1.1 Time-Averaged SAR Verification Summary

This device supports the manufacturer's time-averaged SAR (TAS) mechanism for WLAN operations. The output power is controlled in real-time so that the power averaged over any 60 second window does not exceed the 1gm power level tested for SAR in this report. The time-averaged SAR algorithm tracks the energy contribution relative to the available energy budget for each transmitter, defined as the "utilization ratio". Once the utilization ratios for each of the individual WLAN transmitters are calculated, they are summed to derive the overall WLAN system power utilization ratio. This metric is used by the WLAN chipset to manage power levels over time and ensure that SAR limits are never exceeded.

As per ISED Algorithm acceptance letter and following FCC guidance, the following test scenarios were defined to validate the TAS mechanism. The specific scenarios are constructed to validate the operation of the algorithm in all operational states, including transitions between states/antennas:

• Change in Antenna

• Change in Band (includes connection drop scenario)

Predefined transmit profiles for each test scenario are provided by the manufacturer's test automation software to control the operation of the DUT while synchronized operational data was recorded from internal firmware and external power monitors. The data was plotted over time relative to the utilization limit and measured instantaneous power to demonstrate that the maximum time-averaged power is never exceeded. "Reported" values were output and captured directly from DUT firmware, while "Measured" results were obtained from external power meter. The uncertainty budget applied to the WLAN power control functions for this device is 1.5 dB. In all test cases, WLAN radios were configured to operate at 100% duty cycle.

Table 1-1
Test Configurations for Time-Averaged SAR Verification

Mode	Antenna	Channel	Plim (dBm)	Plim (mW)
802.11b	Core 0 – WF2	6	18.25	66.83
802.11b	Core 1 – WF1	6	18.25	66.83
802.11a	Core 0 – WF2	149	13.75	23.71
802.11a	Core 1 – WF1	149	13.50	22.38
802.11ax	Core 0 – WF2	15	11.25	13.33
802.11ax	Core 1 – WF1	15	11.25	13.33

Plim is the maximum time-averaged output power evaluated for SAR compliance

1.2 Verification Summary

Scenario 1: Change in Antenna from Core 0 to Core 1

For this test, the effect on the time-averaging algorithm from a change in the active transmit antenna was evaluated. Figures F-1, F-2, F-3 show a switch of 2.4 GHz transmissions from Core 0(WF2) to Core 1(WF1) at Time = 120 s. The test automation is controlling the WLAN radios to operate at 100% duty cycle. The utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna.

