TAS ALGORITHM VALIDATION TEST REPORT

EUT Description	**XMM 7560 R+ Cellular Modem embedded in Fibocom M2 L860-GL-16-00 cellular module**
Brand Name	**Fibocom M2**
Model Name	**L860-GL-16-00**
FCC ID	**Generic** (see note in Section 6)
Date of Test Start/End	**2021-02-23 /2021-03-04**
Features	**LTE, UMTS** (see Section 6)

Applicant	**Intel Mobile Communications**
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Test Report identification	**210104-03.TR01**
Revision Control	**Rev. 01** **This test report revision replaces any previous test report revision** (see Section 1)

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1. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2021-03-25	Walid EL HAJJ	First Issue
Rev.01	2021-07-30	Walid EL HAJJ	Modification Following FCC Feedback

2. Scope

This document describes the Time-Averaging SAR (**TAS**) algorithm validation test setup and measurement results of the XMM 7560 R+ Cellular Modem incorporated in a Fibocom M2 L860-GL-16-00 cellular module. The implementation details and **TAS** operating characteristics are described in the "Operation Descriptions" document (confidential), therefore, only a brief summary of the **TAS** operating parameters is included in this test report. The validation tests are performed using mainly conducted power measurements. Single-point SAR measurements are also performed using a generic 2-in-1 convertible PC for correlating the conducted power and SAR measurement results. The details of the test procedures are described in Section 7. The conducted power and single-point SAR measurement test setup and validation results are included in Annex A, B and C. The validation results demonstrate that **TAS** can reliably apply dynamic power control to ensure SAR compliance in real-time.

3. General Conditions, Competences and Guarantees

- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2017 testing laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an Accredited Test Firm recognized by the FCC, with Designation Number FR0011.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to its client for maintaining confidentiality of all information and test results relating to the item under test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs to ensure the measurement equipment used are providing correlated and reliable test results to its customers.
- ✓ This report is only relevant to the item that has undergone testing.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

4. Environmental Conditions

During the tests, the environmental conditions at the site where the measurements were performed are given in the following table:

Temperature	22ºC
Humidity	43%

5. Test Sample

Sample	Control #	Description	Model	Serial #	Note
#1	210104-03.S01	Modem Module	M2 7560 R+	6B72LY1AV6	Conducted Power
	180709-01.S07	Extender Board	-	-	Conducted Power Tests

6. EUT Features

Brand Name	Fibocom M2
Model Name	L860-GL-16-00
FCC ID	Generic*
Software Version Date	M2_7560_R_01.2103.00 2021-01-13
Supported Wireless Configurations and Operating Modes	The Fibocom M2 L860-GL-16-00 module supports only UMTS and LTE with carrier aggregation. The applicable frequency bands and operating modes are identified in the following table, where North America bands are shown in bold.

Mode	Bands	Supported Tx Mode			
		WCDMA	HSDPA	HSUPA	DC-HSDPA
WCDMA / HSPA+	FDD I (1920.0 – 1980.0 MHz)	✓	✓	✓	✓
	FDD II (1850.0 – 1910.0 MHz)	✓	✓	✓	✓
	FDD IV (1710.0 – 1755.0 MHz)	✓	✓	✓	✓
	FDD V (824.0 – 849.0 MHz)	✓	✓	✓	✓
	FDD VIII (880.0 – 915.0 MHz)	✓	✓	✓	✓

Mode	Bands	Supported Channel Bandwidth (MHz)					
		1.4	3	5	10	15	20
LTE FDD	Band 1 (1920.0 – 1980.0 MHz)			✓	✓	✓	✓
	Band 2 (1850.0 – 1910.0 MHz)	✓	✓	✓	✓	✓	✓
	Band 3 (1710.0 – 1785.0 MHz)	✓	✓	✓	✓	✓	✓
	Band 4 (1710.0 – 1755.0 MHz)	✓	✓	✓	✓	✓	✓
	Band 5 (824.0 – 849.0 MHz)	✓	✓	✓	✓		
	Band 7 (2500.0 – 2570.0 MHz)			✓	✓	✓	✓
	Band 8 (880.0 – 915.0 MHz)	✓	✓	✓	✓		
	Band 12 (699.0 – 716.0 MHz)	✓	✓	✓	✓	✓	✓
	Band 13 (777.0 – 787.0 MHz)			✓	✓		
	Band 14 (788.0 – 798.0 MHz)			✓	✓		
	Band 17 (704.0 – 716.0 MHz)			✓	✓		
	Band 18 (815.0 – 830.0 MHz)			✓	✓	✓	
	Band 19 (830.0 – 845.0 MHz)			✓	✓	✓	
	Band 20 (832.0 – 862.0 MHz)			✓	✓	✓	✓
	Band 25 (1447.9 – 1462.9 Mhz)			✓	✓	✓	
	Band 26 (814.0 – 849.0 MHz)	✓	✓	✓	✓	✓	
	Band 28 (703.0 – 748.0 MHz)		✓	✓	✓	✓	✓
	Band 30 (2305.0 – 2315.0 MHz)			✓	✓		
	Band 32 (1452.0 – 1496.0 MHz)			✓	✓	✓	✓
	Band 66 (1710.0 – 1780.0 MHz)	✓	✓	✓	✓	✓	✓
	Band 71 (663.0 –698.0 MHz)			✓	✓	✓	✓
LTE TDD	Band 34 (2010.0 – 2025.0 MHz)			✓	✓	✓	
	Band 38 (2570.0 – 2620.0 MHz)			✓	✓	✓	✓
	Band 39 (1880.0 – 1920.0 MHz)			✓	✓	✓	✓
	Band 40 (2300.0 – 2400.0 MHz)			✓	✓	✓	✓
	Band 41 (2496.0 – 2690.0 MHz)			✓	✓	✓	✓
	Band 48 (3550.0 –3700.0 MHz)			✓	✓	✓	✓

*Note: The algorithm validation is host independent. This report can be used for any host with TAS parameters in the validation range.

7. TAS Algorithm Validation Considerations

As described in the "210305_TAS_Operational_Report_XMM7560_R+_Rev00" document, **TAS** has 5 parameters that are accessible to host devices incorporating the XMM 7560 R+ Cellular Modem. There are two additional control and operating parameters that are derived from these 5 accessible parameters. The parameters are identified in Table 1 below. An illustration of **TAS** functionality, according to these parameters, is shown in Figure 1. Since **TAS** is fully contained within the XMM 7560 R+ Cellular Modem, other than allowing a host device to select the accessible parameters, **TAS** operation is fully independent of the host product.

Table 1 – XMM 7560 R+ Operating Parameters

Accessible Parameters	Derived Parameters
Avg_SAR_UppThresh	***Avg_SAR_LowThresh*** = ***Avg_SAR_UppThresh*** – ***DPR_OFF_SAR_Offset***
DPR_ON_SAR_Offset	***Max_Power_DPR_ON*** = ***Avg_SAR_UppThresh*** – ***DPR_ON_SAR_Offset***
DPR_OFF_SAR_Offset	
Avg_SAR_Check_Period	
Avg_SAR_Roll_Period	

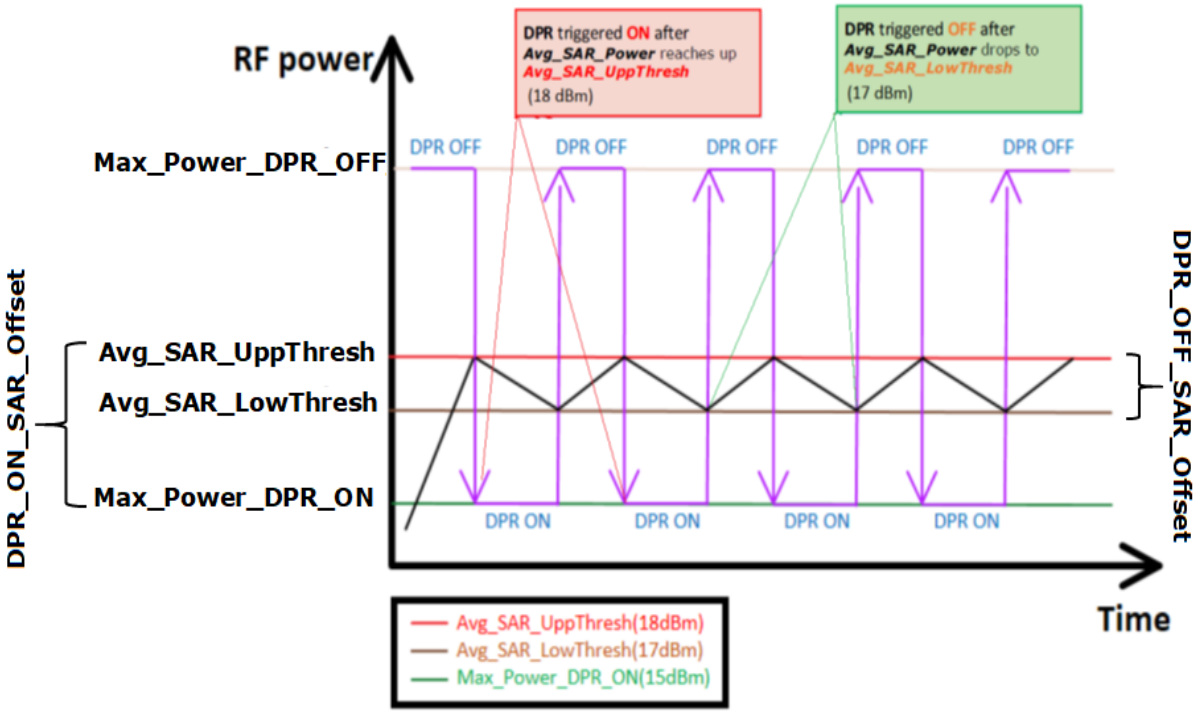


Figure 1 – Power control dynamics of TAS Algorithm for ensuring SAR compliance

When XMM 7560 R+ operates in the end user environment, **TAS** is always enabled; end users do not have the option to disable **TAS**. Therefore, the time-averaged power (***Avg_SAR_Power***) is always kept below the specified upper power threshold (***Avg_SAR_UppThresh***) and SAR compliance is determined in real-time at each ***Avg_SAR_Check_Period*** according to the time-averaging window ***Avg_SAR_Roll_Period***. The required settings of ***Avg_SAR_Roll_Period*** and ***Avg_SAR_Check_Period*** for the XMM 7560 R+ Cellular Modem are 100 sec and below 1 sec, respectively.

7.1. Algorithm Validation using Conducted Power Measurement

TAS operating characteristics and algorithm implementation have been validated using conducted power measurement according to parameters that are applicable to the host products. **TAS** is fully self-contained within the XMM 7560 R+ and, other than the power recording time interval used for UMTS and LTE, 10 msec vs. 1 msec, the same power control mechanism is applied to both 3G and 4G. Since **TAS** operations are independent of frequency band and wireless mode, and SAR compliance can be established at the maximum time-averaged power level specified by ***Avg_SAR_UppThresh***, validation of the algorithm and implementation using conduct power measurement test configurations is appropriate and acceptable.

The following XMM 7560 R+ operating conditions are used in the conducted power measurement configurations to validate **TAS** algorithm implementation. The conducted power measurement test setup is described in Annex A.1.

1. using a diverse range of **TAS** operating and control parameters under maximum output power conditions specified for UMTS and LTE
2. specific power control test sequences are applied under normal UMTS and LTE operations in Connected states
3. when a connection is dropped and re-established
4. when a handover occurs between frequency bands and modes within LTE or UMTS
5. when a handover occurs between LTE and UMTS
6. when a different ***Avg_SAR_Check_Period*** is used; ***Avg_SAR_Check_Periods*** of 1 sec and 100 msec are tested, where steps 1 - 5 above are performed at 1 sec and a selected configuration is tested at 100 msec to show equivalent power control behavior for different ***Avg_SAR_Check Periods***.

7.1.1. Parameters Considered for Algorithm Validation

TAS algorithm validation has been performed for UMTS and LTE according to cases with different combinations of operating parameters listed in Table 2, see details in Tables B.1 and B.2. All attenuations and offsets are accounted for in uplink power measurements at the Main Antenna port. This is described in Annex A.1.1 and illustrated in the test setup photos in Annex A.1.3. The test results are shown in Annex B.2.1.1 for LTE and Annex B.2.1.2 for UMTS.

Table 2 –Parameters used in Validation

Parameters
Avg_SAR_UppThresh
Avg_SAR_LowThresh
Max_Power_DPR_ON

7.1.2. Time Varying Power Control Test Sequences Considered for Algorithm Validation

Two types of power control test sequences are used in the conducted power measurement test setup for **TAS** algorithm validation in selected mode/band configurations under normal LTE and UMTS operations in Connected State. The first test sequence (#1) is for validating the functionality of ***DPR*** (Dynamic Power Reduction) according to the values of ***Max_Power_DPR_OFF, Max_Power_DPR_ON, Avg_SAR_UppThresh*** and ***Avg_SAR_LowThresh*** specified for the mode/band. The second test sequence (#2) consists of a pre-determined sequence of random or arbitrary power levels and durations for validating overall **TAS** functionality to ensure SAR compliance through dynamic power control.

1. **Sequence #1:** Starting at below ***Avg_SAR_LowThresh*** for a fixed duration, the sequence is followed by a sufficiently long duration of transmission at ***Max_Power_DPR_OFF*** until ***DPR*** is turned ON. After it is confirmed that ***Avg_SAR_Power*** remains between ***Avg_SAR_UppThresh*** and ***Avg_SAR_LowThresh***, the XMM 7560 R+ is commanded to reduce output power to below ***Avg_SAR_LowThresh*** to ensure ***DPR*** is subsequently turned OFF.

2. **Sequence #2:** A power profile consisting of varying levels between ***Max_Power_DPR_OFF*** and below ***Max_Power_DPR_ON***, with varying transmission durations in the range of 1 – 20 seconds, are sent by the Call Box to the XMM 7560 R+. The power levels and intervals used in the tests have been determined according to KDB guidance and preliminary test results.

The time durations and power levels used for the two test sequences are listed in Table 3 and Table 4. These sequences are applied to validate **TAS** in both UMTS and LTE. In Table 3, for sequence #1, the power level is set to an initial level below ***Max_Power_DPR_ON*** and followed by maximum output power (***Max_Power_DPR_OFF)*** requests from the Call Box to verify ***DPR*** control and **TAS** responses. This is then followed by a Call Box output power request of below ***Max_Power_DPR_ON*** to ensure proper **TAS** response is observed when ***DPR*** is disabled. Table 4 consists of the sequence of power levels and time durations sent from the Call Box to XMM 7560 R+ to validate dynamic power control under arbitrary/random conditions, similar to those experienced by typical end users, to demonstrate ***DPR*** reliability. Both of these sequences are illustrated in Figure 2.

Table 3 – Test Sequence #1

Sequence 1

Time	Duration	Tx_Power	Notes
150	150	5 dBm	< Low Threshold
350	200	23	Max power
720	370	13	Lower -2 dB

Table 4 – Test Sequence #2

Sequence 2

Time	Duration	Tx_Power	Notes
150	150	5 dBm	< Lower
165	15	14	Upper-4dB
185	20	18	Upper
205	20	20,5	(Upper+Pmax)/2
215	10	10	Upper-8dB
235	20	23	Pmax
250	15	18	Upper
265	15	11	Upper-7dB
285	20	23	Pmax
305	20	13	Upper -5dB
320	15	18	Upper
330	10	12	Upper-6dB
340	10	20,5	Upper+max/2
360	20	11	Upper -7 dB
380	20	11	Upper - 7dB
390	10	20,5	Upper+max/2
400	10	12	Upper-6dB
415	15	18	Upper
435	20	13	Upper -5dB
455	20	23	Pmax
465	10	11	Upper-7dB
480	15	18	Upper
500	20	23	Pmax
515	15	10	Upper-8dB
535	20	20,5	(Upper+Pmax)/2
555	20	18	Upper
570	15	14	Upper-4dB
720	150	5	< Lower Threshold

Note: Pmax=***Max_Power_DPR_OFF*** *(23 dBm)*,
Upper=***Avg_SAR_UppThresh*** (18 dBm) and Lower = ***Avg_SAR_LowThresh*** *(15 dBm)*

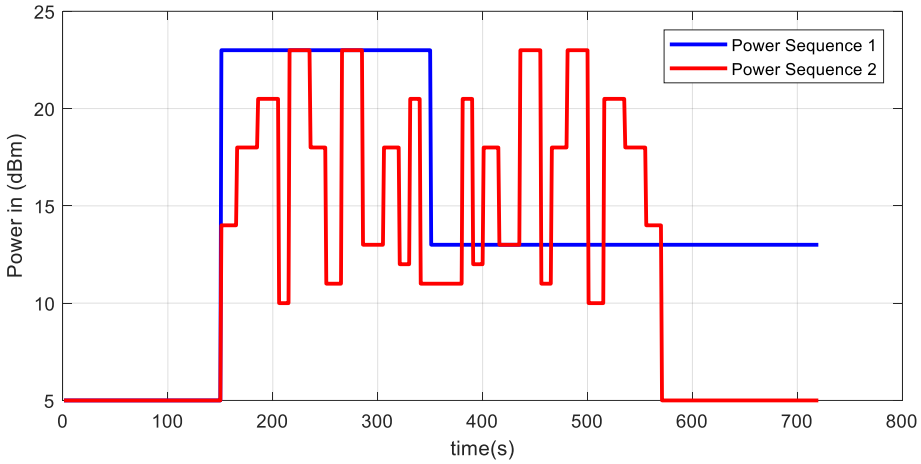


Figure 2 – Plot of Tx power for test sequence #1 and #2

For each test sequence, **TAS** should respond by maintaining ***Avg_SAR_Power*** at or below ***Avg_SAR_UppThresh*** according to ***DPR*** requirements; therefore, SAR measurement at ***Avg_SAR_UppThresh*** according to normally required SAR procedures is all that would be necessary to determine compliance. These are demonstrated by the supporting test results in Annex B.2.2.

