RF Safety Laboratory, LLC
5520 Research Park Drive, Suite 140
Catonsville, Maryland 21228 USA
+1 202 240 9240
info@rfsafetylab.com

Time-Averaging Algorithm Validation Report

FCC ID:	PY7-50337X
Device Type:	Portable Device
Report Issue Date:	April 2, 2025

Sony Corporation
1-7-1 Konan Minato-ku Tokyo, 108-0075, Japan
Certification

The measurement evaluations presented in this report are based on the maximum performance of the tested device(s), which has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/ general population exposure federal limits in 47CFR § 1.1310 and has been tested in accordance with the measurement procedures specified within this report.

This document must be reproduced in its entirety without any alterations unless with written permission from RF Safety Laboratory, LLC.

This report and data apply only for US operations only.

This document has been revised and replaces all previously issued versions of this document with the same Test Report S/N.

Steve Liu
President

Table of Contents

1. DUT Specifics 3
3. TAS Evaluation Test Cases 7
4. Part 2 Test Results 8
5. Background on Radiofrequency (RF) Exposure Limits 14
6. Technology Specific Test Setup Requirements 15
7. Equipment List 25
8. Conclusion 26

Appendix A: Test Setup Photos

1. DUT Specifics

1.1. Time-Averaging Algorithm Verification

This report demonstrates that the Qualcomm® Smart Transmit enabled device is compliant under Tx varying transmission scenarios per Qualcomm's recommended test plan. Part 0 and Part 1 test reports complimenting this Time-Averaging Algorithm Validation Report are necessary for a comprehensive RF Exposure evaluation.

1.2. Device under Test

The manufacturer has confirmed that the device is within operational tolerances expected for production units and has the same physical, mechanical, and thermal characteristics expected for production units. The serial number of the device used for each test is indicated alongside the results.

Software version REG-SYST-3646-V-SHIMANTO-241216-1010-HW-SAPSTA was used during testing.

1.3. Time-Averaging Algorithm for RF Exposure Compliance

This device is enabled with the Qualcomm® Smart Transmit EFS v23 Gen2 feature. Both WWAN and WLAN operations are enabled with Smart Transmit Peak Exposure Mode for this device. For this device, all US Operations are limited to peak exposure mode only, except for Bluetooth. In Peak Exposure Mode, the output power of the device is limited to the lower of the Pmax and the Plimit for each characterized technology and band. The device will never transmit higher than these levels at any point.

Table 1-1
SAR Design Calculations for all technologies except UMTS

SAR_design_target		
SAR_design_target < SAR_regulatory_limit × $10^{\frac{-Total\ Uncertainty}{10}}$		
	Head / Body-Worn / Hotspot 1g SAR	**Phablet 10g SAR**
Total Uncertainty	2.0 dB	2.0 dB
SAR_regulatory_limit	1.6 W/kg	4.0 W/kg
SAR_design_target	1.0 W/kg	2.5 W/kg

Table 1-2
SAR Design Calculations for UMTS

SAR_design_target		
SAR_design_target < SAR_regulatory_limit × $10^{\frac{-Total\ Uncertainty}{10}}$		
	Head / Body-Worn / Hotspot 1g SAR	**Phablet 10g SAR**
Total Uncertainty	1.0 dB	1.0 dB
SAR_regulatory_limit	1.6 W/kg	4.0 W/kg
SAR_design_target	1.2 W/kg	3.0 W/kg

Table 1-3
DSI Descriptions

Scenario	Description	SAR Test Cases
Free Space, Head, Body-worn, Hotspot, Phablet (DSI = 3)	-Device positioned next to head. Ear speaker is activated. - Device in use with a body-worn accessory. Ear speaker is not activated. - Device transmits in hotspot mode near body. Hotspot mode activated. - Device is held with hands.	Head, Body-worn, Phablet SAR per KDB Publication 648474 D04. Hotspot SAR per KDB Publication 941225 D06.

1.4. Time-Averaging Algorithm

Technical description includes detailed information regarding the implementation of the time-averaging algorithm and parameters used for this device.

1.5. Time-Averaging Algorithm Implementation

For this device, all supported technologies implement Peak Exposure mode algorithm except for Bluetooth.

1.6. Test Reduction

There is no test reduction applied to this evaluation. Limited test cases are evaluated to be applicable to Peak Exposure Mode implementation.

1.7. Test Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D05v02r05, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- TCB Workshop October 2018
- 80-W2112-5 (RF Exposure Compliance Test Report for FCC Equipment Authorization of QRD)

2.1. SAR Characterization

Table 1-4
SAR Characterization

Exposure Scenario			Head/Body-Worn/Hotspot/Phablet	Maximum Tune-Up Output Power
DSI			3	
Band	Antenna #	Antenna Group	Plimit* (dBm)	Pmax (dBm)
GSM850 （GSM 1TX）	0	AG0	24.80	32.50
GSM850 （GPRS 1TX）	0	AG0	24.80	32.50
GSM850 （GPRS 2TX）	0	AG0	24.80	30.50
GSM850 （GPRS 3TX）	0	AG0	24.80	29.00
GSM850 （GPRS 4TX）	0	AG0	24.80	28.00
GSM1900 （GSM 1TX）	1	AG0	21.00	30.00
GSM1900 （GPRS 1TX）	1	AG0	21.00	30.00
GSM1900 （GPRS 2TX）	1	AG0	21.00	27.20
GSM1900 （GPRS 3TX）	1	AG0	21.00	25.40
GSM1900 （GPRS 4TX）	1	AG0	21.00	24.20
UMTS 2	1	AG0	18.50	18.50
UMTS 4	1	AG0	19.00	19.00
UMTS 5	0	AG0	18.50	18.50
LTE 2	1	AG0	21.00	21.00
LTE 2	2	AG1	13.50	13.50
LTE 5	0	AG0	18.30	18.30
LTE 17/12	0	AG0	26.00	24.00
LTE 13	0	AG0	25.80	24.30
LTE 25	1	AG0	21.00	21.00
LTE 26	0	AG0	25.80	24.30
LTE 41	1	AG0	18.00	20.00
LTE 4/66	1	AG0	15.30	15.30
LTE 66	2	AG1	15.50	15.50
NR 5	0	AG0	17.80	17.80
NR 41	1	AG0	17.30	17.30
NR 41	2	AG1	19.00	17.30
NR 41	3	AG1	17.30	15.60
NR 41	4	AG1	17.30	15.80
NR 66	1	AG0	15.30	15.30
NR 77	6	AG0	16.00	16.00
NR 77	7	AG1	16.50	16.00
NR 77	4	AG1	16.00	13.80
NR 77	3	AG1	16.00	14.80
WLAN 2.4GHz	5	AG1	13.00	13.00
WLAN 2.4GHz	8	AG0	12.50	12.50
WLAN 5GHz	5	AG1	13.50	13.50
WLAN 5GHz	8	AG0	13.00	13.00
BT 2.4GHz	5	AG1	16.00	14.00
BT 2.4GHz	8	AG0	18.00	14.00

*Note all Plimit levels entered in above table correspond to average power levels after accounting for duty cycle in the case of TDD, GMSK, or OFDM modulation schemes (e.g. LTE TDD, GSM, and WLAN/BT). Pmax levels in the above table correspond to burst power.

The maximum time-averaged output power (dBm) for any Sub6 WWAN/WLAN/BT technology, band, and DSI is the minimum of the "Plimit EFS" and "Maximum tune up output power Pmax" +1dB (for UMTS only) or +2dB (for all technologies beside UMTS) device uncertainty.