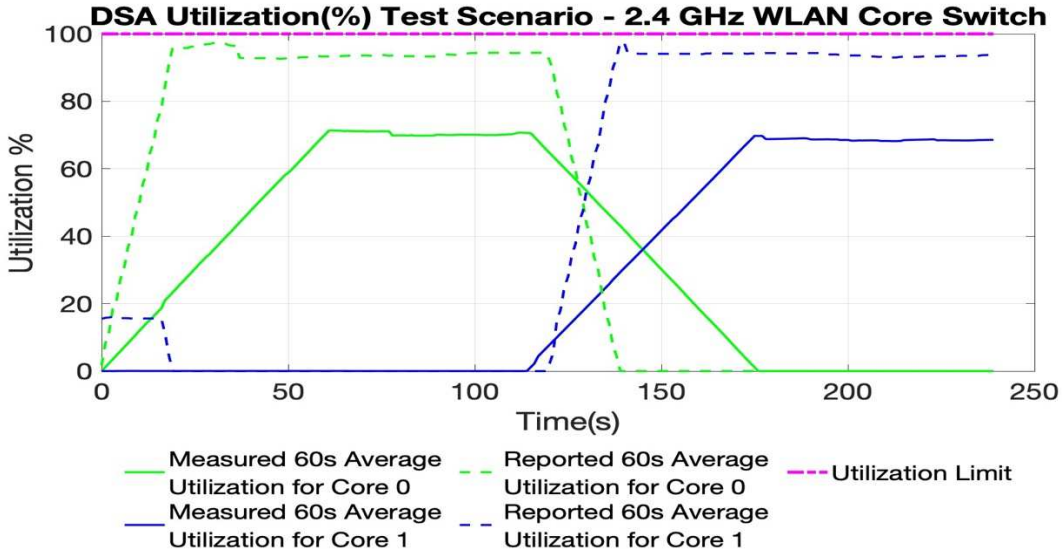

Figure F - 1
60 Sec Average SAR Utilization vs. Time, 2.4 GHz

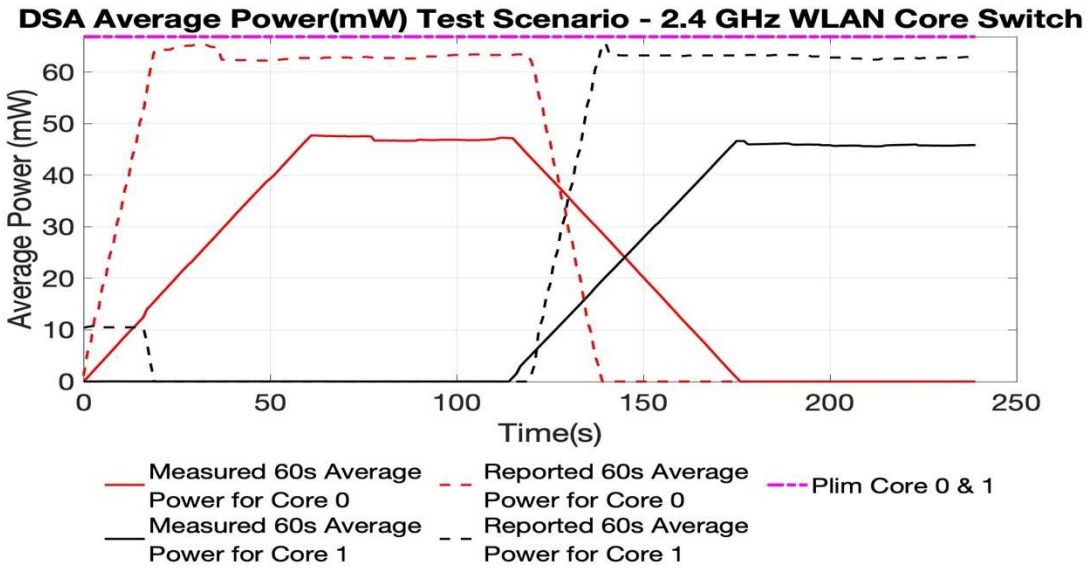

Figure F - 2
60 Sec Average Power vs. Time, 2.4 GHz

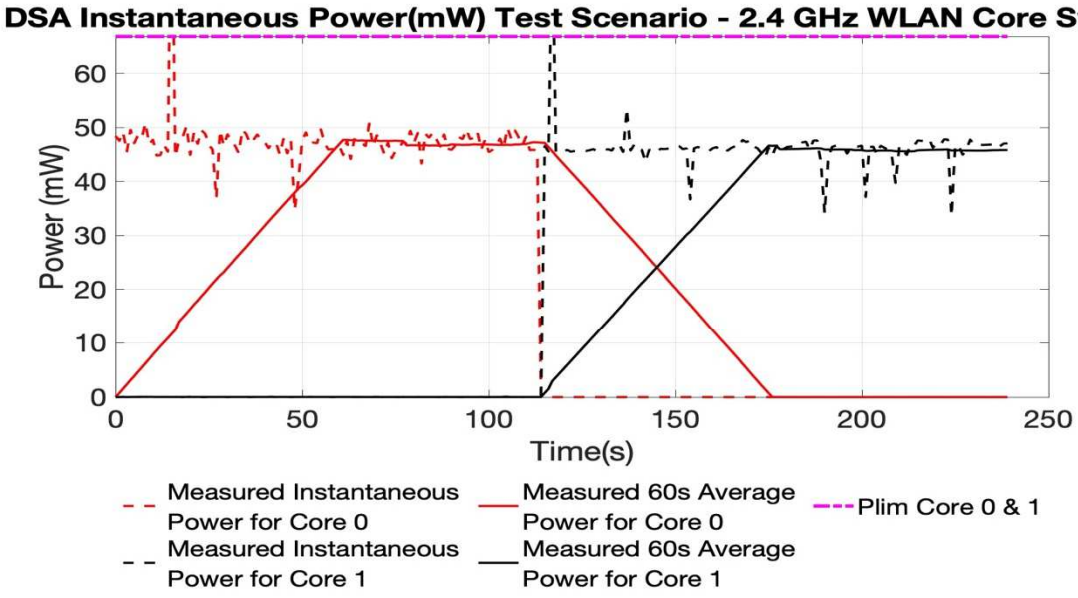

Figure F - 3
60 Sec Instantaneous Power vs. Time, 2.4 GHz

For this test, the effect on the time-averaging algorithm from a change in the active transmit antenna was evaluated. Figures F-4, F-5, F-6 show a switch of 5 GHz transmissions from Core 0(WF2) to Core 1(WF1) at Time = 120 s. The test automation is controlling the WLAN radios to operate at 100% duty cycle. The utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna.