7.1.3. Connection Drop and Technology/Band Handover Validation

In order to demonstrate that **TAS** functions as expected during a drop connection or handover, the first test sequence (#1) in Section 7.1.2 (Table 3) is adapted to validate algorithm control continuity during such temporarily discontinued transmissions. A connection drop or handover is initiated after ***DPR*** is turned ON and ***Avg_SAR_Power*** is maintained between ***Avg_SAR_UppThresh*** and ***Avg_SAR_LowThresh***. When the connection is re-established, maximum output power is requested by the Call Box to ensure ***DPR*** remains ON and **TAS** response is verified to ensure algorithm control continuity. These are demonstrated by the validation results in Annex B.2.3.

8. Summary of Validation Tests and Results

The following table lists the types of **TAS** algorithm validation tests performed and the corresponding Tables and Annexes describing the test configurations and validation results. Description of the conducted power and single-point SAR measurement test setup and photos are included in Annex A.

Validation Type	Test Configurations	Test Results
Range of **TAS** Parameter	Table B1 Table B2	LTE : Annex B.1.1.1 UMTS : Annex B.1.1.2
Time Varying Test Sequences	Table B3	LTE & UMTS: Annex B.1.2
Connection Drop	Table B4	Drop connection: Annex B.1.3.1
Handover	Table B5 Table B6	LTE B2 to LTE B4 handover: Annex B.1.3.2 LTE B2 to UMTS B4 handover: Annex B.1.3.3
Check Period Verification	Table B7	Check Period: Annex B.1.4

Annex A. Conducted Power and Single-Point SAR Measurement Test Setup

A.1 Conducted Power Measurement

A.1.1 Test Setup

The conducted power measurement test setup is described in the following and illustrated in Figure A.1.

- The Fibocom M2 L860-GL-16-00 module, which contains the XMM 7560 R+ Cellular Modem, is installed in an Intel Test Platform (DUT) to emulate a generic host device and to provide proper interface for the Call Box and test equipment. Photos of the Fibocom module, XMM 7560 R+ and test equipment are included in Annex A.1.3 and A.3.
- A control PC is used to configure the Call Box to send power control test sequences to the XMM 7560 R+, according to those described in Section 7.1.2 and Annex B.
- Uplink signal power is monitored by the Spectrum Analyzer and record by the PC with a time resolution of 25 msec, which is substantially less than the power adjustment interval (***Avg_SAR_Check_Period***) of 1 sec used for XMM 7560 R+.
- The values of ***Avg_SAR_Power*** are read from the XMM 7560 R+ by the PC at each ***Avg_SAR_Check_Period***
- In additional to power results, the time sequence of power control commands and power samples are also recorded by the PC to enable results to be correlated and plotted. Uplink signal from the XMM 7560 R+ is fed through a 3 dB Power Splitter, which delivers an equal amount of signal to the Spectrum Analyzer and the Call Box. The Splitter has high isolation between the Spectrum Analyzer and the Call Box. Due to different Uplink/Downlink frequencies and the zero-span time-domain measurement used, interference of Uplink and Downlink signals is avoided.
- Path loss in the power measurement setup from the XMM 7560 R+ Main Antenna port to either the Call Box or the Spectrum Analyzer is 16.5 dB, with less than 0.1 dB difference between Band 2 and Band 4 (used for the tests).

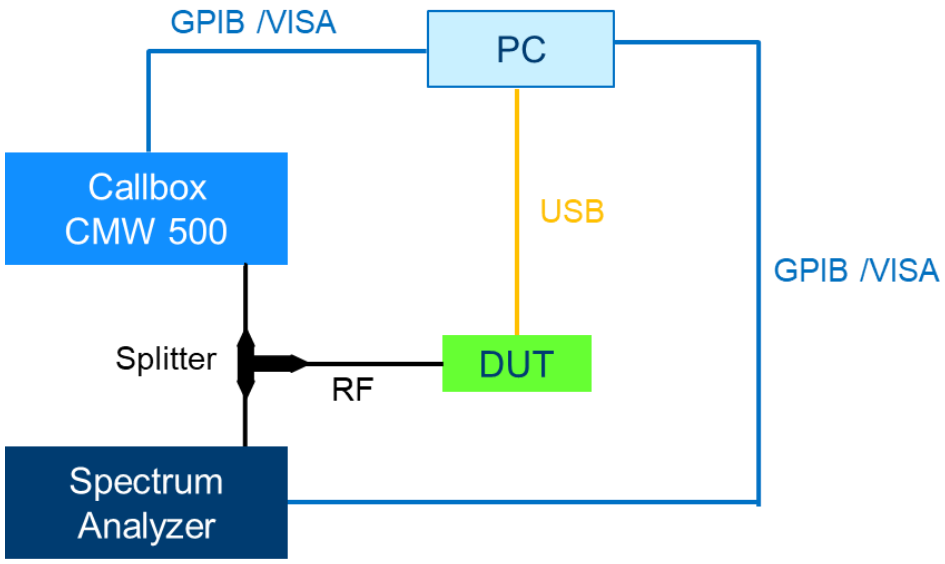


Figure A.1 – Validation using conducted power measurement test setup.

A.1.2 Test Equipment List

Equipment and accessories used for the conducted power measurement test setup are listed below. The Test Platform (DUT), test setup and associated equipment are shown in A.1.3 and A.3.

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0319	Communication Tester	CMW500	152721	Rohde & Schwarz	2020-03-26	2022-03-26
0322	Spectrum Analyzer	FSL6	102143	Rohde & Schwarz	2020-04-08	2022-04-08
-	Power Divider	PE2083	-	Pasternack	Attenuation and loss verified before use	

A.1.3 Conducted Power Test Setup Photos

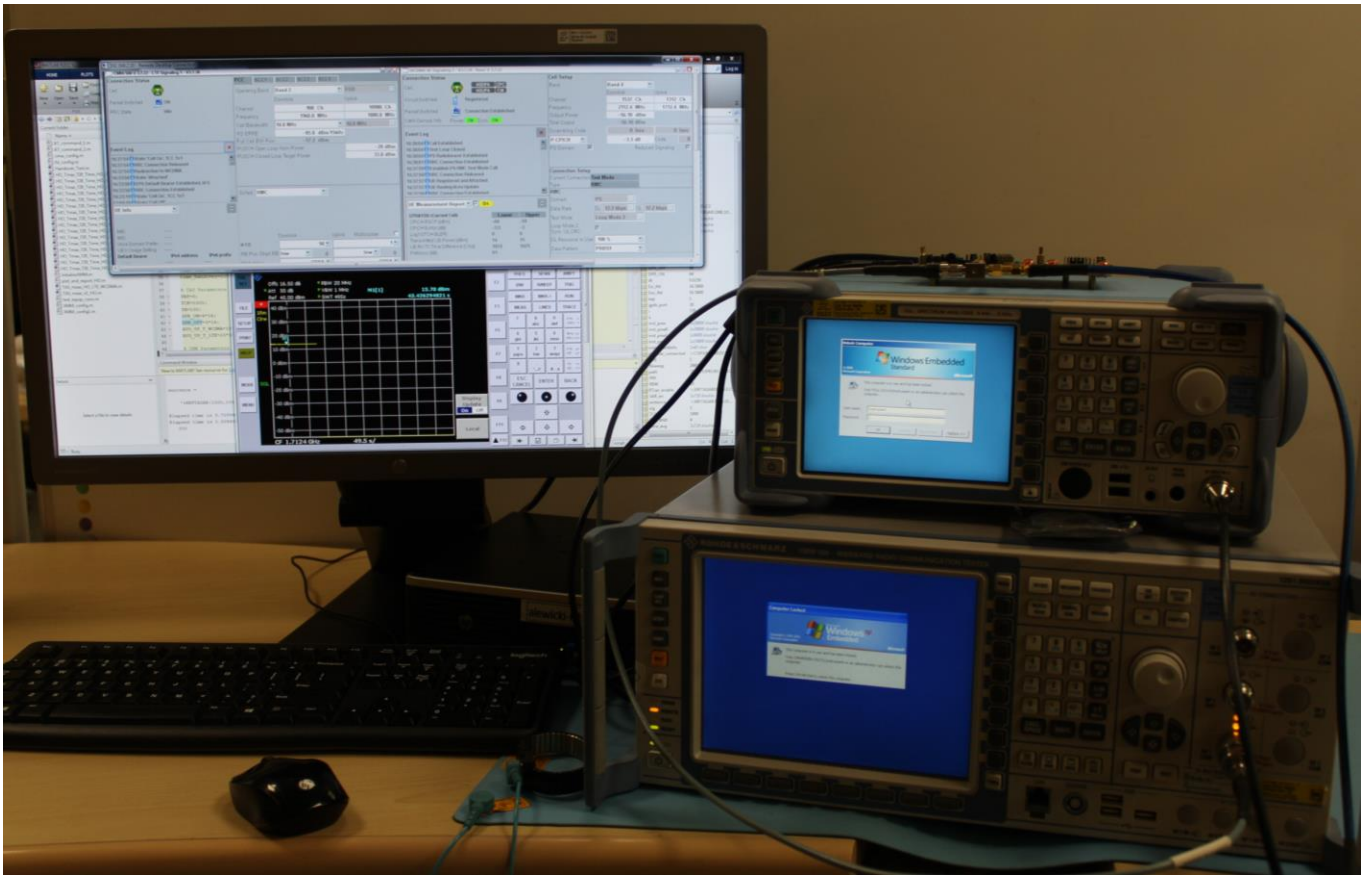
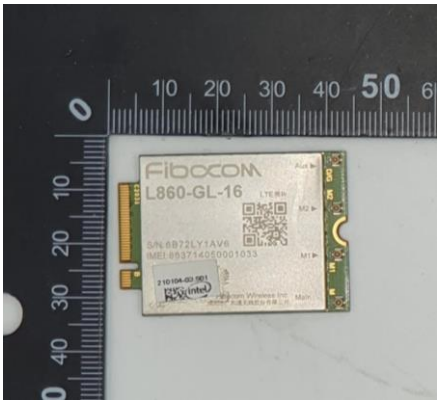
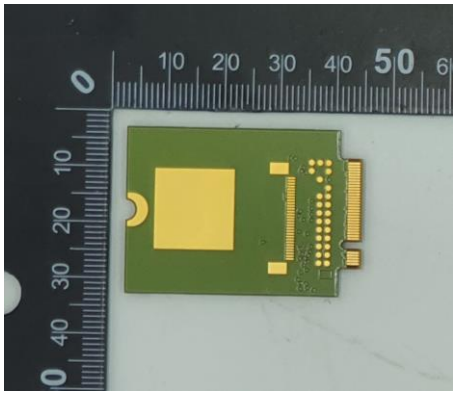
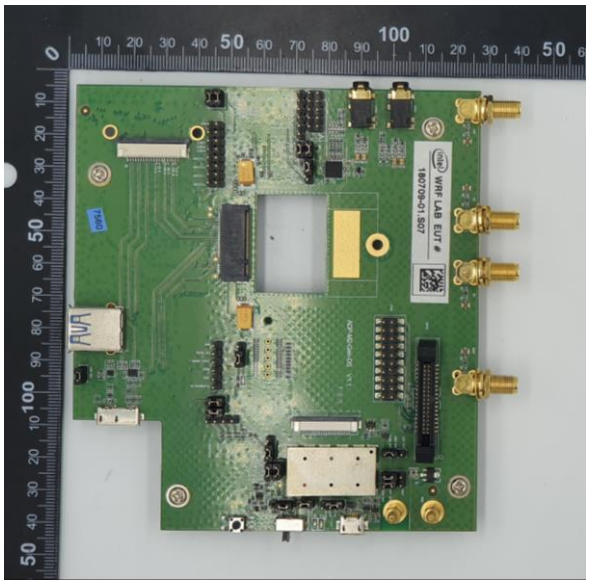
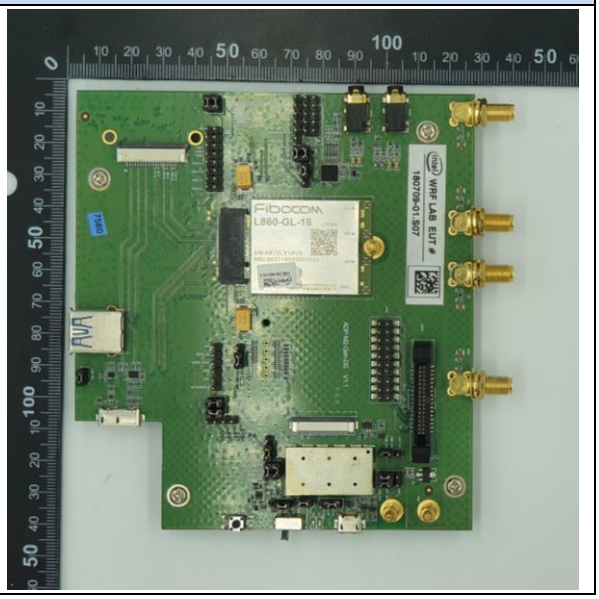


Figure A.1.3 – Fibocom Module with XMM 7560 R+ mounted on the Intel Test Platform, placed on top of the Spectrum Analyzer and Call Box CMW 500, which are under GPIB control through the PC.

A.2 Test Sample

Fibocom Module Front	Fibocom Module Back
	
Extender Board – Test Platform	**Module mounted on the Extender Board**
	

Annex B. Conducted Power Validation Test Results

B.1 Conducted Power TAS Validation Tests and Results with Intel Test Platform

B.1.1 Fundamental Algorithm Validation for a Range Control Parameters

B.1.1.1 Validation for LTE in Band 2

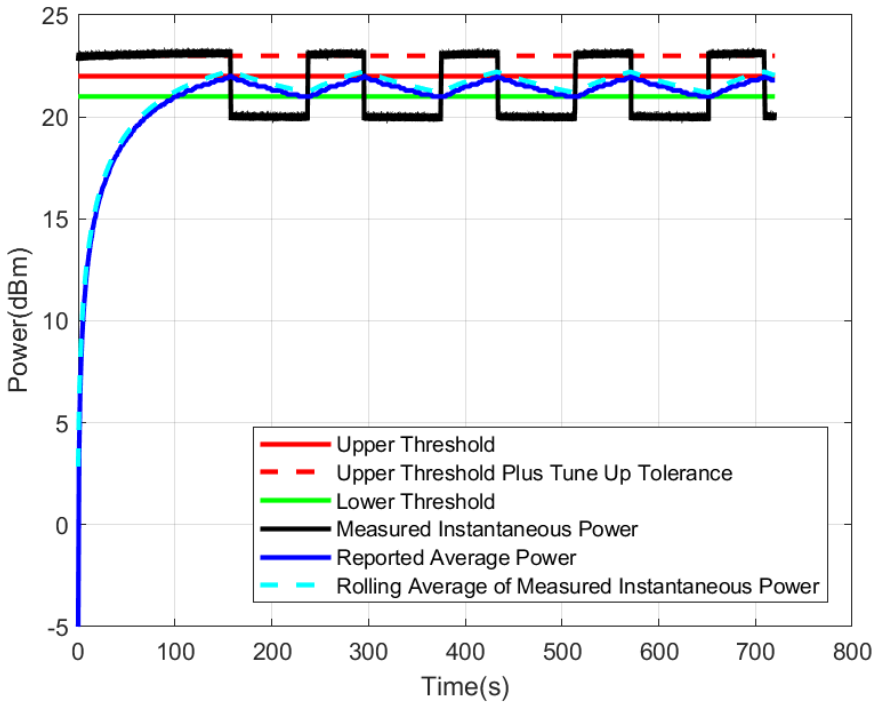
Table B1 – Test Cases for LTE Band 2 using 1 RB and QPSK

Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	LTE B2	23 dBm	100 sec	1 sec	22	21	20
2					22	21	18
3					22	19	18
4					22	19	16
5					20	19	18
6					20	19	16
7					20	17	16
8					20	17	14
9					18	17	16
10					18	17	14
11					18	15	14
12					18	15	12
13					15	14	13
14					15	14	11
15					15	12	11
16					15	12	9
17					13	12	11
18					13	12	9
19					13	10	9
20					13	10	7
21	LTE B2	23 dBm	360 sec	1 sec	18	17	14

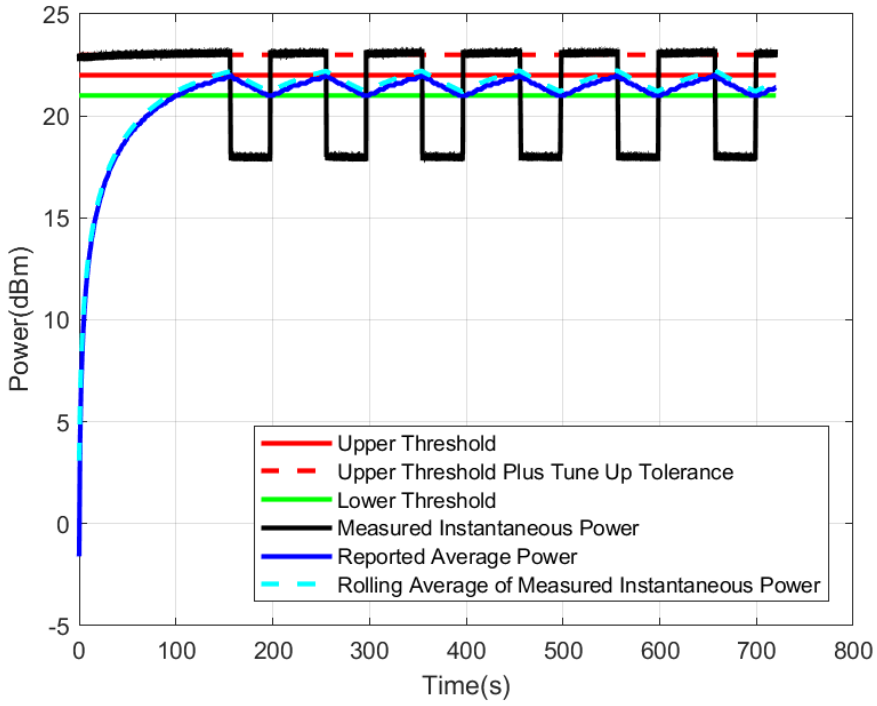
Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** listed in Table 2. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

Results of test cases in **Error! Reference source not found.**B1 are shown in the following plots.

