



CONNECTIVITY TAS EVALUATION REPORT

Applicant Name:

Apple, Inc.
One Apple Park Way
Cupertino, CA, 95014 USA

Date of Testing:

06/16/2025 – 08/20/2025

Test Site/Location:

Element, Morgan Hill, CA, USA

Document Serial No.:

1C2504170041-03.BCG-R2

FCC ID:

BCGA3361

APPLICANT:

APPLE INC.

DUT Type:

Tablet Device

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

A3361

Device Serial Numbers:

Pre-Production Samples [J4NQH]

Note: This revised Test Report supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.



RJ Ortanez
Executive Vice President



CERT #2041.02

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APPENDIX A: TEST SETUP PHOTOGRAPHS

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1. DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
UMTS 850	Data	826.4 - 846.6 MHz
UMTS 1750	Data	1712.4 - 1752.6 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 71	Data	665.5 - 695.5 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 13	Data	779.5 - 784.5 MHz
LTE Band 14	Data	790.5 - 795.5 MHz
LTE Band 26 (Cell)	Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 30	Data	2307.5 - 2312.5 MHz
LTE Band 7	Data	2502.5 - 2567.5 MHz
LTE Band 41	Data	2498.5 - 2687.5 MHz
LTE Band 48	Data	3552.5 - 3697.5 MHz
NR Band n71	Data	665.5 - 695.5 MHz
NR Band n12	Data	701.5 - 713.5 MHz
NR Band n14	Data	790.5 - 795.5 MHz
NR Band n26 (Cell)	Data	816.5 - 846.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n70	Data	1697.5 - 1707.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n30	Data	2307.5 - 2312.5 MHz
NR Band n7	Data	2502.5 - 2567.5 MHz
NR Band n41	Data	2501.01 - 2685.0 MHz
NR Band n48	Data	3555.0 - 3694.98 MHz
NR Band n77 DoD	Data	3455.01 - 3544.98 MHz
NR Band n77	Data	3705.0 - 3975.0 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz
6 GHz WIFI	Voice/Data	U-NII-5: 5935 - 6415 MHz U-NII-6: 6435 - 6515 MHz U-NII-7: 6535 - 6875 MHz U-NII-8: 6895 - 7115 MHz
Bluetooth	Data	2402 - 2480 MHz
802.15.4	Data	2405 - 2475 MHz
NB UNII-1	Data	5162 - 5245 MHz
NB UNII-3	Data	5733 - 5844 MHz
NB UNII-5	Data	6106 - 6420 MHz
WPT	N/A	13.56 MHz

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1.2 Time-Averaging Algorithm for RF Exposure Compliance

This DUT supports time-averaged SAR (TAS) technology for the connectivity transmitters (i.e. WLAN, BT, 802.15.4, NB UNII). A central manager, referenced as the RF Exposure manager, is responsible for maintaining the rolling time-averaged RF exposure over the applicable regulatory compliance window. This manager allocates a total RF exposure budget and specifies the RF exposure compliance limit to the connectivity radios. The radio controllers manage their transmissions to always maintain their consumption below the regulatory RF exposure limit. They report their consumed RF exposure back to the RF exposure manager. The RF exposure manager uses this feedback to allocate updated budget information throughout the regulatory averaging window. This implementation uses a 30-second time-averaging window.

The purpose of this time-averaged RF exposure report is to demonstrate the power control behavior of the DUT based on the manufacturer's algorithm under Tx varying transmission scenarios, thereby evaluating the validity of the manufacturer's time-averaging algorithm feature implementation in this device. It serves to complement the RF Exposure Test Reports to justify compliance per FCC.

The manufacturer's connectivity time averaging algorithm feature can operate in one set of time-averaging windows: 30 seconds.

1.3 Bibliography

Report Type	Report Serial Number
RF Exposure Test Report	1C2504170041-02.BCG

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2. RF EXPOSURE LIMITS

2.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

2.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

2.3 RF Exposure Limits for Frequencies Below 6 GHz

Table 2-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

2.4 Time Averaging Windows for FCC Compliance

Per manufacturer's approved KDB Inquiry, the time-averaging window used for assessing time-averaged exposures using this method is 30 seconds.