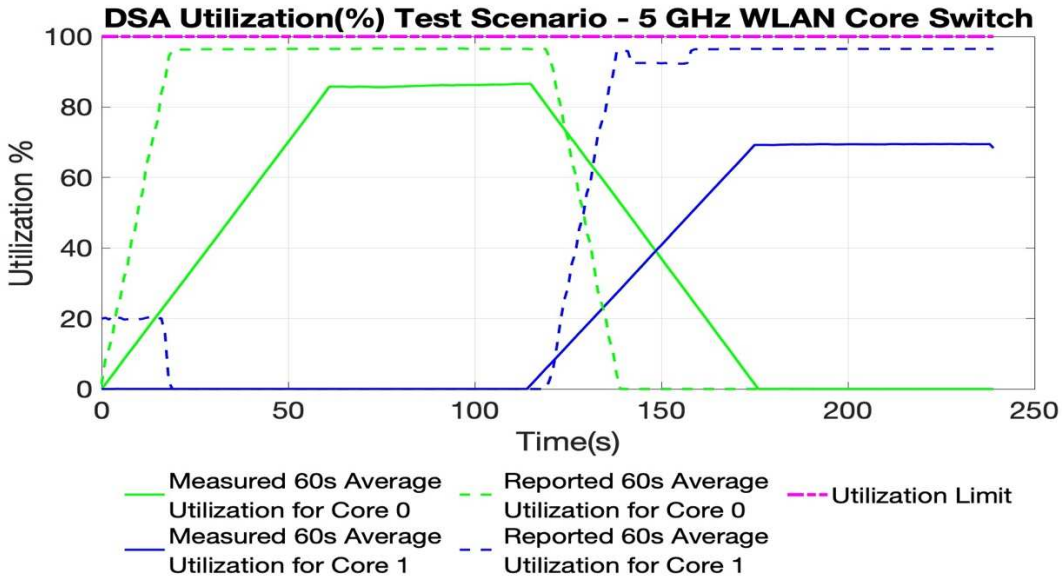

Figure F - 4
60 Sec Average SAR Utilization vs. Time, 5 GHz

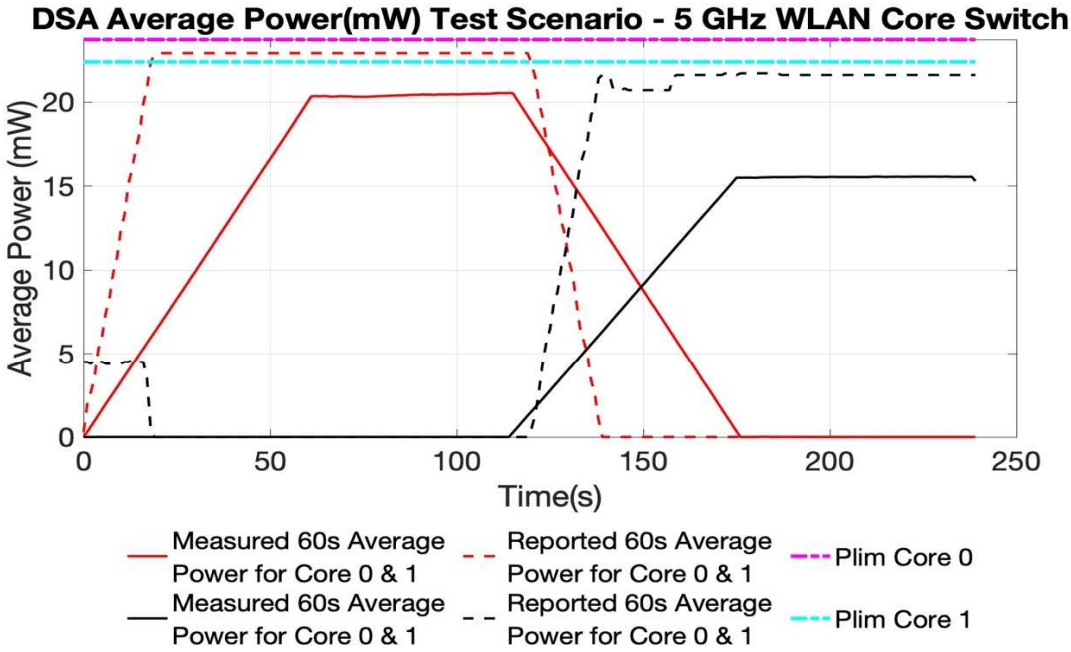

Figure F - 5
60 Sec Average Power vs. Time, 5 GHz

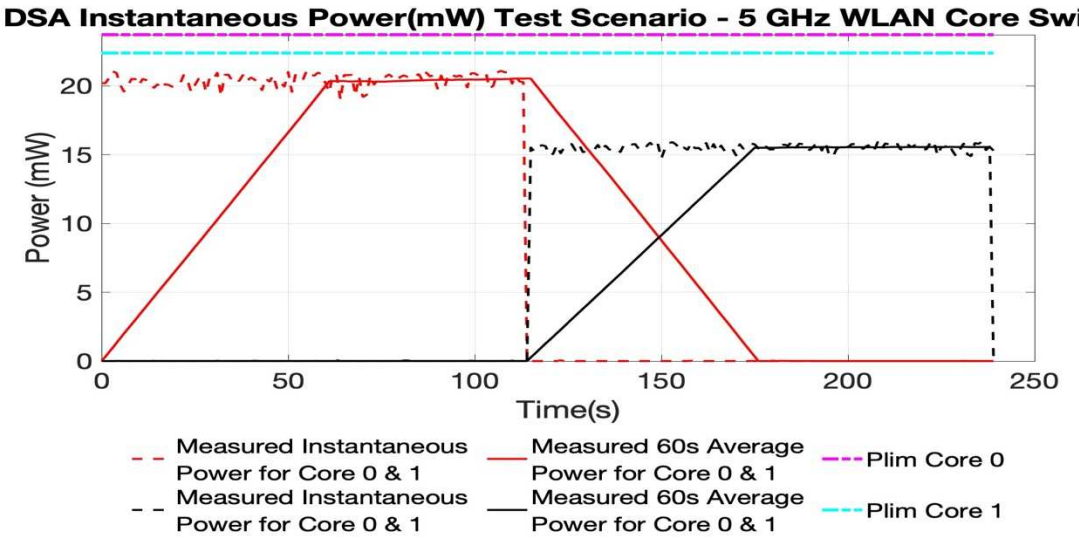

Figure F - 6
60 Sec Instantaneous Power vs. Time, 5 GHz

For this test, the effect on the time-averaging algorithm from a change in the active transmit antenna was evaluated. Figures F-8, F-9 show a switch of 6 GHz transmissions from Core 0(WF2) to Core 1(WF1) at Time = 120 s. The test automation is controlling the WLAN radios to operate at 100% duty cycle. The utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna.