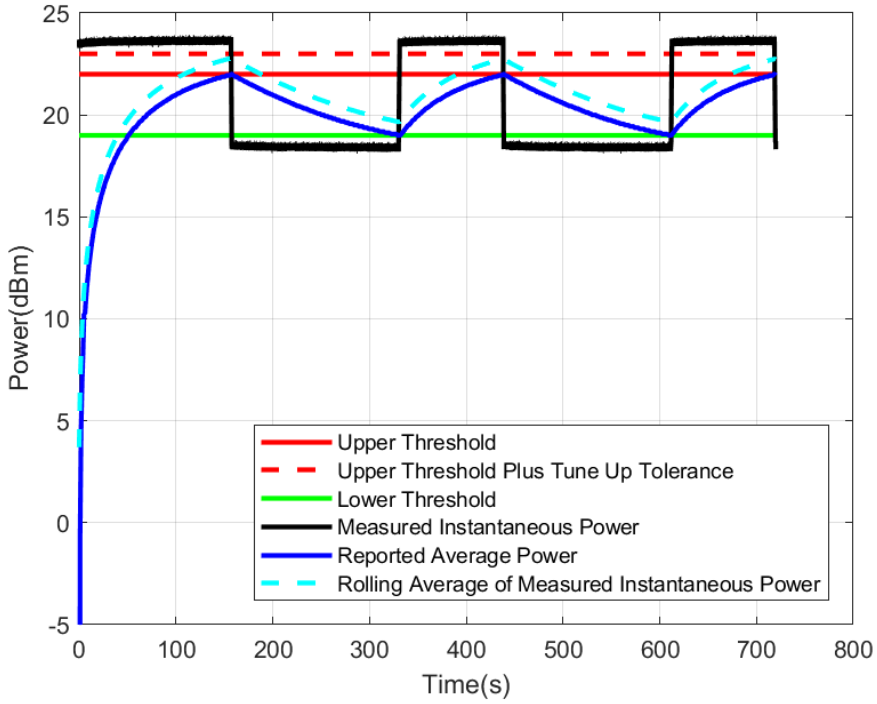
Case #1: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	21	20



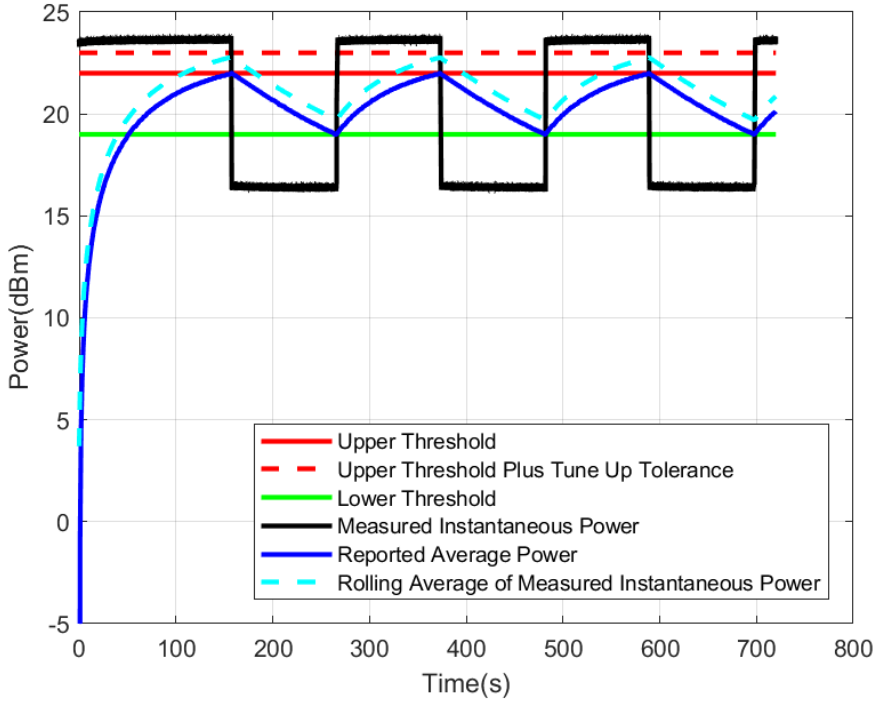
Case #2: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	21	18



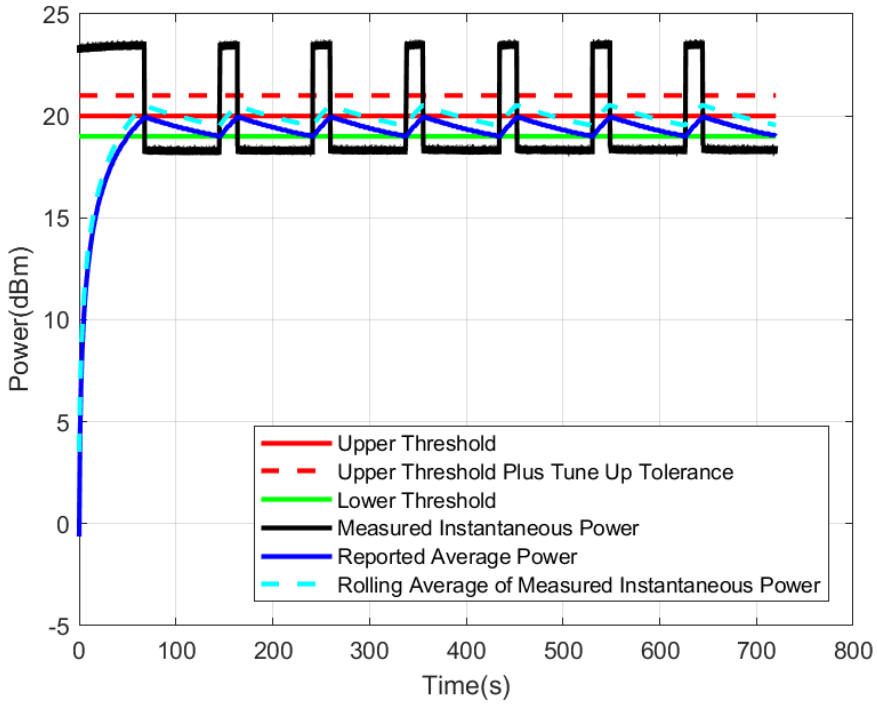
Case #3: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	19	18



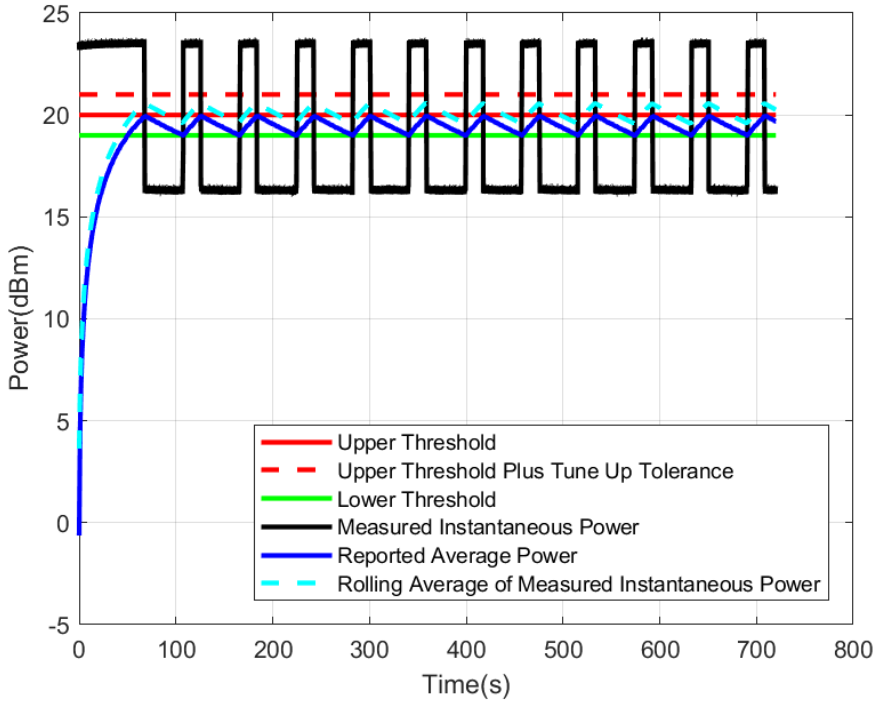
Case #4: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	19	16



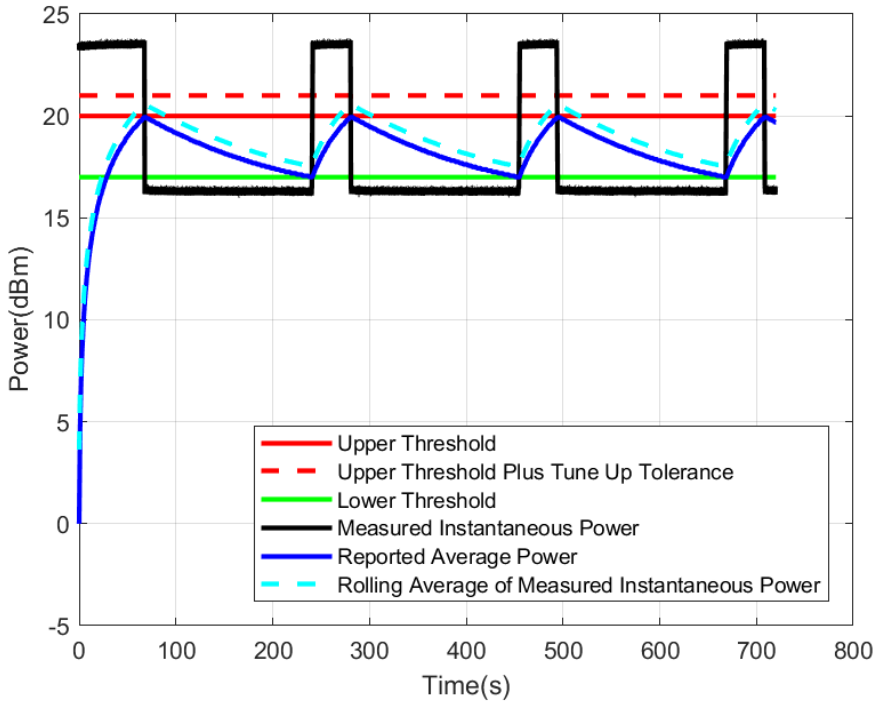
Case #5: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	19	18



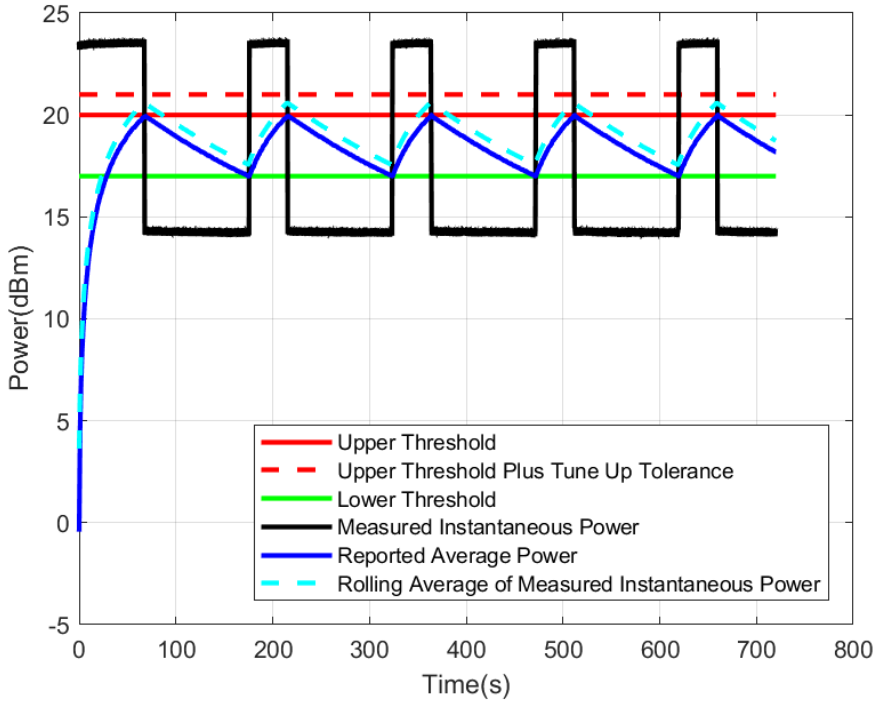
Case #6: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	19	16



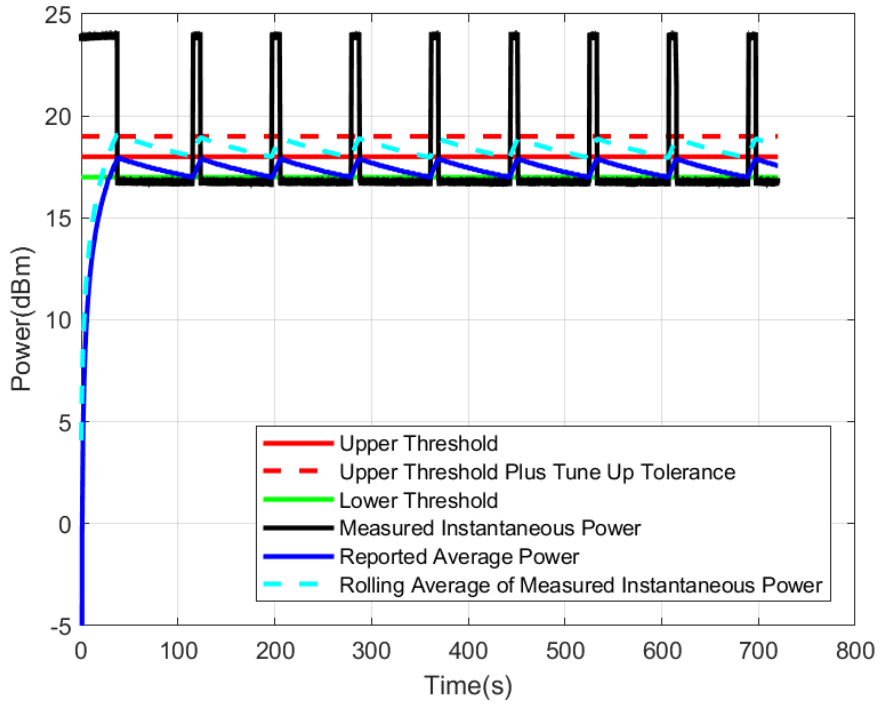
Case #7: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	17	16



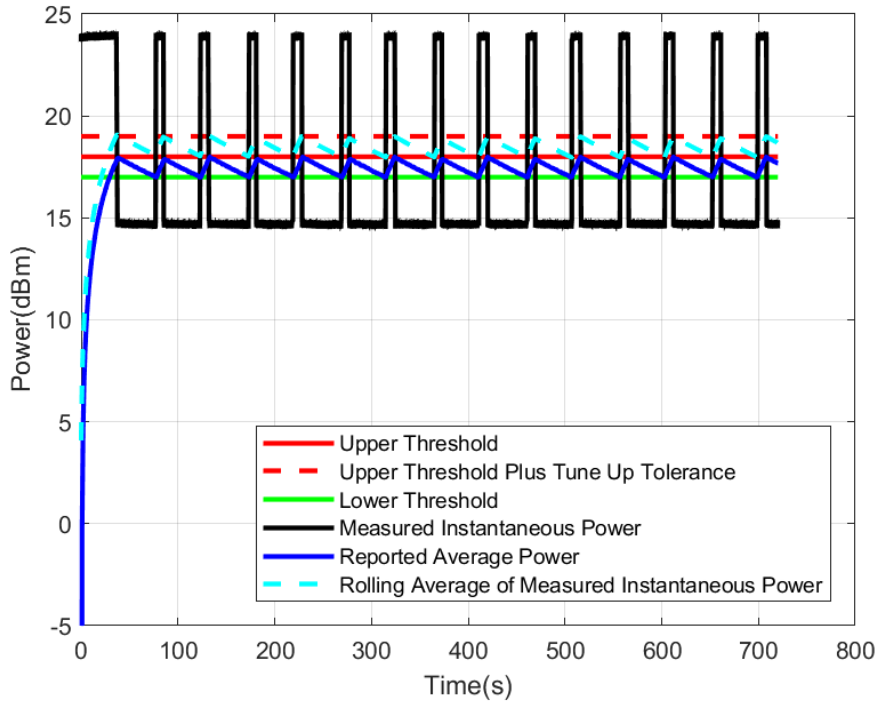
Case #8: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	17	14