3. TAS Evaluation Test Cases

3.1. Part 2 Test Plan

Test Case	Test Scenario (Sub 6)	Tech	Band	Frequency [MHz]	Channel	Configuration	Ant.	DSI	SAR Exposure	DUT S/N	Pmax (dBm)	Plim (dBm)	Measured Plim (dBm)	Measured 1g SAR (W/kg)	Measured 10g SAR (W/kg)	Normalized SAR
1	Time-window for conducted power test	WWAN, LTE	LTE B66	1755	132422	QPSK, 10 MHz BW, 5RB 0 RB Offset	1	3	Hotspot SAR	716875	15.3	15.3	15.04	0.120	-	0.075
		WLAN	5 GHz WLAN	5180	36	802.11ac, 20 MHz BW	8	3	Phablet SAR		13.0	13.0	12.00	-	0.545	0.136
2	SAR exposure switch for conducted power test (same time window)	ENDC (LTE+Sub6 NR)	LTE B66	1755	132422	QPSK, 10 MHz BW, 5RB 0 RB Offset	1	3	Hotspot SAR	716875	15.3	15.3	15.22	0.120	-	0.075
			n5	836.5	167300	DFT-s-OFDM, QPSK, 10 MHz BW, 25RB 12RB Offset	0	3	Hotspot SAR		17.8	17.8	17.41	0.082	-	0.051
3	SAR exposure switch for conducted power test (different time window)	ENDC (LTE+Sub6 NR)	LTE B41	2593	40620	QPSK, 20 MHz BW, 1RB 0 RB Offset	1	3	Hotspot SAR	716875	18.0	18.0	17.70	0.164	-	0.103
			n77	3704.1	646940	DFT-s-OFDM, QPSK, 100 MHz BW, 135RB 57RB Offset	6	3	Hotspot SAR		16.0	16.0	15.45	0.243	-	0.152
4	Dual Band Simultaneous (DBS) Test	WLAN	2.4 GHz WLAN	2437	6	801.11n, 20 MHz BW	8	3	Hotspot SAR	716818	12.5	12.5	11.58	0.161	-	0.101
		WLAN	5 GHz WLAN	5180	36	802.11ac, 20 MHz BW	8	3	Phablet SAR		13.0	13.0	12.31	-	0.545	0.136
5	System Level Compliance Continuity	WWAN, LTE	LTE B66	1755	132422	QPSK, 10 MHz BW, 5RB 0 RB Offset	1	3	Hotspot SAR	716933	15.3	15.3	16.09	0.120	-	0.075
		WLAN	5 GHz WLAN	5180	36	802.11ac, 20 MHz BW	8	3	Phablet SAR		13.0	13.0	12.40	-	0.545	0.136
		Bluetooth	Bluetooth	2402	0	2.4 GHz Bluetooth	8	3	Hotspot SAR		12.9	18.0	11.06	0.113	-	0.071

Given that this device supports peak exposure mode, the following test cases are not applicable: Test Sequence 1, Test Sequence 2, Call Drop, Tech Switch, DSI Switch, Band Switch, Antenna Switch.

3.2. TAS Test Cases and Notes:

1. Time Window: Test case 1 is selected for handover test between two antennas in the same DSI with different time windows (LTE B66 Ant1, 5GHz WLAN Ant8).
2. SAR exposure Switch: Test cases 2-3 are selected for SAR exposure switching test in one of the supported simultaneous WWAN transmission scenarios (LTE B66 + Sub6 NR n5 active in the same time window, LTE B41 + n77 in different time windows). n77 was configured with 50% duty cycle during the test.
3. Dual Band Simultaneous (DBS): Test Case 4 is selected for dual band simultaneous transmission test case for 2.4GHz WLAN and 5GHz WLAN.
4. System Level Compliance Continuity: Test Case 5 is selected for system level compliance continuity test case with LTE B66 + 5 GHz WLAN + BT technologies.
5. All switching, EN-DC, and system level compliance continuity test cases are selected to be performed within the same antenna group.

3.3. EFS Version Verification

Per Qualcomm's 80-W2112-5 document, embedded file system (EFS) version is required to be verified for Smart Tx generation for relevant MCC settings. It was confirmed that this DUT contains EFS v23 configured for Smart Tx second generation (GEN2) with MCC settings for the US market.

EFS Version	v23
Generation	GEN2
MCC	310

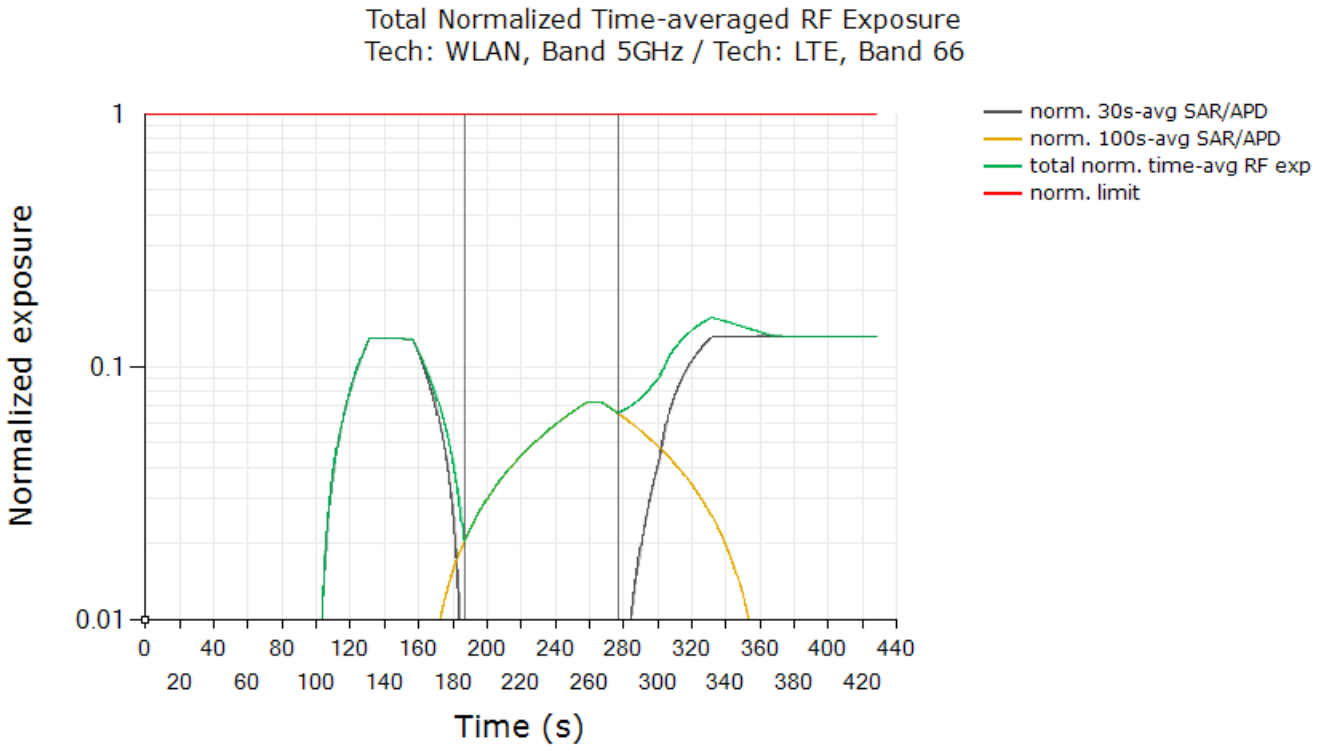
4. Part 2 Test Results

4.1. Conducted Tx Cases (Freq < 6 GHz)

Time-averaged conducted tx power is converted into time-averaged 1g SAR in the figures below. Please see below for time-averaged 1g SAR Normalized to the SAR limit that the test result complies. Section 3 contains detailed information regarding the test configurations.

