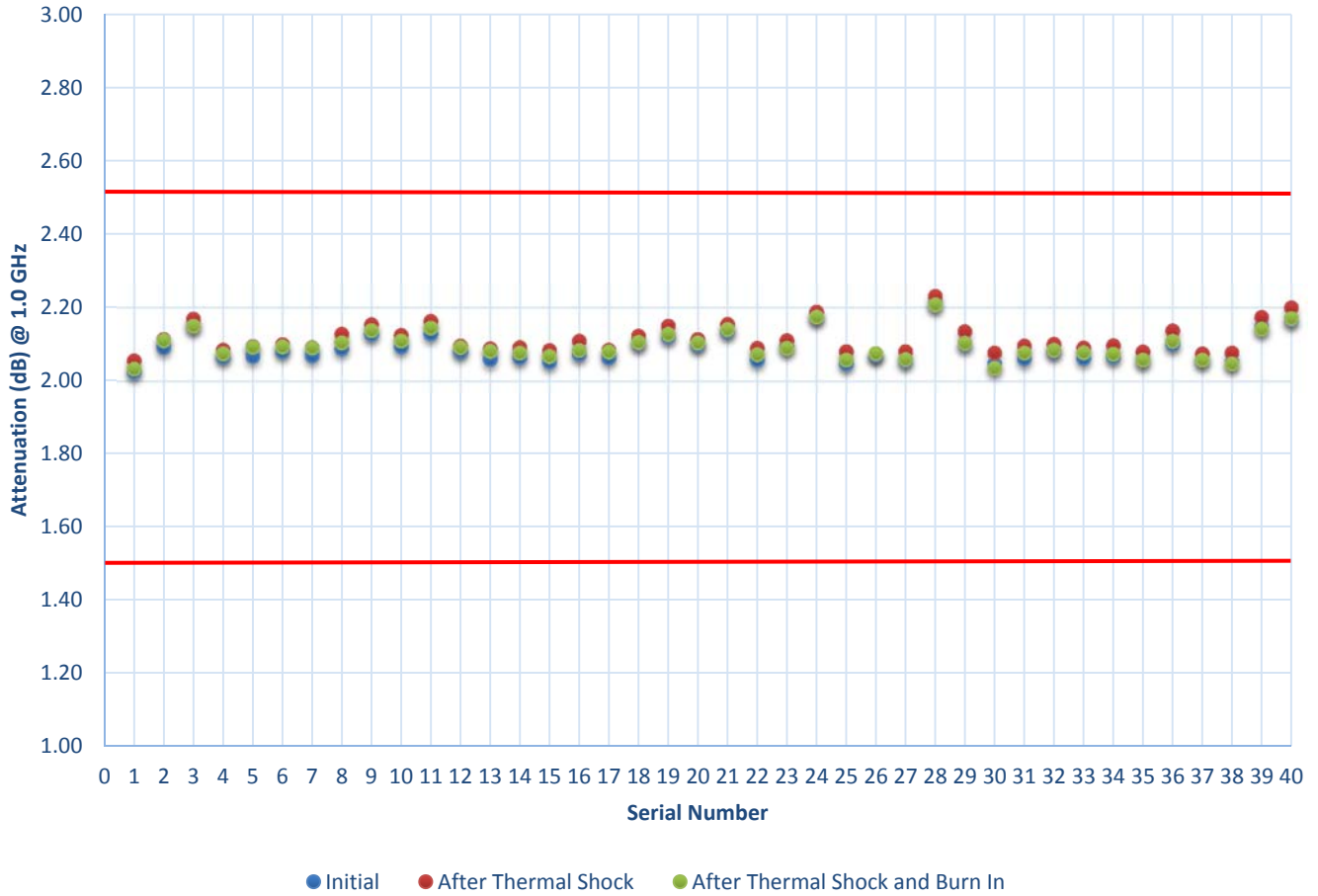


Figure 4 - Group A Sample Inspection RF Attenuation

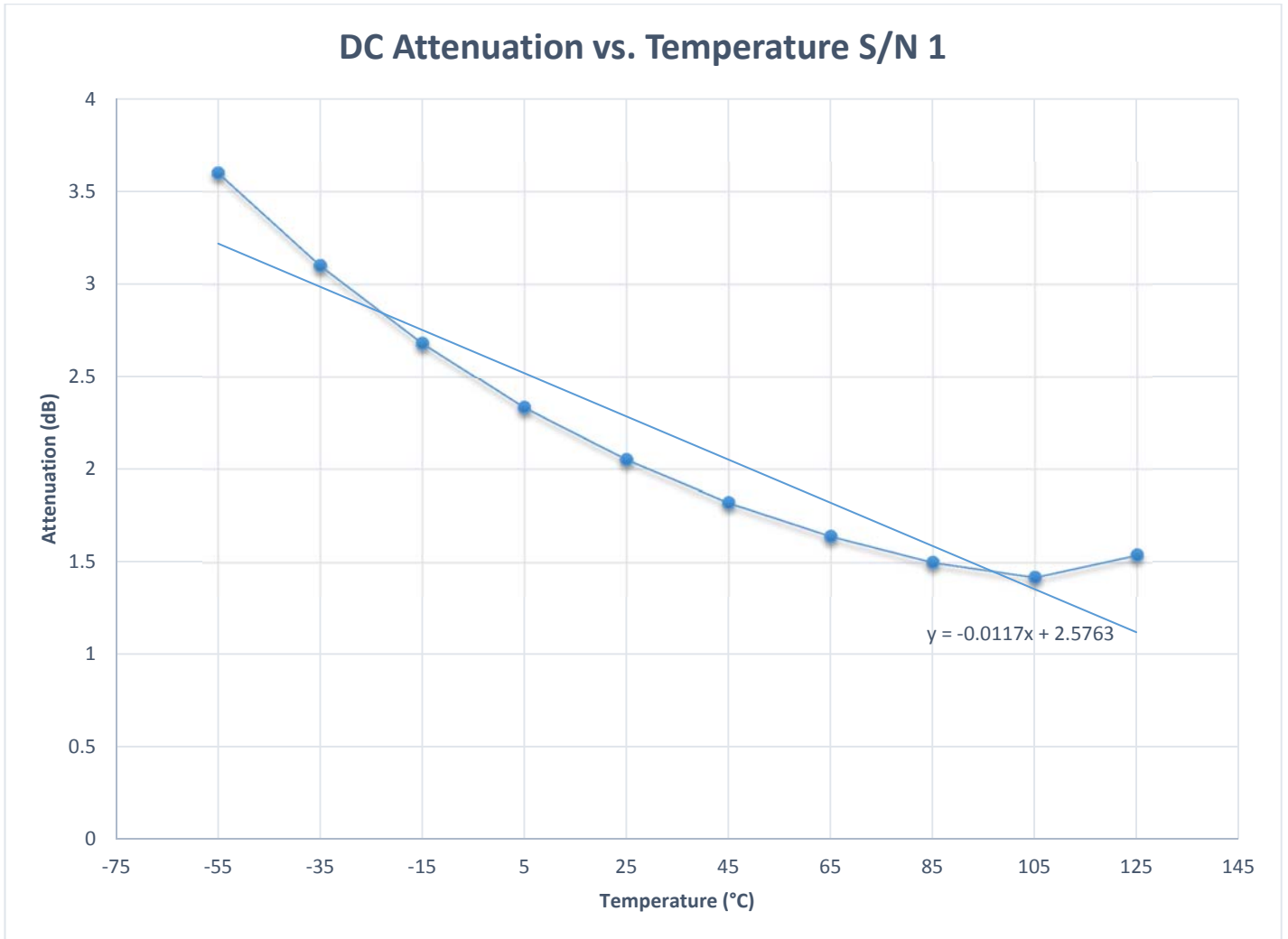


Figure 5 - TCA S/N 1

$$\text{Slope} = -11.67 \text{ dB}/^{\circ}\text{C}$$

$$TCA = \frac{\text{Slope}}{\text{Attenuation @ } 25^{\circ}\text{C}}$$

$$TCA = \frac{-11.67}{2.05}$$

$$TCA = -5.69 \text{ dB/dB}/^{\circ}\text{C}$$

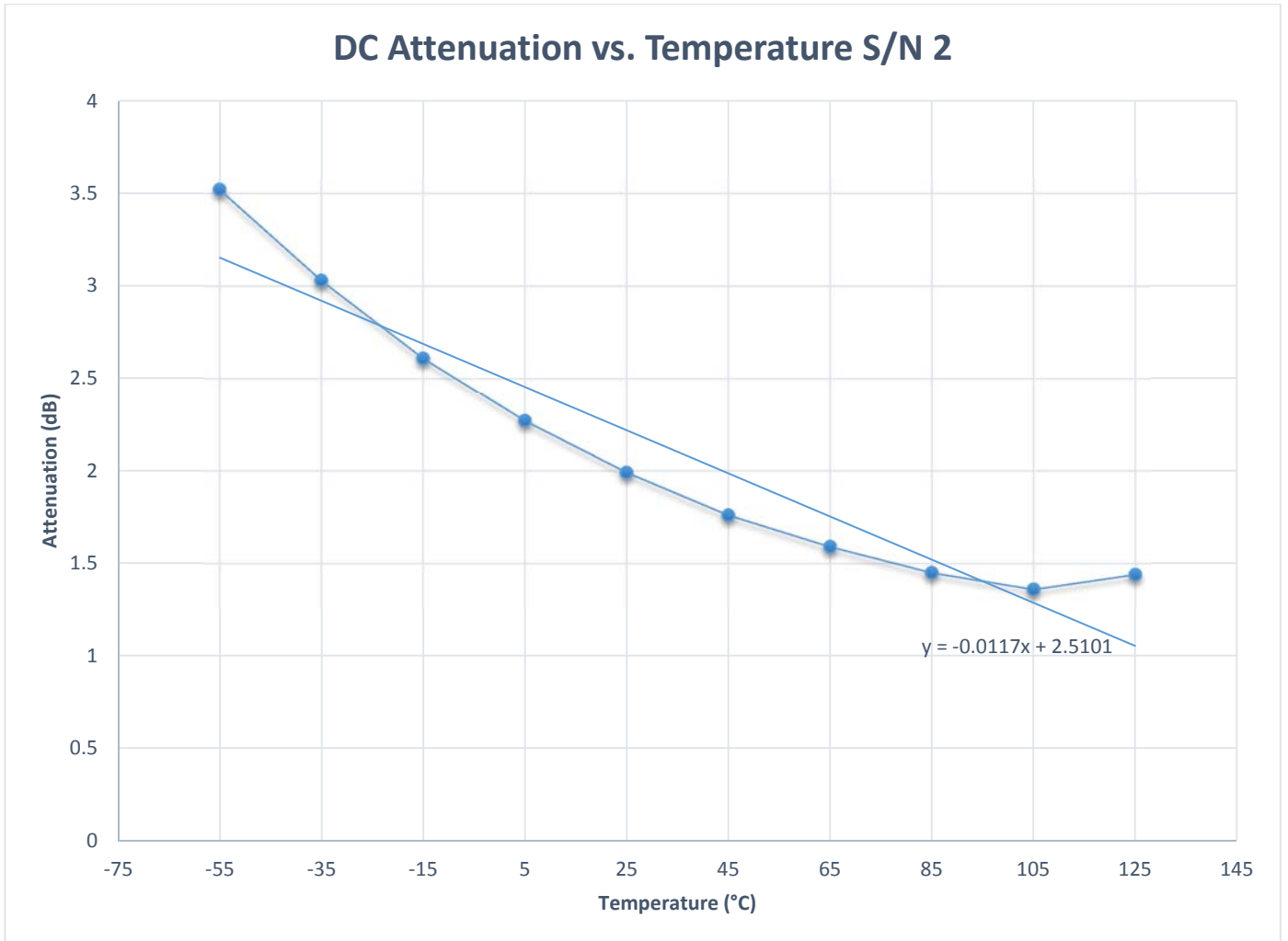


Figure 6 - TCA S/N 2

$$\text{Slope} = -11.66 \text{ dB}/^{\circ}\text{C}$$

$$\text{TCA} = \frac{\text{Slope}}{\text{Attenuation @ } 25^{\circ}\text{C}}$$

$$\text{TCA} = \frac{-11.66}{1.99}$$

$$\text{TCA} = -5.86 \text{ dB}/\text{dB}/^{\circ}\text{C}$$



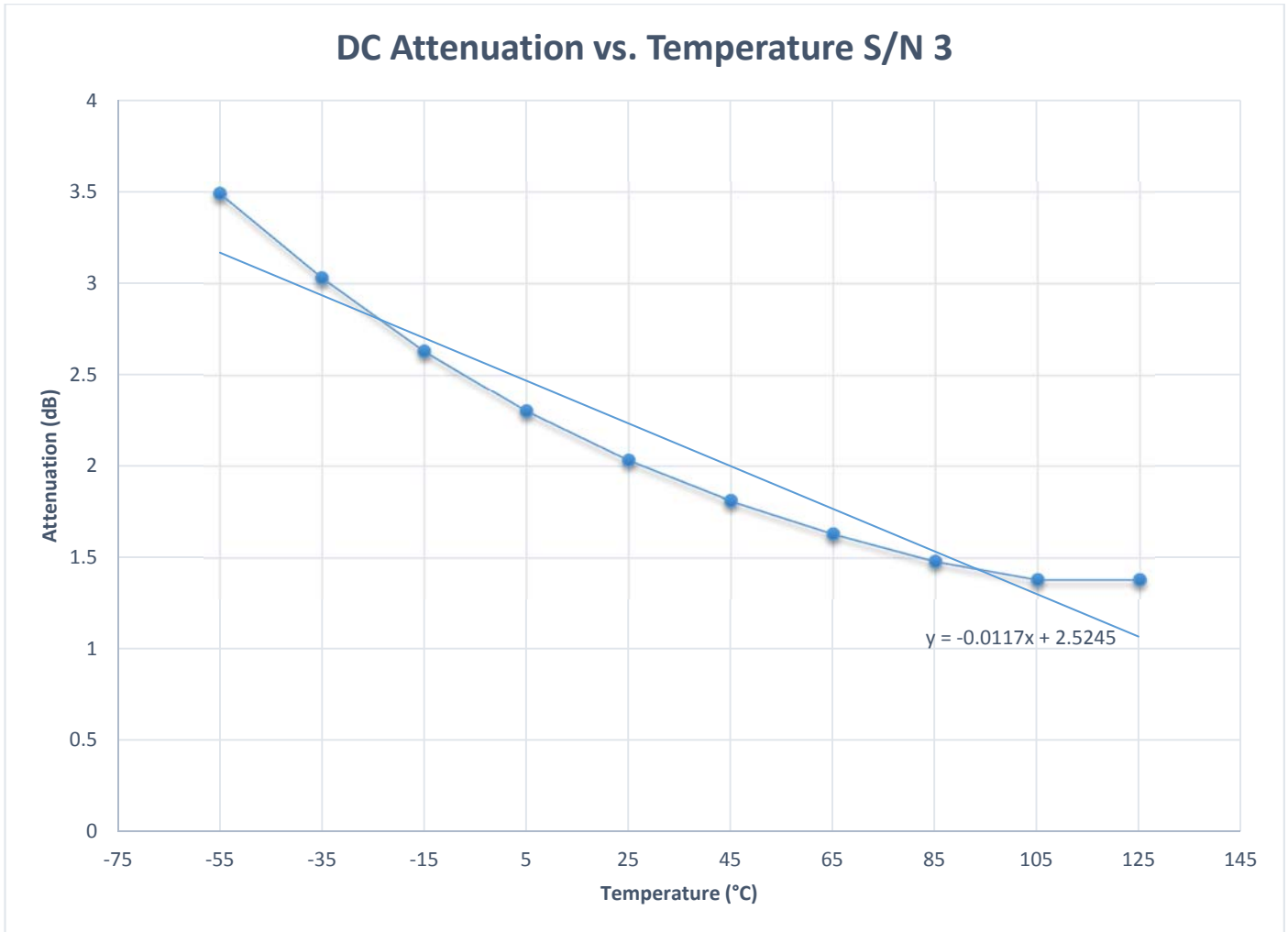


Figure 7 - TCA S/N 3

$$\text{Slope} = -11.67 \text{ dB}/^\circ\text{C}$$

$$TCA = \frac{\text{Slope}}{\text{Attenuation @ } 25^\circ\text{C}}$$

$$TCA = \frac{-11.67}{2.03}$$

$$TCA = -5.75 \text{ dB}/\text{dB}/^\circ\text{C}$$

**Group B Inspection:** 20 pieces were randomly selected from group A testing and subject to group B inspection testing that consists of two subgroups (10 pieces each).

**Subgroup 1:** Consists of initial RF testing (VSWR and attenuation), low temperature operation (power per specification @-55°C for 1 hour), RF testing (VSWR and attenuation), high temperature bake (125°C for 4100 hours), RF testing (VSWR and attenuation) followed by termination solderability and visual examination at 20X for solder coverage. The results can be found in Figures 8, 9 and 10.