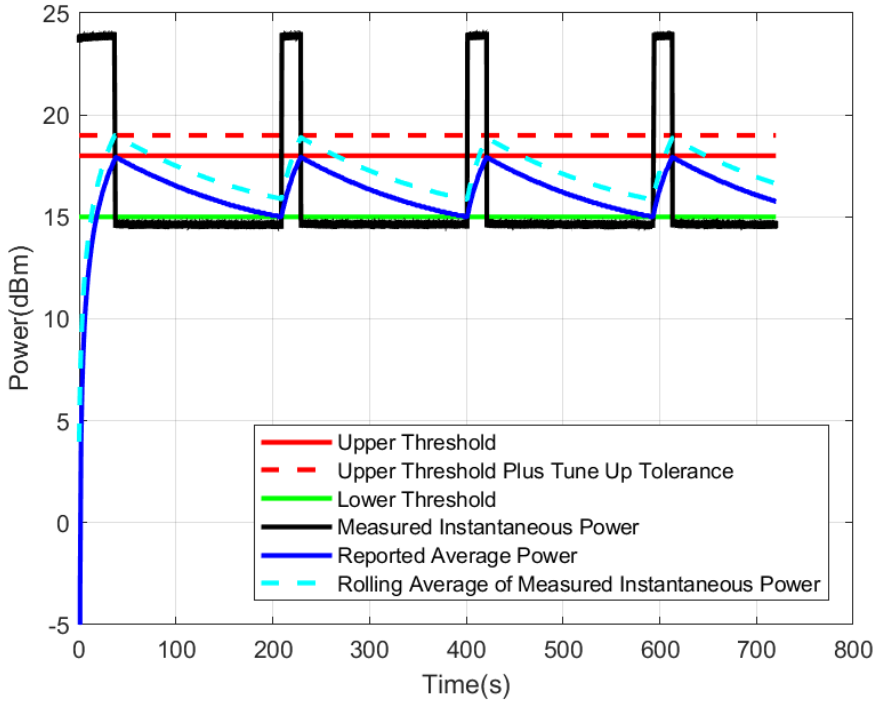
Case #9: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	16



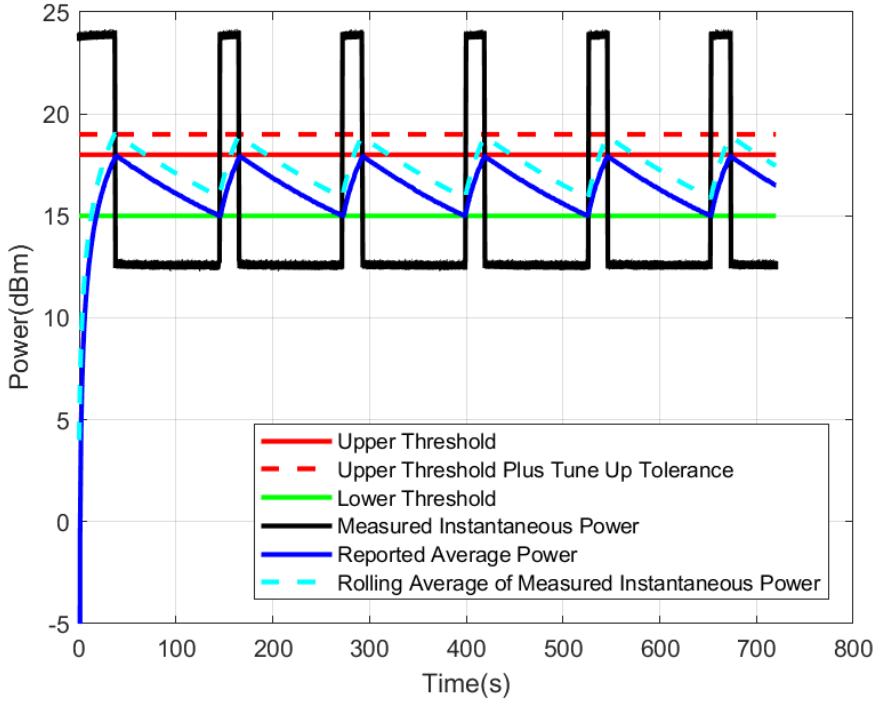
Case #10: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



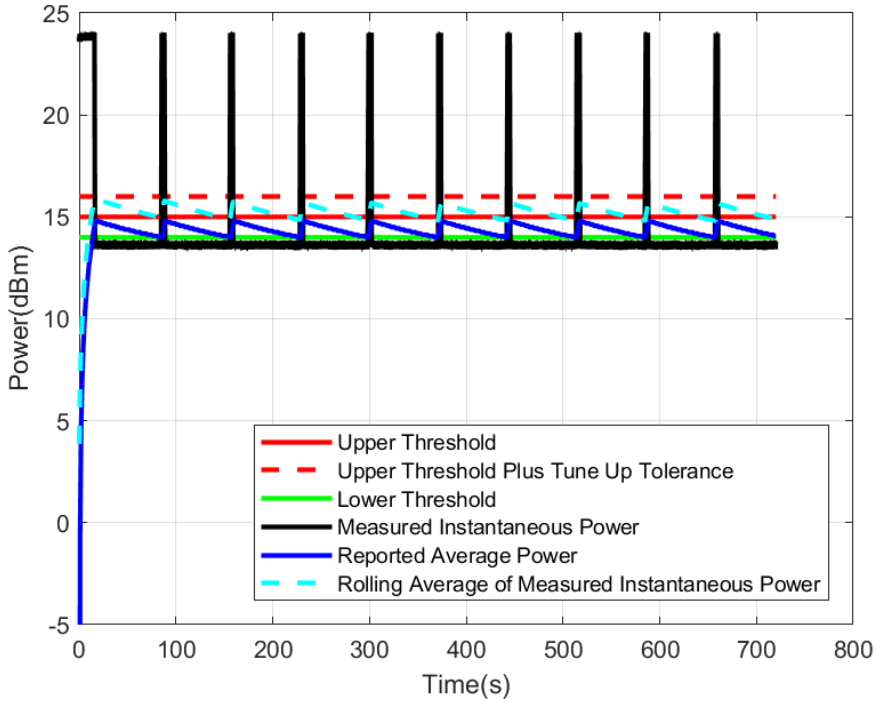
Case #11: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



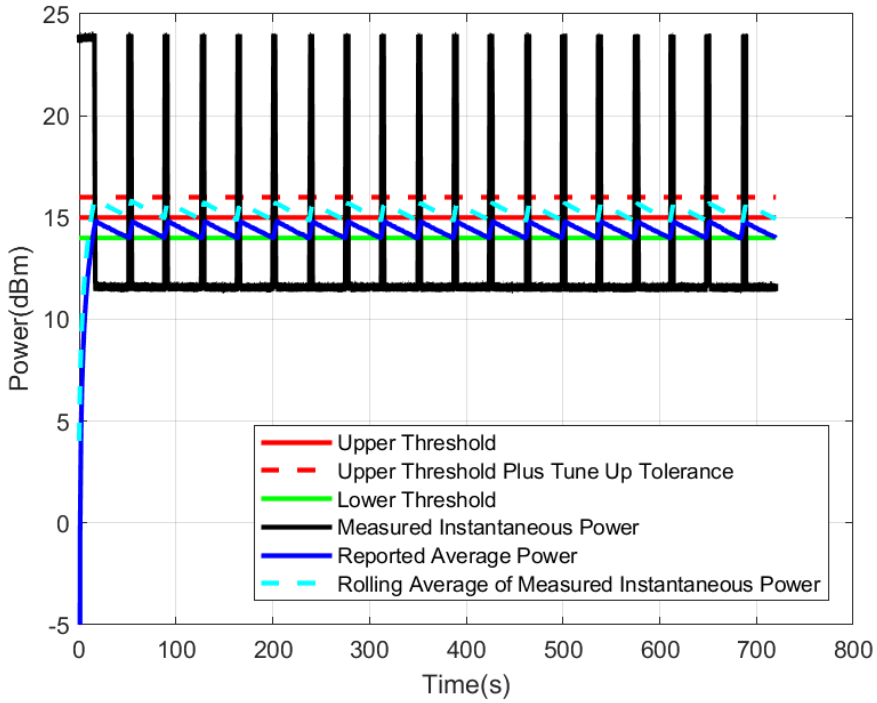
Case #12: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	12



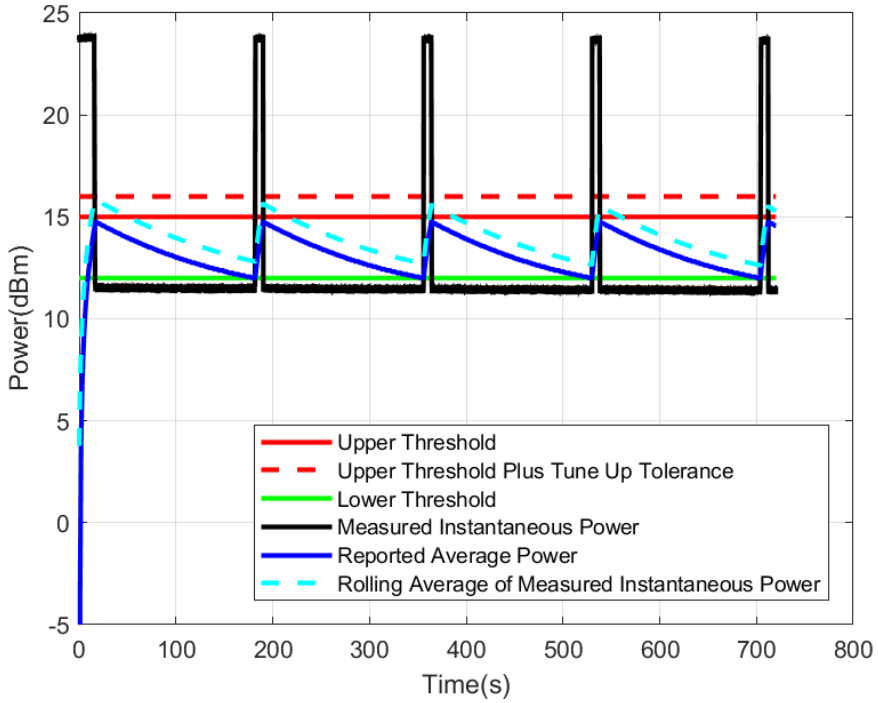
Case #13: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	14	13



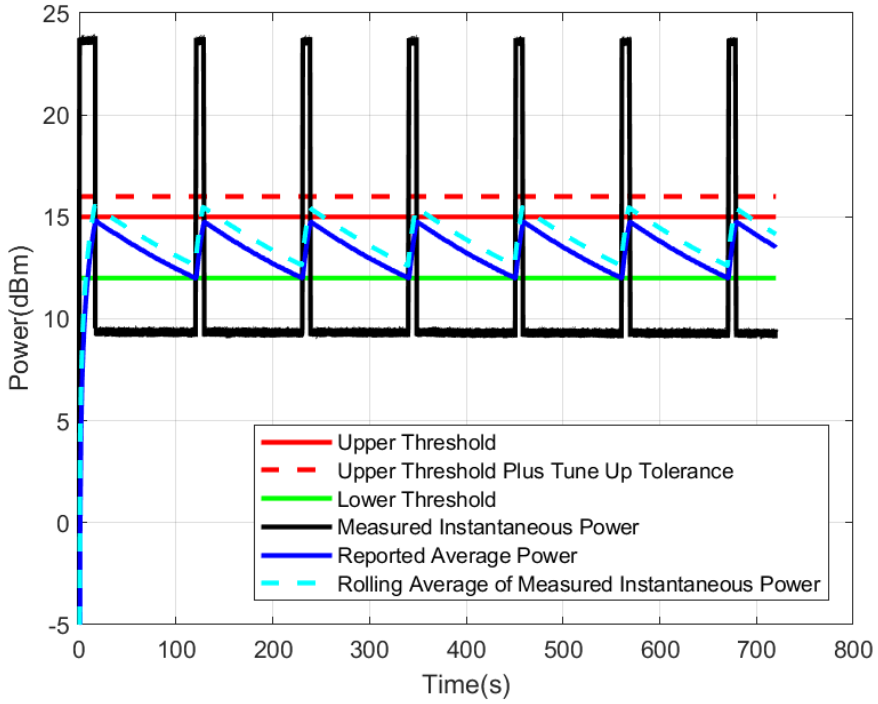
Case #14: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	14	11



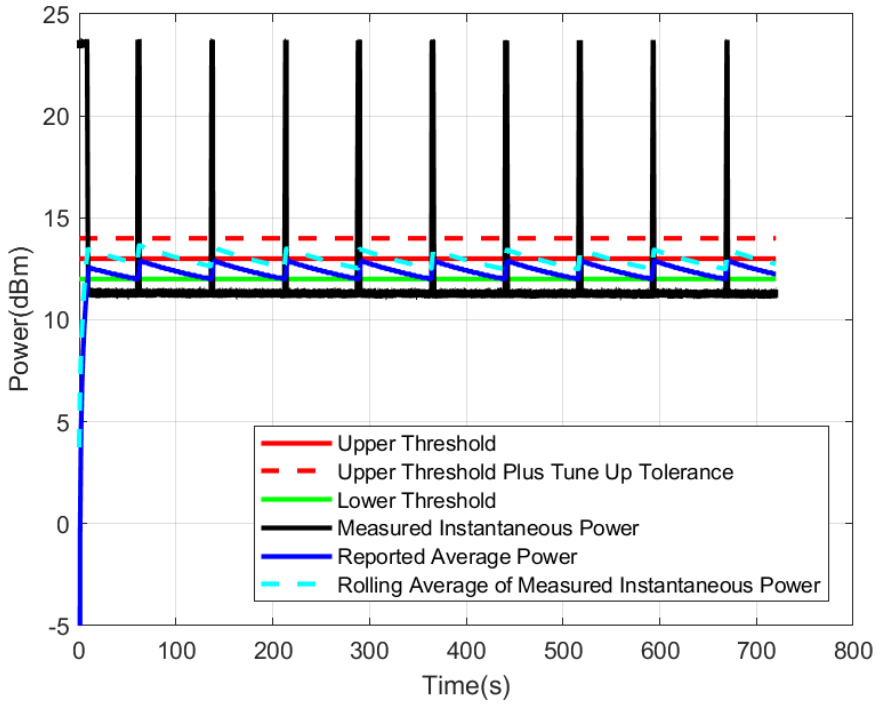
Case #15: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	12	11



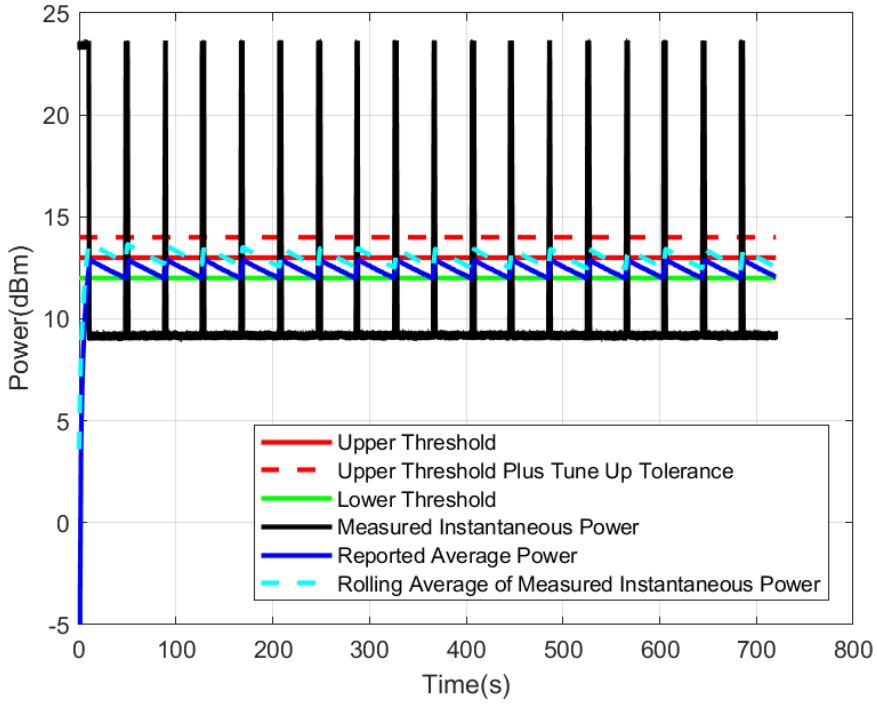
Case #16: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	12	09



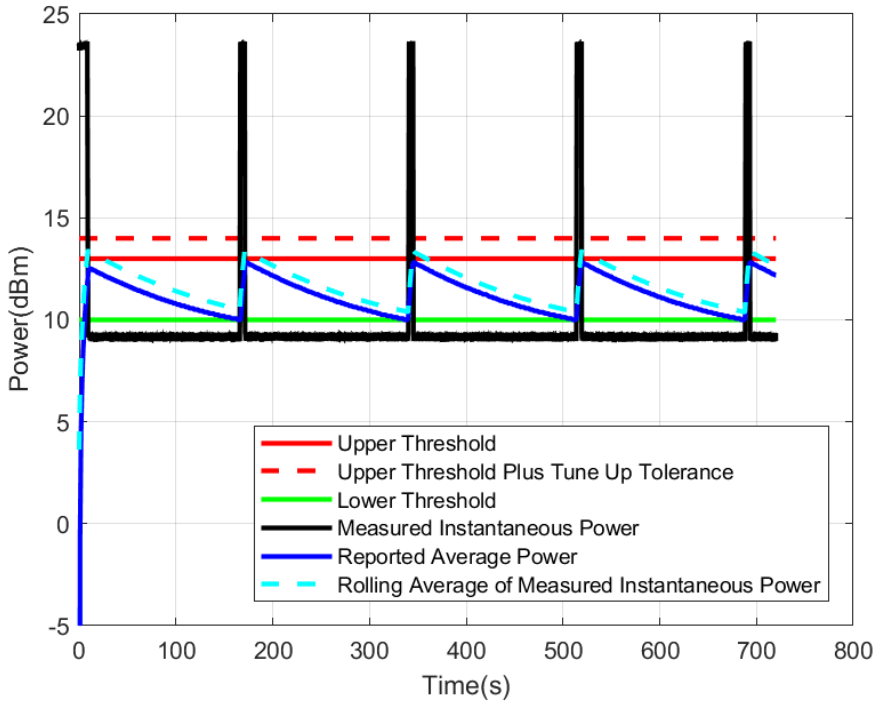
Case #17: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	12	11