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3. TIME VARYING TRANSMISSION TEST CASES

For the completeness of verifying that the proposed connectivity time-averaging algorithm can realize FCC compliance, several test scenarios are constructed as below:

- **Technology Switch Case:**
 - Performed for a single test configuration to display algorithm compliance.
 - This test case may be referenced for validation of simultaneous compliance.
- **Antenna/Band Switch Case:**
 - Performed per connectivity technology for a single test configuration.
 - This test case may be referenced for validation of simultaneous compliance.
- **Device State Switch Case:**
 - Performed for a single test configuration with radio state dependent power control.
 - This test case may be referenced for validation of radio state dependent power control.

The strategy for testing in Tx varying transmission condition is outlined as follows:

- Demonstrate that the normalized, rolling time-averaged power ($P_{avg,norm}$) is maintained less than or equal to 1.
 - Measure conducted Tx power versus time
 - Use the equation below to calculate the normalized average power ($P_{avg, norm}$).
 - Perform running time-averaging over 30s defined time windows.
 - TAS algorithm compliance is validated when $P_{avg, norm}$ is maintained less than or equal to $P_{limit, norm}$ of 1.

Where:

- In cases where the P_{limit} is not constant:

$$P_{avg, norm} = \frac{1}{M} \sum_{m=0}^{M-1} \frac{P_{meas}[n-m]}{P_{limit}[n-m]}$$

- In cases where the P_{limit} is constant:

$$P_{avg, norm} = \frac{1}{M} \sum_{m=0}^{M-1} P_{meas}[n-m]$$

- 'n' is for the nth time step
- 'M' is the total number of reporting periods per time-averaging window
- 'm' is the index of the time-averaging window
- P_{limit} is the specified maximum time-averaged output power to ensure SAR compliance.
- P_{meas} is the instantaneous measured time-averaged output power.

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4. FCC MEASUREMENT PROCEDURES

This chapter provides the test plan configurations and test procedure for validating the manufacturer's TAS algorithm feature for connectivity transmission.

4.1 Test Configuration and Procedure for Connectivity Test: Technology Switch

4.1.1 Configuration

- Technology switch is performed for a single configuration to display algorithm compliance. Where simultaneous transmission is supported, the test case is modified to validate that transmission scenario.
- Configurations where Plimit is 2-4dB below Pmax will be selected for assessment.
- Configurations where Plimit is greater than or equal to Pmax will be excluded from testing as there will be no TAS activity in this condition.

Test Case Scenario: 1	Mode/Band/Antenna(s) 1	Mode/Band/Antenna(s) 2	Mode/Band/Antenna(s) 3 [SDB]
Technology Switch	2.4 GHz Wi-Fi Core 0	NB U-NII 3 Core 1	2.4 GHz Wi-Fi Core 0 + NB U-NII 3 Core 1

4.1.2 Procedure

TX power is measured, recorded, and processed by the following steps:

- Steps 1~2: Measure and record TX power versus time for Technology Switch.
 - Step 1: Configure settings for TAS testing.
 - Step 2: Measure TX power versus time.

Initial Wi-Fi TAS mode: DUT will transmit on 2.4 GHz Wi-Fi Core 0 for approximately 60s.

Switch to NB UNII-3 mode: DUT will switch connection to NB UNII-3 Core 1 for approximately 60s.

Simultaneous Dual Band connection TAS mode: DUT will re-establish the connection via 2.4 GHz Wi-Fi Core 0 while simultaneously maintaining connection with the NB UNII-3 Core 1 band.

- Step 3: Convert the measured conducted TX power into normalized power and plot using the manufacturer post processing tool.
TAS is validated when Pavg, norm is less than Plimit, norm for both bands for the duration of the test.