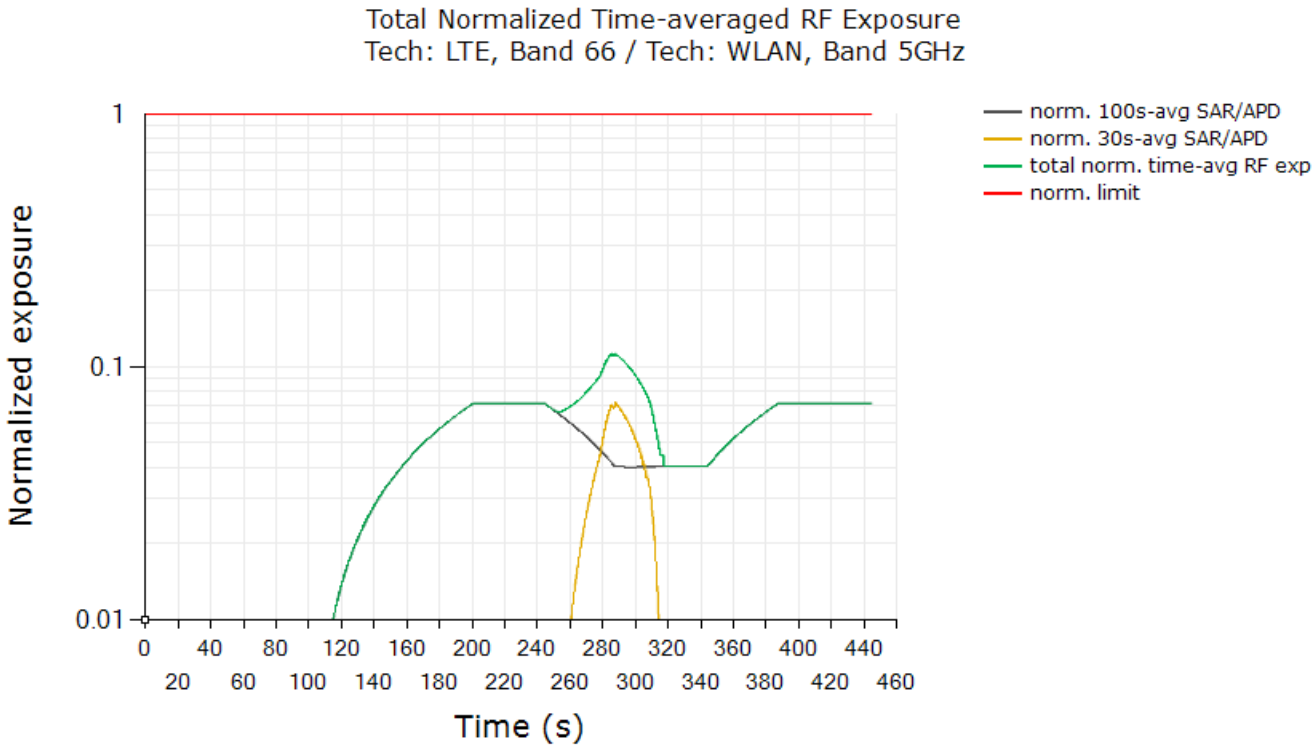
4.1.1. Time Window Switch

4.1.1.1. 30 sec – 100 sec – 30 sec Switch



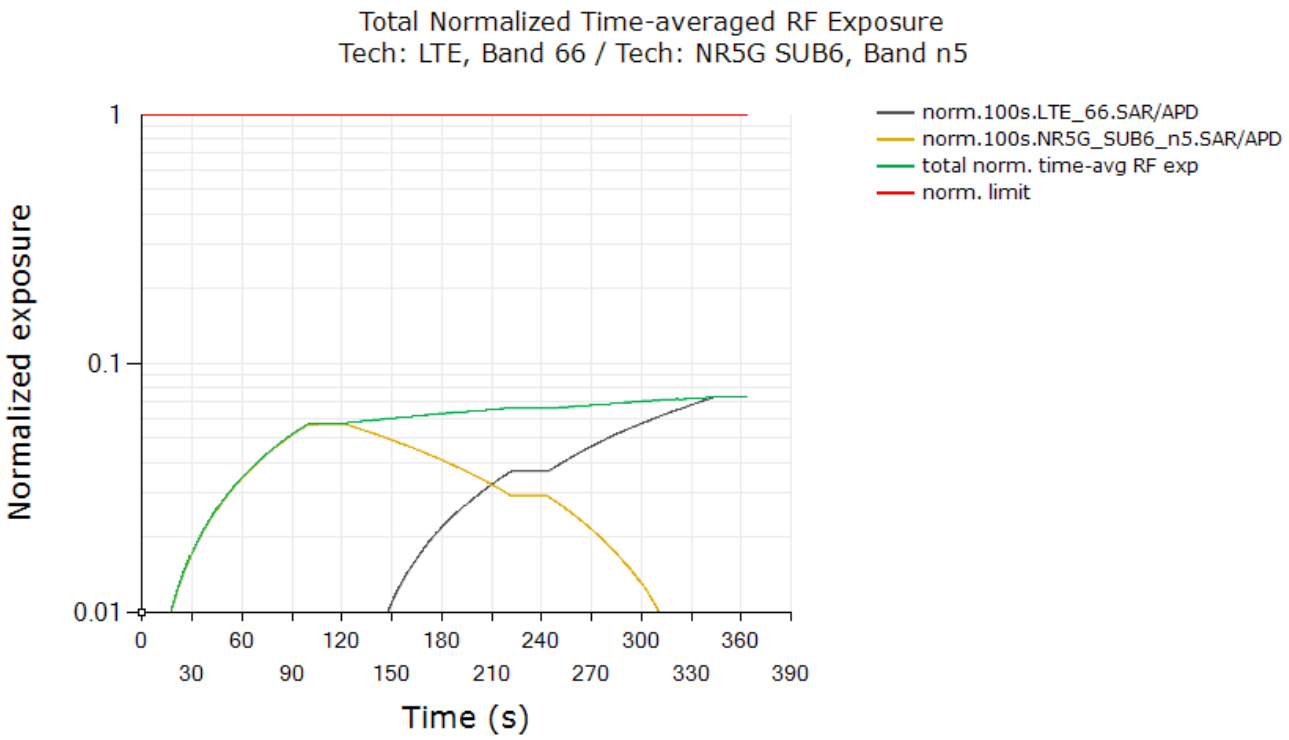
FCC Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.157
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