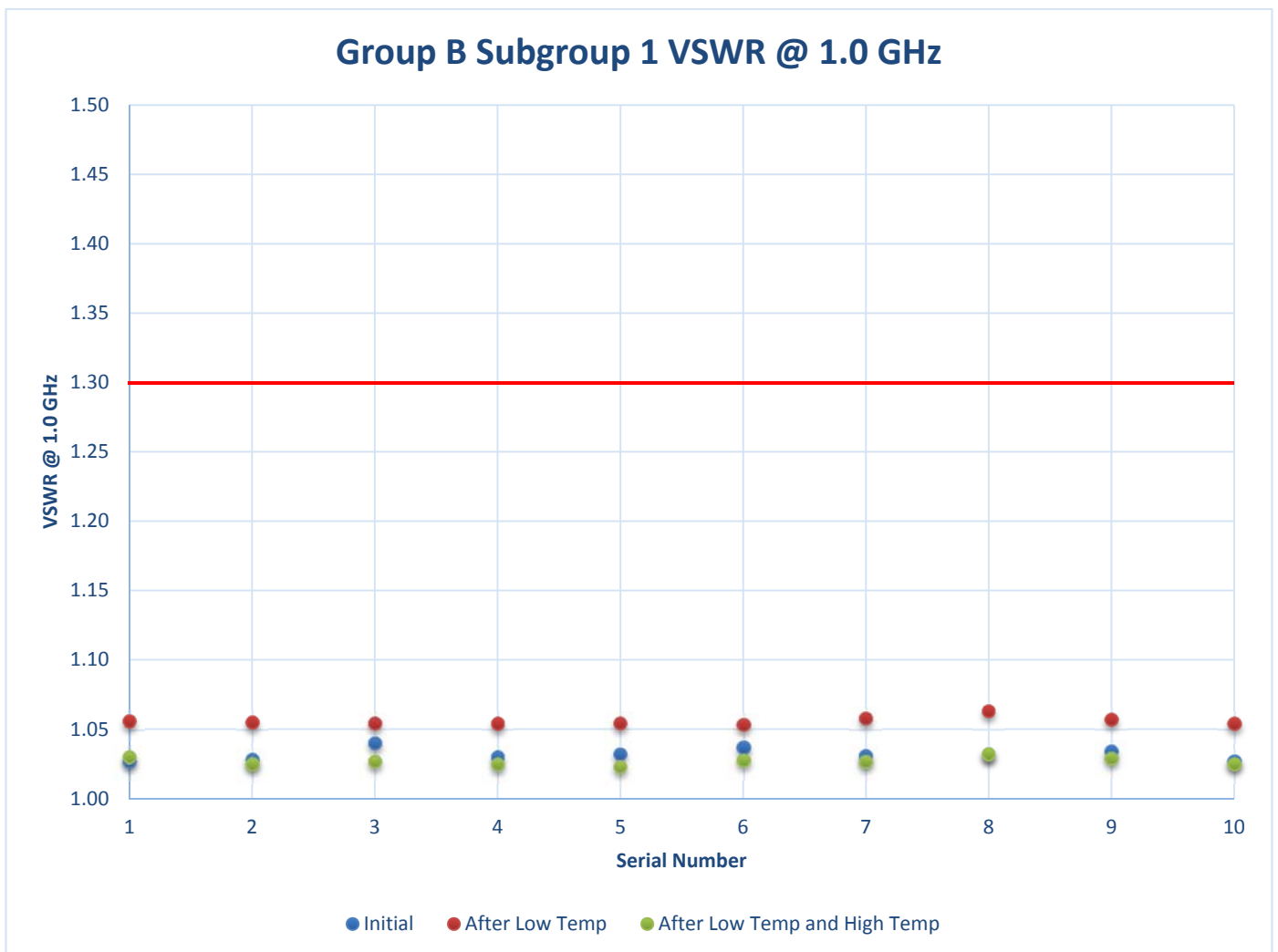


Figure 8 - Group B Subgroup 1 Inspection VSWR

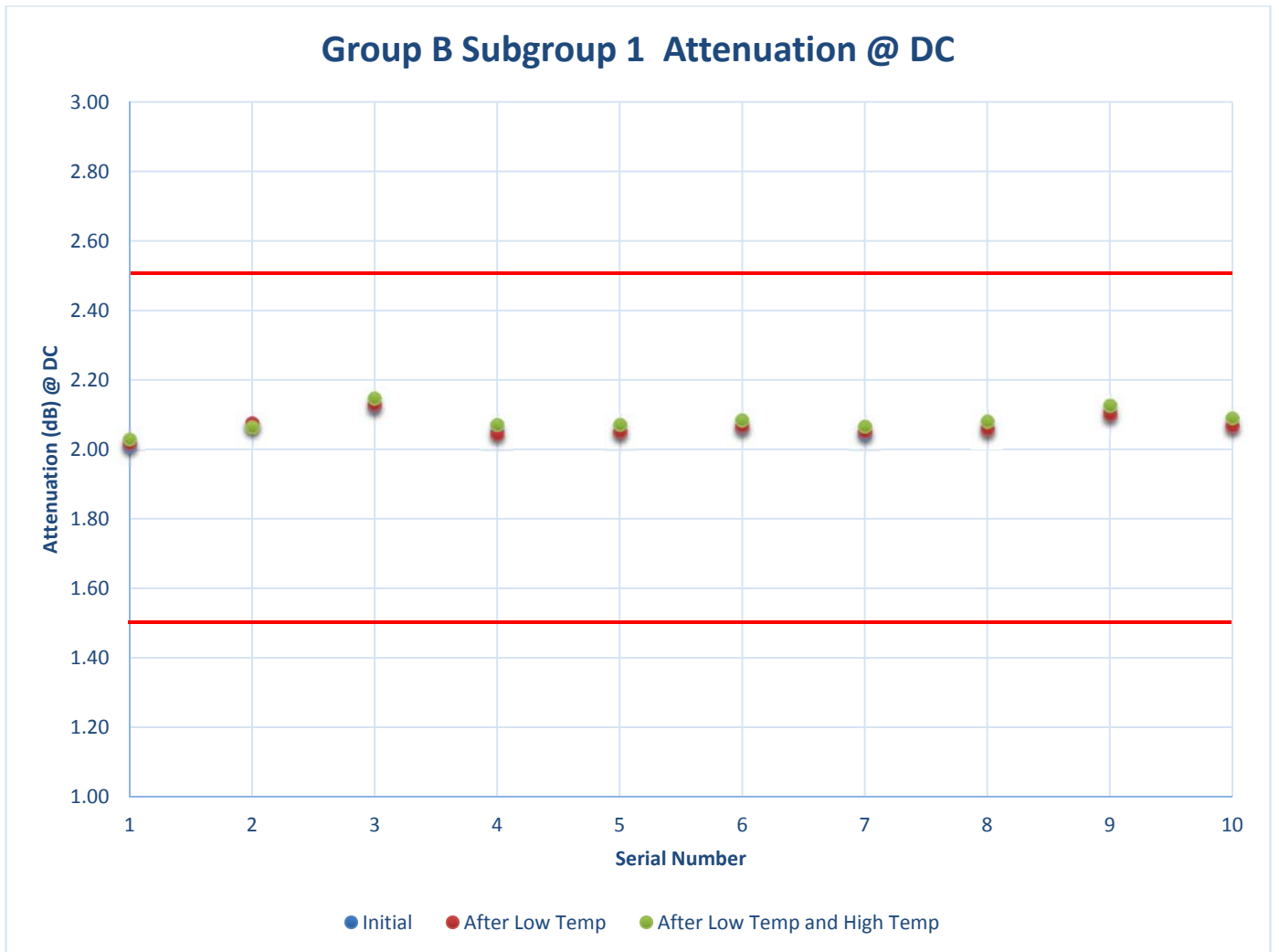


Figure 9 -Group B Subgroup 1 Inspection DC Attenuation

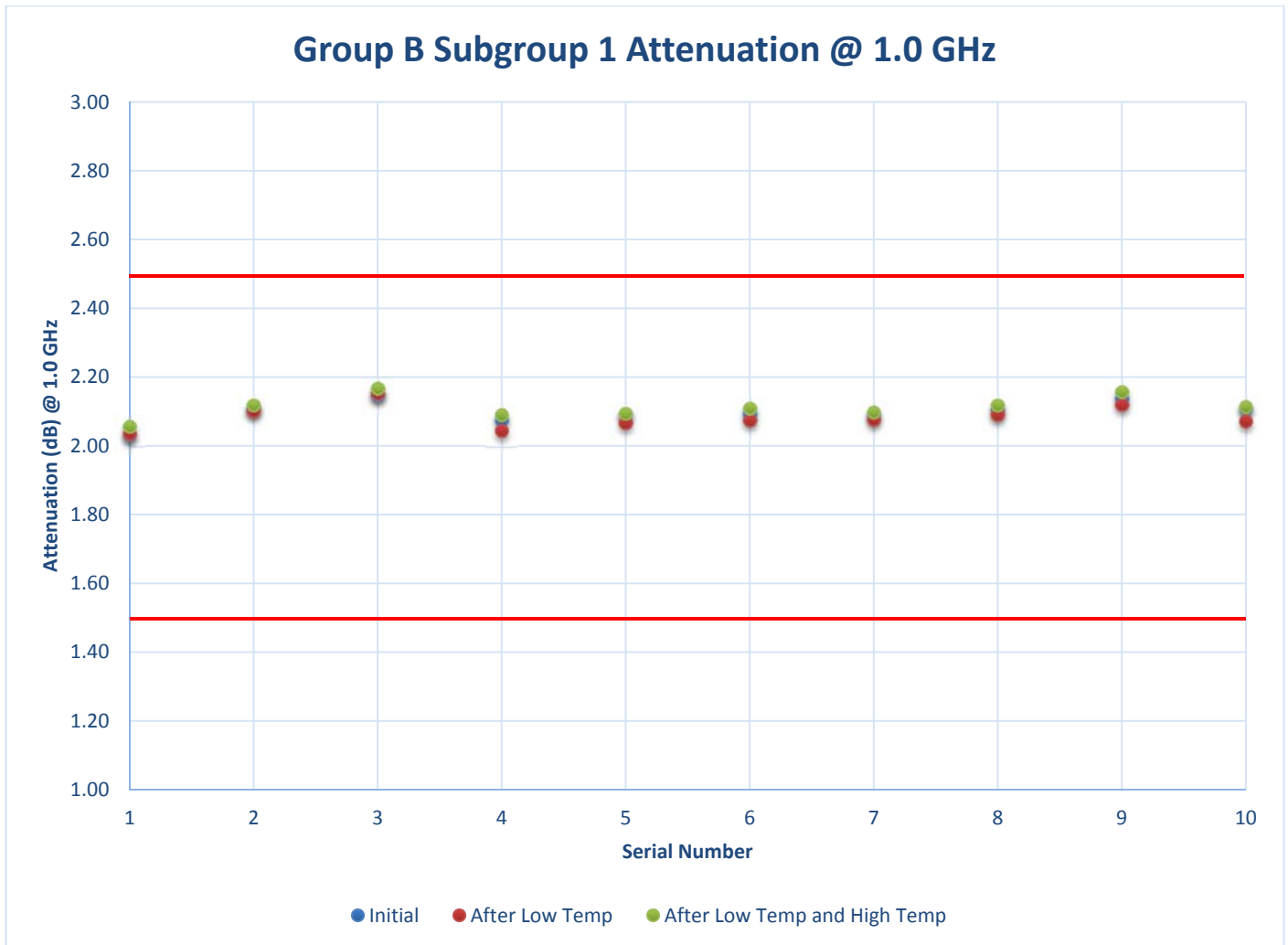


Figure 10 - Group B Subgroup 1 Inspection RF Attenuation

**Subgroup 2:** Consists of initial RF testing (VSWR and attenuation) and a life test for 1000 hours @70°C with input power per the specification followed by final RF testing (VSWR and attenuation). RF testing was also performed after 250 and 500 hour intervals. The results can be found in Figures 11, 12 and 13.