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4.2 Test Configuration and Procedure for Connectivity Test: Antenna/Band Switching

4.2.1 Configuration

- Antenna switch is performed for a single configuration per technology. Where applicable, change in frequency band is validated in the antenna switch test case. Where simultaneous dual band is supported, the antenna switch test case is modified to validate the transmission scenario.
- Configurations where Plimit is 2-4dB below Pmax will be selected for assessment.
- Configurations where Plimit is greater than or equal to Pmax will be excluded from testing as there will be no TAS activity in this condition.

Test Case Scenario: 2	Mode/Band/Antenna(s) 1	Mode/Band/Antenna(s) 2 [SDB]
Antenna/Band Switch	2.4 GHz Wi-Fi Core 0	2.4 GHz Wi-Fi Core 0 + 5 GHz Wi-Fi Core 1

4.2.2 Procedure

TX power is measured, recorded, and processed by the following steps:

- Steps 1~2: Measure and record TX power versus time for Antenna Switch.
 - Step 1: Configure settings for TAS testing.
 - Step 2: Measure TX power versus time.

Initial Wi-Fi TAS mode: DUT will transmit on 2.4 GHz Wi-Fi Core 0 for approximately 60s.

Simultaneous Dual Band connection with 5 GHz Wi-Fi TAS mode: DUT will establish an additional connection with 5 GHz Wi-Fi Core 1 antenna while simultaneously maintaining connection on 2.4 GHz Wi-Fi Core 0 antenna.

- Step 3: Convert the measured conducted TX power into normalized power and plot using the manufacturer post processing tool.

TAS is validated when Pavg, norm is less than Plimit, norm for both bands for the duration of the test.

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4.3 Test Configuration and Procedure for Connectivity Test: Device State Switch

4.3.1 Configuration

- Change in device state is performed for a single combination to display algorithm compliance for the mode with the largest difference in cell on versus cell off power level.
- Configurations where Plimit is 2-4dB below Pmax will be selected for assessment.
- Configurations where Plimit is greater than or equal to Pmax will be excluded from testing as there will be no TAS activity in this condition.

Test Case Scenario: 3	Mode/Band/Antenna(s) 1	Mode/Band/Antenna(s) 2
Device State Switch	2.4 GHz Wi-Fi Core 0 (Cell ON)	2.4 GHz Wi-Fi Core 0 (Cell OFF)

4.3.2 Procedure

TX power is measured, recorded, and processed by the following steps:

- Steps 1~2: Measure and record TX power versus time for Device State Switch.
 - Step 1: Configure settings for TAS testing.
 - Step 2: Measure TX power versus time.
 - Initial Cell On State:** DUT will transmit on the Cell On State for approximately 60s.
 - Switch to Cell Off State:** DUT will switch from Cell On State to Cell Off State and will transmit for an additional 60s.
- Step 3: Convert the measured conducted TX power into normalized power and plot using the manufacturer post processing tool.

TAS is validated when Pavg, norm is less than Plimit for both device states the duration of the test.

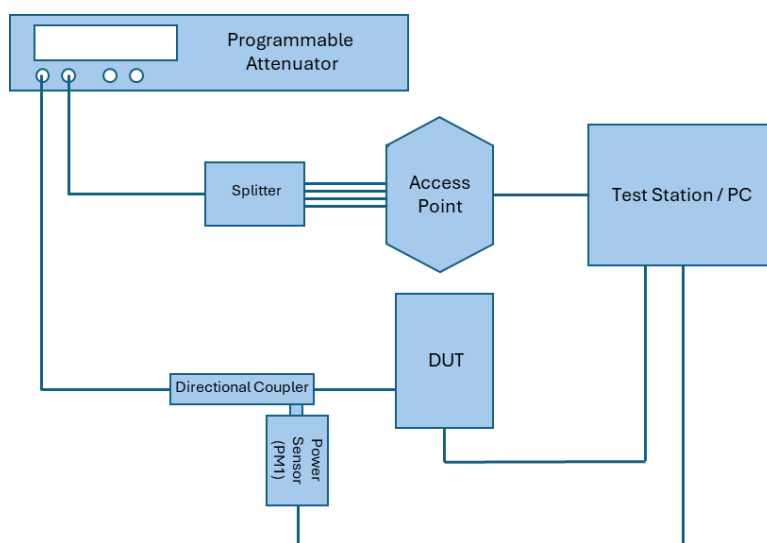
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5. MEASUREMENT TEST SETUP