4.1.1.2. 100 sec – 30 sec – 100 sec Switch



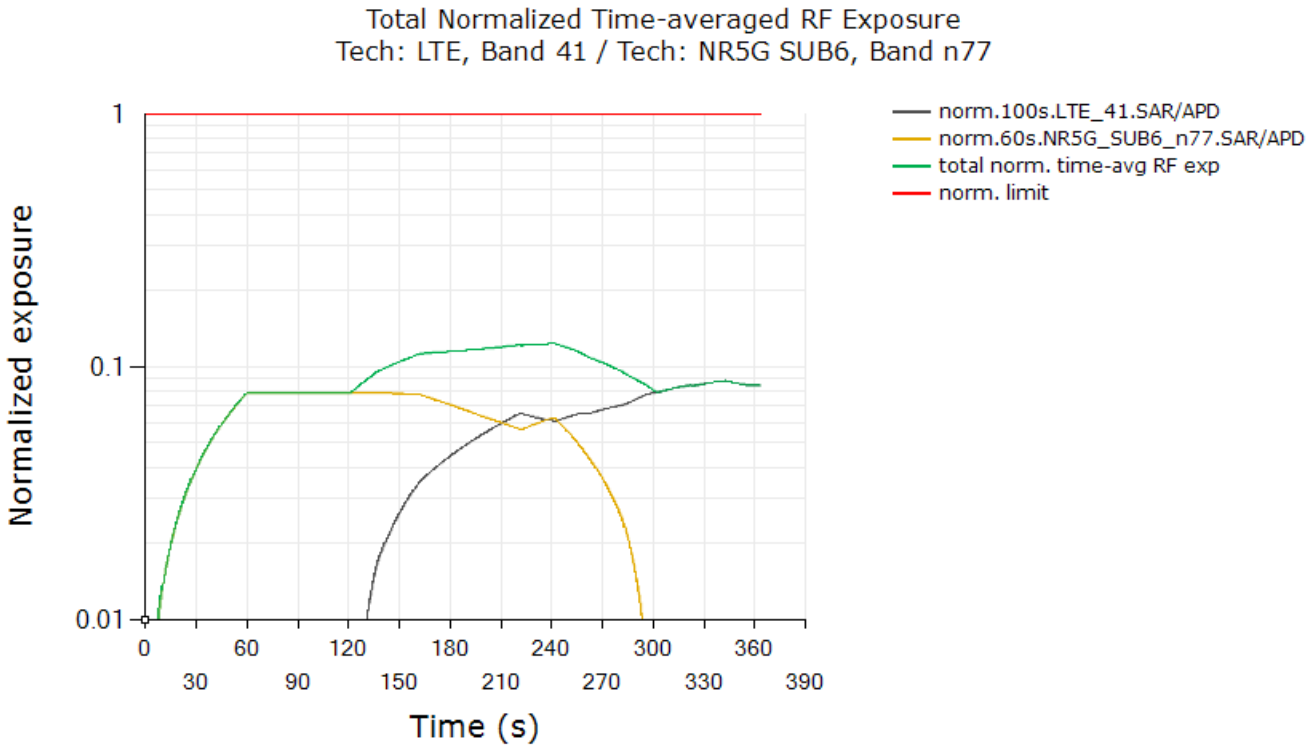
FCC Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.112
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

4.1.2. SAR Exposure Switch (Same Time Window)



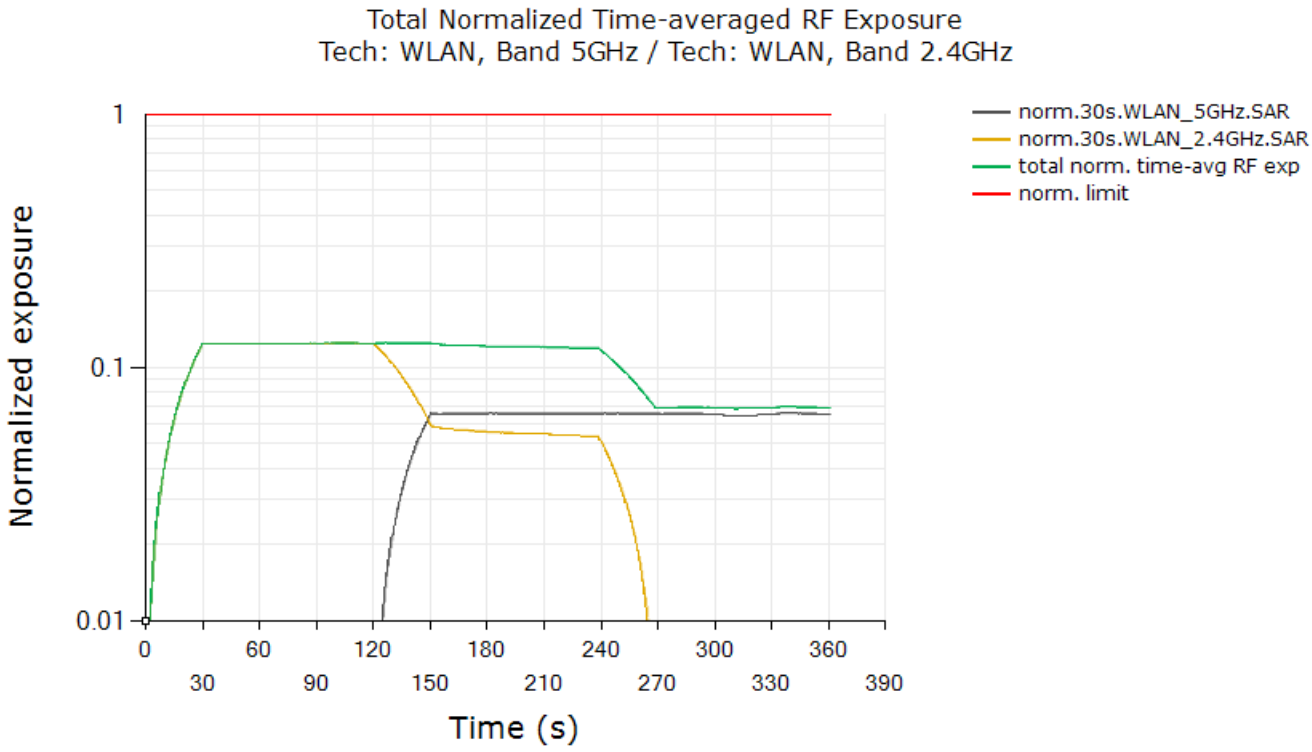
Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.073
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

4.1.3. SAR Exposure Switch (Different Time Window)



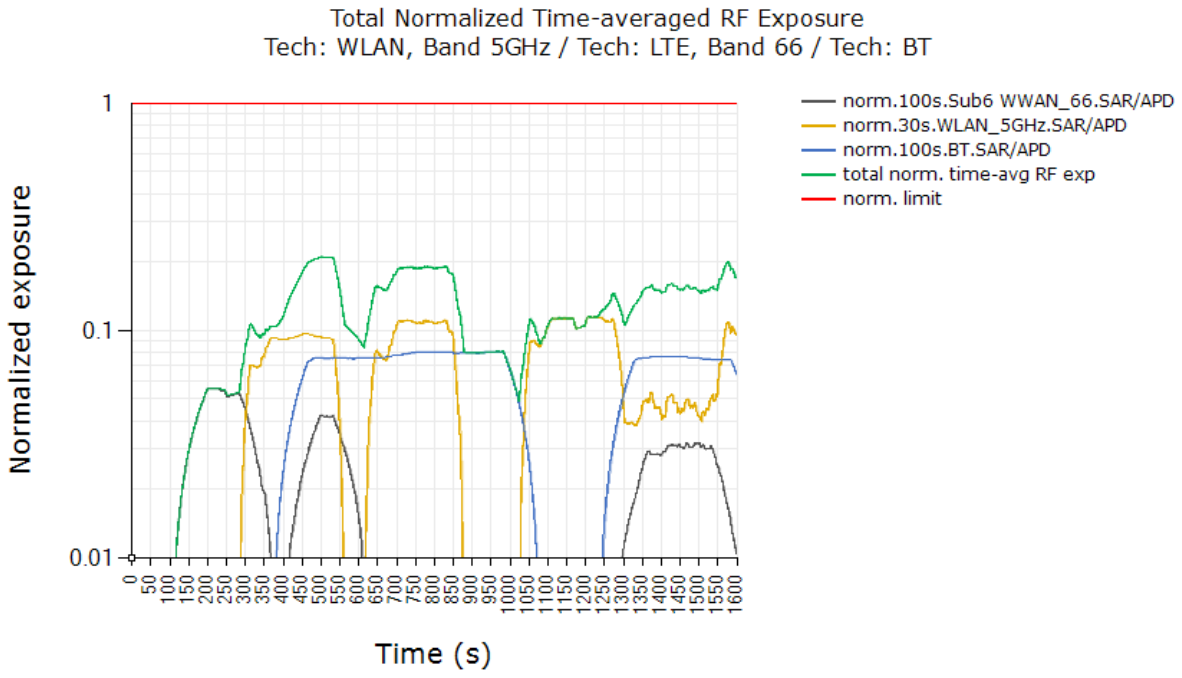
Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.123
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

4.1.4. Dual Band Simultaneous (DBS)



Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.125
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

4.1.5. System Level Compliance Continuity



Normalized SAR Limit	1.0
Max time-averaged Normalized SAR	0.211
Validated: Max time-averaged SAR is within device uncertainty of measured SAR at Plimit	

5. Background on Radiofrequency (RF) Exposure Limits

5.1. Controlled Environment

Controlled environments are defined as locations where the RF field intensities have been adequately characterized by means of measurement or calculation and exposure is incurred by persons who are: aware of the potential for RF field exposure, cognizant of the intensity of the RF fields in their environment, aware of the potential health risks associated with RF field exposure and able to control their risk using mitigation strategies. 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.