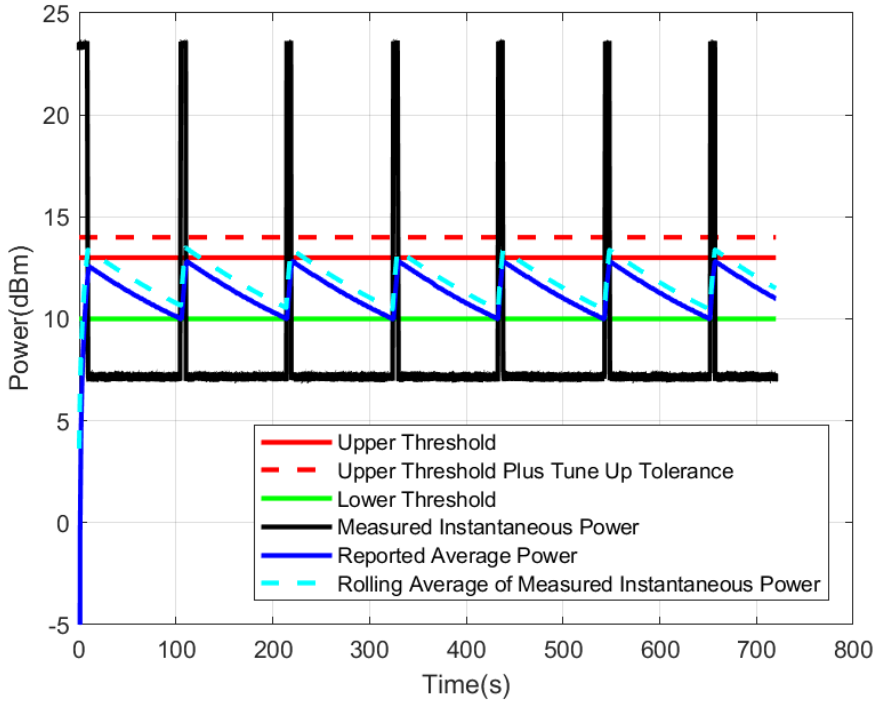
Case #18: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	12	09



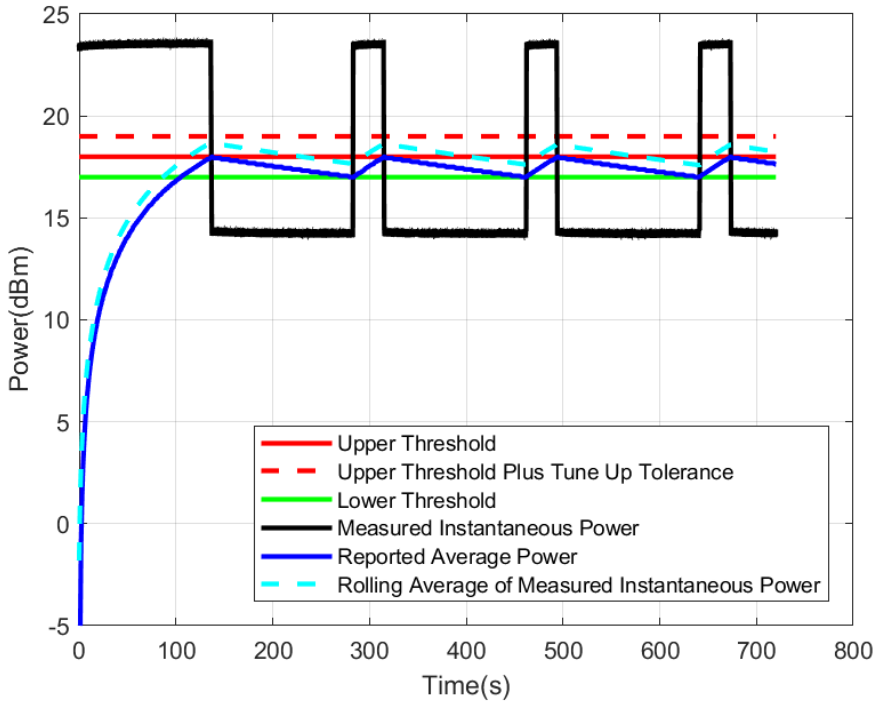
Case #19: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	10	09



Case #20: LTE Band 2 – Max Power 23dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	10	07



Case #21: LTE Band 2 – Max Power 23dBm – Roll Period 360 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



B.1.1.2 Validation of UMTS/WCDMA Band 2

Table B2 – Test Cases for UMTS/WCDMA Band 2 – RMC

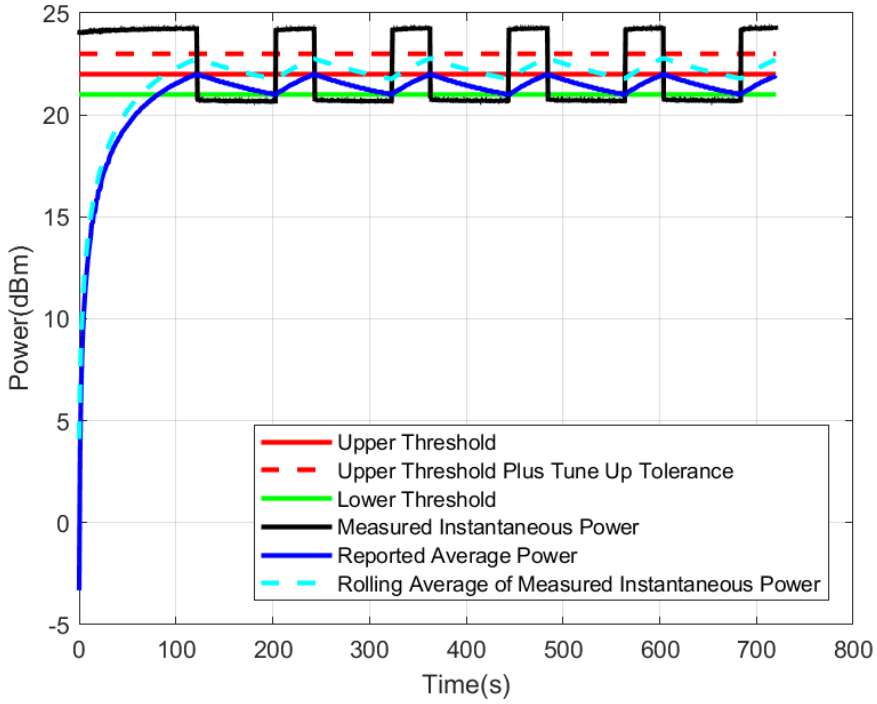
Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	WCDMA B2	23.5 dBm	100 sec	1 sec	22	21	20
2					22	21	18
3					22	19	18
4					22	19	16
5					20	19	18
6					20	19	16
7					20	17	16
8					20	17	14
9					18	17	16
10					18	17	14
11					18	15	14
12					18	15	12
13					15	14	13
14					15	14	11
15					15	12	11
16					15	12	9
17					13	12	11
18					13	12	9
19					13	10	9
20					13	10	7
21	WCDMA B2	23.5 dBm	360 sec	1 sec	18	17	14

Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** listed in Table 2. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

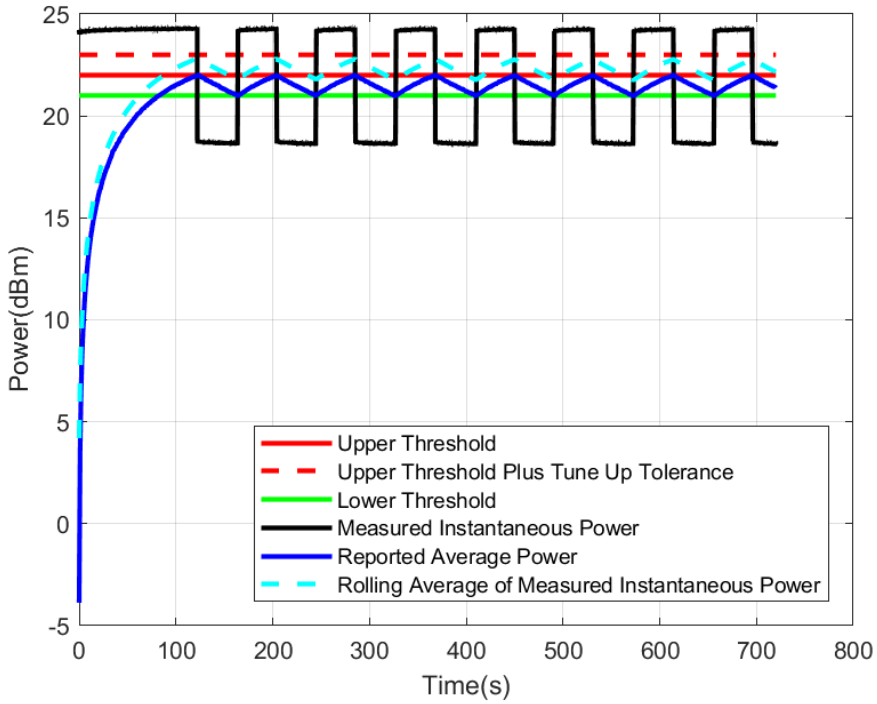
Note2: Values of ***Margin*** are calculated using (E.1), where ***SAR_Power*** = ***Avg_SAR_UppThresh*** + ***Margin***.

Results for the test cases in Table B2 are shown in the following plots.

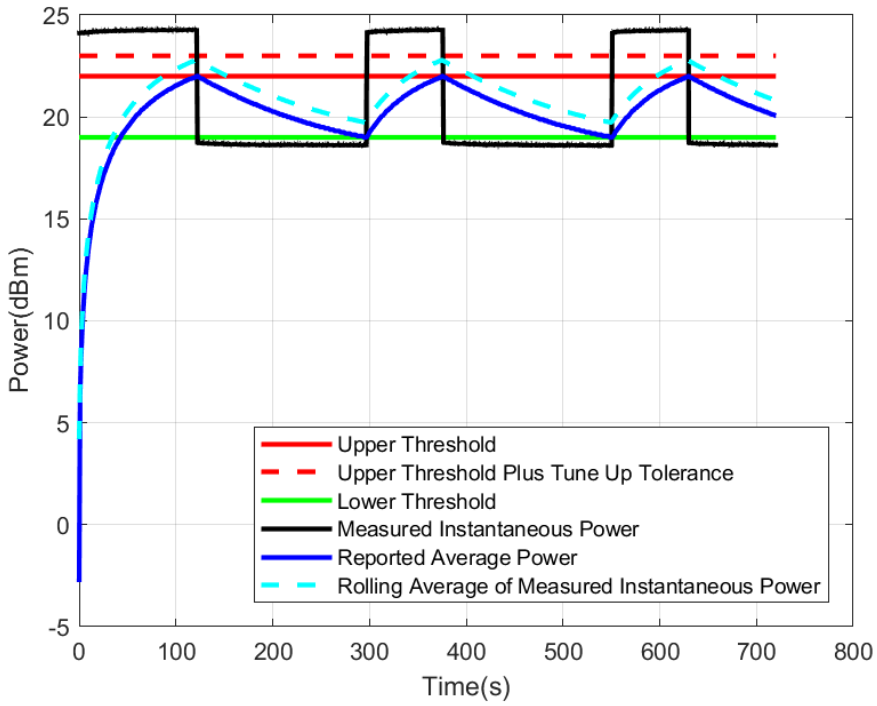
Case #1: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	21	20



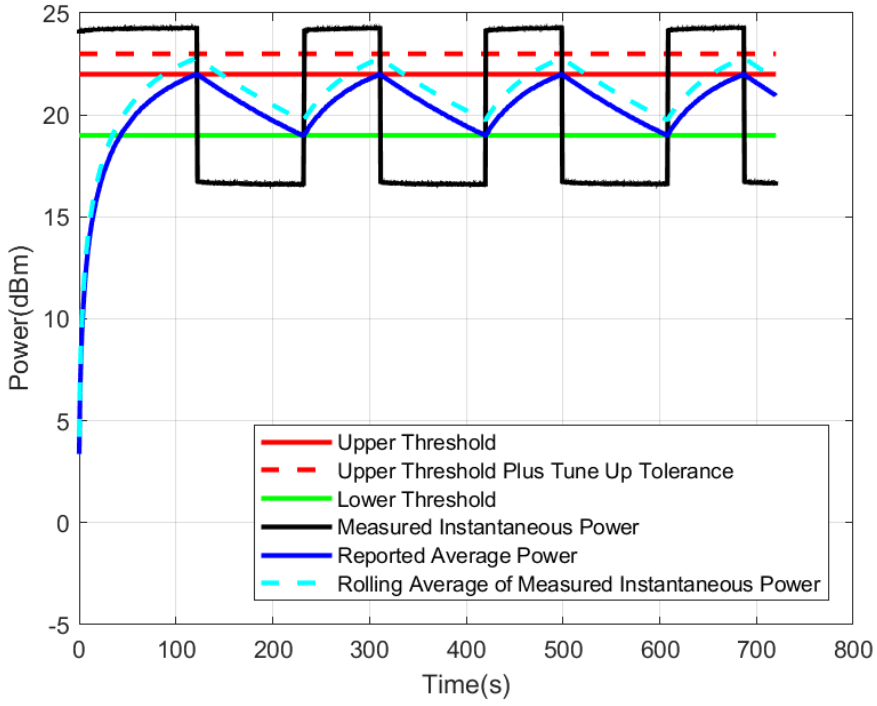
Case #2: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
-Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	21	18



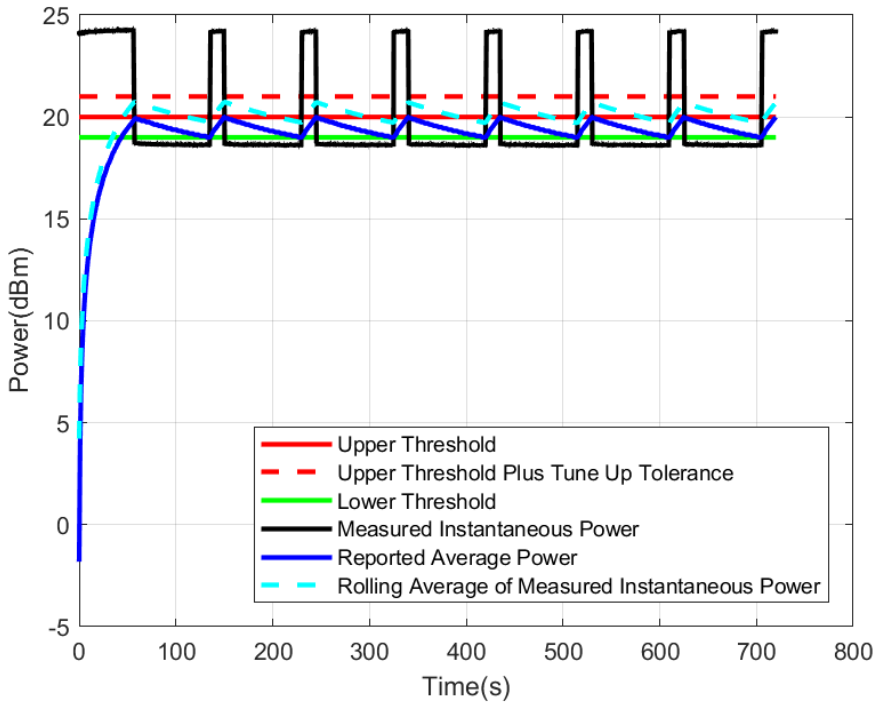
Case #3: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	19	18



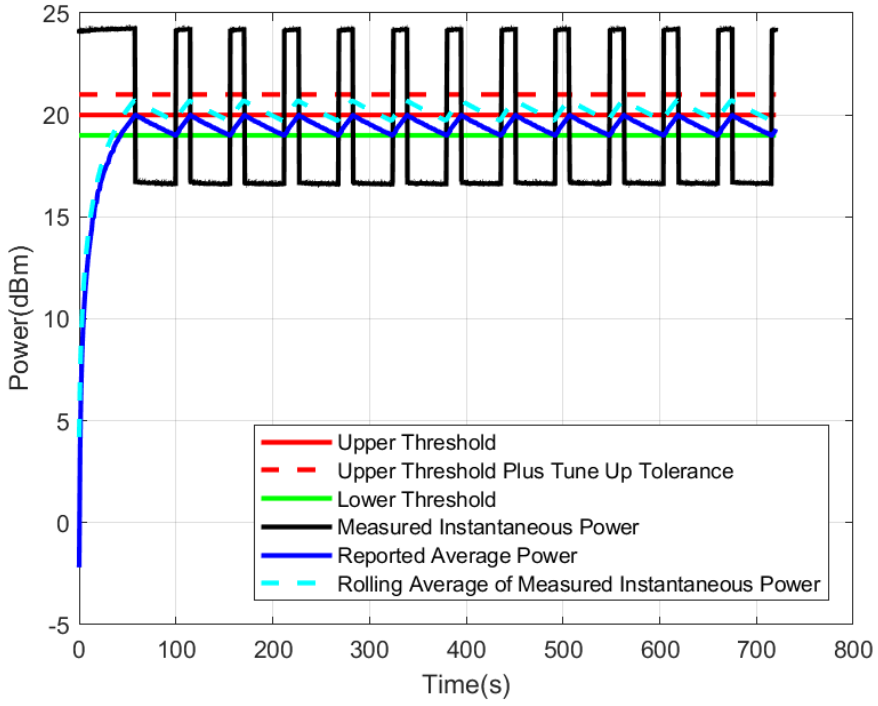
Case #4: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
22	19	16