5.1 Measurement Setup

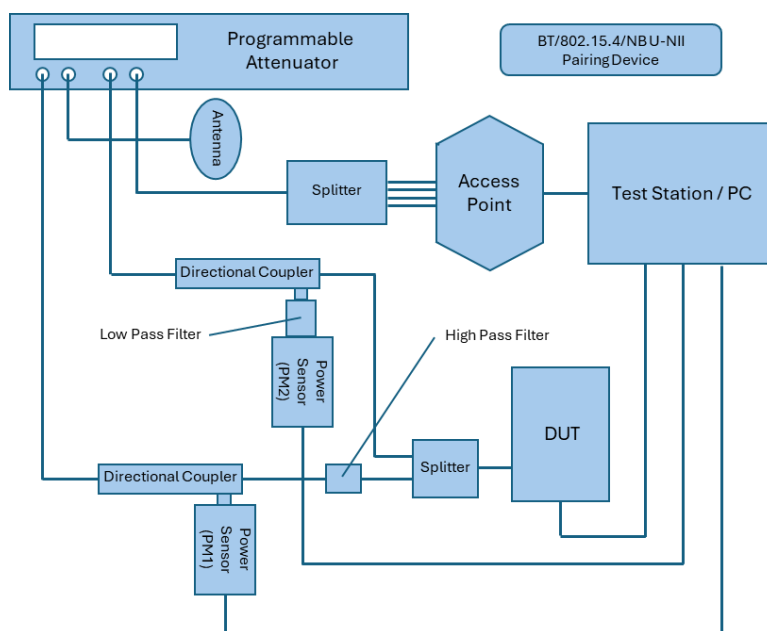
The general measurement setup for the DUT is shown in Figure 5-1. There is a control computer which controls the DUT, power meters, and the AP WiFi traffic control. The WiFi traffic is established between the DUT and the AP via cables for conducted connection. And the DUT is connected to a programmable attenuator that is connected to the power meters.

The test scenarios are controlled by PC command. The transmitter power is measured with R&S power meters.

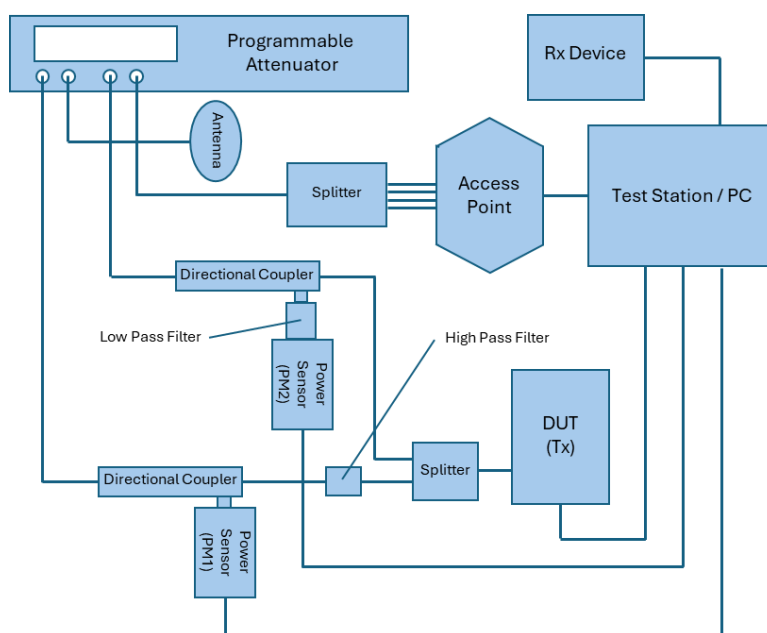


(a) Appendix A – Test Setup Photo 1

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(b) Appendix A – Test Setup Photo 2