5.2. Uncontrolled Environment

Uncontrolled environments are defined as locations where either insufficient assessment of RF fields have been conducted or where persons who are allowed access to these areas have not received proper RF field awareness/safety training and have no means to assess or, if required, to mitigate their exposure to RF fields. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed, or in which persons who may not be made fully aware of the potential for exposure, or cannot exercise control over their exposure. Members of the general public would fall under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.3. RF Exposure Limits for 100kHz – 6 GHz

Per FCC 47 CFR §1.1310, the SAR limits are applied for frequencies 100kHz ~ 6 GHz as shown below.

Table 5-1
Human Exposure to RF Radiation Limits FCC 47 CFR §1.1310 - SAR Basic Restrictions

Environment	Condition	**SAR**	Averaging volume
Uncontrolled / General Population	Head, Neck Trunk	**1.6 W/kg**	1g cube
	Extremity	**4.0 W/kg**	10g cube
Controlled	Head/Trunk	**8 W/kg**	1g cube
	Extremity / Limbs	**20 W/kg**	10g cube

5.4. Time Averaging Windows for FCC Compliance

Per TCB Workshop Notes in October 2018, the time-averaging windows for each frequency segments are as shown below.

Interim Guidance	Frequency (GHz)	Maximum Averaging Time (sec)
SAR	< 3	100
	3 – 6	60
MPE	6 - 10	30
	10 - 16	14
	16 – 24	8
	24 – 42	4
	42 – 95	2

6. Technology Specific Test Setup Requirements

6.1. Measured and Reported SAR

When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR.

6.2. Conducted Power Measurement Test Setup

Callbox and power meter are connected to the test PC and test scripts are custom made for automation. Power meter readings are periodically recorded every 0.1s for supported technologies. A running average of this measured Tx power over the time-averaging window is performed in the post-data processing to determine the time-averaged power.

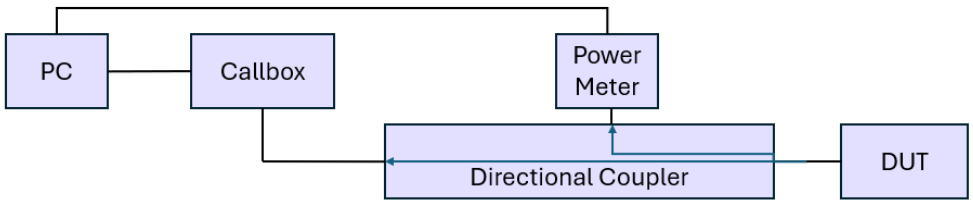


Figure 6-1
Test setup diagram representing connection with 1 Technology

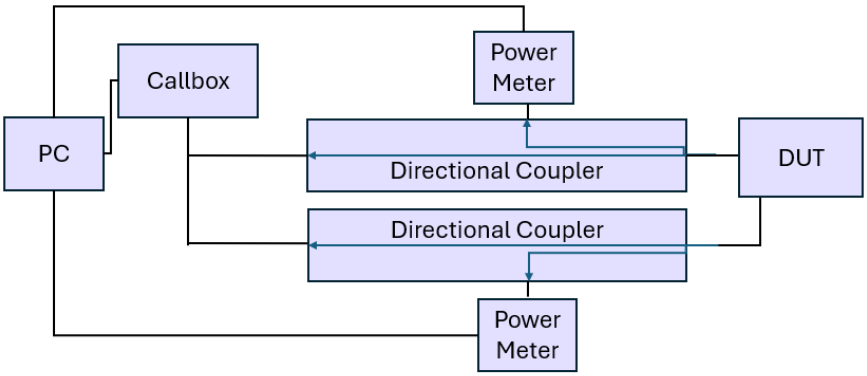


Figure 6-2
Test setup diagram representing connection with 2 technologies

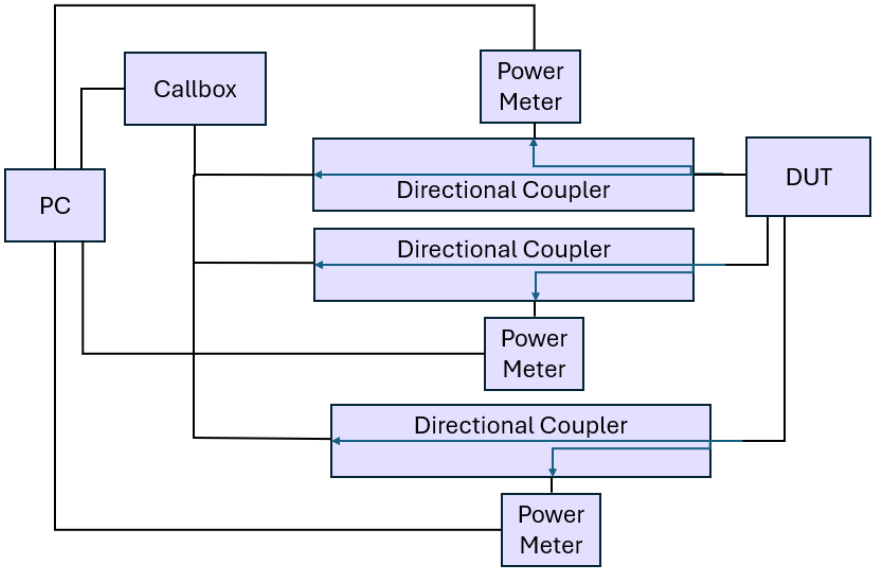


Figure 6-3
Test setup diagram representing connection with 3 technologies

To demonstrate compliance, all the conducted tx power measurement results were converted into 1g_or_10gSAR values by using the equation listed below:

$$1g\_or\_10gSAR\ (t) = \frac{conducted\_Tx\_power(t)}{conducted\_Tx\_power\_Plimit} * 1g\_or\_10gSAR\_Plimit$$

$$\frac{\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} 1g\_or\_10gSAR(t)dt}{FCC\ SAR_{limit}} \leq 1$$

6.3. Test Procedures for Conducted Power Measurements

This section provides general conducted power measurement procedures to perform compliance test under dynamic transmission scenarios.

NOTE: For *Plimit* conducted power test and SAR test@ *Plimit*, the measurement under Smart Transmit Peak exposure mode is effectively the same as the measurement with *Reserve_power_margin* set to 0 dB, therefore, all *Plimit* tests can be performed under Peak exposure mode condition. For devices with Smart Transmit EFS version 18, due to the changes in *Reserve_power_margin*, *Plimit* tests should be conducted with Peak exposure mode.