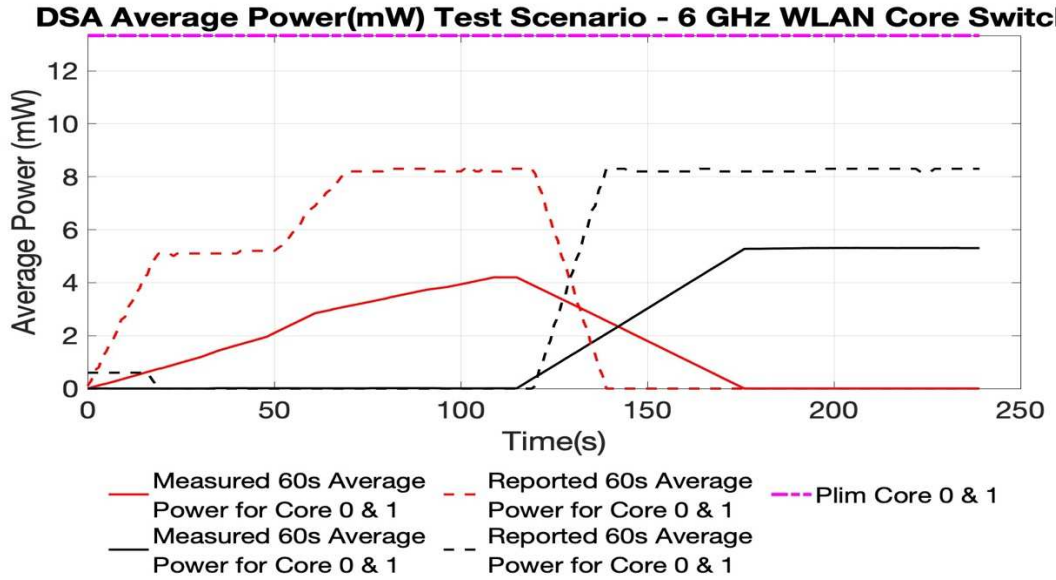

Figure F - 8
60 Sec Average Power vs. Time, 6 GHz

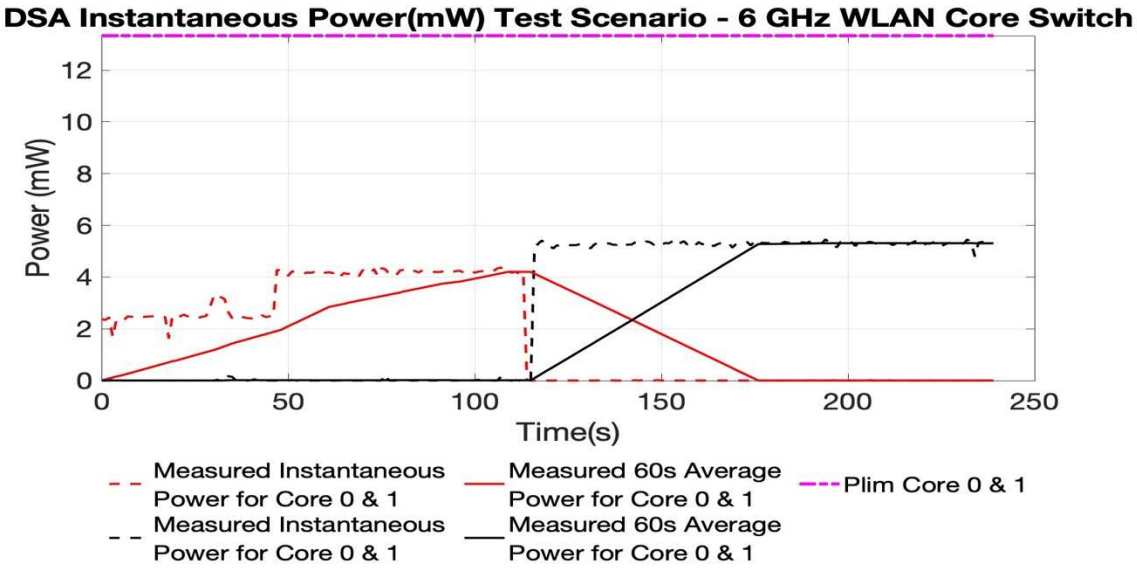

Figure F - 9
60 Sec Instantaneous Power vs. Time, 6 GHz

Scenario 2: Change in Band Test Case on the same Antenna

This test demonstrates the efficacy of the time-averaged SAR algorithm while switching between 2.4 GHz and 5 GHz WLAN bands. In addition, it shows that the algorithm tracks time-averaged power and system utilization when the active transmitter is disabled and then reconnects.

The 2.4 GHz (Core 0 – WF2) transmitter is active at 100% duty cycle until Time = 120 s. When 2.4 GHz transmissions cease, the 5 GHz (Core 0 – WF2) transmitter is activated and begins to negotiate a new connection. The connection is established and the increase in average transmit power and utilization can clearly be seen. In this case the utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna. Figures F-10/11/12 show a switch from 2.4 GHz to 5 GHz transmissions on Core 0 -WF2.