(c) Appendix A – Test Setup Photo 3

Figure 5-1
Conducted power measurement setup

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6. CONDUCTED TEST CASES

6.1 Technology Switch Conducted Power Measurements

This test is the conducted power measurement for change in technology from Wi-Fi 2.4 GHz to NB UNII-3 to Wi-Fi 2.4 GHz + NB UNII-3. The detailed setting is listed in Table 6-1. Figure 6-1 demonstrates the DUT's normalized conducted TX power, the normalized time-averaged conducted TX power behavior over time, and the normalized FCC limit of 1. As seen in these figures, the normalized time-averaged TX power does not exceed the normalized FCC limit of 1.

Table 6-1 TAS parameters setting for Technology Switching

Test Scenario	Technology/Band	Core/Antenna	Plimit [dBm]	Plimit [mW]	Pmax [dBm]	Pmax [mW]	Time Window	Power Meter
Technology Switch	2.4 GHz Wi-Fi	Core 0 (Ant 4a)	19.25	84.14	21.50	141.25	60s	P1
	NB U-UNII 3	Core 1 (Ant 4a)	16.50	44.67	18.50	70.79	60s	P2
	2.4 GHz Wi-Fi + NB U-UNII 3	Core 0 (Ant 4a) / Core 1 (Ant 4a)	19.25 / 16.50	84.14 / 44.67	21.50 / 18.50	141.25 / 70.79	60s	P1 / P2

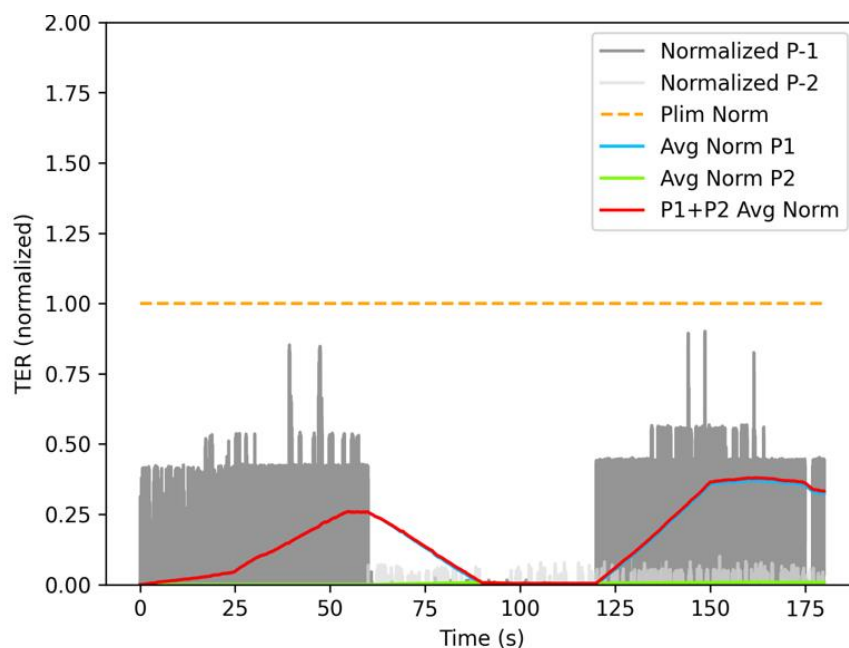


Figure 6-1 Technology Switch Normalized Time-averaged conducted TX power

Normalized P_{limit}	1.00
Highest normalized P_{avg}	0.379
Validation result:	Pass

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6.2 Antenna/Band Switch Conducted Power Measurements

These tests are the conducted power measurement for change in antenna/band per technology. The detailed setting is listed in Table 6-2. Figures 6-2 demonstrates the DUT's normalized conducted TX power, the normalized time-averaged conducted TX power behavior over time, and the normalized FCC limit of 1. As seen in these figures, the normalized time-averaged TX power does not exceed the normalized FCC limit of 1.