6.3.1. Time-varying Tx power scenario

This test is performed with the two pre-defined test sequences for all the technologies and bands selected in the test plan. The purpose of the test is to demonstrate the effectiveness of power limiting enforcement and that the time averaged transmit power when converted into 1g_ or 10g_SAR values does not exceed the regulatory limit at all times.

Test procedure

1. Measure P_{max}, measure P_{limit} and calculate $P_{reserve}$. Generate the test sequences for all the technologies and bands selected in the test plan. Test condition to measure P_{max}, P_{limit} and $P_{reserve}$ is:
   - Measure P_{max} with Smart Transmit disabled and callbox set to request maximum power.
   - Measure P_{limit} with Smart Transmit Peak exposure mode enabled, and callbox set to request maximum power.
   - Measure $P_{reserve}$ via test sequence 1 measurement
2. Set the EUT to the intended Smart Transmit exposure mode, then set callbox to request the EUT to transmit at pre-defined test sequence 1 (generated in Step 1), measure and record Tx power versus time. Once the measurement is done, extract instantaneous Tx power versus time, and convert the conducted Tx power into 1g_or_10g SAR value using P_{limit} result from Step 1 , and then perform 100s running average to determine time-averaged 1g_or_10gSAR versus time as illustrated in figure below.

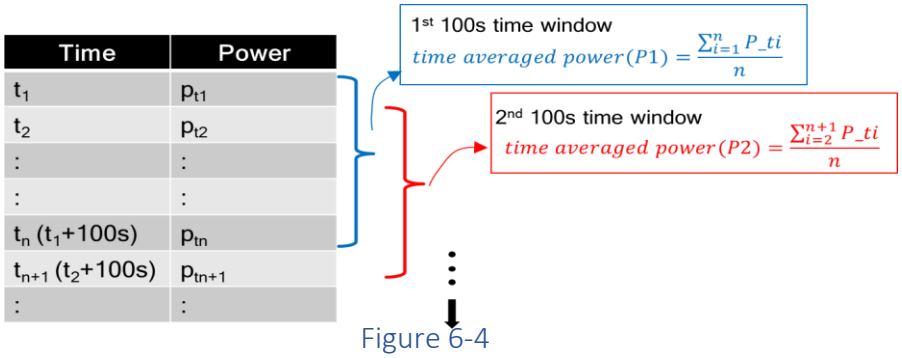


Figure 6-4
100s running average illustration

NOTE: In 1g_or_10gSAR (t) Eq. in Section 6.2, instantaneous Tx power is converted into instantaneous 1g_or_10gSAR value by applying the worst-case 1g_or_10gSAR value for each technology/band at P_{limit} as reported in *RF Exposure Compliance Test Report for FCC Equipment Authorization of QRD (Part 1: Test Under Static Transmission Scenario)* (80-W2112- 4).

NOTE: The "intended Smart Transmit exposure mode" refers to either **Time-Averaged Exposure Mode** or **Peak Exposure Mode** selected by OEMs for their device going through certification test. It is used throughout this document.

3. Make one plot containing:
   a. Computed time-averaged 1g_or_10gSAR versus time determined in Step 2
   b. Corresponding regulatory 1g_or_10gSAR_{limit} limit.
4. Repeat Steps 2~3 for pre-defined test sequence 2.
5. Repeat Steps 2~4 for all the selected technologies and bands.

The validation criteria is, at all times, the time-averaged 1g_or_10g AR versus time determined in Step 2 (and plotted in Step 4) shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.2. Change in call scenario

This test is to demonstrate that Smart Transmit feature accurately accounts for the past Tx powers during time-averaging when a new call is established.

The call drop and re-establishment needs to be performed during power limit enforcement to demonstrate the continuity of RF exposure management and limiting in call change scenario. In other words, the RF exposure averaged over any 100s-time window (including the time windows containing the call change) doesn't exceed the corresponding regulatory $1g\_or\_10gSAR_{limit}$ limit.

Test procedure

1. Measure P_{limit} for the technology/band selected. Measure P_{limit} with Smart Transmit Peak exposure mode enabled, and callbox set to request maximum power.
2. Set EUT to the intended Smart Transmit exposure mode.
3. Establish radio link with callbox in technology/band selected.
4. Request EUT to transmit at 0 dBm for at least one time window specified for the selected technology/band, followed by requesting EUT to transmit at maximum power for about ~60 seconds, and then drop the call for ~10 seconds. Afterwards, re-establish another call in the same radio configuration (i.e., same technology/band/channel) and continue callbox requesting EUT to transmit at maximum power for the remaining time of at least another full duration of the specified time window. Measure and record Tx power versus time.
5. Once the measurement is done, extract instantaneous Tx power versus time, and convert the conducted Tx power into 1g_or_10gSAR value using Step 1 result, and then perform 100s running average to determine time-averaged 1g_or_10gSAR versus time.

NOTE: In 1g_or_10gSAR (t) Eq. in Section 6.2, instantaneous Tx power is converted into instantaneous 1g_or_10gSAR value by applying the worst-case 1g_or_10gSAR value of the technology/band at P_{limit} as reported in *RF Exposure Compliance Test Report for FCC Equipment Authorization of QRD (Part 1: Test Under Static Transmission Scenario)* (80-W2112-4).

6. Make one plot containing: (a) computed time-averaged 1g_or_10gSAR versus time determined in Step 4 for the 1st call, (b) computed time-averaged 1g_or_10gSAR versus time determined in Step 4 for the 2nd call, (c) combined time-averaged 1g_or_10gSAR of the 1st call and 2nd call versus time and (d) corresponding regulatory $1g\_or\_10gSAR_{limit}$ limit.

The validation criteria is, at all times, the combined time-averaged 1g_or_10gSAR versus time shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.3. Change in technology and band

This test is to demonstrate the correct power control by Smart Transmit during technology switches and/or band handovers.

Similar to the change in call test, the technology and band handover needs to be performed to validate the continuity of RF exposure limiting during the transition. The P_{limit} could vary with technology and band, but the instantaneous Tx power for a given band could be converted in 1g_or_10gSAR exposure using:

$$1g\_or\_10gSAR\ (\mathrm{t}) = \frac{pointSAR(t)}{pointSARPlimit} * 1g\_or\_10gSAR\_Plimit$$

$$1g\_or\_10gSAR_1(t) = \frac{conducted\_Tx\_power\_1(t)}{conducted\_Tx\_power\_P_{limit\_1}} * 1g\_or\_10gSAR\_P_{limit\_1}$$

$$1g\_or\_10gSAR_2(t) = \frac{conducted\_Tx\_power\_2(t)}{conducted\_Tx\_power\_P_{limit\_2}} * 1g\_or\_10gSAR\_P_{limit\_2}$$

$$\frac{\frac{1}{T_{SAR}}\left[\int_{t-T_{SAR}}^{t_1} 1g\_or\_10gSAR_1(t)dt + \int_{t-T_{SAR}}^{t} 1g\_or\_10gSAR_2(t)dt\right]}{1g\_or\_10gSAR_{limit}} \leq 1$$

where, *conducted_Tx_power_1(t)*, $conducted\_Tx\_power\_P_{limit\_1}$, and $1g\_or\_10gSAR\_P_{limit\_1}$ correspond to the instantaneous Tx power, conducted Tx power at P_{limit}, and compliance *1g_or_10gSAR* values of technology1/band1 at P_{limit_1}; *conducted_Tx_power_2(t)*, $conducted\_Tx\_power\_P_{limit\_2}$, and $1g\_or\_10gSAR\_P_{limit\_2}$ correspond to the instantaneous Tx power, conducted Tx power at P_{limit}, and compliance *1g_or_10gSAR* values of technology2/band2 at P_{limit_2}. Transition from the technology1/band1 to the technology2/band2 happens at time-instant 't_1'.