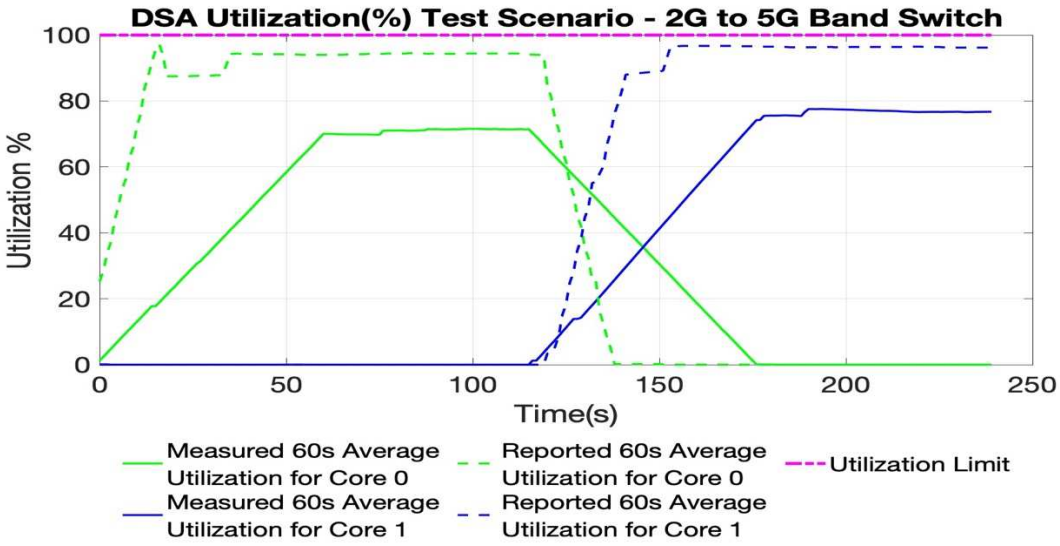

Figure F - 10
60 Sec Average SAR Utilization vs. Time during Band Switch

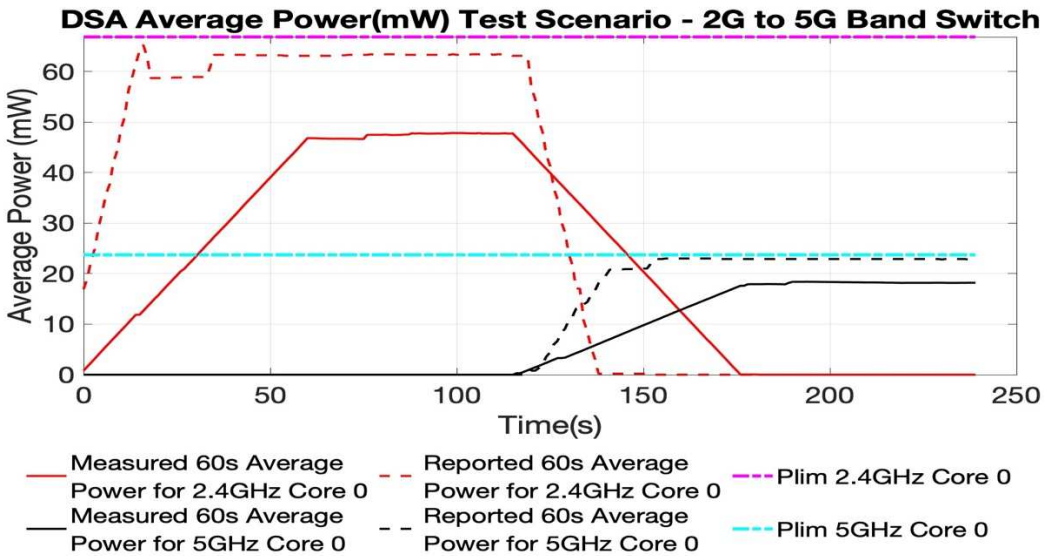

Figure F - 11
60 Sec Average Power vs. Time during Band Switch

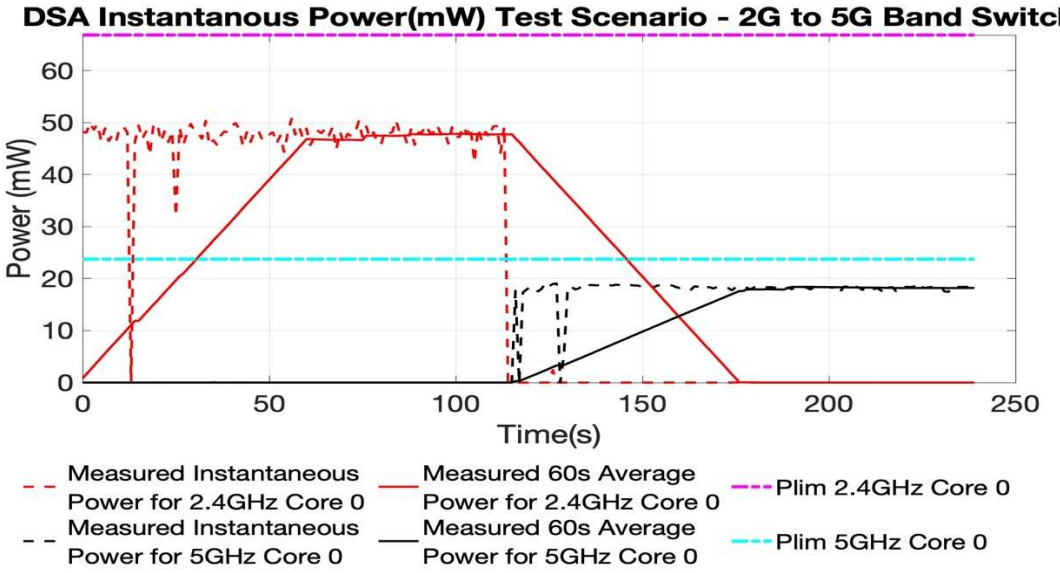

Figure F - 12
60 Sec Average Power vs. Time during Band Switch