Table 6-2 TAS parameters setting for Antenna/Band Switching

Test Scenario	Technology/Band	Core/Antenna	Plimit [dBm]	Plimit [mW]	Pmax [dBm]	Pmax [mW]	Time Window	Power Meter
Wi-Fi Antenna/Band Switch	2.4 GHz Wi-Fi	Core 0 (Ant 4a)	19.25	84.14	21.50	141.25	60s	P1
	2.4 GHz Wi-Fi + 5 GHz Wi-Fi	Core 0 (Ant 4a) / Core 1 (Ant 4a)	19.25 / 19.00	84.14 / 79.43	21.50 / 19.50	141.25 / 89.13	60s	P1 / P2

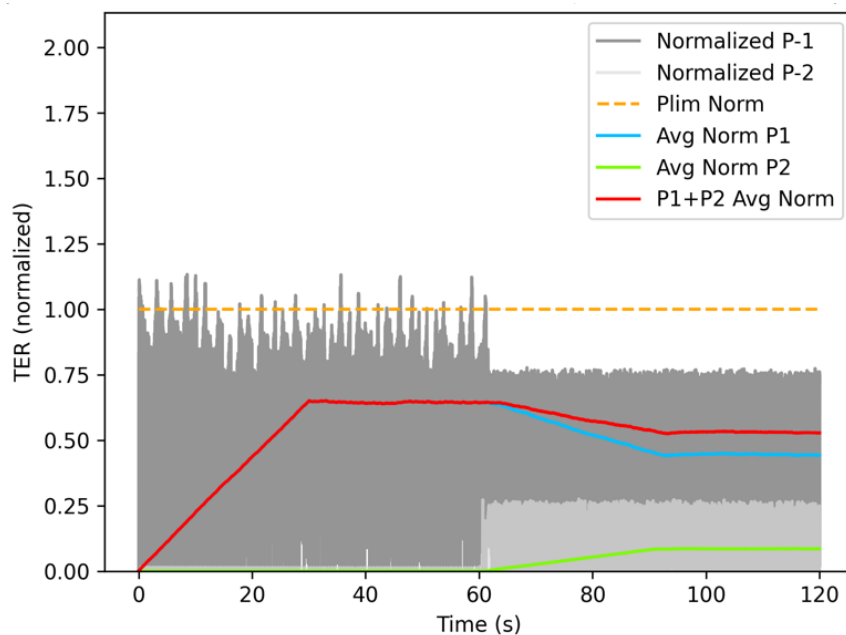


Figure 6-2 Wi-Fi Antenna Switch Normalized Time-averaged conducted TX power

Normalized P_{limit}	1.00
Highest normalized P_{avg}	0.651
Validation result: Pass	

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6.3 Device State Switch Conducted Power Measurements

This test is the conducted power measurement for change in device state from 2.4 GHz Wi-Fi Cell On to 2.4 GHz Wi-Fi Cell Off. The detailed setting is listed in Table 6-3. Figure 6-3 demonstrates the DUT's normalized conducted TX power, the normalized time-averaged conducted TX power behavior over time, and the normalized FCC limit of 1. As seen in these figures, the normalized time-averaged TX power does not exceed the normalized FCC limit of 1.

Table 6-3 TAS parameters setting for Device State Switching

Test Scenario	Technology/Band	Core/Antenna	Plimit [dBm]	Plimit [mW]	Pmax [dBm]	Pmax [mW]	Time Window	Power Meter
Device State Switch	2.4 GHz Wi-Fi (Cell ON)	Core 0 (Ant 4a)	9.63	9.17	21.50	141.25	60s	P1
	2.4 GHz Wi-Fi (Cell OFF)	Core 0 (Ant 4a)	19.25	84.14	21.50	141.25	60s	P1