Test procedure

1. Measure P_{limit} for both the technologies and bands selected. Measure P_{limit} with Smart Transmit Peak exposure mode enabled and callbox set to request maximum power.
2. Set EUT to intended Smart Transmit exposure mode.

3. Establish radio link with callbox in first technology/band selected.
4. Request EUT to transmit at 0 dBm for at least one time window specified for the selected technology/band, followed by requesting EUT to transmit at maximum power for about ~60 seconds, and then switch to second technology/band selected. Continue with callbox requesting EUT to transmit at maximum power for the remaining time of at least another full duration of the specified time window. Measure and record Tx power versus time for the full duration of the test.
5. Once the measurement is done, extract instantaneous Tx power versus time, and convert the conducted Tx power into *1g_or_10g*SAR value using corresponding technology/band Step 1 result, and then perform 100s running average to determine time- averaged 1gSAR versus time. Instantaneous Tx power is converted into instantaneous *1g_or_10g*SAR value by applying the worst-case 1gSAR value for the selected technologies/bands at P_{limit} as reported in *RF Exposure Compliance Test Report for FCC Equipment Authorization of QRD (Part 1: Test Under Static Transmission Scenario)* (80-W2112-4).
6. Make one plot containing: (a) computed time-averaged *1g_or_10g*SAR of the 1st technology/band versus time determined in Step 5, (b) computed time-averaged *1g_or_10g*SAR of the 2nd technology/band versus time determined in Step 5, (c) combined time-averaged *1g_or_10g*SAR of the 1st technology/band and 2nd technology/band versus time determined in Step 5 and (d) corresponding regulatory $1g\_or\_10gSAR_{limit}$ limit.

The validation criteria is, at all times, the combined time-averaged *1g_or_10g*SAR versus time shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.4. Change in antenna

This test is to demonstrate the correct power control by Smart Transmit during antenna switches from primary to diversity. The test procedure is identical with switching antenna instead of technology/band. The validation criteria is, at all times, the time-averaged *1g_or_10g*SAR versus time shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.5. Change in device state

This test is to demonstrate the correct power control by Smart Transmit during device state transitions from one device state (say, body-worn or hotspot or extremity) to another. The test procedure is identical with changing device state instead of technology/band. The validation criteria is, at all times, the time-averaged *1g_or_10g*SAR versus time shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.6. SAR exposure switching

This test is to demonstrate that Smart Transmit feature is accurately accounts for switching in exposures among SAR from radio1 only, SAR from both radio1 and radio2, and SAR from radio2 only scenarios, and ensures total time-averaged RF exposure complies with the limit.

Test procedure:

1. Measure conducted Tx power corresponding to P_{limit} for radio1 and radio2 in selected band. Test condition to measure conducted P_{limit} is:
   - □ Establish device in call with the callbox for radio1 technology/band. Measure conducted Tx power corresponding to radio1 P_{limit} with Smart Transmit Peak exposure mode enabled and callbox set to request maximum power.
   - □ Repeat above step to measure conducted Tx power corresponding to radio2 P_{limit}. If radio2 is dependent on radio1 (for example, non-standalone mode of Sub6 NR requiring radio1 LTE as anchor), then establish radio1 + radio2 call with callbox, and request all down bits for radio1 LTE. In this scenario, with callbox requesting maximum power from radio2 Sub6 NR, measured conducted Tx power corresponds to radio2 P_{limit} (as radio1 LTE is at all-down bits)
2. Set EUT to intended Smart Transmit exposure mode for radio1 + radio2. In this description, it is assumed that radio2 has lower priority than radio1. Established device in radio1+radio2 call, and request all-down bits or low power on radio1, with callbox requesting UE to transmit at maximum power in radio2 for at least one time window. After one time window, set callbox to request UE to transmit at maximum power on radio1, i.e., all-up bits. Continue radio1+radio2 call with both radios at maximum power for at least one time window, and drop (or request all-down bits) radio2. Continue radio1 at maximum power for at least one time window. Record the conducted Tx power for both radio1 and radio2 for the entire duration of this test.
3. Once the measurement is done, extract instantaneous Tx power versus time for both radio1 and radio2 links. Similar to technology/band switch test, convert the conducted Tx power for both these radios into *1g_or_10g*SAR value using corresponding technology/band P_{limit} measured in Step 1, and then perform 100s running average to determine time-averaged *1g_or_10g*SAR versus time. Note that here it is assumed both radios have Tx frequencies < 3GHz, otherwise, 60s running average should be performed for radios having Tx frequency between 3GHz and 6GHz.
4. Make one plot containing: (a) computed time-averaged *1g_or_10g*SAR versus time determined in Step 3 and combined time-averaged *1g_or_10g*SAR versus time, and (b) corresponding regulatory $1g\_or\_10gSAR_{limit}$ limit.

The validation criteria is, at all times, the combined time-averaged *1g_or_10g*SAR versus time shall not exceed the regulatory $1g\_or\_10gSAR_{limit}$ limit.

6.3.7. Change in Time Window

Test procedure

1. Measure Plimit for both the technologies and bands selected. Measure Plimit with Smart Transmit Peak exposure mode enabled, and callbox set to request maximum power.
2. Set EUT to intended Smart Transmit exposure mode.

Transition from time window 1 to time window2, and vice versa

3. Establish radio link with callbox in the technology/band having time window 1.
4. Request EUT to transmit at 0 dBm for at least time window 1 seconds, followed by requesting EUT to transmit at maximum Tx power for about ~140 seconds, and then switch to second technology/band (having time window 2). Continue with callbox requesting EUT to transmit at maximum Tx power for about time window 2 in this second technology/band, and then switch back to the first technology/band. Continue with callbox at least another time window 1 seconds. Measure and record Tx power versus time for the entire duration of the test.
5. Once the measurement is done, extract instantaneous Tx power versus time, and convert the conducted Tx power into 1g_or_10gSAR value using corresponding technology/band Step 1 result, and then perform time window 1 running average to determine time-averaged 1g_or_10gSAR versus time. Note that instantaneous Tx power is converted into instantaneous 1g_or_10gSAR value by applying the worst-case 1g_or_10gSAR value for the selected technologies/bands at Plimit.
6. Make one plot containing: (a) computed time-averaged 1g_or_10gSAR of the 1st technology/band (having time window 1 seconds) versus time determined in Step 5, (b) computed time-averaged 1g_or_10gSAR of the 2nd technology/band (having time window 2 seconds) versus time determined in Step 5, (c) combined time-averaged 1g_or_10gSAR of (a) and (b), and (d) corresponding regulatory 1g_or_10gSARlimit limit.

Transition from time window 2 to time window 1, and vice versa

7. Establish radio link with callbox in the technology/band having time window 2 selected in Section 5.
8. Request EUT to transmit at 0 dBm for at least time window 2 seconds, followed by requesting EUT to transmit at maximum Tx power for more than time window 2 seconds, and then switch to second technology/band (having time window 1) selected. Continue with callbox requesting EUT to transmit at maximum Tx power for about time window 2 in this 2nd technology/band, and then switch back to the first technology/band. Continue with callbox requesting EUT to transmit at maximum Tx power for at least another 140s. Measure and record Tx power versus time for the entire duration of the test.
9. Repeat above Step 5~6 procedures to generate the corresponding plots

The validation criteria is, at all times, the combined time-averaged 1g_or_10gSAR versus time shall not exceed the regulatory 1g_or_10gSARlimit limit.

6.3.8. SAR exposure switching

This test is to demonstrate that Smart Transmit feature is accurately accounts for switching in exposures among SAR from radio1 only, SAR from both radio1 and radio2, and SAR from radio2 only scenarios, and ensures total time-averaged RF exposure complies with the limit.