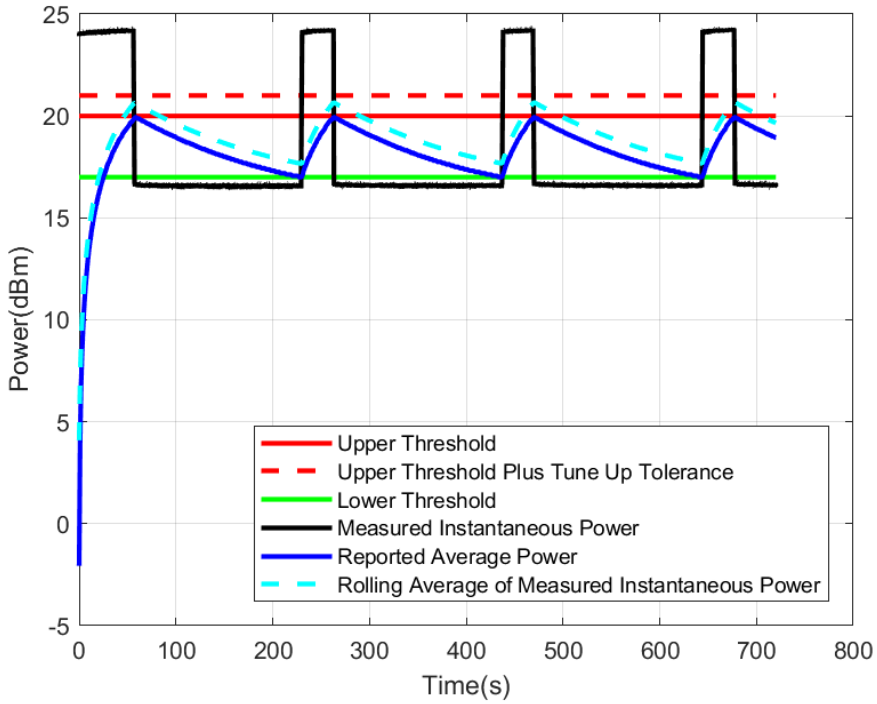
Case #5: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	19	18



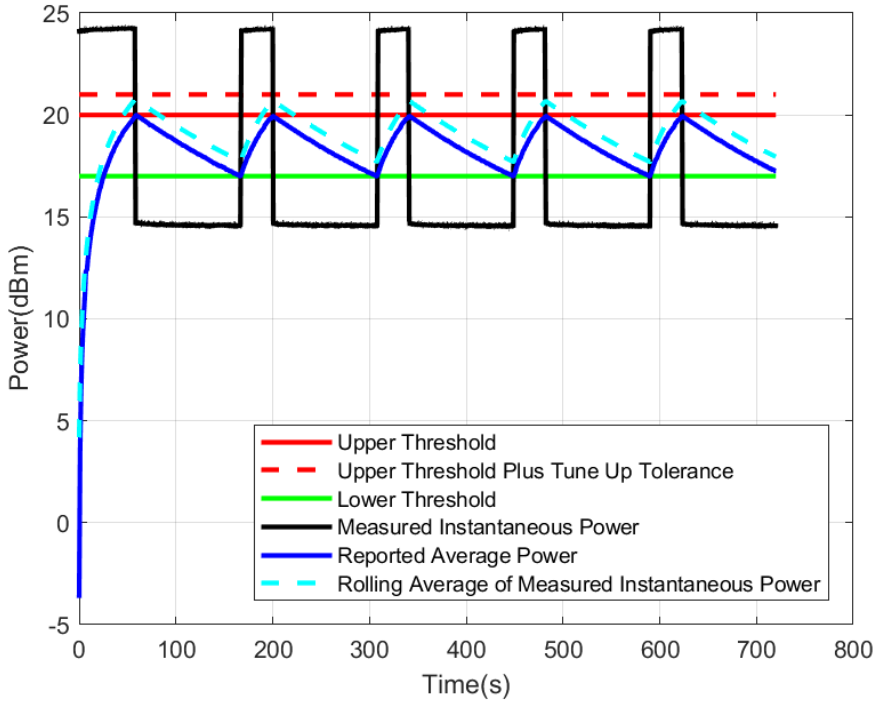
Case #6: WCDMA Band 2 – Max Power 23 dBm dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	19	16



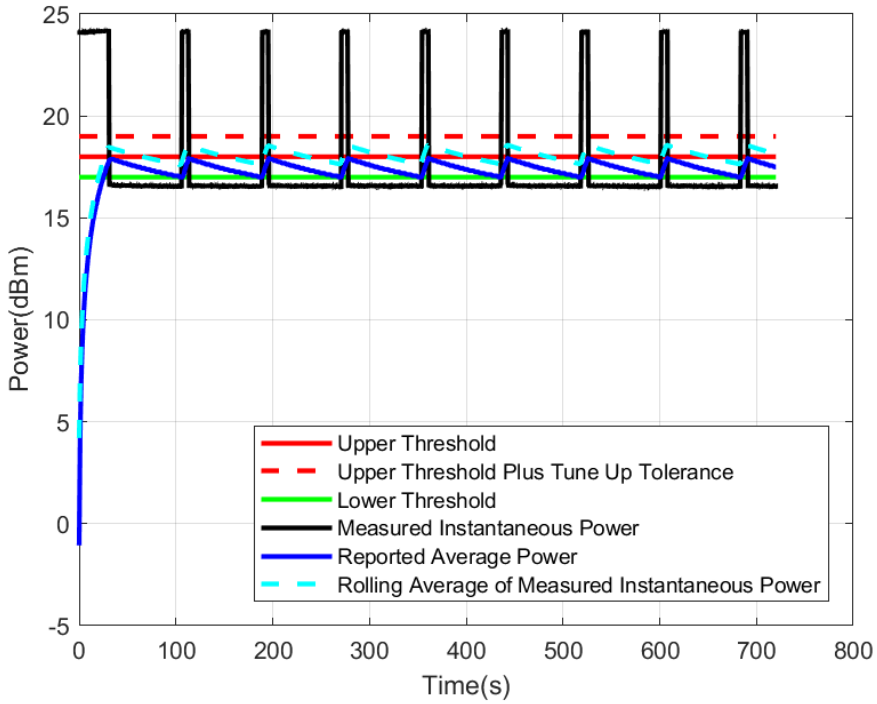
Case #7: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	17	16



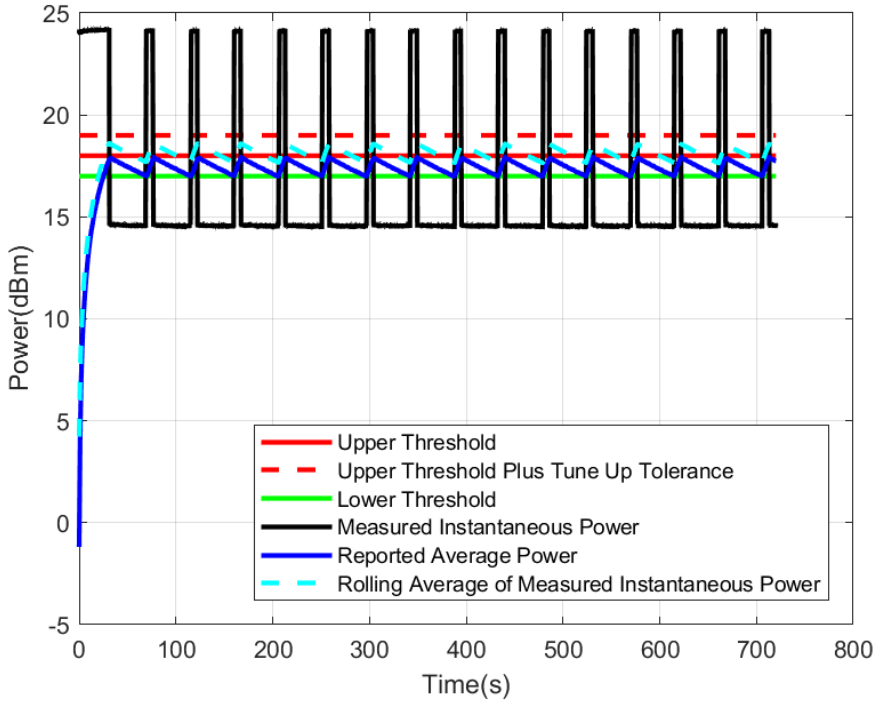
Case #8: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
20	17	14



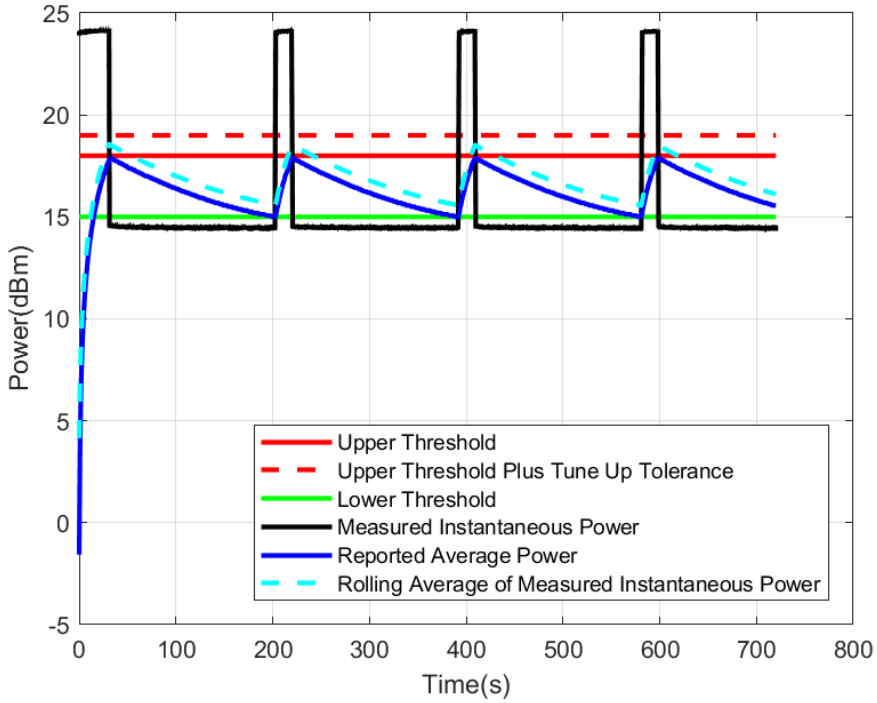
Case #9: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	16



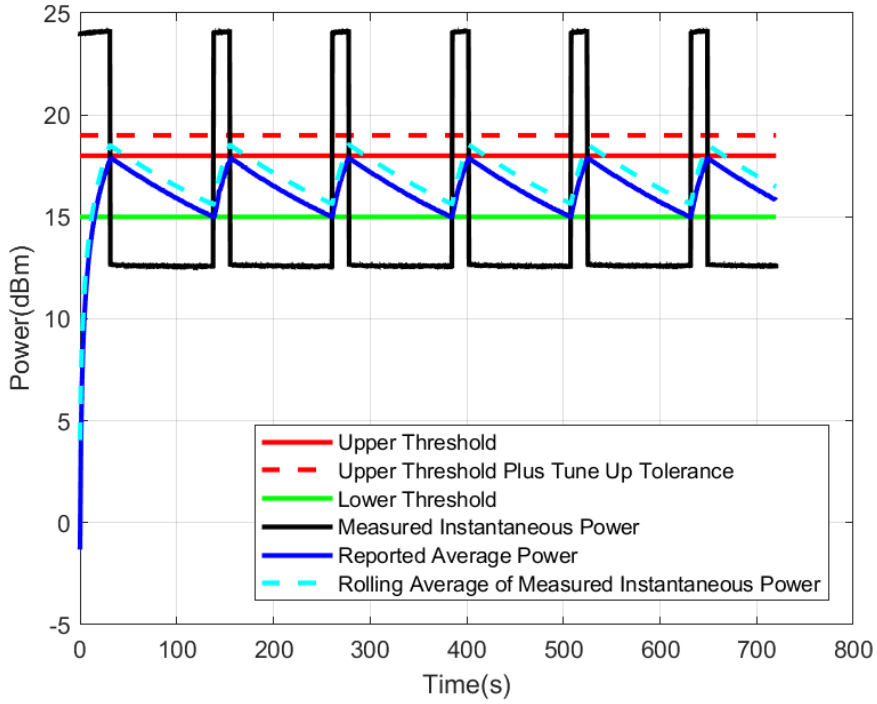
Case #10: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



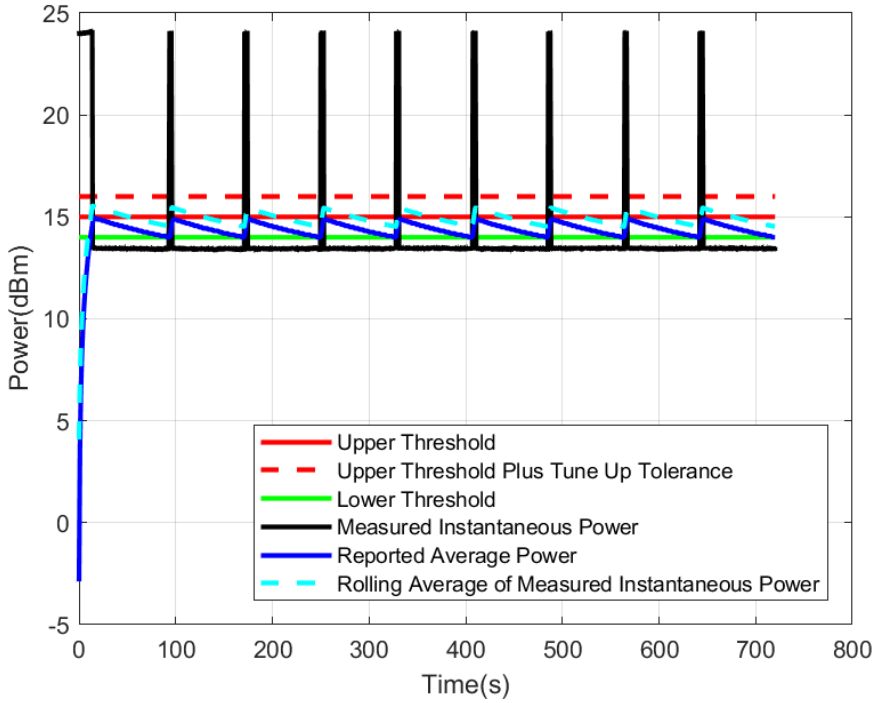
Case #11: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



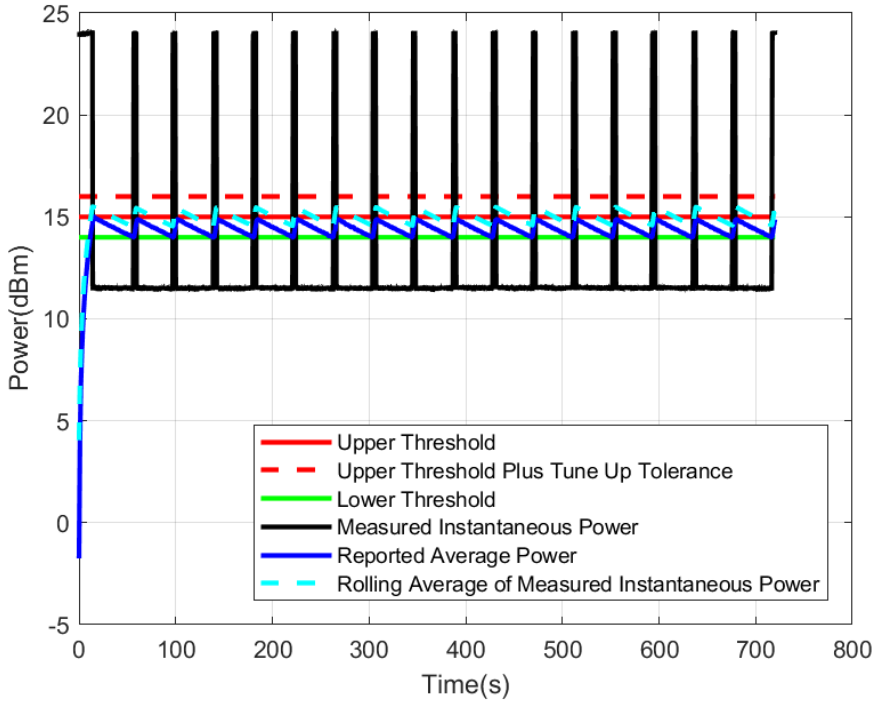
Case #12: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	12



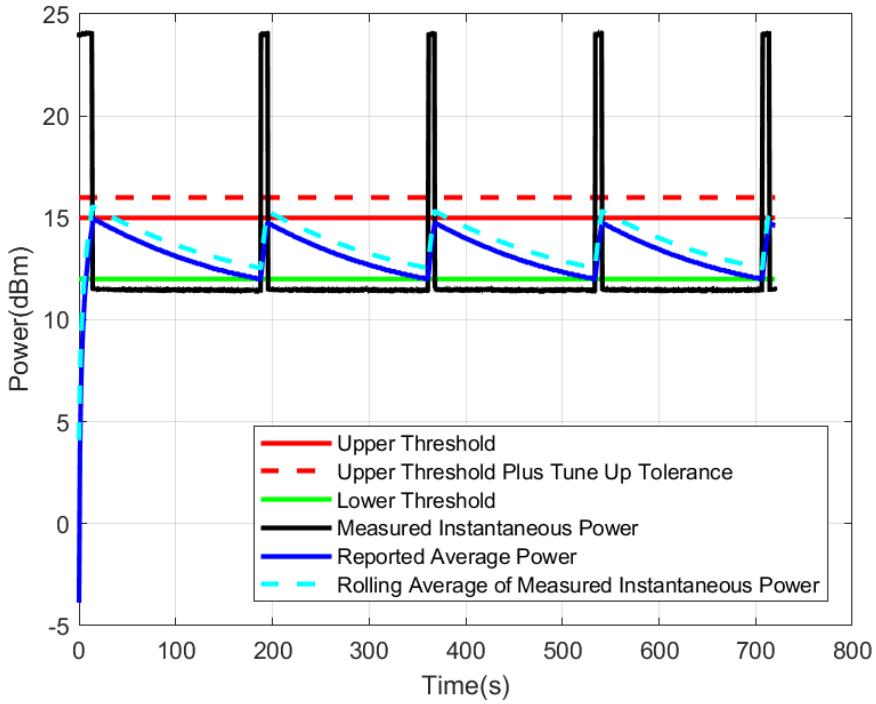
Case #13: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	14	13