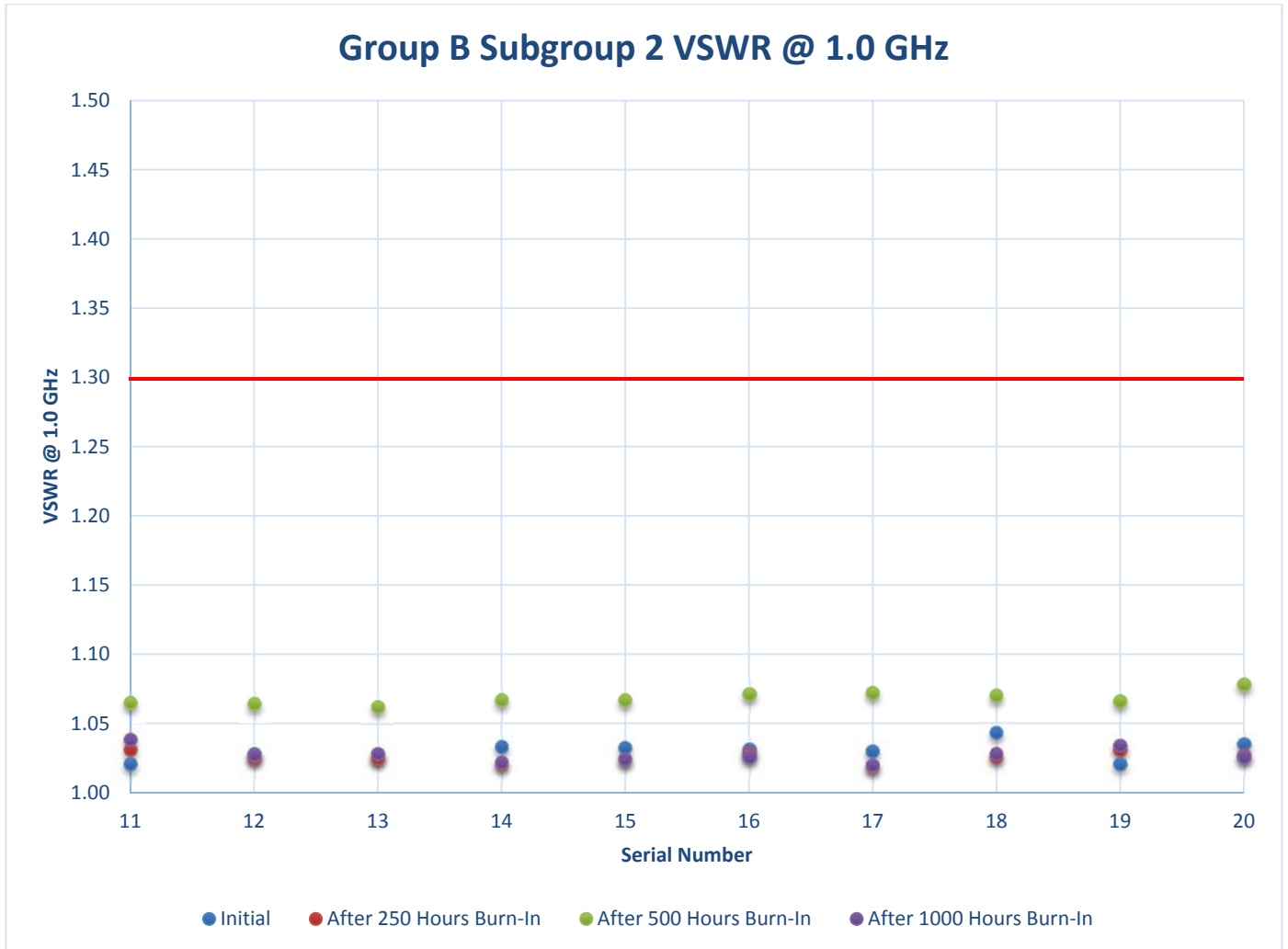


Figure 11 - Group B Subgroup 2 Inspection VSWR

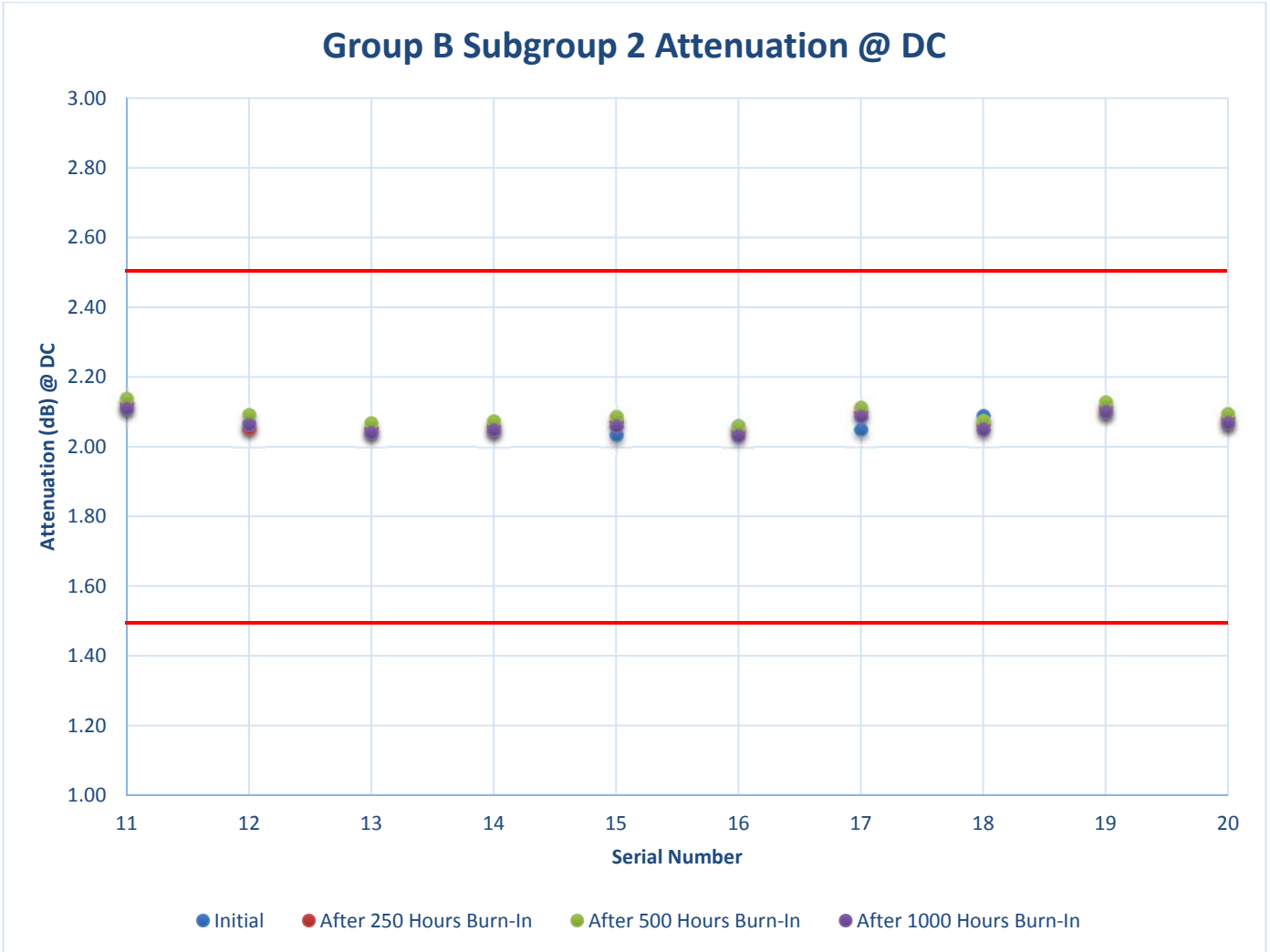


Figure 12 - Group B Subgroup 1 Inspection DC Attenuation

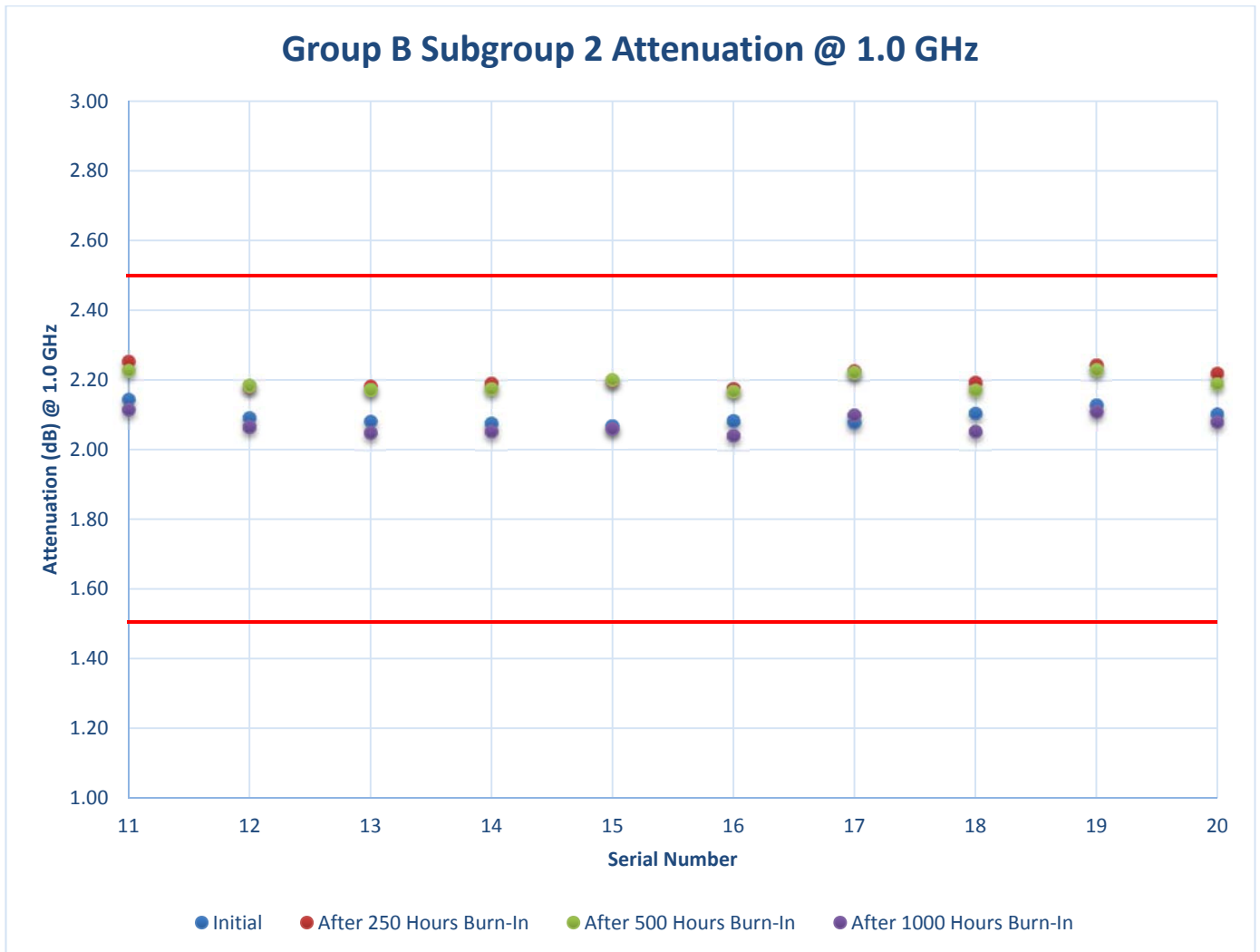


Figure 13 - Group B Subgroup 1 Inspection RF Attenuation

**Group C Inspection:** 20 pieces consisting of 17 group A sample inspection pieces and 3 group A sample inspection subgroup 1 were selected. Testing consists of Load life burn-in at 125°C for a duration of 100 hours at input power per the specification. RF testing was also performed after 250, 500 and 1000 hour intervals. The results can be found in Figures 11, 12 and 13. The results can be found in Figures 14, 15 and 16.