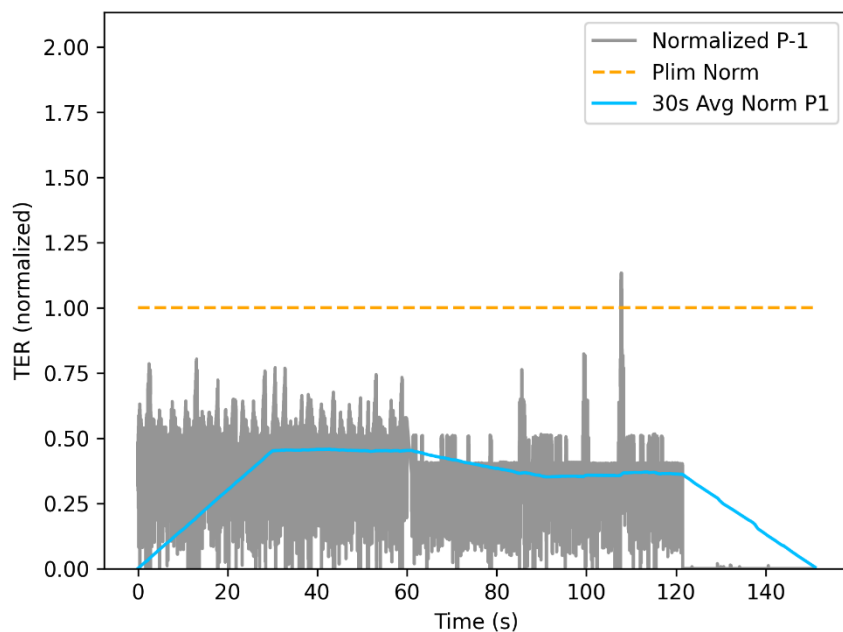


Figure 6-3 Device State Switch Normalized Time-averaged conducted TX power

Normalized P_{limit}	1.00
Highest normalized P_{avg}	0.369
Validation result: Pass	

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7. EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Rohde & Schwarz	ZNB40	S-Parameter Vector Network Analyzer	2/20/2025	Annual	2/20/2026	101412
Mini Circuits	ZN2PD-63-S+	Power Splitter	CBT	N/A	CBT	UU23301311
Mini Circuits	ZN2PD-63-S+	Power Splitter	CBT	N/A	CBT	UU1R602047
Pasternack	PE2088	Power Divider	CBT	N/A	CBT	N/A
Pasternack	PE2088	Power Divider	CBT	N/A	CBT	N/A
Micro-Tronics	HPM50107-G084	High Pass Filter	2/25/2025	Biennial	2/25/2027	HP7700-G084
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	7/3/2025	Annual	7/3/2026	UU19201507
API Weinschel, Inc.	8321	Programmable Attenuator Unit	CBT	N/A	CBT	839
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	NRP8S	3 Path Dipole Power Sensor	2/24/2025	Annual	2/24/2026	109961
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	10/28/2024	Annual	10/28/2025	109956
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	2/24/2025	Annual	2/24/2026	109959
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	10/28/2024	Annual	10/28/2025	109957

Notes:

1. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. Each equipment item is used solely within its respective calibration period.

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8. MEASUREMENT UNCERTAINTIES

For Conducted Power Measurements

List of Contributing Factors	Value [dB]	Distribution Function	Probability Distr. Divisor	Component Uncertainty [dB]
RF Power Sensor Accuracy	0.168	Normal (k=2)	2	0.084
Mismatch antenna port to receiver	0.643	U-Shaped	1.4142	0.455
Expanded Uncertainty				
95% Confidence Level			k=2	0.925

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9. CONCLUSION

This document proposes Wi-Fi TAS test scenarios and procedures and proves that the TAS algorithm can meet the FCC SAR regulation with the proposed test scenarios and procedures. The conducted power measurements in Chapter 6 show that that the TAS algorithm can maintain SAR over time below the FCC regulatory limits. Based on the provided measurement results, it is concluded that the TAS algorithm can be validated for FCC compliance by the proposed test methodology.

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