Test procedure:

Test procedure:

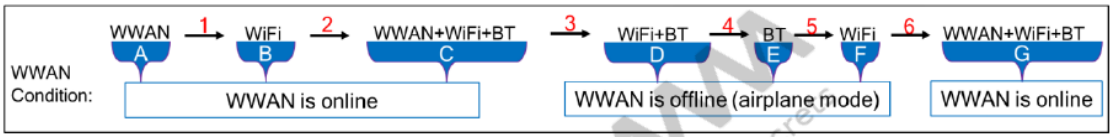
1.Measure conducted Tx power corresponding to Plimit for all three (WWAN, WLAN & BT) technologies in the selected radio configurations. Test condition to measure conducted Plimit for each technology is:

□ Establish device in call with the callbox for the first technology in desired band. Measure conducted Tx power corresponding to the first technology Plimit with Smart Transmit Peak exposure mode enabled and callbox set to request maximum power (or maximum duty cycle in case of WLAN/BT).

□ Repeat above step to measure conducted Tx power corresponding to the remaining two technologies' Plimit. In the case of BT, measured conducted Tx power is compensated by tested duty cycle and BT_STANDALONE EFS parameter, i.e., measured Plimit = conducted power measured in BT standalone condition / BT_STANDALONE / BT_duty_cycle.

2.Set EUT to the intended Smart Transmit exposure mode.

3. As depicted, first



i. Section A: Establish WWAN connection with the callbox in selected WWAN radio configuration. Request EUT to transmit at 0 dBm for at least one WWAN time window (100s or 60s), followed by requesting EUT to transmit at maximum Tx power for {one WWAN time window (TWWAN = 100s if f < 3GHz or 60s if 3GHz < f < 6GHz for FCC, 360s for ICNIRP) + the maximum high power duration allowed in one TWWAN}, denoted as TA_WWAN.

ii. Section B: After TA_WWAN, drop WWAN connection and establish WLAN connection with the callbox in selected WLAN radio configuration and request EUT to transmit at maximum duty cycle (and maximum power) for {one WLAN time-window duration (TWLAN = 30s for all WLAN frequency bands for FCC, 360s for ICNIRP) + the maximum high power duration allowed in one TWLAN}, denoted TB_WLAN.

iii. Section C: After TB_WLAN , add the selected WWAN and BT radios to have the simultaneous transmission of WWAN + WLAN + BT. Request WWAN radio to transmit at maximum power and request WLAN & BT radios to transmit at maximum duty cycle (and maximum power) for at least one max{TA_WWAN, TB_WLAN, TBT}, where, TBT = 100s for FCC, 360s for ICNIRP.

iv. Section D: Drop WWAN connection and set WWAN modem into airplane mode. Continue requesting WLAN & BT radios to transmit at maximum duty cycle (and maximum power) for at least two times the max{ TWLAN, TBT}.

v. Section E: Drop WLAN connection. Continue requesting BT radio to transmit at maximum duty cycle (and maximum power). Continue the test for at least one TBT .

vi. Section F: In the case of FCC time windows, after at least one TBT, drop BT connection and establish back WLAN connection in selected radio configuration. Continue requesting WLAN radio to transmit at maximum duty cycle (and maximum power). Continue the test for at least one max{ TWLAN, TBT}. In the case of ICNIRP time windows, Section F is not required.

vii. Section G: Disable airplane mode and add WWAN and BT connections after Section F in the case of FCC time windows (Disable airplane mode and add WWAN and WLAN connections after Section E in the case of ICNIRP time windows) to have the simultaneous transmission of WWAN + WLAN + BT. Request WWAN radio to transmit at maximum power and request WLAN & BT radios to transmit at maximum duty cycle (and maximum power) for at least one max{TA_WWAN, TB_WLAN, TBT}, where, TBT = 100s for FCC, 360s for ICNIRP.

4. Once the measurement is done, extract instantaneous Tx power versus time for all WWAN, WLAN and BT radios in selected configurations. Similar to technology/band switch test in Section 5.3.3, convert the conducted Tx power for both these radios into 1g_or_10gSAR value (see Eq. (7a) and (7b)) using corresponding technology/band Plimit measured in Step 1, and then perform running average over corresponding time-windows (i.e., 100s/60s for WWAN radio, 30s for WLAN radio and 100s for BT radio in case of FCC time-windows, and 360s for all of them in case of ICNIRP time-windows) to determine time-averaged 1g_or_10gSAR versus time as illustrated in Figure 5-1.

5. Make one plot containing: (a) computed normalized time-averaged 1g_or_10gSAR for WWAN radio configuration versus time determined in Step 4, (b) computed normalized time-averaged 1g_or_10gSAR for WLAN radio configuration versus time determined in Step 4, (c) computed normalized time-averaged 1g_or_10gSAR for BT radio configuration versus time determined in Step 4, (d) computed total normalized time-averaged 1g_or_10gSAR versus time (sum of Steps (5.a), (5.b) and (5.c)) determined in Step 5, and (e) corresponding normalized regulatory 1g_or_10gSARlimit limit of 1.0.

The validation criteria is, at all times, the time-averaged 1g_or_10gSAR versus time shall not exceed the regulatory 1g_or_10gSARlimit limit.

7. Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Amplifier Research	15S4G8AM1	RF Broadband Amplifier (4 - 8 GHz)	0554497			✓
Anritsu	MT8000A	MT8000A Radio Communication Test Station	6262261936	6/14/2023	6/13/2025	
Anritsu	S820E	Vector Network Analyzer	2348026	11/30/2023	11/30/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581656	8/28/2023	8/28/2025	
Hewlett Packard	8648C	HP Signal Generator	3537A01741	3/10/2024	3/10/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3318			✓
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3335			✓
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3329			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
Mini-Circuits	VLF-8400+	Coaxial Low Pass Filter (DC - 8.4 GHz)	-			✓
Mini-Circuits	VLF-6000+	Coaxial Low Pass Filter (DC - 6 GHz)	-			✓
Mini-Circuits	VLF-3000+	Coaxial Low Pass Filter (DC - 3 GHz)	-			✓
Mini-Circuits	VLF-1000+	Coaxial Low Pass Filter (DC - 1 GHz)	-			✓
Mini-Circuits	ZN4PD1-63W-S+	Power splitter	-			✓
Mitutoyo	CD-4"AX	Digital Caliper	B23243217	9/28/2023	9/28/2025	
Narda	24785-20	20 dB SMA Fixed Attenuator (DC - 4.0 GHz)	-			✓
Narda	4226-20 (26733)	20 dB SMA Directional Coupler (0.5 - 18 GHz)	0044			✓
Narda	4226-20 (26733)	20 dB SMA Directional Coupler (0.5 - 18 GHz)	0201			✓
Rohde & Schwarz	NRP8S	Three Path Diode Power Sensor (10 MHz - 8 GHz)	114343	5/27/24	5/27/25	
Rohde & Schwarz	NRP8S	Three Path Diode Power Sensor (10 MHz - 8 GHz)	114183	2/16/2024	2/16/2025	
Rohde & Schwarz	NRP8S	Three Path Diode Power Sensor (10 MHz - 8 GHz)	114184	2/16/2024	2/16/2025	
Rohde & Schwarz	SMCV100B	R&S SMCV100B Vector Signal Generator (VSG)	103882	12/21/2023	12/19/2025	
Rohde & Schwarz	CMW500	CMW500 Radio Communication Test Station	1201.0002K50-167186-cf	1/12/2024	1/12/2026	

* Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) 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.

8. Conclusion

The SAR evaluation indicates that the DUT is capable of compliance with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada (ISED), with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.