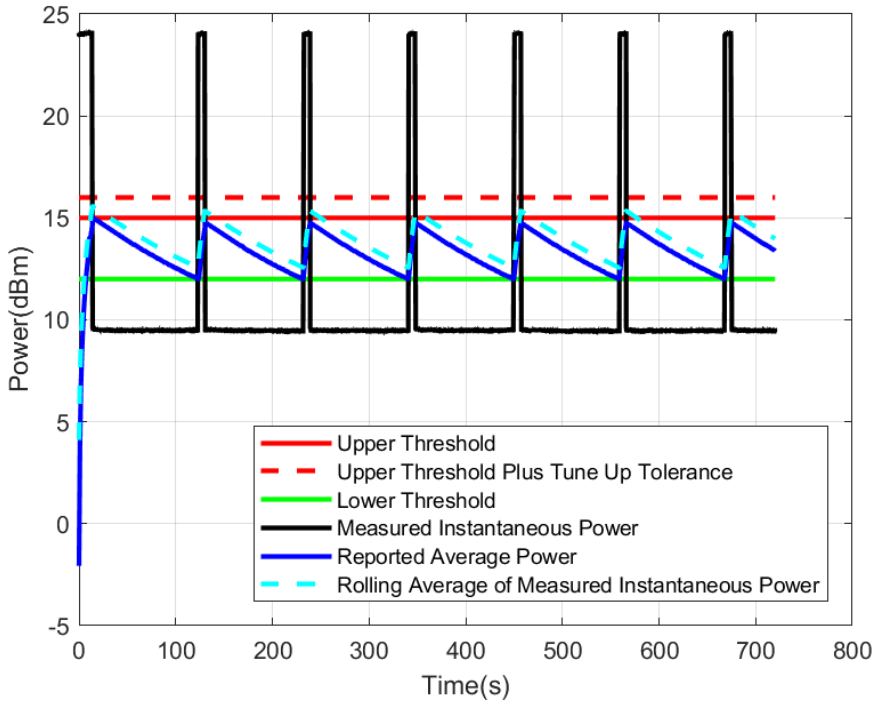
Case #14: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	14	11



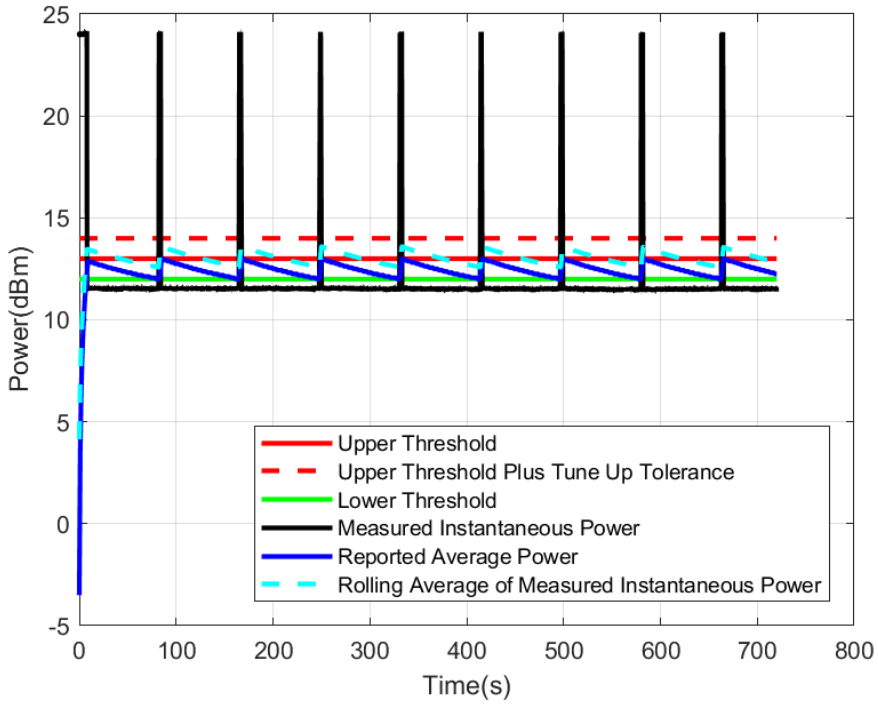
Case #15: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	12	11



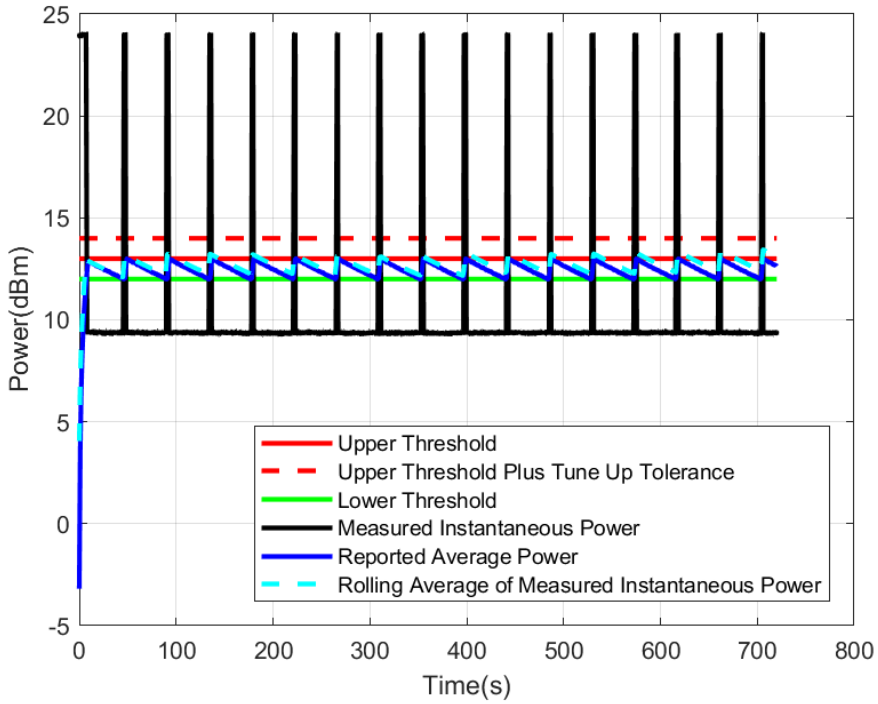
Case #16: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
15	12	09



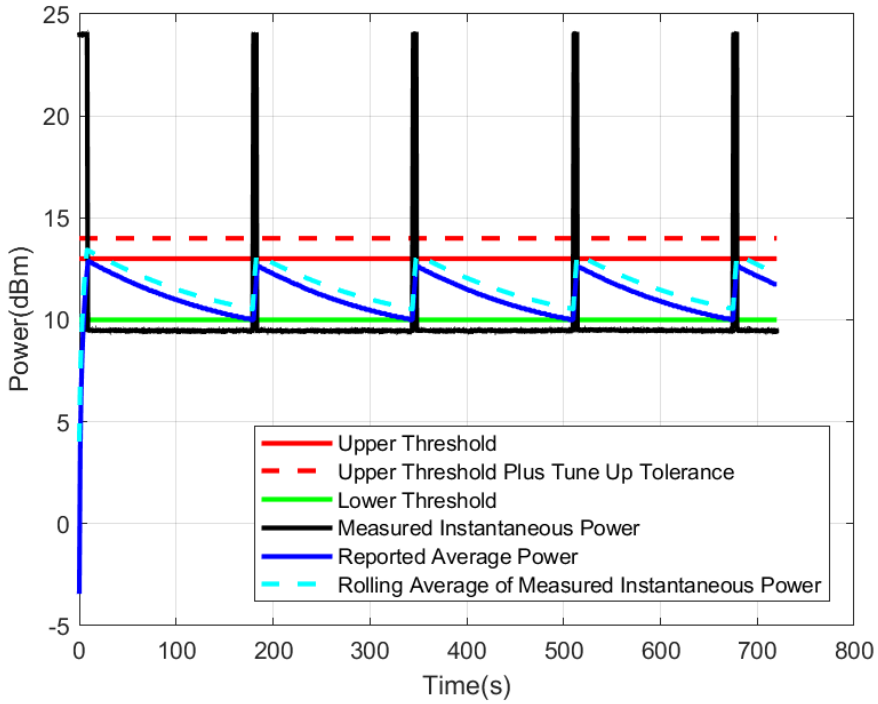
Case #17: WCDMA Band 2 – 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	12	11



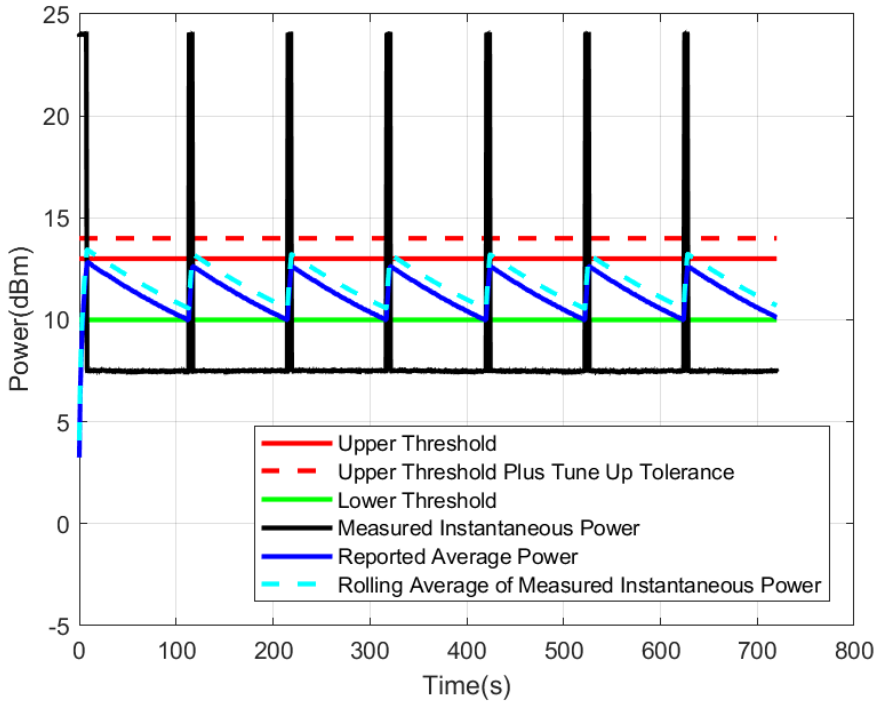
Case #18: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	12	07



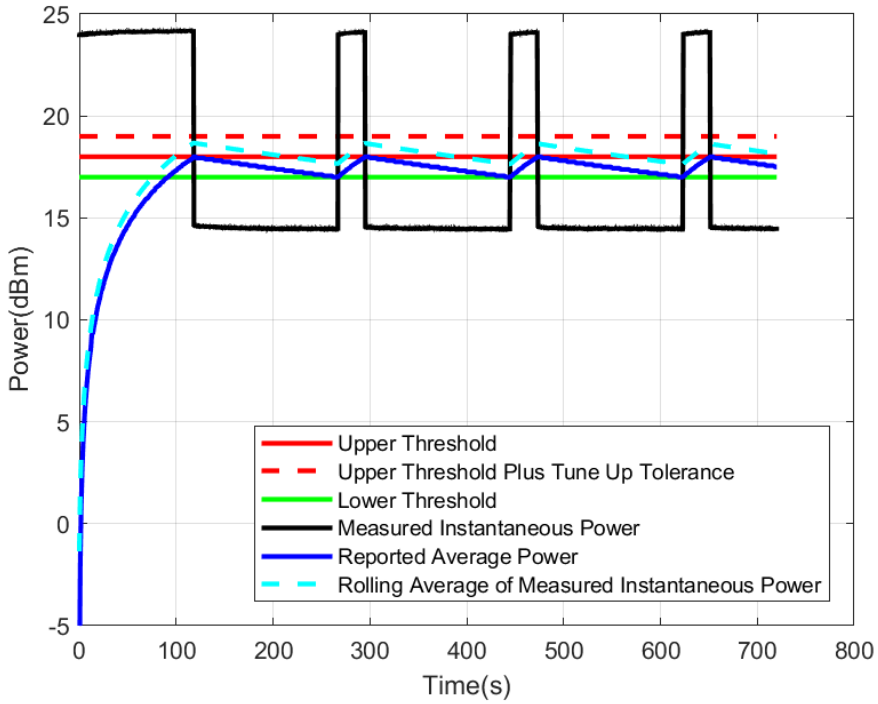
Case #19: WCDMA Band 2 – 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	10	09



Case #20: WCDMA Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
13	10	07



Case #21: WCDMA Band 2 – Max Power 23 dBm – Roll Period 360 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



B.1.2 Algorithm Validation According to Time Varying Power Control Test Sequences

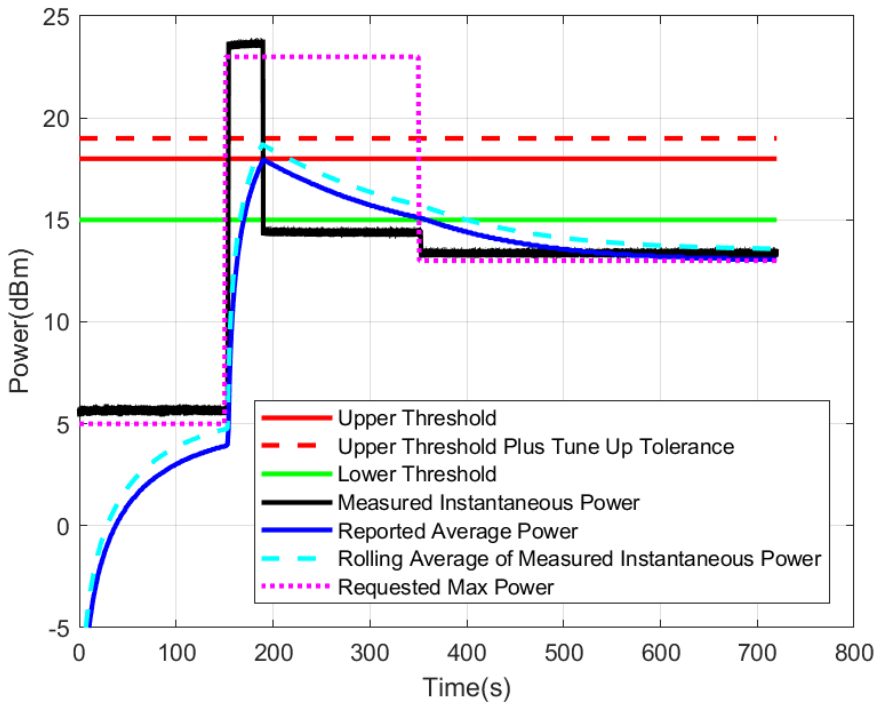
Table B3 – Test Cases for Test Sequences in Tables 2 and 3 for LTE and WCDMA - Band 2

Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	LTE B2	23 dBm	100 sec	1 sec	18	15	14
2					18	15	14
3	WCDMA B2	23.5 dBm			18	15	14
4					18	15	14

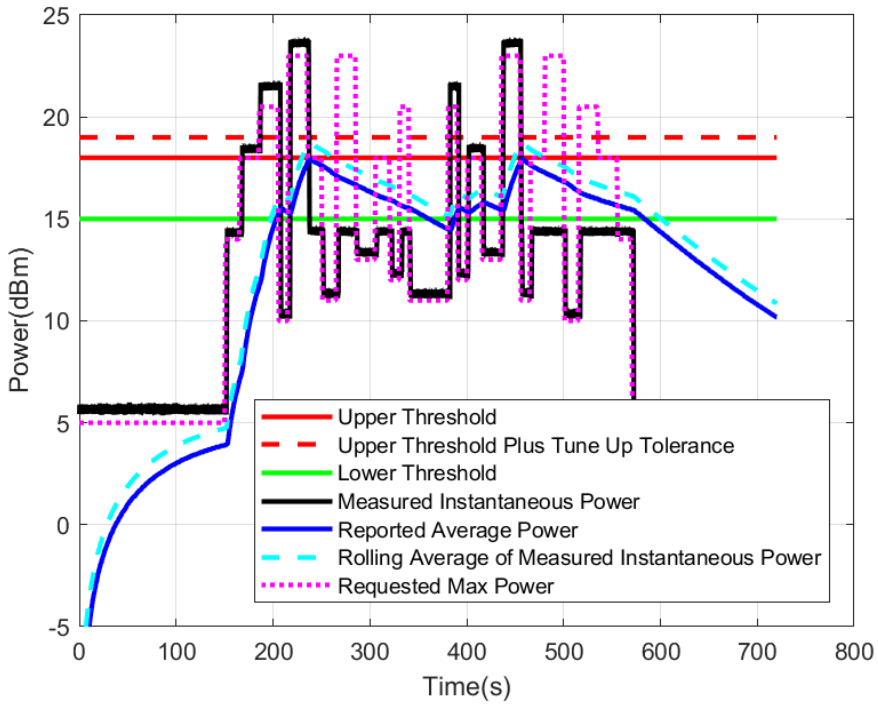
Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Max_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***Avg_SAR_UppThresh***, **Avg_SAR_LowThresh** and ***Max_Power_DPR_ON***. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

Results for the test cases in Table B3 are shown in the following plots.