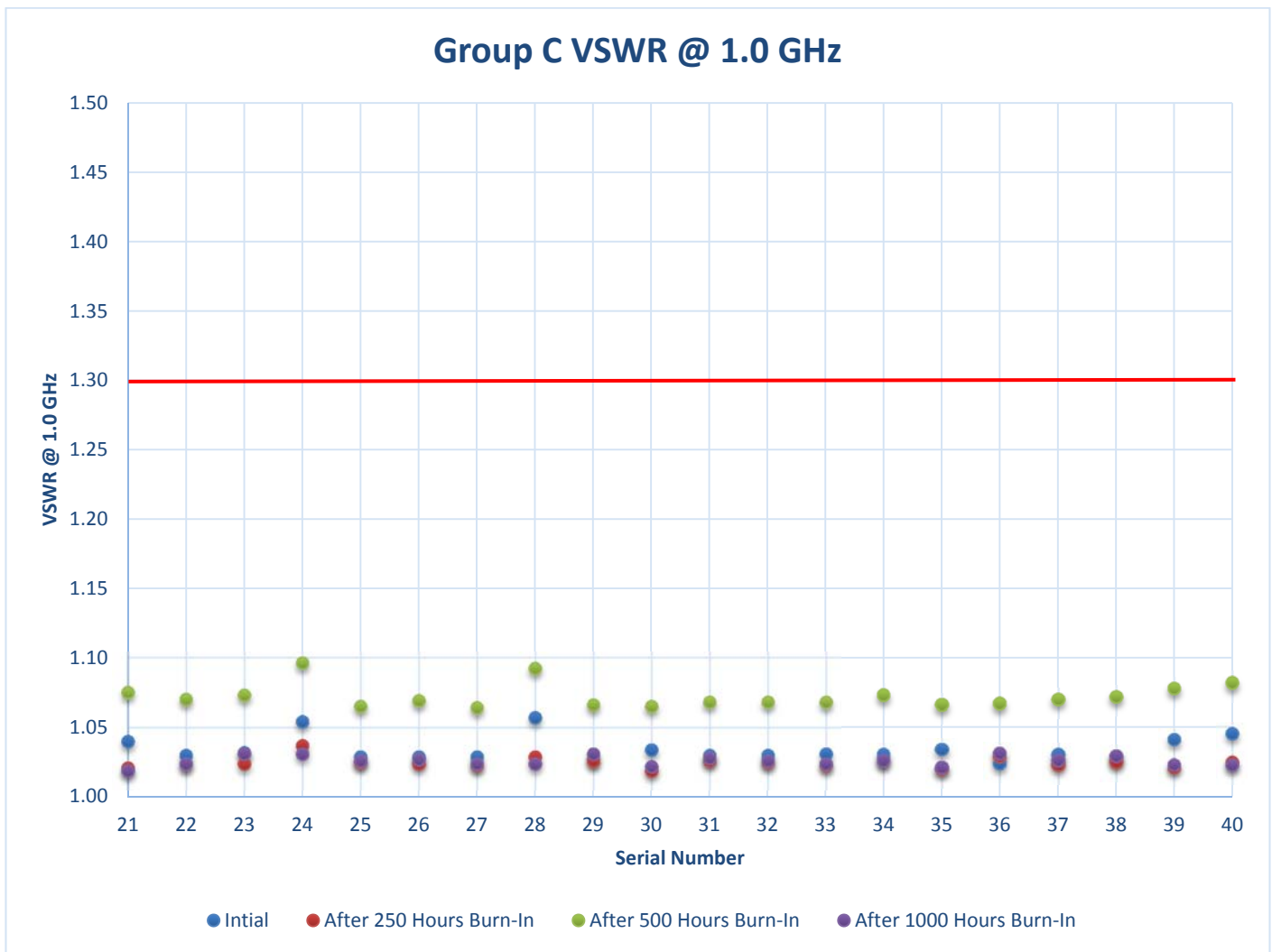


Figure 14 - Group C Inspection VSWR



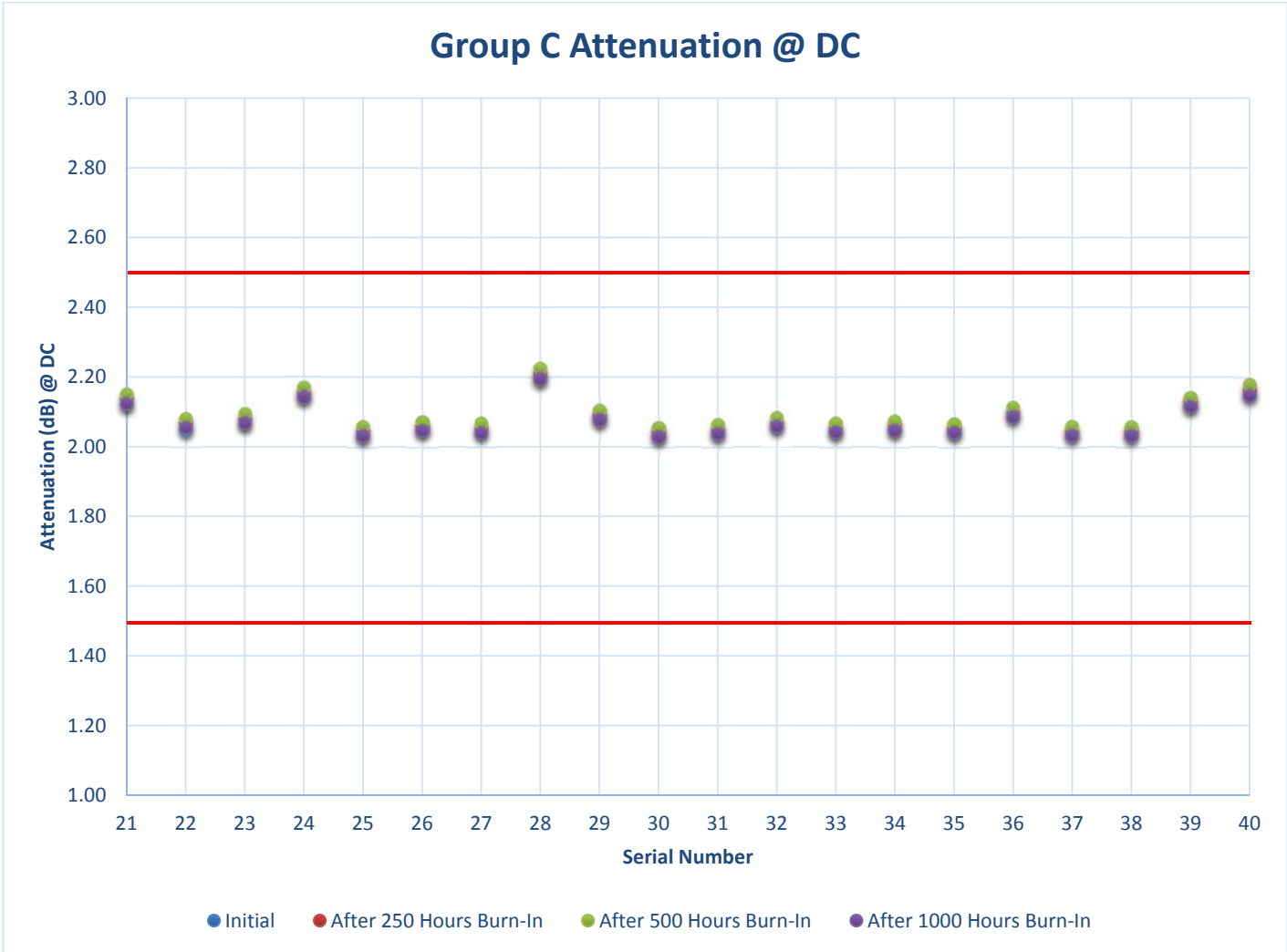


Figure 15 - Group C Inspection DC Attenuation

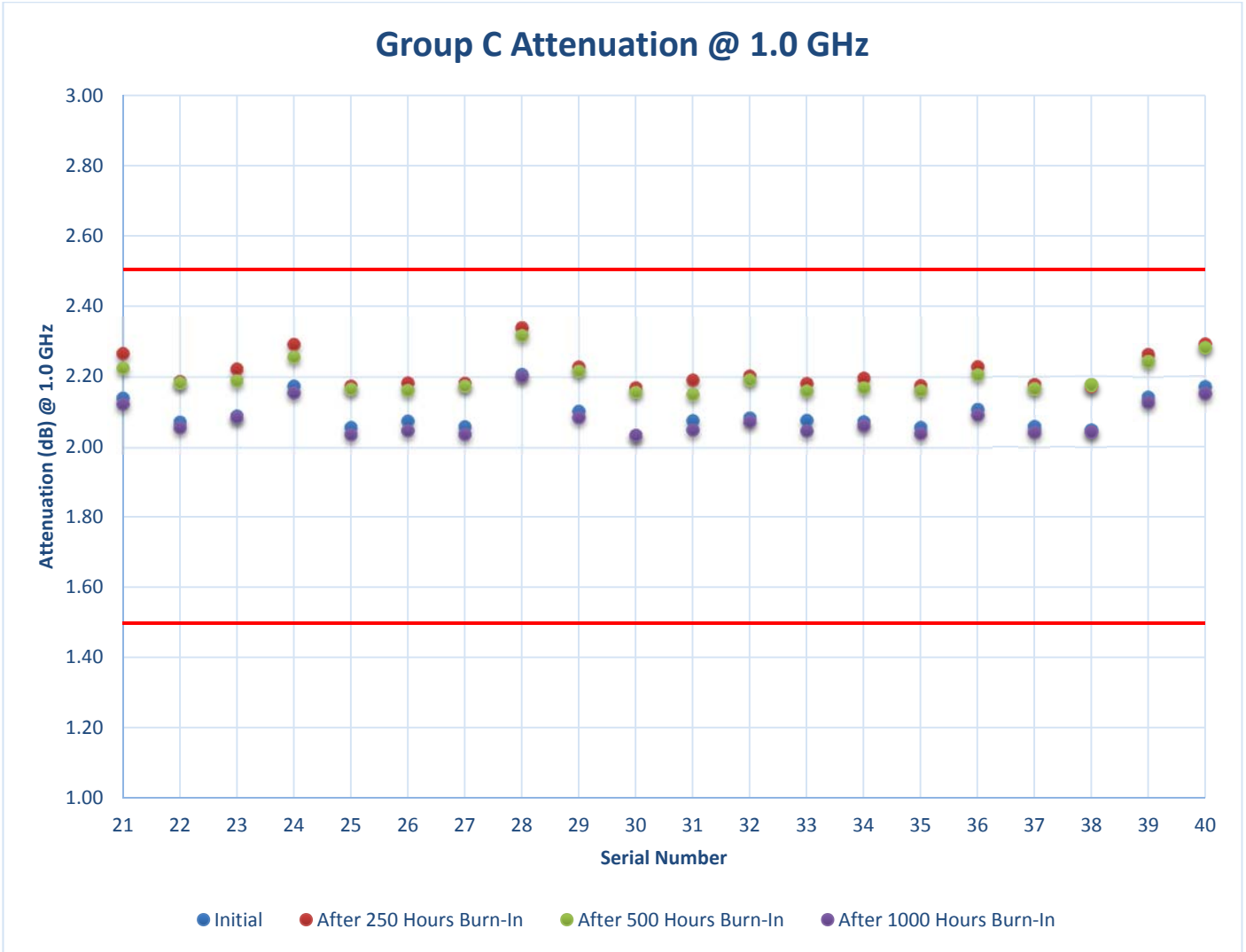


Figure 16 - Group C Inspection RF Attenuation

#### 4. Conclusion

All parts subjected to groups A, B and C testing passed 100%. The lot of 5000 pieces was deemed acceptable per the criteria of TP-9191 for HC series product. This report documents the data and results of the testing. Further information and raw data can be found under lot 577351 in the test data folder.