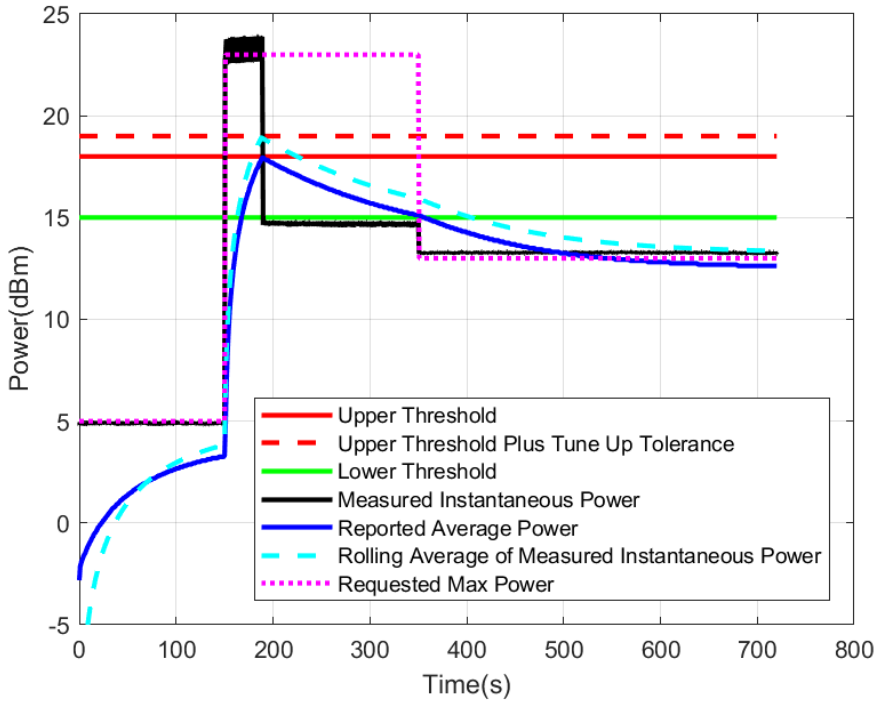
Case #1: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



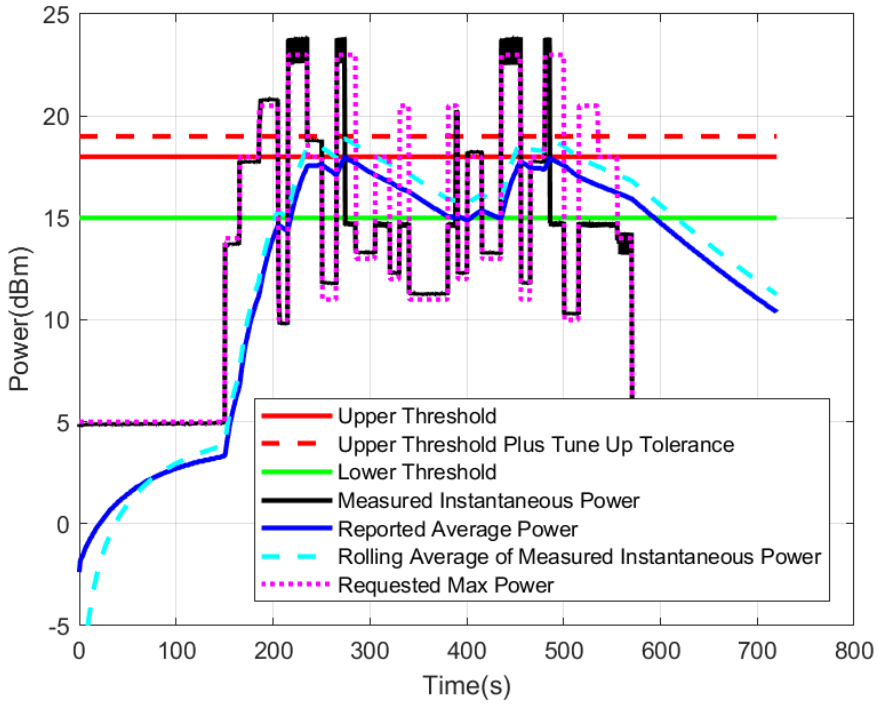
Case #2: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



Case #3: WCDMA Band 2 – Max Power 22.5 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



Case #4: WCDMA Band 2 – Max Power 22.5 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



B.1.3 Algorithm Validation for Drop Connection and Technology/Band Handover

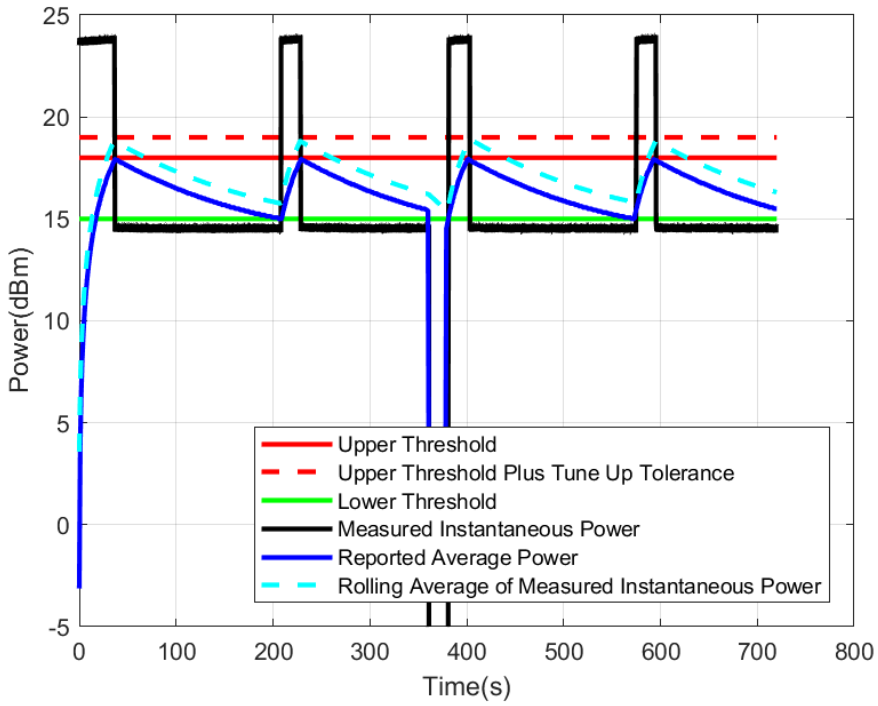
B.1.3.1 Connection Drop and Reboot Scenario Validation

Table B4 – Test Cases for LTE connection drop and reboot

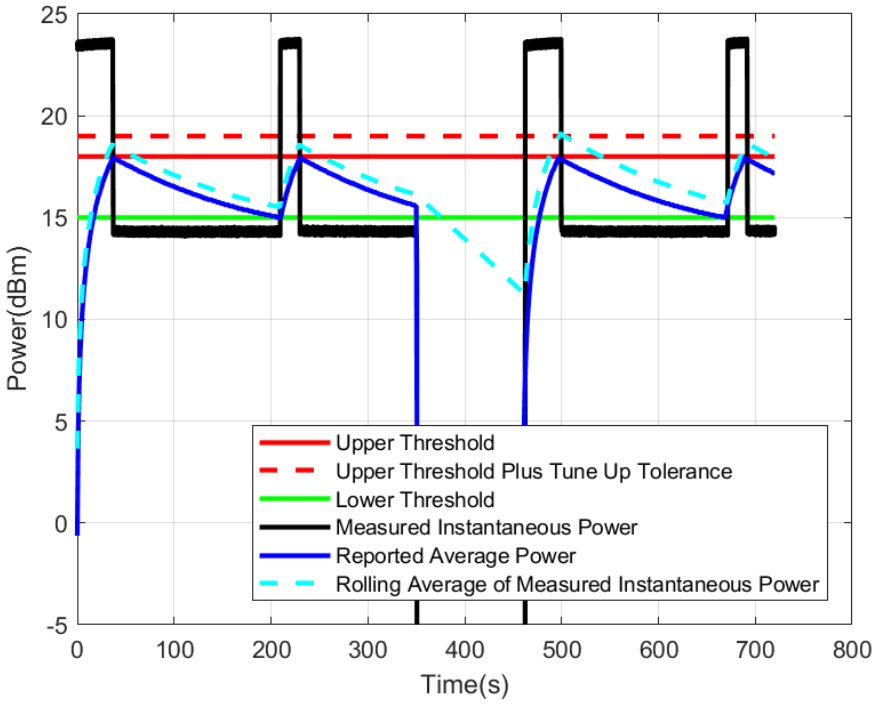
Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1: Drop Connection	LTE B2	23 dBm	100 sec	1 sec	18	17	14
2: Reboot					18	17	14

Results for the test cases in Table B4 are shown in the following plots.

Case #1 (Drop): LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



Case #2 (Reboot): LTE Band 2 – Max Power 23d Bm – Roll Period 100 sec – Check Period 1 sec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	17	14



B.1.3.2 Handover Validation from LTE Band 2 to LTE Band 4

Table B5 – Test Case for Handover from LTE Band 2 to LTE Band 4

Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	LTE B2	23 dBm	100 sec	1 sec	20	17	16
	LTE B4						

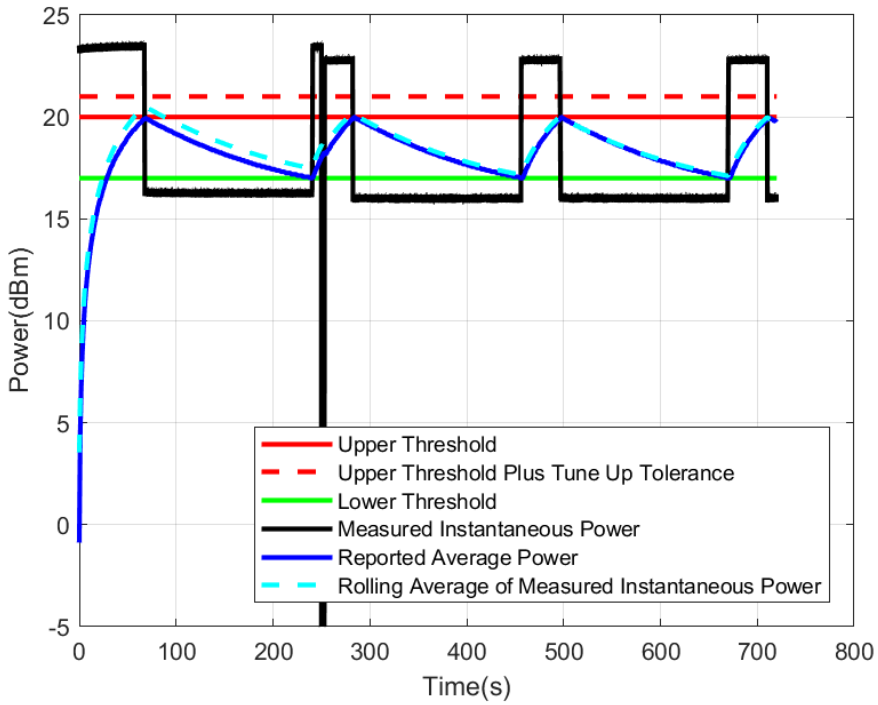
Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Max_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Max_Power_DPR_ON***. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

Results for the test case in Table B5 are shown in the following plot.

Note: This handover test was done at a different time from all of the above tests. The LTE ***Max_Power_DPR_ON*** and ***Max_Power_DPR_OFF*** levels were about 0.5 dB lower than specified due to tune-up tolerances (±1 dB) relating to board temperature introduced power drift. This has no impact on **TAS** operations.

Case #1: LTE Band 2 to LTE 4 – Max Power 23 dBm
Roll Period 100 sec – Check Period 1 sec

Avg_SAR_UppThresh [dBm]		***Avg_SAR_LowThresh*** [dBm]		***Max_Power_DPR_ON*** [dBm]	
LTE Band 2: 20	LTE Band 4: 20	LTE Band 2: 17	LTE Band 4: 17	LTE Band 2: 16	LTE Band 4: 16



B.1.3.3 Handover Validation from LTE Band 2 to WCDMA Band 4

Table B6 – Test Case for Handover from LTE Band 2 to WCDMA Band 4

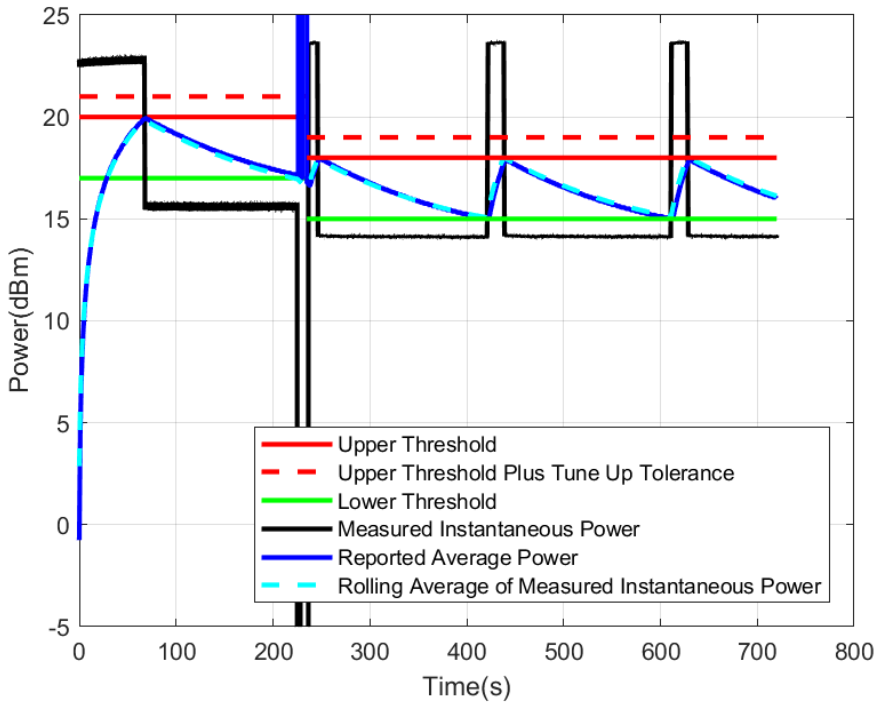
Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	LTE B2	23 dBm	100 sec	1 sec	20	17	16
	WCDMA B4	23.5 dBm			18	15	14

Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Max_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Max_Power_DPR_ON***. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

Results for the test case in Table B6 are shown in the following plot.

Case #1: LTE Band 2 to WCDMA 4 – Max Power 23 dBm (LTE) & 23.5 dBm (WCDMA)
Roll Period 100 sec – Check Period 1 sec

Avg_SAR_UppThresh [dBm]		***Avg_SAR_LowThresh*** [dBm]		***Max_Power_DPR_ON*** [dBm]	
LTE Band 2: 20	WCDMA Band 4: 18	LTE Band 2: 17	WCDMA Band 4: 15	LTE Band 2: 16	WCDMA Band 4: 14



B.1.4 Check Period verification

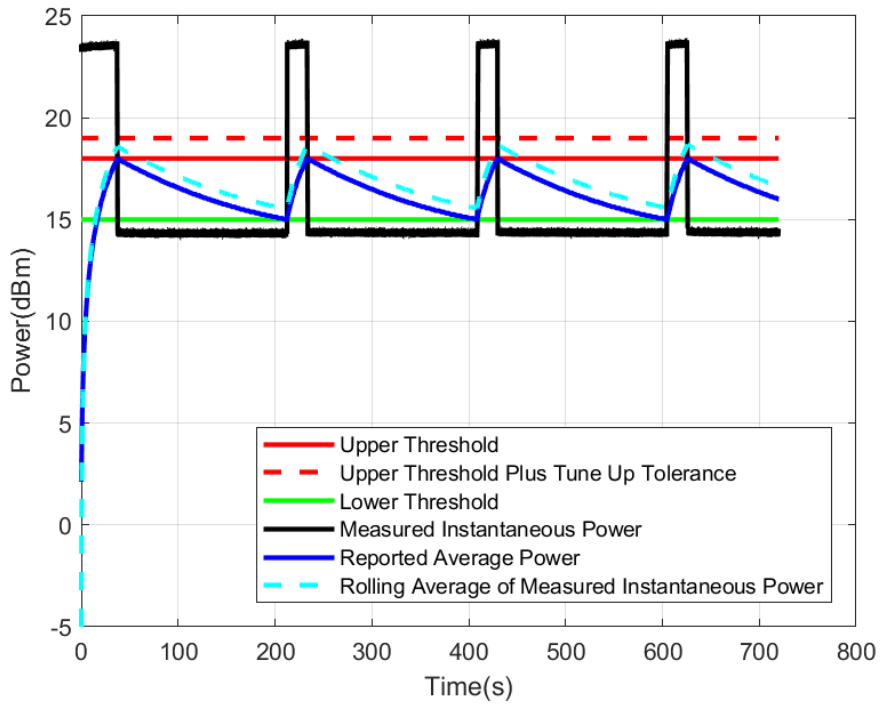
Table B7 – Test Cases for check period in Tables 2 for LTE Band 2

Test Case #	*Band*	*Max Power*	*Roll Period*	*Check Period*	*Avg_SAR_UppThresh [dBm]*	*Avg_SAR_LowThresh [dBm]*	*Max_Power_DPR_ON [dBm]*
1	LTE B2	23 dBm	100 sec	100 msec	18	15	14

Note: Values for ***Max Power***, ***Avg_SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** indicated above are approximated. The exact values for these are set according to the actual ***Max Power*** at the time of testing, accounting for tolerance, and the range (in dB) for ***SAR_UppThresh***, ***Avg_SAR_LowThresh*** and ***Avg_Power_DPR_ON*** listed in Table 2. These can introduce an apparent shift of the curves relative to ***Max Power*** shown in the plots. However, they have no impact to **TAS**.

Results for the test cases in Table B7 are shown in the following plots.

Case #1: LTE Band 2 – Max Power 23 dBm – Roll Period 100 sec – Check Period 100 msec		
Avg_SAR_UppThresh [dBm]	***Avg_SAR_LowThresh*** [dBm]	***Max_Power_DPR_ON*** [dBm]
18	15	14



With ***Avg_SAR_Check_Period*** = 100 msec, the plot shows an equivalent **TAS** behavior compared to that for Test Case # 11 in Table B1 of Section B.1.1.1, which uses the same **TAS** parameters but with ***Avg_SAR_Check_Period*** = 1 sec. The same test sequence is applied to both 1 sec and 100 msec ***Avg_SAR_Check_Period***. The results show that Check Periods of 100 msec vs. 1 sec have no impact on the **TAS** algorithm.